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The value relevance of financial statement numbers

New evidence and perspectives on the impact of intangible assets

Keywords: Financial reporting; US GAAP; Value relevance; Intangible assets; Price value relevance models.

Abstract

Investments in intangible assets have become the main source of value creation for many companies in the US. US GAAP recognizes investments in intangibles generally not as assets so little quantitative and qualitative information about them can be derived from financial statements. Recent studies estimate the annual investments in intangible assets in the US around $ 1 trillion, from which as much as $ 800 billion is excluded from financial statement data. A popular claim is that the value relevance of financial statement information has declined due to the growing importance of intangible assets and the failure of the accounting system to carefully reflect the impact of these intangibles. However, to date, there is mixed empirical evidence on the impact of unrecorded intangible assets. This study adopts a more comprehensive and thorough approach to assess the value relevance of financial statement numbers for intangible-intensive firms. Using a variety of models and specifications, the evidence suggests that the value relevance of the fundamental accounting numbers is lower for firms that rely more heavily on intangible assets than for firms that rely more on tangible capital. Moreover, the results indicate that intertemporal changes in value relevance can partially be explained by the intangible intensity in the sample. The lower value relevance for intangible-intensive firms does not appear to be due to a lower association between market value and the fundamental accounting numbers, but due to the greater variation in firm prices remaining to be explained by other factors. These findings suggest that the difference in value relevance between the two types of firms is likely attributable to one or more unobserved independent variables, higher noise due to non-information-based trading or greater volatility in the stock prices.

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Abbreviations

IASB	International Accounting Standards Board
IFRS	International Financial Reporting Standards
US FASB	United States Financial Accounting Standards Board
US GAAP	United States Generally Accepted Accounting Principles

Glossary

IASB
The IASB is the independent standard-setting body of the IFRS foundation, responsible for the development and publication of IFRSs.

IFRS
IFRS is the set of accounting standards developed by the IASB. Currently, over 100 countries permit or require IFRS for public companies, with more countries expected to transition to IFRS by 2015.

US FASB
Since 1973, the FASB is the standard setting body in the US in the private sector, responsible for the standards of financial reporting that govern the preparation of financial reports by non-governmental organizations.

US GAAP
US GAAP is the set of accounting standards developed by the US FASB. Historically, US GAAP has been regarded as the highest-quality set of financial accounting standards in the world. However, IFRS has begun to overshadow US standards in significance.

Convergence project
In October 2002, the FASB and IASB have jointly undertaken a convergence project in which the boards agreed on working together to converge their accounting standards. In 2006, the boards reaffirmed in a memorandum of understanding that the ultimate goal of the convergence project is to develop a single set of high-quality accounting standards. Thus far, the project is still in progress.

Conceptual Framework
A conceptual framework (CF) can be seen as an attempt to define the nature and purpose of financial accounting. The CF sets out the concepts that underlie the preparation and presentation of financial statements for external users. Further, it helps in developing, reviewing and interpreting accounting standards. A conceptual framework is thus *not* an accounting standard.

Conceptual Framework for Financial Reporting – IASB and FASB
From 2005, the IASB and FASB have been working towards the development of a revised conceptual framework that will be used by both parties. At this moment, the mutual CF is still under construction.

FASB's Statements of Financial Accounting Concepts
Current conceptual frameworks of the IASB and FASB. Although the basic structure of both frameworks in the same, the CFs differ in some other respects. An overview of the (material) differences between the two frameworks can be found in Paz and Griffin (2009).

Introduction

1.1 Background

The optimal allocation of savings into investment opportunities is a critical challenge for any economy. In almost all countries world-wide, capital markets play an essential role in allocating financial resources. Financial reporting fulfills an important task in the functioning of capital markets because it mitigates information and incentive problems[1] which impede the efficient allocation of resources in capital markets (Palepu and Healy 2001). In a nutshell, this is how it works. By publishing financial statements, companies are able to communicate with potential investors, shareholders and other stakeholders. To be of actual use to their stakeholders, financial statements must provide a true and fair summary of the economic consequences of all business activities in a certain period. In order to provide a mechanism through which business activities can be selected, measured and aggregated into financial statement data, accounting standards have been developed (Palepu et al. 2008). Accounting standards "translate" the impact of all business activities in an uniform language, making financial statements of different business enterprises interpretable and comparable. Moreover, the use of accounting standards is necessary because users of financial statements have to rely on the financial statement numbers prepared by companies while they have no direct control on the process of preparation (Palepu and Healy 2001). Accounting standards help thus to ensure that stakeholders are provided with useful financial information on the basis of which they can decide whether or not to provide economic resources to a company (FASB/IASB 2010).

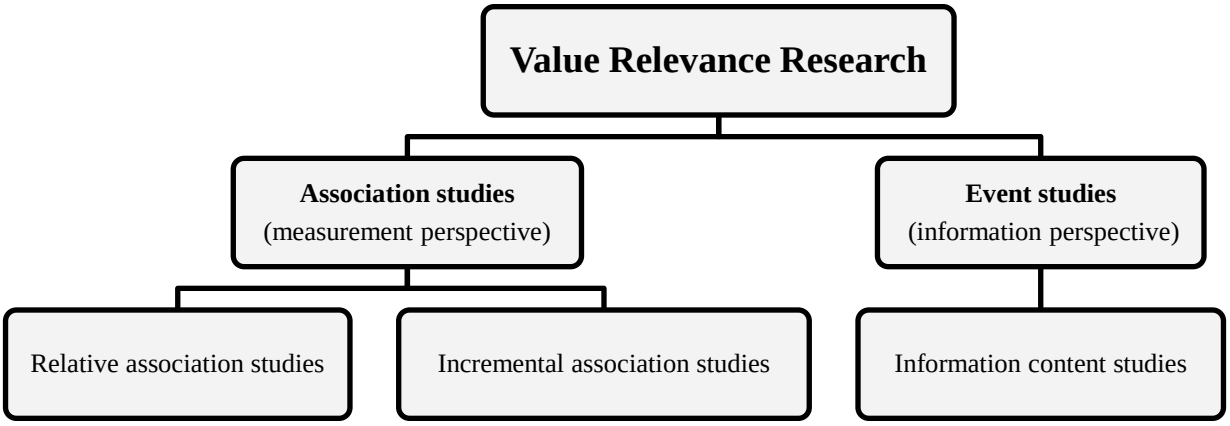
1.2 Value relevance

The distribution of useful financial information to investors, creditors and other users of financial statements for making economic decisions has been identified by the International Accounting Standards Board (IASB) and the US Financial Accounting Standards Board (FASB) as the main purpose of financial reporting (FASB/IASB 2010). Accounting standard setters, auditors and stock market regulators put lots of effort into improving both the quality and transparency level of financial reporting to enhance the usefulness of financial information. For the empirical accounting literature, this serves a major motivation to test whether, and to what extent, financial information is useful to investors[2], or, whether and to what extent the main goal of financial reporting is met. This interesting stream in the accounting literature is part of capital market research and is called "value relevance" research (Barth et al. 2001).

[1] With information problems there is meant that business enterprises have better information about the quality of their business ideas than investors but that they are not able to communicate this information credibly. Incentive problems occur once savers have invested in a business: the business entity has then an incentive to expropriate these savings, creating an agency problem (Palepu and Healy 2001).

[2] The main focus in the value relevance literature is on investors since they are considered the prime users of financial statements (see also chapter 2).

Value relevance research in accounting can be partitioned in "event studies" and "association studies". Both types of research generally employ regression models with stock market metrics as the dependent variable and accounting numbers (often represented by earnings and/or book values, the fundamental accounting numbers). Event studies assess whether an event (for example, an earnings announcement) causes a change in the level or variability of security prices or trading volumes over a short time period around the event (Kothari 2001). An event study provides thus evidence on whether the accounting information of interest provides new information to investors, which is a test of whether it has information content. Price reactions would be considered evidence for value relevance (Holthausen and Watts 2001). Association studies test for a positive association between accounting numbers and market metrics (stock prices or returns), both measured over relatively long periods. The objective is to test whether the financial information captures or summarizes ("measures") the information actually used by investors (Francis and Schipper 1999). The accounting numbers can then be termed value relevant if they are significantly associated with equity market value. Association studies can be classified as "relative association studies" (studies comparing the association of the fundamental accounting numbers and stock market value across time or subsamples) and "incremental association studies" (studies investigating whether the accounting number of interest is able to provide additional information, given the other information available) (Holthausen and Watts 2001). Both types of research differ in their measure of value relevance. Relative association studies generally focus on the extent to which variation in equity value is explained by the accounting information incorporated in the value relevance model. Hence, the explanatory power of the model is used as a measure for value relevance. In contrast, incremental association studies measure value relevance based on (the magnitude of) the coefficient on the variable of interest: the accounting numbers is then termed value relevant if its coefficient is significantly different from zero. This thesis falls under the field of "relative association studies". Value relevance is therefore formally defined as the total variation in equity market value explained by the financial information of interest, i.e. the R^2 of the regression model, unless specified otherwise.



1.3 Value relevance and accounting for intangible assets

Beginning in the 1990s, a specific stream of the value relevance literature, predominantly relative association studies, has addressed the question whether the value relevance of financial information has declined over the past decades. An important motivation for these studies is the concern that accounting numbers prepared in accordance with US GAAP have lost part of their relevance due to the growing importance of intangible assets in the current, knowledge-based US economy (FASB 2001). Under US GAAP, most investments in intangibles must be expensed rather than capitalized[3]. Though these unmeasured intangible assets are of great importance in an economy increasingly dependent on expertise, data and technology (Lev and Daum 2004). Failure to carefully reflect the impact of intangible assets on the current and future performances of a firm implies that the fundamental accounting numbers fail to provide a true and fair view on a firm's financial position. Hence, many academics presume that in the presence of high amounts of unrecorded intangible assets, investors are unable to make efficient allocation decisions based on the information provided in financial statements (Canibano et al. 2000). This suggests that investors turn to other sources than financial statements to base their investment decisions on, indicating that the value relevance of financial statement information is lower for firms which rely more heavily on unrecorded intangible assets ("intangible-intensive firms[4]") compared to firms which depend more on tangible capital. Since intangible assets are increasingly important in the US economy, there is often argued that on the whole the value relevance of financial information has declined over the years (e.g. Lev and Zarowin 1999). Many US studies have documented a decline in value relevance (e.g. Brown et al. 1999). However, most studies are not able to link the declining trend in value relevance to the growing importance of intangibles. Despite the extensive research in this area, there is still no real consensus on how to conduct such value relevance studies, what the results are and how the results should be interpreted (Lo and Lys 2000).

