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Master Thesis:

Differential Accounting Item Value Relevance of High-Tech and IT firms: A Redefined Analysis

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Abstract

This thesis investigates the differences in financial statement item value relevance between high technology and low technology firms over the time period of 1990-2010 as well as a special case of IT sector against other high-tech firms and how this perception changed after the Internet Bubble of 1999. By enriching a common value relevance test with difference-in-difference methodology, I document some evidence of significantly lower value relevance of book values for high-tech firms compared to low-tech firms in the past two decades. Consequently, I find that the value relevance of the same items in terms of overall stock market performance has increased for IT firms compared to other high-tech firms after the Internet stock crash. Finally, goodwill experienced a jump in value relevance of IT firms when measured using book value scaling. Other financial statement items of interest, such as R&D expenses and cash flows plus accruals lack substantial evidence of being significantly different between the categories.

Keywords: Value relevance, high-tech, IT, Internet Bubble

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1 Introduction

Financial transactions, in its simplest form, constitute a series of activities firms undertake in doing business with their customers and other vendors. These movements of funds alter firm financial statements and how they portray the true situation within a firm, provided they are prepared free of any biases. Longer time series of such information present a general and more comprehensive overview of firm performance, as it is commonly believed that company's past can serve as a predictor of current and future performance (Nichols and Wahlen, 2004). Firms that pursue questionable accounting practices or are unprofitable usually receive more skepticism and less trust from investors. However, there is a certain type of firms that do not focus most of their attention to financial reporting – it is the business idea, innovation and the funding for it the key factors at the inception of such a firm. This category is called high technology.

If well-established firms seek to attract investment by demonstrating superior financial performance, entrants are one step behind. It is almost impossible for new firms to make substantial profits during the early days of existence due to large start up and equipment purchasing costs. Instead, entrepreneurs spend their time devising their business ideas and how to properly pitch them to venture capitalists – more specifically, such type of investors have hopes of a breakthrough of newly established firms in a sense that they will become market leaders in the future. The definition of a potentially successful firm is evolving over time as it depends on which products will have the highest demand based on changing customer needs. Quite often, the incremental innovations serve this purpose next to the radical ones, for example, the invention of a computer in the 1940's and its constant development up to the current period.

Such rapid growth of high technology raises several questions – have these firms become mature already? Have their financial statements become a primary indicator of performance? It is of no doubt that they have become significant players in the economy and although prior research has documented accounting value relevance changes, their analyses focused more on the general market and encompassed years before 1990, omitting the outset of Internet firms. The purpose of this analysis is to therefore investigate high technology firms and how their financial statement value relevance compares against the low-technology firms over the past two decades. Furthermore, the already mentioned Internet firms are a special case of high technology that emerged during the time period under investigation. It is therefore interesting to check how these firms compared against the other high technology firms, particularly after the Internet Bubble of the 1999 that is believed to have altered the perception of IT firms and their business. The research question of this thesis is as follows:

Is accounting value relevance different in high-tech firms compared to low-tech firms over the time period of 1990 to 2010? Is this relevance more different in the IT sector compared to other high-tech firms after the Internet Bubble of 1999?

My thesis contributes to existing research in several ways. First of all, I try and address the assumptions of the Ordinary Least Squares, the research method of interest, to the fullest extent possible. I maintain correct inferences by computing heteroskedasticity robust standard errors using White's (1980) estimation, same as done in prior research. On the other hand, standard usage of OLS normally suffers from correlated omitted variables – I assume this problem to be of minor importance since the methodology relies upon the model fit, captured by the adjusted R-squared value, obtained by regressing firm's market performance on financial statement items. Coefficient significance is thus of secondary importance. Secondly, I make a very specific distinction between high-tech and low-tech as well as IT versus the other high-tech sectors in my difference-in-difference regressions, performed while controlling for first-order autocorrelation using Generalized Least Squares (GLS) methodology. Studies by Francis and Schipper (1999) and Core et al. (2003) were one of the first ones that attempted to separate the two groups, however, their efforts were directed more towards the overall market rather than high-tech only. I believe their interpretations serve the foundation of my research well but are of incomplete structure. Next to that, I try to address the change factor in value relevance research by using Fama-French industry database and selecting those industries that produce most of the innovative products as perceived by the general public. Finally, I use scale effects introduced in Brown et al. (1999) on two dimensions to obtain evidence on how investors judge financial items and their relevance based on growth prospects (book value scaling) and overall stock market performance (market value scaling).

As mentioned already, the methodology relies upon adjusted R-squared values obtained from regressions of market performance on financial statement items as a measure of value relevance. To check for differences between high-tech and low-tech, I regress these adjusted

R-squared values on a time variable interacted either with high-tech or IT sectors, and several control variables, first used in Collins et al. (1997). The average R-squared values are higher for the high-tech category in most cases under investigation but not to a large extent – the differences fluctuate mainly between 0% and 5%. Time regressions present somewhat mixed results, especially when looking upon the separate coefficients estimated using different scalings. Nevertheless, the evidence points toward a lower value relevance of assets and liabilities for the high-tech industries compared to low-tech industries under book value scaling scenario only. Research and development expense, although believed to be of bigger importance in the high-tech sector, is not significantly different from low-tech under both scaling specifications. With respect to IT sector, the results also appear mixed but still point toward a specific direction, this time to an increased value relevance of book values after the Internet Bubble under market value scaling scenario. Goodwill and cash flows plus accruals did not become significantly more value relevant for IT firms compared to other high-tech firms post the Bubble, with the exception of goodwill becoming more value relevant under book value scaling scenario only.

The thesis proceeds as follows: section 2 describes theoretical interpretations of high technology, presents the most relevant literature to date and outlines hypotheses development. Section 3 describes the data, sample selection procedures and research methodology. Section 4 discusses the results for high-tech versus low-tech industries. Section 5 discusses the results for IT versus other high-tech industries. Section 6 concludes.

2 Theoretical Framework

2.1 What is high technology?

There are many topics of discussion about high technology and its long-term perspectives with regards to increasing standards of living and booming economies. But what does the concept mean in general? The fundamental definition states that firms specializing in high-tech hold the potential for highest future growth. Because of these long-term outlooks, such activities attract large venture capital investments in hopes of spectacular returns (Elcock, 2013). The general trend is that over the past couple of decades the start-up companies specialize in IT and computer science, an industry not saturated enough, meaning there is more room for innovations and possible opportunities to quickly become market leaders.

However, misconceptions arise upon defining high-tech companies. Those in the IT and semiconductor industries, for instance, produce high technology products but firms operating in, say, aerospace or pharmaceuticals spend a lot on research and development and use most up-to-date equipment to increase their production volumes. The output is not in itself high-tech but is produced *using* high-tech. Therefore, the purpose of this section is to present the multiple existing definitions of high technology.

Bielawska (2010) points out that there is no unambiguous and commonly approved definition of high-tech. She identifies high technology companies as the ones most dependent on knowledge and human resources. Besides the traditional features such as innovative activities and investments in R&D, other characteristics such as fast obsolescence, increased competition in international trade, quick investment devaluation and high levels of employment of scientific and technical personnel are also used to differentiate between high and low tech industries. The conclusion of this short study addresses the previously stated misconception in a sense that all high technology companies are innovative, knowledge-based and use modern information technology, however, not all firms to whom these principles also apply are high-tech. As many approaches as there are, due to constantly changing perception of a high-tech enterprise, more precise explanations are believed to emerge in the future. Wolf and Terrell (2016) take a slightly different approach and emphasize high concentrations of workers in science, technology, engineering and mathematics as an important component of a high-tech industry. Interesting is the fact that employment in such industries increased during the recession years while the other sectors were losing jobs. However, the dot-com Bubble triggered a drop in the demand of technical and scientific personnel and it took longer for these jobs to be recovered compared to other industries. This leads to a conclusion that high-tech firms are hit harder by crises that specifically target them. Steenhuis and Bruijn (2006) question the reliability of R&D expenses as an indicator of high-tech industries. They address a positive correlation between high wages and employment in high-tech sector, however, exemptions apply to industries such as aircraft that spends a lot on R&D but does not pay high wages due to simple assembly jobs. Therefore, they distinguish between industry, firm, product and life cycle based definitions. Industry level is the most commonly applied measure: once it is classified as high technology, all companies in such an industry are considered high technology. The other three definitions focus on product obsolescence and quick product updates, same as described above. To derive a more comprehensive definition of the concept, the authors combine product and process complexity with product development rate. This means that products can be of a complicated nature but easy to assemble and vice versa. Since technologies advance over time, companies must also keep up with the pace: therefore, upon merging these three dimensions of high technology the authors construct a table that classifies technology into low, low-medium, medium-high and high. This is the methodology also followed by the Organization for Economic Cooperation and Development (OECD).

In light of all the definitions, each company nowadays is at least slightly exposed to certain levels of high technologies, either the production of it or its usage. As complex as those definitions are, they give quite a clear overview as to how high technologies are perceived and how the concept is evolving in terms of its application in different circumstances.

2.2 Literature review

There is a considerable body of research on the value relevance of accounting items and its evolution over time. However, the literature focusing on applications to particular sectors has been scarce, especially high-tech due to difficulties to properly separate them from all other sectors. This section will therefore present the most important scholarly work to date in more detail.

2.2.1 Pioneer research

Aside from the general theoretical explanations in accounting, researchers were trying to discover empirical evidence that would confirm or disconfirm a stated observation. Over time, they started implementing more sophisticated techniques that address the assumptions inherent in theoretical explanations. At the outset of value relevance research, however, no such models could accurately capture an effect that is free from any bias in sample selection or omitted variables. Ball and Brown (1968) followed an event study approach where they were trying to figure out how useful accounting earnings are in a context of predicting stock returns. Therefore, one of the theoretical assumptions in this study was that markets are efficient, meaning that all available information is reflected in stock prices and easily accessible to everyone. That is, the information asymmetry is minimized. As a result of their research, the authors conclude that about one half of the available information is captured within accounting earnings number and the rest by more prompt media sources. Feasible as they may sound, the results were not regarded as convincing due to simplistic analytical techniques and small datasets. Nevertheless, the paper gained acceptance over time as further research emerged that tried to address the problems unresolved in the original work. The study is still considered pioneer since it was the very first one to address accounting value relevance from an empirical standpoint.

2.2.2 Links between accounting measures

To make more sense of information content methodology, it is reasonable to search for any existing links between the variables of interest. The purpose of the study by Easton (1985) was to provide empirical evidence of the information link between accounting data (earnings) and the future stream of benefits from an equity investment, and a valuation link, between the future benefits and security price. Value, the key input of this research, is calculated as the present value of expected future benefits of share ownership. The expected future benefits are unobservable and are thus captured by the market-measures of information due to their equivalence with security prices, namely the ex post dividend realizations. Since future cash receipts is the variable about which accounting data should provide information and the formula to determine risk-adjusted dividend capitalization is a widely used one, the dividend realizations are chosen to present the expected future benefits in the process of determining the valuation link. Regarding information link, the data that is the most reliable and accessible to every investor should be used and no other metric than accounting data could better represent starting points for investment decisions. More specifically, unsophisticated investors tend to look at the bottom line of the income statement – net earnings. Indeed, they are readily available and widely used in both popular press and academic research, therefore no exceptions apply here either. The method used by the author is a regression of security prices or earnings (the easily available pieces of information) on dividend capitalization (the implicit measure, calculated using market-based inputs). There is a statistical significance in all of the conducted regressions of the sample period, indicating that accounting earnings are a useful summary about the future cash receipts from an equity investment. On top of that, security prices provide extra power for this statistical relationship, which means some information is not entirely captured within accounting earnings. However, such simplistic analysis does not provide deeper insights into the true relationship between the variables: no controls are taken into consideration, meaning that the resulting correlation is likely to be spurious. Due to that, the observed correlation should not be treated as a causal effect – the conclusions of this paper are therefore subject to careful scrutiny.

2.2.3 Industry analysis

Financial measures, as discussed above, contribute to investor perceptions of firm value to a certain extent. Now, delving a little bit to industry analysis, there could be instances where this relationship is not so apparent. Amir and Lev (1996) investigate cellular companies and compare them against simple industrial firms listed on the New York Stock Exchange. The latter portion of the sample is expected to exhibit patterns observed in virtually every study on value relevance – accounting earnings and their changes (if applicable) are positively related to stock returns (or prices). The cellular industry, as the authors observed, was characterized by consistent reporting of negative quarterly earnings. At the onset of the 1980s, the industry started emerging rapidly and progressively taking a larger portion of the market share. The average annual growth rate of subscribers over almost a decade was 62% - consistent with the definition of high-tech that emphasizes a fast moving environment, the cellular industry could be clearly characterized as a high-tech industry at that time. In addition to that, the research and development expenses together with customer acquisition costs, franchise, brand development and other investments in intangibles contributed to a large share of expenses for the vast majority of companies in the industry, which once again confirms the nature of high-tech industries to attain competitive positions by investing heavily in intangible assets – therefore, it is not surprising to see negative net income and book value numbers in the financial statements of these companies. Indeed, when comparing financial ratios, such as the market-to-book ratio of cellular companies against the rest of companies listed on the NYSE, striking differences can be spotted. The market values are disproportionately larger due to investors buying shares of high-tech firms for reasons specified earlier in this paper. As a result of price regressions, the financial statement data is largely irrelevant for these firms, confirming the notion that investors have hopes for future returns. On the other hand, non-financial information appears to exhibit different conclusions, however, this part of research is not relevant for this paper and thus will not be addressed any further.

2.2.4 Traditional empirical approach of value relevance

Other researchers focused not only on separate relevance of financial statement information but also on the combination of certain items. Collins et al. (1997) investigate this issue in depth by isolating the stand-alone effects of earnings and book values as well as both at the same time by using the explanatory power of yearly regressions as an indicator of a change in value relevance. It was long believed that financial statements have lost their value relevance because of wholesale changes in the economy. This is only partially true as evidenced by the results of the study – there appears to be a shift from earnings to book values over time. More pronounced emergence of a high-tech economy relative to industrialized one is also addressed. The four factors believed to be associated with the mentioned shift are investments in intangibles, frequency and magnitude of special items, incidence of negative earnings and growing number of small firms. Since certain kinds of intangible assets are not required to be reported on firm's financial statements (for example, R&D), the accounting information might not be very useful to assess values of companies that are likely to have large amounts of unrecorded intangibles. Special item incidence is also believed to have caused the decline in value relevance since these items are transitory and often negative, as observed empirically. More firms also started reporting negative earnings – it comes as no surprise that such phenomena force the shift of relevance from earnings to book values. Furthermore, as costs of financial distress become larger, the book values absorb a greater portion of financial statement value relevance – the abandonment value of a firm becomes more relevant as well. Finally, smaller firms are more likely to report losses, which means the earnings persistence is low and thus book values are more value relevant. The first set of results demonstrates that the value relevance of earnings has decreased, the one for book values has increased and the combination of the two has increased slightly.

When controlling for the four factors described above, the results are not that convincing, suggesting there could be unobserved changes in GAAP or any real economic changes that are not directly addressed in this research.

In contrast, other studies document a decline in the financial statement relevance. Lev and Zarowin (1999) articulate that this downward trend is due to change that is forced by innovation, competition and deregulation, altering firm operations and economic conditions not properly reflected by the reporting system. The common activities associated with this change are the same as specified by Amir and Lev (1996) in their analysis on cellular companies, which result in improper matching of expected benefits with costs. Next to the common analysis of earnings and book values, Lev and Zarowin also look at how the earnings response coefficients as well as cash flows react to this change. On both measures there is a declining relevance over a period of 20 years, only for cash flows it is slightly less pronounced due to them being harder to manipulate and their immunity to change-related items. Same results appear when replacing stock returns with stock prices, although the research by Collins et al. (1997), as previously discussed, finds that there is no drop in the overall value relevance. The reason for this was the time period chosen since it can significantly affect the conclusions with the inclusion of new firms over just a few years. Furthermore, the authors investigated whether firms who experience movements in their book and market values of equity are associated with larger magnitudes of value relevance changes. Those firms who experience shifts in their book and market values have a larger decline in financial statement informativeness. Same conclusion holds for firms with larger movements in R&D intensity levels. The aspect in which this research differs from the ones discussed before is that it offers two solutions how to improve the usefulness of financial statements, namely by capitalizing intangible investments and by restating financial reports. The former solution aims to provide more information to investors about the progress and success of innovation-producing activities. However, since some accounting standards require immediate expensing of costs related to certain activities and capitalizing opens room for earnings management, this solution is still not a perfect guide to deal with the problem at hand. With regards to restatements, if there were misinterpretations in historical financial data, the restated version of a report could help resolving uncertainties and portray more realistic patterns of accounting data and prospects.

