Business Failure in UK and US Quoted Firms: Impact of Macroeconomic Instability and the Role of Legal Institutions

Arnab Bhattacharjee, Chris Higson,
Sean Holly and Paul Kattuman

March 2004

CWPE 0420

Business Failure in UK and US Quoted Firms: Impact of Macroeconomic Instability and the Role of Legal Institutions[1]

A. Bhattacharjee[2], C. Higson[3], S. Holly[2], and P. Kattuman[2]

March 17, 2004

ABSTRACT

Firms exit through the mutually precluding events of bankruptcy and acquisition. We use a competing risks hazard regression model to identify the characteristics leading to each of these two outcomes using over thirty years of data on US and UK quoted firms. We find evidence about the way in which macroeconomic factors affect firm survival in these two economies, in addition to firm and industry-specific factors. Further, there are significant differences in the way in which firms in the US and the UK react to changes in the macroeconomic environment and, particularly to macroeconomic instability. We argue that these differences in response may be attributable to differences in bankruptcy codes in the US and the UK.

Subject headings: Bankruptcy, Acquisitions, Macroeconomic Instability, Competing Risks Cox Proportional Hazards Model, Chapter 11, Receivership

JEL classification: L16, G33, E32, K22, C41

1. Introduction

Uncertainty tends to make rational firms delay their investment and disinvestment decisions. Since investment can be in new or in acquired capital, macroeconomic instability can be expected to reduce demand in the acquisitions market. But uncertainty also tends to increase financial distress, so fewer distressed firms will be saved from bankruptcy by

[2]University of Cambridge, UK.

[3]London Business School, UK.

[1]This work was supported by KPMG. Corresponding author: Arnab Bhattacharjee. Tel.: +44-1223-335242. Fax: +44-1223-335299. E-mail address: A.Bhattacharjee@econ.cam.ac.uk

acquisition just when the pool of distressed firms is growing. Uncertainty increases the value of continuing in business, but the ability of a financially distressed firm to postpone disinvestment will be constrained by its creditors and will depend on the legal environment. Reorganisation systems like Chapter 11 may act as a safe haven for distressed firms during adverse macroeconomic conditions, enabling some of them to recover and perhaps be acquired, thus attenuating the impact of macroeconomic instability on bankruptcy hazard.

The existing literatures on the causes and consequences of acquisitions and on the causes of bankruptcy are substantial, but largely separate[4]. In reality, bankruptcy and acquisition can be expected to be partially codetermined – firms at risk of going bankrupt may instead be acquired and their assets redeployed – but only a few papers develop a unified framework nesting acquisitions and bankruptcies as twin routes to exit (Schary, 1991; Jovanovic and Rousseau, 2002). Further, relatively little work exists on the role of the macroeconomic environment in firm exits. Caves (1998) notes that "... these studies ... control for macroeconomic conditions in various ways and degrees, but they leave the impression that... hazard rates are rather insensitive to the observed variation in the macro environment"(pp.1958).[5]

The objective of this paper is to examine the impact of macroeconomic instability on business failure. We develop and test a model in which two competing modes of firm exit, bankruptcy and acquisition, are codetermined by firm-level and industry-level factors and by macroeconomic conditions. In Jovanovic and Rousseau (2002) a firm takes several decisions each period – the decision to exit (either because of distress, or because the firm's continuation value falls below the selling price of its assets), the decision to invest, and the decision to invest in acquired capital. We use this framework to analyse the effect of macroeconomic conditions on these investment and disinvestment decisions.

The model is applied to panel data on listed US and UK firms; the data include firm exits over a long period of time covering several business cycles. Joint determination of the probability of firms being acquired and going bankrupt are explicitly modelled using competing risks hazard regression models. The estimated models show that macroeconomic conditions have a significant impact on bankruptcy and acquisition hazard both in the US and the UK, controlling for firm and industry factors suggested by the existing literature.

---

[4]See Shleifer and Vishny (2003) for a review of the acquisitions literature; Siegfried and Evans (1994) and Caves (1998) for a review of the literature on determinants of firm failures; and Altman and Saunders (1997) for a review of the literature on credit-scoring models.

[5]See Appendix 1 and Bhattacharjee *et al.* (2002) for a detailed discussion of the theoretical and empirical literature.

Macroeconomic instability increases bankruptcy hazard, and reduces acquisition activity. The theoretical model shows how reduced acquisition activity may contribute to higher bankruptcy levels in instable periods (Shleifer and Vishny, 1992). Further, the impact of instability on bankruptcy is observed to be much less marked in the US than in the UK. This difference in responsiveness to macroeconomic instability is partly attributable to the use of Chapter 11 reorganisation, which is available in the US but not in the UK.[6]

Section 2 develops an economic model of the firm's exit decision and explains the corresponding econometric model. Section 3 describes the data and choice of variables, while the results of the econometric analysis are presented and discussed in Section 4. We collect conclusions in Section 5. Appendices provide a detailed derivation and discussion of the economic model, compare the bankruptcy codes in the US and the UK, provide a selective review of the theoretical and empirical literature on firm exits, and explain the econometric methodology in more detail.

2. The model

2.1. A model of the competing risks of firm exit[7]

At any time, t, each firm, i, is at some risk of exit through bankruptcy or by being acquired. Figure 1 gives a schematic representation of the way macroeconomic conditions may affect exit risks. On one side are firms that exit due to financial distress (both through bankruptcy and through being acquired) or that choose to exit even when they are not distressed. Adverse macroeconomic conditions induce financial distress in a larger pool of firms. On the other side are investor firms who are in the market for acquisitions. Any firm that is not distressed will be characterised by some optimal level of investment $I_{i,t}$, conditional on the level and stability of the macroeconomy. The optimal investment, which maximises the expected present value of the firms' assets, will comprise both investment in new capital, X, and acquired capital, Y. The optimal balance between X and Y depends on the relative prices of acquired and new capital, as well as on the fixed and adjustment cost of acquisitions.

---

[6]The welfare implications of protection to failing firms is an issue of considerable importance; Mooradian (1994) and Mason and Weeds (2003) discuss conditions under which such legal protection to firms that would otherwise be liquidated may be welfare-enhancing. Consideration of this issue is outside the scope of the current work and is not addressed in this paper.

[7]See Appendix 2 for a detailed derivation and discussion of the model.

Let the ith firm's state of technology (or efficiency) at time t be denoted by z_{it} and its capital by K_{it}. Firms operate under a production function which takes the form $f(z)K$. Here $f(z)$ is akin to the output-capital ratio and depends on firm efficiency: $\partial f(z)/\partial z > 0$. We assume that the dynamics in z and the economy wide macro-environment variable u are each governed by Markov transition processes. z and u are each assumed to be positively autocorrelated, and independent of each other. Hence, z and u are jointly Markov, *i.e.*,

$$Pr[z_{i,t+1} \leq z', u_{t+1} \leq u' | z_{it} = z, u_t = u] = F(z', u' | z, u).$$

Profits can then be written as $[f(z) - C(x, y) - x - g(u)]K$, where x and y are the (per unit capital) investments in new and acquired capital respectively ($i = x + y$), $C(x, y)$ is the (per unit capital) adjustment cost of investment, and $g(u)$ is the firm specific impact of instability on profits. $g(u)$ is increasing and convex in u, and $g(0) = 0$. Normalising the price of new capital to unity, and denoting the price of acquired capital by q ($q < 1$), the market value of the firm per unit of capital is:

$$Q(z, u) = max_{x \geq 0, y \geq 0}\{f(z) - C(x, y) - x - qy - g(u) + (1 - \delta + x + y)Q'(z, u)\},$$

where

$$Q'(z, u) = \frac{1}{1 + r} \int \int max\{q, Q(z', u')dF(z', u' | z, u)\}$$

is the discounted expected present value of capital in the next period given the firm's z and the economy's u today. Since z and u are independent and positively autocorrelated, $Q(z, u)$ is increasing in z and decreasing in u. Denote by $z_e(u)$ the level of z at which the firm is indifferent between exiting and staying in business, given the macroeconomic conditions, and by $z^*(u)$, the level of technology at which the firm is indifferent between staying out of the acquisitions market or entering it.[8]

In a stable period, when demand is more predictable, the incidence of financial distress will be lower. The smaller pool of distressed firms may also face a larger number of potential acquirers whose investment stances are encouraged by macroeconomic stability. Thus firms that are on the verge of bankruptcy will have a higher probability of being rescued and

[8]We assume a fixed deadweight cost of investing in acquired capital. This ensures existence of a threshold level z^*, above which a firm invests in acquired capital, and below which it does not (Jovanovic and Rousseau, 2002).

observed bankruptcy rates will be lower. Further, in such periods the hazard of acquisitions will be higher, even though there are fewer distressed firms that are candidates for acquisition. With the boost to investment in more stable times, the market for acquisitions may tighten, driving up the market price of acquired assets. This can be expected to induce a larger number of non-distressed firms to enter the pool of potential acquirees. These would be firms who find the offers from potential acquirers to be higher than their own continuation values (Jovanovic and Rosseau, 2001). Thus overall, in a stable period, the propensity for bankruptcy will be lower, and the propensity for acquisitions will be higher.

The implications of changes in u for firm exits and acquisitions can be understood with reference to a plot of the four regions of z, in the spirit of Jovanovic and Rousseau (2002). Let $\overline{u} > u$, then $z_e(\overline{u}) > z_e(u)$ and $z^*(\overline{u}) > z^*(u)$ (Figure 2). Evidently, in a period with higher u, more firms make the decision to exit, and less firms make the decision to acquire. Hence, more firms would go bankrupt during these periods.

2.2. Econometric methodology

We employ hazard regression models within a competing risks framework to study the impact of various explanatory factors (covariates) on firm exit. Unlike discrete outcome or scoring models (probit, logit etc.), hazard models explicitly incorporate the timing of alternative outcomes, and segregate the age aspect of the propensity to survive or exit from the effect of other covariates. This is important in disentangling the influence of macroeconomic conditions on business exit from those of firm-specific and industry factors.

The risk of bankruptcy and acquisitions is modelled in a unified framework where each firm is conceived as being concurrently under risk of bankruptcy and acquisition during each year over its lifetime. Bankruptcy and acquisitions may be thought of as mutually exclusive outcomes that are governed by their own underlying driving processes and compete to restrict the survival of a firm. Under a hazard regression framework, these processes can be suitably parametrised using a competing risk model. Under this model, inference is based on the cause-specific intensity (hazard) rates $\lambda_h(t;\theta)$, defined as

$$\lambda_h(t;\theta) = \lim_{\epsilon \downarrow 0} \frac{1}{\epsilon} P[T < t + \epsilon; H = h | T \geq t; \theta]$$

where T is the random variable denoting the age at failure, $H = 1, ...k$ are the k competing causes of failure, and $\lambda_h(0;\theta) = 0; h = 1, ...k$.

