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Private Equity, Buy-outs, and Insolvency Risk

BY Mike Wright and Nick Wilson

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Mike Wright
Center for Management Buy-out Research
Imperial College Business School, and
University of Ghent
Tel: +44 (0)7725 159 873
Email: mike.wright@imperial.ac.uk

Nick Wilson
Credit Management Research Center
Leeds University Business School
Tel: +44 (0)113 343 4472
Email: nw@lubs.leeds.ac.uk

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Abstract

Private Equity restructuring using debt has been criticised for increasing financial distress and bankruptcy especially following the financial crisis. We build a unique dataset comprising the population of over 9 million company-year observations and 153,000 insolvencies during 1995-2010. We compare the insolvency hazard of the spectrum of buyout types within the corporate population over time and investigate the risk profile of the companies pre-buyout. Controlling for size, age, sector and macro-economic conditions private-equity backed buyouts are no more prone to insolvency than non-buyouts or other types of management buyins. Moreover, leverage is not the characteristic that distinguishes failed buyouts from those surviving.

Keywords: Private Equity, Management Buyouts, Distress, Bankruptcy, Hazard Models

JEL: D21, C25, G24, G32, G33

Contents

Introduction

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There has been increased attention to the behaviour of private equity firms and the performance of the buyouts they finance (see for example, Cumming et al., 2009; Meuleman et al., 2009; Jelic, 2011). Private equity involvement in company restructuring via leverage has been particularly criticized for increasing the risk of default and bankruptcy with consequent economic and social costs. Private equity (PE) has been especially under scrutiny in the aftermath of the global financial crisis and recession (Rasmussen, 2008). Recent evidence pointing, initially, to high default rates amongst PE backed companies during the recession (Moody's 2010) has been criticised for *'developing new and expansive definitions of what constitutes default'* (Thomas, 2010 p1.). In particular, ad hoc measures of 'financial distress' (e.g. loan restructuring) do not distinguish transitory cash-flow problems from serious structural problems. Formal insolvency, on the other hand, involves the loss of assets (or, in the case of administration, control over assets), forces losses on creditors and damages the reputations of PE investors and company directors. In this paper we model insolvency (bankruptcy) as the corporate outcome within a failure prediction framework that controls for company specific characteristics, industry and macro conditions.

Private Equity, Buy-outs, and Insolvency Risk

Research into corporate financial distress and failure, including PE studies, has focused predominantly on listed companies. Yet private companies make up the majority of firms, both in terms of activity and failure. Within the population of limited companies, management buyouts (MBOs) and management buy-ins (MBIs), whether private equity backed or not, form an increasingly important element about which there has been scant evidence on failure propensity. This provides an opportunity to examine whether these types of companies are indeed more likely to fail than other corporations and to assess the impact of PE involvement and leverage on failure propensity. Failures of private equity buyouts, defined as entering liquidation, receivership or administration, the UK's formal bankruptcy regime for firms (Franks and Sussman, 2005), increased sharply in the recession of the early 1990s, and again from 2008 (CMBOR, 2011). Kaplan and Stromberg (2009) have suggested that default rates in the recent recession would likely be lower than those following the 1980s' wave of buyout activity. Their argument was based on the observation that deals concluded during the second wave of buyout activity generally had better coverage ratios and looser covenants than those conducted during the first wave. Moreover, changes to insolvency legislation (e.g., the Enterprise Act 2002 in the UK) aimed to promote a corporate rescue culture and increase the likelihood of the continuation of a business as a going concern. Specifically, prior to the Act the 'administrative receiver' was only accountable to the 'charge-holder' (i.e. creditors that had obtained a fixed or floating charge on assets), with little incentive to act in the interests of other creditors and/or rescue a company. The 2002 Act has given greater weight and negotiation rights to other creditors (Acharya et al., 2011). Firms backed by private equity investors may be particularly proactive in protecting their assets and reputation. Specifically private equity investors appear to be effective in negotiating restructurings of portfolio companies that become or are likely to become distressed and/or require refinancing through the economic cycle, reducing the likelihood of the company entering formal insolvency (Acharya, Kehoe and Reyner, 2009b).

Private Equity, Buy-outs, and Insolvency Risk

Studies of the first wave of private equity buyouts have identified high leverage as a significant contributory factor to failure. Kaplan and Stein (1993) considered a sample of 124 large LBOs, 23 of which had defaulted on their debt, while Andrade and Kaplan (1998) examine 28 LBOs that had entered Chapter 11 proceedings. Wright et al. (1996) examined a sample of 110 UK buyouts, of which 53 had entered bankruptcy proceedings (i.e. receivership in UK terminology). In the wake of the financial crisis it is timely to examine the determinants of failure of private equity buyouts in the second wave. Stromberg (2008) examined longevity in a sample of 21,397 private equity transactions worldwide of which 570 had entered bankruptcy/restructurings but did not include comparisons with non-LBOs.

This study extends previous studies of failure among private equity backed buyouts by comparing such cases with the context of other firms that have not gone through the buyout process. We provide direct evidence on whether buyouts and buy-ins, private equity backed or not, are more or less likely to fail in terms of entering formal insolvency proceedings than other firms and how this varies over the economic cycle. In contrast to other studies we build a new, unique dataset comprising the population of nearly 9 million firm-year observations of public and private firms in the UK during 1995-2010, which encompasses the recent recessionary cycle, of which over 153,000 have failed (1.7% of the total)[1] (see Table I Panels A and B). We estimate generic failure prediction models that isolate key determinants of failure, including company type and incorporate changes in prevailing economic conditions via a macro dependent base line hazard. Unlike previous studies (Axelson et al. 2012), we examine the spectrum of buyout types compared with the corporate population and over time. We include both public to private transactions and the more common buyouts of private companies, such as corporate divisions, family firms, companies already owned by other private equity firms (so-called secondary buyouts), and buyouts of firms in the bankruptcy process. Our time period includes an economic cycle up to and including the recent credit crisis and

[1]We use the population of limited companies that submit annual accounts but we exclude very small companies from the data-base for the purposes of analysis (less than £10k assets). The majority of these are likely to be not active or trading and therefore not subject to insolvency

recession. Our panel study incorporates data for several years pre-buyout for the buyout sub-sample. Our non-buyout sample includes a very significant proportion of the active limited company population and the post-buyout sample has over 25,000 company-year observations and over 1,100 instances of insolvency. We believe this is the most comprehensive study of failure among private equity backed buyouts to date.

The first stage of analysis examines whether the failure rate of private equity backed buyouts differs from that of the corporate population controlling for company size, sector, competition (industry concentration), economic conditions and company ownership type. We study whether firms having undergone a management buyout (MBO) led by inside management or management buy-in (MBI) led by an outside management team are significantly more likely to fail than other firms. We consider whether private equity backed buyouts are more or less likely to fail than other buyout types and the non-buyout population and give consideration to the risk profile of the companies pre-buyout. We isolate, amongst other risk factors, the impact of leverage on failure propensity and whether this is more acute for buy-outs.

We construct models for the whole company population using 'abridged accounts' that even smaller private companies are required to submit, and estimate separate models for larger companies that submit full accounts inclusive of profit and loss and balance sheet statements. Our large sample facilitates estimation of similar models using the buyout sample only. This allows testing for differences in the failure propensity of buy-out type in order to see if the determinants of buy-out failure are the same as those of other companies. Moreover, as the dataset comprises the population of UK limited companies, estimation problems surrounding selection bias are less relevant than in other studies. Finally, we analyse the prediction accuracy of the estimated models by applying them to a

hold-out sample of 1 million companies of which over 11,000 became insolvent in 2010[2].

Controlling for a range of factors, we find that over the whole period under study buyouts have a higher failure rate than the population of non-buyout companies with the MBI sub-category having a higher failure rate than MBOs and private equity backed buyouts/buyins. Our findings indicate a default rate for UK private equity backed buyouts of 5.3% (5.7% for non-PE backed buyouts), which is lower than Stromberg (2008) who found an 8% bankruptcy rate for the UK firms in his sample, but in line with Hotchkiss et al. (2011). We find that the likelihood of failure is significantly associated with higher leverage for all firms but, clearly, has to be analysed in relation to interest coverage, the capacity to service debt. Moreover we find that, in the time period under study, MBOs and private equity backed buyouts only have a higher insolvency risk than the non-buyout population pre-2003, controlling for age, size and sector; post-2003, when changes to the UK bankruptcy process were introduced, there is no significant difference. In contrast MBI's always have a higher propensity to insolvency.

Our findings contribute to the private equity and buyout distress literature in several ways. First, we document failure rates in the period leading up to and during the second private equity wave. We highlight that the nature of failure is related to the heterogeneity of buyout deal types. We compare private equity backed buyout failure rates with those of non-private equity backed firms and in relation to pre-buyout risk. Second, we extend Axelson et al. (2010) by considering directly the link between high leverage and portfolio firm failure. Third, we complement Hotchkiss et al's. (2011) study of a sample of firms receiving leveraged loans, by comparing a population of buyouts and non-buyout corporations entering the formal bankruptcy process. Our context (the UK) involves a richer set of variables for public and private firms than are available in the US context of the Hotchkiss et al. (2011) study. Fourth, we complement Tykvova and Borell (2012) by including a much larger sample that enables us to distinguish

[2]As of the end of December 2010.

further dimensions of the heterogeneity of buyouts to include PE backed buyouts, MBOs and MBIs where differences in insolvency hazard may be expected.

I. Theoretical perspectives

A. Buyouts and private equity

Buy-outs involve the creation of a new legal entity to acquire an existing firm. Ownership becomes concentrated among PE firms and management, with loan capital provided by banks (Kaplan and Stromberg, 2009). PE firms become active investors in many, but not all, buyouts through taking board seats and specifying contractual restrictions on management's behaviour (Acharya, et al., 2009b). PE firms may focus on deals with particular characteristics relating to their ability to service highly leveraged financing structures and to their prospects for performance improvement. PE investors help maintain earnings quality through their active involvement (Beuselinck, Deloof and Manigart, 2009). Buyouts backed by PE investors may also be less vulnerable to failure than those buyouts without PE backing (Jelic, 2011). PE investors are likely to be proactive in restructuring the finances of companies with debt servicing problems to *both* avoid insolvency risk and preserve assets *and* to protect their own reputation.

The buyout form may vary in terms of the role of management. A management buyout (MBO) usually involves a private equity acquisition in which existing management takes a substantial proportion of the equity. A management buy-in (MBI) (Robbie and Wright, 1995) is an MBO where the management team acquiring ownership is outsiders. Management may proactively undertake an MBO as they perceive opportunities for gains (Wright et al., 2000) but may engage in high risk activities absent close monitoring. Some managers may engage in a buyout as a defensive reaction where the alternative is to be fired. As incumbents, management may have superior information to outsiders but their objectives, motivations and competencies may mean that this is overvalued; management may thus overpay and/or be more likely to entrench themselves in the business with

the consequence that they fail to take sufficient actions to establish the viability of the firm. MBIs carry greater risks as incoming management lack insiders' knowledge benefits about the business (Robbie and Wright, 1995). We therefore expect MBIs to be significantly more likely to fail but the relationship between MBOs and failure to be ambiguous.

High leverage places pressures on managers to perform in order to service debt (Jensen, 1986) and can mitigate the problem of over-investment in firms with limited growth opportunities (Dang, 2011). Very high leverage may create debt servicing problems, particularly if cash flow projections are not met, predicated asset sales are not completed or monetary conditions change. Higher leverage therefore has been associated with a high probability of failure. Favourable credit conditions are a major driver of leverage in private equity deals (Axelson, et al., 2012) and, in the initial stages, optimal leverage may be high (Kortweg, 2010). The maximum amount of debt that can be sold against the firm's assets is greater in a boom due to lower default risks (Hackbarth et al., 2006). This implies that leverage increases insolvency risk for firms unable to adjust capital structure prior to/during the downturn or in the face of changing monetary conditions.

B. Insolvency Risk Models

We evaluate propensity to fail amongst buyouts whilst controlling for economic conditions and company specific factors associated with insolvency risk. Specifically, we estimate discrete time hazard models using panel data techniques to determine the likelihood of insolvency and to test, by analysing average marginal effects, for differences in company type. Shumway (2001) suggests that models should be specified as duration models with time-varying covariates. Platt and Platt (2002) show that failure prediction models *"need to include all firms within a population.."* (p.197) in order to avoid choice-based sample bias. Nam et al (2008) show that the discrete time hazard models can be restated and estimated as a panel logit

model inclusive of macro-dependent base line hazard when *"..the probabilities of failure are sufficiently small.."* (p8)[3].

Our use of multi period financial statements allows us to both include time-varying covariates for each company and the data facilitates the estimation of a base hazard function by capturing changes in the macro-economic environment or by utilizing forecasts of the population insolvency rate.

II. Data and Variable Description

A. Data

The database covers the population of UK companies filing statutory accounts during 1995-2010, crucially covering the recession period from 2007-10, and captures the rapid rise (and peak) in insolvencies. The accounts analysed for failed companies are the last set of accounts filed preceding the year of insolvency. For live companies, we include accounts for each surviving year[4]. Thus, our sample includes companies that filed at least one set of accounts and survived until the start of each analysis year under consideration[5].

Reporting exemptions mean two different datasets are prepared. Companies included in the 'full accounts' company dataset are primarily larger companies that file full accounts including a Profit and Loss Account statement. We calculate financial ratios from the main balance sheet for inclusion in the 'all company' dataset and utilise both balance sheet ratios and profit and loss account ratios in the large company dataset. Whereas profit and loss account variables mainly proxy the profitability and turnover generating ability of companies, balance sheet variables proxy size, P&L reserves (profit retention), value of capital structure and asset levels of

[3]As a further check for robustness we estimated models using the cox-proportional hazard estimation and obtained near identical results.
[4]For instance, for analysis year 2008 we use the data available as of 1st January 2008 and flag 'live' companies as those that are still live at the end of 2007. We flag 'failed' as those that are declared legally insolvent during 2008.
[5]For instance, year 1995 sample contains the companies that filed at least one set of accounts and survived until 31/12/1994, which is the start of the period 1995. Year 1996 sample contains the companies that survived until 31/12/1995, and so on.

companies. Most variables created from the accounting data are ratios. Therefore, only the variable used as a proxy for size (total assets) is deflated using the GDP deflator for each analysis year. Breakdown of the sample by data availability and hazard rate is given in Table I.

