Chapter

The Roles of Accounting Valuations and Earnings Management in the Survivorship of Technology Firms during the Global Financial Crisis

Oliver Neoh and Matthias Nnadi

Abstract

This study examines the survivorship of technology firms listed on the NASDAQ market during the immediate and post-2008 global financial crisis period. Underpinned by contingency theory, this study demonstrates the varying roles of accounting valuation and earnings management metrics in the technology industry. Findings in this chapter show during the global financial crisis periods, technology firms have greater survivorships when they are undervalued, and possess a lesser degree of discretionary earnings (DA). The DA factor is a double-edged sword for technology firms since it has positive and negative effects on the returns and survivorships, respectively. The research and development (R&D) variable remains a positive component for both returns and survivorships of these firms.

Keywords: accounting valuation, earnings management, technology, prediction, performance, survivorship

1. Introduction

The technology sector has rapidly gained importance in the past two decades. The NASDAQ Composite, which measures all the stocks on the tech-heavy NASDAQ market, surpassed its dotcom high in 2015.[1] Valuations are also close to the general market today, in sharp contrast to the extreme valuation gap seen in 2000.[2] Firms within the technology sector possess distinct aspects relative to non-technology firms, examples being: innovation and technical advancement leading to high economic growth, opaque information causing moral hazard, longer investment horizon required for technology innovations, greater uncertainties in cash

[1] The transformation of the industry over the past 17 years has been significant. Technology companies are expected to generate more than 25% of the S&P 500's overall earnings in the fourth quarter of this year, compared with 15% at the index's peak in 2000. At that time, tech stocks accounted for more than a third of the benchmark S&P 500. Today that figure has fallen closer to 23%.

[2] Tech stocks trade at 19.4 times 2017 full-year earnings, while the S&P 500 is at 19 times. As per Bloomberg data, in the first quarter of 2000, S&P 500 technology groups traded at 73 times earnings.

flows and growth potentials. It is further asserted that greater litigation risk arises from information asymmetry [1]. Therefore, our goal is to analyse the reasons behind the rapid performance growth and change in survivorship in technology sector during of financial turmoil and its initial recovery of our 2008 global financial crisis. We evaluate the impact of accounting valuation and earnings management indicators considering special aspects of technology firms and our lesson from the technology bubble in 2000.

Currently there exists a gap in the academic discourse comparing the state of the technology sector during the crisis of 2008. Our study fills the present gap by re-evaluating the sector in the aftermath of the most recent crisis and reflects on the findings drawn from preceding crisis of 2000. The current study seeks to evaluate whether the same findings drawn from the earlier crisis literature, referring to [2], are still relevant for capital providers and participants in the post-crisis period. Accordingly, our study sets a considerable contribution to current studies on the effects of valuation measures in the technology sector on the financial crisis, and whether these effects vary over the various periods of the crisis.

Secondly, previous studies limit their scope to analysing performance of stock returns [3, 4]. This chapter however focuses on examining both future performance and the survivorship of firms within the technology-sector. This is linked to our base understanding that accounting valuation and earnings management variables play a much greater role in determining future survivorship within this particular sector that has developed with large strides since the late twentieth century. Moreover, given the uniqueness of the technology sector, such as the larger existence of intangible assets, we anticipate that our evaluation encompassing linked variables such as discretionary accruals (DA) and research and development (R&D) expenditure will be a valuable contribution to the current technology sector literature. We examine how these effects are contingent on different time horizons, short and long run, and morality (ETHICS) of these technology firms' behaviours.

This chapter contributes to ongoing discussion in relation to the determining the effects of accounting valuation and earnings management variables in the performance and survivorship of technology firms during the financial crisis. The three core objectives of the study linked particularly towards future performance and survivorship are:

I. to determine the level of explanatory power of valuation and accounting metrics in determining the short- to long-term performance of securities within the technology sector throughout the most recent global financial crisis (GFC) period;

II. to examine whether valuation and accounting metrics hold predictive power in explaining the future survivorship or failure of technology firms in the immediate and post-crisis period; and

III. to investigate how the technology firms' moral hazard (i.e. opportunistic behaviour) affect their future returns and survivorships during and after the GFC period.

We find that our accounting valuation and earnings management techniques including R&D, market capitalization (MktCap), earnings to price ratio (EP), book to market ratio (BM), and discretionary accruals (DA) have stronger positive effects on longer term performance of the technology firms. In other words, undervaluation, larger firm size, and more discretionary earnings and R&D lead to higher returns which increase more with longer terms. On the other hand, undervaluation,

large firm size (MktCap), more R&D but with less discretionary earnings (DA) increase the survivorships of these firms. We confirm that practising earnings management introduces a double-edged sword for the technology firms since DA has positive and negative effects on the returns and survivorships, respectively particularly during the global financial crisis. R&D mostly increases both the returns and survivorships although the significance may vary. Furthermore, the moral hazard (ETHICS) within the technology firms tends to reduce their future returns while not significantly affecting their survivorships.

1.1 Development of the research hypothesis

The underlying research question for this chapter considers whether in times of financial crisis, capital providers, including investors, equity providers, and debt holders could use accounting valuation, and earnings management variables in predicting the future performance and survivorship/failure of technology-firms. To investigate the research question, we consider the contingency theory as a fitting framework as it suggests that an optimal course is contingent on the circumstance or environment confronting the phenomenon being examined. This is because our study seeks to provide an explanation to phenomena that are dependent upon times of crisis.

Keystone works utilising this contingency approach explore a diverse range of subjects, such as the usefulness of virtual learning environments in education amongst different sectors or groups [5–7], or the optimal conditions in organisations where certain IT implementations will be beneficial [8]. The same framework is applied to our investigation as we seek to identify which accounting valuation, and earnings management techniques are useful in explaining future performance and probability of failure contingent on times of crisis and periodic outlooks. Accordingly, we propose two hypotheses directly relevant to the issues for equity-holders on future performance, and creditors on future probability of failure:

H_1: *Accounting* valuation *and earnings management metrics will be significant at different times of crises in explaining short- to long-term performance, and where they are significant they should follow the conventional relationship these measures have with future returns.*

H_2: *Accounting* valuation*, earnings management, and past performance variables will be significant at different times of crises in explaining future firm failure, and when they do, they adhere to conventional relationships.*

For equity providers and investors of stock markets, this issue of being able to predict the performance of the firm is highly relevant as these groups typically seek to invest in businesses that are set for future success. If the investment is successful, they are rewarded with stock price returns. For debt holders, it is important that they are able to determine the probability of future failure and to assess whether the recipient of the loan would be able to pay-back or risk defaulting on their loan. For accurate prediction of these outcomes, a more robust risk-assessment of lending agreements is essential.