2.2.5 High-tech versus low-tech

Francis and Schipper (1999) reinforce the existing research by concentrating on two different methods to capture relevance to investors as well as by making a distinction between low technology and high technology industries. Apart from the explained variation tests used widely by researchers, this study makes use of portfolio returns tests because they control for changes in the volatility of market returns over time. Furthermore, they also use rank tests next to the standard OLS regressions to overcome the potential bias that can be caused by the linearity assumption of the OLS. In line with previous research, this study also documents a fall in value relevance of earnings and a slight increase in the relevance of book values & earnings. Due to lack of power for the tests used in the analysis, the overall conclusion is that the evidence presented is mixed. The argumentation for a greater drop in relevance for high-tech firms once again rests upon greater expensing of R&D and unrecorded intangibles. Interestingly, the authors do not find a significant difference between high and low tech industries and thus cannot attribute the drop in the overall value relevance based on earnings to the increase in high-tech firms over time. There is only very minor evidence of low-tech firms exhibiting larger accounting value relevance.

2.2.6 Some evidence from the IT sector

To touch upon the information technology sector, which is widely associated with high technologies these days, Muhanna and Dale Stoel (2010) investigated firms with IT intensive operations and how they are related to overall value. Two aspects are stressed – IT capability and IT spending. The former faces challenges of operationalization but is of relevance in determining firm value using information *beyond financial information disclosed in company filings*. The latter, on the other hand, does not exhibit sufficient evidence of a reasonable impact on firm value. Moderating effects have also been found – more complex and munificent industries appear to strengthen the relationship between IT capability and market value. Results with regards to dynamism are less conclusive.

In terms of Internet firm valuation, a lot of ambiguities exist upon the right methodology for this task. The enormous jump in their market values in a short period of time forced researchers to reconsider whether basic accounting line items are really that powerful in helping investors to decide. Contrary to such claims, Hand (2000) finds that for a sample of Internet firms some accounting metrics are actually value relevant – their market values are linear and increasing in book equity and concave and increasing (decreasing) in positive (negative) net income. When earnings are decomposed into revenues and expenses, large marketing costs and R&D expenditures are treated as capitalized intangible assets and together they establish a positive relationship with market values, confirming the fact that certain income statement items are of relevance. Research by Trueman et al. (2001) derives another drawback of traditional valuation methods for IT firms – the relatively short time series of financial information. However, the authors propose a different view from that of Hand (2000) and find limited use of financial statement information for Internet stock valuation purposes with the sole exception of gross profits being value relevant since they reflect firm's operating performance. The bottom line earnings, on the other hand, can contain large transitory items that are often treated as investments rather than expenses. Non-financial information is proven to be of a relatively larger relevance – measured by unique visitors and page views, the initial predictions are confirmed, also after decomposing the sample into sub-categories prevalent in IT firms, namely e-tailers and portal and content/community firms. Demers and Lev (2001) corroborate the findings about the relevance of non-financial measures particularly focusing on the Internet shakeout in early 2000. Specifically, web traffic performance factors of reach and stickiness are proven to be of significant importance, contrary to analysts' claims at that time. The study enhances the findings by finding associations between increased value relevance of market values with top-line earnings (revenues) and cash flows.

2.3 Other Literature

The previous section outlined the most important literature about value relevance perceptions. Of course, the list is by no means exhaustive and does not address everything that has been done in this field so far. Therefore, the purpose of this section is to provide some additional insights into the topic by briefly describing the main takeaways of some extra papers. The following studies comprise not only the issue at hand but also some regulatory background that motivates the observed shift of accounting numbers away from earnings to book values, especially for high-tech industries.

Sever and Boisclair (1990) anticipated the uncertain future of financial statements in the early 1990's. Although the primary focus was how the statements will be perceived and if they will not become too difficult to understand, it can be very much inferred that the rapid emergence of high-tech companies can alter the entire perception of financial statements and whether the information in them, complicated or not, will be of any added value to investors. This view is supported by Rimerman (1990) who argues that financial statement users are turning to other sources of information because the financials alone are becoming less helpful in some cases. The role of Certified Public Accountants is thus facing a challenge of how to "resurrect" financial reports and make investors more aware of the information they contain. Elliott and Jacobson (1991) re-emphasize the issue for the U.S. economy and point out that public bodies like FASB and SEC should intervene and address the concerns. Furthermore, they focus on how to account for off-balance sheet items that have become prevalent in the information era. Jenkins (1994) states that users still somehow obtain the information despite the shortcomings of financial statements. However, this imposes extra costs in doing so. He suggests surveying users and preparers of reports as well as regulators to understand their needs and incorporate the feedback into updating the overall information content of financial information.

Academic research recognized the importance of the issues presented. Aside from the key studies discussed in the previous section, several other researchers attempted to explain the shifts in value relevance. Ely and Waymire (1999) corroborate the findings of Collins et al. (1997) and Francis and Schipper (1999) in terms of increased combined relevance of earnings and book values but they do not conclude that earnings relevance increased due to accounting standard setting bodies and subsequent reorganizations of accounting standard setting processes. Instead, they suggest that specific accounting standards and their effects on value relevance should be examined. Causal inference is also believed not to be addressed properly here. Aboody and Lev (1998) investigate capitalization versus expensing of development costs and conclude that petitions against certain accounting standards concerning expensing of software costs are too aggressive. Even though capitalizing these costs result in assets of questionable benefit-bringing ability being recorded in the balance sheet, they are positively related with capital market variables and future earnings. Analysts' earnings forecasts, on the other hand, are proved to contain larger errors. Brown et al. (1999) question the usefulness of R-squared as a measure of value relevance by arguing that it is subject to scale effects. If they are not properly controlled for, either by taking into account the coefficient of variation or by deflating individual observations by a proxy of scale, the conclusions about value relevance based on R-squared can be completely different, as proven by reiterating the research of Collins et al. (1997) and Francis and Schipper (1999).

More recent research also advocates the methodology used in all previous studies and complements it with extra factors believed to change the usual pattern. Core et al. (2003) name the transition to high-technology the "New Economy" and provide additional evidence that performance of young firms cannot be determined by traditional financial variables but that the entire research in this field is heavily influenced by omitted correlated variables. Dontoh et al. (2004) and Dontoh et al. (2007) discover that the decline in value relevance is driven by an increase in non-information-based trading and that noise in stock prices makes them a less reliable metric to assess relevance. Balachandran and Mohanram (2011) consider accounting conservatism as having impact on the observed decline. However, their evidence does not provide any conclusions on that. Holthausen and Watts (2001) and Barth et al. (2001) provide extensive reviews on value relevance literature and signify the absence of relatable theories and the inapplicability of accumulated evidence to standard setting policies.

2.4 Hypotheses Development

One distinction that divides the analytical part of this thesis is the separation of industries into high-tech and IT sectors. Because the general definition of high-tech encompasses some industries that are mature, their properties can be different from those operating in a relatively younger computer and Internet industry. The paragraphs below outline the hypotheses to be tested, both for the high-tech sector and IT.

As high technology firms boast the largest growth potential, their primary focus lies within pitching themselves to capital investors about their future prospects rather than presenting financials accurately. Due to a high demand of knowledge intensity and scientific personnel to carry out tasks related to the innovative activities of the company, the items of financial statements in such companies may not be a perfect guide for the investors seeking to make profits. Special items, which are negative in most cases, are believed to be the main cause for the drop in earnings relevance, as articulated in prior studies, such as Collins et. al (1997). My first hypothesis is divided into three parts:

H1a: Earnings are less value relevant for high-tech industries compared to low-tech industries in the past two decades

H1b: Book values are less value relevant for high-tech industries compared to low-tech industries in the past two decades

H1c: Earnings & book values are less value relevant for high-tech industries than for low-tech industries in the past two decades

It is of no surprise that continuous research and development is prevalent in high technology sector. The usual proportions of funds spent on R&D activities relative to total expenses are much higher in such firms. Thus, it is sensible to believe that these items would exhibit higher value relevance in high-tech industries. The second hypothesis is thus:

H2: R&D expenses are more value relevant for high-tech industries than for low-tech industries in the past two decades

Touching upon the IT sector, it is interesting to investigate whether investors became more cautious about the firms operating in this sector after the Internet Bubble burst at the end of the last century. It is highly likely to observe the same patterns of value relevance since the IT industries are undoubtedly part of the overall high-tech sector. As the point of focus here is the Internet Bubble, which is a special case for the IT firms, there might be instances that forced investors to reconsider the usefulness of financial statements after they lost billions from their investments. The third hypothesis is again split into three parts, investigating separately each case of financial statement value relevance and the combination of both:

H3a: Earnings became more value relevant in the IT sector compared to other high-tech firms after the Internet Bubble

H3b: Book values became more value relevant in the IT sector compared to other high-tech firms after the Internet Bubble

H3c: Earnings & book values became more value relevant in the IT sector compared to other high-tech firms after the Internet Bubble

The hype in the Internet companies generated a lot of market value for them. When firms engage in acquisitions, their purchase considerations are often higher than the net assets of a target company. Upon an acquisition, this difference is recorded as goodwill. Since there was a lot of overvaluation of Internet companies before the Bubble, it is likely they had values of goodwill way larger than they should have been. After the Bubble burst, the stock prices plummeted and a lot of firms either went private again or filed for Chapter 11. Due to such turmoil, the surviving IT companies were placed under a more watchful eye. The fourth hypothesis is as follows:

H4: Goodwill became less value relevant in the IT sector compared to other high-tech firms after the Internet Bubble

Investors knew that the main message of the dot-com Bubble was that Internet firms were overvalued. Therefore, the supposedly large numbers of goodwill, resulting from offering a large acquisition price, could not be more value relevant after the Internet shock.

The change in regulation in 1987 that required companies to issue cash flow statements each year makes it easier to investigate cash flows and their associated value relevance in the chosen period. Lev and Zarowin (1999) claim that operating cash flows are subject to less managerial manipulation than earnings and are thus claimed to be more informative. Sloan (1996) finds evidence of higher performance of earnings as a result of cash flows compared to the accrual component and its associated effect on earnings performance. Firms with higher levels of accruals exhibit negative future abnormal stock returns as well. Pfeiffer Jr. et al. (1999) build on this topic by separating the accruals into current and non-current components and find no significant differences between valuations of cash flows and accruals.

Since both elements can have different valuation implications, they have proven to be of a more important nature than bottom-line earnings. For the case of IT firms, I expect cash flows and accruals to exhibit higher value relevance compared to other high-tech firms after the Internet Bubble as the IT sector was more susceptible to how well they manage their cash flows and associated accruals to help them overcome potential delisting or even bankruptcy. My last hypothesis is thus:

H5: Cash flows and accruals became more value relevant in the IT sector compared to other high-tech firms after the Internet Bubble

3 Data and Research Methodology

3.1 Sample selection

3.1.1 High-tech industries

Table 1: Sample selection procedure for high-tech industries

Criteria	No. of observations
Raw Dataset	263.780
Removing missing values of R&D, net income, EBITDA, total assets and liabilities, market value of equity, stock price, special items and intangible assets	(194.483)
Intermediate sample #1	69.297
Removing negative and zero asset, liability and equity values	(6.370)
Intermediate sample #2	62.927
Removing financial firms	(2.444)
Intermediate sample #3	60.483
Removing observations with gaps in time series	(21.685)
Intermediate sample #4	38.798
Removing unique observations	(1.079)
Intermediate sample #5	37.719
Removing missing observations due to lagged values	(5.380)
Final sample	32.339

Table 1 above summarizes the steps taken to construct the final sample of data used in this research. The raw dataset consists of 263,780 firm-year observations between 1990 and

2010. Company financials are retrieved from COMPUSTAT database. Stock prices are obtained from CRSP for the purposes of computing market value of equity. After removing missing values from all dependent and independent variables, the sample shrinks to 69,297 observations, mainly due to many firms not reporting their research and development expenses. Following prior studies of Collins et al. (1997), Brown et al. (1999) and Core et al. (2003), I remove negative asset, liability and equity values, which reduces the sample size further to 62,927 observations. I exclude financial firms (SIC codes 6000-6999) because many of their financial items are subject to different reporting rules and are of different nature, for instance, revenues being negative. To generate lagged values, I remove firms with gaps in their time series and firms with only one year of data. The final sample size is 32,339. Appendix A contains variable descriptions. Table 2 below contains descriptive statistics.

Table 2: Descriptive statistics for the low-tech subsample (Panel A), high-tech subsample (Panel B) and the total sample (Panel C)

Variable	*N*	*Mean*	*St. Deviation*	*Min*	*Max*
Panel A: Low-Tech Sample					
MB	18687	3,64	6,13	0,14	49,24
MM	18687	1,247	0,96	0,104	7,32
NIB	18687	-0,05	0,55	-3,87	0,99
NIM	18687	-0,03	0,26	-1,51	0,41
EBITDAB	18687	0,19	0,55	-3,09	1,74
EBITDAM	18687	0,13	0,25	-0,85	1
ATB	18687	2,69	2,28	0,49	15,63
ATM	18687	1,73	1,94	0,07	10,94
LTB	18687	1,48	1,82	0,038	11
LTM	18687	0,956	1,4	0,009	7,83
XRDB	18687	0,09	0,2	0	1,96
XRDM	18687	0,04	0,08	0	0,63

Panel B: High-Tech Sample					
MB	13652	5,228	8	0,14	49,24
MM	13652	1,329	1,218	0,104	7,32
NIB	13652	-0,25	0,72	-3,87	0,99
NIM	13652	-0,1	0,27	-1,51	0,41
EBITDAB	13652	-0,07	0,67	-3,09	1,74
EBITDAM	13652	-0,004	0,22	-0,85	1
ATB	13652	2,18	2	0,49	15,63
ATM	13652	0,968	1,129	0,07	10,94
LTB	13652	0,917	1,323	0,038	11
LTM	13652	0,41	0,719	0,009	7,83
XRDB	13652	0,29	0,36	0	1,96
XRDM	13652	0,11	0,12	0	0,63
Panel C: Total Sample					
MB	32339	4,31	7,03	0,14	49,24
MM	32339	1,28	1,08	0,104	7,32
NIB	32339	-0,14	0,64	-3,87	0,99
NIM	32339	-0,06	0,27	-1,51	0,41
EBITDAB	32339	0,08	0,62	-3,09	1,74
EBITDAM	32339	0,07	0,25	-0,85	1
ATB	32339	2,477	2,18	0,49	15,63
ATM	32339	1,41	1,69	0,07	10,94
LTB	32339	1,24	1,65	0,038	11
LTM	32339	0,725	1,19	0,009	7,83
XRDB	32339	0,18	0,3	0	1,96
XRDM	32339	0,07	0,11	0	0,63

Since the sample contains some very extreme values, all variables are winsorized at their 1st and 99th percentiles. As the formal numerical tests for normality are the most powerful for sample sizes no bigger than 5000 observations, they cannot be used to check for this property in this research because even the slightest deviations from the mean in such samples can cause severe shifts in p-values, affecting the inference of the results.

As is apparent from the table above, high-tech industries are subject to larger average research and development expenses than low-tech industries. Market values scaled by either lagged book or market values of equity (MB and MM) are also larger for high-tech industries (as in Amir and Lev (1996)). Finally, assets, liabilities, EBITDA and net income are lower in high-tech category, confirming the usual trends observed in prior research.

3.1.2 IT Sector

Table 3: Sample selection procedure for IT sector

Criteria	No. of observations
Raw Dataset	263.780
Removing missing values of net income, operating cash flows, EBITDA, total assets and liabilities, market value of equity, stock price, special items, intangible assets, goodwill and year 1990	(137.248)
Intermediate sample #1	126.532
Removing negative and zero asset, liability and equity values	(11.819)
Intermediate sample #2	114.713
Removing financial firms	(16.087)
Intermediate sample #3	98.626
Removing observations with gaps in time series	(35.520)
Intermediate sample #4	63.106
Removing unique observations	(1.678)
Intermediate sample #5	61.428
Removing missing observations due to lagged values	(8.917)
Intermediate sample #6	52.511
Keeping only high-tech industries	(34.982)
Final Sample	17.529

The criteria for IT sample selection differ along three dimensions. First of all, I do not exclude observations with missing R&D data since this variable is not of interest for my hypotheses on IT sector. Secondly, I exclude year 1990 due to insufficient number of observations for that year. Finally, for the purpose of comparing value relevance of IT sector versus the rest of the high-tech sector, I only keep the high-tech subsample[1]. The rest of the sample selection procedure is very similar to the one described previously.