To this company population data-base we match information on UK management buyouts formed during the sample period. The buyout data was provided by the Centre for Management Buyout Research (CMBOR)[6]. This gives 25,484 observations on live buyouts and 1,179 instances of buyout insolvency.

We track the entry and exit years of the buyout sub-sample and code buyouts by type. We have 3 years of pre-buyout observations for each buyout type and can profile aspects of the company characteristics before buyout. Generally, the MBO failure rate is higher than for the non-buyout population and is more sensitive to downturns, e.g., late 1990s and 2001-2 (Table I Panel B). MBIs have a higher failure rate than MBOs. Moreover, PE backed buyouts have a lower failure rate than non-PE backed buyouts. For instance the failure rate of non-private equity backed buyouts is around 5.7 % in the period since 1998 whereas private equity backed ventures have a failure rate of 5.3% in the same period. However, buyouts undertaken pre-2003 had a significantly higher failure rate than those completed post-2003[7]. In the latter period the private equity backed deals are not riskier than non-buyouts (controlling for sector and size), other buyouts or listed companies.

[6]The CMBOR database effectively comprises the population of management buy-outs and buy-ins in the UK, whether private equity backed or not. Data is captured from a twice-yearly survey of private equity firms, intermediaries and banks and obtains a full response rate as respondents are incentivized to supply data through receipt of a free copy of a quarterly review of the buy-out market. Press and corporations' annual reports are also used to identify and check further deals.

[7] As discussed earlier 2003 is also chosen for cut-off because of the 'Enterprise Act 2002', which came into force in 2004, introduced new procedures and abolished administrative receivership for new loans but in practice banks adopted the new procedures for existing (defaulting) loans. As a result of the act most companies (80% of insolvencies) now enter insolvency proceedings via administration.

Table I Data Observations by Analysis year

This table shows the composition of the company-year sample used in the analysis and to build the company panel for failure prediction models. In the first column Panel A, the analysis year is shown and the figure represents the number of companies that were trading at the start of the year and for which we have financial statement and other data. The second column shows the number of companies that failed within the year. Panel B reports the failure (hazard) rate of sub-samples of PE backed buyouts, MBO's, MBI's and listed companies.

Panel A

Year	Companies	Insolvencies
1995-1998	174968	7716
1999	133441	6334
2000	284424	8191
2001	400159	10556
2002	445758	11663
2003	551072	11036
2004	723735	10437
2005	825976	11183
2006	938550	12260
2007	1048356	13142
2008	1151106	18613
2009	1343715	20510
2010	916633	11872
TOTAL	**8,937,893**	**153,513**

Panel B

Year	Companies	Insolvencies	Failure Rate				
			All Companies	PE Buyouts	Non PE MBI	Non PE MBO	Listed
1995-1998	174968	7716	4.41	7.61	15.15	10.36	2.44
1999	133441	6334	4.75	7.94	5.56	8.05	8.23
2000	284424	8191	2.88	8.76	9.21	3.88	4.36
2001	400159	10556	2.64	6.89	4.90	5.35	4.07
2002	445758	11663	2.62	7.07	9.91	6.90	5.70
2003	551072	11036	2.00	5.68	4.80	4.07	3.83
2004	723735	10437	1.44	4.60	7.06	3.00	1.97
2005	825976	11183	1.35	4.15	5.03	2.57	2.45
2006	938550	12260	1.31	3.66	4.80	2.82	2.43
2007	1048356	13142	1.25	3.02	4.73	3.05	2.76
2008	1151106	18613	1.62	3.81	7.12	3.82	4.27
2009	1343715	20510	1.53	3.81	7.32	4.48	4.69
2010	916633	11872	1.30	2.63	5.73	2.60	2.64

B. Variable description

Dependent Variable*:* As other studies, we define *insolvency risk* as entry into the formal UK corporate bankruptcy process.

Independent Variables*:* The variables of interest in our multivariate analysis are type of buyout i.e. whether the buyouts are private equity backed or not and variables related to leverage/coverage:

Buyout type: We include separate dummies for MBOs, MBIs and private equity-backed buyouts. Additionally we identify buyout types pre and post-2003. The period 1995-2003 was relatively turbulent, with recovery from the early 1990's recession and a short recession 2000-2003 accompanied by a decline in buyout activity, and which also encapsulated the dot.com boom. In contrast, the period from 2003 (post Insolvency Act) was initially a stable period of low insolvency across all sectors and was also marked by buyout market recovery culminating in the peak of the second wave in 2007, before the credit crisis and recession of 2008 onwards. It therefore provides a better test of buyout versus non-buyout performance and risk.

Leverage: For leverage variables, we calculate the ratio of short and long term debt to total assets and year on year changes: *Total Debt/Total Assets*[8] and, for companies submitting abridged accounts, *Short Term Debt + Long Term Liabilities/Total Assets*[9]*.* Companies with relatively high borrowings are expected to be more vulnerable to failure.

Control Variables*:* We construct a range of control variables from financial and non-financial data contained in annual reports and accounts, the individual company filing history with Companies House and data from the county courts relating to actions to recover unpaid debts. These are discussed below.

[8]Alternative measures of leverage include *Total Debt/Net worth* measures the total short and long term debt relative to shareholders funds.
[9] This is the only leverage measure consistently available in abridged accounts.

Operational Risk: We are able to capture early signs of financial difficulty through county court actions against the firms and creditor charges on assets (operational risk). Proxies for operational risk include evidence of company default on credit agreements and/or trade credit payments; action by lenders to secure a 'charge on assets' (fixed or floating charges). A *County Court Judgment* stating that a debt must be settled arises from a claim following the non-payment of unsecured debt (usually trade debts). From the register of County Court Judgments (CCJs), which tracks court actions against a company for the recovery of defaulted debt, we capture the real value of CCJs within the previous 12 months expressed as a ratio of total liabilities. Lenders' charges on assets may be especially important in buyout and private equity deals (Citron and Wright, 2008). From company statutory filing histories, we include a variable tracking the number and timing of 'charges on assets' (fixed or floating) taken by creditors against the company in order to mitigate default risk on loans and mortgages in cases of higher risk (Han et al., 2009). Prior to the '2002 Enterprise Act' charge-holders held a strong position as priority creditor(s) in cases of default/distress. Companies with more coordinated or vigilant creditors are more likely to be subject to court action to recover debt and consequently more vulnerable to insolvency. Charges on Assets are measured as a dummy variable indicating at least one fixed or floating charge in the last accounting year.

Company characteristics: We employ variables related to the *age* of the firm as follows: (i) the age of the firm (*AGE*[10]) at the date of the latest accounts, (ii) a dummy variable representing firms at particular risk owing to their age, that is, firms between 3 and 9 years of age (*AGERISK2* = 1). We control for company *size* using total asset values (log). As companies with low asset values are unlikely to be pursued by creditors through the

[10]The variable AGE is the natural logarithm of the age of the company in years. The variable is calculated from the incorporation date registered at Companies House to each accounting reference date. Missing incorporation dates can be interpolated very accurately since we have access to the population of registration numbers and incorporation dates. Registration numbers are issued in strict time sequence and never re-issued and therefore are indicative of incorporation date.

insolvency process, we model size as a quadratic term in the log of total assets and/or use size dummy variables in order to capture non-linearity.

Non-buyout company ownership type: Following Bunn and Redwood (2003), we create a dummy variable *Subsidiary* taking the value 1 where a company is a subsidiary. A subsidiary has access to group resources perhaps leading to a lower likelihood of failure. The group, however, may allow subsidiary companies to fail as part of a wider group strategy. We construct a *family* dummy variable for companies with two or more family directors on the board. The expectation is that family managed businesses are likely to have a lower incidence of insolvency. We construct a dummy variable for companies *listed* on any UK stock market.

Sector variables: We control for sector level *competition* by constructing a *Herfindahl-Hirschman Index* of industry concentration by summing the squared market shares of each firm in the sector. We control for *sector level risk* by including 31 sector level dummy variables. We calculate an additional measure of industry risk as the failure rate in each sector expressed as the log odds of failure (negative values indicating higher risk, positive values lower risk).

Other financial variables: Besides the specific role of leverage in buyout deals outlined above, other financial variables that may influence insolvency risk need to be controlled for. Because of the pooled time-series, cross-section nature of the data, we can explore the financial ratio data in both levels and direction (changes). Our accounting ratios are selected based on other distress studies (Altman et al., 2010; Kaplan and Andrade, 1998). The large degree of overlap between a firm's financial variables and the implications for multi-collinearity requires us to select between them[11]. In constructing financial ratios we are mindful of missing

[11]Interestingly, many of the working capital cycle variables are not strongly correlated with each other. We calculate Variance Inflation Factors (VIF) for estimated models in order to mitigate collinearity problems.

components and extreme values[12]. We incorporate two groups of other financial variables: working capital and earnings.

Working capital: Our variable selection reflects the importance of working capital for private company survival. Private equity firms may introduce closer monitoring of working capital because of its importance in servicing highly leveraged structures (Hudson, 1986). Variables reflecting the working capital cycle are *Cash/Total assets, Inventories/Working capital*, *Trade debtors/Total assets; Trade creditors/Total liabilities.*

Earnings: For the companies submitting full accounts we calculate additional financial ratios from the P&L account. Thus, income gearing or *Interest Coverage (EBITDA/Interest paid)* measures the ability of the company to service interest payments out of profit. *Retained profit/Total assets* is a measure of the cumulative profitability of the firm. Profitability measures also include *EBITDA/Total liabilities* and *ROA.* Changes in net worth and (retained) profit are measured year on year. Financially distressed firms are more likely to have declining or negative net worth.

Regulatory compliance: Late Filing Days, the number of days following the 10 month period allowed for unlisted companies to file accounts following the financial year end is likely an indicator of financial distress. We employ dummy variables to incorporate data contained in audit reports. *AUDITED* takes a value of 1 where the firm has been audited, and 0 otherwise. Auditors are typically vigilant in identifying likely insolvency and in preventing 'technically insolvent' companies from continuing to trade. We incorporate dummy variables to capture the information contained in audit reports, in descending order of report quality: *AQGC* takes a value of 1 where there is a going concern qualification; *AQSEVERE* takes a value of 1 where the qualification is a severe adverse opinion or disclaimer of

[12]Extreme values are adjusted by using the 1% and 99% percentile values of the ratios and also controlling the size of the company. For example, 99% percentile value of a ratio of a particular company size is given to a company of that size and that has an extremely high value for that particular ratio. The statutory requirement to submit accounts and the presence of auditors eliminates a missing value issue with accounting variables. Moreover the Credit Reference Agency which supplies the data undertakes a considerable amount of manual checking and verification to ensure completeness and accuracy.

opinion. We incorporate a dummy variable indicating if the company has switched auditor in the last year as this may reflect problems with the company's health. A dummy variable *Cash Flow Statement* is also constructed taking the value of 1 if a cash flow statement is provided. Finally, we specify the base line hazard rate using forecasts of the aggregate insolvency rate from a macro-economic model[13].

III. Descriptive Statistics

Table II provides descriptive statistics of the variables used in our analysis and by buyout type. We first provide data on pre-buyout characteristics, focusing on private equity targets, and then look at differences between buy-outs and non-buyouts, and failed and non-failed companies.

A. Pre-buyout characteristics of PE-backed and other buyouts

To examine pre-buyout characteristics, we gather data for 3 years pre-buyout of the sub-samples of PE-backed buyouts compared with non-backed buyouts. We construct a control sample of matched non-buyout companies based on the year, industry sectors (2-digit SIC codes), age and assets size bands of the PE-backed buyouts. This results in a large PE control sample of around 300,000 company-year observations.

Table III (Panels A and B) reports logit estimates determining the probability of PE-backed buyout compared to the whole buyout target population and the control sample. Panel A uses variables available in full accounts and Panel B uses the whole sample, abridged accounts.

[13] The results are not sensitive to the choice of proxies for macro-economic conditions including GDP growth and level, real interest rates, business confidence indices etc.

Table II Descriptive Statistics of Buyout-Types

The table reports mean values of variables used in the analysis for buyout sub-samples pre and post 2003 deals.

	PE Backed		MBO		MBI	
Variables	Pre 2003	Post 2003	Pre 2003	Post 2003	Pre 2003	Post 2003
Hirschman-Herfindahl Index (sector and year)	544	432	494	385	480	501
Log(Total Assets)	15.60	16.28	14.59	14.57	14.83	14.58
Log(Age)	8.48	8.37	8.50	8.44	8.53	8.50
Age Dummy <3 years	0.048	0.072	0.047	0.089	0.059	0.080
Age Dummy 3-10 years	0.353	0.352	0.334	0.284	0.345	0.293
Age Dummy >10 years	0.599	0.576	0.619	0.627	0.596	0.627
Cash/Total Assets	0.083	0.120	0.120	0.118	0.108	0.107
Inventory/Working Capital	8.864	5.644	7.104	5.573	8.438	8.090
Trade Creditors/Total Liabilities	0.300	0.272	0.429	0.503	0.408	0.494
Trade Debtors/Total Assets	0.257	0.229	0.331	0.372	0.277	0.319
Profit Margin	0.018	-0.099	0.022	0.062	-0.190	-0.110
ROA	0.054	0.107	0.057	0.077	0.014	0.069
Retained Profit/Total Assets	-0.052	0.085	0.004	0.119	-0.023	0.089
Total Debt/Total Assets	0.272	0.277	0.156	0.121	0.204	0.158
Interest Coverage	103.23	212.28	118.39	133.53	103.38	123.16
Operating Cashflow/Total Assets	0.052	0.056	0.049	0.063	0.036	0.036
Audit Qualification_Going Concern	0.030	0.022	0.017	0.012	0.036	0.028
Audit qualification_Severe	0.003	0.002	0.003	0.001	0.006	0.001
Change of Auditor	0.126	0.168	0.116	0.160	0.120	0.168
Court Judgements/Total Liabilities	0.003	0.002	0.005	0.004	0.013	0.008
Creditor Charge on Assets	0.217	0.352	0.160	0.240	0.201	0.311
Late Filing Accounts (Days)	9.909	6.290	7.909	6.230	10.150	8.724
Late Filing Last Accounts (Days)	9.057	4.816	5.863	4.318	7.888	7.070
Industry Risk (Weight of Evidence)	-0.237	-0.089	-0.203	-0.217	-0.249	-0.254
N	9699	2593	9209	2922	1530	714

Table III: Pre-Buyout Characteristics of Companies by Buyout Type

The tables report the results of panel logit regressions determining the likelihood of a PE target buyout. Separate models are reported for sub-samples of all buyouts, MBI's and MBO's and the corporate population. The likelihood of PE is modelled a function of size, age, competition, industry sector and financial characteristics. Panel A reports models based on full accounts and Panel B based on abridged account fields for all companies.