1.4 Research question

Empirical evidence on the relation between the growing importance of intangible assets and the documented decline in value relevance is mixed and rather thin. Moreover, there is surprisingly little empirical evidence for the claim that the current accounting treatment of intangibles and value relevance are, on a general basis[5], related at all. In addition, most studies concerning the value relevance of earnings and book values (the "fundamental accounting numbers") in relation to the growing importance of intangible assets take on a narrow view and focus only on the R^2s of the value relevance

[3] There is often referred to such an accounting treatment as "conservative accounting"

[4] The intangible intensity of firms refers to the extent to which firms are likely to have high amounts of internally generated intangible assets which are not recognized under US GAAP. The use of a proxy (instead of an exact measure) is necessary because information about investments in non-recognized intangibles is not available in financial statements. Because externally acquired intangible assets are recognized under US GAAP and do not generally raise accounting problems, these intangibles are not the intangible assets of interest in this study. For brevity, there is referred to firms which are likely to have a high stock of unrecorded intangibles as "intangible-intensive firms".

[5] With the additive "on a general basis" there is referred to empirical evidence besides evidence for one industry or a specific type of intangible assets, see also chapter 4.

models. The valuable information offered by the coefficients on the individual accounting numbers is often neglected. This study takes these ambiguities into account by adopting a more comprehensive view on value relevance. Not only the extent to which the fundamental accounting numbers are able to explain variation in equity market value is of interest, but also the reason behind differences in the R^2s of the value relevance models[6]. This study aims thus to contribute to the empirical literature of value relevance theory by providing a more comprehensive and thorough approach to address the frequently asked question whether there is a relation between the conservative accounting treatment of intangible assets and the value relevance of the fundamental accounting numbers. The potential information deficiencies caused by the conservative accounting treatment of intangible assets can be determined by studying firms which differ in intangible intensity. Therefore, the central question in this research is: "*Does the intangible intensity of firms affect the value relevance of financial statement information?"*

1.5 Scope and relevance

The growing importance of intangible assets in current economies and the ambiguities still surrounding the relation between intangible assets and value relevance make this research question of interest to practitioners, accounting standard setters as well as academics. This thesis investigates the question whether the value relevance of financial statement numbers prepared in accordance with US GAAP differ for intangible-intensive firms and their non-intangible-intensive counterparts. The motivation for the focus on the value relevance of US accounting numbers is twofold. First, value relevance research is initiated in the US and there is still no consensus on this matter. There exists a wide amount of US value relevance literature, which enables me to put the results of this study into perspective. Secondly, the IASB and FASB are currently endeavoring to convergence their accounting standards. The ultimate goal of the mutual project is to achieve a single set of high-quality global accounting standards (IASB and FASB 2012). The appropriate treatment of intangibles is still debated, especially by academics. Although the concerns about (the conservative nature of) accounting for intangibles and its consequences apply to both accounting standards, these are especially relevant for firms reporting under US GAAP because US GAAP is addressed as more conservative than IFRS (Wyatt 2008). Yet the real importance of the accounting treatment of intangibles can only be appreciated if the conservative nature of US GAAP is actually related to the extent to which investors consider the information in financial statements useful, i.e. if the current accounting treatment distorts the value relevance of financial information and has real economic consequences. The empirical results of this study are thus of help in the current debate about the appropriate accounting for intangibles and may be of use to the boards in the process of developing the best possible accounting standards.

[6] A lower R^2 does not necessarily imply that the association between the variables of interest and the dependent variable is lower. There are alternative explanations for differences in the R^2s of the regression models, which are not mutually exclusive. For instance, the relative importance of other factors than the factors of interest may cause the lower explanatory power. Also, higher stock price volatility might be responsible for a lower R^2. See for a discussion Kothari and Shanken (2003).

1.6 Methodology

This study investigates whether the value relevance of financial statement numbers is affected by the intangible intensity of firms. The motivation for this research is the concern that the value relevance of accounting numbers prepared in accordance with US GAAP is lower for intangible-intensive firms due to the conservative accounting treatment of intangible assets. The goal of this thesis is to discuss and test some of the empirical implications of the claim that financial statements are affected by the accounting treatment of intangible assets. The main purpose is thus not to comment on the specifics of any suggestions to change accounting standards. The first three chapters consist of a comprehensive literature review. The review discusses all empirical accounting studies relevant for this thesis and constitutes the concepts and theoretical foundations for the models employed in the empirical part. The second part of this thesis encompasses the research design, the results of the empirical tests and the interpretation of the results. Two distinct measures for the intangible intensity of firms are adopted: an industry based classification and measures based on the level of (and change in) R&D spending. There is decided to use two types of proxies for the intangible intensity of firms because there exists no perfect proxy and these measures come consequently with their own advantages and disadvantages. The usage of two measures ensures that the results depend not solely on the choice for the intangible intensity measure. Further, in order to make the results of this study comparable with previous studies, all empirical models are constructed based on the basic price value relevance model, the model most commonly used in relative association studies. Three approaches are adopted to address questions of value relevance. Each approach sheds light on the relation between the intangible intensity of firms and the value relevance of financial information from a different point of view. Jointly, the findings provide a comprehensive answer to the research question.

1.7 Contribution

This study contributes to the existing value relevance literature in various ways. First, this study takes into account the period 1995-2010 instead of only a portion of the 20th century[7] compared to other studies concerning related objects. The value relevance of financial information has likely altered in the last decade compared to the 1980s and 1990s given changes in US GAAP, firm-specific characteristics such as the capital structure of firms and the growing importance of intangibles. Because the database used in this paper consists of a sample gathered over the period 1995 – 2010 there exist several opportunities for new insight. Further, all price value relevance models employed in this study are modified versions of the basic price models. Several (new) control variables are introduced in the basic price value relevance model which enables me to study the impact of a firm being intangible-intensive on value relevance in a relatively unbiased manner. Furthermore, unlike previous relative association studies concerning closely related objects, this study focuses not only on the explanatory power (the R^2)

[7] Balachandran and Mohanram (2011) is the most recent study considering a similar topic and their sample consists of firm date over the period 1975 – 2004. All other comparable studies use samples with data before the 20th century.

of the price value relevance models, but also on the extent to which the fundamental accounting numbers are associated with equity market value (measured by the magnitude of the slope coefficient on the accounting numbers of interest). By adopting this approach, more insight can be gained in the origin of differences in value relevance (measured by the R^2) across subsamples. Another advantage of this approach is that the relative importance of the fundamental accounting numbers can be appreciated. Further, this thesis brings insight in some conceptual issues associated with the concept of value relevance. Although the literature regarding the value relevance of financial statement numbers is extensive, the definition, measurement and interpretation of value relevance are still subject to debate. These ambiguities are addressed in chapters 2, 4 and 6. Finally, the use of two distinct measures for the intangible intensity of firms and the use of three different methods enhances the robustness of the results. Moreover, sensitivity checks are performed to confirm the robustness of the results. To my best knowledge, no prior studies in the US have performed such a thorough analysis of this subject so the results of this study may be rather unique.

1.8 Structure

The remainder of this thesis is organized as follows. Chapter two explains the concept of value relevance. The third chapter attends the difficulties associated with accounting for intangible assets. The last chapter of the literature review is devoted to the empirical accounting literature regarding the relation between (accounting for) intangible assets and value relevance. Chapter five details the research design including the hypotheses development and (econometrical) methods and techniques used. Chapter six discusses the sample construction, the results of the empirical tests and the main limitations of this study. Finally, the last chapter encompasses the conclusion as well as the suggestions for further research.

Chapter 2 Value relevance research

2.1 Introduction

Beginning with the seminal papers of Beaver (1968) and Ball and Brown (1968), there has been an expansion in accounting literature on the impact of financial information on capital markets. One field capital market research covers is the value relevance of financial information. The main purpose of this chapter is to bring insight in the concept of value relevance. The subsequent sections explain the main characteristics of useful financial information and the concept of value relevance. Section 2.4 explains the empirical models frequently employed in the value relevance literature. The fifth section discusses some conceptual issues associated with the concept of value relevance. Section 2.6 elaborates on the main results of previous studies. The last section consists of the conclusion.

2.2 Useful financial information and its qualitative characteristics

According to IASB's and FASB's conceptual framework for financial reporting (2010)[8], "*the objective of general purpose financial reporting is to provide financial information about the reporting entity that is useful to existing and potential investors, lenders and other creditors in making decisions about providing resources to the entity*" (IASB/FASB 2010, p. 9). The IASB and FASB (hereafter: the 'Boards') believe that financial statements prepared for this purpose meet the common needs of most users because almost all users make economic decisions (OB3, IASB/FASB 2010). To fulfill this role in the decision-making process, financial information must possess certain qualities. For instance, incorrect, outdated or misleading information will not be of help to an investor in making efficient investment-decisions. Accordingly, the Boards have identified some primary characteristics useful financial information should possess. These characteristics help to ensure that the financial information provided in financial statements is considered useful.

The conceptual framework elaborates in chapter 3 on these qualities. The fundamental characteristics of useful financial information are relevance and faithful representation. Besides these two fundamentals, the conceptual framework defines four enhancing qualitative characteristics – comparability, verifiability, timeliness and understandability - which are less critical but still important. The primary distinction between the fundamental and non-fundamental characteristics is that financial information cannot be useful without being in accordance with the fundamental qualities, whereas information that is in line with the fundamental characteristics may be useful even though it does not possess any of the enhancing characteristics (BC3.10, IASB/FASB 2010).