The rest of the chapter is structured as follows: Section 2 is the literature review, Section 3 is the data and research design, Section 4 is the results and discussion of findings and Section 5 is the conclusion, implication of study and limitations.

2. Review of literature

Arguably, since the late twentieth century the technology sector has increased its presence within society in every aspect. Its continued rise is now imminent and a

robust understanding of the sector is well in demand. Alongside the sector's rise, a myriad of listed technology companies have also grown in presence and influence in capital markets since its origins. Throughout its history, these high-technology investments have at times showcased behaviours of high-growth characteristics [9]. To understand the issues that the chapter aims to address, we provide the four core areas covered in the existing literature, consisting of the technology sector, financial crises, financial measures, and earnings management.

2.1 The technology sector

Technology stocks have increased immensely in both presence and importance to global financial markets. For instance, from 1990 to 2000, technology firms have emerged from barely being existent to occupying six of the ten largest firms in the US, in terms of market capitalisation [10]. The National Association of Securities Dealers Automated Quotations (NASDAQ) index which is heavily weighted by technology stocks has grown over 29 times to reach a total market capitalisation of $8.4tn.[3] Moreover, the largest stocks in today's financial markets are concentrated to the largest of the technology pioneer companies, namely Apple, Alphabet, and Microsoft. This is testament to the prominence of technology in today's world. Technology firms arguably have adopted increasingly important roles in today's capital market [11].

Nevertheless, technology stocks have faced significant challenges. Particularly, in consequence of the technology bubble and crash of late-1999 to Spring 2000, the world experienced a monumental downturn in the technology sector that sent ripples of distress throughout international financial markets. The next crisis following this was the most recent sub-mortgage crash in 2008, which similarly sent devastating effects to global markets. As such, the periodic context that coincided with the growth of the technology sector was significantly more volatile than its preceding bull-run of the 1950s to 80s.

The explanations that have arisen behind the crisis in 2000 is critical for our study, and its objective of examining the technology sector's reaction to the most recent global financial crisis (GFC) that erupted in 2008. The causes of this credit crunch and its huge impact is explored by many scholars in the field, refer to [3, 12, 13]. The crisis is a prime foundation behind this study which explores the varying dynamics of the financial crises. Close to 8 years after, this presents an opportune moment to look into the consequent shaping of the technology sector and investigate the determinants behind the performance and survivorship in this post-crisis period.

2.2 Financial crises

The cause of financial crisis is a recurring subject in economic history. Referring to the earlier 2000 technology-bubble, much discussion in the academic landscape has evolved in this field where its origins are commonly pointed to the over-optimistic behaviours expressed in the market towards the rise of Internet stocks. For example, some scholars advocate that the absence of traditional valuation metrics proved to be evidence for collective investor irrationality during the initial crash of the tech-sector [4]. As a result of this downturn, there has been a vast array of studies in the financial literature which has examined causes and impacts of the bubble. Two key areas of study have observed technology stocks in: (1) the valuation space, and how traditional metrics may not be as applicable to tech-stocks; and (2) the investment perspective looking at the various co-movements of technology

[3] Data from Bloomberg Terminal.

stocks in comparison to other sectors as well as the behaviour of different investment clienteles.

To exemplify the scale of destruction that crises like the GFC produces, there has been examination of nine crisis episodes, including the GFC and the technology bubble, and their implications on equity markets and the incidence of contagion [3]. They identify the GFC as a global crisis having contagion effects in all the channels tested. Tests on the technology bubble show that it possess normal interdependencies as a result of the downturn. Our research will therefore seek to further evaluate the effects of the GFC specifically towards the technological sector.

2.3 Accounting and valuation metrics

There has been ongoing discussion on the predictive power that accounting and valuation metrics serve in explaining future performance and survivorship of listed technology firms [2, 4, 14]. Due to the nature of tech-firms' wide-ranging business operations, they tend not to have the same drivers of business growth or failure as other sector firms. Within technology remit, the general nature of operations may be heavily service-oriented when referring to the likes of software providers, or more product-driven such as those companies specialising in computer hardware. A lot of these companies may be travelling through their early growth stages, meaning investments and capital expenditure do not necessarily translate to earnings until much later on in their life-cycle.

Furthermore, investment behaviour towards the sector has a track-record of being over-optimistic, as argued in the sector's early development and in the emergence of the 2000 technology-bubble [14]. The chapter recognises this thinking as a reflection based on the origins of the past tech-bubble, however our chapter seeks to enhance understanding in the contemporary links and similarities that the market expressed in the most recent crisis of 2008, and the key implications for equity holders and creditors active within the sector.

2.4 Earnings management

There has also been a wide-ranging scope of literature examining the phenomenon of companies practising earnings management. There has been explanations that earnings management occurs when managers use judgement in financial reporting and in structuring transactions to alter financial reports to either mislead some stakeholders about the underlying economic performance of the company or to influence contractual outcomes that depend on reported accounting practices [15]. The academic discussion on this topic explores the possibility that earnings management may imply on the immediate and future performance of tech companies during financial crisis. There is further evidence showing that firms are likely to manipulate earnings in order to report small profits instead of losses during periods of financial distress [16].

Earnings management generally refers to the management of items such as increasing accruals, as well as cutting discretionary expenditure, such as advertising, selling, general and administrative expenses, and research and development (R&D). This is particularly relevant when looking at how companies manage earnings in preparation for reporting season and meeting analyst expectations. Certain findings indicate high-tech firms are more likely to use discretionary accruals to reward CEOs to meet their earnings expectations compared to low-tech firms [17]. Moreover, some studies make conclusions that firms who show higher levels of earnings management to beat forecasts typically outperform firms who do not engage in this practise as much [18].

3. Data and research design

To explain the sample selection of technology-firms from the NASDAQ market index, we firstly used the COMPUSTAT database to generate a list of firms that were active on the NASDAQ market as of January 2007. The rationale behind selecting the NASDAQ market is that its constituent members are heavily weighted towards the technology sector, a decision similarly applied in reference to [4]. As we identify the pinnacle of the GFC to be the latter half of 2008, we generate a shortlist which comprises of firms which were active as of January 2007 to ensure that each firm within our final sample have been active for at least a year. We also ensure that all firms within our final sample were active as of third quarter of 2008.