Panel A

PE Selection Model : Buyout Companies — **Full Account Fields**

	PE vs All Buyouts		PE vs MBO's		PE vs MBI's		PE vs All Company Control	
Herfindah-Hirschman Index	0.000	0.573	0.000	0.231	0.000	0.107	0.000	0.000
Log Total Assets	**0.390**	0.000	**0.374**	0.000	**0.501**	0.000	**-1.571**	0.000
Log Age	**-0.325**	0.000	**-0.304**	0.000	**-0.502**	0.000	**-0.091**	0.000
Interest Coverage	0.000	0.102	0.000	0.126	0.000	0.237	0.000	0.122
Debt/Total Assets	**0.142**	0.000	**0.128**	0.000	**0.240**	0.057	**-0.082**	0.045
Return on Assets	**0.006**	0.000	**0.005**	0.000	**0.003**	0.047	**0.001**	0.007
Cash/Total Assets	**0.659**	0.003	**0.482**	0.044	**1.468**	0.000	**0.765**	0.000
Retained Profit/Total Assets	0.001	0.259	0.001	0.269	0.002	0.264	0.001	0.143
Inventory/Total Assets	-0.452	0.017	**-0.672**	0.001	**0.729**	0.034	**-0.230**	0.043
Trade Debt/Total Assets	-0.001	0.525	**-0.005**	0.002	**0.020**	0.000	**0.015**	0.000
Audit Qualification_GC	**-0.417**	0.019	**-0.404**	0.032	-0.491	0.080	**0.291**	0.033
Audit Qualification_Severe	-0.537	0.322	-0.714	0.194	0.451	0.688	**-1.013**	0.025
Charge on Assets	**0.159**	0.026	**0.161**	0.033	0.209	0.110	**0.281**	0.000
CCJ/Total Liabilities	-686.545	0.070	-627.970	0.090	-1107.239	0.092	-186.803	0.406
Industry Risk (log odds)	**0.400**	0.000	**0.419**	0.000	**0.402**	0.000	**0.101**	0.004
Constant	**-3.413**	0.000	**-2.969**	0.000	**-2.722**	0.000	**22.669**	0.000
-2 Log likelihood	7049		6369		2514		23769	
observations	5649		5146		3352		179802	

Panel B

PE Selection Model : Buyout Companies — **Abridged Account Fields**

	PE vs All Buyouts		PE vs MBO's		PE vs MBI's		PE vs All Company Control	
Herfindah-Hirschman Index	0.00001	0.336	0.00002	0.136	-0.00002	0.267	0.00005	0.000
Log Total Assets	**0.38978**	0.000	**0.37164**	0.000	**0.42782**	0.000	**-1.89509**	0.000
Log Age	**-0.24569**	0.000	**-0.22487**	0.000	**-0.33073**	0.000	**-0.05269**	0.001
Cash/Total Assets	**0.38684**	0.004	**0.37170**	0.010	**0.40802**	0.059	**0.87515**	0.000
Retained Profit/Total Assets	0.00091	0.164	0.00109	0.112	-0.00106	0.310	**0.00128**	0.023
Inventory/Total Assets	**-0.34549**	0.025	**-0.41737**	0.010	**0.00529**	0.983	**0.19485**	0.044
Trade Debt/Total Assets	**-0.00359**	0.001	**-0.00713**	0.000	**0.01055**	0.000	**0.01793**	0.000
Audit Qualification_GC	**-0.49373**	0.002	**-0.44975**	0.006	**-0.66841**	0.005	0.22592	0.085
Audit Qualification_Severe	-0.63310	0.193	-0.76818	0.121	0.00652	0.994	**-0.99428**	0.016
Charge on Assets	0.09348	0.115	0.08783	0.158	0.15915	0.125	**0.33227**	0.000
CCJ/Total Liabilities	7.64952	0.804	12.39040	0.712	-2.79546	0.928	-93.0309	0.322
Industry Risk (log odds)	**0.40365**	0.000	**0.38942**	0.000	**0.54995**	0.000	**-0.07839**	0.015
Constant	-3.98003	0.000	-3.55408	0.000	-2.56096	0.000	27.26275	0.000
-2 Log likelihood	11641.91		10501.50		4610.32		29910.67	
observations	9413		8380		5108		302624	

The buyout only sample results show that PE investors select larger buyout targets with better profitability (ROA) and cash generation. PE targets are less likely to have problems with short term debt (CCJ's) but are more likely to have debt and a charge on assets and therefore likely to benefit from refinancing. They are in lower risk sectors than other buyouts. Compared to the non-buyout population, PE targets have stronger cash flow and profit with lower levels of debt (controlling for size, age). Thus, PE investors target companies that are likely to be better able to service debt from cash and profit.

B. Univariate analyses

Buyouts and non-buyouts. In Table IV we find, using the *full accounts only* sample, significant differences between buyouts and non-buyouts in respect of nearly all profit and loss account variables, irrespective of whether the firms have failed or not. Compared to non-buyouts, non-failed and failed buyouts are significantly *more* likely to be in riskier sectors (negative *indwoe*) to have lower ROA, lower profit margins, lower pre-tax profit to total liabilities, higher change in retained profit to total assets, and lower cash to total assets. In contrast, non-failed and failed buy-outs are significantly more likely to have higher operating cash flow to total assets, higher debt to net worth but better interest coverage.

Using both *full and abridged* accounts (Table IV), non-failed and failed buyouts are significantly more likely compared to non-buyouts to be older, larger and in riskier industrial sectors. They are likely to have fewer county court judgments but more likely have charges on assets (particularly more fixed charges), audited accounts, clean audits, but not qualified accounts. They are more prone to changes in auditors. Compared to non-buyouts, buyouts are significantly *less* likely to have late filing of accounts. Regarding financial risks they have lower cash/total asset ratios, lower trade creditors/total liabilities and similar trade debtors/total assets ratios.

Table IV: Differences Between Failed and Non-Failed Buyouts and Non-buyouts

We test for differences in the means of a range of variables reflecting company characteristics (financial risk, operational risk, governance) by sub-sample. In the first two columns we report the means of non-failed sub-samples of non-buyouts and buyouts and the significance of the differences based on t-tests. We repeat the test for failed companies using the last set of accounting and non-financial information available in the year before failure.

	Non-Failed Companies: Non-Buyouts Versus Buyouts				Failed Companies: Non-Buyouts Versus Buyouts			
Variables	Company Sub-group	N	Mean	Significance	Company Sub-group	N	Mean	Significance
Hirschman-Herfindahl Index (sector and year)	Non-Buyouts	8621284	380.40		Non-Buyouts	150491	472.05	
	Buyouts	25484	495.03	0.000	Buyouts	1179	466.11	0.000
Log(Total Assets)	Non-Buyouts	8621284	11.85		Non-Buyouts	150491	12.4107	
	Buyouts	25484	15.14	0.000	Buyouts	1179	14.9096	0.000
Log(Age)	Non-Buyouts	8621284	7.8401		Non-Buyouts	150491	7.8680	
	Buyouts	25484	8.4804	0.000	Buyouts	1179	8.4118	0.000
Age Dummy <3 years	Non-Buyouts	8621284	0.1441		Non-Buyouts	150491	0.1410	
	Buyouts	25484	0.0553	0.000	Buyouts	1179	0.0729	0.001
Age Dummy 3-10 years	Non-Buyouts	8621284	0.5015		Non-Buyouts	150491	0.5558	
	Buyouts	25484	0.3345	0.000	Buyouts	1179	0.3808	0.000
Age Dummy >10 years	Non-Buyouts	8621284	0.3417		Non-Buyouts	150491	0.3032	
	Buyouts	25484	0.6101	0.000	Buyouts	1179	0.5462	0.000
Cash/Total Assets	Non-Buyouts	8621284	0.2750		Non-Buyouts	150491	0.1089	
	Buyouts	25484	0.1073	0.000	Buyouts	1179	0.0575	0.000
Inventory/Working Capital	Non-Buyouts	8616835	3.6175		Non-Buyouts	150429	8.6929	
	Buyouts	25484	7.2840	0.000	Buyouts	1178	13.0399	0.000
Trade Creditors/Total Liabilities	Non-Buyouts	8621284	0.5644		Non-Buyouts	150491	0.5867	
	Buyouts	25484	0.3744	0.000	Buyouts	1179	0.4012	0.000
Trade Debtors/Total Assets	Non-Buyouts	8621284	0.2572		Non-Buyouts	150491	0.3593	
	Buyouts	25484	0.2938	0.000	Buyouts	1179	0.3262	0.000
Profit Margin	Non-Buyouts	3207162	-0.0699		Non-Buyouts	56422	-0.2509	
	Buyouts	18552	0.0048	0.000	Buyouts	841	-0.1899	0.000
ROA	Non-Buyouts	3214013	0.2642		Non-Buyouts	56559	-0.0002	
	Buyouts	18751	0.0657	0.000	Buyouts	849	-0.0455	0.000
Retained Profit/Total Assets	Non-Buyouts	8621284	0.0869		Non-Buyouts	150491	-0.2254	
	Buyouts	25484	0.0121	0.000	Buyouts	1179	-0.1533	0.000
Total Debt/Total Assets	Non-Buyouts	8621284	0.0386		Non-Buyouts	55690	0.2167	
	Buyouts	25484	0.2064	0.000	Buyouts	847	0.4152	0.000
Interest Coverage	Non-Buyouts	3093102	63.6792		Non-Buyouts	55690	44.1596	
	Buyouts	18617	128.3930	0.000	Buyouts	847	44.3599	0.000
Operating Cashflow/Total Assets	Non-Buyouts	3036051	0.0108		Non-Buyouts	54801	0.0080	
	Buyouts	17686	0.0520	0.000	Buyouts	823	0.0274	0.017
Audit Qualification_Going Concern	Non-Buyouts	8621284	0.0061		Non-Buyouts	150491	0.0323	
	Buyouts	25484	0.0204	0.000	Buyouts	1179	0.0814	0.000
Audit qualification_Severe	Non-Buyouts	8621284	0.0015		Non-Buyouts	150491	0.0099	
	Buyouts	25484	0.0026	0.000	Buyouts	1179	0.0085	0.000
Change of Auditor	Non-Buyouts	8621284	0.0669		Non-Buyouts	150491	0.0965	
	Buyouts	25484	0.1297	0.000	Buyouts	1179	0.1603	0.000
Court Judgements/Total Liabilities	Non-Buyouts	8621284	0.0078		Non-Buyouts	150491	0.0979	
	Buyouts	25484	0.0028	0.001	Buyouts	1179	0.0427	0.000
Creditor Charge on Assets	Non-Buyouts	8621284	0.0485		Non-Buyouts	150491	0.1303	
	Buyouts	25484	0.2098	0.000	Buyouts	1179	0.3189	0.000
Late Filing Accounts (Days)	Non-Buyouts	8621284	14.2417		Non-Buyouts	150491	26.0890	
	Buyouts	25484	8.0560	0.000	Buyouts	1179	16.8940	0.000
Late Filing Last Accounts (Days)	Non-Buyouts	8615510	10.2944		Non-Buyouts	150412	30.2452	
	Buyouts	25477	6.3089	0.000	Buyouts	1178	19.7589	0.000
Industry Risk (Weight of Evidence)	Non-Buyouts	8585976	0.1057		Non-Buyouts	149677	-0.1498	
	Buyouts	25459	-0.2008	0.000	Buyouts	1179	-0.4062	0.000

Failed and non-failed buyouts. Comparing failed and non-failed buyouts using *full accounts only* (Table V), buyouts that fail are significantly more likely than non-failed buyouts to be in riskier sectors, have lower ROA, lower pre-tax profit to total liabilities, and lower interest coverage. In contrast, failed buy-outs are significantly more likely than non-failed buyouts to have lower operating cash flow to total assets, short-term debt, debt to total assets, lower current ratios, more inventory and more trade debt and credit.

Table V: Differences Between Failed and Non-Failed Buyouts

We test for differences in the means of a range of variables reflecting company characteristics (financial risk, operational risk, governance) for the buyout only sample and by sub-samples of failed and non-failed buyouts. In the first two columns we report the means of non-failed and failed sub-samples of buyouts and the significance of the differences based on t-tests.

