A test of the abandonment options hypothesis using *ex post* insolvent British firms

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by

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Abstract

This paper empirically examines the predictions of the abandonment options hypothesis ("AOH") using a sample of British insolvent firms. Previous research in the equity valuation literature (e.g. Barth *et al* [*JAE* 1998], Schnusenberg and Skantz [*JAAF* 1998]) has shown that the equity valuation roles played by key corporate financial statements are complementarily linked with the likelihood of firms' abandonment options being exercised. In particular, researchers in the US find that the balance sheet plays a more important valuation role vis-à-vis the profit and loss account when the likelihood of exercising the abandonment options is high (or increasing) and vice versa. However, test results obtained in this study show that the AOH is only partially supported in the UK. Although some mild evidence consistent with the hypothesis is initially found, subsequent robustness tests reveal that the results are sensitive to the research design employed. This suggests that the previous findings on the AOH should be re-evaluated, and that there may be other factors other than abandonment options at work which contribute to the non-linear valuation characteristics of key accounting measures.

Keywords: Equity valuation; Valuation roles; Abandonment option; Insolvency.

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Introduction

The intricate relationship between equity returns/market value and accounting measures has been a constant theme in market-based accounting research. One recent reincarnation of this theme takes the form of accounting-based equity valuation. Following the seminal work of Ohlson (1995) and Feltham and Ohlson (1995, 1996), market value of equity ["equity value"] is typically represented as a linear function of earnings, equity book value ["book value"] as well as other information. However, recent empirical evidence suggests that this type of linear valuation functions does not fully characterise the valuation roles played by earnings and book value. In particular, researchers found that (1) equity value is a convex function of earnings and book value in the US and UK and (2) the equity valuation roles played by the profit & loss account and balance sheet in the US are complementarily linked with financial health[1]. A common conjecture proposed by researchers to account for these unusual phenomena is the "abandonment options hypothesis" ("AOH")[2]. To put it plainly, the AOH posits that abandonment options (i.e. the flexibility available to management in either keeping a company's operation in going concern or abandoning it for its salvage value) help determine whether earnings or book value plays a greater role in equity valuation, thereby resulting in the observed phenomena. The rationale for this hypothesis is intuitive and based on the premise that key financial statements provide decision-relevant information. If the likelihood of abandonment options being exercised is high, the AOH posits that book value will be more important in determining the equity value because the balance sheet reflects indirectly the abandonment/liquidation value of the company. In contrast, earnings will have a greater valuation role to play when the likelihood of abandonment options being exercised is low because reported earnings (in the profit and loss account) are a rough indicator of future recurring earnings streams.

The purpose of this paper is to examine this AOH empirically using a sample of *ex post* insolvent British companies. Similar to prior research in the US (e.g. Barth *et al* [1998] ["BBL"] and Schnusenberg and Skantz [1998]), this study seeks to find out if the valuation characteristics of earnings and book value are a function of abandonment likelihood in the UK. Specifically, this study follows BBL and assesses the intertemporal changes in the

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[1] These observations have been referred to as the "convexity" and "complementarity" phenomenon respectively in the literature (e.g. Yee [2000]).

[2] To be precise, the actual terminologies used in the literature to explain these phenomena are quite diverse (e.g. liquidation options, put options, adaptation options etc.) but for practical purposes they can be treated as synonymous with abandonment options in this study.

statistical relationship between equity value and two key accounting measures for a sample of insolvent firms during the last five years of their existence. This study uses *ex post* insolvent firms as samples because they represent real economic events of corporate abandonment and hence provide a unique opportunity to test the AOH.

The motivations of this study are threefold: First, the AOH has important implications for accounting-based equity valuation as well as financial statement analysis. In particular, it suggests that the relationship between accounting measures and security prices is not universal but contextual. Secondly, empirical research into the AOH has so far received very little attention in the UK[3]. Although the AOH has been examined in the context of the US security market, previous research (e.g. Akbar and Stark [2003b]) has shown that empirical regularities observed in the US are not always generalisable to other countries. There are potentially many reasons for this. Differences in institutional factors (e.g. accounting standards, insolvency code)[4] between the US and the UK for one could plausibly give rise to different findings. Finally, this study builds on the existing literature on the AOH by considering new model specifications not previously applied in the two earlier studies. The use of alternative specifications helps ensure that past results are robust to the control of different research designs. Taken together this paper contributes to the equity valuation literature by using new model specifications to examine the AOH in a new country context.

The remainder of the paper is organised as follow. The next section reviews existing literature on the AOH and other similar hypotheses. The third section discusses the research hypotheses and design of this study. The fourth section presents the data and results. Finally, a conclusion is provided in the last section.

Relevant literature

Until recently the notion that abandonment/liquidation options add to a company's value has received very little attention in the accounting literature even though it has long been recognised in the finance literature (Hayn 1995, p.127). Early finance researchers apply such notions to show that capital investment decision could be sub-optimal if the abandonment

[3] To the best of our knowledge, Ashton *et al* (2003) remains the only study so far that has looked into this issue in the UK. However, the focus of their analytical paper is on the convex relationship between accounting measures and security prices whereas the issue considered in this paper is the complementary valuation functions of accounting measures.

[4] For a synopsis of two key institutional differences between the US and the UK, see Lim (2006).

option value of the project is ignored (see e.g. Robichek and Van Horne 1967, Dyl and Long 1969, Bonini 1977, Myers and Majd 1990). In accounting, Chambers (1966) and Sterling (1970) are both early advocates of an accounting system that is based on current exit value (i.e. liquidation value) because it is more useful for decision-making[5]. However, their arguments are essentially normative propositions and they do not consider the potential value of abandonment options or their capital market impact.

This task is taken up by Berger, Ofek and Swary (1996) who show that abandonment options are "priced" by investors at the exit value akin to an American put option. Utilising an option framework, they find that abandonment options make a significant contribution to equity value after controlling for the present value of expected future cash flows. In addition, they also find that abandonment options value is positively and significantly related to the exit values of companies' assets as estimated from their balance sheets.

Whilst Berger *et al* (1996) examines the impact of abandonment options on equity value directly, other market-based accounting researchers investigate how it could *indirectly* affect the way accounting information relates to either stock returns or equity value. In her study of the returns-earnings relationship Hayn (1995) finds that losses are not as informative as profits about the future cash flows of companies because shareholders have a liquidation option to sell their shares instead of allowing the losses to perpetuate. Differently put, losses are found to induce non-linearity into the pricing function of earnings due to the presence of liquidation options and not the mean reversal effect of earnings. Corroborative evidence that liquidation options play a role in the returns-earnings relationship is also offered by Dhaliwal and Reynolds (1994) and Subramanyam and Wild (1996). They find that the default risk of firms' debt and the probability of bankruptcy respectively have a negative impact on the informativeness of earnings with regards to returns.

Apart from earnings, prior empirical research finds that abandonment options also affect the value relevance of book value. For instance, Burgstahler and Dichev (1997) ["BD"] predict and find that the relative importance of earnings and book value in explaining the equity value of firms depends on the firms' profitability level, and that equity value is a convex function of earnings and book value. They attribute this phenomenon to the hypothesis that

[5] See also Ronen and Sorter (1972).

firms generally have options to adapt their resources to more profitable use whenever the firms' profitability level is sufficiently low to trigger such options[6]. In a similar vein, Barth, Beaver and Landsman (1998) ["BBL"] examine and find that the relative value relevance of earnings and book value is complementarily conditioned by the financial health of firms. Using a sample of *ex post* insolvent companies and a larger sample of firms with varying degree of financial health, BBL find that earnings (book value) play a relatively more important valuation role when companies' financial health improves (deteriorates). Their results provide support for the contention that the balance sheet and the profit and loss account fulfil different roles and that abandonment options have an impact on the relative valuation roles of accounting measures. Schnusenberg and Skantz (1998) ["SS"] also test the AOH but instead of using insolvent companies, they use a sample of poorly performing companies that did not liquidate as well as a sample of strongly performing companies that liquidated voluntarily. They find results similar to that of BBL with book value playing a relatively more important valuation role when earnings history is poor (e.g. having consecutive losses) or as companies approach voluntary liquidation. In contrast, earnings' value relevance is found to behave in an opposite way to that of book value.

Given the various interpretations given to book value in equity valuation, Collins, Pincus and Xie (1999) seek to examine its role in the presence of negative earnings. They find empirical evidence consistent with the claim that book value serves as a proxy for the abandonment option for loss companies most likely to cease operations and liquidate, thereby confirming the findings of BD and BBL. Wysocki (1998) further extends this line of enquiry by finding an asymmetric price-earnings relationship exists even at intrafirm level, i.e. segment losses are less value relevant than segment profits in the presence of adaptation options.

Evidence supporting the AOH does not only come in the form of empirical research, recent analytical studies also show that it is consistent with real options theory. For example, Yee (2000) incorporated adaptation options into the well-known Ohlson's linear information dynamics framework to derive a non-linear equity valuation model whose valuation coefficients are a function of adaptation possibilities. He argues that companies need to

[6] BD call these "adaptation options" and further state that adaptation can take various forms including: liquidations, sell-offs, spin-offs, divestitures, CEO changes, mergers, takeovers, bankruptcies, restructurings and new capital investments (p.188). As such, their adaptation concept is more general than the abandonment notion adopted in this study. Nevertheless, both concepts generally yield very similar empirical predictions and hence for practical purposes they are used interchangeably in this paper.

replace deteriorating business lines with new ones in order to maintain a competitive edge and therefore, this ability to exploit new opportunities (i.e. adaptation) has value. In particular his model yields an empirical prediction that equity value is a continuous, increasing convex function of (abnormal) earnings, a pattern not too dissimilar to that found in BD. Moreover, he also proposes an *Equivalence Theorem*, which states that: "*In any Markovian accounting system Modigliani-Miller dividend invariance implies earnings convexity is equivalent to (Barth, Beaver and Landsman-style) complementarity. That is, under these assumptions convexity and complementarity must occur together or not at all.*"

Unlike Yee (2000) who only considers the case of adaptation options, Zhang (2000) further incorporates endogenous capital investment decisions into the Feltham and Ohlson (1995; 1996) framework to yield a non-linear equity valuation model. According to his model, investment decisions are assumed to respond to growth opportunities as well as efficiency signals generated by accounting information, be it to expand, stay put or contract. Taking these contingencies into account, he suggests that equity value generally consists of: (1) capitalised earnings from current operations plus (2) the value of the put option to discontinue operations and (3) the value of the call option to expand operations. Cross-sectionally one of these three components is said to dominate the valuation process depending on the state of efficiency a company is in and the growth potential it has. The resulting prediction of his model is that given book value (earnings), equity value is convex in earnings (book value) for both low-efficiency and growth companies, but for steady-state companies, the relationship is approximately linear. Again, this prediction is broadly consistent with the empirical findings of BD.