After generating the shortlist of firms, we further break down our sample into defined Industry Classification Benchmark (ICB) codes within the NASDAQ index to arrive at a total of 350 firms. These represent the chapter's scope in evaluating technology firms. The earliest starting point of our data is selected as the year-ending 2007 so that we may calculate figures which require a year-on-year change, such as the calculation of yearly sales growth. In other words, if the financial data involves a year-on-year change, the earliest data point used to calculate this change figure will be the 2007 value. All financial and valuation data are generated from the financial year end of 2008, which is December. This is the same for 2009 and 2010.

In addition, we collect the overall firms' ethical behaviour scores (ETHICS) in US from The Global Competitiveness Report (2008–2010). This variable measures the effect of ethical behaviour of the technology firms to their returns and bankruptcies in our further analysis. The descriptions of the accounting valuation and earnings management metrics used in the study are detailed in **Table 1**.

In terms of their data extraction, we use yearly data where it refers to an accounting reported figure (Sales_g, EBITDA, RD, and calculation of DA) and quarterly data for valuation metrics (EP, BM, PS and MktCap) from the Bloomberg Terminal ranging from 2007 to 2015. Where the variables are extracted on an annual basis, we use the base year figures 2008, 2009, and 2010. Where the variables are quarterly, we use the Q4 data from the base years, 2008, 2009, 2010 to form the independent variable pool as this aligns with the financial year-end figures of our accounting data.

All accounting items required to conduct the DA procedures are extracted using yearly data from the Bloomberg database for each year, 2008–2010. The 2007 figures are also generated considering that some items require a calculation to measure the change. The *non-discretionary accruals using the Jones Model* is express as:

$$NDA_t = a_1\left(\frac{1}{A_{t-1}}\right) + a_2(\Delta REV_t) + a_3(PPE_t) \tag{1}$$

The total accruals using the Jones Model is express as:

$$TA_t = a_1\left(\frac{1}{A_{t-1}}\right) + a_2(\Delta REV_t) + a_3(PPE_t) + \vartheta_1 \tag{2}$$

where ΔREV_t = revenues in year t less revenues in year $t-1$ scaled by total assets at $t-1$; PPE_t = gross property plant and equipment in year t scaled by total assets at $t-1$; A_{t-1} = total assets at $t-1$; $a_1a_2a_3$ = firm-specific parameters; TA_t = total accruals scaled by lagged total assets; income before extraordinary items—CF from continuing operations.

Type	Variables	Description
Valuation	Earnings to price ratio (EP)	Also known as the earnings yield, the EP ratio is the inverse of the PE ratio measuring the earnings per share of a company divided by the share price of the company. Generally, the higher an EP ratio gets, the company can either be seen by the market with low confidence in its earnings, or is currently undervalued
	Book to market ratio (BM)	The book to market ratio is a ratio that calculates the book value of a firm relative to its market value. This ratio is also used in valuation practices to identify undervalued, typically over 1.00, or overvalued securities, if less than 1.00
	Price to sales ratio (PS)	Another ratio that divides a company's stock price by its revenues. It is used to indicate the value attached to each dollar of a company's sales or revenues. Lower values tend to suggest undervaluation while higher values may indicate overvalued stocks or those with higher confidence assigned by the market
Accounting	Market capitalisation (MktCap)	Market capitalisation is derived by calculating the company's shares outstanding multiplied by the current market price. It is used as a close proxy for size of the firm, and typically larger firms tend to survive crises
	Sales growth ($Sales_g$)	Sales growth in our study is defined as the growth in sales revenue year on year in Q4 of a particular year. Those with higher growth are assumed to enjoy greater return prospects and lower likelihood of failure
	Earnings before interest, taxes, depreciation, and amortisation (EBITDA)	An accounting item that acts as a strong indicator of a company's financial performance. It is useful in displaying the earning potential of a business as well as a gauge to analyse profitability that eliminates the effects of financing and accounting decisions
	R&D expenditure (R&D)	Refers to expenses linked to the research and development of a company's goods or services. Importantly, the technology sector is amongst the highest users of RD and the level may be viewed by market participants as either an expense or investment initiative, a key part to our study
	3m, 6m, 1y, 3y, 5y	These are the firm's 3-month, 6-month, 1-year, 3-year, and 5-year performance measured by stock returns. These explain the firm's performance from the short to long term
	Failed_6m, Failed_1y, Failed_3y, Failed_5y	These are the dummy variables assigned 1 if the firm fails and 0 if otherwise in 6-month, 1-year, 3-year, and 5-year
Earnings management	Discretionary accruals (DA)	Along with non-discretionary accruals, they make up the total accruals practiced by the company. Discretionary accrual is associated with management choices whereas non-discretionary accruals originate from business conditions. DA is a good proxy for earnings quality and our study employs the Jones and Modified Jones Model for its calculation
Qualitative data	ETHICS	The scores of firm's ethical behaviour in US collected from The Global Competitiveness Report (2008–2010)

The table shows the description of the variables we use. It shows the description for our valuation (EP, BM, PS), accounting (MktCap, $Sales_g$, EBITDA, R&D, (3m, 6m, 1y, 3y, 5y) returns, (Failed_6m, Failed_1y, Failed_3y, Failed_5y) failures, DA, and ETHICS).

Table 1.
Variable description.

We also compute the non-discretionary accruals using the Modified Jones Model which is express as:

$$NDA_t = a_1\left(\frac{1}{A_{t-1}}\right) + a_2(\Delta REV_t - \Delta REC_t) + a_3(PPE_t) \quad (3)$$

where ΔREC_t = net receivables in year t less net receivables in year $t-1$ scaled by total assets at $t-1$; NDA_t = non-discretionary accruals scaled by total assets of prior year.

Once we have calculated the discretionary accruals value for each firm in their MJDA and JDA forms, we then measure each firm's value relative to the sample median in percentage terms similar to the methodology adopted by past studies, refer to [18]. Consequently, a positive value refers to a firm who has greater discretionary accruals for that particular year relative to its peer group. The descriptive statistics of our overall data is shown in the following **Table 2**.