The Cox Proportional Hazards (PH) model conveniently describes the regression re-

lationship between the cause-specific hazard rates corresponding to the competing causes of failure and various explanatory variables (covariates). These describe firm characteristics such as firm size and profitability and industry characteristics (jointly $\underline{f}_{i,t}$), and the macroeconomic environment ($\underline{u}_t$), given the age of the firm since listing ($a_{i,t}$). The macro environment will depend on the level of overall economic activity and primary sources of macroeconomic instability such as volatility in price levels, interest rates, and exchange rates. The model postulates that the logarithm of the cause-specific hazard function is a linear function of the covariates,

$$\lambda_h(a_{i,t}, \underline{z}_{i,t}; \underline{\theta}_h) = \lambda_{0h}\left(a_{i,t}\right) . \exp\left[\underline{\theta_h}' \underline{z}_{i,t}\right]$$

where $H = 1, ...k$ are the k competing causes of failure, $\lambda_{0h}(.)$ are the baseline hazard functions correponding to the h-th cause of failure[9], $\underline{z}_{i,t}$ is the vector of covariates (comprising both $\underline{f}_{i,t}$) and $\underline{u}_t$), and $\underline{\theta_h}$ are the vectors of coefficients corresponding to the h-th cause of failure. This is a flexible regression framework for the study of the impact of various covariates on the hazards of failure due to competing causes, as well as differences in the way different cause-specific hazards vary with changes in the explanatory variables. The cause-specific hazard rates of bankruptcy and acquisition may then be written as $\lambda_b(a_{i,t}|\underline{f}_{i,t}, \underline{u}_t)$ and $\lambda_a(a_{i,t}|\underline{f}_{i,t}, \underline{u}_t)$ respectively. λ_b will increase in $\underline{u}_t$ (adverse macroeconomic conditions, including instability), and λ_a will decrease in $\underline{u}_t$.

2.3. The effect of bankruptcy codes[10]

Conclusions about the effect of u on bankruptcy depend on the institutional setting and in particular on whether the bankruptcy code permits firms to take legal shelter from their creditors for a period of time. Such a mechanism is not available in the UK but does exist in the US in the form of Chapter 11. Chapter 11 was instituted on October 1, 1979, as a consequence of the Bankruptcy Reform Act of 1978. Before then the US bankruptcy code was similar to, and historically derived from, the insolvency system in the UK (Skeel, 2001). A primary aim of the 1978 Act was to make it easier for businesses and individuals to file for bankruptcy in order to reorganise. To facilitate this, the existing management ('the debtor')

[9]In our case, h is binary – bankruptcy or acquisition. In one of the applications considered later in the paper, h constitutes the alternative legal routes to bankruptcy in the US, namely Chapter 11 and Chapter 7.

[10]See Appendix 3 for a discussion of the legal institutional setting in the two economies.

continues to manage the firm and retain significant rights as debtor-in-possession. Filing under Chapter 11 stays almost all claims, and while interest accrues on fully secured debt it does not accrue on unsecured or partly secured debt. The court mandates the management to propose a reorganisation plan. The initial 120 days to do this may be extended repeatedly by the court and for medium to large firms the Chapter 11 process typically takes two to three years (LoPucki and Whitford, 1993a,b), and in some cases may continue for over six years.

Large listed US firms in distress rarely file directly under Chapter 7, which constitutes automatic liqidation, and go initially through Chapter 11. The court may then decide that the continuation value of the firm is low and convert a Chapter 11 filing to Chapter 7. Evans (2003) finds that a significant number of firms that are retained under Chapter 11 either get reorganised or are acquired by other firms. Out of the sample of 290 firms that completed voluntary Chapter 11 filings in Evans (2003), 41 per cent (which is 118 firms) were reorganized in Chapter 11; 79 of these 118 firms restructured their debt and 39 were acquired as part of the plan of reorganization. Of the 172 cases converted to Chapter 7, 4 were because of failed acquisition.

The receivership system has offered the principle alternative to immediate liquidation for a distressed firm in the UK, but Chapter 11 and receivership are substantially different in their effects. The receiver represents creditors and replaces management and the appointment of a receiver closes off all other options. Moreover, the receiver's scope for action is severely limited by secured creditors who can withdraw the assets over which they have security even though those assets are vital for continuing the business. The UK 1986 Insolvency Act introduced the 'administration' process to offer some of the characteristics of Chapter 11 but secured creditors can block the appointment of an administrator by appointing a receiver and, in practice, administration has been used relatively little. In terms of the formal bankruptcy code the 1986 Act has not materially changed the creditor orientation of the UK system. In both the US and the UK informal workouts may avoid bankruptcy proceedings altogether and some commentators have argued that, in the nineties in the UK, large banks have been more effective in softening the impact of the bankruptcy code through coordination on workouts (Armour *et al.*, 2002).

Reorganisation systems like Chapter 11 act as a safe haven for distressed firms in periods of high macroeconomic instability, enabling some of these firms to recover and perhaps be acquired. We predict that adverse macroeconomic conditions and instability may have a stronger impact in increasing bankruptcy hazard in the UK than in the US and, as a second order effect, a stronger impact in depressing acquisitions in the US than in the UK .

3. Data and construction of variables

3.1. Data

The evaluation of the impact of macroeconomic conditions on firm exits requires data spanning several business cycles. For the US, we use the Compustat database for data on firm accounts matched with the CRSP database to identify listed firms and to extract listing data. This gives an unbalanced panel of about 13,700 US industrial and commercial firms over the period 1969 to 2000. There were 566 exits due to bankruptcy and 2,529 acquisitions in around 133,000 firm years over the 32 year period. For the UK, we use the Cambridge-DTI, Datastream and Exstat databases of firm accounts matched with the London Share Price Database (LSPD). This provides an unbalanced panel of about 4,300 UK listed industrial and commercial firms over the period 1965 to 1998. There are 166 instances of bankruptcy and 1,859 acquisitions in around 49,000 firm years over the 34 year period[11].

For each US firm listed at any point over the period of analysis, the data used for the analysis pertain to years, since 1969, during which the firm was listed on any of the stock exchanges in the US[12]. Similarly, for the UK, the data pertain to years, since 1965, when the firm was listed on the London Stock Exchange. Hence, for each firm, the available data are left-truncated, and do not pertain to the entire period that it is listed. The data are censored to the right, by the competing causes of exits, including delisting. The covariates used to explain exit-probabilities or hazard rates are time varying covariates, representing firm-level and industry-level characteristics as well as indicators of macroeconomic conditions and volatility.

Figures 3 and 4 for the UK and Figures 5 and 6 for the US plot the annual incidence of bankruptcies and acquisitions, respectively, against the business cycle indicator for the year. In the UK, the incidence of bankruptcy is high during years when the economy turned down after a peak, and lower during upturns in the business cycle, while acquisitions are procyclical. For the US the pattern is similar, except that the responsiveness of bankruptcies to turnaround in the business cycle is lower for the US than for the UK. These plots

[11]A firm may stop publishing accounts one or two years prior to actually being declared bankrupt. From the point of view of econometrically modelling bankruptcy it is sensible to reassign the date of bankruptcy to the year of last published accounts when the firm has been declared bankrupt within a 2 year period. This implies that our assignment of a bankruptcy to a particular point in time may be characterised as the time period when the "real"economic bankruptcy takes place, rather than the year when the firm is actually declared bankrupt.

[12]The NYSE/AMEX, NASDAQ, Over-the-Counter or any of the regional exchanges (Boston, Midwest, Montreal, Pacific or Philadelphia).

suggest that macro instability is important in explaining the survival of listed firms, before conditioning on firm and industry-specific characteristics.

The competing risks framework involves estimation of two separate Cox PH models, one for exits due to bankruptcy and one for acquisitions. In each case we treat exits due to the other cause as censored cases, in addition to observations originally censored (due to delisting and other reasons). The duration data are, thus, left-truncated, (randomly) right censored by (potentially dependent) competing risks, and the covariates explaining the nature of the cause-specific hazards are time-varying. We obtain efficient estimates of the model parameters making the censoring duration non-informative about the exit duration, after conditioning on an adequate selection of covariates. Further, we take into account possible violation of the proportionality assumption inherent in the Cox regression model, by allowing the covariate effects to vary over the age of the firm.[13]

The duration data are augmented by annual indicators of macroeconomic conditions, as well as firm and industry-specific factors. Here, we describe the construction of covariates for the US data; the constructs for the UK data are similar.

Measures of macroeconomic conditions.

We include a number of measures of macroeconomic conditions as covariates in the estimated hazard regression models. Output gap (o_t), the difference between the trend output and actual output, is measured by an HP-filtered series of output per capita. The sharpness of the economic turnaround is measured by $[o_t - o_{t-1}] - [o_{t-1} - o_{t-2}]$, which is the increment of the change in output gap in the current year ($o_t - o_{t-1}$) from that in the previous year. This is a measure of the curvature or second order derivative of the HP filter of output per capita. Over a business cycle, this measure would be lowest right after the peak, when the economy turns around downwards, and continue to increase gradually upto its maximum right after the trough, when the economy picks up. Over different business cycles, this measure would be lower (or higher) for a cycle in which the economy turns down sharply after a sharp upturn (or turns up sharply after a sharp downturn).

Real interest rates are measured as the annual average of monthly 10-year treasury bill rates, minus the annual rate of inflation. The exchange rate is measured by the annual average of monthly nominal broad dollar index (based on appropriate trade composition with G-10 economies). We measure instability in the foreign exchange markets by the year-on-year

[13]Refer to Appendix 4 and Bhattacharjee *et al.* (2002) for further details of the econometric methodology underlying the efficient estimation of the model under dependent competing risks, and potential violation of proportionality.

change in the exchange rate. Instability in prices, and long-and short-term interest rates are measured by the largest month-to-month rate of change within the year, of consumer price index, 10-year T-bill rates, and 3-month T-bill rates respectively. The indicator of business entries is the log-difference of the number of new listed firms in the accounting database for each year.

Firm and industry determinants of failure and acquisition.

The existing theoretical and empirical literature has identified several firm and industry-specific features as important determinants of firm exits (Siegfried and Evans, 1994; Caves, 1998).[14] The literature suggests that the age of a firm is an important determinant of survival probabilities of new entrants, though it is not clearly indicated whether the same may also hold for mature (listed) firms. In our hazard model specification, we consider age-since-listing (in years) as the measure of firm age and explore this issue.

Other firm-level factors, such as size (or start-up size), firm-level efficiency /productivity, and financial constraints are reported to be significant for firm exits. We proxy these firm-level effects with *firm age, size,* the ratio of*cash flow to capital,* and *return on capital.* Size is measured as the logarithm of fixed capital (in real terms), incremented by unity. Cash flow is measured as the total of operating profits and depreciation, net of taxes (excluding taxes on non-operating income, but including taxes saved on interest payments). Cash flow to capital is the ratio of cash flow to total assets. Return on capital is the ratio of post-tax profits to capital employed. Besides firm-level factors, several industry characteristics are also observed to have significant impact on exit rates; we use industry dummies to capture these effects.

The sample characteristics display significant variability both across firms, and over the period of analysis (the 32-year period 1969 to 2000 for the US, and the 34-year period 1965 to 1998 for the UK).

4. Results

4.1. Impact of macroeconomic conditions on firm exit

Table 1 presents parameter estimates and goodness-of-fit measures for the four models (for bankruptcies and acquisitions, and for the two economies). Controlling for industry and firm-level characteristics, macroeconomic conditions have a significant impact on hazard

[14]Selective reviews of the literature are contained in Appendix 1 and Bhattacharjee *et al.* (2002).

rates of exit by bankruptcy or acquisition in both economies. But there are considerable differences in the impact of the macroeconomy on business failure in the UK and the US.

Figures 7 and 8 show hazard ratios against the quantiles of volatilty in the different macroeconomic factors, for the US and the UK. The effect of macroeconomic instability is non-linear and strong for UK quoted firms, but is smaller for US firms. Youngest UK firms are more likely to go bankrupt immediately after the economy passes its peak; whereas there is no significant effect of economic turnaround on US bankruptcies, after controlling for firm and industry-specific characteristics and other macroeconomic factors. The hazard ratio at the 3rd percentile of stability according to this measure is about 20 times higher than that at the 97th percentile in the UK, while for the US firms the hazards are about the same at both these percentiles.