To account for the convexity phenomenon documented by BD, Ashton, Cooke and Tippett (2003) ["ACT"] also derive a non-linear equity valuation model based on embedded adaptation options. ACT generalise the linear information dynamics used by Ohlson (1995) to propose an *Aggregation Theorem* which shows that equity value is an aggregate of two interacting value components[7] whose sizes are proportionately related to each other. According to the theorem, the recursion value component will dominate the other adaptation value component in accounting for the equity value of a firm whenever the prospects of

[7] The two value components are "recursion value" and "adaptation value". Recursion value is defined as the present value of future earnings assuming that a company continues to apply its current business technology to its resources. Adaptation value is defined as the value of the company's resources independent of the company's current business technology.

payoffs (from the current business operations of the firm) are more certain and vice versa. Since accounting measures such as earnings and book value are rough approximations of these value components, the logical implication of the theorem is that equity value will be non-linearly related to them. Consistent with their model's prediction except for extreme ranges, ACT find a convex relationship exists between equity value and earnings (after controlling for book value) in the UK similar to that found by BD in the US.

In summary, prior empirical and analytical research suggest that abandonment options induce both "convexity" and "complementarity" effects on the valuation roles of earning and book value. To date evidence on the convexity effect of the AOH is fairly consistent across the US and the UK. However, the complementarity effect of the AOH has only been tested in the context of the US security market. This paper serves to fill this gap in the literature.

Research hypotheses and design

Informational roles of financial statements

A central premise to the AOH is that key financial statements such as the profit and loss account and the balance sheet play a different informational role to financial statements users. As BBL argue: …*The fundamental role of the income statement is for equity valuation whereas the balance sheet is to facilitate loan decisions and monitoring of debt contracts.*[8] *The income statement fulfils its role by providing information about rents associated with the firm's future growth opportunities and other unrecognised net assets. The balance sheet fulfils its role by providing information on liquidation values assuming book values approximate liquidation values*" (BBL, p.4). The rationale for these arguments is obvious given the existing empirical evidence and the historical evolution of financial reporting in the UK. For instance, the long history of market-based accounting research on the earnings-returns relationship has repeatedly shown that earnings information (as a summary measure of the profit and loss account) is useful for investment/valuation purposes. This conclusion is supported by other non-market based research, which has found the price/earnings (P/E) ratio to be the primary valuation model used by financial analysts/institutional investors (see e.g.

[8] BBL and others have obviously taken a forward decision-usefulness view on the informational roles of financial statements and ignored the other side of the accounting duality, which is to provide historical information for management control and stewardship assessment purposes (see e.g. Ronen 1979, Demski *et al* 2002, pp. 159-161 for further details on the accounting duality). However, this omission can be overlooked in this particular instance because it does not alter the tenets of their arguments and results.

Govindarajan 1980, Lee and Tweedie 1981, Arnold and Moizer 1984, Day 1986, Pike et al 1993, Previtts *et al* 1994, and Barker 1999).

The historical evolution of financial reporting in the UK also lends support to this argument. It is well known that until the late 1920s the balance sheet took primacy in financial reporting because bankers, lenders and creditors were in those days the major financial contributors to business entities (Lee 1996, p.20). Emphasis was therefore placed on the balance sheet as it reflects the financial soundness and solvency of business entities. It gave away its prime position to the profit and loss account only when a sophisticated investment community and security markets began to develop, and accounting information relevant for investor protection and decision-making was needed (ibid). Hence, the differing informational roles played by the two main financial statements have had a long history. Based on these roles, it is easy to see that the profit and loss account provides information about the value of a firm (assuming it is a going concern) whereas the balance sheet indirectly reflects how much the firm is worth should it liquidate. Therefore, from a valuation perspective the two primary financial statements are generally hypothesised to play a complementary role with each other depending on the likelihood of management exercising their abandonment options.

Research designs and models specification

In order to examine the AOH, this study follows BBL and assesses the statistical relationship between equity value and the two key summary measures from the profit and loss account and balance sheet (i.e. earnings and book value respectively) for a sample of *ex post* insolvent firms and over a period of five years prior to the firms' delisting. Essentially this research design takes the date on which delisting/insolvency occurs as the "event date" and the five years prior to that as the "event window" to examine how the statistical relationship changes intertemporally as firms approach delisting/insolvency. This approach allows the changes in statistical relationship to be tested against the predictions of the AOH. The statistical relationship is determined by running the following cross-sectional ordinary least squares ("OLS") regression[9] for each of the preceding five years:

$$MV_{it} = a_0 + a_1 NI_{it} + a_2 NI \cdot D1_{it} + a_3 BV_{it} + a_4 BV \cdot D2_{it} + \varepsilon_{it} \qquad (1)$$

where MV is equity market value, a_0 is an intercept, NI is earnings before exceptional and extraordinary items, BV is book value, ε is an error item with mean zero, i is firm subscripts

[9] See BBL for more details on the valuation model that underlies this regression model.

and t is relative year (i.e. t_{-5}, … t_{-1}) to delisting year (t_0). $D1$ and $D2$ are dummy variables taking the value one if earnings and book value are negative respectively. This means the sum of coefficients a_1 and a_2 (a_3 and a_4) gives the coefficient on negative earnings and negative book values respectively. The reasons for using dummy variables are twofold. First, prior research e.g. Hayn (1995) has shown that negative earnings have different pricing multiples and if ignored, could confound the regression results. This also applies to book value. Secondly, deletion of samples with negative earnings or book value data is inappropriate because it will drastically reduce the sample size. Using dummy variable avoids this problem.

In addition to estimating regression coefficients, the individual incremental explanatory power of earnings and book value is also estimated by decomposing the total explanatory power (i.e. coefficient of determination) of model (1) into its individual components in accordance to Thiel (1971).

Based on the research design above, it is possible to derive the following specific hypotheses with regards to the impact of abandonment options on equity valuation:

H1: *The coefficient on earnings* (a_1) *decreases as companies approach insolvency.*

H2: *The coefficient on book value* (a_3) *increases as companies approach insolvency.*

H3: *The incremental explanatory power* (*incremental* R^2_{NI}) *of earnings decreases as companies approach insolvency.*

H4: *The incremental explanatory power* (*incremental* R^2_{BV}) *of book value increases as companies approach insolvency.*

For the remaining coefficients of model (1), a_2 is predicted to be negative following Hayn (1995) but a_4 is undetermined since negative book value is devoid of economic meaning. Testing of regression coefficients will be conducted using the White-adjusted t-statistics (White 1980) since the classic OLS assumption of homoskedasticity is often violated in cross-sectional regressions. With regards to the testing of relative explanatory power, the Vuong (1989) test will be used. It should also be noted that although five years of accounting history are used to examine the relative valuation effects of earnings and book value, there is nothing sacrosanct about the choice of this event window. As a result, no prediction is made concerning the timing of these valuation effects in this study.

Alternative model specifications

In addition to using equation (1) as the primary model to test the AOH, this study also applies alternative model specifications to ensure that the results are robust to model choice. Econometric issues such as: omitted variables, scale effects, non-linearity, cross-sectional and time-variations in coefficient estimates etc. can pose inference problems if not controlled for. In view of this, the following additional model specifications are also used:

Alternative model 1 – Control for cross-sectional variations

Prior research (e.g. Atiase [1985], Kormendi and Lipe [1987], Collins and Kothari [1989], Biddle and Seow [1991], etc) has shown that economic factors such as: size, information environment, earnings persistence, growth, risks, industry characteristics and so forth have an impact on the returns-earnings relationship. One implication of these studies is that grouping a variety of firms with different characteristics into one single pool of sample may distort the regression coefficients estimated. To control for these potential cross-sectional variations in coefficient estimates, the relatively small sample of insolvent firms is partitioned into sub-groups according to two firm characteristics[10] (i.e. *size* and *industry membership*) for separate analyses. Accordingly, the alternative models estimated are as follow:

$$MV_t = \begin{cases} a_0^S + a_1^S NI_t + a_2^S NI \cdot D1_t + a_3^S BV_t + a_4^S \cdot D2_t + \varepsilon_t^S & \textit{Small} \\ a_0^L + a_1^L NI_t + a_2^L NI \cdot D1_t + a_3^L BV_t + a_4^L \cdot D2_t + \varepsilon_t^L & \textit{Large} \end{cases} \qquad \text{(A1a)}$$

and

$$MV_t = \begin{cases} a_0^M + a_1^M NI_t + a_2^M NI \cdot D1_t + a_3^M BV_t + a_4^M \cdot D2_t + \varepsilon_t^M & \textit{Manufacturing} \\ a_0^N + a_1^N NI_t + a_2^N NI \cdot D1_t + a_3^N BV_t + a_4^N \cdot D2_t + \varepsilon_t^N & \textit{Non-manufacturing} \end{cases} \qquad \text{(A1b)}$$

where all the variables are as defined earlier except for the coefficients which take on superscripts of *S*, *L*, *M* and *N* to mean coefficients for small, large, manufacturing and non-manufacturing firms respectively.