	Buyout Companies : Failed versus Non-Failed				All Companies : Failed versus Non-Failed			
Variables	**Company Sub-group**	**N**	**Mean**	**Significance**	**Company Sub-group**	**N**	**Mean**	**Significance**
Hirschman-Herfindahl Index (sector and year)	Non-Failed	25484	495.03		Non-Failed	8621284	380.40	
	Failed	1179	466.11	0.259	Failed	150491	472.05	0.000
Log(Total Assets)	Non-Failed	25484	15.14		Non-Failed	8621284	11.85	
	Failed	1179	14.91	0.000	Failed	150491	12.41	0.000
Log(Age)	Non-Failed	25484	8.4804		Non-Failed	8621284	7.8401	
	Failed	1179	8.4118	0.019	Failed	150491	7.8680	0.000
Age Dummy <3 years	Non-Failed	25484	0.0553		Non-Failed	8621284	0.1441	
	Failed	1179	0.0729	0.023	Failed	150491	0.1410	0.010
Age Dummy 3-10 years	Non-Failed	25484	0.3345		Non-Failed	8621284	0.5015	
	Failed	1179	0.3808	0.001	Failed	150491	0.5558	0.000
Age Dummy >10 years	Non-Failed	25484	0.6101		Non-Failed	8621284	0.3417	
	Failed	1179	0.5462	0.000	Failed	150491	0.3032	0.000
Cash/Total Assets	Non-Failed	25484	0.1073		Non-Failed	8621284	0.2750	
	Failed	1179	0.0575	0.000	Failed	150491	0.1089	0.000
Inventory/Working Capital	Non-Failed	25484	7.2840		Non-Failed	8616835	3.6175	
	Failed	1178	13.0399	0.000	Failed	150429	8.6929	0.000
Trade Creditors/Total Liabilities	Non-Failed	25484	0.3744		Non-Failed	8621284	0.5644	
	Failed	1179	0.4012	0.003	Failed	150491	0.5867	0.000
Trade Debtors/Total Assets	Non-Failed	25484	0.2938		Non-Failed	8621284	0.2572	
	Failed	1179	0.3262	0.000	Failed	150491	0.3593	0.000
Profit Margin	Non-Failed	18552	0.0048		Non-Failed	3207162	-0.0699	
	Failed	841	-0.1899	0.001	Failed	56422	-0.2509	0.000
ROA	Non-Failed	18751	0.0657		Non-Failed	3214013	0.2642	
	Failed	849	-0.0455	0.000	Failed	56559	-0.0002	0.000
Retained Profit/Total Assets	Non-Failed	25484	0.0121		Non-Failed	8621284	0.0869	
	Failed	1179	-0.1533	0.000	Failed	150491	-0.2254	0.000
Total Debt/Total Assets	Non-Failed	25484	0.2064		Non-Failed	3093211	0.1276	
	Failed	1179	0.2596	0.000	Failed	55690	0.2167	0.000
Interest Coverage	Non-Failed	18617	128.3930		Non-Failed	3093102	64.8661	
	Failed	847	44.3599	0.000	Failed	55690	44.1596	0.000
Operating Cashflow/Total Assets	Non-Failed	17686	0.0520		Non-Failed	3036051	0.0108	
	Failed	823	0.0274	0.000	Failed	54801	0.0080	0.017
Audit Qualification_Going Concern	Non-Failed	25484	0.0204		Non-Failed	8621284	0.0061	
	Failed	1179	0.0814	0.000	Failed	150491	0.0323	0.000
Audit qualification_Severe	Non-Failed	25484	0.0026		Non-Failed	8621284	0.0015	
	Failed	1179	0.0085	0.028	Failed	150491	0.0099	0.000
Change of Auditor	Non-Failed	25484	0.1297		Non-Failed	8621284	0.0669	
	Failed	1179	0.1603	0.005	Failed	150491	0.0965	0.000
Court Judgements/Total Liabilities	Non-Failed	25484	0.0028		Non-Failed	8621284	0.0078	
	Failed	1179	0.0427	0.000	Failed	150491	0.0979	0.000
Creditor Charge on Assets	Non-Failed	25484	0.2098		Non-Failed	8621284	0.0485	
	Failed	1179	0.3189	0.000	Failed	150491	0.1303	0.000
Late Filing Accounts (Days)	Non-Failed	25484	8.0560		Non-Failed	8621284	14.2417	
	Failed	1179	16.8940	0.000	Failed	150491	26.0890	0.000
Late Filing Last Accounts (Days)	Non-Failed	25477	6.3089		Non-Failed	8615510	10.2944	
	Failed	1178	19.7589	0.000	Failed	150412	30.2452	0.000
Industry Risk (Weight of Evidence)	Non-Failed	25459	-0.2008		Non-Failed	8585976	0.1057	
	Failed	1179	-0.4062	0.000	Failed	149677	-0.1498	0.000

Using *full and abridged accounts* (Table V), buyouts that fail are significantly more likely than non-failed buyouts to exhibit clear signs of distress in advance of failure through late filing of accounts, larger county court judgments (CCJ), larger CCJ/total liabilities, more going concern audit qualifications, greater industry risk, higher trade creditors/total liabilities and trade debtors/total assets, higher stock/working capital and stock/current assets, lower cash/total assets and lower retained profit to total assets. Interestingly, buyouts that fail also have more charges on assets.

IV. Multivariate Analysis Methodology

Although we are predicting failure in discrete time, at least one year prior to failure, it is desirable to incorporate dynamics that utilize firm specific time varying covariates and changes in the base line hazard. We follow Shumway (2001) and Nam *et al.* (2008) to construct a model dealing with time varying covariates where estimation is undertaken with company-year observations and a limited dependent variable. Discrete-time hazard modelling uses the complementary log-log (cloglog) link as a binary dependent variable model. As shown by Beck *et al.* (1998), cloglog link and logit link are identical especially when the probabilities of failure are rather small. Shumway (2001) also reveals that the likelihood functions of a multi-period logit model and a discrete-time hazard model are identical. Following Nam *et al.* (2008), we employ a logistic analogue and estimate the following equation:

$$P\left(y_{i,t}=1\middle|x_{i,t}\right)=h\left(t\middle|x_{i,t}\right)=\frac{1}{1+exp\{-(x'_{i,t}\beta+\delta_t+\alpha)\}} \qquad (2)$$

where $h\left(t\middle|x_{i,t}\right)$ is the individual hazard rate of company *i* at time *t*, $x'_{i,t}$ is covariates signifying the independent variables and controls, discussed above, for each company *i* at time *t*, δ_t is the baseline hazard rate, and α is the constant term. Beck *et al.* (1998) employ time dummy variables to proxy the baseline hazard rate. Nam *et al.* (2008), however, argue that it is more effective to use macroeconomic variables for this purpose. We use an established macro-economic model to forecast the aggregate insolvency

rate that is accurate over an 18 month horizon[14]. We use the forecast insolvency rate to adjust the base hazard.

The statistical significance of coefficients is tested via robust (clustered) standard errors with company identification numbers as the cluster criterion. We calculate and report 'average' marginal effects for variables of interest and among sub-samples of company type. Further diagnostic tests relate to in and out of sample prediction. The receiver operating curve (ROC) plots the true positive against the false positive rate as the threshold to discriminate between failed and non-failed firms is varied. The area under the ROC curve (AUC)[15] measures the prediction accuracy of the model, with a value of 1 representing a perfect model.

The full model (M1) includes all the risk characteristics and controls discussed above from which we isolate the effects of buyout type on insolvency risk.

(M1) Fail = (Base Hazard; Basic Controls (Age; Size; Sector; Competition; Company Type); Buyout Type; Leverage (L); Financial Characteristics (FC);Operational Risk (OR); Compliance (C))

We formulate alternative specifications of the time discrete time duration model, nested in M1. Most importantly, we look first at the failure of buyout companies and leverage variables (L) only controlling for age, size and sector (Basic Controls) with the macro dependent base line hazard. We include levels and changes in leverage in some specifications of the basic

[14] The macro model uses Co-integration and Vector Error Correction techniques to determine the UK corporate insolvency rate for the period 1995 to 2010. The model finds that the insolvency rate has a co-integrating long term relationship with labour conditions, money availability, and capital gearing level. The main reason insolvency rate predictions of the macroeconomic model are used is that direct measures of macroeconomic conditions tend to have lagged effects on companies. The forecasting model predictions reflect the impact of the macroeconomic environment on insolvency risk in a timely manner. We experimented with other proxies for macro conditions e.g. real interest rates, GDP growth, bank lending to the corporate sector, business confidence indices and key results were not materially different.

[15] The area under the ROC Curve (AUC) and the equivalent index, the Gini Coefficient are widely used to measure the performance of classification rules and side step the need to specify the costs of different kinds of misclassification. The AUC is a measure of the difference between the score distributions of failed and non-failed companies and the Gini Coefficient is and index which can be calculated as ((2*AUC)-1) and the K-S statistic measures the distance between the two distributions at the optimal cut-off point and is approximately 0.8*Gini.

model. This allows us to determine the failure rate of buyouts and PE backed buyouts within the corporate population and to test for the impact of leverage alone (financial risk). We then estimate models, controlling for risks associated with stewardship and the economic factors that are generally related to corporate bankruptcy. We include factors reflecting OR and C, with and without L and with and without FC. We then estimate the full model (M1). Finally, we estimate best-fitting failure prediction models for the buyout subsample only and test the effects of private equity involvement.

V. Results

A. Full sample of buyouts and non-buyouts

Initially we include 31 industry dummies to control for sector, asset size (expressed as a quadratic), the log age of the company and age risk (dummy for 3-9 years old), listing status, a subsidiary, whether it is family-managed, the degree of sector competition and the macro-economic indicator. We then add three dummies that indicate a private equity backed management buyout; a non-private equity backed MBO and a non-private equity backed MBI. As explained above, we then subdivide these into 6 dummy variables reflecting whether the buyout deal was completed pre or post-2003.

We re-estimate base models including variables reflecting levels and changes in debt to assets. Models are estimated using the subsample filing full accounts (Table VI Panels A1 and A2) and the full database of buyouts and non-buyouts (Table VI Panels B1 and B2). The models include the variable capturing the base line hazard rates.

A1. Companies with full accounts

Over the whole period, buyouts are generally more risky than the private non-buyout population. MBIs have the highest insolvency risk and PE backed deals are riskier than standard MBOs (Table VI panel A1). We note

that controlling for leverage does not affect the significance of other variables in the models. We control for the level and direction of leverage with debt/total assets and the year-on-year change. Both variables are positive and significant (Panel A1 and A2 models 2 and 3) confirming that high leverage and increases in leverage are generally associated with insolvency risk for all companies[16].

To further test the impact of leverage on buyout risk we calculate the average marginal effect of buyout type over the range of debt/assets ratio in the sample (Figure 3 Panel B). We find that the increase in risk for PE buyouts is less than that of MBIs and infer that PE insolvencies are not dominantly associated with changes in leverage and/or have more capacity to service debt.

If we take the two distinct time periods, the post-2003 MBOs and PE backed deals are not riskier than non-buyouts, controlling for age, size, sector and macro conditions (Table VI panel A2) and the level and direction of change in debt/total assets. Indeed PE backed restructurings are predominantly buy-ins and as such are significantly less likely to fail than non-PE buy-ins.

The control variables have expected signs and significance. Initial results in model 1 in Panels A1 and A2 confirm a strong quadratic relationship between insolvency risk and asset size; a negative relationship between risk and company age with the exception of the 3-9 years period and parent support for subsidiaries. Family managed companies have a lower insolvency rate and listed companies a higher rate. Sectors characterized by market dominance experience a higher incidence of insolvency.

[16] At the suggestion of an anonymous reviewer we re-estimated the models in Table VI Panel B1 inclusive of interaction terms PE*Debt or PE* Change in Debt. The coefficients are always very small and insignificant. However we accept arguments put forward by Ai and Norton (2003) that the interpretation of the sign and significance of interaction terms in non-linear (logit) models is particularly complex. Analysis of the impact of interaction terms on individual probabilities is not helpful in explaining the effects of PE*Debt interactions. We, instead calculate the average marginal effects of PE over the range of debt levels, conditional on the covariates in Table VI Panel B and PE*Debt interactions.

Table VI Buyouts and Insolvency Risk

We estimate discrete time hazard models determining the probability of insolvency for each company. The models determine insolvency risk using company characteristics, age, size, and company type whilst controlling for industry competition with an HH Index and sector using 31 separate sector dummy variables. Models are estimated that control for changes in and levels of leverage (debt/total assets). The equations include estimates of the base line hazard rate from a macro-economic model. From maximum likelihood estimation we report the estimated coefficients, robust (clustered) standard errors and the significance level of each coefficient. Overall fit is gauged by log-likelihood statistics, chi-square and Pseudo R2. We test for the significance of buyout dummy variables, PE-backed buyouts, non-PE-backed MBO's and non-PE-backed MBI's (A1, B1). We create and test additional dummies that categorise the buyouts created pre and post 2003 (A2, B2). For each model we report the average marginal effects of the 'buyout type' dummy variables and their significance Panel A reports models estimated for companies that report full accounts (including profit and loss data). Panel B reports the estimates for the full sample.

Panel A (1)

Discrete Time Duration Models: hazard models with time-varying covariates and macro dependent baseline hazard rate (1995-2010) - Full Accounts

Independent	(1) b/se	(1) Ave. Marginal Effect	(2) b/se	(2) Ave. Marginal Effect	(3) b/se	(3) Ave. Marginal Effect
Log Total Assets	1.5785***		1.5768***		1.5313***	
	(0.0221)		(0.0221)		(0.0221)	
(Log Total Assets)^2	-0.0546***		-0.0546***		-0.0539***	
	(0.0008)		(0.0008)		(0.0008)	
Log Age	-0.1348***		-0.1357***		-0.1202***	
	(0.0052)		(0.0052)		(0.0052)	
Agerisk 3-9 years	0.2640***		0.2638***		0.2527***	
	(0.0094)		(0.0094)		(0.0094)	
Subsidiary Company	-0.1101***		-0.1117***		-0.1775***	
	(0.0112)		(0.0112)		(0.0116)	
Herfindahl-Hirschman Ind	0.0001***		0.0001***		0.0001***	
	(0.0000)		(0.0000)		(0.0000)	
Family Company	-0.2438***	-0.0040***	-0.2434***	-0.0040***	-0.2411***	
	(0.0100)	(0.0002)	(0.0100)	(0.0002)	(0.0100)	
Listed Company	0.7341***	0.0177***	0.7277***	0.0175***	0.7677***	0.0188***
	(0.0408)	(0.0013)	(0.0408)	(0.0013)	(0.0407)	(0.0014)
PE Backed Buyout	0.4716***	0.0100***	0.4692***	0.0099***	0.4249***	0.0088***
	(0.0478)	(0.0012)	(0.0478)	(0.0012)	(0.0477)	(0.0012)
Management Buyout non-PE	0.1643**	0.0030**	0.1610*	0.0029*	0.1446*	0.0026*
	(0.0628)	(0.0012)	(0.0627)	(0.0012)	(0.0625)	(0.0012)
Management Buyin non-PE	0.7902***	0.0197***	0.7856***	0.0196***	0.7443***	0.0181***
	(0.1169)	(0.0041)	(0.1167)	(0.0041)	(0.1170)	(0.0039)
Change Debt/TA			0.0540***	0.0009***	0.0302***	0.0005***
			(0.0057)	(0.0001)	(0.0060)	(0.0001)
Debt/TA					0.5580***	0.0094***
					(0.0172)	(0.0003)
Macro Base Hazard	2.2101***		2.2092***		2.2126***	
	(0.0426)		(0.0426)		(0.0426)	
Constant	-17.5872***		-17.5668***		-17.1992***	
	(0.1555)		(0.1556)		(0.1553)	
Industry Dummies	Yes		Yes		Yes	
Failed= 57,761						
N	3320392		3320392		3320392	
Log Likelihood	-277017.805		-276980.852		-276474.263	
LR Chi-Square	27762.264		27854.226		29420.202	
Pseudo R2	0.0490		0.0491		0.0508	