Similarly, more UK firms go bankrupt in periods when the exchange rate is stronger while no such effect is observed for US firms. Young UK firms are likely to go bankrupt during years when the domestic currency depreciates sharply (the hazard for the 97th percentile is 14 times that for the 3rd percentile) while no such effect can be detected in the US (the hazards are about the same). Price instability increases bankruptcy in the UK, but not in the US. While interest rate instability does not have much effect on bankruptcy; bankruptcy in the US, if anything, is lower in periods of high interest rate instability.

For acquisitions, empirical observations are broadly in line with our *a priori* expectations. Both UK and US firms are more likely to be acquired during growth phases in the economy than during downturns. Price instability has only a marginal effect on acquisitions in either economy. In both economies, firms are more likely to be acquired during periods of higher long-term real rates of interest. However, unlike the UK, acquisitions in the US are depressed in years when real rates of interest are volatile; similarly, in years when the exchange rate increases sharply.

4.2. Firm and industry-level factors

Firm-level covariates and industry, proxied by industry dummies, are also significant in determining exit rates. While exit rate declines in size at higher ranges in the UK, very large US firms (except very young) are more likely to exit. As expected, bankruptcy is declining in profitability and cash flow in both economies. Among US firms and younger firms in the UK, those with higher cash flow are more likely to be acquired.

The age of firms, post-listing, significantly affects exit rates due to both bankruptcy and acquisitions. Plots of the baseline cumulative hazard functions of bankruptcy, for the UK

and the US, against the post-listing age of the firm show a convex pattern. This indicates that exit rates due to bankruptcy decline with age (learning effect), after controlling for covariates. In the case of quoted US firms, the baseline hazard for bankruptcy seems to be lower in the first 8 years of post-listing life as compared to ages 8-25 years, before declining again after 25 years. This is consistant with what Evans (1987) and Dunne *et al.* (1989) report for new firms in the US. While the baseline hazard due to acquisitions in the UK appears to be constant over the post-listing lifetime of a firm, this shows a declining trend in the US.

Figures 3 to 6 also show the year-wise predicted incidence rates[15] of bankruptcies and acquisitions in both economies. The close proximity of the predicted and observed incidence rates is noteworthy. This indicates the ability of our estimated models to reflect aggregate trends in the number of corporate bankruptcies and acquisitions in the UK and the US.

There has been some debate in the literature regarding the explanation for merger waves in the US. Jovanovic and Rousseau (2002) explain these in terms of availability of profitable capital reallocation opportunities (their model does not explain the 1960s merger wave well) while Shleifer and Vishny (2003) stress the role of stock market misvaluations. Our model predicts all the major merger waves in the US (end of the 1960s, the 1980s and 1990s) fairly well, and provides an alternative (macroeconomic) explanation for these merger waves.

4.3. The impact of Chapter 11

Differences in bankruptcy code may be one reason for the differential impact of instability on bankruptcies in the US and the UK. We argued in Section 2 that US Chapter 11, which has no correlate in the UK, may reduce the impact of instability on bankruptcies in the US. Chapter 11 may have a second order effect on acquisitions, by providing a ready supply of acquisition candidates during periods of low instability and of high demand for acquired capital. To the extent that Chapter 11 shields businesses from bankruptcy during periods of high macroeconomic instability, the detrimental effect of instability on bankruptcies may be lower on firms that follow the Chapter 11 route as compared with those that pass through Chapter 7. If this were true, Chapter 7 bankruptcies, like bankruptcies in the UK, may respond more to the macroeconomic instability than Chapter 11 bankruptcies.[16]

---

[15]By incidence rate, we mean the number of firms that fail as a proportion of total firms in business during that year.

[16]There is a self-selection issue here, in that only unviable firms may be sent to the Chapter 7 route. However, if after conditioning on adequate firm and industry-level covariates, the exits through Chapter 7

We estimate models for bankruptcies separately for Chapter 11 (since 1980[17]) and Chapter 7 (including all bankruptcies upto 1979 and the Chapter 7 ones since then) under a similar competing risks framework. As compared with Chapter 11, Chapter 7 bankruptcies display a higher sensitivity to instability, especially to interest rate and exchange rate volatility. The plot of log-hazard ratios against quantiles of aggregate uncertainty[18] (Figure 8) provide further support for this observation. While the hazard of bankruptcy through the Chapter 11 route at the 97th percentile of aggregate uncertainty is only about twice as high as that at the 3rd percentile, the hazard for Chapter 7 bankruptcies at the 97th percentile is 24 times as high as that at the 3rd percentile. For each year, we use these estimated models to predict the proportion of firms that would have failed through the Chapter 11 route as against those failing through Chapter 7; Figure 9 shows that the expected number of bankruptcies from Chapter 11 is rather less than those from Chapter 7. A similar test for the effect of Chapter 11 on the number of acquisitions was carried out by estimating models for acquisitions separately for the periods 1969 to 1979, and 1980 to 2000. The estimates for the 1980-2000 period show higher responsiveness to macroeconomic instability, but this difference is not as striking as the difference between Chapter 7 and Chapter 11 bankruptcies.

In summary, we find evidence that the differences in the impact of macroeconomic instability on bankruptcy hazard can be attributed, in significant measure, to the difference between the Chapter 7 and Chapter 11 route. In other words, the legal protection afforded under Chapter 11 in the US appears to reduce the adverse effect of macroeconomic instability on bankruptcies.

5. Conclusions

This paper examines the relationship between business exits and macroeconomic instability, based on an economic model of the exit decisions of firms. Our model predicts higher bankruptcy and lower acquisitions in periods of high macroeconomic instability. Further, the

---

and Chapter 11 are rendered independent of each other, then the usual partial likelihood inference would be valid; this is very similar to the non-informativeness argument embodied in hazard regression models with censoring due to competing risks. Thus, so far as the impact of macroeconomic conditions on exits through Chapters 7 and 11 go, we can make adequate inference, conditional on firm and industry-level covariates, if the decision process allocating firms to these two routes depend only on these covariates.

[17]The Chapter 11 reorganisation process was instituted in 1979; all observations on Chapter 11 bankruptcy exits are post 1979.

[18]Aggregate uncertainty is measured a linear combination of interest rate and exchange rate volatility that is implied by the estimates for the model for bankruptcies in the US.

model indicates that the impact of instability may be lower in the presence of legal systems like Chapter 11 that temporarily protect distressed firms from bankruptcy. We estimate an econometric competing risks model for the probabilities of exit through bankruptcies and acquisitions, in terms of firm and industry characteristics and features of the business cycle, for large and mature (listed) US and UK firms, over a long period. At the firm level our findings corroborate earlier results. The estimated model also explains the observed time variation in the incidence of bankruptcy and acquisitions quite well.

While macroeconomic conditions and instability influence firm exits in both the US and the UK, after controlling for firm and industry-specific factors, the effect on bankruptcy is more pronounced in the UK, and on acquisitions more pronounced in the US. We attribute these differences in the impact of the macro-environment to differences in bankruptcy codes in the two economies.

References

Altman, E.I. and Saunders, A. (1997). Credit risk measurement: Developments over the last twenty years. *Journal of Banking and Finance* **21**. 1721–1742.

Armour, J., Cheffins, B.R. and Skeel, D.A. Jr. (2002). Corporate ownership structure and the evolution of bankruptcy law: Lessons from the UK. *Vanderbilt Law Review* **55**. 1699–1785.

Bhattacharjee, A., Higson, C., Holly, S. and Kattuman, P. (2002). Macro economic instability and business exit: Determinants of failures and acquisitions of large UK firms. DAE Working Paper **0206**, Department of Applied Economics, University of Cambridge.

Caves, R.E. (1998). Industrial organization and new findings on the turnover and mobility of firms. *Journal of Economic Literature* **36**. 1947–1982.

Dunne, T., Roberts, M.J. and Samuelson, L. (1989). The growth and failure of U.S. manufacturing plants. *Quarterly Journal of Economics* **104**. 671–698.

Evans, D.S. (1987). The relationship between firm growth, size, and age: Estimates for 100 manufacturing industries. *Journal of Industrial Economics* **35**. 567–581.

Evans, J. (2003). The effect of discretionary actions on small firms' ability to survive Chapter 11 bankruptcy. *Journal of Corporate Finance* **9**. 115–128.

Jovanovic, B. and Rousseau, P.L. (2001). Acquisitions and Technological Change: 1885–1998. Working Paper No. **01-W16**. Department of Economics, Vanderbilt University.

—— and —— (2002). The Q-Theory of acquisitions. *American Economic Review - Papers and Proceedings*. May 2002.

LoPucki, L.M. and Whitford, W.C. (1993a). Corporate governance in the bankruptcy reorganization of large publicly held firms. *University of Pennsylvania Law Review* **141**, 669–800.

—— and —— (1993b). Bankruptcy reorganization of large, publicly held firms. *Cornell Law Review*, 597–618.

Mason, R. and Weeds, H. (2003). The failing firm defence: Merger policy and entry. Mimeo.

Mooradian, R.M. The effect of bankruptcy protection on investment: Chapter 11 as a screening device. *Journal of Finance* **49**. 1403–1430.

Schary, M.A. (1991). The probability of exit. *Rand Journal of Economics* **22**. 339–353.

Shleifer, A. and Vishny, R. (1992). Liquidation Values and debt capacity: A market equilibrium approach. *Journal of Finance* **47**, 1343–1366.

—— and —— (2003). Stock market driven acquisitions. *Journal of Financial Economics*. Forthcoming.

Siegfried, J.J. and Evans, L.B. (1994). Empirical studies of entry and exit: A survey of the evidence. Review of Industrial Organization **9**. 121–155.

Skeel, D.A., Jr. (2001). *Debt's Dominion: A History of Bankruptcy Law in America*. Princeton University Press: Princeton and Oxford.

Appendix 1: Literature review

The existing literature on firm exits is sizeable but fragmented; Siegfried and Evans (1994) and Caves (1998) elaborately review the existing literature. A number of papers identify firm-level characteristics that determine failure and acquisition, and describe the time-series properties of the aggregate failure and acquisition processes.

Most of the existing literature examines the influence of firm-level factors such as financial performance, size and firm age on either the bankruptcy or the acquisition process. Relatively few studies analyse acquisitions and corporate failure within a unified framework, and hence not much is known about the extent to which bankruptcies and acquisitions are co-determined. Also, not much is known about the way in which macroeconomic conditions and instability affect exit decisions at the firm-level.

Aggregate and macro determinants of failure

The aggregate levels of bankruptcy and acquisition are usually believed to be cyclical. Bankruptcies are associated with recessions and acquisitions with economic recoveries. Futher, studies that focus on the impact of aggregate shocks on aggregate measures of firm formation and dissolution suggest that entry and exit rates are highly correlated, though the strength of this relationship differs across industries and over the ascending and descending stages of the business cycle. However, there is not much empirical evidence, at the firm-level, about the impact of the macroeconomy on business exit, and neither do the micro-based theories explain why the acquisition and failure processes should be episodic. Caves (1998), in his review of the literature on exits of new entrants, points out: "... these studies of intertemporal entry-exit linkages control for macroeconomic conditions in various ways and degrees, but they leave the impression that ... hazard rates are rather insensitive to the observed variation in the macro environment"(pp.1958). In a slightly different context, some recent work suggests that the macroeconomic environment may affect firm specific features (such as financial structure and profitability of firms) (Higson *et al.*, 2002), which in turn may have an impact on exit hazard.