3.1 Research design

The core methodologies used for our research include the linear regression and logistic regression models. In our linear regression section investigating H_1, we conduct OLS regressions for each base year measuring 3-month, 6-month, 1-year, 3-year, and 5-year performance as the dependant variable. In addressing H_2,

	3m	6m	1y	3y	5y	EP	BM	PS	MktCap	$Sales_g$
Average	7.95	21.59	35.16	59.73	80.14	0.06	0.74	2.28	2.66	0.08
Median	7.06	11.53	20.84	33.86	37.94	0.05	0.55	1.69	2.65	0.01
Min	−59.69	−100.00	−100.00	−100.00	−100.00	0.00	0.02	0.05	0.27	−4.21
Max	103.87	314.04	1358.18	1089.90	2880.31	0.84	11.01	27.98	5.47	9.07
Std.	20.44	48.84	85.65	148.61	231.81	0.07	0.79	2.21	0.86	0.49
10th per	−16.59	−18.92	−34.44	−100.00	−100.00	0.01	0.23	0.43	1.57	−0.06
90th per	32.29	70.69	117.39	214.18	290.98	0.12	1.30	4.44	3.74	0.28
N	866	866	866	866	866	866	866	866	866	866
	EBITDA	**Failed_6m**	**Failed_1y**	**Failed _3y**	**Failed _5y**	**MJDA**	**JDA**	**R&D**	**ETHICS**	
Average	1.16	0.01	0.04	0.15	0.26	0.43	0.39	0.10	5.36	
Median	0.00	0	0	0	0	0	0	0.09	5.40	
Min	−29.32	0	0	0	0	−16.37	−15.71	0.00	5.20	
Max	350.67	1	1	1	1	35.87	34.33	0.54	5.50	
Std.	13.00	0.11	0.19	0.35	0.44	3.82	3.70	0.07	0.12	
10th per	−0.05	0	0	0	0	−2.41	−2.39	0.02	5.20	
90th per	0.59	0	0	1	1	3.26	3.10	0.18	5.50	
N	866	866	866	866	866	866	866	866	866	

The table shows the descriptive statistics of the data set we used. We show the average, median, minimum (min), maximum (max), standard deviation (Std.), 10th percentile (10th per), 90th percentile (90th per), and the total number of sample (N) for our overall data. Our overall data include 3m, 6m, 1y, 3y, 5y, EP, BM, PS, MktCap, $Sales_g$, EBITDA, Failed_6m, Failed_1y, Failed_3y, Failed_5y, MJDA, JDA, R&D, and ETHICS from 2008 to 2010.

Table 2.
Descriptive statistics.

we conduct logistics regression using 3-models for each base year measuring 1-year failure, 3-year failure, and 5-year failure. One year is chosen as the earliest measure of failure as any earlier, such as 6-months, would consist of an insignificant number of firms that have failed. Logistic regression results earlier than 1-year, in our case, are limited in their validity.

Our linear regression model for determining future performance is express as:

$$r_{a_t} = a + b_1EP + b_2BM + b_3PS + b_4MktCap + b_5EBITDA + b_6Sales_g + b_7MJDA + b_8RD \tag{4}$$

And our logistic regression model for determining future failure is express as:

$$Failed\ firmt = a + b_1EP + b_2BM + b_3PS + b_4Sales_g + b_5MJDA + b_6RD + b_7MktCap + b_8EBITDA + b_91y... + b_{11}5y \tag{5}$$

In Eq. (4), the methodology for the linear regression involves a similar framework used in reference to [4], examining the market value of securities in the tech sector during the tech-bubble of 2000. In our case, the dependent variable is selected as the percentage return over the prescribed period (3m, 6m, 1 y, 3 y, and 5 y) from the end of the selected base-years (2008, 2009, and 2010). The independent variables include our valuation, accounting, and earnings management variables of each underlying security in the sample, as described in **Table 1**. A positive significant coefficient would imply a positive relationship between the indicator and future returns.

Our linear regression model for determining future performance using our overall data including ETHICS is express as:

$$r_{a_t} = a + b_1EP + b_2BM + b_3PS + b_4MktCap + b_5EBITDA + b_6Sales_g + b_7MJDA + b_8RD + b_9ETHICS \tag{6}$$

Furthermore, our logistic regression model for determining future failure using our overall data including ETHICS is express as:

$$Failed\ firmt = a + b_1EP + b_2BM + b_3PS + b_4Sales_g + b_5MJDA + b_6RD + b_7MktCap + b_8EBITDA + b_9ETHICS + b_{10}6m... + b_{13}5y \tag{7}$$

Then the corresponding null and alternative hypotheses for linear (Eq. (6)) and logistic regressions (Eq. (7)) are coefficients equal zero and non-zero, respectively, as before.

4. Results and discussion of findings

4.1 Future performance

Table 3 is the result of the multivariate analyses using the Jones Model and shows that the R&D is significant[4], and follows the traditional relationship with

[4] In this paper, we mostly discuss the results that show significantly strong results (i.e., p-values ≤ 0.05). Weakly significant results (i.e., $0.05 < p$-values < 0.10) are sometimes aligned with the strongly significant results, but we do not actively discuss these.

	3m	6m	1y	3y	5y	EP	BM	PS	MktCap	$Sales_g$	EBITDA	Failed_6m	Failed_1y	Failed_3y	Failed_5y
3m	1***														
6m	0.3***	1***													
1y	0.21***	0.67***	1***												
3y	0.14***	0.42***	0.49***	1***											
5y	0.03	0.26***	0.3***	0.62***	1***										
EP	-0.08**	0.19***	0.23***	0.15***	0.13***	1***									
BM	-0.09***	0.29***	0.28***	0.18***	0.11***	0.42***	1***								
PS	0.02	-0.15***	-0.11***	-0.09***	-0.08**	-0.27***	-0.37***	1***							
MktCap	0.05	-0.14***	-0.14***	-0.09**	-0.03	-0.19***	-0.43***	0.48***	1***						
$Sales_g$	0.02	0.01	-0.03	-0.02	-0.05	0.06*	-0.01	-0.03	-0.09***	1***					
EBITDA	-0.04	-0.05	-0.04	-0.02	0	-0.01	0	-0.04	-0.06*	0.01	1***				
Failed_6m	0.05	-0.28***	-0.17***	-0.12***	-0.09**	-0.05	-0.02	0.01	-0.02	-0.1***	0.06*	1***			
Failed_1y	0	-0.12***	-0.32***	-0.22***	-0.16***	-0.05	-0.04	-0.04	-0.02	-0.04	0.03	0.51***	1***		
Failed_3y	-0.05	-0.08**	-0.17***	-0.45***	-0.32***	-0.07*	0.01	-0.09	-0.12***	-0.02	0.01	0.24***	0.49***	1***	
Failed_5y	-0.04	-0.03	-0.12***	-0.32***	-0.46***	-0.06*	0.07**	-0.08**	-0.18***	0.04	-0.01	0.17***	0.34***	0.71***	1***