Note: Robust(clustered) SE's

Private Equity, Buy-outs, and Insolvency Risk

Panel A (2)

Discrete Time Duration Models: hazard models with time-varying covariates and macro dependent baseline hazard rate (1995-2010) - Full Accounts

Independent	(1) b/se	(1) Ave. Marginal Effect	(2) b/se	(2) Ave. Marginal Effect	(3) b/se	(3) Ave. Marginal Effect
Log Total Assets	1.5779***		1.5762***		1.5307***	
	(0.0221)		(0.0221)		(0.0221)	
(Log Total Assets)^2	-0.0546***		-0.0546***		-0.0538***	
	(0.0008)		(0.0008)		(0.0008)	
Log Age	-0.1348***		-0.1357***		-0.1202***	
	(0.0052)		(0.0052)		(0.0052)	
Agerisk 3-9 years	0.2639***		0.2637***		0.2527***	
	(0.0094)		(0.0094)		(0.0094)	
Subsidiary Company	-0.1101***		-0.1118***		-0.1776***	
	(0.0112)		(0.0112)		(0.0116)	
Herfindahl-Hirschman Ind	0.0001***		0.0001***		0.0001***	
	(0.0000)		(0.0000)		(0.0000)	
Family Company	-0.2438***	-0.0040***	-0.2434***	-0.0040***	-0.2411***	-0.0039***
	(0.0100)	(0.0002)	(0.0100)	(0.0002)	(0.0100)	(0.0002)
Listed Company	0.7338***	0.0177***	0.7273***	0.0175***	0.7674***	0.0188***
	(0.0408)	(0.0013)	(0.0408)	(0.0013)	(0.0407)	(0.0014)
PE Backed Pre 2003	0.5071***	0.0110***	0.5058***	0.0109***	0.4587***	0.0097***
	(0.0516)	(0.0014)	(0.0516)	(0.0014)	(0.0515)	(0.0013)
PE Backed Post 2003	0.2810*	0.0054	0.2734	0.0053	0.2427	0.0046
	(0.1244)	(0.0027)	(0.1252)	(0.0027)	(0.1259)	(0.0026)
MBO Pre 2003	0.1676*	0.0031*	0.1650*	0.0030*	0.1451*	0.0026*
	(0.0700)	(0.0014)	(0.0700)	(0.0014)	(0.0697)	(0.0013)
MB0 Post 2003	0.1519	0.0028	0.1460	0.0026	0.1425	0.0026
	(0.1390)	(0.0027)	(0.1389)	(0.0027)	(0.1382)	(0.0027)
MBI Pre 2003	0.6630***	0.0155***	0.6617***	0.0155***	0.6188***	0.0141***
	(0.1441)	(0.0045)	(0.1439)	(0.0045)	(0.1443)	(0.0043)
MBI Post 2003	1.0789***	0.0183***	1.0657***	0.0180***	1.0280***	0.0174***
	(0.1932)	(0.0033)	(0.1930)	(0.0033)	(0.1929)	(0.0033)
Change Debt/TA			0.0540***	0.0009***	0.0302***	0.0005***
			(0.0057)	(0.0001)	(0.0060)	(0.0001)
Debt/TA					0.5579***	0.0094***
					(0.0172)	(0.0003)
Macro Base Hazard	2.2102***		2.2092***		2.2127***	
	(0.0426)		(0.0426)		(0.0426)	
Constant	-17.5837***		-17.5631***		-17.1959***	
	(0.1556)		(0.1556)		(0.1553)	
Industry Dummies	Yes		Yes		Yes	
Failed= 57,761						
N	3320392		3320392		3320392	
Log Likelihood	-277014.778		-276977.822		-276471.429	
LR Chi-Square	27786.804		27879.398		29444.724	
Pseudo R2	0.0490		0.0491		0.0508	

Note: Robust(clustered) SE's

Panel B (1)

Discrete Time Duration Models: hazard models with time-varying covariates and macro dependent baseline hazard rate (1995-2010) - All Companies

Independent	(1) b/se	(1) Ave. Marginal Effect	(2) b/se	(2) Ave. Marginal Effect	(3) b/se	(3) Ave. Marginal Effect
Log Total Assets	1.7887***		1.7859***		1.7718***	
	(0.0181)		(0.0181)		(0.0181)	
(Log Total Assets)^2	-0.0627***		-0.0627***		-0.0629***	
	(0.0007)		(0.0007)		(0.0007)	
Log Age	-0.1323***		-0.1330***		-0.1138***	
	(0.0037)		(0.0037)		(0.0036)	
Agerisk 3-9 years	0.2677***		0.2669***		0.2547***	
	(0.0059)		(0.0059)		(0.0058)	
Subsidiary Company	-0.0413***		-0.0403***		-0.0366***	
	(0.0083)		(0.0083)		(0.0083)	
Herfindahl-Hirschman Ind	0.0001***		0.0001***		0.0001***	
	(0.0000)		(0.0000)		(0.0000)	
Family Company	-0.2642***	-0.0043***	-0.2647***	-0.0043***	-0.2625***	
	(0.0056)	(0.0001)	(0.0056)	(0.0001)	(0.0056)	
Listed Company	0.8872***	0.0230***	0.8806***	0.0227***	0.9402***	0.0250***
	(0.0407)	(0.0015)	(0.0407)	(0.0015)	(0.0408)	(0.0016)
PE Backed Buyout	0.5296***	0.0115***	0.5278***	0.0114***	0.5126***	0.0110***
	(0.0438)	(0.0012)	(0.0438)	(0.0012)	(0.0438)	(0.0012)
Management Buyout non-PE	0.2224***	0.0041***	0.2194***	0.0041***	0.2284***	0.0043***
	(0.0484)	(0.0010)	(0.0484)	(0.0010)	(0.0483)	(0.0010)
Management Buyin non-PE	0.7594***	0.0185***	0.7562***	0.0184***	0.7541***	0.0183***
	(0.0930)	(0.0031)	(0.0930)	(0.0031)	(0.0930)	(0.0031)
Change Debt/TA			0.0812***	0.0014***	0.0510***	0.0009***
			(0.0035)	(0.0001)	(0.0037)	(0.0001)
Debt/TA					0.7441***	0.0124***
					(0.0100)	(0.0002)
Macro Base Hazard	2.1066***		2.1135***		2.0943***	
	(0.0282)		(0.0282)		(0.0281)	
Constant	-19.2573***		-19.2340***		-19.1836***	
	(0.1213)		(0.1214)		(0.1211)	
Industry Dummies	Yes		Yes		Yes	
Failed = 153,513						
N	8937764		8937764		8937764	
Log Likelihood	-740644.081		-740389.456		-737984.781	
LR Chi-Square	65757.632		66555.384		72380.029	
Pseudo R2	0.0457		0.0460		0.0491	

Panel B (2)

Discrete Time Duration Models: hazard models with time-varying covariates and macro dependent baseline hazard rate (1995-2010) - All Companies

Independent	(1) b/se	(1) Ave. Marginal Effect	(2) b/se	(2) Ave. Marginal Effect	(3) b/se	(3) Ave. Marginal Effect
Log Total Assets	1.7884***		1.7856***		1.7715***	
	(0.0181)		(0.0181)		(0.0181)	
(Log Total Assets)^2	-0.0627***		-0.0626***		-0.0629***	
	(0.0007)		(0.0007)		(0.0007)	
Log Age	-0.1323***		-0.1330***		-0.1138***	
	(0.0037)		(0.0037)		(0.0036)	
Agerisk 3-9 years	0.2677***		0.2669***		0.2547***	
	(0.0059)		(0.0059)		(0.0058)	
Subsidiary Company	-0.0414***		-0.0404***		-0.0366***	
	(0.0083)		(0.0083)		(0.0083)	
Herfindahl-Hirschman Ind	0.0001***		0.0001***		0.0001***	
	(0.0000)		(0.0000)		(0.0000)	
Family Company	-0.2642***	-0.0043***	-0.2647***	-0.0043***	-0.2625***	-0.0043***
	(0.0056)	(0.0001)	(0.0056)	(0.0001)	(0.0056)	(0.0001)
Listed Company	0.8870***	0.0230***	0.8804***	0.0227***	0.9400***	0.0250***
	(0.0407)	(0.0015)	(0.0407)	(0.0015)	(0.0408)	(0.0016)
PE Backed Pre 2003	0.5596***	0.0123***	0.5565***	0.0122***	0.5365***	0.0116***
	(0.0475)	(0.0013)	(0.0475)	(0.0013)	(0.0475)	(0.0013)
PE Backed Post 2003	0.3759***	0.0075***	0.3803***	0.0076***	0.3879***	0.0078***
	(0.1120)	(0.0027)	(0.1120)	(0.0027)	(0.1119)	(0.0027)
MBO Pre 2003	0.2337***	0.0044***	0.2316***	0.0043***	0.2381***	0.0045***
	(0.0556)	(0.0012)	(0.0556)	(0.0012)	(0.0555)	(0.0012)
MB0 Post 2003	0.1859	0.0034	0.1801	0.0033	0.1967*	0.0036*
	(0.0978)	(0.0019)	(0.0976)	(0.0019)	(0.0976)	(0.0020)
MBI Pre 2003	0.6110***	0.0138***	0.6098***	0.0137***	0.6025***	0.0135***
	(0.1201)	(0.0035)	(0.1201)	(0.0035)	(0.1200)	(0.0035)
MBI Post 2003	1.0145***	0.0170***	1.0071***	0.0168***	1.0155***	0.0170***
	(0.1430)	(0.0024)	(0.1431)	(0.0024)	(0.1433)	(0.0024)
Change Debt/TA			0.0811***	0.0014***	0.0509***	0.0009***
			(0.0035)	(0.0001)	(0.0037)	(0.0001)
Debt/TA					0.7440***	0.0124***
					(0.0100)	(0.0002)
Macro Base Hazard	2.1066***		2.1135***		2.0943***	
	(0.0282)		(0.0282)		(0.0281)	
Constant	-19.2552***		-19.2320***		-19.1818***	
	(0.1213)		(0.1214)		(0.1211)	
Industry Dummies	Yes		Yes		Yes	
Failed = 153,513						
N	8937764		8937764		8937764	
Log Likelihood	-740640.266		-740385.804		-737981.305	
LR Chi-Square	65784.662		66581.516		72404.881	
Pseudo R2	0.0457		0.0460		0.0491	

A2. All companies

The above result weakens when we include smaller companies (Table VI panels B1 and B2) but PE deals are confirmed to be less likely to fail than buy-ins and listed companies and the marginal effect[17] of PE-backing on insolvency is small compared to the base rate, lower than listed companies and not higher than pre-buyout risk. The results are confirmed in the table in the average marginal effects column. Thus, rather than increase risk through leverage post buyout risk is lower.

Again, including variables capturing leverage, (levels and changes) does not impact on the coefficients of the buyout dummies (i.e. the buyout dummy is not a proxy for leverage) and the ranking of failure rate by company type. Thus over-leveraged firms are likely to fail but buyouts show

[17] We report the 'average marginal effect 'of variables of interest where the marginal effect is the coefficient multiplied by a scale factor, which, of course, varies with each observation. The 'margins' command in STATA 11/12 calculates the scale factor for every observation and then takes the average.

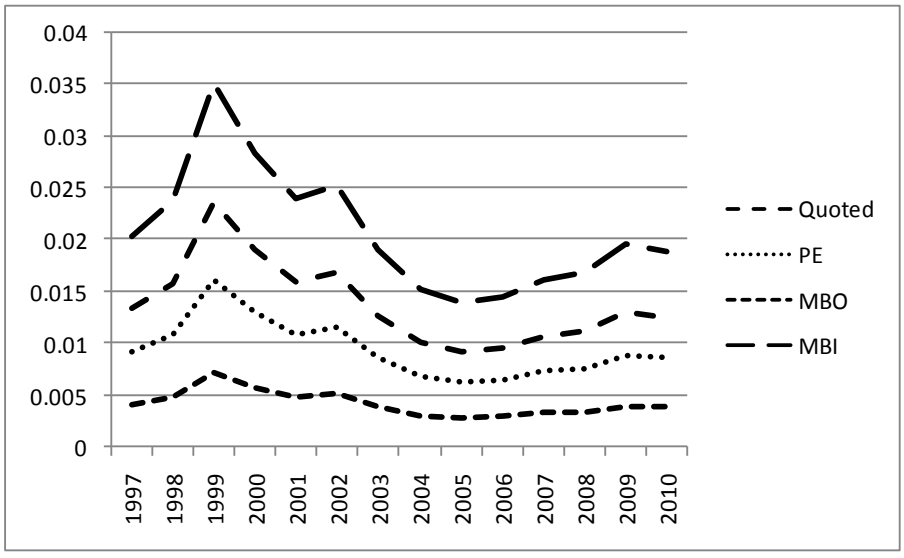
no greater propensity to increase risk by over-leverage than other companies.

For all models we report the 'average marginal effects' of each independent variable in addition to logit coefficients. We focus on the average marginal effects of the buyout dummies. Moreover we generate, from the multivariate models, the average marginal effects of buy-out type for each analysis period. For example, we report the average marginal effect of buy-out type over each analysis year in Figure 3. Results confirm the differences in failure propensity over the cycle for the three buy-out types. MBIs have the highest insolvency risk over the entire period, particularly in the late nineties and dot.com bust around 2000. Interestingly, contrasting with other types, MBIs show a marked increase in insolvency risk as the economy moved into recession from 2007.