Several studies have noted that entry and exit rates are highly correlated (Schwalbach, 1991, studies several countries; Dunne *et al.*, 1989; and Dunne and Roberts, 1991, study the US; and Geroski, 1991a, 1991b, study the UK), though the nature of the relationship between the entry and exit differ across industries (Agarwal and Gort, 1996), as well as over the ascending and descending stages of the business cycle (Boeri and Bellman, 1995; Sleuwaegen and Dehandschutter, 1991; Baldwin and Johnson, 1996; and Mata *et al.*, 1995). Over the business cycle, exit rates increase during the downturn (Caballero and Hammour, 1994, 1996; and Audretsch and Mahmood, 1995).

Cooley and Quadrini (1999) present a general equilibrium model of firms reacting to macroeconomic financial drivers and show how financial factors affect firm survival through the internal finance channel, and why the response of small firms might be larger.[19] Delli Gatti *et al.* (2000, 2001) also present a theoretical model linking the macro-economic environment, financial fragility and entry and exit of firms. These models await empirical support.[20]

At the firm level, Goudie and Meeks (1991, 1992, 1998) have explored the role of macroeconomic factors in corporate failure by tracing the probable effects of exogenous macro shocks upon the finances and viability of individual companies by simulating their financial statements, contingent on macroeconomic developments. They found a significant asymmetric and non-linear impact of the exchange rate on the failure rates of UK companies. Through retrospective analysis of macro shocks they show how for a notable minority among the major failing corporations, the shock determined their collapse.

In a recent paper, Bhattacharjee *et. al* (2002) find empirical evidence that, in addition to firm and industry-specific factors, macroeconomic conditions and instability significantly affect failure of quoted firms in the UK. Further, they observe notable differences in the way in which recently listed firms, and those listed some years previously respond to changes in the macro-economic environment. There is higher propensity of UK firms that have been listed during the upturn of the business cycle to go bankrupt as soon as the economy turns down. Firms that have weathered the downturn after their listing and in that sense proven themselves "capable", are most likely to be acquired immediately after the economy enters an up phase. Uncertainty in the form of sharp increases in inflation and sharp depreciation of the Pound adversely affect freshly listed firms in the UK. They are more likely to go bankrupt during such years; particularly because acquistion activity is also subdued in such years. Similar empirical microeconomic evidence on the impact of macroeconomic factors is largely lacking for other economies, including the US. A natural question arises as to whether such effects are absent in these other economies, and if so, why.

Firm and Industry-level determinants of failure[21]

"Passive learning"formulations (Jovanovic, 1982; also Hopenhayn, 1992 and Cabral, 1993)

---

[19]Their simulation exercise suggests that financial factors do not affect aggregate economy in a large way, though they may cause volatility in financial markets, particularly stock markets.

[20]Among other models, Corres and Ioannides (1996) present a model that allows for three kinds of exits - bankruptcy, (endogenous) exits when the current value of expected profit stream falls below a threshold (voluntary liquidation), and (exogenous) exits caused by macro-economic shocks. See also Abowd *et al.* (1995).

[21]See also reviews by Siegfried and Evans (1994) and Caves (1998).

model firms as entering uncertain of their capability, and then receiving repeated noisy signals of their capability, which induce them to expand, contract, or exit. These models predict that exit hazard declines with firm age though not necessarily from the outset. Low capability firms learn only from experience about their poor fitness. Empirical evidence in favour of the model includes Evans (1987) and Dunne *et al.* (1989) on US firms. In the "active learning"formulation (Nelson and Winter, 1978; Ericson and Pakes, 1992, 1995; Pakes and Ericson, 1998) firms invest in uncertain but expectedly profitable innovations, and grow if successful, shrink or exit if unsuccessful.[22] Empirical evidence suggests that exit rates decline with firm age (Dunne *et al.*, 1989 and Audretsch, 1991, for the US; Baldwin, 1995, in Canada; Mata *et al.*, 1995, in Portugal; and Disney *et al.*, 2000, for the UK), consistent with theoretical models of learning.

Growth rates and exits vary with nominal and real shocks (Judd and Treham, 1995). Firm-level factors, such as size (and start-up size) (Dunne *et. al.*, 1989; Mata *et al.*, 1995; and Caves, 1998) and financial fragility (Fazzari *et al.*, 1988; Klepper, 1996; Cooley and Quadrini, 1998, 1999; Delli Gatti *et al.*, 2000, 2001) are significant for firm exits. The impact of firm-level efficiency (Audretsch and Mahmood, 1991), productivity (Winter, 1999; Doms *et al.*, 1995) and profitability (Schary, 1991; Corres and Ioannides, 1996) on business failure have also been explored.

Industry characteristics, such as technology orientation (Mahmood, 1992) and presence of MNCs (technology transfers) (Gőrg and Strobl, 2000) have significant impact on exit rates, while market growth and R&D intensity appears to have relatively negligible effect (Mahmood, 1992).

Aggregate and macro determinants of mergers

Research on aggregate merger activity fall in two branches. The first aims at understanding the time series patterns in aggregate merger activity, and has found evidence of merger waves and stochastic trends (recently Chowdhury, 1993; Linn and Zhu, 1997). The second branch, the merger-macro literature, seeks explanation of merger wave patterns in terms of economy wide macroeconomic and financial variables that display a similar cyclical pattern. Jovanovic and Rousseau (2002) explain these in terms of availability of profitable capital reallocation opportunities, and Shleifer and Vishny (2003) stress the role of stock market misvaluations. Evidence suggests that merger activity is positively related to aggregate share price levels (recently Benzing, 1991, 1993; Clarke and Ioannidis, 1996). With respect to other aggregate

[22]Plants descend through the productivity ranking with age until refurbished or retired. Passive learning model fit retailing sector better, while active learning may be more appropriate for the manufacturing sector (Pakes and Ericson, 1998).

or economy-wide measures[23], evidence is mixed (recently, Weston *et al.*, 1990; Crook, 1995, 1996). With the exception of Bhattacharjee *et al.* (2002) and Goudie and Meeks (1991, 1992, 1998), none of the studies has explicitly analysed the micro-evidence for the impact of macroeconomic conditions.

Firm level determinants of mergers

The main discriminator between acquirers and their targets is size, while targets do not seem to be generally under-performers (e.g. Singh, 1971, 1975; Meeks, 1977; Cosh *et al.*, 1980; Levine and Aaranovitch, 1981; Kumar, 1984; Palepu, 1986; Powell and Thomas, 1994; Powell, 1997). The studies by Singh give early evidence that the already great degree of overlap of characteristics between acquirers and their targets becomes greater during 'merger booms'. Evidence suggests that discriminating factors vary in strength and nature depending on whether the period under study is a merger boom or a normal merger activity period (e.g. Cosh *et al.*, 1989; Higson and Elliott, 1993; Antoniou *et al.*, 1998).

Gaps in the literature

The empirical literature on firm exits, though elaborate, is deficient in several aspects. Firstly, little is known about the impact of the macroeconomy on business failure at the firm level, and even less is known about the similarities and differences between these effects for various forms of exit (Caves, 1998; Bhattacharjee *et al.*, 2002), except in the case of UK quoted firms (Bhattacharjee *et al.*, 2002). The empirical evidence on the importance of macroeconomic stability in the UK underscore the importance of smooth macroeconomic management for the corporate sector, and similar evidence for other economies requires to be explored.

Second, the micro-based theories of mergers cannot explain, by themselves, why the merger process should be episodic. Antoniou *et al.* (1998, p.2) admit that "[p]articularly puzzling is the observation that even without obvious changes to its market or financial posture, a firm could become a target for acquisition at one particular point in its life, but not at others."Generally, a characteristic of all these micro-studies has been the lack of strong statistical results and explanatory power in discriminating between competing theories, or the financial characteristics of companies involved in takeovers. Weston *et al.* (1990, p.276) also note: "[a] complete theory of mergers should have implications on the timing of merger activity. As the matter stands, there does not exist an accepted theory which simultaneously explains motivations behind mergers, characteristics of acquiring and acquired firms, and the

[23]Including, among others, industrial activity, growth rate of real GNP, Tobins' q, interest rates, the general business cycle, tax rates, capacity utilisation rates, the market premium, and the cost of debt.

determinants of the levels of aggregate merger activity."

Further, there have been no studies aiming to understand the importance of legal procedures related to bankruptcy on business failure across different economies, though there are appreciable differences between economies in the kind of bankruptcy procedures, and a debate exists about the appropriateness of legal systems for the financial health of firms. These are some of the issues that this paper aims to shed light on.

Appendix 2: Derivation of the model

The ith firm's state of technology (or efficiency) at time t is indicated by z_{it} and its capital by K_{it}. Firms operate under a production function which takes the form $f(z)K$. Here $f(z)$ is akin to the output-capital ratio and depends on firm efficiency: $\partial f(z)/\partial z > 0$. Following Jovanovic and Rousseau (2001, 2002), we assume that firm specific technology z follows a first-order Markov process and is positively autorrelated. We also assume that the time evolution of the the economy wide macro-environment variable u is Markov and has positive autorrelation, and that z and u are independent of each other. It follows that z and u jointly have Markov transition:

$$Pr[z_{it+1} \leq z', u_{t+1} \leq u' | z_{it} = z, u_t = u] = F(z', u' | z, u).$$

The assumption is reasonable in a world where each firm comes under the influence of the same macroeconomic environment irrespective of their z, and where the the draw of z in any period depends only on the level of technology in the previous period and is, therefore, independent of u. The Markov transition in u and the positive autocorrelation of z and u are also reasonable in this setup.

There is a market for K, but there is no market for z or for u. Investment in new capital is denoted X and investment in acquired capital is denoted by Y. K evolves as $K' = (1-\delta)K + X + Y$, where δ is the depreciation rate. Internal costs of adjustment $C(K, X, Y)$ are homogeneous of degree 1 in K, X, Y, $C(K, X, Y) = KC(1, X/K, Y/K) = Kc(x, y)$, where $x = X/K$ and $y = Y/K$. We assume that $c(0, 0) = 0$, increasing and convex in (x, y), and differentiable.

It is now possible to determine the value of the firm with K units of capital following Hayashi and Inoue (1991). Normalise the price of new capital to unity, so that the price of acquired capital $q < 1$. Macroeconomic instability enters the profit function by decreasing profits in firm specific ways. For example, in the case of production-to-stock industries instability in demand will lead to higher costs through the build up of inventories.

Profits can then be written as $[f(z) - C(x, y) - x - g(u)]K$, where $g(u)$ is the firm specific impact of instability on profits, with $g(0) = 0$, increasing and convex in u. The market value per unit of capital is then:

$$Q(z, u) = max_{x \geq 0, y \geq 0}\{f(z) - C(x, y) - x - qy - g(u) + (1 - \delta + x + y)Q'(z, u)\},$$

where

$$Q'(z, u) = \frac{1}{1 + r} \int \int max\{q, Q(z', u')dF(z', u'|z, u)\}$$

is the discounted expected present value of capital in the next period given the firm's z and the economy's u today. The firm has an option of selling its capital in the next period on the acquisition market at a price of q per unit of capital. Following Hayashi and Inoue (1991), $Q(z, u) = Q\left(f(z) - g(u)\right)$. Since z and u are jointly Markov, $f(z) - g(u)$ is Markov. Further, since z and u are both positively autocorrelated, $f(z) - g(u)$ is also positively autocorrelated. Hence, $Q(z, u)$ increases in z and decreases in u.