[8]The IASB and US FASB have been undertaken jointly an initiative to develop an improved conceptual framework for financial reporting. The overall objective of the project is an improved and common conceptual framework that provides a sound foundation for the development of accounting standards (www.ifrs.com). See also the ´Glossary´ on page 4.

With the fundamental characteristic *relevance*, the conceptual framework refers to the extent to which financial information is able to make a difference in the (economic) decisions made by users. Financial information is capable of making a difference in decisions when it consists of predictive value - it can be used as an input to predict future outcomes -, confirmatory value - it provides feedback about previous evaluations -, or both (QC6 – QC11, IASB/FASB 2010). For financial information to be *faithfully represented*[9], it should be complete, neutral and free from error. These three features are not meant as absolute criteria but can merely be seen as qualities that should be maximized. For financial information to be useful, the information must be both relevant and faithfully represented. After all, financial statement users cannot make well-founded decisions based on a faithful representation of an irrelevant fact or an unfaithful representation of a relevant fact (QC12 – QC 16, IASB/FASB 2010).

The other four qualitative characteristics enhance the usefulness of financial information that is already determined relevant and faithfully represented. *Comparability* of financial information enables investors to choose between alternatives. Users of financial information should be able to identify and understand the similarities in, and differences among, specific items (QC20 – QC25, IASB/FASB 2010). Financial information is *verifiable* when it helps assure financial statement users that the information faithfully represents the item of interest. When a certain item is verifiable, different users of financial statement information should reach the same decision regarding whether the item is represented faithfully (QC26, IASB/FASB 2010). With *timeliness* the framework means having information available to users in time to be capable of influencing their decisions (QC29, IASB/FASB 2010). Last, *understandability* refers to the extent to which the information is characterized and presented clearly and concisely. Since financial reports are prepared for users who have a reasonable knowledge of business and economic activities, the information of interest should be understandable for the general financial statement user, not for anybody per se (QC30 – Q32, IASB/FASB 2010).

2.3 The concept of value relevance

The conceptual framework makes clear that the objective of financial reporting focuses on the information needs of capital providers, e.g. investors, lenders and other creditors. Over the past decades, accounting standard setters, auditors and stock market regulators have put great effort in improving both the quality and the transparency level of financial reporting. Examples include the development of the conceptual framework(s), the (annual) revisions of accounting standards and the "convergence" project the IASB and FASB jointly undertake at this moment. This serves a major motivation to test whether, and to what extent, financial information is actually useful to investors and other users of financial statements (Zeghal and Maaloul 2010). That is, to test whether, and to what extent, the main goal of financial reporting is met. This niche in the accounting literature is called "value relevance research". Value relevance studies are often motivated by standard-setting purposes (Holthausen and Watts 2001)

[9] The characteristic "faithfully representation" has replaced the "old" characteristic "reliability" in the conceptual framework. Because these qualities refer to the same conditions, that is, financial information should be neutral, free from error and complete, these terms are used interchangeable in this thesis.

and provide useful insights into financial reporting effectiveness for accounting standard setters and other users (Hellstrom 2006).

There are various definitions and interpretations of the term value relevance in use, see Barth et al. (2001) and Holthausen and Watts (2001) for examples. Although the practiced definitions differ, the bottom line is the same: an accounting number can be termed value relevant if it has a significant association with the stock price (or returns) of a company. When there is no association between the former and the latter, the accounting number cannot be termed value relevant (Beaver 2002). Francis and Schipper (1999) distinguish four different interpretations of value relevance. Financial information is value relevant when *"(i) it influences stock prices by capturing intrinsic value towards which stock prices drift, (ii) it contains the variables used in a valuation model or assists in predicting those variables, (iii) it changes stock prices because it causes investors to revise their expectations or, (iv) there is a statically significant association between financial information and equity market value*" (Francis and Schipper 1999, p. 325-326). The fourth definition of Francis and Schipper (1999) is thus the one most commonly used in the value relevance literature and is also the leading definition of value relevance in this study.

The distinction Francis and Schipper (1999) make is important because it sheds light on the difference between the "information perspective" and the "measurement perspective" on accounting. The information perspective is consistent with the third definition of Francis and Schipper (1999). When the financial information of interest "*alters the investors' beliefs, ultimately causing the stock price to change, there can be assumed that it has "information content*" (Beaver et al. 1997). According to this interpretation, the accounting information is thus value relevant if it has information content. Under this approach, market reactions are studied over short time-windows. When a security market reaction is observed through a short time-window (a few days or maybe a month) surrounding an "event" (for example an earnings announcement), there can be argued that the event caused the securities market's reaction[10]. Because there are relatively few (firm-specific) events during such a short period of time other than the event of interest, it is reasonable to assume that the accounting event conveyed new information that revised the market's previous expectations (Kothari 2001). The presumption is that favorable reactions to information are evidenced by a price increase in the particular security, whereas unfavorable reactions to information yield the opposite result. When there is no change in price this implies that there is no reaction to the information, i.e. the information release had no information content (Deegan and Unerman 2011). The reaction of an investor to the release of financial information is thus evidenced by his capital market transaction(s) (Beaver 2002). This type of study is called an event study. Studies adopting the information perspective of value relevance generally employ event study methodology.

[10] Information content studies rely often on the underlying assumption that equity markets are semi-strong efficient, meaning that share prices fully impound all publicly available information, including information available in financial statements and other financial disclosures, in an unbiased manner as it is released (Deegan and Unerman 2011).

Under the measurement view, financial information is value relevant when it captures or summarizes ("measures") the information actually used by investors (fourth definition, Francis and Schipper 1999). It is thus not necessary that the investor actually uses the information item of interest. Research concerning the measurement approach analyses the relation (association) between market based metrics and accounting over long-time windows. Evaluation of security returns over a wide time-window (a few months or even years) may capture several events. Since investors have access to many sources of information about the firm's performance during that time-window, such studies do not presume that the event of interest presents the only relevant information. As a result, there cannot be concluded that a certain event during a wide time-window caused a change in the stock price. Nevertheless, there can be concluded whether there is an association between the information that is released (the focus is generally on information provided in quarterly or annual reports) and market based metrics (Kothari 2001). Association studies provide thus an upper bound of the usefulness of financial information because there cannot be concluded whether the information item of interest caused the share price's reaction, or that other, timelier information resulted in the change (Lev and Zarowin 1999). The focus in this thesis is on association studies because "value relevance" under the measurement view is measured with association studies. For a more in depth discussion of capital market research and event studies see Kothari (2001).

Note that the concept of value relevance as characterized in this section is not the same as decision-usefulness in the conceptual framework. Financial information can be value relevant, that is, the item shows a significant association with equity market value, while the financial information is not decision-relevant to users due to lack of timeliness (Barth et al. 2001). Further, it is important to understand the ratio between "value relevance", "relevance" and "faithful representation". Financial information is *value relevant* when it captures or summarizes the information actually used by investors to value a company. That is, there is a significant association between the accounting number of interest and equity market value. There can then be inferred that the financial information is "*relevant*" in the meaning of the conceptual framework, that is to say, the financial information consists of predictive value, confirmatory value or both. Value relevance studies also reveal something about the *faithful representation* (or reliability) of financial statement information, the other fundamental characteristic of useful financial information in the conceptual framework. If there is a significant association between equity market value and the financial number of interest, it can be indirectly inferred that the financial information is faithfully represented enough to be reflected in the stock price, i.e. to be value relevant. However, the extent to which the information is reliable cannot be measured with the "general" value relevance study. (Wyatt 2008; Barth et al. 2001). Value relevance studies reveal thus not which part of the value relevance of financial information can be attributed to relevance or reliability, but can be seen as a joint test of these fundamental characteristics (Barth et al. 2001).

2.4 Measuring value relevance

Value relevance research is a niche of capital market research which explores the role of financial information in capital markets (Kothari 2001). Capital market research generally encompasses statistical tests of the relation between financial information and share prices or returns. In contrast to behavioral research, which analyses individual responses of actors to financial reporting, capital market research assesses the aggregate effect of financial reporting on investors (Beaver 2002). Conclusions about the market´s reaction to, or association with, information (releases) are thus based on empirical evidence from a large number of companies. There are several methods to measure value relevance. Because investors represent a large class of financial statement users, most value relevance studies focus on the relevance of financial statement information from the perspective of equity investors. Investors are primarily interested in information that will help them determine company value. Therefore, valuation models are usually employed to address questions of value relevance (Barth et al. 2001)

2.4.1 Equity valuation models

The residual income valuation model (RIV) of Ohlson (1995) is often taken as a starting point in value relevance research. The framework of Ohlson shows how the market value of a company can be expressed in terms of fundamental balance sheet and income statement components. Ohlson starts from the neoclassical point of view that states that the theoretical value of a company's equity is the present value of all future dividends discounted at the risk free rate[11]. This model is called the dividend discount model and is represented by the following equation:

$$P_t = \sum_{\tau=1}^{\infty} R_F^{-\tau} E_t[\tilde{d}_{t+\tau}], \qquad \textbf{(1)}$$ Ohlson (1995, p. 666)

Where Pt denotes the market value (price) of the firm at date *t*, R_f represents the risk free rate plus one, d represents dividends and Et[.] denotes the expected value operator conditioned on the information available at date t.