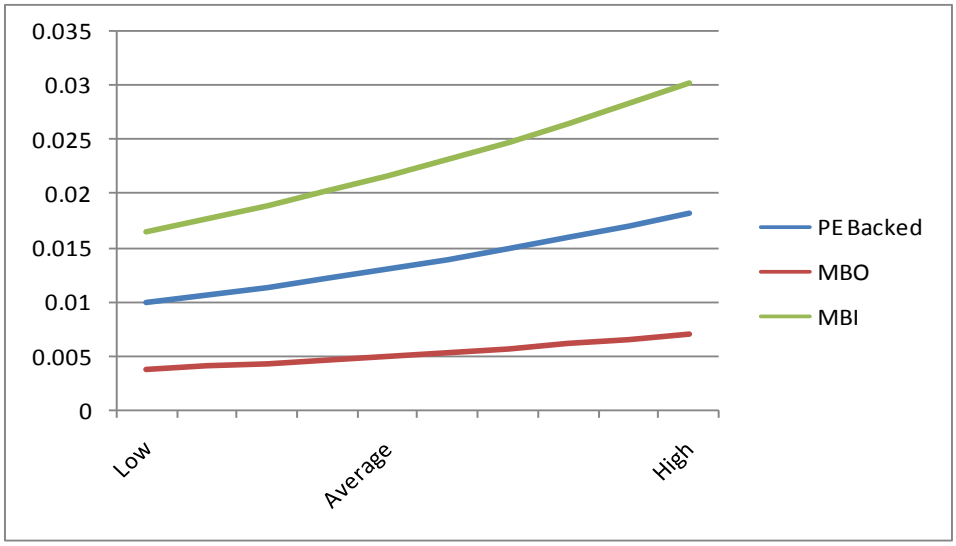
Figure 3 Average Marginal Effects of Buy-Out Type on Insolvency Probability Over Time

The Chart plots the average marginal effects of buy-out type and listed companies on insolvency risk. The estimates are derived from Table VI (Panel B Model 1) using post-estimation sub-population analysis. The chart highlights the marginal effects of changing from 0-1 on each dummy variable for each time period.

Panel A: Average marginal effect over time



Panel B: Average marginal effect over debt range



B. Analyses including financial and other risk factors

Models are re-estimated using the full range of risk-related company characteristics using the discrete time hazard model framework. Multivariate models using the full range of variables, standard in failure prediction models, are built using data on companies submitting full accounts (Table VII panel A); and for the whole sample using variables common to both (Table VII panel B).

The models reported in Table VII (Panels A and B) include basic controls for company size, age and sector competition and the independent variables of interest, buyout type. To test the robustness of our models we add various combinations of control variables reflecting 'compliance' (model 1); financial characteristics (model 2); company characteristics control variables and ‘operational risk and compliance’ (model 3). Model 4 adds financial characteristics and leverage variables and Model 5 includes all variables (M1). Generally the control variables attract the expected signs and are all strongly significant.

Table VII (panel A) reports estimated models for companies with full accounting information. Buy-out dummies are consistent across models 1-5.

Pre-2003 buyout deals have a higher propensity to failure than the population of private companies and family businesses. Again MBIs show the highest failure probability. The coefficients on post-2003 deals are not significant with the exception of non-PE MBIs. Thus, we find that MBOs and PE backed deals completed post-2003 are not riskier than the non-buyout population if we control for various financial and non-financial factors.

B1.Companies with full accounts

The control variables give consistent and significant results. Thus in the full model (Model 5), companies with a high ratio of cash to total assets exhibit lower failure propensity as do companies that can adequately cover interest payments on loans out of profits and show higher profit and retained profit to asset ratios. Companies with higher levels of short-term and long-term debt to equity are more prone to failure, as expected, but the marginal effects are negligible.

Table VII Multivariate Models Predicting Insolvency

We estimate discrete time hazard models determining the probability of insolvency for each company. The models determine insolvency risk using company characteristics, age, size and company type whilst controlling for industry competition with an HH Index and sector using 31 dummy variables. We estimate models (1-5) including different combinations of variables reflecting financial characteristics, regulatory compliance, operational risk and debt. The equations include macro-economic estimates of the base line hazard rate. From maximum likelihood estimation we report the estimated coefficients and significance level of each coefficient based on robust (clustered) standard errors. Overall fit is gauged by log-likelihood statistics and chi-square. We test for the significance of buyout dummy variables, PE-backed buyouts, non-PE-backed MBO's and non-PE-backed MBI's created pre and post 2003. For each model we report the average marginal effects of the 'buyout type' dummy variables and their significance. Panel A reports models estimated for companies that report full accounts (including profit and loss data). Panel B reports the estimates for the full sample. In both tables Model 1 includes variables reflecting company age, size and company type and includes variables measuring compliance. Model 2 adds financial ratios to the model financial risks. Model 3 includes variables reflecting company age, size and company type and includes variables measuring compliance and operational risk. Model 4 includes variables reflecting company age, size and company type and includes variables measuring financial characteristics, debt and compliance. Model 5 includes all variables. For each model we report the average marginal effects of the 'buyout type' dummy variables and their significance.

Panel A

Full Accounts	Discrete Time Duration Models: hazard models with time-varying covariates and macro dependent baseline hazard rate (1995-2010)										
Control Variables	Variable	(1) b/se	Ave. dydx	(2) b/se	Ave. dydx	(3) b/se	Ave. dydx	(4) b/se	Ave. dydx	(5) b/se	Ave. dydx
Size, Age, Type	Size Dummy	-0.4868***		-0.2974***		-0.5464***		-0.2992***		-0.3775***	
		(0.0119)		(0.0123)		(0.0121)		(0.0126)		(0.0129)	
	Size Dummy	-0.3687***		-0.3569***		-0.3077***		-0.3329***		-0.2767***	
		(0.0131)		(0.0133)		(0.0131)		(0.0135)		(0.0135)	
	Log Age	-0.1095***		-0.1034***		-0.0987***		-0.1002***		-0.0915***	
		(0.0051)		(0.0051)		(0.0050)		(0.0050)		(0.0050)	
	Agerisk 3-9 years	0.1954***		0.1544***		0.1422***		0.1533***		0.1099***	
		(0.0095)		(0.0095)		(0.0096)		(0.0095)		(0.0097)	
	Subsidiary Company	-0.2132***		-0.2697***		-0.1718***		-0.2747***		-0.2217***	
		(0.0120)		(0.0120)		(0.0121)		(0.0123)		(0.0124)	
	Herfindahl-Hirschman	0.0001***		0.0001***		0.0001***		0.0001***		0.0001***	
		(0.0000)		(0.0000)		(0.0000)		(0.0000)		(0.0000)	
	Family Company	-0.1739***	-0.0028***	-0.1565***	-0.0025***	-0.1470***	-0.0024***	-0.1570***	-0.0025***	-0.1369***	-0.0022***
		(0.0101)	(0.0002)	(0.0101)	(0.0002)	(0.0102)	(0.0002)	(0.0101)	(0.0002)	(0.0102)	(0.0002)
	Listed Company	0.5681***	0.0125***	0.5024***	0.0106***	0.4723***	0.0096***	0.4990***	0.0105***	0.4257***	0.0084***
		(0.0398)	(0.0011)	(0.0399)	(0.0010)	(0.0403)	(0.0010)	(0.0400)	(0.0010)	(0.0408)	(0.0010)
Financial Characteristics	Cash/Total Assets			-1.3556***				-1.3341***		-1.1796***	
				(0.0249)				(0.0249)		(0.0249)	
	Trade debtors/Total Assets			0.4209***				0.4092***		0.4102***	
				(0.0170)				(0.0171)		(0.0174)	
	Trade Creditors/Total Liabilities			0.5323***				0.5749***		0.5080***	
				(0.0153)				(0.0156)		(0.0161)	
	Inventory/Working Capital			0.0208***				0.0191***		0.0170***	
				(0.0004)				(0.0004)		(0.0004)	
	Retained Earnings/Total Assets			-0.0937***				-0.0910***		-0.0819***	
				(0.0033)				(0.0033)		(0.0035)	
	Return on Assets			-0.2201***				-0.2161***		-0.1800***	
				(0.0087)				(0.0087)		(0.0087)	
	Change in Profit			-0.0048***				-0.0042***		-0.0037***	
				(0.0004)				(0.0004)		(0.0004)	
Debt	EBITDA/Interest Paid							-0.0004***	-0.0000***	-0.0004***	-0.0000***
								(0.0000)	(0.0000)	(0.0000)	(0.0000)
	Debt/TA							0.1679***	0.0028***	0.1473***	0.0024***
								(0.0183)	(0.0003)	(0.0184)	(0.0003)
Compliance	Audited	0.4847***		0.3736***		0.4177***		0.3631***		0.3253***	
		(0.0122)		(0.0120)		(0.0125)		(0.0121)		(0.0125)	
	Cashflow Statement	-0.1971***		-0.2289***		-0.1468***		-0.2336***		-0.1872***	
		(0.0154)		(0.0155)		(0.0154)		(0.0155)		(0.0154)	
	Accounts Overdue	0.0018***		0.0017***		0.0011***		0.0017***		0.0011***	
		(0.0001)		(0.0001)		(0.0001)		(0.0001)		(0.0001)	
	Late filing last accounts	0.0047***		0.0040***		0.0033***		0.0040***		0.0029***	
		(0.0001)		(0.0001)		(0.0001)		(0.0001)		(0.0001)	
	Charge on Assets	0.7431***		0.5954***		0.6998***		0.5842***		0.5642***	
		(0.0131)		(0.0130)		(0.0132)		(0.0131)		(0.0132)	
Operational Risk	County Court Judgements/Total Liabilities					3.0065***				2.7056***	
						(0.0222)				(0.0224)	
	Account Qualification - Severe					0.8581***				0.6697***	
						(0.0447)				(0.0441)	
	Account Qualification - Going Concern					1.1862***				0.8798***	
						(0.0209)				(0.0217)	
	Change in Auditor					0.2241***				0.1945***	
						(0.0143)				(0.0143)	
	PE Backed Pre 2003	0.4821***	0.0102***	0.3880***	0.0077***	0.5088***	0.0106***	0.3662***	0.0072***	0.4074***	0.0080***
		(0.0511)	(0.0013)	(0.0509)	(0.0012)	(0.0518)	(0.0013)	(0.0509)	(0.0012)	(0.0513)	(0.0012)
Buyout Type	PE Backed Post 2003	0.0993	0.0017	0.1370	0.0024	0.1054	0.0018	0.1321	0.0023	0.1444	0.0025
		(0.1238)	(0.0023)	(0.1235)	(0.0023)	(0.1236)	(0.0022)	(0.1233)	(0.0023)	(0.1221)	(0.0023)
	MBO Pre 2003	0.2122**	0.0039**	0.1082	0.0019	0.2349***	0.0043***	0.0985	0.0017	0.1302	0.0023
		(0.0698)	(0.0014)	(0.0696)	(0.0013)	(0.0698)	(0.0014)	(0.0696)	(0.0013)	(0.0695)	(0.0013)
	MB0 Post 2003	0.1721	0.0031	0.1500	0.0027	0.1983	0.0036	0.1423	0.0025	0.1739	0.0031
		(0.1362)	(0.0027)	(0.1360)	(0.0026)	(0.1369)	(0.0027)	(0.1359)	(0.0026)	(0.1362)	(0.0026)
	MBI Pre 2003	0.6433***	0.0147***	0.5403***	0.0116***	0.6058***	0.0132***	0.5299***	0.0113***	0.5086***	0.0105***
		(0.1396)	(0.0042)	(0.1408)	(0.0038)	(0.1370)	(0.0039)	(0.1405)	(0.0038)	(0.1375)	(0.0035)
	MBI Post 2003	1.0592***	0.0299***	1.0062***	0.0272***	1.0985***	0.0305***	0.9942***	0.0267***	1.0447***	0.0278***
		(0.1949)	(0.0085)	(0.1968)	(0.0080)	(0.1919)	(0.0082)	(0.1983)	(0.0079)	(0.1940)	(0.0078)
	Macro Base Hazard	2.0454***		2.0068***		1.9380***		2.0128***		1.9155***	
		(0.0421)		(0.0415)		(0.0426)		(0.0415)		(0.0420)	
Macro Conditions	Constant	-6.7192***		-6.6231***		-6.6552***		-6.6346***		-6.5891***	
		(0.0586)		(0.0582)		(0.0588)		(0.0583)		(0.0587)	
Industry	Industry Dummies	Yes		Yes		Yes		Yes		Yes	
Failed=57,761	N	3320392		3319295		3320392		3319295		3319295	
	Log Likelihood	-273359.940		-265500.035		-264456.775		-265321.920		-258342.547	
	LR Chi-Square	41802.649		53044.513		64545.277		53275.583		72111.175	
	Pseudo R2	0.0615		0.0883		0.0921		0.0889		0.1128	