At an interior maximum, the optimal x and y satisfy the first order conditions $c_1(x, y) = Q'(z, u) - 1$ and $c_2(x, y) = Q'(z, u) - q$. Assume that there is a fixed cost φ of acquiring the capital of other firms. Let $i = x + y$ be the gross investment rate in efficiency units. A low-i firm will avoid the cost φ by setting $y = 0$ and using only x, whereas a high-i firm will use both margins. The value, i^*, at which the firm is indifferent between buying in the acquisitions market and staying out, solves for i in the equation:

$$i + c(i, 0) = \varphi + min_y\{(i - y) + qy + c(i - y, y)\}.$$

The LHS is lower when i is small, and the RHS is lower when i is high, where i itself depends on z and u. A firm may exit, either by liquidation and selling off its capital, or by getting acquired. In either case, it gets q per unit of capital. The point of indifference between exiting and staying in business is given by the level z_e that solves $Q(z, u) = q$. Since $\partial Q(z, u)/\partial u < 0$, $\partial z_e/\partial u > 0$. Given u, let $z^*(u)$ be such that $i(z^*, u) + c(i(z^*, u), 0) = \varphi + min_y\{(i(z^*, u) - y) + qy + c(i(z^*, u) - y, y)\}$ and $i^* = i(z^*, u)$. Since, given z, $\partial i(z, u)/\partial u < 0$, $\partial i(z, u)/\partial u > 0$.

In a steady state in which the distribution of z repeats itself period after period (Hopenhayn, 1992), the fate of the incumbents can be represented by the four regions of z (Jovanovic and Rousseau, 2002). Jovanovic and Rousseau (2001, 2002) provide empirical evidence for y becoming positive beyond z^* (the value of z that corresponds to i^* , given u), and y

overtaking x beyond z_0[24]. This is the case if there were no u, unlike our case where the macroeconomy (u) has a role to play.

The implications of changes in u on firm exits and acquisitions can now be understood with reference to Jovanovic and Rousseau's (2002) plot on the four regions of z. Let $\overline{u} > u$. Then, $z_e(\overline{u}) > z_e(u)$ and $z^*(\overline{u}) > z^*(u)$ (Figure 2).

Evidently, in a period with higher u, more firms make the decision to exit, and less firms make the decision to acquire. Hence, more firms would go bankrupt during these periods if there is no mechanism like Chapter 11 whereby firms can take legal shelter from their creditors for a period of time, until a period when u falls back again.

Appendix 3: The institutional framework

Chapter 11 was introduced in the US by the 1978 bankruptcy code. Its aim is the survival of the firm as a going concern even if this reduces the proceeds available to creditors (Skeel, 2001). To facilitate this, existing management ('the debtor') continue to manage the firm and have significant rights as debtor-in-possession. Filing under Chapter 11 stays almost all claims, and while interest accrues on fully secured debt it does not accrue on unsecured or partly secured debt. The court mandates the management to propose a reorganisation plan. They initially have 120 days to do this, though the period may then be extended repeatedly by the court. Creditors can resist a Chapter 11 filing by themselves petitioning for an immediate winding-up. Gilson (1991) shows that while Chapter 11 had almost always been preceded by an attempt at informal workout or reorganisation, there may have been a radical shift in the 1990s, with many firms opting to go directly to Chapter 11 and others spending much less time in workout before going to Chapter 11. He attributes this to the 1986 Tax Reform Act which increased the relative attractiveness of Chapter 11 as compared to an informal workout.

In the UK, the receivership system offers the main alternative to immediate liquidation of a distressed firm. The UK 1986 Insolvency Act introduced the 'administration' process to offer some of the characteristics of Chapter 11. Either the firm or a creditor may apply for the appointment of an administrator who represents all creditors and has strong powers to delay creditors claims – interest payments on loans are frozen, and lessors may be prevented

[24]Their evidence suggests that i_0 has fallen over the past two decades from 1.43 in 1980, to 1.09 in 1989, and to just 0.5 in 1998. This suggests that φ must also be falling. Their plot of used and acquired capital as percentages of total investment also reflect the complementary nature of the two series.

from repossessing assets deemed necessary for the running of the business. However, secured creditors can block the appointment of an administrator by appointing a receiver and this is likely to happen when secured and unsecured creditors have conflicting interests. In consequence, administration has been used relatively little. Franks and Torous (1991) suggest that receivers are conscious of their reputation with the small group of major lending institutions that appoint most receivers, and that there is less risk to receivers in a rapid sale of assets. In 1990, around three-quarters of UK formal reorganisations were liquidations while 22 per cent used receivership (Rajak, 1994).

Thus, Chapter 11 and UK receivership are substantially different in their effects. Chapter 11 encourages the management to take out further borrowing with priority over many existing claims. Though a UK receiver can borrow, any borrowing would be junior to existing claims, with the result that receivers rarely take out further loans. While, in receivership interest on loans continues to accrue, interest no longer accrues (other than on secured loans) from the moment a firm enters Chapter 11. Also the receiver's scope for action is severely limited by secured creditors who can withdraw the assets over which they have security even though these assets may be vital for continuing the business, whereas in Chapter 11 there is an immediate stay on creditors exercising their claims. Hence, while the US code has usually been seen as debtor-oriented, the UK code is seen as being creditor-oriented and potentially leads to premature liquidation of UK firms.

The Chapter 11 process can take some years. Research suggests that smaller firms typically spend less than a year in Chapter 11 (LoPucki, 1983; Kerkman, 1987), but that in larger bankruptcies the period is typically two or three years. In Flynn (1989), two-thirds of the Chapter 11 bankruptcy cases are concluded in the second or third year after filing. In LoPucki and Whitford (1993a,b), who study bankruptcies greater than $100 million in size, firms spend two or three years in Chapter 11. White (1994) reviews four studies which examine samples of between 30 and 50 large US firms that had publicly traded equity and that filed for bankruptcy during the 1980s. Almost all of the firms studied filed under Chapter 11. It is very rare for large listed US firms to file under Chapter 7.[25] However, after a Chapter 11 filing, the court makes a decision whether the continuation value of the firm is high enough to justify a reorganisation. If such reorganisation is not justifiable, the firm goes into Chapter 7. In Eberhart *et al.* (1990) firms spend on average 2.1 years in reorganisation, with a range of 10 months to over six years. In Franks and Torous (1991) firms spent an average of 3.7 years in reorganisation. White (1994) also cites a study by Hotchkiss (1993) who studies a complete sample of 809 listed firms filing for Chapter 11 between 1979 and

[25]Chapter 7 is the bankruptcy procedure, which inevitably leads to the winding up of the firm and the sale of its assets. It is equivalent to the UK liquidation procedure.

1988. In this sample the average time in reorganisation was 1.6 years. 197 of Hotchkiss' sample of 809 firms emerged from Chapter 11 as listed firms. She found that one third of these subsequently either restructured, filed for bankruptcy again, or were liquidated within a few years. Based on data on 290 closely held firms that completed voluntary Chapter 11 filings at the Northeast Division of the Atlanta Bankruptcy Court between December 31, 1993 and December 31, 1994, Evans (2003) estimate that fewer firms were reorganized in Chapter 11 (41 per cent) than were liquidated in Chapter 7 (59 per cent). Of the 118 firms that reorganized in Chapter 11, 79 restructured their debt and 39 were acquired as part of the plan of reorganization. Of the 172 cases converted to Chapter 7, 4 were because of failed acquisition.

Existing management are normally given the exclusive right to make reorganisation proposals under Chapter 11. Whereas Flynn (1989) found that only 17 per cent of Chapter 11 bankruptcy cases resulted in an agreed plan, LoPucki (1983) found that of 57 Chapter 11 filings that he studied during the period 1979 to 1980, one third of the firms were still trading two-to-three years after bankruptcy. The natural bidders in an auction will be firms in the same industry, but to the extent that financial distress is sector-wide in its causes, the supply of such bidders will be further limited just when they are needed (Shleifer and Vishny, 1992). LoPucki and Whitford (1993a,b) examine the 43 largest Chapter 11 bankruptcies between 1979 and 1998. They show that all asset sales were to existing firms which were usually from the same sector and that no new firms were formed.

Thus, in summary, the way in which a reorganisation system like Chapter 11 works, it can act as a safe haven for distressed firms during adverse macroeconomic conditions, enabling some of them to recover and perhaps be acquired, thus attenuating the impact of macroeconomic instability on bankruptcy hazard. Such a possibility is largely absent in the UK bankruptcy code.

Appendix 4: Econometric Methodology

We model the competing risks due to bankruptcy and acquisitions using hazard regression models. Two separate Cox proportional hazards models (Cox, 1972) are estimated for the competing risks, where exits due to the other risk are considered as censored observations. Credible inference in this setup requires making the cause-specific hazard function of interest independent of the censoring, conditional on an adequate selection of covariates. If then, the conditional censoring becomes noninformative about the conditional cause-specific hazard of interest (in an appropriate sense, see Andersen *et. al.*, 1992, pp.150-151; Arjas and

Haara, 1984), efficient inference can be made.[26] In the model for bankruptcy, we include all covariates that affect the hazard of exits due to acquisition, and vice versa, and conditional on the covariates the exits due to either of the two competing causes are assumed to be independent of censoring due to the other. The explicit estimation of separate models for the two major competing causes of exit allows us to take care of dependence between these two different modes of exit.

In addition to right-censoring (by dependant competing risks), the models presented in this paper are based on duration data truncated to the left; in that they pertain only to the period since 1965 (for the UK firms) and 1969 (for the US firms). For the US, for example, the left-truncation duration is given by $L = \max(L^{**}, 1969 - B)$, where B is the listing-year of the firm, and L^{**} represents any delay in entry into the panel subsequent to listing. The Cox partial likelihood estimates based on a modified definition of risk sets (delayed entry) would be valid even if truncation and exit durations are independent conditional on covariates. We evaluate the robustness of results to dependent truncation by estimating the exit duration models conditioned on different ranges of the truncation duration and comparing estimates for similarity.[27]

Further, the Cox PH model substantially restricts interdependence between the explanatory variables and duration - the coefficients of the hazard function regressors are restricted to be constant over time. This may not hold in many situations, or may even be unreasonable from the point of view of relevant economic theory (McCall, 1994). In particular, the effect of a covariate on the hazard is often observed to be increasing or decreasing in age (sometimes over the whole covariate space, and sometimes over a range of the covariate space). This clearly constitutes a violation of the proportionality assumption.[28]

An appealing solution to such violation of proportionality is to allow the covariate to have different effects on the hazard according to age of the firm. Several estimators have been proposed in the literature (see, for example, Zucker and Karr, 1990; Murphy and Sen, 1991; Martinussen *et al.*, 2002) that allow for such time-varying coefficients in the Cox regression

---

[26] In particular, if the censoring depends on time-invariant covariates which are not included in the model for the cause-specific hazard under study, then the inference is efficient. If, however, the same covariates are included in the cause-specific hazard and censoring mechanisms, inference is possible (after specifically taking care to include these covariates also in the hazard model) since then one can assume that the censoring is independent of the cause-specific hazard, conditional on the covariates.