The table shows the correlation matrix of our data set we used. It uses a Pearson correlation calculation.
**Significance at 10% level.*
***Significance at 5% level.*
****Significance at 1% level.*

Table 3.
Correlation Table

both survivorship and future performance of tech-firms. Across two of the three years in the study, namely 2008 and 2009, the longer the returns are, the stronger the positive effects from BM, MktCap, MJDA, and R&D become. R&D acts a good predictor of future performance with significant coefficients of 155.73 in 6 months, 265 in 1 year and 335.09 in 3 years respectively in 2008 model. In the 2009 model, the R&D results remain significant at 56.41 and 286.02 respectively.

Sales growth is negatively significant to the medium-term returns (1y) in 2010 with a coefficient of −16.35 (**Table 3**). This suggests that firms who reported increased growth in year-on-year sales did not necessarily enjoy corresponding positive returns in medium-term. This finding corroborates with past literature suggesting there is a significant association between three-day market returns and Internet firm revenue announcements [19]. This finding and the PS results shed valuable insights into the characterisation of tech stock returns in the crisis periods. Our discretionary accruals (MJDA) variable also exhibits significant linkage to the explanation of increased short- to medium-term returns from 2008. As shown in **Table 3** the variable possesses positive coefficients of 1.23 and 4.25 in 2008s 6-month and 3-year outlook respectively which indicates a positive linkage to future returns. Therefore, discretionary accruals is a positive element for the returns which amplifies with longer returns.

As a whole, the accounting variables such as BM, MktCap, MJDA, and R&D have stronger positive effects on the longer-term performances in 2008 and 2009. In general, the large firm size (MktCap), undervaluation (EP and BM), more discretionary accruals and R&D are positive drivers for the returns of the technology firms. The negative effects from sales growth occur in 2010 sometime after the crisis. The overvaluation measured by PS seemed to positively affect the long-term returns but this effect fades out as time goes by.

4.2 Future survivorship

For future survivorship, **Table 4** shows that the R&D variable plays a significant role in a firm's 1-year outlook over the three crises years with negative coefficients of −88.16, −95.25, and −64 across 2008–2010. This reveals key points about the practice of R&D expenditure in the technology sector and why firms who practice higher levels tend to experience positive future returns and a higher likelihood of survivorship.

Furthermore, our findings suggest that firms with higher MktCap tend to survive and are more likely to outperform in the longer-term. With negative coefficients ranging from −2.17 and −0.48 in 2008, and −0.86 and −0.91 in 2010, the explanatory power for future failure is in line with the argument that undercapitalisation is a core reason to every technology business failure evaluated [20]. The R&D is significantly negative which highlights the importance of R&D expenditure in the technology sector as an investment rather than an asset. Support for this expenditure figure in providing a 'truer measure of a company's value because this spending often turns out to be money in an investor's pocket in the future' is also advocated in reference to [21]. This implies that expenditure in the technology industry leads to improved efficiency, increased sales, and ultimately increasing company value.

The level of discretionary accruals (MJDA) practiced by firms is also a good predictor of future failure in the medium- to long-term in 2008 and 2010. In predicting future failure in **Table 4**, the coefficients suggest that higher levels of discretionary accruals translate to greater likelihood of failure with positive coefficients of 0.18 in 2008; 0.36 and 0.27 respectively in 2010. Importantly, this conforms closely with our expectation that practising earnings management introduces

$MODEL: r_{a_{t+p}} = a + b_1EP + b_2BM + b_3PS + b_4MktCap + b_5EBITDA + b_6Sales_g + b_7MJDA + b_8R\&D$

	Years								
	2008				2009		2010		
	3m	6m	1y	3y	3m	1y	3m	1y	5y
Const	−4.45 (−0.76)	4.57 (0.31)	2.99 (0.11)	22.78 (0.51)	9.43 (1.56)	2.61 (0.13)	**14.33**** **(2.24)**	−1.6 (−0.13)	**−76.04*** **(−1.82)**
EP	−9.82 (−0.67)	47.8 (1.29)	**252.49***** **(3.85)**	**220.46*** **(1.95)**	−28.34 (−1.26)	−117.87 (−1.52)	−44.66 (−1.43)	14.96 (0.24)	23.24 (0.11)
BM	−0.59 (−0.42)	**12.85***** **(3.66)**	**19.83***** **(3.18)**	**23.41**** **(2.18)**	**6.37*** **(1.89)**	**22.56*** **(1.93)**	−0.61 (−0.13)	−5.36 (−0.57)	−2.03 (−0.07)
PS	0.44 (0.4)	0.54 (0.19)	1.77 (0.36)	**19.93**** **(2.35)**	0.42 (0.69)	**5.15**** **(2.46)**	−0.54 (−1.12)	0.63 (0.67)	−5.09 (−1.63)
MktCap	**4.72**** **(2.5)**	3.53 (0.74)	−1.31 (−0.16)	−5.51 (−0.38)	**−2.84*** **(−1.69)**	−5.57 (−0.96)	−0.8 (−0.47)	−2.96 (−0.89)	**33.94***** **(3.08)**
EBITDA	−0.27 (−1.1)	−0.63 (−1.01)	−0.72 (−0.64)	−2.6 (−1.35)	−0.07 (−0.46)	−0.41 (−0.8)	−0.04 (−0.75)	−0.08 (−0.79)	0.22 (0.64)
$Sales_g$	2.2 (1.08)	−3.84 (−0.75)	−6.07 (−0.67)	−0.1 (−0.01)	1.2 (0.4)	0.92 (0.09)	**6.23*** **(1.66)**	**−16.35**** **(−2.21)**	−16.96 (−0.69)
MJDA	0.32 (1.34)	**1.23**** **(2.07)**	0.93 (0.88)	**4.25**** **(2.34)**	−0.25 (−0.52)	0.9 (0.55)	−1.08 (−1.27)	2 (1.19)	−2.84 (−0.51)
R&D	−5.25 (−0.29)	**155.73***** **(3.36)**	**265***** **(3.22)**	**335.09**** **(2.37)**	**56.41***** **(3.15)**	**286.02***** **(4.61)**	4.55 (0.29)	30.75 (0.98)	127.85 (1.24)
F-test	**2.55*****	**4.81*****	**6.27*****	**3.46*****	**2.47****	**3.80*****	1.36	1.16	**1.96***
Adjusted R^2	0.03	0.08	0.11	0.05	0.05	0.09	0.01	0.00	0.03
N	350	350	350	350	241	241	275	275	275