Table 4: Descriptive statistics for the Non-IT sample (Panel A), IT sample (Panel B) and the total sample (Panel C)

Variable	*N*	*Mean*	*St. Deviation*	*Min*	*Max*
Panel A: Non-IT Sample					
MB	16300	4,77	7,7	0,14	53,33
MM	16300	1,32	1,24	0,89	8,47
NIB	16300	-0,218	0,783	-5,12	1,11
NIM	16300	-0,085	0,29	-1,62	0,43
EBITDAB	16300	0,006	0,71	-3,74	1,95
EBITDAM	16300	0,036	0,257	-0,95	1,03
OANCFB	16300	-0,029	0,62	-3,31	1,58
OANCFM	16300	0,023	0,224	-0,83	0,87
ACCB	16300	-0,19	0,457	-2,88	1,11
ACCM	16300	-0,11	0,254	-1,55	0,41
ATB	16300	2,45	2,459	0,463	18,28
ATM	16300	1,22	1,42	0,06	9,25
LTB	16300	1,159	1,7	0,035	11,58
LTM	16300	0,578	0,95	0,009	6,53
GDWLB	16300	0,247	0,52	0	3,53
GDWLM	16300	0,119	0,248	0	1,48
Panel B: IT Sample					
MB	1229	5,3	9,34	0,14	53,33
MM	1229	1,4	1,51	0,89	8,47
NIB	1229	-0,272	0,876	-5,12	1,11
NIM	1229	-0,109	0,318	-1,62	0,43
EBITDAB	1229	-0,006	0,738	-3,74	1,95
EBITDAM	1229	0,019	0,269	-0,95	1,03
OANCFB	1229	-0,029	0,663	-3,31	1,58
OANCFM	1229	0,014	0,234	-0,83	0,87
ACCB	1229	-0,246	0,515	-2,88	1,11
ACCM	1229	-0,128	0,275	-1,55	0,41
ATB	1229	2,7	3,13	0,463	18,28
ATM	1229	1,246	1,55	0,06	9,25
LTB	1229	1,348	2,204	0,035	11,58
LTM	1229	0,61	1,1	0,009	6,53
GDWLB	1229	0,335	0,69	0	3,53
GDWLM	1229	0,149	0,3	0	1,48

[1] This procedure keeps 1229 firm-year observations in the IT sector. If I do not drop the low-tech subsample, this number becomes 1500. This difference, in my opinion, is not substantial

Panel C: Total Sample					
MB	17529	4,81	7,82	0,14	53,33
MM	17529	1,327	1,263	0,89	8,47
NIB	17529	-0,222	0,79	-5,12	1,11
NIM	17529	-0,087	0,285	-1,62	0,43
EBITDAB	17529	0,005	0,716	-3,74	1,95
EBITDAM	17529	0,035	0,258	-0,95	1,03
OANCFB	17529	-0,029	0,627	-3,31	1,58
OANCFM	17529	0,022	0,225	-0,83	0,87
ACCB	17529	-0,198	0,461	-2,88	1,11
ACCM	17529	-0,11	0,256	-1,55	0,41
ATB	17529	2,47	2,51	0,463	18,28
ATM	17529	1,22	1,43	0,06	9,25
LTB	17529	1,17	1,74	0,035	11,58
LTM	17529	0,58	0,96	0,009	6,53
GDWLB	17529	0,253	0,534	0	3,53
GDWLM	17529	0,121	0,252	0	1,48

As expected, IT firms have higher average values of goodwill. Market value scaled by book value is very comparable between IT and non-IT firms as well as net income (EBITDA), asset and liability values, making the descriptive statistics look slightly different from the ones on high versus low-tech samples. The winsorization criteria are the same as outlined in the previous sub-section.

3.2 Research Methodology

3.2.1 High-tech industries

For the entire analysis, I use the residual income valuation model, developed by Ohlson (1995) and Feltham and Ohlson (1995) and used very commonly in value relevance research. I test hypothesis 1 with the standard OLS equations below:

(1) $(M_t/B_{t-1}) = \beta_0 + \beta_1(NI_t/B_{t-1}) + \varepsilon_t$

(2) $(M_t/B_{t-1}) = \beta_0 + \beta_1(AT_t/B_{t-1}) + \beta_2(LT_t/B_{t-1}) + \varepsilon_t$

(3) $(M_t/B_{t-1}) = \beta_0 + \beta_1(NI_t/B_{t-1}) + \beta_2(AT_t/B_{t-1}) + \beta_3(LT_t/B_{t-1}) + \varepsilon_t$

I scale all variables by book value of equity as in Core et al. (2003) to tackle the problem of scale effects raised in Brown et al. (1999). (M_t/B_{t-1}) represents market value of equity in year t over book value of equity in year t-1, NI_t/B_{t-1} is earnings of a firm in year t over its book value of equity in year t-1, (AT_t/B_{t-1}) and (LT_t/B_{t-1}) are assets and liabilities in year t over book value of equity in year t-1, respectively. For hypothesis 2, I estimate the following:

$$(4)\ (M_t/B_{t-1}) = \beta_0 + \beta_1(XRD_t/B_{t-1}) + \varepsilon_t$$

XRD_t/B_{t-1} is research and development expense in year t over book value of equity in year t-1. I use an alternative scaling of lagged market value of equity in all four equations.[2]

The purpose of the above equations is not to compare the significance of the coefficients but to rather check the model fit. It is said that an accounting item is value relevant if it helps to explain the variation in market values. Therefore, this analysis rests on the assumption of efficient markets, formally developed by Fama (1970). I run regressions (1) to (4) on each year in the sample and obtain 21 adjusted R-squared values, both for the high-tech and low-tech sub-samples (42 in total per equation). I then regress each group of the extracted R-squared values separately on the following variables using difference-in-difference estimation (I use GLS to control for first-order autocorrelation, same as in Collins et al. (1997)):

$$(5)\ R^2 = \beta_0 + \beta_1 TIME_t + \beta_2 HIGHTECH + \beta_3 TIME_t * HIGHTECH + \beta_4 ONE_t + \beta_5 ONE_t * HIGHTECH + \beta_6 LOGSIZE_t + \beta_7 LOGSIZE_t * HIGHTECH + \beta_8 PCHT + \beta_9 PCHT * HIGHTECH + \beta_{10} LOSS_t + \beta_{11} LOSS_t * HIGHTECH + \varepsilon_t$$

TIME is a trend variable corresponding to the years in the sample – 1 for 1990, 2 for 1991 etc. HIGHTECH is a dummy variable equal to 1 for high-tech industries and 0 otherwise, ONE is the mean absolute value of special items as a percent of net income for the high-tech and low-tech subsamples in year t, LOGSIZE is the natural logarithm of the average market value of equity for the high-tech and low-tech subsamples in year t, PCHT is the percentage of firms in high-tech industries and LOSS is the percentage of high-tech and low-tech firms in year t with negative net income. All control variables are the same as in the R-squared regressions in Collins et al. (1997) with the following exceptions: first, I calculate variables ONE, LOGSIZE and LOSS for both subsamples per year rather than for the entire

[2] That means, all items in equations (1) to (4) are scaled by lagged market value of equity instead of lagged book value of equity

sample, and second, I use interaction terms to determine the differential value relevance across industries and how it has changed over time. The coefficient of interest is thus β_3. If it is positive (negative), then the associated financial statement items are more (less) value relevant in the high-tech sector over the past two decades.

To investigate the differences between high-tech and low-tech industries, I use two methods. First of all, I follow Francis and Schipper (1999) and classify industries into high-tech subsample by their likelihood of having significant unrecorded intangible assets.[3] The second method is the Fama-French 48 industry classification, targeted to address the change factor of industries. After grouping all industries in the sample, I select industries numbered 13, 22, 32, 34, 35 and 36 to be included in the high-tech subsample. The list of Fama-French industries is included in Appendix B.

3.2.2 IT sector

To analyze the IT sector, I run regressions (1) to (3) in a similar fashion (hypothesis 3). For hypotheses 4 and 5, I estimate the following regressions, respectively:

(6) $(M_t/B_{t-1}) = \beta_0 + \beta_1(GDWL_t/B_{t-1}) + \varepsilon_t$

(7) $(M_t/B_{t-1}) = \beta_0 + \beta_1(OANCF_t/B_{t-1}) + \beta_2(ACC_t/B_{t-1}) + \varepsilon_t$

GDWL is goodwill, OANCF is operating cash flow and ACC is total accruals, calculated by subtracting the operating cash flows from the earnings of a company. Again, I re-run the equations using market value scaling. To check for a difference in relevance after the Internet Bubble, I use an equation similar to (5) (again controlling for first-order autocorrelation):

(8) $R^2 = \beta_0 + \beta_1 POST_t + \beta_2 IT + \beta_3 POST_t * IT + \beta_4 ONE_t + \beta_5 ONE_t * IT + \beta_6 LOGSIZE_t + \beta_7 LOGSIZE_t * IT + \beta_8 PCHT + \beta_9 PCHT * IT + \beta_{10} LOSS_t + \beta_{11} LOSS_t * IT + \varepsilon_t$

POST is a dummy variable that equals 1 for years 2000-2010 and 0 otherwise. Control variables are the same as described in the previous section, with the only exception of calculating the values per year based on the IT and non-IT samples.

[3] These industries are classified by the 3-digit SIC codes of 283, 357, 360, 361, 362, 363, 364, 365, 366, 367, 368, 481, 737 and 873

The determination of IT sector is somewhat arbitrary in this research. I follow the list provided in Hand (2000) and extract all firms whose names contain these keywords most commonly associated with Internet companies[4]: .com, online, digital, communications, web, network, information, Internet, cyber and connect. Furthermore, I select those companies without the aforementioned keywords that make the list of largest Internet companies in the world, namely Facebook, Alphabet, Priceline Group, Ebay, Netflix, Expedia, Yahoo, Groupon, Linkedin, Twitter, Airbnb and Tripadvisor. All companies that qualify these criteria get assigned a value 1 for IT and 0 otherwise.

The coefficient of interest is β_3. Positive (negative) values indicate increased (decreased) value relevance of the associated financial statement values for the IT sector after the Internet Bubble compared to non-IT firms.

[4] Hand's (2000) definition of an Internet company states that more than half (at least 51%) of its operations must be provided online

4 Results: High-tech industries

4.1 Value relevance of earnings, book values, earnings & book values and R&D expenses

Bottom-line earnings do not appear to exhibit striking differences between the two groups of industries under investigation as can be seen from Table 5, column "Earnings relation". The average adjusted R-squared value for high-tech group (11,09%) is not by much lower than the value for low-tech group (12,38%). For robustness, I use non-GAAP earnings, proxied by earnings before income, taxes, depreciation and amortization (EBITDA) instead of net income in equation (1) as it is sometimes regarded that this measurement gives a better measurement of firm financial performance. Untabulated results show slightly different but qualitatively the same results, with the adjusted R-squared value being 6,95% for the high-tech group and 6,26% for the low-tech group. I use terms non-GAAP earnings and EBITDA interchangeably in this research.

Balance sheet items (Table 5, column "Book value relation") portray more pronounced explanatory power levels obtained after running equation (2). The difference between the two groups is about 6%, the average numbers being 44,68% and 38,28% for high-tech and low-tech industries, respectively. Similar differences can be observed in column "Combined", which shows the average adjusted R-squared values obtained after running equation (3) for both groups (50,12% for high-tech and 45,18% for low-tech). Again, same conclusions follow after including non-GAAP earnings in place of net income in equation (3). Overall, the primary results suggest high-tech industries exhibit higher on average value relevance of income statement and balance sheet items.

Table 5: Adjusted R-squared values obtained from regressions (1) to (3), run separately for each year per subsample. High-tech reports R-squared values for the high-tech subsample and low-tech reports these values for the low-tech subsample. N is the yearly number of observations

(1) Earnings relation: $(M_t/B_{t-1}) = \beta_0 + \beta_1(NI_t/B_{t-1}) + \varepsilon_t$

(2) Book value relation: $(M_t/B_{t-1}) = \beta_0 + \beta_1(AT_t/B_{t-1}) + \beta_2(LT_t/B_{t-1}) + \varepsilon_t$

(3) Combined: $(M_t/B_{t-1}) = \beta_0 + \beta_1(NI_t/B_{t-1}) + \beta_2(AT_t/B_{t-1}) + \beta_3(LT_t/B_{t-1}) + \varepsilon_t$

M_t/B_{t-1} is current year's market value of equity divided by previous year's book value of equity, NI_t/B_{t-1} is current year's net income divided by previous year's book value of equity, AT_t/B_{t-1} is current year's assets divided by previous year's book value of equity and LT_t/B_{t-1} is current year's liabilities divided by previous year's book value of equity

	Earnings relation				Book value relation				Combined			
Year	N	High-Tech	N	Low-Tech	N	High-Tech	N	Low-Tech	N	High-Tech	N	Low-Tech
1990	52	0,1898	139	0,4247	52	0,1174	139	0,5695	52	0,3867	139	0,6545
1991	298	0,0902	611	0,1371	298	0,5524	611	0,2903	298	0,6215	611	0,3955
1992	332	0,1500	669	0,1629	332	0,5609	669	0,4908	332	0,5862	669	0,5472
1993	387	0,1526	742	0,2318	387	0,5056	742	0,3324	387	0,6640	742	0,4532
1994	430	-0,0006	814	0,0356	430	0,4597	814	0,3172	430	0,4783	814	0,3766
1995	472	0,0703	886	0,1309	472	0,4902	886	0,3744	472	0,5269	886	0,4877
1996	608	0,0665	995	0,1023	608	0,4953	995	0,4085	608	0,5089	995	0,4401
1997	692	0,0765	1097	0,0021	692	0,4902	1097	0,3071	692	0,4966	1097	0,3398
1998	689	0,0028	1073	0,0226	689	0,3696	1073	0,2891	689	0,3785	1073	0,3066
1999	687	0,0805	1038	0,1327	687	0,3850	1038	0,4089	687	0,4008	1038	0,4786
2000	765	0,0835	1015	0,1953	765	0,4406	1015	0,3535	765	0,4480	1015	0,3968
2001	893	0,0491	1000	0,0882	893	0,3504	1000	0,3675	893	0,3957	1000	0,4396
2002	899	0,0496	1022	0,0274	899	0,4134	1022	0,3801	899	0,4577	1022	0,4347
2003	859	0,1801	1028	0,1306	859	0,5153	1028	0,4635	859	0,5788	1028	0,5228
2004	828	0,1739	991	0,1408	828	0,5353	991	0,3453	828	0,5681	991	0,4105
2005	839	0,0834	976	0,1010	839	0,5210	976	0,4366	839	0,5267	976	0,4694
2006	826	0,1132	954	0,1196	826	0,4945	954	0,4525	826	0,5330	954	0,5196
2007	853	0,1413	973	0,1329	853	0,3874	973	0,4465	853	0,4116	973	0,5050
2008	827	0,0934	960	0,0908	827	0,2200	960	0,3217	827	0,3193	960	0,4161
2009	770	0,1582	948	0,0747	770	0,5250	948	0,3842	770	0,6095	948	0,4663
2010	646	0,3252	756	0,1158	646	0,5532	756	0,3000	646	0,6286	756	0,4280
Average		**0,1109**		**0,1238**		**0,4468**		**0,3828**		**0,5012**		**0,4518**

The main objective of high technology firms is to maintain the cutting edge in innovation and product upgrades. As a result, their R&D expenditures are substantially larger when compared to other, more static firms, as evidenced in Table 2. If this is the main criterion to distinguish these two types of companies, then it should be clear that investors deem R&D expenditures more value relevant when investing in high technology firms. However, as can be seen from Table 6, the adjusted R-squared values for high-tech subsample, averaging 24,06%, are slightly lower than for low-tech subsample, amounting to 27,50%.