[27] See Bhattacharjee *et al.* (2002) for further details of the econometrics and evaluation of robustness of the empirical results.

[28] Some applications where such violations of the PH model is evident and tests of the PH model against such alternatives is presented in Bhattacharjee and Das (2002).

model. In this paper, we have used the appealing histogram-sieve estimators of Murphy and Sen (1991), based on the method of sieves (Grenander, 1981), which we find intuitively appealing and amenable to useful inference. This method entails dividing the duration axis into several intervals and including the continuous covariate multiplied by an indicator function that reflects each of the intervals as covariates in a modified Cox PH model.

In the analysis in this paper, the lives of firms, post-listing, was divided into four intervals (0-8 years, 9-16 years, 17-25 years, and greater than 25 years). Our results demonstrate how this helps us to effectively characterise the way the impact of a covariate varies over the life of the firm. In particular, we find the expected result that the adverse effect of instability declines in the age of the firm, post-listing. Bhattacharjee (2003) considers estimation of hazard regression models where such ordered covariate dependence is known *a priori*. The estimates of the impact of instability under such an order restriction provides useful inference.

The estimates of covariate effects reported in Table 1 are the maximum partial likelihood estimates (Kalbfleisch and Prentice, 1980). The reported z-scores are based on robust standard error estimates proposed by Lin and Wei (1989) for regression coefficients in the Cox proportional hazards model. The fit of the models is judged using the goodness-of-fit test by Grambsch and Therneau (1994) based on adjusted Schoenfeld residuals; these statistics suggest that the estimated models are satisfactory descriptions of the duration data.

Additional Appendix References

Abowd, J.M., Crépon, B., Kramarz, F. and Trognon, A. (1995). A la recherche des moments perdus: Covariance models for unbalanced panels with endogenous death. Technical Working Paper No. **180**, National Bureau of Economic Research, Cambridge, MA.

Agarwal, R. and Gort, M. (1996). The evolution of markets and entry, exit and survival of firms. *Review of Economics and Statistics* **78**, 89–98.

Antoniou, A., Owen, S. and Pescetto, G.M. (1998). The market for corporate control and macroeconomic activity. No. **200**, Working Papers Series in Economics and Finance, Department of Economics and Finance, University of Durham.

Arjas, E. and Haara, P. (1984). A marked point process approach to censored failure data with complicated covariates. *Scandinavian Journal of Statistics* **11**. 193–209.

Audretsch, D.B. (1991). New-firm survival and the technological regime. *Review of Economics and Statistics* **73**, 441–450.

—— and Mahmood, T. (1991). The hazard rate of new establishments: A first report. *Economics Letters* **36**. 409–412.

—— and Mahmood, T. (1995). New firm survival: New results using a hazard function. *Review of Economics and Statistics* **77**, 97–103.

Baldwin, J.R. (1995). *The Dynamics of Industrial Competition: A North American Perspective*. Cambridge University Press: New York.

—— and Johnson, J. (1996). Survival of new Canadian manufacturing firms: The importance of financial structure. Working Paper, Micro-Economic Studies and Analysis Division, Statistics Canada.

Benzing, C. (1991). The determinants of aggregate acquisition activity – before and after Celler-Kefauver. *Review of Industrial Organisation* **6**, 61–72.

—— (1993). acquisitions – What the "Grimm"data tell us. *Review of Industrial Organization.* **8**, 6, 747–753.

Bhattacharjee, A. (2003). Estimation in hazard regression models under ordered departures from proportionality. *Computational Statistics and Data Analysis* (to appear) and Cambridge Working Papers in Economics No. **0337**, University of Cambridge.

—— and Das, S. (2002). Testing proportionality in duration models with respect to continuous covariates. DAE Working Paper **0220**, Department of Applied Economics, University of Cambridge.

Boeri, T. and and Bellmann, L. (1995). Post-entry behavior and the cycle: Evidence from Germany. *International Journal of Industrial Organization* **13**. 483–500.

Caballero, R.J. and Hammour, M.L. (1994). The cleansing effect of recessions. *American Economic Review* **84**. 1350–1368.

—— and —— (1996). On the timing and efficiency of creative destruction. *Quarterly Journal of Economics* **111**. 805–852.

Cabral, L.M.B. (1993). Experience advantages and entry dynamics. *Journal of Economic Theory* **59**. 403–416.

Chowdhury, A.R. (1993). Univariate time-series behaviour of acquisition activity and its various components in the United States. *Applied Financial Economics* **3**, 1, 61–66.

Clarke, R. and Ioannidis, C. (1996). On the relationship between aggregate acquisition activity and the stock market: Some further empirical evidence. *Economics Letters* **53**, 349–356.

Cooley, T.F. and Quadrini, V. (1998). Financial markets and firm dynamics. Unpublished Manuscript.

—— and —— (1999). Monetary policy and the financial decisions of firms. Preprint.

Corres, S. and Ioannides, Y.M. (1996). Endogenous attrition of firms. Working Papers **96-03, 96-04**, Department of Economics, University of Wales, Swansea.

Cosh, A.D. and Hughes, A. (1993). The death process: A comparison of large and small firm failures and acquisitions. University of Cambridge Small Business Research Centre Working Papers No. **33**.

——, ——, Lee, K. and Singh, A. (1989). Institutional investment, acquisitions, and the market for corporate control. *International Journal of Industrial Organisation* **7**, 73–100.

——, —— and Singh, A. (1980). The causes and effects of takeovers in the United Kingdom: An empirical investigation for the late 1960s at the microeconomic level. in Mueller, D.C. eds *The Determinants and Effects of acquisitions: An International Comparison.* Cambridge: MA, 227—270.

Cox, D.R. (1972). Regression models and life tables (with discussion). *Journal of the Royal Statistical Society, Series B* **34**. 187–220.

Crook, J. (1995). Short and long run movements in U.S. acquisition activity, *Review of Industrial Organization* **11**, 307–323.

—— (1996). Time series explanations of acquisition activity: Some econometric results. *International Review of Applied Economics* **9**, 59–85.

Delli Gatti, D., Gallegati, M., Guilioni, G. and Palestrini, A. (2000). Financial fragility, pattern of firms' entry and exit and aggregate dynamics. Preprint.

——, ——, —— and —— (2001). Financial fragility, heterogenous agents' interaction, and aggregate dynamics. Preprint.

Disney, R., Haskel, J. and Heden, Y. (2000). Entry, exit and establishment survival in UK manufacturing. Preprint.

Dixit, A. (1989). Entry and Exit Under Uncertainty. *Journal of Political Economy* **97**(3). 620–638.

Doms, M., Dunne, T. and Roberts, M.J. (1995). The role of technology use in the survival and growth of manufacturing plants. *Internation Journal of Industrial Organization* **l3**. 523–545.

Dunne, T. and Roberts, M.J. (1991). Variation in producer turnover across US manufacturing

industries. in Geroski, P.A. and Schwalbach, J. eds. *Entry and Market Contestability: An international comparison*, Blackwell: Oxford. 187–203.

Eberhart, A.C., Moore, W.T. and Roenfeldt, R.L. (1980). Security pricing and deviations from the absolute priority rule in bankruptcy proceedings, *Journal of Finance*, **XLV**, 5, 1457–1469.

Ericson, R. and Pakes, A. (1992). An alternative theory of firm and industry dynamics. Yale Cowles Foundation Discussion Paper **1041**.

—— and —— (1995). Markov-perfect industry dynamics: A framework for empirical work. *Review of Economic Studies* **62**. 53- -82.

Fazzari, S.M., Hubbard, R.G. and Petersen, B.C. (1988). Financing constraints and corporate investment. *Brookings Papers on Economic Activity* **1**. 141–195.

Flynn, E. M. (1989). Statistical analysis of Chapter 11. Mimeo, The Bankruptcy Division of the Administrative Office of the United States Courts.

Franks, J.R. and Torous, W.N. (1991). How firms fare in workouts and chapter 11 reorganizations. University of California-Los Angeles, Working Paper No. **1-91**.

Geroski, P.A. (1991a). *Market Dvnamics and Entry.* Basil Blackwell: Oxford.

—— (1991b). Domestic and foreign entry in the United Kingdom: 1983-1984. in Geroski, P.A. and Schwalbach, J. eds. *Entry and Market Contestability: An international comparison*, Blackwell: Oxford. 63-88.

Gilson, S.C. (1991). Managing default: Some evidence on how firms choose between workouts and Chapter 11. *Journal of Applied Corporate Finance* **4**, 62–70.

Goudie, A.W. and Meeks, G. (1991). The exchange rate and firm failure in a macro-micro model of the UK firm sector. *Economic Journal* **101**. 444–457.

—— and —— (1992). Forecasting and explaining corporate failure: A study of contingent financial statements. University of Cambridge Discussion Papers in Accounting and Finance No. **AF1**.

—— and —— (1998). firm failure and hysteresis. in Begg, I. and Henry, S.G.B. eds. *Applied Economics and Public Policy*, DAE Occasional Papers, vol. **63**, Cambridge University Press: New York. 209–221.

Gőrg, H. and Strobl, E. (2000). Multinational firms, technology spillovers and firm survival: Evidence from Irish manufacturing. Research Paper No. **2000/12**, Centre for Research on

Globalisation and Labour Markets, School of Economics, University of Nottingham.

Grambsch, P.M. and Therneau, T.M. (1994). Proportional hazards tests and diagnostics based on weighted residuals. *Biometrika* **81**. 515–526.

Grenander, U. (1981). *Abstract Inference*. John Wiley and Sons: New York.

Hayashi, F. and Inoue, T. (1991). The relation between firm growth and Q with multiple goods: Theory and evidence from panel data on Japanese firms. *Econometrica* **59**, 731–753.

Higson, C. and Elliott, J. (1993). Are acquired firms distinctive? The effect of Choice of control. IFA Working Paper **170-93**, London Business School.

——, Holly, S. and Kattuman, P. (2002 forthcoming). The Cross Sectional Dynamics of the US Business Cycle: 1950-1999. *Journal of Economic Dynamics and Control*.

——, ——, —— and Platis, S. (2001). The Business Cycle, Macroeconomic Shocks and the Cross Section: The Growth of UK Quoted firms. DAE Working Paper **0114**.

Hopenhayn, H.A. (1992). Entry, exit, and firm dynamics in long run equilibrium. *Econometrica* **60**. 1127–1150.

Hotchkiss, E.S. (1993). *Investment Decisions under Chapter 11 Bankruptcy*. Ph.D dissertation, New York University.

Jovanovic, B. (1982). Selection and the evolution of industry. *Econometrica* **50**. 649–670.

Kalbfleisch, J.D., and Prentice, R.L. (1980). *The Statistical Analysis of Failure Time Data*. John Wiley and Sons: New York.

Kattuman, P., Higson, C. and Holly, S. (2000) Mobility, Reversion, Divergence: Evolution of Returns in British Industry. (Mimeo).

Klepper, S. (1996). Entry, exit, growth, and innovation over the product life cycle. *American Economic Review* **86**. 562–583.

Kerkman, J. (1987). The debtor in full control - A case for the adoption of the Trustee System. *Marquette Law Review*, 159–209.

Kumar, M.S. (1984). *Growth, Acquisition and Investment*. Cambridge University Press.

Levine, P. and Aaronovitch, S. (1981). The financial characteristics of firms and theories of acquisition activity. *The Journal of Industrial Economics* **30**, 149–172.

Lin, D.Y. and Wei, L.J. (1989). The robust inference for the Cox proportional hazards model. *Journal of the American Statistical Association* **84**. 1074–1078.