Alternative model 2 – Control for intertemporal variations

The use of the event-year research method means that a large cross-section of *ex post* insolvent firms are pooled from different years and put into five portfolios that have been aligned on a notional time-scale (i.e. based on the year relative to delisting). Since insolvency rates are naturally linked with economic conditions, this creates a time-clustering

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[10] There are potentially many characteristics one can use to partition the sample. In this particular study where the sample size is small, special considerations are given to the need to balance statistical power (i.e. degrees of freedom), meaningful segregation, and practicality (i.e. data availability). Naturally this means that the firm characteristics chosen have to be fairly general and yet defining. Both size and industry membership meet this criteria because the former parsimoniously proxies for risks and information environment whilst the latter risk, earnings persistence and growth, and accounting practices.

problem in that a relatively large number of samples went into insolvency in recession-stricken years (e.g. 1980-81, 1989-91)[11]. Besides, pooling samples across time (nb. 1975-2000) may also introduce some time-varying elements into the regressions, which may distort the empirical results if uncontrolled for. To tackle these issues, this study applies two separate measures. The first is to introduce yearly dummy intercepts into model (1) to capture time-varying omitted variables. Formally, the revised model becomes:

$$MV_{it} = a_{1975} + \sum_{Y=1976}^{2000} a_Y \cdot D_Y + a_1 NI_{it} + a_2 NI \cdot D1_{it} + a_3 BV_{it} + a_4 BV \cdot D2_{it} + \varepsilon_{it} \qquad \text{(A2a)}$$

where D_Y's are dummy intercepts that take on the value one if the observation is from one particular fiscal year {1976…2000} and zero otherwise, and other variables are as previously defined.

The second measure is to partition the sample into two sub-groups according to the relative macroeconomic conditions prevailing at the time. This in effect involves segregating the samples into two relative[12] (i.e. stronger vs. weaker) economic regimes for separate analyses. The challenge facing this approach is how to conduct the partitioning. One logical partitioning method that has been applied in extant research is to use the *annual change* in the retail price index (RPI) or real gross national product (GNP) (see e.g. Lev and Thiagarajan 1993, Al-Debie and Walker 1999). Although this method works well on a *single* large pooled sample in Lev and Thiagarajan (1993), it is inappropriate here because there are five consecutive annual pooled samples to consider. To circumvent this problem, a five-year moving average of annual change in real gross domestic product ("MA-GDPΔ") is used as a partitioning variable[13]. In other words, firm samples whose last financial reporting year-end falls on relatively high MA-GDPΔ years are segregated from those whose year-end falls on relatively low MA-GDPΔ. The regression models estimated in this case are as follow:

$$MV_t = \begin{cases} a_0^{LG} + a_1^{LG} NI_t + a_2^{LG} NI \cdot D1_t + a_3^{LG} BV_t + a_4^{LG} \cdot D2_t + \varepsilon_t^{LG} & \textit{Low growth} \\ a_0^{HG} + a_1^{HG} NI_t + a_2^{HG} NI \cdot D1_t + a_3^{HG} BV_t + a_4^{HG} \cdot D2_t + \varepsilon_t^{HG} & \textit{High growth} \end{cases} \qquad \text{(A2b)}$$

11 Detailed descriptive statistics are presented in Section 4 below. BBL did not investigate this issue because their data is not clustered in particular calendar years except for the recession years 1989 and 1990. They thus argue that their findings are not likely to be calendar time-dependent (ibid, p.12).

12 Relative is preferred to absolute partitioning to ensure two roughly equal-sized partitions are obtained.

13 GDP is preferred to GNP here because (1) both are economic indicators with similar characteristics and (2) the former's data series (at constant prices) is comparatively easier to obtain.

where all the variables are as defined earlier except for the coefficients which take on superscripts of LG and HG to mean coefficients for firms fallen into insolvency in relatively low and high growth period respectively.

Alternative model 3 – Control for omitted independent variables

Another econometric issue that warrants special attention is omitted independent variables. The primary model used to test the AOH in BBL and this study (i.e. model 1) is essentially a two-factor model. BBL (footnote 17) cite Landsman and Magliolo (1988) to defend this approach by arguing that "*…to the extent that size or any other omitted variable is constant across years, our tests should be unaffected*." Since this relies on the (untested) assumption that other omitted variables are intertemporally constant, it is an *open* empirical issue as to whether or not the regression coefficients of earnings and book value actually change in the presence of other independent variables that have been shown to be value relevant in the UK. To this end, additional control variables are introduced to ensure possible coefficient bias[14] is mitigated. These include: research and development expenditures (Green *et al* 1996, Stark and Thomas 1998), dividends (Rees 1997), and capital contributions (Akbar and Stark 2003a,b). Accordingly, the following revised model is estimated:

$$MV_{it} = a_0 + a_1 NI_{it} + a_2 NI \cdot D1_{it} + a_3 BV_{it} + a_4 BV \cdot D2_{it}$$
$$+ a_5 RD + a_6 DIV + a_7 CC + \varepsilon_{it} \qquad \text{(A3)}$$

where RD is research and development expenditures, DIV is dividends, CC is capital issues or contributions, and the rest is as previously defined.

It should be pointed out that the main concern of this analysis is to test the original hypotheses under a new model specification, and not the coefficients of the additional control variables. Moreover, no attempt will be made to further disaggregate earnings into its separate components (e.g. cash flows from operations and accruals) even though extant research suggests this may increase the explanatory power of the regressions. This is because the main tenet of this study is on the relative valuation roles of the profit and loss account vis-à-vis the balance sheet and not of aggregation vis-à-vis disaggregation. For this reason, it is implicitly assumed (as in BBL) that the coefficients are constant for each component of earnings and book value.

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[14] If the assumption that other omitted variables are *not* intertemporally constant, then coefficient bias is likely to arise since the usual omitted variables (e.g. dividends) are correlated with either earnings or book value. However, the magnitude of the bias is unknown *a priori.*

Alternative model 4 – Control for scale effects

The issue of scale effects is one of the major econometric problems that plagues the levels-based regression approach in accounting research and has been extensively studied over the years (see e.g. Christie 1987, Landsman and Magliolo 1988, Kothari and Zimmerman 1995, Barth and Kallapur 1996, Easton 1998, Brown *et al* 1999, Lo and Lys 2000, Barth and Clinch 2001, Easton and Sommers 2003 etc.). It is an important issue because scale effects can potentially lead to coefficient bias, heteroskedasticity and inflated R^2 if uncontrolled for[15]. To mitigate such negative effects, this study uses a standard deflation-by-opening market value approach[16] as an alternative. Formally, the deflated primary and augmented models are (firm and time subscripts suppressed hereinafter):

$$\begin{aligned} MV/OMV = {} & a_0(1/OMV) + a_1(NI/OMV) + a_2(NI/OMV)\cdot D1 \\ & + a_3(BV/OMV) + a_4(BV/OMV)\cdot D2 + \varepsilon^* \end{aligned} \tag{A4a}$$

and

$$\begin{aligned} MV/OMV = {} & a_0(1/OMV) + a_1(NI/OMV) + a_2(NI/OMV)\cdot D1 \\ & + a_3(BV/OMV) + a_4(BV/OMV)\cdot D2 \\ & + a_5(RD/OMV) + a_6(DIV/OMV) + a_7(CC/OMV) + \varepsilon^* \end{aligned} \tag{A4b}$$

where ε^* is ε/OMV and other variables are as previously defined. The regrettable aspect of this deflation procedure is that it results in the loss of an intercept term[17], which renders the interpretation and use of R^2 difficult (see Pindyck and Rubinfeld 1998, p.89). Consequently, the hypotheses related to the incremental explanatory power of earnings and book value (i.e. H3 and H4 above) cannot be tested because they both rely on the Thiel (1971) R^2-decomposition technique.

Alternative model 5 – Control for non-linearity

The last alternative model considered in this study is one that controls for non-linearity in a different way. As prior research shows, equity value is a convex, non-linear function of accounting measures. Although the use of dummy variables in the primary model is an

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[15] See e.g. Lo and Lys (2000) and Brown *et al* (1999).

[16] Akbar and Stark (2003b) show that typical levels-based regression results (of price on accounting measures) in the UK are not very sensitive to the choice of deflators used. As a result, opening market value is chosen because it proxies for scale and does not alter the sign of the original variables.

[17] Some researchers deflate only the independent variables of the original equation and leave the intercept term unchanged (e.g. Lo and Lys 2000). As pointed out by Akbar and Stark (2003b), this amounts to estimating a different model. Similarly, if deflation is used to mitigate heteroskedasticity, econometricians also warn of the danger of not including the reciprocal of the deflator as an additional independent variable unless the deflator is one of the independent variables (e.g. Maddala 1992, p.215).

attempt to capture some discrete forms of non-linearity, there is still a concern that it might not accurately reflect the true non-linear relationship between equity value and accounting measures. To this end, this study makes use of the following empirical model which is adapted from Zhang (2000)[18] to test the AOH:

$$MV = a_0 + a_1 NI + a_2 BV + a_3\left(\frac{NI^2}{BV}\right) + a_4\left(\frac{NI^3}{BV}\right) + \varepsilon \qquad \text{(A5)}$$

where all the variables are as previously defined.

There are two observations that can be made about model (A5). First, the model specification can also be independently derived from the ACT model, which is based on a more general real options-based valuation framework. Secondly, the dummy variables used in the earlier model specifications are omitted in model (A5) because the proposed non-linear relationship is now captured by the two new terms in brackets. It should be remembered that this new model specification represents a novel attempt to parsimoniously capture the dynamic valuation impact of real options through discrete approximation. Whilst the model's coefficients (especially those associated with power-terms) may not have a direct economic interpretation, it nevertheless represents the only non-linear regression specification that is empirically feasible to operationalise. In an exploratory analysis such as this, some poetic licence to its use are called for.

Sample Selection and Variables

The insolvent company samples used in this study are identified on the 2000 London Share Prices Database ("LSPD") as having delisted because of insolvency during the period 1975-2000[19]. The reason of this wide sampling period is to maximise sample size because the number of corporate insolvencies per annum has been traditionally low in the UK. Market and accounting data of these companies identified is then collected from the Datastream Database ("Datastream") for each of their last five accounting periods prior to the delisting year. To avoid a sample selection bias and to maximise sample size, companies with fewer

[18] See Appendix A for details of this model development.