Table 6: Adjusted R-squared values obtained from regression (4), run separately for each year per subsample. High-tech reports R-squared values for the high-tech subsample and low-tech reports these values for the low-tech subsample. N is the yearly number of observations

(4) $(M_t/B_{t-1}) = \beta_0 + \beta_1(XRD_t/B_{t-1}) + \varepsilon_t$

M_t/B_{t-1} is current year's market value of equity divided by previous year's book value of equity and XRD_t/B_{t-1} is current year's research and development expense divided by previous year's book value of equity

	High-Tech		Low-Tech	
Year	Number of Observations	R-Squared	Number of Observations	R-Squared
1990	52	0,1786	139	0,6389
1991	298	0,3709	611	0,3775
1992	332	0,2732	669	0,3227
1993	387	0,1491	742	0,2837
1994	430	0,0793	814	0,0969
1995	472	0,3226	886	0,2261
1996	608	0,2168	995	0,3261
1997	692	0,1951	1097	0,0934
1998	689	0,0640	1073	0,2148
1999	687	0,1633	1038	0,3165
2000	765	0,2751	1015	0,3136
2001	893	0,2735	1000	0,3250
2002	899	0,2223	1022	0,3111
2003	859	0,3400	1028	0,2807
2004	828	0,2860	991	0,2038
2005	839	0,2883	976	0,1274
2006	826	0,2682	954	0,2196
2007	853	0,1430	973	0,2054
2008	827	0,1643	960	0,3058
2009	770	0,2859	948	0,3137
2010	646	0,4932	756	0,2726
Average		**0,2406**		**0,2750**

The average R-squared values reported above provide some initial evidence on the behaviour of the variables. However, there is no easily observable trend in any of the reported values under each specification – the variation is simply too large. Furthermore, the chosen time period is known to have witnessed rapid improvements in technology that might have altered the perception of financial statements of companies. To check for differences over time between the two subgroups, I build upon the time regression used by Collins et al. (1997) and Lev and Zarowin (1999) by transforming it into the difference-in-difference regression, as equation (5) specifies.

VARIABLES	(1) r2H1aabook	(2) r2H1bbook	(3) r2H1cabook	(4) r2H2book
time	0.00535	-0.000521	0.00332	0.00288
	(0.00819)	(0.00913)	(0.00952)	(0.00994)
high_tech	0.234	-0.907	-0.0363	-0.0518
	(0.578)	(0.644)	(0.672)	(0.701)
timehightech	0.00451	-0.0262**	-0.0165	-0.00883
	(0.0108)	(0.0120)	(0.0125)	(0.0131)
one	0.00753	-0.0149	-0.00241	-0.0250
	(0.0463)	(0.0516)	(0.0539)	(0.0562)
onehightech	0.0570	0.0664	0.0527	0.146**
	(0.0548)	(0.0611)	(0.0637)	(0.0665)
logsize	0.0520	0.0449	0.0793	0.0805
	(0.0877)	(0.0977)	(0.102)	(0.106)
logsizehightech	-0.0898	0.0700	-0.0624	-0.0555
	(0.106)	(0.119)	(0.124)	(0.129)
pcht	-1.939**	-0.700	-1.613*	-2.178**
	(0.816)	(0.910)	(0.949)	(0.990)
pchthightech	1.482	3.262*	3.217*	2.711
	(1.515)	(1.688)	(1.761)	(1.837)
loss	0.479	0.323	0.405	1.802***
	(0.401)	(0.447)	(0.466)	(0.487)
losshightech	-0.627	-1.288**	-1.264*	-1.816***
	(0.565)	(0.629)	(0.657)	(0.685)
Constant	0.300	0.232	0.340	-0.0747
	(0.495)	(0.551)	(0.575)	(0.600)
Observations	42	42	42	42

*Table 7: Generalized Least Squares (GLS) regression output of R-squared time regressions (equation (5)). R2H1aabook is the adjusted R-squared values from equation (1), run cross-sectionally for each year, r2H1bbook is the adjusted R-squared values from equation (2), run cross-sectionally for each year, r2H1cabook is the adjusted R-squared values from equation (3), run cross-sectionally for each year, r2H2book is the adjusted R-squared values from equation (4), run cross-sectionally for each year time is a trend variable, equal to 1 for year 1990, 2 for year 1991 etc. up till 2010, which is assigned a value of 21, high_tech is a dummy variable equal to 1 for industries classified as high technology according to the methodology by Francis and Schipper (1999), timehightech is the interaction term between time and high_tech, one is the mean absolute value of special items as a percent of net income for the high-tech and low-tech subsamples in year t, onehightech is the interaction term between one and high_tech, logsize is the natural logarithm of the average market value of equity for the high-tech and low-tech subsamples in year t, logsizehightech is the interaction term between logsize and high_tech, pcht is the percentage of firms in high-tech industries in year t, pchthightech is the interaction term between pcht and high_tech, loss is the percentage of high-tech and low-tech firms in year t with negative net income and losshightech is the interaction term between loss and high_tech. *, ** and *** indicate significance at 10%, 5% and 1%, respectively. Standard errors are reported in parentheses*

The coefficient regarding earnings relation is positive (0,00451, variable timehightech from column (1)) but not significantly different from zero. This means that value relevance of bottom-line earnings was very comparable between high-tech industries and the rest of the sample over the period between 1990 and 2010. These results are inferentially the same when non-GAAP earnings are used instead of net income (coefficient of interest is 0,003 and not significant). Book values, on the other hand, were less value relevant over the past two decades for investors in high-tech companies. In fact, the coefficient of -0,0262 (column (2)) indicates that book values were significantly (at 5% level) less value relevant in comparison with low-tech industries. Regressing the adjusted R-squared values from the combined relation equations shows that the broader picture of the overall information from financial statements is not much different between the categories (the coefficient of interest is -0,0165 in column (3) but not statistically significant). Non-GAAP specification of firm earnings and its usage in combination with balance sheet items yields qualitatively the same results (-0,02 and not significant).

My results are different from those reported in Francis and Schipper (1999) in a sense that they document higher explained variations in low-tech firms compared to high-tech firms on both balance sheet and combined relations. However, they express doubts regarding increasing number and importance of high-tech firms and the associated drop in overall value relevance. Their results provide mixed support that under all specifications the financial statements of high technology firms are less value relevant. I present my results following alternative specifications of market value scaling later in this section.

To check for systematic differences between changes of R&D value relevance over time, I use equation (5) again, this time using the adjusted R-squared values obtained from equation (4). The coefficient of interest is -0,00883 (column (4)) but is not significantly different from zero (Table 7). Thus, R&D value relevance appears to be almost the same for both high-tech and low-tech industries. An explanation of such phenomenon could be that as firms expand their areas of activity, it becomes harder to properly classify them into particular industries, as some of them might have operations that do not require any usage of high technology while others might possess such features. As discussed in the literature review section, the definition of high-tech is evolving and it is thus difficult to account for this change factor, a problem also raised by Core et al. (2003). Attrition in the sample as a result of removing observations with missing R&D data also plays a role in making reasonable inferences.

4.2 Value relevance: market value scaling

The main analysis focuses how financial statement items help explain the variation in market-to-book ratio, often used as a proxy for firm growth. A growing firm is attractive to investors and is therefore worth investing to. On the other hand, growth is not the only factor under consideration – performance in stock market is also crucial for investment decisions. In this section I present how value relevant financial statement items are in determining stock market performance measured by overall market value (under the assumption of efficient capital markets).

Table 8 reports the adjusted R-squared values in a similar way as Table 5 does. The only difference is that all variables are scaled by lagged market values of equity. Net income and its associated average explanatory power over the period of investigation is 2,12% for high-tech sector and 2,14% for low-tech sector. Non-GAAP specification of company earnings yields average values of 2,68% and 4,66% for high-tech and low-tech, respectively – very mild differences as well. Book values exhibit similar average value relevance for high-tech group (14,01% versus 12,04%), same holds for the combined relation (15,63% versus 14,37%), robust to non-GAAP earnings specification (15,30% versus 14,48%).

Table 8: Adjusted R-squared values obtained from regressions (1) to (3), run separately for each year per subsample. High-tech reports R-squared values for the high-tech subsample and low-tech reports these values for the low-tech subsample. N is the yearly number of observations

(1) Earnings relation: $(M_t/M_{t-1}) = \beta_0 + \beta_1(NI_t/M_{t-1}) + \varepsilon_t$

(2) Book value relation: $(M_t/M_{t-1}) = \beta_0 + \beta_1(AT_t/M_{t-1}) + \beta_2(LT_t/M_{t-1}) + \varepsilon_t$

(3) Combined: $(M_t/M_{t-1}) = \beta_0 + \beta_1(NI_t/M_{t-1}) + \beta_2(AT_t/M_{t-1}) + \beta_3(LT_t/M_{t-1}) + \varepsilon_t$

M_t/M_{t-1} is current year's market value of equity divided by previous year's market value of equity, NI_t/M_{t-1} is current year's net income divided by previous year's market value of equity, AT_t/M_{t-1} is current year's assets divided by previous year's market value of equity and LT_t/M_{t-1} is current year's liabilities divided by previous year's market value of equity

	Earnings relation				Book value relation				Combined			
Year	N	High-Tech	N	Low-Tech	N	High-Tech	N	Low-Tech	N	High-Tech	N	Low-Tech
1990	52	0,0310	139	0,1383	52	-0,0361	139	0,0185	52	0,0182	139	0,1873
1991	298	0,0040	611	0,0027	298	0,1542	611	0,1394	298	0,1514	611	0,1505
1992	332	0,0032	669	0,0194	332	0,1401	669	0,0908	332	0,1484	669	0,0964
1993	387	0,0121	742	0,0143	387	0,1999	742	0,0715	387	0,2003	742	0,0735
1994	430	0,0542	814	0,0199	430	0,1570	814	0,0976	430	0,1728	814	0,1218
1995	472	-0,0016	886	0,0092	472	0,1621	886	0,0381	472	0,1651	886	0,0412
1996	608	0,0021	995	0,0145	608	0,0995	995	0,1198	608	0,1085	995	0,1263
1997	692	0,0177	1097	0,0334	692	0,1440	1097	0,1502	692	0,1542	1097	0,1919
1998	689	-0,0013	1073	0,0123	689	0,0905	1073	0,1088	689	0,0893	1073	0,1121
1999	687	0,0133	1038	0,0099	687	0,0795	1038	0,1229	687	0,0861	1038	0,1293
2000	765	0,0084	1015	-0,0008	765	0,2415	1015	0,0977	765	0,2423	1015	0,0969
2001	893	0,0112	1000	0,0394	893	0,1712	1000	0,0967	893	0,2132	1000	0,1473
2002	899	0,0168	1022	0,0099	899	0,1591	1022	0,1325	899	0,1993	1022	0,1663
2003	859	0,0438	1028	0,0146	859	0,1788	1028	0,1467	859	0,1899	1028	0,1552
2004	828	0,0994	991	0,0014	828	0,2154	991	0,1437	828	0,2544	991	0,1453
2005	839	0,0083	976	-0,0002	839	0,1156	976	0,2452	839	0,1332	976	0,2486
2006	826	0,0255	954	0,0260	826	0,1771	954	0,1170	826	0,1905	954	0,1413
2007	853	0,0051	973	0,0002	853	0,1325	973	0,1602	853	0,1335	973	0,1597
2008	827	0,0374	960	0,0876	827	0,0635	960	0,0567	827	0,1106	960	0,1464
2009	770	0,0443	948	-0,0010	770	0,1895	948	0,2758	770	0,2102	948	0,2820
2010	646	0,0103	756	-0,0008	646	0,1078	756	0,0983	646	0,1113	756	0,0977
Average		**0,0212**		**0,0214**		**0,1401**		**0,1204**		**0,1563**		**0,1437**

With regards to R&D, the primary results are surprisingly different from the ones observed before. Although this time larger for high-tech industries (6% versus 3,54%), the percentage difference remains similar but the overall value relevance seems to be much lower.

Table 9: Adjusted R-squared values obtained from regression (4), run separately for each year per subsample. High-tech reports R-squared values for the high-tech subsample and low-tech reports these values for the low-tech subsample. N is the yearly number of observations

(4) $(M_t/M_{t-1}) = \beta_0 + \beta_1 XRD_t/M_{t-1} + \varepsilon_t$

M_t/M_{t-1} is current year's market value of equity divided by previous year's market value of equity and XRD_t/M_{t-1} is current year's research and development expense divided by previous year's market value of equity

	High-Tech		Low-Tech	
Year	Number of Observations	R-Squared	Number of Observations	R-Squared
1990	52	-0,0130	139	0,0027
1991	298	0,0191	611	0,0009
1992	332	0,0370	669	0,0473
1993	387	0,0277	742	0,0340
1994	430	0,0569	814	0,0053
1995	472	0,1498	886	0,0567
1996	608	0,0555	995	0,0128
1997	692	0,0036	1097	0,0250
1998	689	0,0061	1073	0,0036
1999	687	0,0297	1038	0,1058
2000	765	0,1051	1015	0,0544
2001	893	0,0613	1000	0,0103
2002	899	0,0170	1022	0,0066
2003	859	0,1852	1028	0,0735
2004	828	0,1614	991	0,0272
2005	839	0,0630	976	0,0148
2006	826	0,0653	954	0,0014
2007	853	0,0015	973	0,0407
2008	827	0,0032	960	0,0019
2009	770	0,1479	948	0,0955
2010	646	0,0761	756	0,1228
Average		**0,0600**		**0,0354**

The R-squared regressions provide weaker evidence in comparison to the results obtained from previous specification. Earnings are less value relevant for high-tech subsample but this difference is not statistically significant. However, when EBITDA numbers are used, the negative coefficient (-0,016) becomes significant at the 1% level. For investors, there is no need to base their decisions solely on earnings numbers as there is something else, highly likely non-financial, that helps them make their choices.

Balance sheet item value relevance is lower for the high-tech sector (-0,00624, column (2)) but not significantly different from zero. The coefficient of the combined relation is -0,0117 (column (3)) and insignificant, confirming the conclusion made in the previous section on book value scaling. Non-GAAP earnings specification yields the same result (-0,014 and insignificant). R&D value relevance, although less pronounced for high-tech firms as evidenced by the negative coefficient, is not significant.

VARIABLES	(1) r2H1aamarket	(2) r2H1bmarket	(3) r2H1camarket	(4) r2H2market
time	0.00664**	-0.00637	0.000908	0.00552
	(0.00299)	(0.00608)	(0.00600)	(0.00585)
high_tech	-0.143	-0.00209	-0.119	-0.323
	(0.211)	(0.429)	(0.423)	(0.412)
timehightech	-0.00522	-0.00624	-0.0117	-0.00604
	(0.00393)	(0.00799)	(0.00789)	(0.00769)
one	0.00922	-0.0646*	-0.0622*	0.0234
	(0.0169)	(0.0344)	(0.0339)	(0.0331)
onehightech	-0.0259	0.0614	0.0485	-0.0192
	(0.0200)	(0.0407)	(0.0401)	(0.0391)
logsize	-0.0513	0.0988	0.0355	0.0341
	(0.0320)	(0.0651)	(0.0642)	(0.0626)
logsizehightech	0.0160	-0.0344	-0.0166	0.00551
	(0.0388)	(0.0790)	(0.0779)	(0.0760)
pcht	-0.224	-0.0730	-0.211	-0.859
	(0.298)	(0.606)	(0.598)	(0.583)
pchthightech	0.680	1.201	1.651	0.892
	(0.553)	(1.124)	(1.109)	(1.081)
loss	0.264*	0.242	0.621**	-0.106
	(0.146)	(0.298)	(0.294)	(0.286)
losshightech	-0.455**	-0.392	-0.801*	0.0662
	(0.206)	(0.419)	(0.413)	(0.403)
Constant	0.335*	-0.585	-0.237	0.0962
	(0.180)	(0.367)	(0.362)	(0.353)
Observations	42	42	42	42

*Table 10: Generalized Least Squares (GLS) regression output of R-squared time regressions (equation (5)). R2H1aamarket is the adjusted R-squared values from equation (1), run cross-sectionally for each year, r2H1bmarket is the adjusted R-squared values from equation (2), run cross-sectionally for each year, r2H1camarket is the adjusted R-squared values from equation (3), run cross-sectionally for each year, r2H2market is the adjusted R-squared values from equation (4), run cross-sectionally for each year, time is a trend variable, equal to 1 for year 1990, 2 for year 1991 etc. up till 2010, which is assigned a value of 21, high_tech is a dummy variable equal to 1 for industries classified as high technology according to the methodology by Francis and Schipper (1999), timehightech is the interaction term between time and high_tech, one is the mean absolute value of special items as a percent of net income for the high-tech and low-tech subsamples in year t, onehightech is the interaction term between one and high_tech, logsize is the natural logarithm of the average market value of equity for the high-tech and low-tech subsamples in year t, logsizehightech is the interaction term between logsize and high_tech, pcht is the percentage of firms in high-tech industries in year t, pchthightech is the interaction term between pcht and high_tech, loss is the percentage of high-tech and low-tech firms in year t with negative net income and losshightech is the interaction term between loss and high_tech. *, ** and *** indicate significance at 10%, 5% and 1%, respectively. Standard errors are reported in parentheses*

Overall, most of the evidence points towards negligible differences between high-tech and low-tech accounting item value relevance with the only exception of book values under book value scaling, where the difference is significantly lower for high-tech category. In this case, the general public is less concerned about the assets and liabilities of the companies they invest in. It could very well be that only a certain portion of balance sheet items are of relevance to investors, for instance, intangible assets. When considered together with net income, the numbers again appear to exhibit similar value relevance to the one observed in the low-tech sample. Although research and development is believed to be this distinguishing feature between the two types of industries, the numbers show that over the past two decades there were no systematic differences. This could be attributed to high-tech equipment that has recently become prevalent in any firm whose final outputs are not high-tech in themselves but are produced *using* high-tech.