Private Equity, Buy-outs, and Insolvency Risk

Panel B

ALL Companies	Discrete Time Duration Models: hazard models with time-varying covariates and macro dependent baseline hazard rate (1995-2010)										
Control Variables	**Variable**	(1) b/se	Ave. dydx	(2) b/se	Ave. dydx	(3) b/se	Ave. dydx	(4) b/se	Ave. dydx	(5) b/se	Ave. dydx
Size, Age, Type	Size Dummy	-0.4677***		-0.4560***		-0.5288***		-0.4335***		-0.4936***	
		(0.0066)		(0.0067)		(0.0066)		(0.0068)		(0.0068)	
	Size Dummy	-0.4346***		-0.3291***		-0.3646***		-0.3335***		-0.2712***	
		(0.0109)		(0.0110)		(0.0109)		(0.0110)		(0.0111)	
	Log Age	-0.0962***		-0.1031***		-0.0834***		-0.0966***		-0.0838***	
		(0.0035)		(0.0036)		(0.0034)		(0.0036)		(0.0035)	
	Agerisk 3-9 years	0.2100***		0.1603***		0.1581***		0.1577***		0.1147***	
		(0.0059)		(0.0059)		(0.0059)		(0.0059)		(0.0060)	
	Subsidiary Company	-0.1592***		-0.2988***		-0.1337***		-0.2706***		-0.2302***	
		(0.0087)		(0.0088)		(0.0088)		(0.0088)		(0.0088)	
	Herfindahl-Hirschman Index	0.0001***		0.0001***		0.0001***		0.0001***		0.0001***	
		(0.0000)		(0.0000)		(0.0000)		(0.0000)		(0.0000)	
	Family Company	-0.1950***	-0.0032***	-0.1708***	-0.0028***	-0.1653***	-0.0026***	-0.1749***	-0.0028***	-0.1496***	-0.0024***
		(0.0057)	(0.0001)	(0.0057)	(0.0001)	(0.0057)	(0.0001)	(0.0057)	(0.0001)	(0.0057)	(0.0001)
	Listed Company	0.5329***	0.0114***	0.4415***	0.0090***	0.4471***	0.0089***	0.4674***	0.0096***	0.4009***	0.0077***
		(0.0395)	(0.0011)	(0.0398)	(0.0010)	(0.0400)	(0.0010)	(0.0398)	(0.0010)	(0.0407)	(0.0009)
Financial Characteristics	Cash/Total Assets			-1.9783***				-1.9046***		-1.7272***	
				(0.0168)				(0.0169)		(0.0168)	
	Trade debtors/Total Assets			0.4951***				0.5110***		0.5182***	
				(0.0088)				(0.0089)		(0.0091)	
	Trade Creditors/Total Liabilities			0.1992***				0.3180***		0.2926***	
				(0.0072)				(0.0084)		(0.0084)	
	Retained Earnings/Total Assets			-0.1966***				-0.1827***		-0.1685***	
				(0.0018)				(0.0019)		(0.0020)	
	Change in Networth			-0.0099***				-0.0089***		-0.0071***	
				(0.0006)				(0.0006)		(0.0006)	
Debt	Debt/Total Assets							0.4005***	0.0066***	0.3562***	0.0057***
								(0.0122)	(0.0002)	(0.0124)	(0.0002)
Compliance	Audited	0.4118***		0.3796***		0.3464***		0.3945***		0.3398***	
		(0.0071)		(0.0070)		(0.0072)		(0.0070)		(0.0072)	
	Accounts Overdue	0.0015***		0.0014***		0.0006***		0.0014***		0.0006***	
		(0.0000)		(0.0000)		(0.0000)		(0.0000)		(0.0000)	
	Late filing last accounts	0.0051***		0.0044***		0.0038***		0.0044***		0.0033***	
		(0.0000)		(0.0000)		(0.0000)		(0.0000)		(0.0000)	
	Charge on Assets	0.8748***		0.7550***		0.8317***		0.7417***		0.7160***	
		(0.0085)		(0.0084)		(0.0086)		(0.0084)		(0.0085)	
Operational Risk	County Court Judgements/Total Liabilities					3.0882***				2.8207***	
						(0.0128)				(0.0128)	
	Account Qualification - Severe					0.9101***				0.7842***	
						(0.0331)				(0.0323)	
	Account Qualification - Going Concern					1.1756***				0.9014***	
						(0.0169)				(0.0173)	
	Change in Auditor					0.2283***				0.2008***	
						(0.0090)				(0.0091)	
Buyout Type	PE Backed Pre 2003	0.4339***	0.0089***	0.3350***	0.0065***	0.4540***	0.0091***	0.3433***	0.0066***	0.3771***	0.0072***
		(0.0470)	(0.0012)	(0.0468)	(0.0010)	(0.0475)	(0.0012)	(0.0468)	(0.0011)	(0.0471)	(0.0011)
	PE Backed Post 2003	0.1054	0.0018	0.0705	0.0012	0.1091	0.0019	0.0856	0.0015	0.1020	0.0017
		(0.1111)	(0.0020)	(0.1110)	(0.0020)	(0.1109)	(0.0020)	(0.1110)	(0.0020)	(0.1100)	(0.0019)
	MBO Pre 2003	0.2069***	0.0038***	0.0947	0.0016	0.2349***	0.0042***	0.1076	0.0019	0.1393*	0.0024*
		(0.0552)	(0.0011)	(0.0550)	(0.0010)	(0.0548)	(0.0011)	(0.0550)	(0.0010)	(0.0547)	(0.0010)
	MB0 Post 2003	0.1527	0.0027	0.0534	0.0009	0.1794	0.0032	0.0660	0.0011	0.0933	0.0016
		(0.0962)	(0.0018)	(0.0958)	(0.0017)	(0.0957)	(0.0018)	(0.0958)	(0.0017)	(0.0950)	(0.0017)
	MBI Pre 2003	0.5252***	0.0112***	0.4431***	0.0090***	0.4495***	0.0090***	0.4499***	0.0092***	0.3948***	0.0076***
		(0.1167)	(0.0031)	(0.1154)	(0.0028)	(0.1182)	(0.0029)	(0.1154)	(0.0029)	(0.1172)	(0.0027)
	MBI Post 2003	0.9258***	0.0242***	0.8516***	0.0211***	0.9347***	0.0236***	0.8610***	0.0215***	0.8704***	0.0210***
		(0.1430)	(0.0055)	(0.1439)	(0.0051)	(0.1433)	(0.0053)	(0.1438)	(0.0051)	(0.1439)	(0.0049)
	Macro Base Hazard	1.9481***		1.9107***		1.8598***		1.9008***		1.8294***	
		(0.0273)		(0.0272)		(0.0275)		(0.0273)		(0.0275)	
Macro Conditions	Constant	-6.9228***		-6.7465***		-6.8403***		-6.9173***		-6.8594***	
		(0.0366)		(0.0368)		(0.0366)		(0.0370)		(0.0370)	
Industry	Industry Dummies	Yes		Yes		Yes		Yes		Yes	
Failed = 153,513											
N		8937764		8937764		8937764		8937764		8937764	
Log Likelihood		-730494.044		-708051.238		-704818.411		-707540.408		-686072.748	
LR Chi-Square		108806.152		129322.475		177013.409		129747.649		190765.293	
Pseudo R2		0.0588		0.0877		0.0918		0.0883		0.1160	

Note: Robust(clustered) SE's

We decompose the components of the current ratio and model the ratios of trade debt to total assets; trade creditors to total liabilities and inventories to working capital. All three attract positive and significant signs. Thus companies that rely on and extend trade credit are vulnerable to insolvency as are companies that tie up capital in inventories.

With respect to non-financial and non-accounting control variables defined earlier, we find, as expected, that age of company is negatively related to failure propensity, indicating that the longer a company survives then the less likely it is to fail. However, our dummy variable representing age 3-9 years is positive and significant. Thus, in line with previous studies, we find that companies in the age bracket 3-9 years are more vulnerable to failure.

The late filing of accounts is associated with a higher probability of failure. The longer a company takes to file accounts after the year end, the more likely the company is to encounter difficulties and/or disagreements with the auditors. The variable *Cash Flow Statement* is significant and negative confirming the assertion that companies that submit detailed cash flow statements, and therefore volunteer extra information, are generally lower risk. We find that the number and the value of *CCJs* in the years prior to failure are likely symptoms of financial distress. Whether a creditor has taken out a fixed or floating charge on the company's assets in order to secure a debt attracts a positive and significant sign.

The subsidiary dummy is negative and significant indicating a lower insolvency risk. The family dummy variable consistently attracts a negative and significant sign whereas listed companies have a higher propensity to fail than the population of private companies.

Audited companies with 'audit qualifications' (e.g., 'severe' or 'going concern') are more prone to failure since the auditor is indicating that the long term viability of the company is in some doubt. The variable 'Change in Auditor', indicating whether the company has changed the auditor or not, is positive and significant.

We model the size relationship using a quadratic term in the log of total assets. The signs of the coefficients show the expected insolvency/risk-size relationship. The results suggest a threshold level of real assets before 'legal insolvency' becomes attractive for creditors. The control for industry sector is significant and picks up the effects of the average sector level failure rate on the companies probability of failure. Controlling for other factors, companies with higher leverage, whether a buyout or not, are significantly more likely to fail.

B2. All companies

As in the model using full accounts only, we find for the larger sample (Table VII panel B) (n= 8,937,764, fails=153,513) that MBIs are most likely to fail pre and post-2003. The results for post-2003, MBOs and private equity-backed buyouts, again suggest that these types are no riskier than the population of non-buyouts. The selected financial ratios are all highly significant (Models 2,4 and 5) and attract appropriate signs. The non-financial data is again very predictive and the signs are consistent with the previous models. As with full accounts, the macro-economic variables are all significant and attract the expected signs. The marginal effects of buyout type are consistent across all models.

C. Buyout sample

In Table VIII (Panel A and Panel B) we focus solely on the buy-out sample. The model reported in Table VIII (Panel A) is based on full accounts for 19,602 buyouts of which 841 failed. Selected financial ratios and non-financial variables are all significant and attract appropriate signs, as before. We include dummy variables for MBIs and Private equity backed buyouts both pre and post-2003. Relative to MBOs, MBIs are significantly more likely to fail, while relative to non-private equity backed buyouts private equity backed buyouts pre-2003 are significantly more likely to fail but this is not the case post-2003.

The results reported in Table VIII (Panel B) are based on abridged accounts fields for 26,664 buyouts of which 1,179 failed. Again, the selected financial ratios are all highly significant and attract appropriate signs. Retained profit to total assets and changes in retained profit attract significant negative signs, implying that buyouts that can accumulate profit from trading are less prone to failure. Having liquidity and cash is associated with a lower probability of failure. The results in relation to MBIs and private equity backed buyouts pre and post-2003 are again consistent with our earlier findings. Of particular note is the fact that debt to total assets and its year on year changes are not significant in distinguishing buyouts that fail from non-fails.

D. Robustness tests

To evaluate model performance we estimate the models on the 1995-2009 sample and retain 2010 as a hold-out. We report receiver operating characteristics (ROC). The in-sample ROC Curve results are reported in Figures 5 (Panels A and B). Panel A reports the results for the full model for full accounts. Panel B reports the same models for all companies. Figure 6 reports the out of sample ROC curves for the full models (panels A and B). The models achieve strong classification performance with AUC around 0.8 both within and out-of-sample.

Table VIII Multivariate Models Predicting Insolvency: Buyout Sample

We estimate discrete time hazard models determining the probability of insolvency for buyout companies only. The models determine insolvency risk using company characteristics, age, size and buyout type whilst controlling for industry sector risk using the industry failure rate. The equations include macro economic variables for modelling the base line hazard rate. From maximum likelihood estimation we report the estimated coefficients, robust (clustered) standard errors and the significance level of each coefficient. Overall fit is gauged by log-likelihood statistics, chi-square and Pseudo R2. We test for the significance of buyout dummy variables, PE-backed buyouts and non-PE-backed MBI's. We create and tests additional dummies that categorise the buyouts created pre and post 2003. Panel A reports models estimated for companies that report full accounts (including profit and loss data). Panel B reports the estimates for the full sample. For each model we report the average marginal effects of all of the variables and their significance.

Panel A

Discrete Time Duration Models: hazard models with time-varying covariates and macro dependent baseline hazard rate (1995-2010)

Variable	(1) b/se	Ave. dy/dx	(2) b/se	Ave. dy/dx	(3) b/se	Ave. dy/dx	(4) b/se	Ave. dy/dx	(5) b/se	Ave. dy/dx
Log Total Assets	-0.1622***		-0.1500***		-0.1713***		-0.1513***		-0.1570***	
	(0.0256)		(0.0259)		(0.0259)		(0.0259)		(0.0261)	
Cash/Total Assets	-2.1955***		-2.1054***		-1.8314***		-2.0904***		-1.7683***	
	(0.4555)		(0.4440)		(0.4520)		(0.4441)		(0.4409)	
Trade Creditors/Total Liabilities	0.4810*		0.5128**		0.9058***		0.5165**		0.8986***	
	(0.1924)		(0.1948)		(0.2207)		(0.1954)		(0.2226)	
Inventory/Working Capital	0.0177***		0.0165***		0.0141***		0.0164***		0.0133***	
	(0.0025)		(0.0025)		(0.0026)		(0.0025)		(0.0026)	
Return on Assets	-0.6908***		-0.6533***		-0.5571***		-0.6421***		-0.5291***	
	(0.1039)		(0.1038)		(0.1019)		(0.1032)		(0.1033)	
EBITDA/Interest Paid					-0.0006**	-0.0000**			-0.0006**	-0.0000**
					(0.0002)	(0.0000)			(0.0002)	(0.0000)
Debt/TA					0.6242***	0.0246***			0.5616***	0.0217***
					(0.1680)	(0.0066)			(0.1688)	(0.0065)
Change In Debt/TA					0.0519	0.0020	0.0594	0.0023	0.0500	0.0019
					(0.0340)	(0.0013)	(0.0323)	(0.0013)	(0.0341)	(0.0013)
Cashflow Statement	-0.2090**		-0.1730*		-0.2231**		-0.1634*		-0.1888*	
	(0.0761)		(0.0772)		(0.0766)		(0.0778)		(0.0778)	
Accounts Overdue	0.0023***		0.0021***		0.0023***		0.0021***		0.0021***	
	(0.0006)		(0.0006)		(0.0006)		(0.0006)		(0.0006)	
Late filing last accounts	0.0051***		0.0041***		0.0050***		0.0041***		0.0040***	
	(0.0007)		(0.0008)		(0.0007)		(0.0008)		(0.0008)	
Charge on Assets	0.4942***		0.4831***		0.4857***		0.4860***		0.4747***	
	(0.0774)		(0.0781)		(0.0772)		(0.0781)		(0.0779)	
County Court Judgements/Total Liabilities			3.5625***				3.5684***		3.5850***	
			(0.3823)				(0.3840)		(0.3793)	
Account Qualification - Going Concern			0.9447***				0.9386***		0.8700***	
			(0.1564)				(0.1561)		(0.1590)	
PE Backed Pre 2003	0.3021***	0.0121***	0.3117***	0.0122***	0.2868***	0.0115***	0.3143***	0.0123***	0.2992***	0.0117***
	(0.0850)	(0.0035)	(0.0860)	(0.0034)	(0.0851)	(0.0035)	(0.0860)	(0.0034)	(0.0861)	(0.0034)
PE Backed Post 2003	0.1825	0.0077	0.1747	0.0072	0.1848	0.0078	0.1698	0.0070	0.1776	0.0073
	(0.1451)	(0.0065)	(0.1463)	(0.0064)	(0.1448)	(0.0065)	(0.1460)	(0.0063)	(0.1459)	(0.0064)
MBI Pre 2003	0.3807*	0.0174*	0.3053	0.0132	0.3842*	0.0175*	0.3058	0.0133	0.3124*	0.0136*
	(0.1582)	(0.0083)	(0.1591)	(0.0077)	(0.1584)	(0.0083)	(0.1590)	(0.0077)	(0.1594)	(0.0077)
MBI Post 2003	0.7433***	0.0397***	0.7867***	0.0417***	0.7202***	0.0380***	0.7772***	0.0411***	0.7672***	0.0403***
	(0.2106)	(0.0147)	(0.2092)	(0.0146)	(0.2128)	(0.0145)	(0.2087)	(0.0145)	(0.2114)	(0.0145)
Base Hazard	1.4798***		1.3515***		1.4698***		1.3534***		1.3307***	
	(0.3429)		(0.3451)		(0.3425)		(0.3457)		(0.3450)	
Constant	-3.5753***		-3.7013***		-3.5474***		-3.6932***		-3.6878***	
	(0.8361)		(0.8032)		(0.8150)		(0.8017)		(0.7935)	
industry	Yes		Yes		Yes		Yes		Yes	
N	19602		19602		19602		19602		19602	
Log Likelihood	-3180.695		-3119.756		-3164.283		-3118.393		-3105.736	
LR Chi-Square	563.882		659.166		572.749		665.179		664.560	
Pseudo R2	0.0893		0.1067		0.0940		0.1071		0.1108	