[19] This comprises companies that have been classified by LSPD under the following codes: "07 – *Liquidation (usually valueless, but there may be liquidated payments)*"; "11 – *Voluntary liquidation, where value remains and was/is being distributed*"; "16 – *Receiver appointed/liquidation. Probably valueless, but not yet certain*"; and "20 – *In Administration/Administrative receivership*". Notice that since LSPD predates the Insolvency Acts 1986, its classification scheme does not correspond precisely with the numerous insolvency proceedings available under the Acts. However, all four categories are in substance alternative forms of corporate abandonment and hence can be treated as same.

than five years of available data (prior to their delisting) are also included for the number of years for which they have available data. In addition, all finance, property, and utilities related companies are excluded from the sample for conventional reasons[20].

The variables used in the analysis are estimated as follow:

(i) Market value of equity (*MV*): This is the total market capitalisation of all issued ordinary shares measured at six months after the balance sheet date to ensure that the market value reflects the information contained in the companies' annual reports.

(ii) Earnings (*NI*): This is defined as profit earned on ordinary activities before extraordinary and exceptional items (but after minority interests and preference dividends).

(iii) Book value of equity (*BV*): This is total shareholders' funds as reported in the financial statements of companies.

(iv) Dividends (*DIV*): This is measured as reported ordinary dividends in the profit and loss account.

(v) Research & development (*RD*): Following Green *et al* (1996) and others, this is defined as research and development costs as expensed and reported in the profit and loss account.

(vi) Capital issues (*CC*): This is measured as the total proceeds of all share issues during the year (net of expenses) as shown in the Reconciliation statements of movements in shareholders funds.

Initial data search returns a total of 247 insolvent industrial companies that were delisted from the stock exchange during the period 1975-2000. In the wake of the Enron, WorldCom debacle, it is important to ensure that the test sample is free from companies that had gone into insolvency under suspicious circumstances e.g. creative accounting, management fraud etc. This is because the research metrics (e.g. accounting measures, share prices) of these companies are likely to be severely distorted and therefore unrepresentative of the whole

[20] It is important to point out that neither BBL nor SS appears to have applied this restriction. For instance, BBL (p.12) states, "… *untabulated statistics reveal that, although most industries are represented in the sample, bankrupt firms are clustered in durable manufacturing and retailing...*" In SS (footnote 17), the authors state, "*We also examined the firm by industry for the liquidating and distressed groups. The distressed firms are represented in every industry. Approximately 33% of the liquidating firms come from the insurance or real estate sectors; no liquidating firms were in the chemical or pharmaceutical sectors*". Without further information, it is difficult to know what effects this inclusion of the finance/property related companies has on their results. If, hypothetically speaking, these companies have used "mark-to-market" accounting (see e.g. Danbolt and Rees 2002), then it is conceivable that the regression results could have been biased by such a sampling strategy. For reasons of prudence and not being able to locate data for these types of British companies, such a strategy is not followed here.

population. Besides, the distorting effect is also hard to even out when the total sample size is relatively small. In order to identify these "suspicious" companies, this study makes use of an influential book by Terry Smith – *Accounting for Growth* (Smith 1996). The book is by far the most comprehensive survey of creative accounting practices and fraudulent management behaviour behind some real high-profiled UK companies, including those that have gone into insolvency. Although this identification procedure appears *ad hoc*, it is nevertheless considered the best available. There are three companies so identified: Maxwell Communication Corporation, Polly Peck PLC and Coloroll PLC[21]. In addition to this, influential observations are further eliminated from each of the five pre-delisting years' sample by deleting any observation with an absolute studentised residual that is greater than three[22]. Albeit arbitrary, the choice of three yields a reasonable balance between excessive loss of observations and effectiveness. This procedure leaves a net total of 240 sample firms in year t–1 (with varying number of years of pre-delisting data)[23] eligible for analysis. Table 1 below gives summary information of the sample collected.

Insert Table 1 here

Panel (a) of Table 1 analyses the sample distribution by year and shows that a higher number of insolvencies occurred in recession periods (e.g. 1981-82, 1990-92)[24]. This phenomenon is to be expected because market selection was at its sternest during this time. The year in Panel (a) refers to the year in which the firms were delisted from the Stock Exchange or if earlier, an insolvency practitioner was appointed to initiate insolvency proceedings. These years do not always correspond to the last accounting year-end of the insolvent companies because many companies (understandably) failed to report their results in the year of their demise. Hence there are some discrepancies between the actual years used in the empirical data and those reported in Panel (a) above. Finally, sample distribution by industry

[21] Outright fraud was involved in the case of Maxwell Communication Corporation and Polly Peck PLC. In the case of Coloroll PLC, numerous creative accounting techniques were found in its financial statements over many years (see Smith 1996, Appendix 1) and were sufficiently severe to warrant an exclusion.

[22] This procedure has also been used by Francis and Schipper (1999), Francis *et al* (2000), Courteau *et al* (2001) etc.

[23] Because the data-trimming procedure applies to each of the five pre-delisting years' data *individually* and some companies do not have five years of financial reporting history, membership across the five consecutive panels of data is not constant. However, variable membership is unlikely to affect the results qualitatively since the data analysis is based on cross-sectional regressions.

[24] The highest number of insolvency cases in a single year amounts to just 29 (1991), which explains why samples have to be intertemporally pooled to generate sufficient sample size.

membership in Panel (b) shows that all non-finance related industries are represented in the sample.

Results and findings

Primary model specification

Some descriptive statistics and key financial ratios of the empirical samples are listed in Table 2 below. In general, a deteriorating pattern can be observed from the table as companies approach insolvency. Median earnings begin with an upward drift from the year *t*–5 to *t*–4 before progressively sliding into deficit by *t*–1[25]. The number of companies with negative earnings also increases progressively over time. A deteriorating pattern can also be observed from the mean book value and mean market value; albeit the trend is not as monotonic. Interestingly, both mean and median total assets employed have increased over the five years, which suggests that the companies continue to expand during this period. However, it appears that the expansions are matched by an even greater increase in debts (be it current or long term) since book value displays a downward trend.

Insert Table 2 here

Like many other variables, the mean/median earnings-to-price (*E/P*) ratios also decrease progressively over time. In contrast, an unusual V-shaped pattern is observed on the book-to-market (*B/M*) ratio. Besides, the mean *B/M* ratio on average hovers above one, which suggests that the carrying value of net assets might be higher than the assets' recoverable amount. As BBL (p.12) warn, the ability to detect a predicted increase in the book value pricing multiple as insolvency approaches could be impaired if asset write-downs[26] do not result in book value approaching liquidation value as firms approach insolvency. Finally, earnings and book value are positively correlated in most years[27] and with the exception of years *t*–5 and *t*–4, the correlation appears moderate (circa 18%).

[25] Mean earnings would have shown a similar pattern had the Year *t*-4 figure not been distorted by an extraordinary £157 million loss incurred by Ferranti International Plc. Excluding this observation returns a £787.1 million mean earnings figure for *t*-4.

[26] Under the UK generally accepted accounting practice, an asset is normally valued using historical cost with the proviso that its carrying amount should not be more than its recoverable value; the latter being the higher of the net realisable value or value-in-use of the asset. Since financial statements are prepared on a going concern basis and asset write-down decisions are contingent upon the future prospects of a firm, asset write-downs may not always promptly take place.

[27] Once again, the year *t*-4 figure is distorted by the observation identified in the footnote 2. If the observation is excluded, the correlation between earnings and book value is 0.70.

Table 3 below presents the regression results of the primary model specification (i.e. equation 1). Panel (a) reports statistical evidence on the tests of hypotheses H1 and H2 as it reveals the coefficient estimates of earnings and book value for each of the five years preceding the sample firms' insolvency. Panel (b) presents findings on hypotheses H3 and H4 as it shows the incremental explanatory power of each variable over the same time period.

Insert Table 3 here

As revealed in Table 3 Panel (a), the coefficient of earnings (*NI*) increases initially from 5.57 (year *t*–5) to 11.23 (year *t*–4) but then decreases predictably as firms approach insolvency to 4.57 (year *t*–1)[28]. Since the earnings slope is allowed to vary with sign, this decreasing pattern is not due to the valuation effects of negative earnings documented in prior research. Moreover, the coefficients are also statistically significant across the years. This finding is broadly consistent with hypothesis H1.

In sharp contrast, the coefficient of book value (*BV*) exhibits an erratic pattern intertemporally. In between the years *t*–5 and *t*–1, it moves from 0.81 initially to –0.01 the next year, and then to 0.36, 0.25 before ending it again at 0.36. Although in all but one year the coefficients are statistically significant at the 10% level, there is not a discernable pattern to their coefficient changes. Even leaving the farthest year (*t*–5) aside temporarily, the evidence does not suggest that the pricing multiple of book value increases as firms approach insolvency. Therefore hypothesis H2 is firmly rejected.

Consistent with prediction and prior research (e.g. Hayn 1995), the incremental coefficient of earnings ($NI{\cdot}D1$) is statistically and consistently negative. It also closely mirrors that of positive earnings, which suggests that the pricing multiple of negative earnings (i.e. $a_1 + a_2$) is nearly zero[29]. Interestingly, the incremental coefficient of book value ($BV{\cdot}D2$) is positive in all but one year, which suggests that negative book value of equity is priced at a higher multiple than positive ones in the years immediately preceding insolvency. Nevertheless,

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[28] Recall that the choice of a five-year window is for expedience rather than theoretical purposes. Hence no prediction is made concerning the *timing* of the hypothesised valuation effects.

[29] Untabulated tests of the linear restriction $a_1 + a_2 = 0$, indicate that the null hypothesis cannot be rejected at the 1% significance level for each of the five years (i.e. the heteroskedasticity-consistent *F*-statistics are insignificant).

they are mostly insignificant and hence can be ignored[30]. Finally, the intercepts in most years are huge and statistically significant, which suggests that there may be other omitted value relevant variables not captured by the model[31].

Turning to examine the incremental explanatory power of earnings and book value (for market value of equity), Table 3 Panel (b) reveals a mixed picture of intertemporal changes. As firms approach insolvency, the incremental explanatory power of earnings increases gradually from 6% (in year t–5) to 30% (in year t–2) before dropping back to 15% (in year t–1). In contrast, the incremental explanatory power of book value starts off at 10% (in year t–5), and then fizzles out in the next three years before returning to 9% in the last year preceding insolvency.