The table shows the valuation and accounting variables' effect on the technology firms' returns from 2008 to 2010. The dependent variables are 3 months (3m), 6 months (6m), 1 year (1y), and 3 years (3y) returns of the technology firms. Then we use the earnings to price ratio (EP), book to market ratio (BM), price to sales ratio (PS), market capitalization (MktCap), EBITDA, sales growth ($Sales_g$), modified Jones for discretionary accruals (MJDA), and research and development (R&D) as our independent variables. The values in parentheses are the t*-values to the corresponding coefficients.*

**Significance at 10% level.*

***Significance at 5% level.*

****Significance at 1% level.*

Table 4.
Multivariate analysis of periodic returns of NASDAQ technology firms—using modified Jones model for discretionary accruals (MJDA).

a double-edged sword. On one hand, firms practising greater degrees of earnings management tend to enjoy greater returns up to a certain point as seen in our analysis on future returns, however at the same time high levels of discretionary accruals damages their earnings quality and heightens risk of potential failure.

4.3 Ethical behaviour of the firms

Furthermore, the earnings managements can be related with the opportunistic behaviour of the firm. We investigate this issue by analysing the effect of ethical behaviour of the firms using ETHICS variable on their future returns and future survivorship. Since the ETHICS is an annual value identical within a year while different across the years, we include this in our overall sample including all periods

Model : Failed firmt $= a + b_1EP + b_2BM + b_3PS + b_4MktCap + b_5EBITDA + b_6Sales_g + b_7MJDA + b_8R\&D + b_91y... + b_{11}5y$

	Years							
	2008		**2009**			**2010**		
	1y	**5y**	**1y**	**3y**	**5y**	**1y**	**3y**	**5y**
Const	**5.54* (1.66)**	0.77 (1.1)	3.29 (0.96)	1.24 (0.91)	−0.34 (−0.3)	1.12 (0.46)	1.35 (0.94)	1.77 (1.57)
EP	−16.07 (−1.01)	**−5.86** (−2.37)**	−7.98 (−0.56)	**−13.27* (−1.73)**	−4.81 (−1.07)	−4.52 (−0.47)	**−12.41** (−2.08)**	0.41 (0.1)
BM	−1.66 (−1.32)	0.19 (1.09)	−1.17 (−0.84)	0.18 (0.31)	0.47 (0.85)	−1.14 (−0.74)	−0.36 (−0.37)	−0.45 (−0.58)
PS	0.4 (0.78)	−0.21 (−1.18)	−0.28 (−0.65)	−0.27 (−1.35)	0.03 (0.27)	−0.34 (−1.29)	−0.06 (−0.53)	0.01 (0.12)
MktCap	**−2.17* (−1.81)**	**−0.48* (−1.89)**	−0.77 (−0.84)	−0.53 (−1.38)	−0.43 (−1.3)	−0.02 (−0.03)	**−0.86** (−2.29)**	**−0.91*** (−3.07)**
EBITDA	0.08 (1.44)	−0.01 (−0.58)	−0.05 (−0.52)	−0.01 (−0.26)	−0.01 (−0.4)	−0.09 (−0.29)	−0.04 (−0.31)	−0.01 (−0.36)
$Sales_g$	**−4.3* (−1.85)**	0.15 (0.78)	−1.43 (−1.23)	0.51 (0.99)	0.01 (0.02)	−1.06 (−0.65)	−0.05 (−0.1)	−0.82 (−1.63)
MJDA	**0.18* (1.85)**	0.03 (1.14)	−0.06 (−0.32)	0.14 (1.38)	−0.04 (−0.45)	0.19 (0.97)	**0.36*** (2.78)**	**0.27* (1.67)**
R&D	**−88.16*** (−3.04)**	0.4 (0.18)	**−95.25*** (−3.09)**	−3.4 (−0.84)	−2.49 (−0.78)	**−64*** (−3.92)**	−2.4 (−0.91)	−0.01 (0)
3m	0.05 (1.57)	−0.01 (−0.78)	0.02 (0.68)	**0.02* (1.92)**	**0.03*** (2.72)**	0.03 (1.51)	0 (−0.45)	0 (0.29)
6m	0 (−0.27)	0 (1.35)	**−0.04** (−2.02)**	0.01 (1.15)	0 (0.33)	−0.01 (−0.95)	0.01 (0.65)	0 (0.45)
1y		0 (0.28)		**−0.03*** (−4.2)**	0 (−0.35)		**−0.03*** (−4.52)**	0 (0)
3y		**−0.01*** (−5.85)**			**−0.02*** (−5.61)**			**−0.02*** (−5.26)**
χ^2	**38.78*****	**78.62*****	**60.26*****	**52.54*****	**77.59*****	**57.14*****	**49.95*****	**78.30*****
Pseudo R^2	0.57	0.20	0.63	0.26	0.29	0.49	0.21	0.24
N	350	350	241	241	241	275	275	275

The table shows the valuation and accounting variables' effect on the technology firms' returns from 2008 to 2010. The dependent variables are dummy variables indicating 1 if the technology firm fails in 1 year (1y), and 3 years (3y), and 5 year (5y) and 0 otherwise. Then we use the earnings to price ratio (EP), book to market ratio (BM), price to sales ratio (PS), market capitalization (MktCap), EBITDA, sales growth ($Sales_g$), modified Jones for discretionary accruals (MJDA), and research and development (R&D) as our independent variables. The values in parentheses are the t*-values to the corresponding coefficients.*

**Significance at 10% level.*

***Significance at 5% level.*

****Significance at 1% level.*

Table 5.
Logistic analysis of failed NASDAQ firms using modified Jones model for discretionary accruals (MJDA).