Subsequently, the RIV model assumes that all changes in book value are reported as either income or as dividends. The dividends reduce book value without affecting current earnings. This relation is referred to as "the clean surplus relation", because all changes in assets and liabilities unrelated to dividends must occur through the income statement (and thus not through the balance sheet). The clean surplus relation is defined as follows:

$$y_{t-1} = y_t + d_t - x_t \qquad \textbf{(2)}$$ Ohlson (1995, p. 666)

Where x_t denotes earnings for the period $(_{t-1, t})$, y_t is net book value at date t and d_t denotes dividends at date t. Next, Ohlson defines abnormal earnings as current earnings minus the risk free rate times the beginning of period book value, that is, earnings minus a charge for the use of capital.

$$x_t^a \equiv x_t - (R_f - 1)\, y_{t-1} \qquad \textbf{(3)}$$ Ohlson (1995, p. 667)

[11] The model assumes thus risk-neutral investors

Where x_t^a represents abnormal earnings, R_f represents the risk free rate plus one. Combined with the clean surplus relation (see **2**[12]), this yields equation (**4**), which is known as the residual income model. The market value of the firm is equal to the book value of equity plus the present value of all future residual income.

$$P_t = y_t + \sum_{\tau=1}^{\infty} R_f^{-\tau} E_t[\tilde{x}_{t+\tau}^a] \qquad \textbf{(4)} \text{ Ohlson (1995, p. 667)}$$

The next assumption of Ohslon's model is related to the behavior of the abnormal earnings. The model specifies that the abnormal earnings evolve following an autoregressive process[13]. The intuition behind this autoregressive process in abnormal earnings is that on one hand, competition will eventually erode above normal returns while on the other hand firms that experience below normal returns will eventually exit. Hence there is assumed that abnormal earnings are a temporarily phenomena which will typically decline over time (Kothari 2001). After showing that the residual income model can be expressed as a linear function of book value and a function of future abnormal earnings and other value relevant information, Ohlson derives the following equation:

$$P_t = k(\varphi x_t - d_t) + (1 - k)y_t + \alpha_2 v_t \qquad \textbf{(5)} \text{ Ohlson (1995, p. 670-671)}$$

$$\varphi \equiv R_f/(R_f - 1)$$
$$k = (R_f - 1)\alpha_1 = (R_f - 1)\omega/(R_f - \omega)$$

Where v_t represents the "other relevant information" and the other variables are as defined in equations (**1**) to (**4**). The Ohlson model can be viewed as a weighted average of book value and current earnings, with adjustments for dividends and other relevant information that is not reflected in the income statement (Ohlson 1995). Equation (**5**) and the subsequent work of Feltham and Ohlson (1995, 1996) is often considered as the theoretical foundation for the explanatory power models (see hereafter) used in value relevance research (Barth et al. 2001). The Ohlson model has as main advantage over models with other theoretical foundations that it allows equity market value to be expressed in current accounting numbers, which can directly be derived from the financial statement of a company. "Other" models are regularly more difficult to employ than the Ohlson model due to the necessity of specifying a link between the accounting numbers of interest and the economic constructs (Barth et al. 2001). Holthausen and Watts (2001) have identified the models most frequently used in the value relevance literature: the "price model", "returns model" and "portfolio returns model". The subsequent subsections elaborate on these models.

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[12] Equation 2 and 3 combined yields the following equation:

$$d_t = x_t^a - y_t + R_f y_{t-1}$$

[13] $\tilde{x}_{t+1}^a$ represents the abnormal earnings and v_{t+1} information other than abnormal earnings

$$\tilde{x}_{t+1}^a = \omega x_t^a + v_t + \varepsilon_{1t+1}$$
$$v_{t+1} = \quad + \gamma v_t + \varepsilon_{2t+1}$$

The disturbance terms are random disturbance terms with constant variance and zero mean.

2.4.2 Price model

The first model that is often employed in the value relevance literature is the price value relevance model which is shown by the following equation:

$$P_{it} = \alpha_0 + \alpha_1 BV_{it} + \alpha_2 E_{it} + \varepsilon$$

where P_{it} is the stock price per share of company *i* three months after the fiscal year end of the year *t*[14], BV_{it} is the book value of equity per share of company *i* at the end of year *t*, E_{it} represents the earnings per share of company *i* at the end of year *t* and the disturbance term ε. The explanatory power (adjusted R-squared) of the regression model is examined to see how much variation in equity value is explained by the accounting information. Hence, the explanatory power of the model is used as a measure for value relevance (e.g. Collins et al. 1997).

The price model faces some disadvantages. First, the model is often criticized because the results of the model are likely biased due to differences in scale (Brown et al. 1999). Most studies add a "scaling factor" to the model to make data for different firms comparable. At first, most researchers used the number of shares outstanding as deflator. This version of the price model is also shown above. However, the management of a company has the discretionary ability to choose the number of shares outstanding. A change in the number of shares changes the price of shares without necessarily changing the underlying economic characteristics of the firm. This implies that scaling by using per share values does not necessarily solve the scaling problem. Therefore, the results of regressions using this deflator should be interpreted with caution (Easton 1999; Easton and Sommers 2003). More recent accounting research often controls for scale effects by deflating the price regressions by other "size measures", such as the book value of equity (Core et al. 2003), (lagged) market value of equity (Brown et al. 1999) or average or total assets (Veenman 2011).

The second difficulty related to the price model is the estimation method which is generally employed, the ordinary least square regression (OLS regression). An OLS regression assumes that the estimation errors are normally distributed. However, previous studies have shown that the distribution of the error terms tends to be highly skewed and the skewedness of the distribution may lead to poor estimates from the OLS procedure (Ye 2007). Further, there is argued that the price model has a disadvantage in terms of explanatory power due to an omitted explanatory variable. This argument is based on the finding that "prices lead earnings" (Kothari and Zimmerman 1995), meaning that the market anticipates a portion of future earnings changes (Kothari and Sloan 1992). Because of this uncorrelated, omitted variable, the explanatory power of the model would be reduced.

[14] There is often decided to use a term of three months because the annual reports of companies are then publicly available due to the legal requirements.

2.4.3 Returns model

The second regression model that is often put to use in the value relevance literature is the "returns value relevance model". The focus in this model is not on the stock price, but on the change in the stock price, i.e. the stock return. The returns value relevance model[15] is as follows:

$$R_{i,t} = \alpha_t + \beta_{1,t}E_{i,t}/P_{i,t-1} + \beta_{2,t}(\Delta E_{it}/P_{i,t-1}) + \varepsilon$$

where R_{it} is the stock return of company *i* for fiscal year *t*, E_{it} is the reported earnings per share of company *i* in year *t*, P_{t-1} is the stock price at the beginning of the period, ΔE_{it} is the change in reported earnings of company *i* in year *t* and the disturbance term ε.

Just as with the price model, the explanatory power (adjusted R-squared) of the model is then used as a measure for value relevance. A different perspective on the value relevance of earnings is provided by the combined earnings response coefficient (ERC), which measures the average change in stock price associated with a dollar change in earnings. The ERC can be measured by summing up the slope coefficients on earnings and change in earnings ($\beta_1 + \beta_2$) variables. A low slope coefficient indicates that the reported earnings are not value relevant to investors whereas a high slope indicates that a change in price is associated with a change in the the reported earnings (Lev and Zarowin 1999)

An advantage of the returns model over the price model is that the rate of return is a scale free variable. The scale problem related to the price regression can thus be overcome by the use of the returns model (Easton 1999). Also, prior research has shown that the returns model better fits the assumptions behind the OLS regression model (Easton 1999). However, the returns model also contains an important disadvantage. Current earnings are assumed to consist of a "surprise" component and an "expected" component on which is already anticipated by the market in earlier periods. According to Kothari and Zimmerman (1995), "*in the returns model, the expected component is irrelevant in explaining current returns and thus constitutes an error in the independent variable, biasing the slope coefficient on earnings towards zero (e.g. Brown et al. 1987)*" (Kothari and Zimmerman 1995, p. 156). The price model does not suffer from this bias because the stock price reflects the cumulative information content of both the expected and surprise component of earnings (Kothari and Zimmerman 1995). Another shortcoming of the returns model is that it provides no information about the value relevance of book value.

2.4.4 Portfolio returns model

The third model frequently used in the value relevance literature is the portfolio returns model based on the model of Alford et al. (1993) and Francis and Schipper (1999). This approach measures value

[15] The returns model can also be derived from the Ohlson (1995) model by taking the first differences in equation (**5**), invoking the clean-surplus relation and by dividing through the price at the beginning of the period (Easton and Harris 1991; Easton 1999). Both the price model and the returns model are thus motivated by the theoretical foundation of Ohlson.

relevance as the total return that could be earned from a portfolio based on perfect foresight, i.e. as if one knew at the start of the year, of the different parts of financial statement information. Hedge portfolios are constructed based on returns that would be predicted with perfect knowledge of the financial statement number(s) of interest. Then, these returns are market adjusted by scaling them by the maximum possible hedge returns that could be earned by perfect knowledge of returns (Francis and Schipper 1999). The resulting scaled measures capture the extent to which perfect foresight of the accounting number helps predict returns. Hence, this measure is used as a measure for value relevance. This model can take different forms and different accounting-based portfolios can be used. Examples can be found in Francis and Schipper (1999) and Balachandran and Mohanram (2011).

The main advantage of the portfolio returns model is that the (potential) changes in volatility of market returns over time is taken into account (see section 2.5), while the price- and return measures do not control for this volatility. Also, just as with the returns model, the scaling problem is nonexistent in this model because returns are a scale-free variable. However, an important disadvantage of the portfolio returns model is that the relative importance of earnings and balance-sheet information cannot be evaluated as clearly as in the price model (Thinggaard and Damkier 2008). Last, the theoretical foundation of the portfolio returns model is not as strong as the foundation of the explanatory power models.