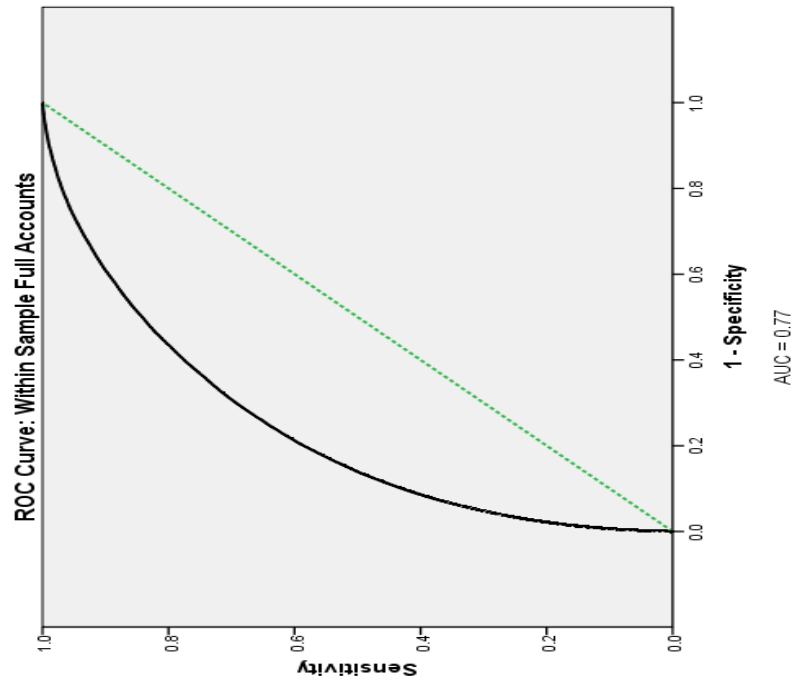
Panel B

Discrete Time Duration Models: hazard models with time-varying covariates and macro dependent baseline hazard rate (1995-2010)

Variable	(1) b/se	Ave. dydx	(2) b/se	Ave. dydx	(3) b/se	Ave. dydx	(4) b/se	Ave. dydx	(5) b/se	Ave. dydx
Log Total Assets	-0.1449***		-0.1245***		-0.1535***		-0.1247***		-0.1312***	
	(0.0187)		(0.0187)		(0.0187)		(0.0187)		(0.0188)	
Cash/Total Assets	-2.1252***		-1.9972***		-1.9397***		-1.9898***		-1.8521***	
	(0.3486)		(0.3380)		(0.3454)		(0.3377)		(0.3366)	
Inventory/Working Capital	0.0193***		0.0170***		0.0179***		0.0170***		0.0159***	
	(0.0020)		(0.0020)		(0.0020)		(0.0020)		(0.0021)	
Debt/TA					0.6446***	0.0261***	0.0185	0.0007	0.5273***	0.0208***
					(0.1328)	(0.0054)	(0.0294)	(0.0012)	(0.1365)	(0.0054)
Change in Debt/TA					0.0090	0.0004			0.0043	0.0002
					(0.0304)	(0.0012)			(0.0309)	(0.0012)
Accounts Overdue	0.0024***		0.0022***		0.0024***		0.0022***		0.0022***	
	(0.0005)		(0.0005)		(0.0005)		(0.0005)		(0.0005)	
Late filing last accounts	0.0058***		0.0046***		0.0056***		0.0046***		0.0045***	
	(0.0006)		(0.0006)		(0.0006)		(0.0006)		(0.0006)	
Charge on Assets	0.5742***		0.5626***		0.5774***		0.5623***		0.5651***	
	(0.0670)		(0.0676)		(0.0671)		(0.0676)		(0.0677)	
County Court Judgements/Total Liabilities			3.3816***				3.3802***		3.3923***	
			(0.2879)				(0.2882)		(0.2910)	
Account Qualification - Going Concern			1.1159***				1.1150***		1.0463***	
			(0.1298)				(0.1297)		(0.1321)	
PE Backed Pre 2003	0.2550***	0.0106***	0.2461***	0.0100***	0.2334**	0.0097**	0.2460***	0.0100***	0.2305**	0.0093**
	(0.0709)	(0.0030)	(0.0719)	(0.0030)	(0.0713)	(0.0030)	(0.0719)	(0.0030)	(0.0723)	(0.0030)
PE Backed Post 2003	0.1254	0.0053	0.1068	0.0044	0.1141	0.0048	0.1083	0.0045	0.0997	0.0041
	(0.1261)	(0.0056)	(0.1260)	(0.0054)	(0.1262)	(0.0056)	(0.1260)	(0.0054)	(0.1260)	(0.0053)
MBI Pre 2003	0.2868*	0.0130*	0.1706	0.0072	0.2760*	0.0124*	0.1713	0.0072	0.1642	0.0069
	(0.1294)	(0.0065)	(0.1329)	(0.0060)	(0.1291)	(0.0064)	(0.1329)	(0.0060)	(0.1325)	(0.0059)
MBI Post 2003	0.6686***	0.0355***	0.6574***	0.0337***	0.6690***	0.0355***	0.6564***	0.0336***	0.6592***	0.0338***
	(0.1543)	(0.0104)	(0.1587)	(0.0103)	(0.1542)	(0.0104)	(0.1587)	(0.0103)	(0.1581)	(0.0102)
Base Hazard	1.9146***		1.7949***		1.9160***		1.7981***		1.7883***	
	(0.2963)		(0.3001)		(0.2969)		(0.3004)		(0.3008)	
Constant	-3.9413***		-4.1799***		-3.9714***		-4.1844***		-4.1993***	
	(0.5965)		(0.5928)		(0.5931)		(0.5920)		(0.5912)	
industry	Yes		Yes		Yes		Yes		Yes	
N	26664		26664		26664		26664		26664	
Log Likelihood	-4448.388		-4340.541		-4436.724		-4340.362		-4333.070	
LR Chi-Square	685.260		830.160		688.485		830.850		823.733	
Pseudo R2	0.0777		0.1001		0.0801		0.1001		0.1016	

Figure 5 Within Sample Diagnostic Tests

The two charts plot ROC curves for within-sample model performance. Within sample we plot the model performance of the models reported in the tables (full model). This performance is reflected in the AUC (Area Under the Curve) statistic.



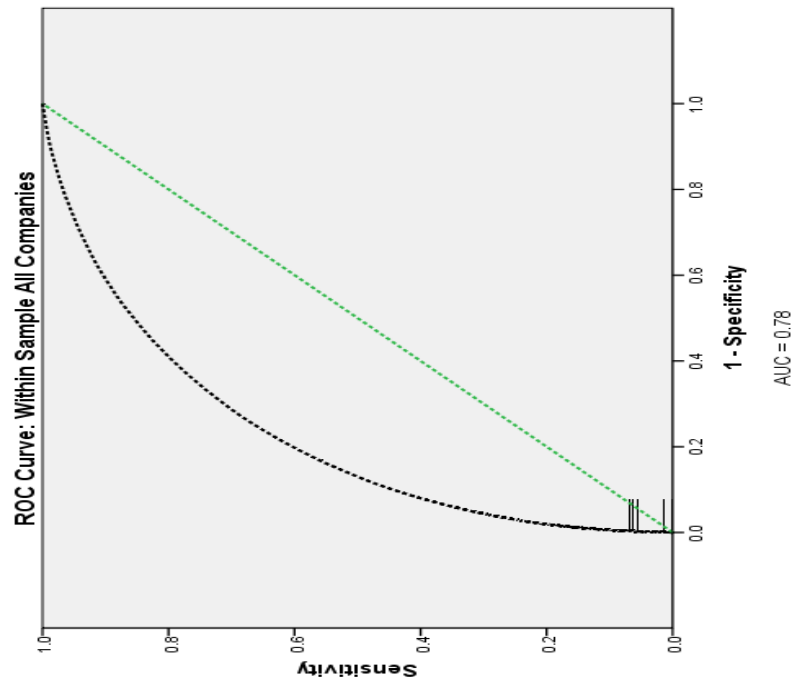
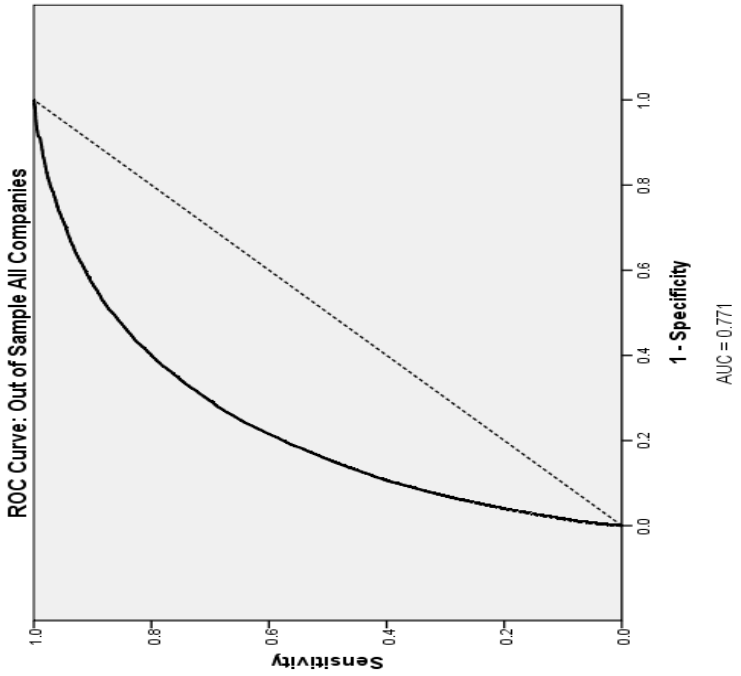
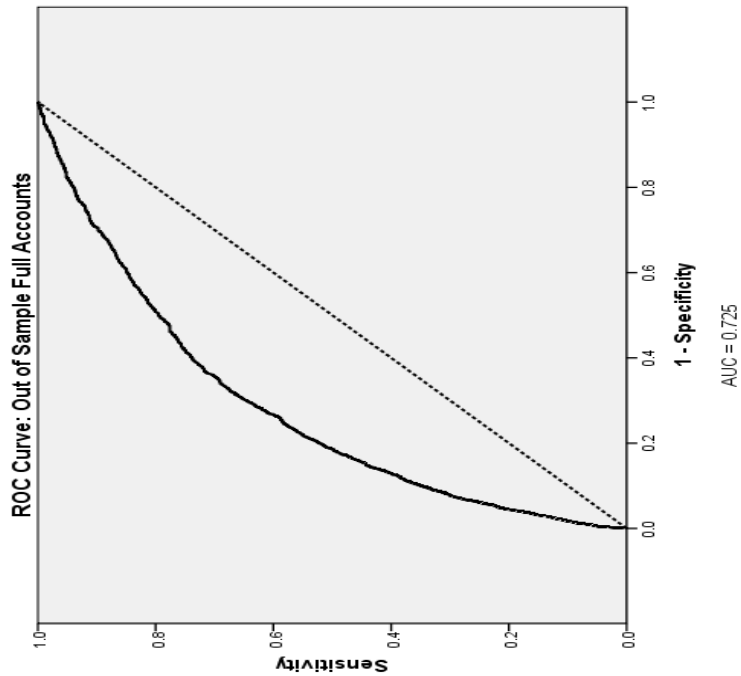


Figure 6 Robustness Checks: Hold-Out Sample Diagnostic Tests

We confirm the robustness of the estimated coefficients by re-estimating models and retaining the 2010 observations for hold-out tests. The two charts plot ROC curves for hold-out-sample model performance.





V. Conclusions

Using a unique, hand-collected dataset comprising the population of over 8 million private firms in the UK during 1995-2010, of which over 150,000 had entered formal insolvency, we find that PE investors target underperforming companies with better prospects in terms of profit and cash generation. We find a higher incidence of insolvency amongst buyouts in comparison with the corporate population and this holds when we control for firm and industry characteristics. MBIs carry the higher risk of insolvency but PE presence reduces the risk of MBI failures. The generally smaller MBOs have the lowest insolvency risk in this subsample. Moreover, it is important to note that the insolvency risk is not higher (in fact is lower) than expected given pre-buyout risk characteristics. Leverage is found to be an important factor that increases insolvency risk for all company types. However, an important finding from our analysis is that PE insolvencies are not differentially associated with leverage. Analysis of average marginal effects finds that the increase in insolvency risk in relation to leverage for the PE sub-sample is relatively low compared to other MBIs. Indeed the analysis of PE selection criteria suggests that PE investors choose firms that are likely to generate a healthy coverage ratio. Further, MBOs and PE backed buyouts completed post-2003 are not riskier than the population of non-buyouts if we control for size, age, macro and industry characteristics. Controlling for financial performance and operational risk we confirm that PE backed buyouts are likely to avoid insolvency even when they exhibit signs of distress. The buyout only subsample confirms that leverage is not important in distinguishing buyouts that fail from those that survive.

When we tracked the extent and determinants of failure during the peak of the recessionary period to end-2010, we still do not find support for the view that higher rates of entering the formal insolvency process due to higher leverage are a specific feature of PE backed buyouts. We suggest that PE backed companies as well as targeting better buyout prospects are in a better position, because of active ownership and governance, to adjust capital structure over the economic cycle and, therefore, manage

insolvency risk and protect assets. PE investors protect their financial and reputational capital by actively restructuring and renegotiating finances when distress is finance rather than economic related.

These are important findings in the context of the current policy debate. First, we highlight the need to recognize that it is not only buyouts and PE backed buyouts in particular that are highly leveraged; indeed not all buyouts are highly leveraged. Second, our findings suggest active involvement by PE firms help portfolio companies deal better and more timely with trading difficulties, particularly in the more recent period leading up to the credit crunch.

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ERC
Enterprise Research Centre

Centre Manager
Enterprise Research Centre
Warwick Business School
Coventry, CV4 7AL
Enquiries@enterpriseresearch.ac.uk

Centre Manager
Enterprise Research Centre
Aston Business School
Birmingham, B1 7ET
Enquiries@enterpriseresearch.ac.uk

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