$MODEL: r_{a_{t+p}} = a + b_1EP + b_2BM + b_3PS + b_4MktCap + b_5EBITDA + b_6Sales_g + b_7MJDA + b_8R\&D + b_9ETHICS$

	3m	6m	1y	3y	5y
Const	−5.69 (−0.18)	**−147.8** ** **(−2.05)**	**−971.81** *** **(−7.98)**	−263.65 (−1.16)	**−1137.59** *** **(−3.18)**
EP	−17.02 (−1.58)	**49.28** ** **(2.03)**	**174.69** *** **(4.26)**	**179.28** ** **(2.35)**	**327.49** *** **(2.72)**
BM	−1.63 (−1.5)	**15.35** *** **(6.26)**	**23.33** *** **(5.64)**	**25.51** *** **(3.31)**	**21.78** * **(1.79)**
PS	−0.27 (−0.73)	−0.58 (−0.7)	1.58 (1.12)	−0.07 (−0.03)	−3.83 (−0.92)
MktCap	0.55 (0.55)	−0.71 (−0.32)	−2.08 (−0.55)	−4.01 (−0.57)	13.44 (1.21)
EBITDA	−0.06 (−1.07)	−0.16 (−1.29)	−0.16 (−0.77)	−0.2 (−0.52)	0.12 (0.21)
$Sales_g$	1.18 (0.83)	0.52 (0.16)	−2.97 (−0.55)	−7.71 (−0.76)	−20.39 (−1.28)
MJDA	0.2 (1.07)	**1.3** *** **(3.1)**	**1.42** ** **(2.01)**	**4.21** *** **(3.19)**	0.32 (0.15)
R&D	8.64 (0.84)	**90.11** *** **(3.9)**	**205.73** *** **(5.27)**	**231.66** *** **(3.19)**	**200.81** * **(1.75)**
ETHICS	2.64 (0.45)	**27.78** ** **(2.09)**	**179.05** *** **(7.97)**	52.32 (1.25)	**211.71** *** **(3.2)**
F-test	1.49	**13.43** ***	**21.88** ***	**6.69** ***	**4.01** ***
Adjusted R^2	0.01	0.11	0.18	0.06	0.03
N	866	866	866	866	866

The table shows the valuation and accounting variables' effect on the technology firms' returns from 2008 to 2010. The dependent variables are 3 months (3m), 6 months (6m), 1 year (1y), 3 years (3y), and 5 years (5y) returns of the technology firms. Then we use the earnings to price ratio (EP), book to market ratio (BM), price to sales ratio (PS), market capitalization (MktCap), EBITDA, sales growth ($Sales_g$), modified Jones for discretionary accruals (MJDA), research and development (R&D), and firm's ethical behaviour score (ETHICS) as our independent variables. The values in parentheses are the t*-values to the corresponding coefficients.*

**Significance at 10% level.*

***Significance at 5% level.*

****Significance at 1% level.*

Table 6.

Full multivariate analysis of periodic returns of NASDAQ technology firms—using modified Jones model for discretionary accruals (MJDA).

(2008, 2009, and 2010) and run linear and logistic regressions as in our Sections 4.2 and 4.3. The results for the future returns and future survivorships are shown in **Tables 5** and **6**, respectively.

In **Table 5**, we do find highly similar relationship of EP, BM, MJDA and R&D with the future returns as in our **Table 3**. However, using the overall sample in **Table 5** shows more significant effects of these variables on the future returns. Then we find that the ETHICS has positive effect on the future returns in technology firms. In other words, the ethical behaviour of the technology firms tend to increase the future returns. Thus, the opportunistic behaviour of the technology firms is likely to decrease their future returns.

The similar relationship of EP, BM, PS, MktCap, Salesg, MJDA, and R&D on future survivorships are also found between **Tables 4** and **6** while the latter one using overall data tend to show more significant relationships. However, in this case, we do not find highly significant effect of ETHICS on the future survivorships of the technology firms. Therefore, the opportunistic behaviour of the technology

firms are more likely to reduce their future returns while leaving their future survivorships not significantly affected.

4.4 Robustness check

To provide a robustness check on the results obtained, we have compare the output generated when running our returns and survivorship analyses using the Modified Jones Discretionary Accruals (MJDA) method. As shown in **Table 7**, there is no difference between the two results.

From **Table 7**, we can deduce that our results in evaluating predictors of future performance are robust in being replicated across the MJDA and JDA procedures. Each regression model provides the same significance and similar explanatory power through their R-squared. All variables across the two methods possess the same signage of coefficients and remain within the statistical significance zone. In testing the robustness of our results in finding predictors of the survivorship of tech-firms, we find similar result using the JDA as presented in **Table 8**. All models remain significant just as in the MJDA results and the variables hold the same meaning within the outputs. These confirm that our results are consistent with the initial findings. We further perform our robustness check on the results from **Tables 7** and **8** where we used our overall data including ETHICS.

$$Model: Failed\ firmt = a + b_1EP + b_2BM + b_3PS + b_4MktCap + b_5EBITDA + b_6Sales_g + b_7MJDA + b_8R\&D + b_9ETHICS + b_{10}6m... + b_{13}5y$$

	6m	1y	3y	5y
Const	−4.75 (−0.33)	9.48 (1.02)	6.25 (1.37)	**7.22* (1.94)**
EP	**−26.86** (−2.33)**	**−12.62** (−2.17)**	**−7.12*** (−2.81)**	**−5.29*** (−3.14)**
BM	−0.54 (−0.57)	**−1.22* (−1.91)**	−0.27 (−1.4)	0.06 (0.54)
PS	0.01 (0.06)	−0.21 (−1.41)	−0.16** (−2.15)	−0.02 (−0.42)
MktCap	0.06 (0.11)	−0.44 (−1.25)	**−0.49*** (−3.08)**	**−0.61*** (−4.73)**
EBITDA	0.01 (0.72)	0 (0.08)	0 (−0.41)	−0.01 (−0.64)
$Sales_g$	**−2.32*** (−3.42)**	−0.97 (−1.33)	−0.12 (−0.61)	0.08 (0.58)
MJDA	**0.13* (1.77)**	**0.09* (1.71)**	0.03 (1.08)	0.02 (1.1)
R&D	**−53.67*** (−3.8)**	**−73.42*** (−6.29)**	**−5.84*** (−3.49)**	−1.23 (−1.03)
ETHICS	0.69 (0.26)	−1.3 (−0.76)	−0.99 (−1.17)	**−1.18* (−1.71)**
χ^2	**44.69*****	**138.67*****	**44.01*****	**48.06*****
Pseudo R^2	0.38	0.48	0.06	0.05
N	866	866	866	866