The divergent path taken by the two incremental explanatory power (notional) time-series variables is also borne out in the Vuong (1989) test. In year t–5, both earnings and book value jointly explain market value of equity but neither provides relatively more explanatory power than the other (Z-statistic = –0.28, p–value = 0.78). Over the next three years, earnings consistently outperform book value in terms of relative explanatory power (Vuong [1989] Z-statistics at least > 1.645, p–value < 0.10). The increasing trend of earnings' incremental R^2 (up to year t–1) against a backdrop of decreasing earnings' pricing multiple is somewhat intriguing. This is because it suggests that the market continues to rely on earnings (*vis-à-vis* book value) as a source of value relevant information despite the deteriorating price-earnings ratio. However, in year t–1 when the incremental explanatory power of earnings drops to 15% and book value increases to 9%, earnings cease to dominate book value in explaining the market value of equity (Z-statistic = 0.72, p–value = 0.47). This last result (i.e. for the changes from year t–2 to t–1) lends some support to the contention that book value complements earnings in explaining equity market value as abandonment likelihood increases. Admittedly, the evidence is weak since it works only in a two-year window. Therefore on the balance of evidence, the hypotheses that the incremental explanatory power of earnings (book value) decreases (increases) as firms approach insolvency [i.e. hypotheses H3 and H4 respectively] can be rejected.

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30 Like the coefficient of negative earnings, the coefficient of negative book value (a_3 + a_4) is also statistically insignificant in each of the five years.

31 To ensure coefficient bias (due to correlated omitted variables) is mitigated, additional independent variables are later added to the original model specification. Results from this analysis are presented below.

In summary, using the primary model specification the empirical results presented in Table 3 above suggest that all but the first hypothesis [H1] can be rejected[32]. Unless the event window is limited to two years, the balance sheet (as summarised by book value) does not appear to increasingly complement the the profit and loss account (as summarised by earnings) in an *ex post* valuation setting when the likelihood of corporate abandonment increases. These findings using *ex post* insolvent firms stand in stark contrast to those of Barth, Beaver and Landsman (1998) and Schnusenberg and Skantz (1998) in the US, which both show that the value relevance of book value and earnings are complementarily linked with abandonment likelihood[33].

Insert Table 4 here

Alternative model 1 – Control for cross-sectional variations

To ensure that the results in the previous section are not driven by the pooling procedure, the original sample is partitioned into sub-groups (according to size and industry membership) for separate analyses. Untabulated descriptive statistics for the two sub-groups as partitioned by size show that larger firms absolutely dwarf their counterparts in terms of total assets[34], equity value and book value. Besides, the larger firms are also consistently more profitable than the small ones. As for the industry membership-partitioning, untabulated descriptive statistics show that there are roughly three times as many manufacturing firms as non-manufacturing firms in the samples. Moreover, comparison of the pooled statistics reveals that both sets of firms are roughly comparable in terms of median earnings, book value, earnings-to-price ratio and returns-on-equity. The only notable contrasting statistics is in the book-to-market (*B/M*) ratio where manufacturing firms have a *B/M* ratio that is consistently higher than or close to unity in each individual year and in the pooled samples. In contrast, non-manufacturing firms have a considerably lower median *B/M* ratio. This difference partly reflects the fact that manufacturing firms typically carry more assets in their balance sheets whilst non-manufacturing firms have more unrecognised intangible assets.

[32] Using equity market value measured at three months after the balance sheet date as a dependent variable does not alter the results qualitatively. Neither does augmenting the main model specification with a dummy intercept term that takes on the value of one if either earnings or book value is negative and zero otherwise.

[33] For informational purposes, Table 2 of Barth, Beaver and Landsman (1998) is reproduced as Table 4 below.

[34] This is by default because the size partitioning is conducted using average total assets (ATA) as a metric. Firms with higher (lower) than median ATA are deemed large (small) firms.

Despite the differences in descriptive statistics, estimating alternative models (A1a) and (A1b) to allow the regression coefficients to vary with size or industry membership does not alter the original results qualitatively. Untabulated results show that, in each sub-group, there are signs that earnings' pricing multiples decrease as abandonment likelihood increases. However, the decrease does not appear to be complemented by an increase in book value's coefficient and incremental explanatory power unless a two-year event window is imposed.

Alternative model 2 – Control for intertemporal variations

The first measure taken to ensure that the original results are not affected by pooling samples from different time periods is to estimate alternative model (A2a). Apart from slightly improving the goodness of fit in terms of adjusted R^2, untabulated regression results show that the coefficients estimated for earnings and book value are very similar to those in the original analysis. Besides, the intertemporal incremental R^2 trends of both accounting measures have also remained roughly the same; with earnings incremental R^2 higher than that of book value in all but the last (t–1) year. In other words, the results do not qualitatively alter the original conclusions reached.

Estimating alternative model (A2b) to allow the coefficient estimates to vary with economic regimes does not alter the conclusions either. Although firms that went insolvent during a high economic growth period typically had larger equity value, book value and earnings than those from a low economic growth period (untabulated statistics), untabulated results for both sets of firms show that the predictions with regards to the pricing multiples of book value (H2), and the incremental explanatory power of earnings (H3) and book value (H4) are largely rejected unless a two-year event window is imposed. However, the earnings multiples are found to be predictably decrease according to H1.

Alternative model 3 – Control for potential omitted variables

Untabulated descriptive statistics for the variables used in the estimation of alternative model (A3) for the pooled sample show that the variable distributions are generally skewed as indicated by the differences between the mean and median values, and in line with many other comparable value relevance studies. The pairwise correlations between the variables indicate that, apart from the correlation between dividends and book value (0.45), all other correlations appear to be minimal.

The summary regression results using model (A3) are reported in Table 5 below. It is evident from the table that augmenting the original model (1) with additional independent variables gives a better result in terms of goodness of fit. Adjusted R^2 of the revised model increases considerably especially for the years t–5 to t–3. The earnings coefficient continues to show a downward trend from the year t–4 (12.92) to year t–1 (4.25) as predicted. However, the coefficient for the year t–5 somehow loses its statistical significance after all the other variables are added to the model. This puzzling feature is difficult to interpret rationally because it suggests that the market appears to use other information such as dividend and research and development expenditure instead of earnings in market valuation. The result looks even stranger when the significantly positive incremental coefficient associated with book value (i.e. 18.16) is taken into account. As such, the regression results of year t–5 should be treated as a suspicious anomaly. Barring that, the coefficient for book value is now slightly more in line with the hypothesis, rising from an insignificant 0.08 in year t–4 to a statistically significant 0.40 in year t–1.

Insert Table 5 here

The table also shows that the coefficient on *RD* is predictably positive and consistent with prior studies. More importantly, it shows that as firms approach insolvency, the pricing multiple on *RD* progressively decreases. This finding is intuitive because intangible fixed assets (as proxied by *RD* expenditure) become less valuable when firms' going concern status is in question. A somewhat interesting result is on capital movements in the form of dividends (*DIV*) and capital contributions (*CC*). Apart from the year t–5 (and to a lesser extent t–3 for *CC*), neither variable is found to be statistically significant. This outcome is in sharp contrast to those of extant research (e.g. Akbar and Stark [2003a]), which has consistently found them to be highly value relevant. One plausible reason for this is sampling variation. The maximum number of firm-samples used in this analysis amounts to only 240 whereas prior research has typically used at least 700. Besides, the samples here consist of only insolvent firms whose idiosyncratic factors may have affected the results of *DIV* and *CC*. For example, this could suggest that the market perceives earnings to be a more useful indicator of future prospects for firms with higher financial risks because dividends are being truncated.

The introduction of the new variables also leads to some changes to the incremental R^2 of earnings and book value. Although the incremental R^2 of earnings continues to be higher than that of book value, there is no longer an upward drift after year t–4 as in the original analysis. On the other hand, the incremental R^2 of book value now shows an increasing pattern from year t–4 (0.00) to t–1 (0.09). In particular, the sharp increase in the last year closes the gap between the two incremental R^2's (0.12 vs. 0.09). The Vuong (1989) Z-statistic (0.42) further confirms that earnings no longer statistically dominate book value in terms of relative explanatory power in the last year.

Overall, using alternative model (A3) in place of the original represents an improvement because it leads to a slightly better goodness of fit. The coefficients and incremental R^2 obtained on the main variables are also slightly more in line with the hypotheses. That said, the results of year t–5 remain puzzling. If they are set aside, the remaining results suggest that book value increasingly complements earnings as firms approach insolvency and in line with the AOH.

Alternative model 4 – Control for scale effects

Untabulated descriptive statistics for the variables used in estimating alternative models (A4a) and (A4b) are very similar to their undeflated versions in that most of the variables show signs of skewness and are mildly correlated. However, deflating the primary model (1) and alternative model (A3) with opening market value drastically changes the original results, as shown in the regression output in Panel (a) and (b) of Table 6 below respectively. For instance, the earnings coefficient in Panel (a) now exhibits a diametrically opposite trend when compared to the previous results in Table 3, increasing progressively from 2.47 in the year t–5 to 8.06 in year t–2 before ending at 6.25 in the last year. Therefore, the earnings result under model (A4a) is inconsistent with hypothesis H1. Besides, Panel (a) also shows that the book value coefficient now runs from 0.43 in the year t–5 to 0.24 in the year t–1, a result that is also inconsistent with hypothesis H2. The coefficient results of model (A4b) are also very similar.

Insert Table 6 here

On the other hand, adopting the revised model does not alter the result of the dummy earnings variable, which is expected to be significantly negative. Besides, almost all other variables except for the scaled intercepts are now statistically significant, thereby indicating their value relevance. In relation to the scaled intercept, the results show that its magnitude is considerably lower than the original undeflated version (*cf.* Table 3) and is statistically significant only in the last two years. Finally, the only regrettable aspect of this specification is that it is no longer possible to test the incremental R^2 of either accounting measure because of the lack of a regression constant. In view of the evidence above, however, it can be safely concluded that *under the deflated model specification* the AOH is not empirically supported.