Linn, S. C. and Zhu, Z. (1997). Aggregate acquisition activity: New evidence on the wave hypothesis, *Southern Economic Journal* **64**, 130–146.

LoPucki, L.M. (1983). The debtor in full control: Systems failure under Chapter 11 of the Bankruptcy Code? Second Installment. *American Bankruptcy Law Journal* **57**, 3, 247—73.

McCall, B.P. (1994). Testing the proportional hazards assumption in the presence of unmeasured heterogeneity. *Journal of Applied Econometrics* **9**. 321–334.

Mahmood, T. (1992). Does the hazard rate for new plants vary between low- and high-tech industries?. *Small Business Economics* **4**. 201–209.

Martinussen, T., Scheike, T.H. and Skovgaard, Ib M. (2000). Efficient estimation of fixed and time-varying covariate effects in multiplicative intensity models. Paper presented at the 18th Nordic Conference on Mathematical Statistics, Grimstad (Norway), June 2000.

Mata, J., Portugal, P. and Guimarães, P. (1995). The survival of new plants: Start-up conditions and post-entry evolution. *International Journal of Industrial Organization* **13**. 459–481.

Meeks, G. (1977). *Disappointing Marriage: A Study of the Gains From Acquisition.* Cambridge.

Murphy, S.A. and Sen, P.K. (1991). Time-dependent coefficients in a Cox-type regression model. *Stochastic Processes and their Applications* **39**. 153–180.

Nelson, R.R. and Winter, S.G. (1978). Forces generating and limiting concentration under Schumpeterian competition. *Bell Journal of Economics* **9**. 524–548.

Pakes, A. and Ericson, R. (1998). Empirical implications of alternative models of firm dynamics. *Journal of Economic Theory* **79**. 1–46.

Palepu, K. (1986). Predicting takeover targets: A methodological and empirical analysis. *Journal of Accounting and Economics* **8**, 3–35.

Peel, M.J. (1990). *The Liquidation/ acquisition Alternative.* Aldershot: Hong Kong.

—— and Wilson, N. (1989). The liquidation/acquisition alternative: Some results for the UK corporate sector. *Managerial and Decision Economics* **10**. 209–220.

Powell, R.G. (1997). Modelling takeover likelihood. *Journal of Business, Finance and Accounting.* **24**. 1009–1030.

—— and Thomas, H.M. (1994). Corporate control and takeover prediction. Working Paper **94/07**, Department of Accounting and Financial Management, University of Essex.

Rajak, H. (1994). The challenges of commercial reorganizations in insolvency: Empirical evidence from England. in Ziegel J.S. eds. *Current Developments in International and Comparative Insolvency Law*, Clarendon Press: Oxford.

Schoenfeld, D. (1982). Partial residuals for the proportional hazards regression model. *Biometrika* **69**. 239–241.

Schwalbach, J. (1991). Entry, exit, concentration, and market contestability. in Geroski, P.A. and Schwalbach, J. eds. *Entry and Market Contestability: An international comparison*, Blackwell: Oxford. 121–142.

Singh, A. (1971). *Takeovers: Their Relevance to the Stock Market and the Theory of the Firm*. Cambridge University Press: Cambridge.

Sleuwaegen, L. and Dehandschutter, W. (1991). Entry and exit in Belgian manufacturing. in Geroski, P.A. and Schwalbach, J. eds. *Entry and Market Contestability: An international comparison*, Blackwell: Oxford. 111–120.

Weston, J.F., Chung, K.S. and Hoag, S.E. (1990). *acquisitions, Restructuring and Corporate Control*. Prentice-Hall International.

Wheelock, D.C. and Wilson, P.W. (2000). Why do banks disappear? The determinants of U.S. bank failures and acquisitions. *Review of Economics and Statistics* **82**. 127–138.

White, M.J. (1994). Corporate bankruptcy as a filtering device: Chapter 11 reorganizations and out-of-court debt restructurings. *Journal of Law, Economics, and Organization* **10**, 268–295.

Winter, J.K. (1999). Does firms' financial status affect plant-level investment and exit decisions?. Preprint.

Zucker, D.M. and Karr, A.F. (1990). Nonparametric survival analysis with time-dependent covariate effects: A penalized partial likelihood approach. *Annals of Statistics* **18**. 329–353.

TABLE 1: Model Estimates, UK and US

Variables	UK, Bank.	UK, Acq.	US, Bank.	US, Acq.
Industry Dummies				
(not reported)				
Firm × Year Level				
Size: log(real fixed				
capital +1) = s	1.487 (1.6)	1.412 (5.3)**		
– $s \times I_1$			0.571 (-1.4)	2.539 (5.1)**
– $s \times I_2$			0.078 (-6.6)**	1.120 (0.8)
– $s \times I_3$			0.067 (-5.4)**	1.149 (0.8)
– $s \times I_4$			0.132 (-6.0)**	0.931 (-0.7)
Size-squared = s^2	0.942 (-2.2)*	0.961 (-6.2)**		
– $s^2 \times I_1$			1.058 (0.3)	0.725 (-3.5)**
– $s^2 \times I_2$			1.549 (5.8)**	0.917 (-1.6)
– $s^2 \times I_3$			1.463 (3.1)**	0.889 (-1.9)$^+$
– $s^2 \times I_4$			1.297 (3.6)**	0.950 (-2.0)*
Cash flow to Capital = c			1.000 (1.6)	1.001 (2.4)*
– $c \times I_1$	0.908 (-3.3)**	4.179 (4.4)**		
– $c \times I_2$	0.682 (-4.0)**	1.302 (2.5)*		
– $c \times I_3$	0.113 (-1.6)	0.351 (-2.8)**		
– $c \times I_4$	0.381 (-3.3)**	0.661 (-2.0)*		
Retn. on capital employed	0.997 (-2.2)*	1.001 (0.9)	1.000 (-4.2)**	0.999 (-2.3)*
Macroeconomic				
Conditions				
Output gap = o				
– $o \times I_1$	34901 (1.4)	75131 (4.2)**	0.409 (-0.2)	29.60 (1.4)
– $o \times I_2$	0.002 (-0.7)	1734 (3.2)**	0.001 (-2.0)*	2.231 (0.4)
– $o \times I_3$	2.9e-5 (-1.1)	0.043 (-1.0)	0.000 (-1.5)	1920 (2.5)*
– $o \times I_4$	4716 (1.2)	28.53 (1.2)	0.002 (-0.8)	336.9 (1.9)$^+$
Entries (y-o-y growth rates)	1.014 (1.7)$^+$	0.997 (-1.7)$^+$	0.979 (-0.3)	1.043 (1.7)$^+$
Long-term real int. rate = r				
– $r \times I_1$	1.163 (1.4)	1.121 (3.6)**	1.469 (9.0)**	1.345 (14.1)**
– $r \times I_2$	1.018 (0.4)	0.945 (-4.0)**	1.142 (4.2)**	1.246 (12.4)**
– $r \times I_3$	0.962 (-0.9)	0.994 (-0.3)	1.130 (2.4)*	1.133 (4.5)**
– $r \times I_4$	1.072 (0.9)	0.973 (-1.4)	1.189 (2.4)*	1.167 (5.7)**
Exchange rate = e	0.080 (-1.9)$^+$	7.048 (5.2)**		
– $e \times I_1$			0.954 (-7.1)**	0.963 (-12.6)**
– $e \times I_2$			0.973 (-7.6)**	0.977 (-10.6)**
– $e \times I_3$			0.985 (-3.1)**	1.001 (0.7)
– $e \times I_4$			1.007 (1.2)	1.011 (5.7)**

TABLE 1: Contd.

Variables	UK, Bank.	UK, Acq.	US, Bank.	US, Acq.
Macroeconomic Instability				
Turnaround = trn			1.718 (0.4)	0.923 (-0.2)
– $trn \times I_1$	9.3e-11 (-3.0)**	0.017 (-1.7)$^+$		
– $trn \times I_2$	0.152 (-0.3)	300.3 (2.6)**		
– $trn \times I_3$	0.001 (-1.0)	19.79 (1.4)		
– $trn \times I_4$	0.000 (-1.0)	1.834 (0.2)		
y-o-y increase in exchange rate = v			1.002 (0.1)	0.963 (-3.9)**
– $v \times I_1$	9.6e+5 (3.5)**	0.424 (-0.7)		
– $v \times I_2$	289.456 (1.4)	0.322 (-1.1)		
– $v \times I_3$	17.577 (0.5)	0.072 (-1.8)$^+$		
– $v \times I_4$	1305 (1.7)$^+$	1.037 (0.0)		
Volatility - prices	1.276 (5.8)**	0.904 (-5.9)**	0.686 (-1.3)	1.355 (2.4)*
Volatility - Long term int. rate = l	0.987 (-0.2)	1.033 (1.7)$^+$		
– $l \times I_1$			1.065 (1.7)$^+$	1.018 (1.0)
– $l \times I_2$			0.968 (-0.9)	1.007 (0.4)
– $l \times I_3$			0.947 (-1.4)	1.051 (2.6)**
– $l \times I_4$			0.901 (-1.8)$^+$	1.037 (1.8)$^+$
Volatility - Short term int. rate	0.949 (-1.4)	0.991 (-0.8)	1.005 (0.9)	1.009 (3.7)**
No. of firms	4,320	4,320	13,655	13,655
No. of exits	166	1,859	561	2,516
Total time at risk (in years)	45,527	45,527	132,410	132,410
Log-likelihood	-1090.59	-12947.1	-4210.73	-19075.2
Chi-square test stat.(PH assmp.)	29.99	14.36	16.52	28.19
degrees of freedom	38	38	39	39
p-value	82.0	100.0	99.9	90.0

z-scores in parentheses.

Parameters reported are hazard ratios (exponential of the actual parameter values).

For the UK, I_1, I_2, I_3 and I_4 represent the indicator functions I(age 0-5 yrs.), I(age 6-15 yrs.), I(age 16-25 yrs) and I(age > 25 yrs) respectively.

For the US, the same represent I(age 0-8 yrs.), I(age 9-16 yrs.), I(age 17-25 yrs) and I(age > 25 yrs) respectively.

Volatility is measured as maximum monthly difference during the year, divided by the no. of intervening mths.

**, * and $^+$ – Significant at 1%, 5% and 10% level respectively.

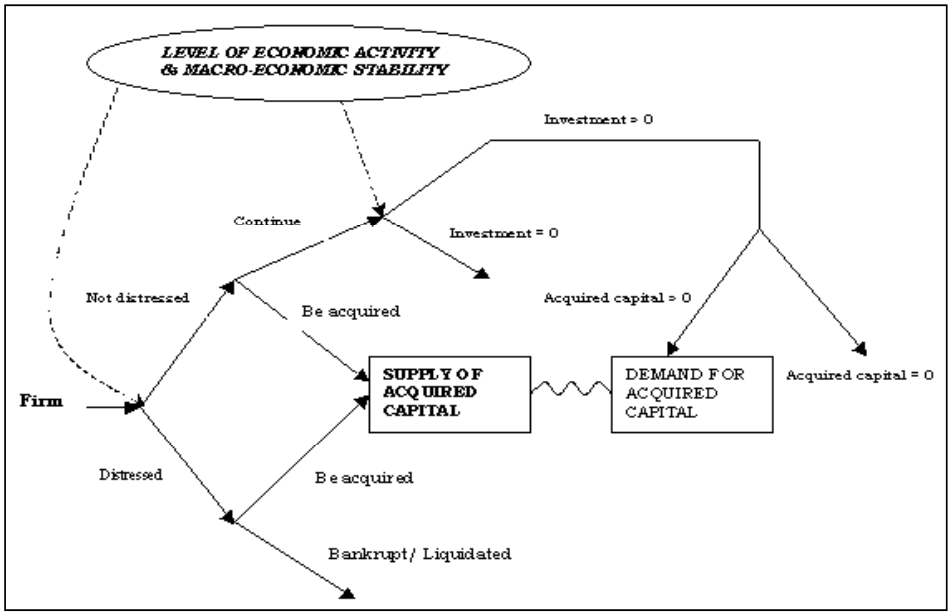

Fig. 1.— A model of firm bankruptcies and acquisitions.