2.4.5 Concluding remarks regarding the value relevance models

The three models contain as explained all their own advantages and disadvantages. There is no "right or wrong" model to measure value relevance, but it depends on the specific circumstances which model should be used. According to Landsman and Magliolo (1988), "*the decision of whether to select a price level or price change (return) specification is a joint function of the economic model of equilibrium that is assumed and the nature of the econometric properties of the data that causes OLS assumptions to be violated*" (Landsman and Magliolo, p. 586). Also, by choosing the applicable model, the type of research should be taken into account. As Barth et al. (2001) explain: "*the key distinction between value relevance studies examining price levels and those examining price changes, is that the former are interested in determining what is reflected in firm value and the latter are interested in determining what is reflected in changes in value over a specific period of time*" (Barth et al. 2001, p. 19). Thus, to investigate the value relevance of certain accounting numbers, the price model is the best fit. If the main focus is on value creation, one should use the return model. Because the results of the two models can be compared, and also may complement each other, in some cases it is best to use both models, especially if the purpose is to study general cases (Barth et al. 2001). The portfolio returns model is occasionally employed in studies which examine the development of value relevance of financial information over time because this model controls for the impact of market volatility. However, the portfolio returns model is harder to implement than the other two models and therefore the latter two are often favored. Further, the explanatory power models provide more transparent

information about the value relevance of the accounting number(s) of interest, that is, they are easier to interpret.

2.5 The concept of value relevance 2.0

Though there is consensus in the literature over the concept of value relevance ("an accounting number can be termed value relevant if it is significantly associated with equity market value", see section 2.3), the exact implications of this definition are still subject to debate. The measurement of value relevance as discussed in the previous section is the approach commonly adopted by studies that can be classified as "relative association studies". This stream of research compares the relationship between stock prices (returns) and accounting numbers across periods or across subsamples. Such studies usually test for differences in the explanatory power of the regression model (see the discussion about the price and returns models). The accounting measures with the highest R^2s are then termed most value relevant. An alternative approach is followed by "incremental association studies". These studies assess the contribution provided by an accounting number in explaining a company's market value or market-returns given by other specified variables. Incremental studies measure value relevance by the coefficient on the accounting number of interest: the information is then termed value relevant if its coefficient is significant different from zero. (Holthausen and Watts 2001). The number of value relevance studies is quite large (see for example Holthausen and Watts (2001) for an overview). Among these studies, this thesis focuses primarily on those dealing with value relevance in relation to accounting for intangible assets (see chapter 4). Studies concentrating on this relation are predominantly relative association studies. The practiced measure for value relevance in this thesis is therefore, unless explicitly specified otherwise, the total variation in equity market value that is explained by the accounting numbers of interest, i.e. the R^2 of the value relevance regression model.

This brings about another complication. The R^2 is no absolute measure, but a relative one. A change (or difference) in the R^2 is thus not necessarily caused by a change (or difference) in the "value relevance" of the information item of interest. This point can be illustrated by the following example. For a comparison of R^2s across years, Francis and Schipper (1999) argue that due to an increasing (decreasing) market volatility over time, price (or return) regressions are biased downwards (upwards) to the result that value relevance is decreasing (increasing), while the "absolute amount" of value relevant information has not actually changed. Francis and Schipper (1999) address this ambiguity as follows: *"we favor the portfolio tests over the explanatory power tests because the former control for changes in the variability of returns and the latter do not. It might be argued that value relevance consists of explaining a reasonably high and constant percentage of the total variation in returns, regardless of shifts in that variation. We believe this argument has greater empirical content when returns variability that is not explained by financial reporting information is driven by information which at least in principle is competing with financial statement information for market share"* (Francis and Schipper 1999, p. 329). Lev and Zarowin (1999), another well-cited study in the value relevance

literature, argue that the results on the slope coefficients (ERS) supplement the information provided by the R^2s of the returns regressions; "*because changes in the ERCs provide evidence for a change in value relevance on a stand-alone basis, while changes in the explanatory power of the returns regression model might be driven by other factors, such as the relative importance of non-accounting information*" (Lev and Zarowin 1999, p.356). However, these arguments are quite inconsistent with the current practice to use the R^2s of the regression models as the sole measure for value relevance. Relative association studies generally not attend alternative measures, such as the coefficients on the accounting numbers of interest. In addition, many studies fail to define the practiced definition and measure of value relevance precisely which makes it hard to interpret and compare the results of these studies. Holthausen and Watts (2001) and Kothari and Shanken (2001) have already recognized these concerns and argue the importance of taking into account the different factors influencing the R^2s from the regression models. These ambiguities should be kept in mind when studying the literature reviewed in chapter 4.

2.6 Some general findings from prior value relevance research

Beaver (1968) and Ball and Brown (1968) can be seen as the initiators of capital market research. In their seminal paper, Ball and Brown (1968) show that firms' share returns respond to information in financial statements. Their study shows that the security market did respond to the good news or bad news during the short time window (one month). Moreover, their results suggest that the market began to anticipate the good (or bad) news as much as a year early, with the result that returns accumulated steadily over the period (long time window). These findings have led to a long stream of research regarding the value relevance of various accounting numbers reported in financial statements (Kothari 2001; Hribar and Collins 2002). This section details only the main findings of previous research with regard to the value relevance of the fundamental accounting numbers.

In a survey of value relevance studies for the period 1980-88, Lev (1989) finds on average a relatively weak association between (unexpected) earnings[16] and stock returns. Cross-sectional studies with very narrow time-windows (two to five days) find R^2s of 2 to 5 percent, whereas studies with medium to long time-windows (a quarter to two years) yield R^2s within a range from 4 to 8 percent[17]. These findings indicate that the extent to which earnings (measured with association studies) and earnings surprises (measured in event studies) are value relevant to investors does not differ considerably. The results do not appear to be sample or period specific since different sample periods (ranging from early 70s to mid 80s) are used in the various studies. Also, the results hold in both time-

[16] The accounting number where most value relevance studies focus on is reported earnings. There are also studies that have looked into the relation between cash-flows and stock returns, arguing that cash flows contain more information about future cash-flows than earnings, i.e. that cash flow is a more value relevant accounting number to investors. However, prior capital market research has shown that cash flows account for a smaller change in stock returns, indicating that earnings contain more value relevant information than cash flows (Ball and Brown 1968; Dechow 1994). Recent literature regarding the value relevance of accounting numbers focuses therefore mostly on earnings rather than on cash-flows.

[17] R-squares of 10 percent or higher are reported, but, as Lev (1989) points out, these results seem to be based on the search for an optimal time-window (highest R-square) or an optimal subsample rather than on a superior research design.

series and cross-sectional regressions[18]. Although the relation between earnings and equity market value is statistically significant, the relation is less severe than often expected.

Accounting research has proposed several explanations for the weak association between earnings and equity market value. Lev (1989) identifies lack of earnings quality as the most reasonable explanation. Collins et al. (1994) argue that the lack of timeliness of earnings and value-irrelevant noise lead to the weak earnings-returns relation. Basu (1997) addresses accounting conservatism, defined as the practice, consistently applied, to keep the book value of assets low, as an explanation. Hayn (1995) shows that losses (negative earnings) are less value-relevant than earnings because investors perceive losses as temporarily phenomena. In addition, Easton (1999) shows with a scatter-plot of earnings and returns that there is a non-linear relation between these two variables. The bias due to the non-linearity of earnings can be overcome by including a control variable for losses in the value relevance models. Results from regression models controlling for losses lead to superior results in terms of value relevance (see e.g. Balachandran and Mohanram 2011). Further, the "age" of a firm seems related to the value relevance of earnings. Collins et al. (1997) argue that current earnings of start-up firms are a bad indicator for future earnings, because the future earnings of such firms depend on growth-potential rather than on current earnings. In valuing such firms, investors will more heavily rely on book value than on earnings, resulting in the weak association between earnings and returns. By the use of a more balanced sample or the use of a control variable for the age of a firm, more reliable results about the relevance of earnings for "normal" firms can be found. Last, model misspecification and econometrical problems (think of the disadvantages of the models discussed in section 2.5) are often addressed as potential factors causing the weak association between earnings and market value. The aforementioned list of potential explanations for the weak earnings-return relation is not exhaustive but gives a bit an idea of the research performed in this regard.

More recent value relevance research with updated empirical models shows superior results. For example, Balachandran and Mohanram (2011) find an R-squared around 28 percent employing a returns model[19] with controls for losses and different industries (sample period 1975 to 2004). Their model with perfect foresight measures yields on average a value relevance of 39 percent during the same sample period. The price value relevance model shows on average an explanatory power of 77 percent. The difference between the results of the price model and the returns model can be explained by the fact that the book value of equity, which is an explanatory variable in the price model and not in the returns model, and stock prices are generally highly associated.

[18] Cross-sectional and time-series regressions differ with regard to the underlying assumptions. Cross-sectional studies are based on the (unrealistic) assumption of a constant response coefficient, that is, investors react identically to information rereleases (e.g. net earnings) of all firms. Time-series regressions are based on the (more realistic) assumption that investors react the same to releases of information (e.g. earnings) of the same firm over time.

[19] The returns model (see section 2.5.3) has both current earnings and change in earnings as explanatory variables. Since the early results as found in Lev (1989) are derived from various value relevance models which have in the main only earnings, unexpected or earnings changes as explanatory variable (and thus not a combination of them), this explains part of the (great) difference between the "early results" (Lev 1989) and the results of Balachandran and Mohanram (2011).

2.7 Conclusion

Value relevance research has been a major area in empirical accounting research in the last 40 years. Motivated by the main objective of financial reporting, to provide useful information to investors, lenders and other creditors, value relevance studies empirically examine the association between financial information and equity market value. Because most value relevance studies focus on the usefulness of financial statement information to investors, valuation models are generally put in use to examine questions of value relevance. The price model, the returns model and the portfolio returns model are the models most commonly used in the literature. Each model contains its own advantages and disadvantages so it depends on the specific research question, the dataset and the research design which model should be employed. Prior research has shown that financial information is value relevant to investors, although to a limited extent. A more recent concern is that the value relevance of financial statement information seems to decrease over time (see e.g. Lev and Zarowin 1999). This concern and the widely held reasoning behind it are attended in chapters 3 and 4.