Alternative model 5 – Control for non-linearity

The final alternative model (A5) relaxes the linearity assumption of model (1) and takes into consideration the potential value of abandonment options. Since the options components of the model [e.g. (NI^2/BV), (NI^3/BV)] have book value as denominator, firms with negative book value have to be deleted from the sample in order to operationalise the model. This is because their presence can induce undesired sign-changing effects. The summary regression results of this approach are presented in Table 7 below.

Insert Table 7 here

An immediate comment that can be made on the results in Table 7 is that the goodness of fit is inferior when compared to the earlier models. For instance, the adjusted R^2 of model (1) is generally higher than that of model (A5) in all the years except for t–5. This shows that a specification that uses an interacting earnings dummy variable is better than a non-linear model in capturing the non-linear pricing features of accounting variables *in this particular setting*. However, the non-linear model (A5) has theoretical merits because it explicitly accounts for the value of abandonment options. This is reflected in the coefficients and incremental R^2 obtained. For example, most of the coefficients obtained are statistically significant and of the predicted signs. In particular, the non-linear terms (i.e. NI^2/BV and NI^3/BV) exhibit the predicted signs (i.e. positive and negative respectively) in all but two instances. The only exceptions are the coefficient of NI^2/BV in years t–3 and t–1 where the estimates are respectively, –0.03 (t-statistics = –0.04) and –0.13 (t-statistics = –2.54).

Under this new specification the earnings coefficient continues to exhibit a decreasing trend from year t–5 (6.13) to year t–1 (0.94) that is in line with hypothesis H1. However, the intertemporal trend of the book value coefficient over the five years remains mixed with no sign of an increasing pattern as predicted by hypothesis H2. Despite this, the incremental R^2 trends of the two variables under the new specification are now more in line with hypotheses H3 and H4. As firms approach insolvency, earnings' incremental R^2 decreases (from year t–3 onward) while book value's increases (from year t–4). These opposing movements from year t–4 onward are reflected in the sign of the Vuong (1989) Z-statistics, which switches from 0.79 (in year t–4) to ultimately –3.35 (in t–1). This last result is particularly significant because it shows that book value statistically dominates earnings in terms of explanatory power in the year immediately preceding insolvency. Under this model specification, the results lend some support to the AOH.

Conclusions and implications

This paper empirically examined the AOH using a sample of insolvent British firms drawn from the industrial and commercial sectors during the period 1975 to 2000. Using a five-year event window and a primary model specification that had been previously employed in prior studies, this study first found that only one out of the four hypotheses tested was supported by the empirical evidence; namely, the earnings coefficient decreased as the likelihood of abandonment increased (H1). In relation to the others three hypotheses, H2 was not supported because there was no clear evidence that *over the five-year event window* book value increased as firms approached insolvency. H3 and H4 were also similarly rejected because the incremental R^2 of earnings (book value) did not decrease (increase) over the same five-year event window. The only reservation to these conclusions is that they are sensitive to the event-window chosen. If the event window is shortened to two years then there is some mild evidence to support the AOH.

In addition to the primary model specification, the paper also employed alternative model specifications to test the robustness of the early conclusions and to extend extant knowledge about the AOH. These included specifications designed to control for (A1) cross-sectional and (A2) intertemporal variations that inherently come with sample pooling; (A3) potential omitted variables, (A4) scale effects, and (A5) potential non-linearity. Results on alternative specifications (A1) and (A2) revealed that controlling for size-, industry membership-, yearly- and economic regime-variations did not materially alter the tenor of the results. The results on applying alternative model (A3) to control for potential omitted variables slightly improved the goodness-of-fit as well as some of the coefficient estimates. However, the results suggested that there was mild evidence to support the AOH *only if* the event-window was shortened to four years. More drastic results were obtained when scale effects were controlled for in model (A4). In this case, neither the deflated original nor deflated augmented models' results supported the AOH. The resulting coefficient estimates of earnings and book value in these new specifications simply did not exhibit any coherent intertemporal pattern even though most of them were statistically significant. All these suggested that both earnings and book value are value relevant for firms approaching insolvency but neither behaves *strictly* in accordance with what the AOH would predict. Last but not least, the results obtained from using the exploratory model (A5) that controlled for non-linearity further compounded the issues. First, they showed that augmenting the primary model with non-linear powered terms that proxied for real options has theoretical as well as empirical merits. Secondly, they also showed that the AOH was supported if a four-year event window was used.

Taken overall, the conclusions on the AOH appear to be highly sensitive to the event-window as well as to the model specification used. In many ways, the event-window is the lesser of the two issues because no particular *timing* prediction is made on when the complementary valuation effects (of earnings and book value) will set in. Informationally efficient though the UK security market may appear to be, there has been no empirical evidence to suggest that security prices lead accounting information or insolvency signals by five years[35]. As a result, accepting a shorter event-window is not too difficult to justify. However, the main issue here is with the choice of model specifications especially when it comes to controlling for potential scale effects. Extant research has not been able to come to a general consensus about how best to account for this econometric issue. For this reason, the decision to use both undeflated and deflated levels regressions and present their results are made in this study. Readers can then use the evidence presented to make their own interpretations. On that basis, it is fair to conclude that overall the AOH is only partially supported by the empirical evidence in the UK.

The mixed results of this paper have some important implications. First, it shows that empirical regularities observed in the US may not automatically be generalised to other market economy-based countries such as the UK despite the perceived similarities between

[35] However, some useful hints can be drawn from the "Prices lead earnings" literature. For instance, Kothari and Sloan (1992) found that security returns in the US could anticipate accounting earnings for at least three years. Donnelly and Walker (1995) also found a similar phenomenon in the UK but the extent to which prices anticipated earnings was less than that reported by Kothari and Sloan (1992) for US companies.

these countries. One possible source of these differences could be the (potential) inclusion of Finance/Property industry firms as samples in the two previous US studies[36]. Another possible cause is the institutional differences in insolvency codes and accounting practices between the two countries. In particular, the US bankruptcy code is known to be highly debtor-orientated whereas the UK insolvency code heavily errs on the side of creditors (see e.g. Franks and Torous [1992]). As such, management in the US typically enjoys more timing options and capacity to strategically abandon or reorganise their firms' operations than their UK counterparts.

The second implication is that the evidence supporting the AOH in previous US studies (i.e. BBL and SS) may now need to be interpreted with caution. For instance, BBL based their results essentially on an *undeflated* levels-based regression specification[37]. The findings in this study suggest that their results could well be different if a deflation procedure was to be applied to their data. Similarly, the positive results obtained by SS might also be different under the same circumstances because their study was conducted using an undeflated levels-based regression approach initially and then supplemented with a series of returns-based regressions.

Finally, the findings also have implications for our extant understanding of the AOH. For example, according to Yee's (2000) *Equivalence Theorem*, in any Markovian accounting system Modigliani-Miller dividend invariance implies "earnings convexity" (as documented by BD in the US and by ACT in the UK) is equivalent to "earnings-equity book value complementarity" (as documented by BBL and SS in the US). In other words, extant analytical and empirical studies *up to now* have shown that convexity-complementarity phenomena are a mirror image of each other. However, the findings of this study clearly show that this convexity-complementarity equivalence in the UK is empirically far less clear-cut than is the case in the US. More importantly, the equivalence appears to hold only when the complementarity phenomenon is examined using an *undeflated* levels-based regression approach. The precise reasons for this have not been specifically addressed in this paper. Apart from the earlier conjecture that institutional differences might be a factor, there is also a remote possibility that the reason lies in the assumptions of Yee's *Equivalence Theorem*.

[36] See footnote 21 earlier.

[37] BBL did control for scale effects by including scale proxies as independent variables but they did it only in their larger pool of sample and not in their insolvent sample.

For example, extant research (e.g. Rees 1997, Akbar and Stark 2003a) and this study (e.g. Table 6 Panel b) have found a *positive* relationship between dividends and equity value in the UK, which appears contradictory to what the *Equivalence Theorem* assumes. Furthermore, it is also possible that there are other factors at work which contribute to the non-linear valuation characteristics of key accounting measures. As a result, more research effort is needed to answer these unresolved issues.

APPENDIX A
DEVELOPMENT OF THE ADAPTED ZHANG (2000) MODEL

The non-linear model used in this study is adapted from Zhang (2000). Zhang proposes a real-option based equity valuation model that accounts for the managerial flexibility to expand or contract business operations depending on the state of operating efficiency of a firm. Implicitly assumed in the model is that operating cash flows are non-linearly linked with the asset base on the basis of two interacting factors: operating efficiency and endogenous investment decisions. Formally, the model expresses equity market value (*MV*) as:

$$MV_t = \frac{1}{R-1}\left(NI_t + \Delta u_t\right) + P_d\left(\frac{NI_t + \Delta u_t}{BV_{t-1} + u_{t-1}}\right)\left(BV_t + u_t\right)$$
$$+ G \times C_e\left(\frac{NI_t + \Delta u_t}{BV_{t-1} + u_{t-1}}\right), \qquad (1)$$

where t is a time subscript, R is one plus risk-free rate, NI is accounting earnings, BV is equity book value, Δu and u are biases related to earnings and equity book value respectively, G is a constant to represent growth potential, and $P_d(.)$ and $C_e(.)$ are put and call options respectively.

Equation (1) states that equity market value is a function of capitalised unbiased economic earnings, plus a put option that is a multiple of economic assets, and a call option associated with a firm's growth potential. Under certain simplifying assumptions, Zhang applies a Taylor series expansion at appropriate points and converts his model into three individual state-models for (I) low-efficiency firms, (II) steady-state firms, and (III) growth firms. He further suggests three plausible regression specifications to correspond to each model[38]. Out of his three regression specifications, Model (I) is the most applicable to this study because the samples used are all *ex post* insolvent firms, which are by nature the result of market selection. Accordingly, his Model (I) expresses market value (*MV*) as a function of earnings, book value and put options terms:

$$MV = a_0 + a_1 NI + a_2 BV + a_3\left(\frac{NI^2}{BV}\right) + \varepsilon \qquad (2)$$

[38] Due to space constraints, only the relevant regression specification is discussed below. The full details of all three state-models and their derivations can be found in Zhang (2000, Section 7).