4.3 Value relevance: Fama-French 48 industry classification

Determining which industries belong to high technology sector is not an easy task. Francis and Schipper (1999) use the likelihood of possessing significant unrecorded intangible assets as a criterion to include industries to the high-tech category. Change factor complicates this procedure as shifts in R&D activities can trigger a reclassification of a certain industry into either high-tech due to innovative product upgrades or low-tech due to its main lines of business becoming obsolete. To try and address this problem to a certain extent, I use the Fama and French database and classify those industries into high-tech that are closest to the most innovative products being produced over the course of the past two decades, namely 13 – Drugs, 22 – Electrical Equipment, 32 – Communications, 34 – Business Services, 35 – Computers and 36 – Electronic Equipment. Some of these industry groups already fall into the same group as in Francis and Schipper (1999), such as drugs. However, I believe the Fama-French classification is more complete as it encompasses broad categories of SIC codes that were excluded from the previous method of defining high technology industries.

The analysis follows the exact same order as in the previous section. For brevity reasons, I do not report the descriptive statistics table for this specification. Table 11 shows primary evidence of value relevance between the two subsamples. Same as before, there is a minor difference in earnings relation (10,33% versus 13,27%), robust to non-GAAP specification as well (6,24% versus 6,92%). Book values exhibit just slightly higher average explanatory power in high-tech sector (43,49% versus 39,12%), same for the combination of the two (49,03% versus 46,19%), robust to non-GAAP specification as well (48,26% versus 45,29%).

Table 11: Adjusted R-squared values obtained from regressions (1) to (3), run separately for each year per subsample. High-tech reports R-squared values for the high-tech subsample and low-tech reports these values for the low-tech subsample. N is the yearly number of observations

(1) Earnings relation: $(M_t/B_{t-1}) = \beta_0 + \beta_1(NI_t/B_{t-1}) + \varepsilon_t$

(2) Book value relation: $(M_t/B_{t-1}) = \beta_0 + \beta_1(AT_t/B_{t-1}) + \beta_2(LT_t/B_{t-1}) + \varepsilon_t$

(3) Combined: $(M_t/B_{t-1}) = \beta_0 + \beta_1(NI_t/B_{t-1}) + \beta_2(AT_t/B_{t-1}) + \beta_3(LT_t/B_{t-1}) + \varepsilon_t$

M_t/B_{t-1} is current year's market value of equity divided by previous year's book value of equity, NI_t/B_{t-1} is current year's net income divided by previous year's book value of equity, AT_t/B_{t-1} is current year's assets divided by previous year's book value of equity and LT_t/B_{t-1} is current year's liabilities divided by previous year's book value of equity

	Earnings relation				Book value relation				Combined			
Year	N	High-Tech	N	Low-Tech	N	High-Tech	N	Low-Tech	N	High-Tech	N	Low-Tech
1990	59	0,2199	132	0,4095	59	0,1107	132	0,5759	59	0,4162	132	0,6505
1991	318	0,0544	591	0,1859	318	0,5193	591	0,3242	318	0,5876	591	0,4399
1992	355	0,0393	646	0,2448	355	0,5009	646	0,5246	355	0,5106	646	0,5968
1993	413	0,1765	716	0,2065	413	0,5201	716	0,3030	413	0,6498	716	0,4265
1994	450	-0,0008	794	0,0381	450	0,4789	794	0,3054	450	0,4973	794	0,3634
1995	494	0,0875	864	0,1041	494	0,5184	864	0,3199	494	0,5558	864	0,4330
1996	640	0,0704	963	0,0976	640	0,4840	963	0,4166	640	0,5011	963	0,4441
1997	741	0,0553	1048	0,0177	741	0,4642	1048	0,3292	741	0,4704	1048	0,3787
1998	739	0,0022	1023	0,0268	739	0,3776	1023	0,2784	739	0,3879	1023	0,2967
1999	733	0,0943	992	0,1081	733	0,3963	992	0,3802	733	0,4166	992	0,4453
2000	830	0,0769	950	0,2215	830	0,3824	950	0,4298	830	0,3910	950	0,4702
2001	964	0,0453	929	0,0962	964	0,3375	929	0,3936	964	0,3869	929	0,4559
2002	964	0,0568	957	0,0195	964	0,3660	957	0,4206	964	0,4264	957	0,4573
2003	921	0,1749	966	0,1355	921	0,5050	966	0,4808	921	0,5704	966	0,5360
2004	886	0,1657	933	0,1499	886	0,5258	933	0,3546	886	0,5538	933	0,4263
2005	900	0,0697	915	0,1230	900	0,5319	915	0,4308	900	0,5383	915	0,4658
2006	882	0,1054	898	0,1373	882	0,4854	898	0,4675	882	0,5177	898	0,5502
2007	908	0,1517	918	0,1274	908	0,3872	918	0,4465	908	0,4154	918	0,5015
2008	886	0,0851	901	0,1011	886	0,2191	901	0,3216	886	0,3163	901	0,4200
2009	826	0,1409	892	0,0937	826	0,4714	892	0,4302	826	0,5661	892	0,5131
2010	696	0,2972	706	0,1423	696	0,5500	706	0,2817	696	0,6204	706	0,4281
Average		**0,1033**		**0,1327**		**0,4349**		**0,3912**		**0,4903**		**0,4619**

As in the previous section on book value scalings, low-tech industries maintain a higher average explanatory power of R&D expenses (28,51%) than high-tech ones (23,66%).

Table 12: Adjusted R-squared values obtained from regression (4), run separately for each year per subsample. High-tech reports R-squared values for the high-tech subsample and low-tech reports these values for the low-tech subsample. N is the yearly number of observations

(4) $(M_t/B_{t-1}) = \beta_0 + \beta_1(XRD_t/B_{t-1}) + \varepsilon_t$

M_t/B_{t-1} is current year's market value of equity divided by previous year's book value of equity and XRD_t/B_{t-1} is current year's research and development expense divided by previous year's book value of equity

	High-Tech		Low-Tech	
Year	Number of Observations	R-Squared	Number of Observations	R-Squared
1990	59	0,1786	132	0,6611
1991	318	0,3343	591	0,4349
1992	355	0,2443	646	0,3592
1993	413	0,2004	716	0,2230
1994	450	0,0899	794	0,0941
1995	494	0,3226	864	0,1996
1996	640	0,2038	963	0,3453
1997	741	0,1711	1048	0,1485
1998	739	0,0778	1023	0,1928
1999	733	0,1756	992	0,2992
2000	830	0,2543	950	0,3557
2001	964	0,2515	929	0,3467
2002	964	0,1931	957	0,3830
2003	921	0,3279	966	0,3052
2004	886	0,2828	933	0,2039
2005	900	0,2812	915	0,1140
2006	882	0,2654	898	0,2379
2007	908	0,1459	918	0,2198
2008	886	0,1655	901	0,3097
2009	826	0,3027	892	0,3146
2010	696	0,5001	706	0,2383
Average		**0,2366**		**0,2851**

The R-Squared regression results report that earnings value relevance (0,00761 (column (1), variable timehightech2) is not significantly different between the two sectors, robust to using EBITDA specification. Book values are lower in high-tech industries, same as before (-0,0222 and significant at 10% level (column (2)). Finally, combined financial statement value relevance (-0,0119 (column (3)) and R&D expenditures (-0,000887 (column (4)) show negative but insignificant effects, also robust to non-GAAP earnings specification.

VARIABLES	(1) r2H1aabook2	(2) r2H1bbook2	(3) r2H1cabook2	(4) r2H2book2
time	0.00106	-0.00651	-0.00258	-0.00685
	(0.00900)	(0.00927)	(0.00937)	(0.0102)
high_tech2	0.510	-0.619	0.418	0.392
	(0.604)	(0.622)	(0.629)	(0.687)
timehightech2	0.00761	-0.0222*	-0.0119	-0.000887
	(0.0123)	(0.0127)	(0.0128)	(0.0140)
one	-0.000859	-0.0313	-0.0220	-0.0517
	(0.0454)	(0.0468)	(0.0472)	(0.0516)
onehightech2	0.0539	0.0775	0.0611	0.162**
	(0.0568)	(0.0585)	(0.0591)	(0.0646)
logsize	0.0508	0.0365	0.0881	0.0445
	(0.0896)	(0.0923)	(0.0932)	(0.102)
logsizehightech2	-0.128	0.0908	-0.0922	-0.0440
	(0.104)	(0.107)	(0.108)	(0.118)
pcht	-1.329*	0.130	-0.936	-0.586
	(0.785)	(0.809)	(0.818)	(0.893)
pchthightech2	1.524	2.478	2.919*	1.843
	(1.509)	(1.554)	(1.571)	(1.716)
loss	0.571	0.675	0.758*	2.176***
	(0.432)	(0.445)	(0.450)	(0.492)
losshightech2	-0.855	-1.922***	-1.909***	-2.622***
	(0.618)	(0.637)	(0.643)	(0.703)
Constant	0.131	-0.0805	-0.00775	-0.416
	(0.531)	(0.547)	(0.553)	(0.604)
Observations	42	42	42	42

*Table 13: Generalized Least Squares (GLS) regression output of R-squared time regressions (equation (5)). R2H1aabook2 is the adjusted R-squared values from equation (1), run cross-sectionally for each year, r2H1bbook2 is the adjusted R-squared values from equation (2), run cross-sectionally for each year, r2H1cabook2 is the adjusted R-squared values from equation (3), run cross-sectionally for each year, r2H2book2 is the adjusted R-squared values from equation (4), run cross-sectionally for each year, time is a trend variable, equal to 1 for year 1990, 2 for year 1991 etc. up till 2010, which is assigned a value of 21, high_tech2 is a dummy variable equal to 1 for industries numbered 13, 22, 32, 34, 35 and 36 in the Fama-French 48 industry classification database, timehightech2 is the interaction term between time and high_tech2, one is the mean absolute value of special items as a percent of net income for the high-tech and low-tech subsamples in year t, onehightech2 is the interaction term between one and high_tech2, logsize is the natural logarithm of the average market value of equity for the high-tech and low-tech subsamples in year t, logsizehightech2 is the interaction term between logsize and high_tech2, pcht is the percentage of firms in high-tech industries in year t, pchthightech2 is the interaction term between pcht and high_tech2, loss is the percentage of high-tech and low-tech firms in year t with negative net income and losshightech2 is the interaction term between loss and high_tech2. *, ** and *** indicate significance at 10%, 5% and 1%, respectively. Standard errors are reported in parentheses*

Results from market value scalings can be interpreted in a similar way as under the previous high-tech definition. Negligible differences in adjusted R-squared values (2,20% versus 2,23% for earnings, 13,10% versus 12,08% for book values and 14,82% versus 14,46% for earnings and book values) do not provide evidence strong enough to make a reasonable distinction between the two industry categories. Non-GAAP earnings provide inferentially the same conclusions.

Table 14: Adjusted R-squared values obtained from regressions (1) to (3), run separately for each year per subsample. High-tech reports R-squared values for the high-tech subsample and low-tech reports these values for the low-tech subsample. N is the yearly number of observations

(1) Earnings relation: $(M_t/M_{t-1}) = \beta_0 + \beta_1(NI_t/M_{t-1}) + \varepsilon_t$

(2) Book value relation: $(M_t/M_{t-1}) = \beta_0 + \beta_1(AT_t/M_{t-1}) + \beta_2(LT_t/M_{t-1}) + \varepsilon_t$

(3) Combined: $(M_t/M_{t-1}) = \beta_0 + \beta_1(NI_t/M_{t-1}) + \beta_2(AT_t/M_{t-1}) + \beta_3(LT_t/M_{t-1}) + \varepsilon_t$

M_t/M_{t-1} is current year's market value of equity divided by previous year's market value of equity, NI_t/M_{t-1} is current year's net income divided by previous year's market value of equity, AT_t/M_{t-1} is current year's assets divided by previous year's market value of equity and LT_t/M_{t-1} is current year's liabilities divided by previous year's market value of equity

	Earnings relation				Book value relation				Combined			
Year	N	High-Tech	N	Low-Tech	N	High-Tech	N	Low-Tech	N	High-Tech	N	Low-Tech
1990	59	0,0380	132	0,1376	59	-0,0312	132	0,0215	59	0,0388	132	0,1905
1991	318	-0,0017	591	0,0074	318	0,1430	591	0,1348	318	0,1427	591	0,1484
1992	355	-0,0002	646	0,0392	355	0,1201	646	0,0858	355	0,1194	646	0,1055
1993	413	0,0106	716	0,0159	413	0,1649	716	0,0740	413	0,1692	716	0,0767
1994	450	0,0505	794	0,0190	450	0,1358	794	0,1001	450	0,1604	794	0,1228
1995	494	-0,0020	864	0,0098	494	0,1295	864	0,0409	494	0,1300	864	0,0442
1996	640	0,0024	963	0,0171	640	0,1059	963	0,1175	640	0,1131	963	0,1245
1997	741	0,0244	1048	0,0296	741	0,1573	1048	0,1484	741	0,1718	1048	0,1872
1998	739	-0,0013	1023	0,0145	739	0,0743	1023	0,1229	739	0,0731	1023	0,1267
1999	733	0,0210	992	0,0024	733	0,0902	992	0,1040	733	0,0961	992	0,1074
2000	830	0,0167	950	-0,0001	830	0,2232	950	0,0869	830	0,2243	950	0,0862
2001	964	0,0133	929	0,0402	964	0,1660	929	0,0936	964	0,2015	929	0,1490
2002	964	0,0203	957	0,0067	964	0,1519	957	0,1289	964	0,1888	957	0,1604
2003	921	0,0461	966	0,0102	921	0,1694	966	0,1512	921	0,1848	966	0,1555
2004	886	0,0911	933	0,0020	886	0,2203	933	0,1397	886	0,2631	933	0,1425
2005	900	0,0105	915	0,0009	900	0,1159	915	0,2539	900	0,1341	915	0,2561
2006	882	0,0227	898	0,0308	882	0,1685	898	0,1145	882	0,1835	898	0,1430
2007	908	0,0075	918	0,0019	908	0,1245	918	0,1658	908	0,1272	918	0,1649
2008	886	0,0405	901	0,0840	886	0,0576	901	0,0592	886	0,1045	901	0,1457
2009	826	0,0422	892	-0,0011	826	0,1643	892	0,2949	826	0,1830	892	0,3008
2010	696	0,0092	706	-0,0006	696	0,0986	706	0,0994	696	0,1033	706	0,0989
Average		**0,0220**		**0,0223**		**0,1310**		**0,1208**		**0,1482**		**0,1446**

Research and development expense is just slightly more value relevant in the high-tech sector (5,84% versus 3,52%).