Chapter 3 Accounting for intangible assets

3.1 Introduction

The appropriate accounting treatment of intangible assets is still subject to debate. Intangibles are seen by many as increasingly important to business success and growth but are generally not recognized as assets so little quantitative and qualitative information about them can be derived from financial statements (FASB 2001). Because for many firms these days the main source of economic value is the creation and manipulation of intangible assets rather than the production of material goods (Goldfinger 1997), it is often argued that accounting standards fail in "counting what counts" (Stewart 2002) with regard to intangibles, causing a decline in the value relevance of financial statement information (see e.g. Lev and Zarowin 1999). However, thus far, little has changed with regard to accounting for (internally generated) intangible assets and accounting standard setters still struggle with deciding on the appropriate way to account for them (Powell 2010). The purpose of this chapter is to bring understanding in accounting for intangible assets and the debate on the matter of intangible assets. The next section looks into different types of intangibles. Section 3.3 discusses accounting for intangibles under US GAAP. Section 3.4 elaborates on the ongoing debate over accounting for intangible assets. The conclusions are presented in section 3.5.

3.2 Types of intangible assets

Intangible assets include a lot of things. Many people underestimate not only the importance or relevance of intangible assets in current economies (see section 3.4) but also misjudge how many types of intangibles exist. The term intangible asset is not interchangeable with R&D, for example, although some might think so. To give an impression of the wide range of intangibles that can be identified, table **I** shows some of the intangible assets the FASB believes to possess the necessary characteristics (see section 3.3.3) to be recognized apart from goodwill by acquiring business combinations.

Table I
Intangible assets (categories identified by FASB: Appendix A FASB ASC 805-20-55)
Marketing-related intangible assets Trademarks, service marks, internet domain names, non-competition agreements **Customer-related intangible assets** Customer lists, customer contracts and relationships **Artistic-related intangible assets** Plays, books, musical work, pictures, video's **Contract-based intangible assets** Licensing, royalties, advertising, construction, lease agreements, franchise agreements, servicing contracts, employment contracts, operating and broadcast rights **Technology-based intangible assets** Patented technology, computer software, unpatented technology, databases, trade secrets

3.3 Accounting for Intangible assets under US GAAP

A critical issue in reporting intangibles is to determine what intangible assets actually are (Canibano et al. 2000), that is, under what conditions an intangible asset might be considered as an asset for the purpose of financial reporting. The general definition of an asset can be found in the Statements of Financial Accounting Concepts (SFAC), issued by the FASB[20]. The conceptual framework defines assets as "*probable future economic benefits obtained or controlled by a particular enterprise as a result of past transactions or events"* (SFAC 6). This implies that an item needs not to be tangible to be classified as an asset. Intangible assets are therefore defined as both current and noncurrent assets that lack physical substance (Bragg 2011). According to SFAC 5, the balance sheet of a business does not reflect all assets and liabilities of a business, but only those that meet certain criteria[21]. For an (intangible) asset to be recognized in financial statements, the item must "*(a) meet the definition of an (intangible) asset, (b) have a relevant attribute measurable with sufficient reliability, (c) represent the information faithfully, verifiably and neutrally (i.e. reliably), and (d) be capable of making a difference in users decisions (i.e. be relevant)*" (SFAC 5, par. 63; FASB 2009)[22]. While the recognition criteria hold true for most intangibles obtained in acquisition processes, the opposite is true for internally generated intangibles. Therefore, significant differences between accounting for internally and externally developed intangibles exist (Powell 2010).

3.3.1 Externally generated intangible assets

Intangible assets are termed "externally developed intangible assets" if they are obtained from outside the firm, either individually or with a group[23] (FASB ASC[24] 350 Intangibles - Goodwill and Other, formerly SFAS No. 142). Because this type of intangible assets is generally acquired in an arm's length transaction, meaning that both parties act in their own self interest and are not subject to any (external) pressure, the asset can be reliably measured (FASB 2009). Accordingly, the FASB concludes that such transactions provide a basis for recognizing those assets in financial statements (FASB 2009)[25]. An (individually) acquired intangible asset might still fail the recognition criteria if the future economic benefits associated with the asset are too uncertain or if one of the other criteria is not met

[20] The FASB has designed a conceptual framework which consists of seven pronouncements, called Statements of Financial Accounting Concepts, which prescribe the objective, functioning and limitations of financial reporting. There is referred to this framework, and not the mutual framework of the IASB and FASB (2010), because the latter is not finished in this regard at the moment of writing. See also the Glossary on page 4.

[21] Note that the impact of capitalization on financial statement data is twofold. First, the costs incurred for the intangible appear on the balance sheet rather than as an expense in the income statement. Secondly, the deprecation (amortization) of the (intangible) asset is considered as an expense in subsequent periods.

[22] The following costs can never be recognized as intangible assets: internally generated goodwill, customer lists, start-up costs and training costs (FASB 2009).

[23] The initial recognition and measurement of intangibles acquired in a business combination is different, see "ASC 805 Business Combinations" and section 3.2.3, so intangibles purchased in a business combination are not covered by ASC 350.

[24] ASC stands for the FASB Accounting Standards Codification. The ASC became the legal source of nongonvernmental GAAP in the US on July 1, 2009.

[25] Although the Board acknowledges that "*the fair value estimates for some intangible assets that meet the recognition criteria might lack the precision of the fair value measurements for other assets*", the Board also concludes "*the financial information that will be provided by recognizing intangible assets at their estimated fair value is more representationally faithful than that would be provided if those intangible assets were not recognized due to measurement problems*" (FASB 2009).

(Powell 2010). However, this is quite uncommon since there is believed that assets acquired in (bargained) transactions that are conducted at arm's length provide reliable evidence about the existence and fair value of those assets (FASB 2009)[26]. Therefore, externally acquired intangibles are generally capitalized under US GAAP.

Externally generated intangible assets are initially recognized at their fair values[27]. The fair value is based upon the price that the market would determine, i.e. the price that would be paid in a transaction between two willing parties, regardless of whether the business intends to use the intangible in a manner that is its highest and best use (FASB ASC 350-30-25-1, 25-2, 350-20-35-29). By acquiring a group of assets, the costs of the total group must be allocated to the individual intangibles based on their relative fair values. Therefore, goodwill does not occur in case of such acquisitions (FASB ASC 805-50-30-3; Bragg 2011). The accounting for recognized intangible assets is based on their useful life to the reporting entity. If there are no (legal, economical or other) factors that limit the useful life of the intangible asset, the useful life is determined indefinite (FASB ASC 350-30-35-4). An intangible asset with a finite useful life is amortized, whereas an intangible asset with indefinite useful life is not (FASB ASC 350-30-35-6; FASB ASC 350-30-35-15, 35-17). Both intangible assets with a finite and an indefinite useful life are each year reviewed for impairment (FASB ASC 350-30-35-14, 35-18).

3.3.2 Business combinations

A specific type of transaction resulting in the acquirement of externally generated intangible assets is a business combination. Under certain conditions, a group of assets and liabilities constitutes a business. When an entity obtains control over one or more business, this is called a "business combination" (FASB ASC 805-50-30-3). A business combination can be structured in different legal forms (FASB ASC 805-10-55-2, 55-3). Accounting for business combinations is not set out in ASC 350, but in ASC 805 (formerly, SFAS 141(R)), which reveals that all business combinations are to be accounted for using one method – the purchase method. FASB ASC 805-20-30-1 states that "*the acquirer shall measure the identifiable assets acquired, the liabilities assumed and any noncontrolling interest in the acquiree at their acquisition-date fair values*". By acquiring a business, intangible assets may form a major component of the total costs the acquirer incurs. These acquired intangible assets must be recognized at their fair value at the acquisition date, apart from goodwill, if they are separately identifiable (FASB ASC 805-20-25-10). These intangible assets are identifiable when they arise from contractual rights, legal rights or when the intangible asset is separable, that is, capable of being separated or divided from the acquired company (FASB ASC 805-20-55-2, 55-3). Goodwill is then

[26] ASC 350-30-25-1 states that: "an intangible asset that is acquired individually or with a group of other assets shall be recognized".

[27] ASC 805 and ASC 350 have replaced APB opinion 17 in 2001. According to the FASB, one of the main advantages of ASC 805 over opinion 17 is that there is no longer presumed that goodwill and other intangibles acquired in business combinations are "wasting assets", i.e. assets with a finite live. Under ASC 805, goodwill and intangible assets with an infinite live are not amortized but are tested for impairment. There is assumed that this improves financial reporting because the financial statements of companies that acquire goodwill and other intangible assets will better reflect the underlying economics of these assets (FASB 2001(2)). Also, intangible assets are recognized at their fair values under the new regime, not at costs.

defined as the excess of the purchase price over the fair value of the acquired assets (FASB ASC 805-30-30-1). The acquired goodwill is not amortized but is subject to an annual impairment test (FASB ASC 350). After initial recognition, ASC 350 provides guidance on the subsequent accounting for the intangibles and goodwill acquired (see 3.2.2).

3.3.3 Internally generated intangible assets

With regard to internally generated intangible assets, ASC 350 states, "*Costs of internally developing, maintaining, or restoring intangible assets (including goodwill) that are not specifically identifiable, that have indeterminate lives, or that are inherent in a continuing business and related to an entity as a whole, shall be recognized as an expense when incurred*" (FASB ASC 350-30-25-3)[28]. This codification has to be interpreted in conjunction with ASC 730 (formerly, SFAS No. 2), which requires that all research and development costs be expensed as incurred (FASB 2009)[29]. As a result, almost all costs incurred in connection with the internal development, maintenance or restorement of intangible assets are precluded from being capitalized under US GAAP. There are some exceptions to this general rule, including costs associated with the development of software for internal use (FASB ASC 350-40), costs for the development of software to be sold (FASB ASC 985-20), website development costs (FASB ASC 350-50) and advertisement costs (FASB ASC 720-35). If all conditions set out in the aforementioned codifications (ASCs) are fulfilled, expenditures on these types of internally generated intangible assets must be capitalized instead of expensed.