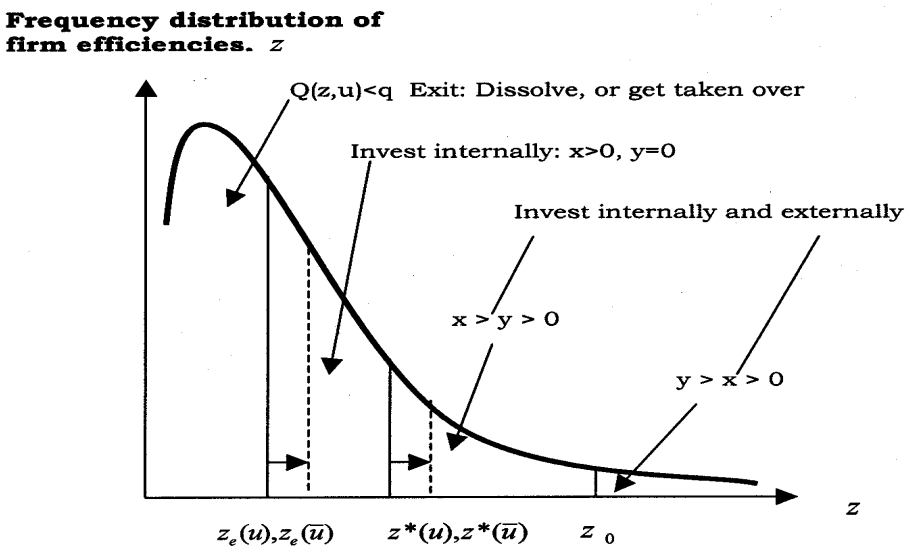

Figure: The four regions of z

(From Jovanovic and Rousseau, 2002 - modified)

Fig. 2.— Impact of Macroeconomic Instability on Business Exits.

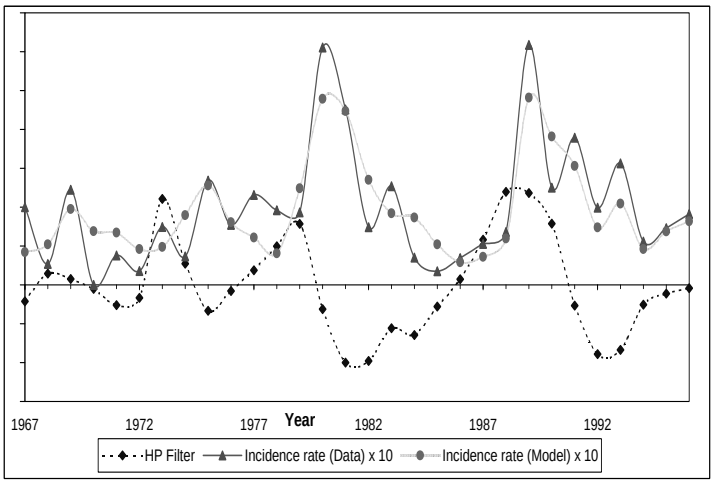

Fig. 3.— Model Fit: Business cycle and Bankruptcies, UK.

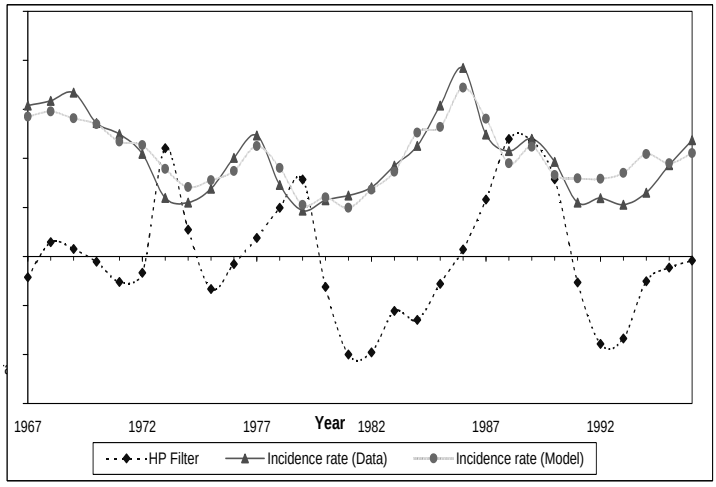

Fig. 4.— Model Fit: Business cycle and Acquisitions, UK.

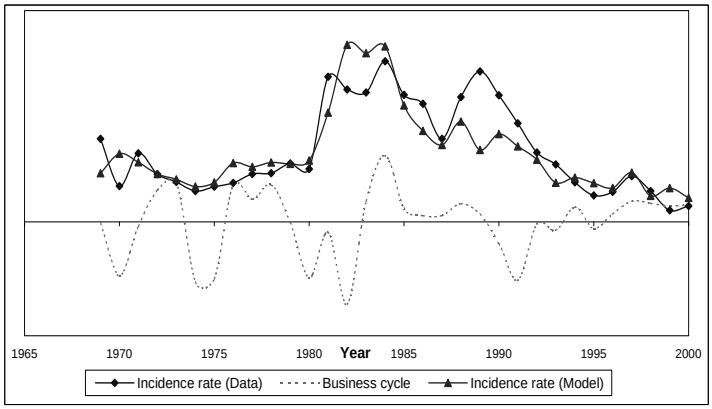

Fig. 5.— Model Fit: Business cycle and Bankruptcies, US.

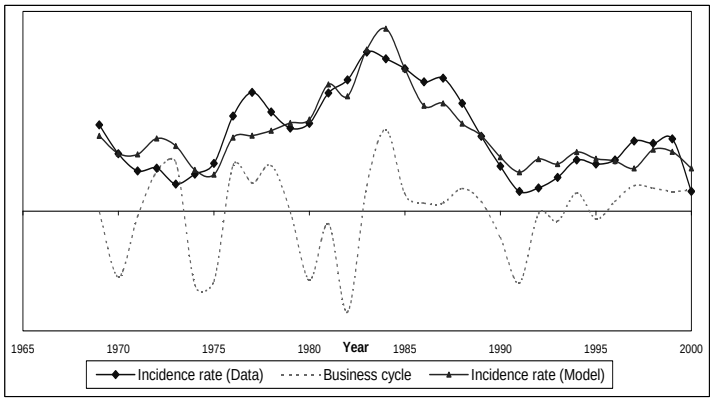

Fig. 6.— Model Fit: Business cycle and Acquisitions, US.

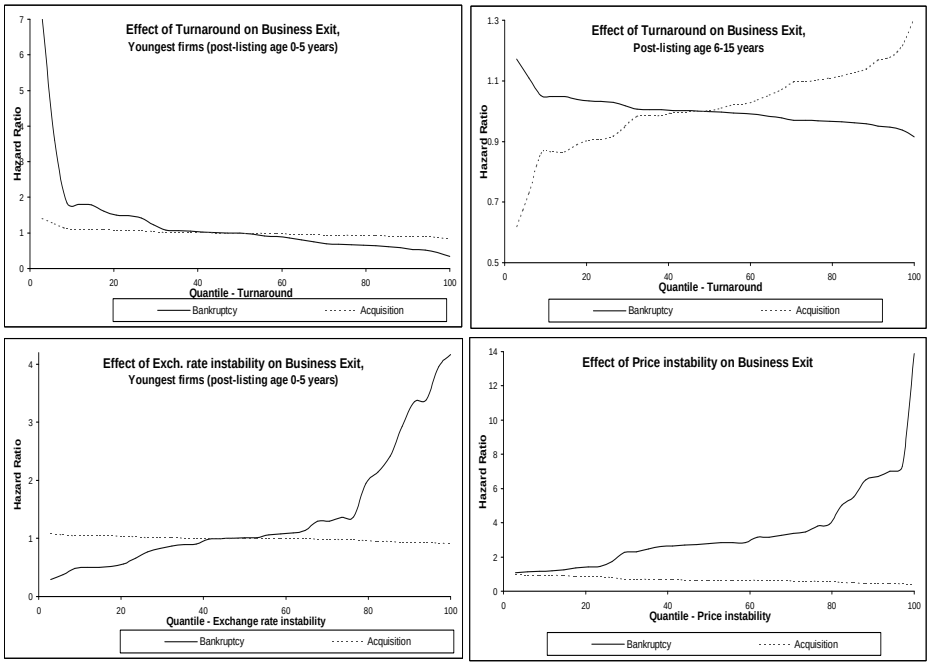

Fig. 7.— UK: Effect of Macroeconomic Instability on Firm Exits (Hazard Ratios).

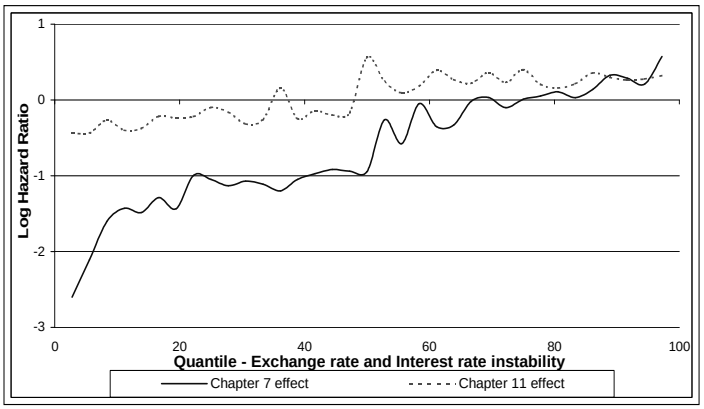

Fig. 8.— Effect of Exch. Rate and Int. rate instability on Business Exit – Chapter 7 and Chapter 11.

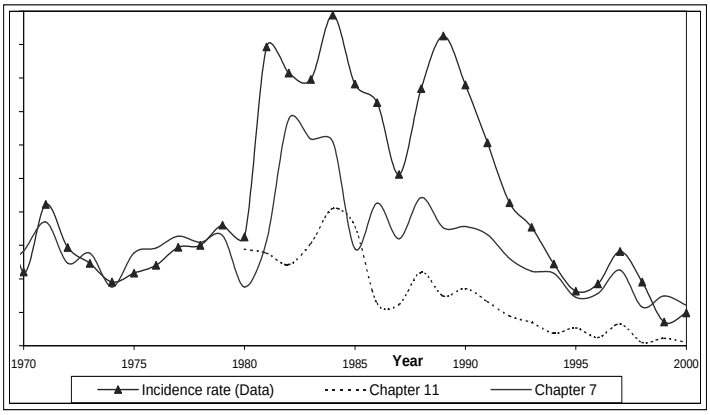

Fig. 9.— Predicted Incidence rates – Chapter 7 and Chapter 11 bankruptcies.