However, it has to be acknowledged that operating efficiency is explicitly modelled with the book rate of return in Zhang (2000) and Model (I) [i.e. equation 2] is best suited to low-efficiency firms with negative returns to equity. In this regard, the model's feature does not fully accord with the financial characteristic of the sample firms and thus its adoption may introduce uncertain biases. For instance, when a firm's earnings (*NI*) are large and *negative*, the (put) option value as captured by the intercept (α_0) and the power-term [$\alpha_3\left(NI^2/BV\right)$] will also be high as expected. However, if *NI* is large and *positive* then the option value is supposed to be small but this will not be borne out in equation (2) since the option terms will yield a large value. As a result, applying equation (2) to a sample of insolvent companies with mixed earnings records can potentially lead to incorrect inference. A way to improve the model specification is to increase the Taylor series expansion up to order three[39] as in:

$$MV = a_0 + a_1 NI + a_2 BV + a_3\left(\frac{NI^2}{BV}\right) + a_4\left(\frac{NI^3}{BV}\right) + \varepsilon \qquad (3)$$

and with $a_3 > 0$ and $a_4 < 0$. In this case, the option terms in the revised model will yield a large value when earnings are large and *negative* (i.e. abandonment likelihood is high), and a small value when earnings are large and *positive* (i.e. abandonment likelihood is low).

[39] The author is grateful to Mark Tippett for this suggestion.

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Table 1

Distribution of Sample by Year of Insolvency and Industry Membership

Panel (a) By year of insolvency

*Year**	*No. of firms*	*Year**	*No. of firms*
1976	1	1989	5
1977	2	1990	17
1978	4	1991	29
1979	4	1992	27
1980	11	1993	6
1981	13	1994	3
1982	20	1995	7
1983	9	1996	9
1984	12	1997	6
1985	6	1998	12
1986	5	1999	16
1987	2	2000	10
1988	4	Total	240

* This is based on the year in which the firms were delisted from the Stock Exchange or if earlier, an insolvency practitioner was appointed to initiate insolvency proceedings.

Panel (b) By industry membership

*Industry membership ***	*Manufacturing*	*Non-manufacturing*	*Total*
Resources	3		3
Basic Industries	42		42
General Industries	59		59
Cyclical Consumer Goods	54		54
Non-cyclical Consumer Goods	11		11
Cyclical Services		68	68
Information Technology		3	3
Total	169	71	240

** Industry membership is based on Datastream INC3 classification scheme.

TABLE 2

Descriptive statistics of key variables and ratios for *ex post* insolvent company samples from the period 1975 - 2000.
Year refers to year relative to delisting. All amount in £ thousands except ratios.

	Year t - 5			Year t - 4			Year t - 3			Year t - 2			Year t - 1		
	Mean	Median	Std. dev.	Mean	Median	Std. dev.	Mean	Median	Std. dev.	Mean	Median	Std. dev.	Mean	Median	Std. dev.
Total assets (*TA*)	21,348.4	9,267.0	31,218.8	33,487.8	11,617.0	89,790.8	33,944.6	12,500.0	68,288.6	37,822.6	16,624.0	68,584.6	36,020.1	19,441.0	62,733.5
Market value (*MV*)	12,625.6	4,040.0	20,137.5	18,902.3	5,940.0	32,153.0	17,140.0	6,670.0	26,912.9	15,018.8	6,780.0	22,895.5	9,405.0	4,090.0	13,074.0
Earnings (*NI*)	512.1	243.0	1,651.4	-30.4	266.0	11,562.0	385.6	263.5	3,550.8	135.0	106.0	3,820.1	-1,319.2	-315.5	5,152.4
No of negative earnings	41			45			53			93			146		
Book value of equity (*BV*)	7,925.7	3,298.0	11,668.8	11,864.4	4,259.0	25,850.8	10,314.7	4,725.0	19,411.0	10,995.7	5,179.0	17,448.4	7,716.6	4,103.5	13,033.1
No of negative book value	4			4			10			8			19		
Earnings-to-price (*E/P*) ratio	0.00	0.05	0.32	-0.01	0.06	0.26	-0.08	0.06	0.45	-0.20	0.03	1.20	-0.40	-0.13	1.05
Book-to-market (*B/M*) ratio	1.27	0.98	1.27	1.10	0.81	1.15	1.09	0.80	2.36	1.44	0.91	2.09	1.40	1.03	2.31
Return on equity (*ROE*)	0.09	0.09	0.46	0.01	0.07	0.43	0.03	0.08	1.18	-0.08	0.04	1.21	-0.45	-0.07	2.90
No of observations	175			193			214			231			240		
NI-BV Pearson correlation	0.49			-0.49			0.19			0.18			0.18		

Notes: *TA* denotes total assets employed and is the sum of fixed assets and current assets. *MV* denotes market value of equity measured at six months after the reporting date. *NI* denotes net income/earnings before exceptional and extraordinary items. *BV* denotes book value of equity. The *E/P*, *B/M* and *ROE* ratios are calculated using the variables defined above.

TABLE 3

Summary statistics from regressions of market value of equity on earnings and equity book value and test of incremental explanatory power for UK insolvent company samples from the period 1975 – 2000. Year is relative to delisting.

Panel (a): $MV_{it} = a_0 + a_1 NI_{it} + a_2 NI \cdot D1_{it} + a_3 BV_{it} + a_4 BV \cdot D2_{it} + \varepsilon_{it}$ (1)

	Year $t-5$		Year $t-4$		Year $t-3$		Year $t-2$		Year $t-1$	
	coef.	*White-t*	*coef.*	*White-t*	*coef.*	*White-t*	*coef.*	*White-t*	*coef.*	*White-t*
Intercept	1,670.70	1.39	6,640.20 **	3.23	2,881.00 **	2.90	3,593.30 **	4.22	2,486.20 **	3.79
NI	5.57 **	2.48	11.23 **	6.40	9.71 **	5.30	7.61 **	9.39	4.57 **	4.89
BV	0.81 **	3.10	-0.01	-0.08	0.36 *	1.86	0.25 **	2.61	0.36 **	4.59
$NI \cdot D1$	-7.51 *	-1.72	-12.30 **	-6.50	-10.80 **	-4.57	-8.91 **	-7.93	-5.52 **	-4.86
$BV \cdot D2$	2.01	0.41	1.20 **	2.09	-0.27	-0.93	0.28	0.69	0.03	0.08
Adj. R^2	0.60		0.55		0.69		0.68		0.53	
No. of observations	175		193		214		231		240	

Panel (b): Test of incremental R^2 based on regressions with *NI* and *BV*, *NI* only, and *BV* only as independent variables

	Year $t-5$	Year $t-4$	Year $t-3$	Year $t-2$	Year $t-1$
NI and BV total	0.60	0.55	0.69	0.68	0.53
NI Incremental R^2	0.06	0.16	0.24	0.30	0.15
BV Incremental R^2	0.10	0.00	0.03	0.02	0.09
Vuong (1989) Z-statistic	-0.28	1.88 *	1.85 *	3.38 **	0.72

Notes: MV = equity market value measured at six months after the reporting date. NI = earnings. BV = equity book value. i, t = firms and years respectively. $D1$ ($D2$) is interacting dummy variable that equals one if a firm has negative earnings (equity book value) and zero otherwise. *White-t* = t-statistics computed using White's (1980) adjusted standard errors. *, ** = coefficient is statistically significant at 10% and 5% or lower levels (two-tail) respectively. NI incremental R^2 refers to the R^2 from a regression with both earnings and equity book value variables (as well as their dummies), less the R^2 from a regression with BV (and its dummy) only. BV incremental R^2 is similarly calculated except that the R^2 from a regression with NI (and its dummy) are used instead of BV (and its dummy).

TABLE 4

Reproduction of Barth, Beaver, and Landsman (1998) Table 2

Table 2
Summary statistics from regressions of market value of equity on equity book value and net income and tests of incremental explanatory power for a sample of Compustat firms that delisted from Compustat because of bankruptcy between 1975–93. Year is relative to delisting.

Panel A: $MVE_{it} = a_0 + a_1 BVE_{it} + a_2 BVE\_NEG_{it} + a_3 NI_{it} + a_4 NI\_NEG_{it} + e_{it}$

	Year $t-5$		Year $t-4$		Year $t-3$		Year $t-2$		Year $t-1$	
	coef.	t-stat	coef.	t-stat	coef.	t-stat	coef.	t-stat	coef.	t-stat
Intercept	17.58	5.20	19.75	8.38	15.40	8.12	14.09	6.72	8.95	5.20
NI	4.00	3.34	2.92	6.15	3.31	6.51	0.98	1.70	0.00	0.01
BVE	0.41	2.55	0.42	6.52	0.49	7.83	0.64	9.36	0.84	4.85
NI_NEG	− 0.45	− 3.25	− 0.28	− 5.23	− 0.35	− 6.04	− 0.12	− 1.81	− 0.03	− 0.19
BVE_NEG	− 0.03	− 0.07	− 0.32	− 1.04	− 0.10	− 0.32	− 0.40	− 1.95	− 0.53	− 2.80
Adj. R^2	0.80		0.78		0.84		0.65		0.53	
No. of obs.	208		255		290		352		396	

TABLE 4 (continued)

Reproduction of Barth, Beaver, and Landsman (1998) Table 2

Panel B: Tests of incremental R^2 based on regressions with NI and BVE, NI only, and BVE only as independent variables

	Year $t-5$	Year $t-4$	Year $t-3$	Year $t-2$	Year $t-1$
NI and *BVE* total	0.80	0.78	0.84	0.65	0.53
NI incremental	0.04	0.04	0.03	0.00	0.02
BVE incremental	0.02	0.04	0.04	0.11	0.35
Vuong (1989) *Z*-statistic	-0.43	0.06	0.41	1.94	2.21

Incremental R^2_{NI} or $R^2_{BVE} = \alpha_0 + \alpha_1 \tau + e$

Dependent variable	coefficient	t-statistic	Adj. R^2
R^2_{NI}	-0.01	-2.00	0.43
R^2_{BVE}	0.07	2.68	0.61

MVE = market value of equity at fiscal year end.
BVE = book value of equity.
NI = net income available for common shareholders before extraordinary items and discontinued operations.
i, t = firms and years, respectively, $\tau = 0, \ldots, 5$, denoting event year; and e is an error term.
_NEG denotes *NI* (or *BVE*) is multiplied by an indicator variable that equals one if a firm has negative *NI* (or *BVE*), and zero otherwise.
NI (*BVE*) incremental R^2 refers to the R^2 from a regression with the net income and book value of equity variables, less the R^2 from a regression with only *BVE* (*NI*).