3.3.4 Concluding remarks

Under US GAAP, the accounting treatment of internally generated and externally generated intangible assets differs significantly. Externally acquired intangibles are generally capitalized, meaning that investments in such intangibles are treated as valuable investments with probable future benefits. On the other hand, investments in internally generated intangible assets are generally expensed as incurred, implying that these expenditures have been consumed in the period in which they took place.

3.4 Accounting for intangibles: the debate

For western economies, investments in intangible assets have become increasingly important over the past three decades. Empirical evidence suggests that for developed countries, investments in intangible assets grow faster than investments in tangibles. In the US, the total expenditure in intangibles exceeds investments in tangible capital since 2002 (Zeghal and Maaloul 2010). The extended importance of intangible assets in developed economies is, among others, induced by

[28] One should note that it is possible that an entity is involved in the creation of another type (thus, not R&D, see ASC 730) of an internally developed, identifiable intangible asset which is not prohibited from capitalization based on the criteria in ASC 350. However, even in that case, recognition of such an asset is difficult due to the uncertainty of future benefits, the notion of control and the requirement of reliability (see also 3.2.2.).

[29] The FASB has decided to implement SFAS 2 in 1974 (currently, ASC 730) based on the argument that empirical studies were unable to demonstrate that there exists a direct relationship between research and development costs and specific future revenue (Canibano 2000).

intensified global competition, new business models and the growing importance of the service sector. The change in investment structure is thus mainly driven by the transition of an industrial economy (based on tangible assets) towards a new, knowledge-based economy (based on intangible assets) (FASB 2001; Lev and Daum 2004).

Although the importance of intangibles as key value drivers is widely accepted and there seems agreement that traditional accounting systems are unable to provide adequate information about intangible assets and their economic impact (Lev 2001), the debate about the appropriate way to account for these intangibles is still going on. Many argue that internally generated intangible assets should be capitalized because these intangibles are intended to acquire future benefits, and accordingly, should be accounted for the same way as tangible capital or externally acquired intangible assets (see e.g Deng and Lev 2006). This is rather logical from an economical point of view since there is no theoretical basis upon which a distinction between intangible and tangible assets can be justified. After all, both tangible and intangible assets represent future economic benefits for the firm which result from past events (Canibano et al. 2000). However, current US GAAP treats resources spent on internally generated intangibles not as valuable investments with book value, but as costs that are not to be expected to generate any future benefits (Hoegh-Crohn and Knivsfla 2000).

Recent studies estimate the annual investment in the US in intangible assets around $ 1 trillion, from which as much as $ 800 billion is excluded from financial statement data, i.e. is expensed rather than capitalized (Corado et al. 2009). The costs incurred to internally create intangible assets constitute thus a substantial part of the total expenditures on intangibles. Failure to carefully reflect the impact of internally generated intangible assets on the current and future performances of a business implies that financial statements fail to provide a true and fair view on a firm's financial position and performance[30] (Canibano et al. 2000). Capitalizing and then amortizing intangible assets will more properly match costs with future benefits, which is believed to increase the value relevance of financial statements (Hoegh-Crohn and Knivsfla 2000; Lev and Zarowin 1999). The following example illustrates this point. For start-up firms in high-technology industries (for example, the biotechnology industry), internally generated intangible assets like R&D and knowledge are the most important long-term assets firms possess. However, under US GAAP, none of these intangibles is recognized as an asset in financial statements and all costs associated with these intangibles must be expensed as incurred. Financial statements of such firms provide investors thus with conservative estimates of the firm's current value (book value) and future performances (earnings). Consequently, for this type of firms, financial statements provide non-relevant information on the basis of which investors will most likely be unable to make efficient allocation decisions (Canibano et al. 2000). It is thus likely that due to the conservative accounting treatment of intangibles, investors turn to other sources than financial statements to base

[30] Due to the differences in accounting for internally and externally generated intangible assets, it is difficult to compare the financial statements of a firm that has built up substantial intangible assets internally with those of another firm that has purchased most of its assets (FASB 2001).

their investment decision on (Rimmerman 1990). This implies that the value relevance of financial information is lower for firms that strongly depend on (unrecorded) intangible assets. Building forth upon this argument, there is often assumed that value relevance on the whole has declined due to the growing importance of intangible assets in current economies (see e.g. Lev and Zarowin 1999).

The FASB has acknowledged the foregoing criticism. In a proposal for a new agenda subject, the FASB (2001) states, among others: "*The principal goal of the project would be to make new information available to investors and creditors and to improve the quality of information currently being provided. A secondary goal would be to take a first step in what might become an evolution toward recognition in an entity's financial statements of internally generated intangible assets*" (FASB 2001, p. 1). However, thus far, US GAAP continues the strict prohibition against the capitalization of internally generated assets. The preference for this accounting treatment is based on the concern that recognizing internally generated assets will render financial statements unreliable. Because internally generated intangible assets are hard to measure objectively; there is often great uncertainty about the future benefits[31] and easing of the recognition criteria extends the degree of discretion given to managers, that is, there are more possibilities for earnings management[32] (Hoegh-Crohn and Knivsfla 2000; Lev et al. 2005). The best way to account for intangibles is thus questioned until today. Or, as Hoegh-Crohn and Knivsfla (2000) conclude: "*How far we should go in recognizing intangible assets is determined by the trade-off between how the relevance and the reliability of intangible assets capitalization affect the informativeness of accounting – and could only be determined empirically*" (Hoegh-Crohn and Knivsfla 2000, p. 244).

3.5 Conclusion

The appropriate treatment of intangible assets is still debated. Although the view that intangible assets are the main value drivers in current economies is widely accepted, many intangibles are not recognized due to the conservative nature of US GAAP. Externally generated assets do not generally raise accounting problems and are recognized in the balance sheet. However, most internally generated intangible assets are expensed rather than capitalized. Many argue that as a result of this conservative accounting treatment, financial statements fail to reflect the underlying economic reality of the business and consequently, investors turn to other sources than financial statements to base their investment decisions on. This implies that the value relevance of financial information is lower if a firm relies heavily on internally generated intangible assets. These concerns have resulted in an extensive number of (empirical) value relevance studies discussing the relation between (accounting for) intangible assets and the value relevance of financial information. The next chapter discusses the main findings of this research.

[31] As Deng and Lev (2006) point out: "*Accounting standard setters claim that wile, on average, R&D is associated with future benefits, individual R&D projects developed by specific companies are highly uncertain*."

[32] Intangible assets are difficult to verify. Thus, when a manager can choose to capitalize or expense an intangible, this discretion can be used to manage or manipulate earnings (Hoegh-Crohn and Knivsfla 2000).

Chapter 4 Intangible assets and value relevance

4.1 Introduction

A large number of studies has examined the value relevance of information reported with respect to intangibles. Also, many studies have empirically addressed the question whether the growing importance of intangible assets in current economies is related to the documented decline in value relevance in the US. The purpose of this chapter is to gain insight in the main findings of former empirical literature regarding the relation between (accounting for) intangible assets and the value relevance of financial information to investors. Section 4.2 attends the problems associated with measuring (internally generated) intangible assets. Section 4.3 discusses value relevance research attending specific types of intangible assets or specific industries. The next section provides an overview of studies that examine the value relevance of financial information over time in relation to the growing importance of intangible assets. Section 4.5 concludes with a discussion of what we have learned from prior research. Last, section 4.6 lists all discussed results.

4.2 Measuring intangible assets

Measuring intangible assets is probably the most difficult part of research on intangible assets. Because financial statements do not report on the total expenditures allocated to intangible assets, it is a nearly impossible task to measure them accurately for each firm. For that reason, some studies focus on the value relevance of externally generated intangible assets because total spending on this type of intangibles can directly be derived from financial statements. Research has also addressed issues related to internally generated intangible assets. The exceptions under US GAAP on the expense of internally generated intangible assets, such as the capitalization of computer software, are a popular subject in value relevance research. There are also studies that focus on specific intangible-intensive industries to acquire better knowledge about the impact of (internally generated) intangible assets on the usefulness of financial information in such industries. Also, some studies use proxies to estimate the impact of unrecorded intangible assets on value relevance. The next sections detail the various types of studies considering the relation between value relevance and intangible assets.

4.3 Specific types of intangible assets and evidence for specific industries

There is a vast quantity of US studies regarding the value relevance of specific types of intangible assets. Another stream of value relevance literature focuses on the value relevance of accounting numbers in specific industries. These studies are often “incremental association studies”. The main goal of such studies is to assess whether (adjusted or additional) accounting numbers are helpful in explaining equity market value given the other information available. Recall from chapter 2 that this type of research generally uses another measure of value relevance than relative association studies. The focus is not (purely) on the R^2s of the regression models, but on the (magnitude of the) slope

coefficients on the accounting numbers of interest. This section discusses only the most relevant contributions to the literature in this area because research concerning the relation between accounting for intangibles and value relevance on a general basis is the main point of interest. See for a detailed summary of value relevance research in this regard Wyatt (2008).

4.3.1 The value relevance of specific types of intangible assets

As explained in chapter 3, costs incurred for internally generated research and development (R&D) are generally not recognized but expensed under US GAAP. Though the expenditures are not reflected in the balance sheet, the disclosure requirements under US GAAP with regard to R&D enable researchers to estimate total expense on R&D in a certain period. According to FASB ASC 730-10-50 (formerly SFAS 2), "*disclosure shall be made in the financial statements of the total research and development costs charged to expense in each period for which an income statement is presented*". The widely available data on R&D has led to a stream of empirical literature focusing on the value relevance of R&D numbers.

Monahan (2005) evaluates the impact of conservative accounting for R&D and past growth in R&D on the relation between earnings and stock returns. He shows that capitalization leads to a significant increase in value relevance when a firm has a high future R&D growth and high conservatism (measured by the intensity of R&D capital to total asset ratio). These findings are in line with the results of Lev and Sougiannis (1996). After estimating firm-specific R&D capital and adjusting the reported earnings and book values of the sample firms for the capitalization of R&D, they find that the adjusted accounting numbers are significantly associated with equity market value. These results indicate that capitalized R&D is value relevant to investors.