Table 15: Adjusted R-squared values obtained from regression (4), run separately for each year per subsample. High-tech reports R-squared values for the high-tech subsample and low-tech reports these values for the low-tech subsample. N is the yearly number of observations

(4) $(M_t/M_{t-1}) = \beta_0 + \beta_1 XRD_t/M_{t-1} + \varepsilon_t$

M_t/M_{t-1} is current year's market value of equity divided by previous year's market value of equity and XRD_t/M_{t-1} is current year's research and development expense divided by previous year's market value of equity

	High-Tech		Low-Tech	
Year	Number of Observations	R-Squared	Number of Observations	R-Squared
1990	59	-0,0083	132	0,0073
1991	318	0,0097	591	0,0062
1992	355	0,0498	646	0,0469
1993	413	0,0297	716	0,0316
1994	450	0,0586	794	0,0055
1995	494	0,1312	864	0,0643
1996	640	0,0497	963	0,0134
1997	741	0,0047	1048	0,0255
1998	739	0,0057	1023	0,0034
1999	733	0,0370	992	0,0947
2000	830	0,1102	950	0,0409
2001	964	0,0639	929	0,0019
2002	964	0,0150	957	0,0079
2003	921	0,1808	966	0,0761
2004	886	0,1473	933	0,0273
2005	900	0,0510	915	0,0183
2006	882	0,0644	898	0,0015
2007	908	0,0009	918	0,0475
2008	886	0,0033	901	0,0013
2009	826	0,1392	892	0,1040
2010	696	0,0835	706	0,1131
Average		**0,0584**		**0,0352**

Regression output does not give any values that are significantly different from zero, with the only exception of earnings relation when EBITDA is used to retrieve adjusted R-squared values (-0,014 and significant at 10% level). R&D still retains robustness by not being significantly different between the two categories.

VARIABLES	(1) r2H1aamarket2	(2) r2H1bmarket2	(3) r2H1camarket2	(4) r2H2market2
time	0.00489	-0.00507	0.000175	0.00714
	(0.00307)	(0.00616)	(0.00606)	(0.00565)
high_tech2	-0.103	-0.0241	-0.0273	-0.397
	(0.206)	(0.414)	(0.407)	(0.379)
timehightech2	-0.00305	-0.00873	-0.0120	-0.00797
	(0.00420)	(0.00843)	(0.00830)	(0.00774)
one	0.00665	-0.0555*	-0.0547*	0.0206
	(0.0155)	(0.0311)	(0.0306)	(0.0285)
onehightech2	-0.0231	0.0512	0.0373	-0.0113
	(0.0194)	(0.0389)	(0.0383)	(0.0357)
logsize	-0.0401	0.103*	0.0479	0.0200
	(0.0306)	(0.0613)	(0.0603)	(0.0562)
ogsizehightech2	0.0137	-0.0453	-0.0389	0.0179
	(0.0354)	(0.0709)	(0.0698)	(0.0651)
pcht	-0.188	-0.228	-0.252	-0.806
	(0.268)	(0.538)	(0.529)	(0.493)
pchthightech2	0.441	1.504	1.835*	0.842
	(0.515)	(1.033)	(1.017)	(0.947)
loss	0.292**	0.278	0.679**	-0.0938
	(0.148)	(0.296)	(0.291)	(0.271)
losshightech2	-0.402*	-0.483	-0.937**	0.0562
	(0.211)	(0.423)	(0.416)	(0.388)
Constant	0.256	-0.577	-0.313	0.181
	(0.181)	(0.363)	(0.358)	(0.333)
Observations	42	42	42	42

*Table 16: Generalized Least Squares (GLS) regression output of R-squared time regressions (equation (5)). R2H1aamarket2 is the adjusted R-squared values from equation (1), run cross-sectionally for each year, r2H1bmarket2 is the adjusted R-squared values from equation (2), run cross-sectionally for each year, r2H1camarket2 is the adjusted R-squared values from equation (3), run cross-sectionally for each year, r2H2market2 is the adjusted R-squared values from equation (4), run cross-sectionally for each year, time is a trend variable, equal to 1 for year 1990, 2 for year 1991 etc. up till 2010, which is assigned a value of 21, high_tech2 is a dummy variable equal to 1 for industries numbered 13, 22, 32, 34, 35 and 36 in the Fama-French 48 industry classification database, timehightech2 is the interaction term between time and high_tech2, one is the mean absolute value of special items as a percent of net income for the high-tech and low-tech subsamples in year t, onehightech2 is the interaction term between one and high_tech2, logsize is the natural logarithm of the average market value of equity for the high-tech and low-tech subsamples in year t, logsizehightech2 is the interaction term between logsize and high_tech2, pcht is the percentage of firms in high-tech industries in year t, pchthightech2 is the interaction term between pcht and high_tech2, loss is the percentage of high-tech and low-tech firms in year t with negative net income and losshightech2 is the interaction term between loss and high_tech2. *, ** and *** indicate significance at 10%, 5% and 1%, respectively. Standard errors are reported in parentheses*

As a final check, I re-define high_tech2 by excluding industries 22 and 34 due to some of their industry groups taking part in activities having questionable connections with modern high-tech, for instance, lighting equipment, security or advertising. Untabulated results do not show drastically different results in terms of earnings and book values, apart from non-GAAP earnings becoming negative and significant in earnings value relevance under market value scaling. Some other coefficients switch signs, however, the significance remains the same. Thus, no major differences arise.

Albeit mixed, the results portray the high technology sector possessing lower value relevance of balance sheet items, evident only under book value scaling. Minor deviations in coefficient sign and significance aside, this second method of defining high-tech industries is not much different from Francis and Schipper (1999) specification since a lot of industries seem to overlap. These few extra industries that are believed to spark changes in value relevance in the high-tech sector do not seem to be that important as some researchers thought they would be. So far, smaller players in the market are not (yet) able to reverse the currently observed trends, particularly in the value relevance of research and development expense.

5 Results: IT sector

Some high-tech industries are characterized as having certain qualities that distinguish them from other industries classified as high-tech. External shocks are also prone to alter the perception of some features of the affected firms, be it financial statements and their value relevance. One such example is the Internet Bubble at the outset of the new millennium that triggered investors to think more carefully before investing in Internet firms. The hype and belief of an eventual dominance of the IT sector inflated its stock price up to a point when it dropped to its record low in just a few weeks. The purpose of this section is to therefore investigate if the basic financial statement items became more relevant in such firms after the Internet Bubble compared to other high-tech firms. Furthermore, I check whether goodwill and cash flows and accruals also became more value relevant in response to the Bubble.

First of all, I discuss the results from book value scalings. Table 17 demonstrates that IT firms had an average R-squared value of earnings relation of 13,4% whereas for the rest of the sample this number is 11,3%. As for the book value relation, the number for IT is 45,1% and for the rest it is 43,2% and finally for the combined relation the numbers are 49,5% and 47,4%, respectively. Non-GAAP earnings specification is robust in both earnings and the combined relations. The patterns are quite similar as observed in the previous sections on high technology versus low technology industries in a sense that there are slight differences between the categories. In this specific scenario the IT sector acts as a "higher level" high-tech category when compared against other high-tech industries.

Table 17: Adjusted R-squared values obtained from regressions (1) to (3), run separately for each year per subsample. IT reports R-squared values for the IT subsample and non-IT reports these values for the subsample of all other high-tech industries. N is the yearly number of observations

(1) Earnings relation: $(M_t/B_{t-1}) = \beta_0 + \beta_1(NI_t/B_{t-1}) + \varepsilon_t$

(2) Book value relation: $(M_t/B_{t-1}) = \beta_0 + \beta_1(AT_t/B_{t-1}) + \beta_2(LT_t/B_{t-1}) + \varepsilon_t$

(3) Combined: $(M_t/B_{t-1}) = \beta_0 + \beta_1(NI_t/B_{t-1}) + \beta_2(AT_t/B_{t-1}) + \beta_3(LT_t/B_{t-1}) + \varepsilon_t$

M_t/B_{t-1} is current year's market value of equity divided by previous year's book value of equity, NI_t/B_{t-1} is current year's net income divided by previous year's book value of equity, AT_t/B_{t-1} is current year's assets divided by previous year's book value of equity and LT_t/B_{t-1} is current year's liabilities divided by previous year's book value of equity

	Earnings relation				Book value relation				Combined			
Year	N	IT	N	Non-IT	N	IT	N	Non-IT	N	IT	N	Non-IT
1992	27	0,1565	408	0,0152	27	0,2692	408	0,3904	27	0,2426	408	0,3901
1993	31	0,0866	484	0,2034	31	0,2368	484	0,4620	31	0,5018	484	0,5515
1994	37	-0,0084	537	0,0110	37	0,0100	537	0,4695	37	0,0035	537	0,4773
1995	46	-0,0155	575	0,0999	46	0,4730	575	0,5552	46	0,4614	575	0,5977
1996	53	0,1934	717	0,0578	53	0,3935	717	0,5184	53	0,3979	717	0,5233
1997	70	0,4016	827	0,0205	70	0,5470	827	0,3697	70	0,6307	827	0,3734
1998	75	0,3709	828	0,0163	75	0,4941	828	0,3793	75	0,6167	828	0,3916
1999	66	0,2576	825	0,2081	66	0,4402	825	0,4348	66	0,4400	825	0,4802
2000	82	0,0095	918	0,1201	82	0,3307	918	0,3444	82	0,3354	918	0,3748
2001	76	-0,0130	994	0,1531	76	0,4981	994	0,3613	76	0,5215	994	0,4433
2002	69	0,3880	1000	0,1150	69	0,6584	1000	0,4091	69	0,8095	1000	0,4737
2003	72	-0,0107	1070	0,2338	72	0,3036	1070	0,4798	72	0,3488	1070	0,5546
2004	72	0,0744	1049	0,2311	72	0,5865	1049	0,5787	72	0,6467	1049	0,6183
2005	74	0,1292	1081	0,0520	74	0,5089	1081	0,4465	74	0,5022	1081	0,4531
2006	75	0,3126	1056	0,1017	75	0,7751	1056	0,4818	75	0,7974	1056	0,5146
2007	75	-0,0120	1074	0,0810	75	0,7584	1074	0,4134	75	0,7957	1074	0,4232
2008	82	0,0428	1046	0,0519	82	0,1114	1046	0,2165	82	0,1329	1046	0,2939
2009	76	0,1876	989	0,1242	76	0,7791	989	0,4040	76	0,8185	989	0,4881
2010	71	-0,0140	822	0,2501	71	0,4014	822	0,4983	71	0,3958	822	0,5792
Average		**0,134**		**0,113**		**0,451**		**0,432**		**0,495**		**0,474**

Goodwill has a higher average R-squared value (8,37%) in the IT sector than in all other high-tech firms (2,93%). Cash flows and accruals exhibit higher numbers for IT as well, being 20,03% for IT and 13,42% for the rest.

Table 18: Adjusted R-squared values obtained from regressions (6) and (7), run separately for each year per subsample. IT reports R-squared values for the IT subsample and non-IT reports these values for the subsample of all other high-tech industries. N is the yearly number of observations

(6) Goodwill relation: $(M_t/B_{t-1}) = \beta_0 + \beta_1(GDWL_t/B_{t-1}) + \varepsilon_t$

(7) Cash flow and accruals relation: $(M_t/B_{t-1}) = \beta_0 + \beta_1(OANCF_t/B_{t-1}) + \beta_2(ACC_t/B_{t-1}) + \varepsilon_t$

M_t/B_{t-1} is current year's market value of equity divided by previous year's book value of equity, $GDWL_t/B_{t-1}$ is current year's goodwill divided by previous year's book value of equity, $OANCF_t/B_{t-1}$ is current year's cash flow from operating activities divided by previous year's book value of equity and ACC_t/B_{t-1} is current year's accruals (net income minus cash flow from operating activities) divided by previous year's book value of equity

	Goodwill relation				Cash flow and accrual relation			
Year	N	IT	N	Non-IT	N	IT	N	Non-IT
1992	27	-0,0396	408	0,0512	27	0,1174	408	0,1317
1993	31	-0,0290	484	0,0260	31	0,2135	484	0,1832
1994	37	-0,0037	537	0,0642	37	-0,0218	537	0,0144
1995	46	-0,0147	575	0,0817	46	0,0107	575	0,1418
1996	53	-0,0082	717	0,0229	53	0,1217	717	0,0580
1997	70	0,0657	827	0,0439	70	0,3384	827	0,0105
1998	75	0,0289	828	0,0249	75	0,3476	828	0,0099
1999	66	0,0353	825	0,0441	66	0,2532	825	0,2160
2000	82	0,1358	918	0,0147	82	0,0286	918	0,1268
2001	76	0,3560	994	0,0005	76	0,3255	994	0,1693
2002	69	0,3264	1000	0,0083	69	0,3647	1000	0,0985
2003	72	0,0854	1070	0,0177	72	-0,0155	1070	0,2405
2004	72	0,0178	1049	0,0698	72	0,2361	1049	0,1658
2005	74	-0,0117	1081	0,0176	74	0,2490	1081	0,1427
2006	75	0,0046	1056	0,0237	75	0,3406	1056	0,1467
2007	75	0,1667	1074	0,0137	75	0,0278	1074	0,0870
2008	82	-0,0090	1046	0,0180	82	0,0753	1046	0,0757
2009	76	0,2774	989	0,0111	76	0,5896	989	0,2258
2010	71	0,2062	822	0,0036	71	0,2040	822	0,3053
Average		**0,0837**		**0,0293**		**0,2003**		**0,1342**

Regression results (Table 19) provide no evidence that financial statements of IT firms became more value relevant after the Bubble compared to other high-tech industries (robust to EBITDA specification). There is no significant difference of cash flows and accruals between the two categories as well. Only goodwill has become slightly more value relevant for the IT firms (0,156 and significant at 5% level (column (6)).

VARIABLES	(1) r2H3aabook	(2) r2H3bbook	(3) r2H3cabook	(6) r2H4book	(7) r2H5book
post	-0.0255	-0.0620	-0.0415	-0.0147	0.0232
	(0.0935)	(0.123)	(0.137)	(0.0528)	(0.103)
IT	0.320	-0.647	-0.447	-0.0428	-0.200
	(0.631)	(0.830)	(0.926)	(0.356)	(0.694)
postit	-0.0879	0.151	0.0682	0.156**	-0.0552
	(0.126)	(0.166)	(0.185)	(0.0712)	(0.139)
one	0.0728	0.0322	0.0524	-0.0168	0.0712
	(0.0648)	(0.0852)	(0.0950)	(0.0366)	(0.0712)
oneit	-0.114	0.0107	-0.0741	0.00316	-0.133
	(0.0910)	(0.120)	(0.134)	(0.0514)	(0.100)
logsize	0.0712	0.0587	0.0517	-4.81e-05	0.0433
	(0.0779)	(0.102)	(0.114)	(0.0440)	(0.0856)
logsizeit	-0.0806	-0.00442	-0.000888	-0.0314	-0.0240
	(0.0854)	(0.112)	(0.125)	(0.0482)	(0.0938)
pcht	-4.847	-5.242	-5.948	0.292	-3.500
	(4.938)	(6.493)	(7.242)	(2.788)	(5.425)
pchtit	5.204	3.600	1.196	0.709	4.170
	(6.453)	(8.485)	(9.464)	(3.644)	(7.090)
loss	0.194	-0.351	-0.211	-0.154	-0.0910
	(0.464)	(0.610)	(0.680)	(0.262)	(0.510)
lossit	0.0518	0.775	0.798	0.365	0.472
	(0.530)	(0.696)	(0.777)	(0.299)	(0.582)
Constant	-0.190	0.552	0.610	0.0977	0.0616
	(0.525)	(0.690)	(0.770)	(0.296)	(0.577)
Observations	38	38	38	38	38

*Table 19: Generalized Least Squares (GLS) regression output of R-squared time regressions (equation (8)). R2H3aabook is the adjusted R-squared values from equation (1), run cross-sectionally for each year, r2H3bbook is the adjusted R-squared values from equation (2), run cross-sectionally for each year, r2H3cabook is the adjusted R-squared values from equation (3), run cross-sectionally for each year, r2H4book is the adjusted R-squared values from equation (6), run cross-sectionally for each year, r2H5book is the adjusted R-squared values from equation (7), run cross-sectionally for each year, post is a dummy variable equal to 1 for years 2000 to 2010 and 0 for years 1992 to 1999, IT is a dummy variable equal to 1 for firms containing these keywords in their company names: .com, online, digital, communications, web, network, information, internet, cyber and connect, as well as companies without these keywords in their names that make the list of largest Internet companies in the world, namely Facebook, Alphabet, Priceline Group, Ebay, Netflix, Expedia, Yahoo, Groupon, Linkedin, Twitter, Airbnb and Tripadvisor, postit is the interaction term between post and IT, one is the mean absolute value of special items as a percent of net income for the IT and non-IT subsamples in year t, oneit is the interaction term between one and IT, logsize is the natural logarithm of the average market value of equity for the IT and non-IT subsamples in year t, logsizeit is the interaction term between logsize and IT, pcht is the percentage of firms in IT sector in year t, pchtit is the interaction term between pcht and IT, loss is the percentage of IT and non-IT firms in year t with negative net income and lossit is the interaction term between loss and IT. *, ** and *** indicate significance at 10%, 5% and 1%, respectively. Standard errors are reported in parentheses*

Moving on to the market value scalings, earnings relation of IT firms exhibits an average explanatory power of 6,52%. The number for non-IT sample is 1,94% (non-GAAP earnings show 3,47% and 2,87%, respectively, which is a smaller difference). Book values are on average more value relevant in the IT sector (18,91% versus 13,72%). Ultimately, the combined value relevance is greater for IT firms (21,59% versus 15,10%, robust to non-GAAP specification).