Note: The direction used in the computation of the Vuong (1989) *Z*-statistic by Barth, Beaver, and Landsman (1998) above is opposite to that used in Table 3 earlier. Hence the sign of the statistics should be reversed when compared.

TABLE 5

Summary statistics from regressions of market value of equity on earnings, equity book value and other potential omitted variables, and test of incremental explanatory power for UK insolvent company samples. Year is relative to delisting.

$$MV_{it} = a_0 + a_1 NI_{it} + a_2 NI \cdot D1_{it} + a_3 BV_{it} + a_4 BV \cdot D2_{it} + a_5 R\&D + a_6 DIV + a_7 CI + \varepsilon_{it} \quad \text{(A3)}$$

	Year $t-5$			Year $t-4$			Year $t-3$			Year $t-2$			Year $t-1$		
	coef.		*White-t*	*coef.*		*White-t*	*coef.*		*White-t*	*coef.*		*White-t*	*coef.*		*White-t*
Intercept	84.26		0.08	3,782.60	**	3.08	2,717.70	**	2.88	3,455.00	**	3.58	1,492.50	**	2.23
NI	2.39		0.98	12.92	**	4.13	8.73	**	3.70	8.25	**	5.09	4.25	**	4.17
BV	0.51	*	1.66	0.08		0.51	0.28		1.62	0.23	**	2.61	0.40	**	4.39
$NI \cdot D1$	-3.49		-0.92	-13.85	**	-4.38	-7.31	**	-2.41	-9.25	**	-5.18	-5.22	**	-4.42
$BV \cdot D2$	18.16	**	3.87	0.54		1.32	-0.56	*	-1.88	0.34		0.85	0.01		0.02
RD	35.48	**	6.07	48.56	**	4.88	13.34	**	2.75	6.02	**	2.86	7.54		1.51
DIV	15.68	**	3.29	-6.60		-1.04	0.48		0.10	-1.81		-0.47	-0.19		-0.72
CC	-1.04	**	-3.06	-0.54		-1.47	-0.57	*	-1.89	-0.04		-0.24	-0.14		-1.49
No. of observations	174			193			214			231			240		
Adj. R^2	0.71			0.73			0.78			0.70			0.57		
Adj. R^2 (original)	0.60			0.55			0.69			0.68			0.53		
NI Incremental R^2	0.00			0.11			0.08			0.11			0.12		
BV Incremental R^2	0.04			0.00			0.01			0.02			0.09		
Vuong (1989) Z-statistic	-0.65			2.71	**		1.64			1.85	*		0.42		

Notes: *MV* = equity market value measured at six months after the reporting date. *NI* = earnings. *BV* = equity book value. *RD* = research and development expenditure. *DIV* = dividends. *CC* = capital contributions. *i*, *t* = firms and years respectively. *D*1 (*D*2) is interacting dummy variable that equals one if a firm has negative earnings (equity book value) and zero otherwise. *White-t* = *t*-statistics computed using White's (1980) adjusted standard errors. *, ** = coefficient is statistically significant at 10% and 5% or lower levels (two-tail) respectively. *NI* incremental R^2 refers to the R^2 from a regression with both earnings and equity book value variables (as well as their dummies), less the R^2 from a regression with *BV* (and its dummy) only. *BV* incremental R^2 is similarly calculated except that the R^2 from a regression with *NI* (and its dummy) are used instead of *BV* (and its dummy).

TABLE 6

Summary regression results of equity market value on primary and augmented independent variables, all deflated by opening equity market value. Year is relative to delisting.

Panel (a) Deflated primary model

$$MV/OMV = a_0(1/OMV) + a_1(NI/OMV) + a_2(NI/OMV)\cdot D1 + a_3(BV/OMV) + a_4(BV/OMV)\cdot D2 + \varepsilon^* \quad \text{(A4a)}$$

	Year $t-5$			Year $t-4$			Year $t-3$			Year $t-2$			Year $t-1$		
	coef.		*White-t*	*coef.*		*White-t*	*coef.*		*White-t*	*coef.*		*White-t*	*coef.*		*White-t*
1/OMV	13.77		0.29	246.97		1.02	-65.86		-1.12	393.20	**	2.90	242.32	**	3.91
NI/OMV	2.47	**	3.68	3.65	**	2.15	6.70	**	8.58	8.06	**	9.29	6.25	**	7.11
BV/OMV	0.43	**	4.86	0.49	**	4.32	0.28	**	5.58	0.15	**	2.62	0.24	**	3.32
$NI/OMV \cdot D1$	-3.17	**	-3.36	-3.94	*	-1.67	-7.29	**	-8.67	-8.33	**	-8.77	-6.58	**	-6.81
$BV/OMV \cdot D2$	-1.05		-0.93	-2.05	*	-1.70	-0.30	**	-5.42	-0.31	*	-1.65	-0.45	*	-1.77
No. of observations	161			178			190			210			228		

TABLE 6 (continued)

Summary regression results of equity market value on primary and augmented independent variables, all deflated by opening equity market value. Year is relative to delisting.

Panel (b) Deflated augmented model

$$MV/OMV = a_0(1/OMV) + a_1(NI/OMV) + a_2(NI/OMV)\cdot D1 + a_3(BV/OMV) + a_4(BV/OMV)\cdot D2$$
$$+ a_5(RD/OMV) + a_6(DIV/OMV) + a_7(CC/OMV) + \varepsilon^* \qquad \text{(A4b)}$$

	Year $t-5$		Year $t-4$		Year $t-3$		Year $t-2$		Year $t-1$	
	coef.	*White-t*	*coef.*	*White-t*	*coef.*	*White-t*	*coef.*	*White-t*	*coef.*	*White-t*
1/OMV	40.16	0.95	287.38	1.20	-10.88	-0.18	367.27 **	2.71	243.81 **	3.71
NI/OMV	2.36 **	2.64	1.20	0.62	5.51 **	6.10	6.37 **	6.54	5.84 **	5.90
BV/OMV	0.26 **	2.17	0.34 **	3.37	0.22 **	3.57	0.11 **	2.41	0.23 **	2.92
$NI/OMV \cdot D1$	-3.17 **	-2.73	-1.84	-0.74	-6.01 **	-6.17	-6.52 **	-6.45	-6.16 **	-5.86
$BV/OMV \cdot D2$	1.07	0.42	-1.83	-1.48	-0.25 **	-3.65	-0.34 *	-1.91	-0.43 *	-1.67
RD/OMV	6.74	0.84	1.59	0.06	11.96 **	4.88	13.90 **	6.34	5.99 **	2.77
DIV/OMV	5.27 *	1.66	12.55 *	1.91	3.50 *	1.74	4.47 *	1.86	1.18	0.92
CC/OMV	-0.11 *	-1.69	-0.10	-0.71	-0.04	-0.75	-0.13	-1.30	-0.02	-0.45
No. of observations	161		178		190		210		228	

Notes: *MV* = equity market value measured at six months after the reporting date. *NI* = earnings. *BV* = equity book value. *RD* = research and development expenditure. *DIV* = dividends. *CC* = capital contributions. *OMV* = opening equity market value. *D*1 (*D*2) is interacting dummy variable that equals one if a firm has negative earnings (equity book value) and zero otherwise. $\varepsilon^* = \varepsilon / OMV$. *White-t* = *t*-statistics computed using White's (1980) adjusted standard errors. *, ** = coefficient is statistically significant at 10% and 5% or lower levels (two-tail) respectively.

TABLE 7

Summary statistics from regressions of equity market value on earnings, equity book value and non-linear real options terms, and test of incremental explanatory power for UK insolvent company samples. Year is relative to delisting.

$$MV = a_0 + a_1 NI + a_2 BV + a_3\left(\frac{NI^2}{BV}\right) + a_4\left(\frac{NI^3}{BV}\right) + \varepsilon \qquad \text{(A5)}$$

	Year $t-5$		Year $t-4$		Year $t-3$		Year $t-2$		Year $t-1$	
	coef.	*White-t*	*coef.*	*White-t*	*coef.*	*White-t*	*coef.*	*White-t*	*coef.*	*White-t*
Intercept	-251.65	-0.25	7,297.70 **	3.49	4,933.80 **	3.43	4,594.10 **	3.37	4,183.50 **	5.36
NI	6.13 **	3.03	6.17 **	3.56	6.28 **	4.12	2.72 **	2.23	0.94 **	2.69
BV	1.05 **	5.57	0.36 **	1.97	0.70 **	3.34	0.69 **	3.76	0.62 **	8.51
NI^2/BV	13.00 **	3.20	6.89 **	2.67	-0.03	-0.04	2.30 **	2.66	-0.13 **	-2.54
NI^3/BV	-0.004 **	-2.99	-0.00002	-0.77	-0.0005 **	-2.77	-0.00003	-0.32	-0.00003 **	-5.04
Adj. R^2	0.69		0.50		0.60		0.50		0.50	
Adj. R^2 (original)	0.48		0.55		0.69		0.68		0.55	
No. of observations	171		189		204		223		221	

	Year $t-5$	Year $t-4$	Year $t-3$	Year $t-2$	Year $t-1$
NI and *BV* total	0.69	0.50	0.60	0.50	0.50
NI Incremental R^2	0.07	0.09	0.12	0.07	0.04
BV Incremental R^2	0.19	0.03	0.12	0.23	0.34
Vuong (1989) Z-statistic	-1.13	0.79	0.01	-1.10	-3.35 **

Notes: *MV* = equity market value measured at six months after the reporting date. *NI* = earnings. *BV* = equity book value. Adj. R^2 (original) denotes adjusted explanatory power obtained based on the primary model specification but without the equity book value dummy term. *White-t* = *t*-statistics computed using White's (1980) adjusted standard errors. *, ** = coefficient is statistically significant at 10% and 5% or lower levels (two-tail) respectively.