The table shows the valuation and accounting variables' effect on the technology firms' returns from 2008 to 2010. The dependent variables are dummy variables indicating 1 if the technology firm fails in 6 months (6m), 1 year (1y), and 3 years (3y), and 5 year (5y) and 0 otherwise. Then we use the earnings to price ratio (EP), book to market ratio (BM), price to sales ratio (PS), market capitalization (MktCap), EBITDA, sales growth ($Sales_g$), Modified Jones for discretionary accruals (MJDA), research and development (R&D), and firm's ethical behaviour score (ETHICS) as our independent variables. The values in parentheses are the t*-values to the corresponding coefficients.*
**Significance at 10% level.*
***Significance at 5% level.*
****Significance at 1% level.*

Table 7.
Full logistic analysis of failed NASDAQ firms using modified Jones model for discretionary accruals (MJDA).

$MODEL: r_{a_{t+p}} = a + b_1EP + b_2BM + b_3PS + b_4MktCap + b_5EBITDA + b_6Sales_g + b_7JDA + b_8R\&D.$

	Years								
	2008				2009		2010		
	3m	6m	1y	3y	3m	1y	3m	1y	5y
Const	−4.46 (−0.76)	4.44 (0.3)	2.35 (0.09)	22.85 (0.51)	9.43 (1.56)	2.63 (0.13)	**14.36**** **(2.24)**	−1.73 (−0.14)	**−76*** **(−1.82)**
EP	−9.76 (−0.67)	48.08 (1.3)	**253.12***** **(3.86)**	**221.03*** **(1.96)**	−28.35 (−1.27)	−117.9 (−1.52)	−44.95 (−1.44)	15.39 (0.25)	22.41 (0.11)
BM	−0.59 (−0.42)	**12.86***** **(3.66)**	**19.89***** **(3.19)**	**23.38**** **(2.18)**	**6.37*** **(1.89)**	**22.56*** **(1.93)**	−0.6 (−0.13)	−5.35 (−0.57)	−1.98 (−0.06)
PS	0.44 (0.4)	0.53 (0.19)	1.74 (0.35)	**19.95**** **(2.36)**	0.42 (0.69)	**5.15**** **(2.46)**	−0.54 (−1.12)	0.63 (0.66)	−5.09 (−1.63)
MktCap	**4.74**** **(2.51)**	3.6 (0.76)	−1.08 (−0.13)	−5.44 (−0.38)	**−2.84*** **(−1.69)**	−5.58 (−0.96)	−0.8 (−0.47)	−2.94 (−0.88)	**33.93***** **(3.07)**
EBITDA	−0.27 (−1.1)	−0.63 (−1.01)	−0.71 (−0.64)	−2.61 (−1.36)	−0.07 (−0.46)	−0.41 (−0.8)	−0.04 (−0.76)	−0.08 (−0.79)	0.22 (0.64)
$Sales_g$	2.23 (1.1)	−3.71 (−0.73)	−5.91 (−0.65)	0.31 (0.02)	1.2 (0.4)	0.93 (0.09)	6.17 (1.64)	**−16.22**** **(−2.19)**	−17.08 (−0.7)
JDA	0.33 (1.34)	**1.27**** **(2.05)**	0.86 (0.78)	**4.46**** **(2.36)**	−0.24 (−0.52)	0.9 (0.56)	−1.07 (−1.27)	2.08 (1.26)	−2.77 (−0.51)
R&D	−5.25 (−0.29)	**155.82***** **(3.36)**	**266.04***** **(3.23)**	**334.49**** **(2.36)**	**56.41***** **(3.15)**	**286.01***** **(4.61)**	4.51 (0.29)	30.96 (0.99)	127.8 (1.24)
F-test	**2.55****	**4.80*****	**6.25*****	**3.48*****	**2.47****	**3.80*****	1.36	1.18	**1.95***
Adjusted R^2	0.03	0.08	0.11	0.05	0.05	0.09	0.01	0.01	0.03
N	350	350	350	350	241	241	275	275	275

The table shows the valuation and accounting variables' effect on the technology firms' returns from 2008 to 2010. The dependent variables are 3 months (3m), 6 months (6m), 1 year (1y), and 3 years (3y) returns of the technology firms. Then we use the earnings to price ratio (EP), book to market ratio (BM), price to sales ratio (PS), market capitalization (MktCap), EBITDA, sales growth ($Sales_g$), Jones for discretionary accruals (JDA), and research and development (R&D) as our independent variables. The values in parentheses are the t*-values to the corresponding coefficients.*

*Significance at 10% level.

**Significance at 5% level.

***Significance at 1% level.

Table 8.
Multivariate analysis on periodic returns of NASDAQ technology firms—using Jones model for discretionary accruals (JDA).

5. Conclusion and implication of study

We find that, during the global financial crisis periods, the technology firms have larger returns with undervaluation, larger firm size, and more discretionary earnings and R&D which increases more with longer terms. On the other hand, these firms have greater survivorships when they are undervalued, larger in size, have more R&D but with less discretionary earnings (DA). DA is a double-edged sword for the technology firms since it has positive and negative effects on the returns and survivorships, respectively. R&D is a positive component for both returns and survivorships of these firms. The moral hazard (ETHICS) tend to reduce the returns of these firms but do not have significant effect on their survivorships.

The key implications for investors, equity holders and creditors derived from our results and analyses are threefold. Firstly, the alignment of our results and underlying expectation that certain variables should demonstrate significant explanatory power at various times of crisis illustrates the strong relevance of contingency theory in evaluating the phenomenon of tech firms during periods of financial turmoil. Secondly, through our analysis of results, we reiterate that traditional relationships of accounting valuation and earnings management measures may not always hold especially during crisis periods. Thirdly, from a general perspective, the results indicate that the variables employed in this study demonstrate greater predictive power in determining the phenomena of future tech-firm failure than performance.

Author details

Oliver Neoh and Matthias Nnadi*
School of Management, Cranfield University, Bedfordshire, UK

*Address all correspondence to: matthias.nnadi@cranfield.ac.uk

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