Table 20: Adjusted R-squared values obtained from regressions (1) to (3), run separately for each year per subsample. IT reports R-squared values for the IT subsample and non-IT reports these values for the subsample of all other high-tech industries. N is the yearly number of observations

(1) Earnings relation: $(M_t/M_{t-1}) = \beta_0 + \beta_1(NI_t/M_{t-1}) + \varepsilon_t$

(2) Book value relation: $(M_t/M_{t-1}) = \beta_0 + \beta_1(AT_t/M_{t-1}) + \beta_2(LT_t/M_{t-1}) + \varepsilon_t$

(3) Combined: $(M_t/M_{t-1}) = \beta_0 + \beta_1(NI_t/M_{t-1}) + \beta_2(AT_t/M_{t-1}) + \beta_3(LT_t/M_{t-1}) + \varepsilon_t$

M_t/M_{t-1} is current year's market value of equity divided by previous year's market value of equity, NI_t/M_{t-1} is current year's net income divided by previous year's market value of equity, AT_t/M_{t-1} is current year's assets divided by previous year's market value of equity and LT_t/M_{t-1} is current year's liabilities divided by previous year's market value of equity

	Earnings relation				Book value relation				Combined			
Year	N	IT	N	Non-IT	N	IT	N	Non-IT	N	IT	N	Non-IT
1992	27	0,3177	408	0,0145	27	0,1827	408	0,1141	27	0,2714	408	0,1245
1993	31	-0,0343	484	0,0013	31	-0,0554	484	0,1912	31	-0,0910	484	0,1921
1994	37	-0,0269	537	0,0377	37	-0,0210	537	0,1233	37	-0,0508	537	0,1559
1995	46	-0,0220	575	0,0036	46	0,0212	575	0,0890	46	-0,0018	575	0,1028
1996	53	0,3244	717	-0,0002	53	0,1687	717	0,1318	53	0,3535	717	0,1340
1997	70	-0,0037	827	0,0273	70	0,1463	827	0,2043	70	0,1358	827	0,2131
1998	75	0,0843	828	0,0020	75	0,0612	828	0,0642	75	0,1672	828	0,0648
1999	66	-0,0020	825	0,0512	66	0,1007	825	0,1109	66	0,0865	825	0,1344
2000	82	0,0165	918	0,0037	82	0,2716	918	0,1443	82	0,2757	918	0,1445
2001	76	0,0165	994	0,0106	76	0,3536	994	0,1715	76	0,3453	994	0,1955
2002	69	0,0323	1000	0,0007	69	0,3277	1000	0,1166	69	0,3283	1000	0,1233
2003	72	0,0173	1070	0,0367	72	0,1800	1070	0,1725	72	0,1817	1070	0,1836
2004	72	0,0023	1049	0,0583	72	0,2296	1049	0,1632	72	0,2182	1049	0,2024
2005	74	0,3601	1081	0,0134	74	0,4319	1081	0,2040	74	0,4831	1081	0,2229
2006	75	-0,0034	1056	0,0155	75	0,2663	1056	0,1370	75	0,2724	1056	0,1448
2007	75	0,0171	1074	0,0015	75	0,1593	1074	0,1564	75	0,1539	1074	0,1580
2008	82	0,0018	1046	0,0516	82	0,4621	1046	0,0357	82	0,5217	1046	0,0822
2009	76	0,0191	989	0,0405	76	0,2800	989	0,2157	76	0,2995	989	0,2293
2010	71	0,1220	822	-0,0012	71	0,0256	822	0,0611	71	0,1513	822	0,0603
Average		**0,0652**		**0,0194**		**0,1891**		**0,1372**		**0,2159**		**0,1510**

Market value scalings do not alter the cash flow and accrual relations much, yielding average R-squared values of 10,39% and 2,97% for IT and non-IT, respectively. The gap in the goodwill relation, however, is smaller compared to book value scaling scenario (2,34% versus 1,62%).

Table 21: Adjusted R-squared values obtained from regressions (6) and (7), run separately for each year per subsample. IT reports R-squared values for the IT subsample and non-IT reports these values for the subsample of all other high-tech industries. N is the yearly number of observations

(6) Goodwill relation: $(M_t/M_{t-1}) = \beta_0 + \beta_1(GDWL_t/M_{t-1}) + \varepsilon_t$

(7) Cash flow and accruals relation: $(M_t/M_{t-1}) = \beta_0 + \beta_1(OANCF_t/M_{t-1}) + \beta_2(ACC_t/M_{t-1}) + \varepsilon_t$

M_t/M_{t-1} is current year's market value of equity divided by previous year's market value of equity, $GDWL_t/M_{t-1}$ is current year's goodwill divided by previous year's market value of equity, $OANCF_t/M_{t-1}$ is current year's cash flow from operating activities divided by previous year's market value of equity and ACC_t/M_{t-1} is current year's accruals (net income minus cash flow from operating activities) divided by previous year's market value of equity

	Goodwill relation				Cash flow and accrual relation			
Year	N	IT	N	Non-IT	N	IT	N	Non-IT
1992	27	-0,0229	408	0,0325	27	0,2891	408	-0,0011
1993	31	-0,0341	484	-0,0014	31	0,1295	484	0,0222
1994	37	-0,0285	537	0,0043	37	-0,0375	537	0,0587
1995	46	-0,0216	575	0,0215	46	0,0250	575	0,0062
1996	53	0,1611	717	0,0110	53	0,3834	717	0,0030
1997	70	-0,0043	827	0,0691	70	0,0050	827	0,0311
1998	75	-0,0052	828	0,0184	75	0,1467	828	-0,0004
1999	66	0,0147	825	-0,0008	66	-0,0115	825	0,0517
2000	82	0,0069	918	0,0060	82	0,0644	918	0,0006
2001	76	0,1676	994	0,0430	76	0,0000	994	0,0282
2002	69	-0,0147	1000	0,0318	69	0,1551	1000	0,0447
2003	72	-0,0103	1070	0,0116	72	0,0572	1070	0,0605
2004	72	0,0574	1049	0,0182	72	-0,0152	1049	0,0766
2005	74	0,0152	1081	0,0118	74	0,3795	1081	0,0230
2006	75	-0,0024	1056	0,0067	75	-0,0142	1056	0,0312
2007	75	-0,0091	1074	0,0060	75	0,0255	1074	-0,0004
2008	82	0,1445	1046	0,0084	82	0,1447	1046	0,0520
2009	76	0,0449	989	0,0069	76	0,1762	989	0,0594
2010	71	-0,0144	822	0,0033	71	0,0713	822	0,0176
Average		**0,0234**		**0,0162**		**0,1039**		**0,0297**

Regression output shows somewhat different results than observed under book value scalings. Table 22 shows that book values are more value relevant for IT sector than in other high-tech industries after the Internet Bubble. The coefficient of postit in column (2) is 0,195 and significant at 5% level. Interestingly, the coefficient of postit in column (3) is not significant but the non-GAAP earnings specification of this combined relation yields a coefficient of 0,248, which is significant at the 1% level. Results regarding goodwill and cash flows and accruals are less conclusive here, with both coefficients being negative but not significantly different from zero.

VARIABLES	(1) r2H3aamarket	(2) r2H3bmarket	(3) r2H3camarket	(6) r2H4market	(7) r2H5market
post	-0.0112	-0.00524	-0.00212	-0.00542	-0.0107
	(0.0727)	(0.0679)	(0.0843)	(0.0349)	(0.0759)
IT	0.434	0.128	-0.0790	-0.176	0.429
	(0.491)	(0.458)	(0.569)	(0.235)	(0.512)
postit	0.0244	0.195**	0.174	-0.0232	-0.0188
	(0.0981)	(0.0916)	(0.114)	(0.0470)	(0.102)
one	-0.0113	-0.00754	-0.0179	0.0109	0.00168
	(0.0504)	(0.0471)	(0.0585)	(0.0242)	(0.0526)
oneit	-0.0134	0.00587	-0.0216	-0.0337	-0.0653
	(0.0708)	(0.0661)	(0.0821)	(0.0339)	(0.0739)
logsize	0.0226	0.0150	0.0185	-0.0136	0.0233
	(0.0606)	(0.0565)	(0.0703)	(0.0290)	(0.0632)
logsizeit	-0.0434	-0.0332	-0.0326	0.0325	-0.0327
	(0.0664)	(0.0620)	(0.0770)	(0.0318)	(0.0693)
pcht	-0.536	-3.189	-3.337	-0.0537	-1.803
	(3.840)	(3.585)	(4.455)	(1.841)	(4.007)
pchtit	0.941	0.0465	4.073	-1.473	0.319
	(5.018)	(4.685)	(5.822)	(2.406)	(5.237)
loss	-0.0261	0.0969	0.0843	0.151	0.0729
	(0.361)	(0.337)	(0.418)	(0.173)	(0.376)
lossit	-0.289	0.0983	0.00938	0.139	-0.210
	(0.412)	(0.385)	(0.478)	(0.198)	(0.430)
Constant	-0.0923	0.204	0.208	0.0499	-0.0515
	(0.408)	(0.381)	(0.473)	(0.196)	(0.426)
Observations	38	38	38	38	38

*Table 22: Generalized Least Squares (GLS) regression output of R-squared time regressions (equation (8)). R2H3aamarket is the adjusted R-squared values from equation (1), run cross-sectionally for each year, r2H3bmarket is the adjusted R-squared values from equation (2), run cross-sectionally for each year, r2H3camarket is the adjusted R-squared values from equation (3), run cross-sectionally for each year, r2H4market is the adjusted R-squared values from equation (6), run cross-sectionally for each year, r2H5market is the adjusted R-squared values from equation (7), run cross-sectionally for each year, post is a dummy variable equal to 1 for years 2000 to 2010 and 0 for years 1992 to 1999, IT is a dummy variable equal to 1 for firms containing these keywords in their company names: .com, online, digital, communications, web, network, information, internet, cyber and connect, as well as companies without these keywords in their names that make the list of largest Internet companies in the world, namely Facebook, Alphabet, Priceline Group, Ebay, Netflix, Expedia, Yahoo, Groupon, Linkedin, Twitter, Airbnb and Tripadvisor, postit is the interaction term between post and IT, one is the mean absolute value of special items as a percent of net income for the IT and non-IT subsamples in year t, oneit is the interaction term between one and IT, logsize is the natural logarithm of the average market value of equity for the IT and non-IT subsamples in year t, logsizeit is the interaction term between logsize and IT, pcht is the percentage of firms in IT sector in year t, pchtit is the interaction term between pcht and IT, loss is the percentage of IT and non-IT firms in year t with negative net income and lossit is the interaction term between loss and IT. *, ** and *** indicate significance at 10%, 5% and 1%, respectively. Standard errors are reported in parentheses*

As a final check, I compare the IT firms against all other firms in the sample, not just the high-tech ones. Untabulated results show similar relations between the basic financial statement items under book value scaling scenario. Under market value scaling, next to book values and combined relation with EBITDA specification being significant, earnings relation using non-GAAP specification shows a positive and significant coefficient (at 5% level) as well. The conclusions on goodwill and cash flows and accruals are exactly the same.

6 Conclusions, limitations and suggestions for further research

The sections above present a large amount of evidence related to differential accounting item value relevance between higher technology firms and more mature, established firms. Although mixed along the different specifications, the results from book value scaling scenario point towards lower value relevance of book values in high-tech industries on both high-tech definitions, confirming the prediction of hypothesis H1b. Earnings, on the other hand, lack significance in many of the estimated regressions – hypothesis H1a therefore lacks support. The combination of key income statement and balance sheet items and their differential value relevance between high-tech and low-tech industries is also less conclusive in general - hypothesis H1c is not confirmed. As for market value scaling results, none of the coefficients of interest show significant differences between the two categories of interest. From the economic perspective, it seems that high-tech firms and their balance sheet items became less value relevant for investors seeking to invest in a growing high-tech firm – as mentioned earlier in the text, market-to-book ratio is often used as a proxy for firm growth in empirical research. When stock market performance is taken into consideration, these differences are not substantial. This could mean that during the time period of investigation more careful investment decisions were made based on those high-tech companies that portray themselves as potential leaders in the future. Regarding overall stock market performance, the decisions were not strikingly different. As for hypothesis 2, there is almost no evidence that high-tech firms exhibited significantly higher value relevance of R&D than low-tech ones. This is likely attributed to the expanding business activities of all firms, where even the simplest manufacturing firm might be spending on R&D to develop their equipment that is used to improve firm productivity.

As for the IT sector case, the results provide more evidence in favour of an increased value relevance of balance sheet items in IT firms compared to other high-tech firms after the Internet Bubble, but this time only under market value scaling. Hypothesis H3b has support here, whereas H3a and H3c lack evidence in the same way as H1a and H3c do. The economic interpretation of this conclusion can be explained by the increased investor awareness of IT firms and their performance in stock markets around the Internet stock crash. It seems that certain balance sheet items became more important for investors to decide on their investments post the Bubble but only considering the overall stock market performance – this time the growth factor does not play the same role as it did for high-tech analysis, likely due to this massive dot.com collapse that touched Internet firms of various size and growth prospects. Finally, results regarding hypotheses 4 and 5 demonstrate different signs on the coefficient of interest under all specifications, as well as lack significance with the only exception of goodwill exhibiting higher value relevance for the IT sector under book value scaling. As goodwill is a large part of a firm's intangible assets and assets taken together with liabilities have become more value relevant for IT firms post the Bubble, it is reasonable for investors to focus more on those asset categories that carry potential value, especially for growing firms. The overall takeaway of this thesis is that value relevance of balance sheet items is lower for growing higher technology firms than for low technology firms during the past two decades and that this relevance is larger for IT sector than for other higher technology firms after the Internet stock crash based solely on stock market performance. R&D expenses and cash flows plus accruals are not significantly more value relevant in high-tech and IT firms and their importance depends more under book value scaling scenario – that is, higher R-squared values are observed when considering growth prospects of a firm. Goodwill, on the other hand, plays a bigger role in growing IT firms compared to growing all other high-tech firms.

This research is subject to several limitations. First of all, the discretion in research and development expense reporting results in a loss of many observations – as companies choose whether to disclose such information in their financial statements, the inferences cast doubt on the true interpretation of R&D value relevance in a sense that the sample shrinks by more than 50% after removing missing observations. Such attrition levels can seriously jeopardize the research and its validity. Extreme values, although dealt with to a certain extent, still pose difficulties in terms of correctly interpreting many of the items selected in this research. From the standpoint of selecting industries into high-tech, it is difficult to account for industry dynamics and the changing perception of it. At current levels of technological advance, the pace of innovation is increasing exponentially and thus industries can experience reclassification from high-tech to low-tech and vice versa very quickly due to sudden changes in their unrecorded intangible assets. As for the IT sector definition, the selection is quite arbitrary and can easily result in a lot of firms that qualify being excluded as well as in a lot of firms who do not qualify being included. Finally, the analysis rests on perfect capital markets assumption[5] and only public firms are taken into consideration. Even though a large part of the effect in high-tech firms could be hidden in private firm performance (since technological

[5] Aboody et al. (2002) relaxes this assumption in his research

startups take several years before they go public), the momentum from either good or bad performance is believed to be transferred on to the publicly traded firms as well.

To overcome the issues discussed, further research should make improvements in methodology to capture effects that are less susceptible to biases. One improvement is already under consideration and is directed towards dealing with non-linearities and over fitting of the data, common pitfalls of OLS. This method is called classification and regression trees estimation (CART) and is used in Barth et al. (2017). Furthermore, due to rapid advances in technology, value relevance research should be conducted periodically, including more recent years in the sample. Firms that receive a lot of media attention should be investigated even more carefully since they are the potential key players in future economy. That is, researchers should consider doing case studies on such firms. Innovative products and the competition between them is also a topic of interest since nowadays firms have become so diversified that classifying them into one particular industry is becoming a difficult, if not an impossible, task.

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Appendix A: Variable Definitions

Variable Name	Variable equivalent used in the equations	Definition
MB	(M_t/B_{t-1})	Current year's market value of equity divided by previous year's book value of equity
MM	(M_t/M_{t-1})	Current year's market value of equity divided by previous year's market value of equity
NIB	(NI_t/B_{t-1})	Current year's net income divided by previous year's book value of equity
NIM	(NI_t/M_{t-1})	Current year's net income divided by previous year's market value of equity
EBITDAB	Not specified but used instead of net income	Current year's earnings before interest, tax, depreciation and amortization divided by previous year's book value of equity
EBITDAM	Not specified but used instead of net income	Current year's earnings before interest, tax, depreciation and amortization divided by previous year's market value of equity
OANCFB	$(OANCF_t/B_{t-1})$	Current year's cash flow from operating activities divided by previous year's book value of equity
OANCFM	$(OANCF_t/M_{t-1})$	Current year's cash flow from operating activities divided by previous year's market value of equity
ACCB	(ACC_t/B_{t-1})	Current year's accruals (net income minus cash flows from operating activities) divided by previous year's book value of equity
ACCM	(ACC_t/M_{t-1})	Current year's accruals (net income minus cash flows from operating activities) divided by previous year's market value of equity
ATB	(AT_t/B_{t-1})	Current year's assets divided by previous year's book value of equity
ATM	(AT_t/M_{t-1})	Current year's assets divided by previous year's market value of equity
LTB	(LT_t/B_{t-1})	Current year's liabilities divided by previous year's book value of equity
LTM	(LT_t/M_{t-1})	Current year's liabilities divided by previous year's market value of equity
GDWLB	$(GDWL_t/B_{t-1})$	Current year's goodwill divided by previous year's book value of equity
GDWLM	$(GDWL_t/M_{t-1})$	Current year's goodwill divided by previous year's market value of equity
XRDB	(XRD_t/B_{t-1})	Current years research and development expense divided by previous year's book value of equity
XRDM	(XRD_t/M_{t-1})	Current years research and development expense divided by previous year's market value of equity

Variable Name	Variable equivalent used in the equations	Definition
R2H1aabook (2)	R^2	Adjusted R-squared values from equation (1), run cross-sectionally for each year. Same definition goes for R2H1aabook2
R2H1aamarket (2)	R^2	Adjusted R-squared values from equation (1), run cross-sectionally for each year. Same definition goes for R2H1aamarket2
R2H1bbook (2)	R^2	Adjusted R-squared values from equation (2), run cross-sectionally for each year. Same definition goes for R2H1bbook2
R2H1bmarket (2)	R^2	Adjusted R-squared values from equation (2), run cross-sectionally for each year. Same definition goes for R2H1bmarket2
R2H1cabook (2)	R^2	Adjusted R-squared values from equation (3), run cross-sectionally for each year. Same definition goes for R2H1cabook2
R2H1camarket (2)	R^2	Adjusted R-squared values from equation (3), run cross-sectionally for each year. Same definition goes for R2H1camarket2
R2H2book (2)	R^2	Adjusted R-squared values from equation (4), run cross-sectionally for each year. Same definition goes for R2H2book2
R2H2market (2)	R^2	Adjusted R-squared values from equation (4), run cross-sectionally for each year. Same definition goes for R2H2market2
R2H3aabook	R^2	Adjusted R-squared values from equation (1), run cross-sectionally for each year
R2H3aamarket	R^2	Adjusted R-squared values from equation (1), run cross-sectionally for each year
R2H3bbook	R^2	Adjusted R-squared values from equation (2), run cross-

		sectionally for each year
R2H3bmarket	R^2	Adjusted R-squared values from equation (2), run cross-sectionally for each year
R2H3cabook	R^2	Adjusted R-squared values from equation (3), run cross-sectionally for each year
R2H3camarket	R^2	Adjusted R-squared values from equation (3), run cross-sectionally for each year
R2H4book	R^2	Adjusted R-squared values from equation (6), run cross-sectionally for each year
R2H4market	R^2	Adjusted R-squared values from equation (6), run cross-sectionally for each year
R2H5book	R^2	Adjusted R-squared values from equation (7), run cross-sectionally for each year
R2H5market	R^2	Adjusted R-squared values from equation (7), run cross-sectionally for each year
Time	$TIME_t$	Trend variable, equal to 1 for year 1990, 2 for year 1991 etc. up till 2010, which is assigned a value of 21
High_tech (2)	$HIGHTECH$	Dummy variable equal to 1 for high tech industries defined by Francis and Schipper (1999) (industries 13, 22, 32, 34, 35 and 36 using Fama-French database) and 0 otherwise
Post	$POST_t$	Dummy variable equal to 1 for years 2000 to 2010 and 0 for 1992 to 1999
IT	IT	Dummy variable equal to 1 for IT firms and 0 otherwise
One	ONE_t	Mean absolute value of special items as a percent of net income for the IT (or high-tech) and non-IT (or low-tech) subsamples in year t
Logsize	$LOGSIZE_t$	Natural logarithm of the average market value of equity for the IT (or high-tech) and non-IT (or low-tech) subsamples in year t

Pcht	$PCHT$	Percentage of firms in IT (or high-tech) sector in year t
Loss	$LOSS_t$	Percentage of IT (or high-tech) and non-IT (or low-tech) firms in year t with negative net income
Onehightech (2)	$ONE_t * HIGHTECH$	Interaction term between One and high_tech (high_tech2)
Logsizehightech (2)	$LOGSIZE_t * HIGHTECH$	Interaction term between Logsize and high_tech (high_tech2)
Pchthightech (2)	$PCHT * HIGHTECH$	Interaction term between Pcht and high_tech (high_tech2)
Losshightech (2)	$LOSS_t * HIGHTECH$	Interaction term between Loss and high_tech (high_tech2)
Oneit	$ONE_t * IT$	Interaction term between One and IT
Logsizeit	$LOGSIZE_t * IT$	Interaction term between Logsize and IT
Pchtit	$PCHT * IT$	Interaction term between Pcht and IT
Lossit	$LOSS_t * IT$	Interaction term between Loss and IT

Appendix B: Fama-French 48 industry classification

No.	**Industry**
1	Agriculture
2	Food Products
3	Candy & Soda
4	Beer & Liquor
5	Tobacco Products
6	Recreation
7	Entertainment
8	Printing and Publishing
9	Consumer Goods
10	Apparel
11	Healthcare

12	Medical Equipment
13	Pharmaceutical Products
14	Chemicals
15	Rubber and Plastic Products
16	Textiles
17	Construction Materials
18	Construction
19	Steel Works Etc
20	Fabricated Products
21	Machinery
22	Electrical Equipment
23	Automobiles and Trucks
24	Aircraft
25	Shipbuilding, Railroad Equipment
26	Defense
27	Precious Metals
28	Non-Metallic and Industrial Metal Mining
29	Coal
30	Petroleum and Natural Gas
31	Utilities
32	Communication
33	Personal Services
34	Business Services
35	Computers
36	Electronic Equipment
37	Measuring and Control Equipment
38	Business Supplies
39	Shipping Containers
40	Transportation
41	Wholesale

42	Retail
43	Restaurants, Hotels, Motels
44	Banking
45	Insurance
46	Real Estate
47	Trading
48	Almost Nothing

Appendix C: Predictive validity framework (Libby boxes)

Figure 1: Libby boxes for equations (1), (2), (3) and (4) (High-tech)

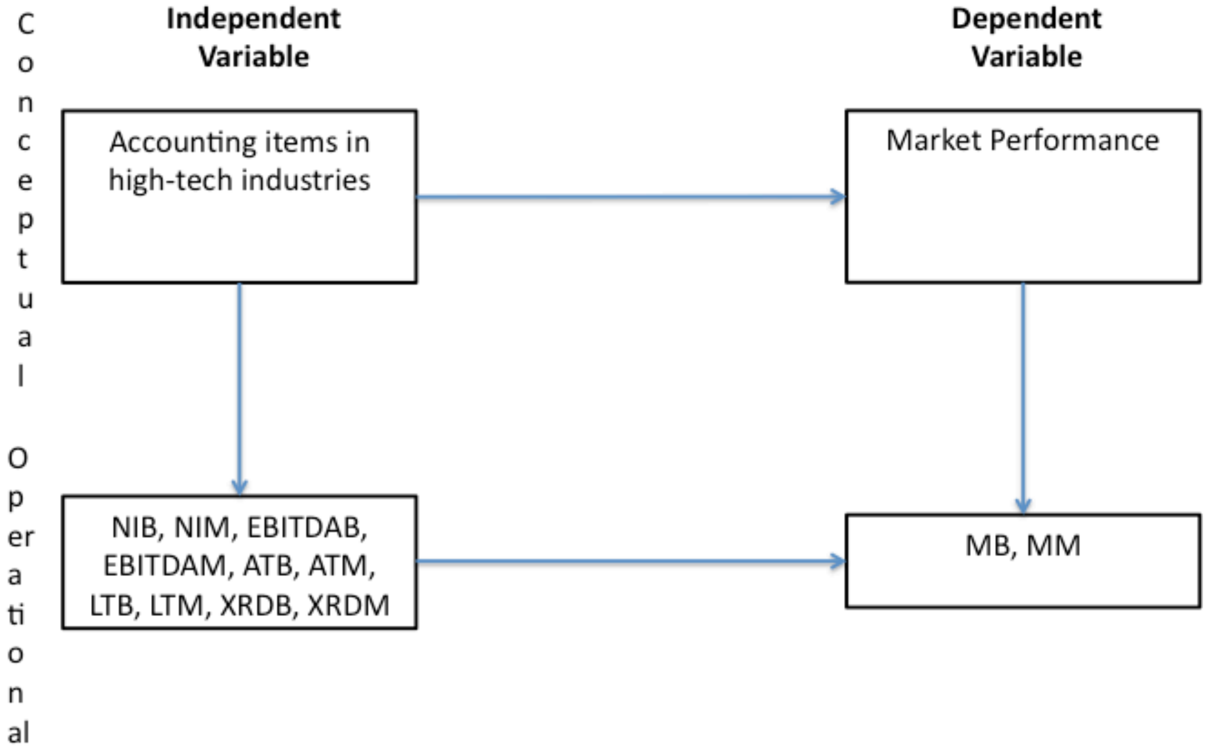

Figure 2: Libby boxes for equations (1), (2), (3), (6) and (7) (IT sector)

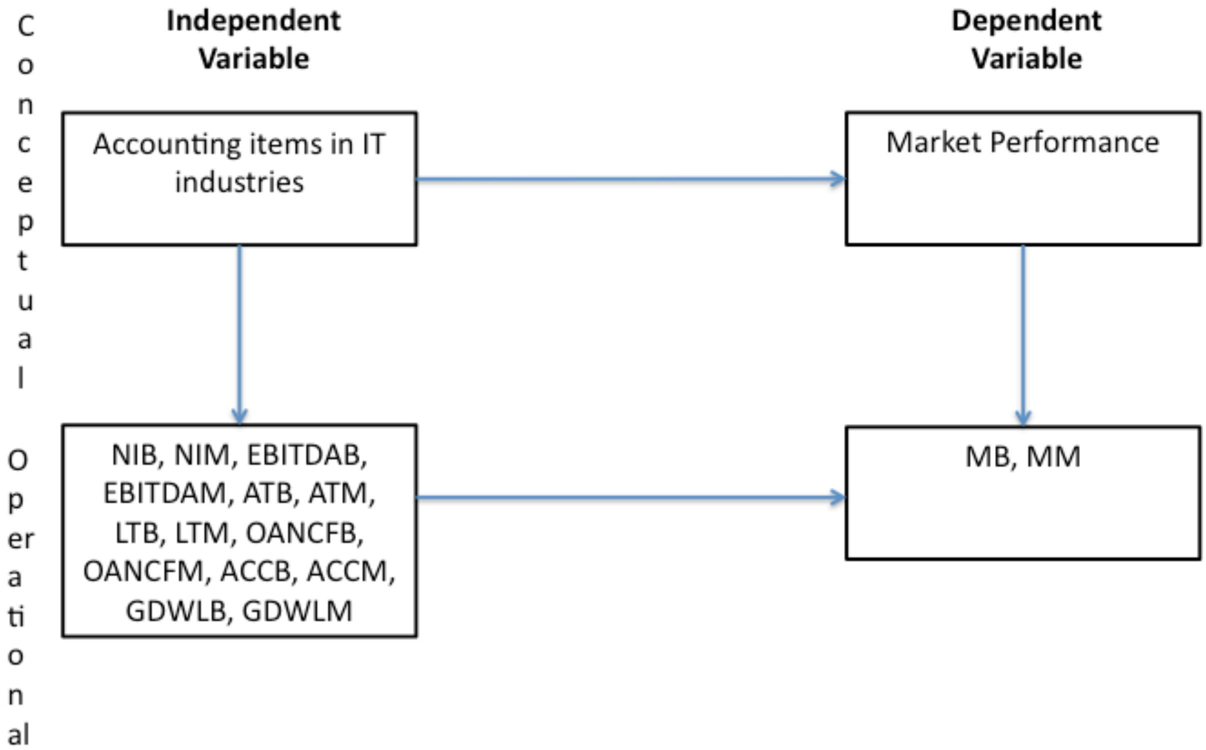

Figure 3: Libby boxes for equation (5)

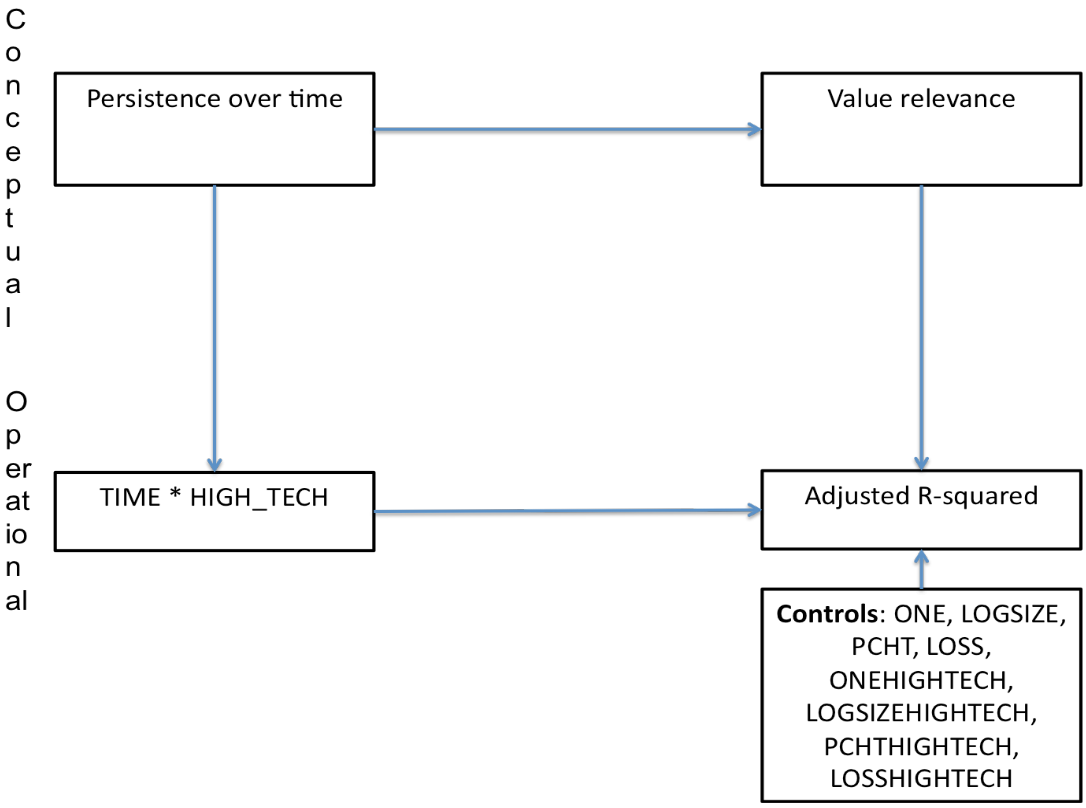

Figure 4: Libby boxes for equation (8)