Further, the more flexible accounting treatment of development costs for software under US GAAP (see chapter 3) enables researchers to test the value relevance of these identified intangible assets. Aboody and Lev (1998) find a positive association between capitalized development costs and stock returns. Also, the cumulative software reported on the balance sheet is associated with stock prices. Based on these findings, they conclude that the capitalization of software provides value relevant information to investors. Jennings et al. (1996) examine the relation between purchased goodwill and equity market value. They find a significant, positive relation between goodwill and the market value of a company. More specifically, their results indicate "*a strong positive cross-sectional association between market equity values and recorded goodwill asset amounts, after controlling for other components of net assets*" (Jennings et al. 1996, p. 514). Their results confirm that investors value goodwill acquired in business combinations as an asset. Hirschey and Richardson (2004) look into the relation between patent quality information and the value relevance of financial information. Overall, they find that measures of patent quality have positive and significant effects on stock prices. Therefore, they conclude that patent information helps investors assess firm value. Other examples of (internally generated) intangible assets that are determined value relevant include the quality of a firm's human

resource management system (Huselid et al. 1997), advertisement expenditures (Chauvin and Hirschey 1993) and patent application citations (Deng et al. 1999).

4.3.2 Value relevance in intangible-intensive industries

There are also studies that have studied certain, intangible-intensive industries to provide a more comprehensive view on the impact of unrecorded intangible assets on the value relevance of financial information. An example is the study of Amir and Lev (1996). They explore the value relevance of accounting numbers in the telecommunication industry. Based on a panel data set with quarterly information of fourteen independent cellular companies, they infer that there is no reaction of investors to earnings announcements. Moreover, earnings, book values and cash flows seem roughly irrelevant on a stand-alone basis for valuation purposes. Overall, they conclude that the large investments in intangible assets distort the value relevance of financial information in this industry. Trueman et al. (2000) focus on internet firms. They find an insignificant association between earnings and stock prices. However, when earnings numbers are split into components, the component "gross profit" is significantly associated with stock prices. They attribute these findings to the high amount of transitory items included in internet firm's earnings and the expense of investments in internally generated intangible assets while these intangibles are particularly important for internet firms. They conclude that financial statement information is of limited use in the valuation of internet firms.

4.3.3 Concluding remarks

Empirical research has shown that the association between financial information and equity market value can be improved by capitalizing specific types of intangible assets. Also, internally generated intangible assets that are already capitalized (software development costs and externally acquired intangible assets) are determined value relevant. These findings indicate that the capitalization of these intangibles (would) improve(s) the value relevance of financial information. Building forth upon this argument, it can be argued that the current expense of these types of intangible assets distorts the value relevance of financial information. Moreover, evidence from specific intangible-intensive industries reveals that financial information in these industries is more or less irrelevant in explaining equity market value. Though the results of these studies should be interpreted with caution due to the small sample sizes (see table **II**). Overall, studies regarding the value relevance of specific types of intangible assets or the value relevance of accounting in specific industries provide evidence on the intuitive that the two factors are related. However, due to the narrow scope of these studies, the results cannot be generalized for the value relevance of financial information on a whole.

4.4 The decline in value relevance and the growing importance of intangible assets

Following on from the debate in chapter 3, a common concern is that the value relevance of financial information has declined due to the growing importance of intangible assets. A great body of empirical accounting research has tried to prove this hypothesized relation. These studies focus thus on

the relation between accounting for intangibles and value relevance on a more general basis than the studies discussed in the previous section. As explained in chapter 2, studies concerning differences across subsamples or across years are generally relative association studies. The applicable measure for value relevance is therefore the explanatory power (the R^2) of the price - and returns regression models. For the portfolio returns model, value relevance is measured by the percentage that could be earned with perfect foresight of accounting information.

4.4.1 The declining value relevance of financial information

Empirical studies show that the value relevance of financial information has been decreasing over the past decades[33]. That is, accounting numbers are less able to explain the variances in equity market value than before (e.g. Lev and Zarowin 1999, Core et al. 2003, Dontoh et al. 2004 and Balachandran and Mohanram 2011). Value relevance studies concerning trends in value relevance generally makes use of the price -, returns -, and portfolio returns models (or a combination of these three models) and regress the results of these models on a time trend (see e.g. Brown et al. 1999). The decline in value relevance is then evidenced by the (significantly) declining explanatory power of the price -, and returns value relevance models or by the declining percentage that could be earned with perfect foresight of accounting information.

As shortly addressed in section 2.5, Brown et al. (1999) have shown that for the price (level) regression models, the use of the (adjusted) R^2s as a measure for value relevance is unreliable in the presence of scale effects. According to Brown et al. (1999), the R^2s of regression models will be higher in samples in which the cross-sectional distribution of the scale factor has a larger variance to its mean, holding value relevance constant. They explain the phenomenon "scale effect" as follows: "*scale is a multiplicative factor that affects the observed dependent and independent variables. When scale effects are large (small), ceteris paribus, one can expect the R-squared to be higher (lower), because the scale factor contributes more (less) variation to the observed variables relative to the amount contributed by the variables of interest. When scale effects are large enough, the researcher is essential regressing s on itself, resulting in an R-squared that approaches unity. Thus, a difference in R-squared between two samples can arise from differential scale effects in the samples*" (Brown et al. 1999, p. 91). Because of the scale effect, differences in R-squares across sample years (or subsamples) can be only be treated as evidence of differences in value relevance if scale effects are minimal or have been controlled for.

Many accounting studies control for scale effects by the use of stock prices and accounting numbers on a per share basis in price regressions, as proposed by among others Kothari and Zimmerman (1995). Though the problem with per share values is that they also differ in scale. These scale differences exist due to the discretionary power of company's management to change the number of shares outstanding. This choice implies that the scale of the accounting numbers of interest can be changed without

[33] Kim and Kross (2005) report contradicting results: according to them, the value relevance of earnings has increased over time (sample period 1970 – 2000). However, because this study does not focus on the value relevance of financial information in relation to (the growing importance) of intangible assets, this study is beyond the scope of this research.

changing the underlying economic reality (Brown et al. 1999). Current empirical accounting research has caught up with this critique and often uses proxies other than per share values to control for firm size. Examples include (lagged) market capitalization (Easton 1999), book values (Core et al. 2003) total or average assets (Dontoh et al. 2004) or the coefficient of variation (Brown et al. 19999).

Scale effects are particularly important for studies regarding changes in value relevance over time or studies focusing on the value relevance for different types (for example, intangible-intensive versus non-intangible-intensive) of firms. Because conclusions in such studies are based on differences in R^2s from samples drawn in different time periods or from samples based on differences in firm-characteristics. Without the use of an appropriate scaling factor, the results of such studies are thus likely biased. Besides Core et al. (2003), Balachandran and Mohanram (2011) and Dontoh et al. (2004)[34], all studies discussed in the next section use per share values to control for scale effects. The impact of not appropriately scaling seems severe. Brown et al. (1999) determine the consequences of the bias in the results of Collins et al. (1997) due to scale effects. Collins et al. (1997) conclude that the value relevance of financial information has not declined over time and even seems to have increased. However, Brown et al. (1999) show that the increasing R^2s as found by Collins et al. (1999) are largely attributable to the increase in scale effects which have more than offset the decline in the explanatory power of the underlying relation. Moreover, after controlling for scale effects, Brown et al. (1999) find a significant decline in value relevance during the same sample period. The results of all price regressions performed with per share values discussed in the next section are thus likely biased and should be interpreted with caution.

4.4.2 The declining value relevance of financial information and intangible assets

In a pioneer study, Collins et al. (1997) investigate the explanatory power common to both book values and earnings, the incremental explanatory power of earnings and the incremental explanatory power of book values. All regressions are based on the price value relevance model of Ohlson (1995). Overall, they find no systematic decline in the combined value relevance of book value and earnings, although they find that the value relevance of 'bottom-line' earnings is lower. However, this decline is offset by the increased value relevance of book values in their model, so they infer from their results that the combined value relevance of financial information has slightly increased during their sample period. Their empirical evidence shows that much of the shift in value relevance from earnings to book value can be explained by the intensity of intangible assets across time, nonrecurring items, negative earnings and firm size. When they put controls for these factors in their price regressions, they find no systematic decline in the usefulness of financial information. Collins et al. (1997) define firms as intangible-intensive when they are part of certain industries which are likely to contain large amounts of

[34] Core et al. (2003) control for scale effects by deflating their equation by the book value of equity, Balachandran and Mohanram (2011) add the coefficients of variation of price and book value as independent variables in the time trend regressions and Dontoh et al. (2004) scale their equation by total assets.

unrecorded intangible assets[35]. With regard to the relation between the value relevance of financial information and intangible assets, they find a slightly higher explanatory power of earnings and book value for intangible-intensive firms (56,7%) than for non-intangible-intensive firms (54,0%). These findings are thus in contrast with the believe that unrecognized intangible assets cause financial statement information to be less informative.

Francis and Schipper (1999) use a more thorough approach and employ both the explanatory power models as well as the portfolio returns model. They find mixed evidence on whether accounting numbers have lost relevance, depending on the value relevance measure and model used. To test the claim that financial statements have lost their relevance due to the accounting treatment of intangible assets and the growing importance of them in current economies, they use the following approach. They divide their sample into a subsample with 'high-technology' firms (such as pharmaceuticals, computers and telecommunications) and 'low-technology' firms (such as grocery stores, wood, paper products and railroads), arguing that if the decline in value relevance is related to the increase in relative importance of technology based industries, the decline in value relevance must be less prevalent in the low-technology sample and more prevalent in the high-technology sample. Their tests provide mixed evidence on whether there is a significant difference in value relevance for low-tech and high-tech firms. Their results indicate that the explanatory power of book value and combined book value and earnings for high-tech firms is slightly lower, whereas the explanatory power of earnings is the same for both high-tech and low-tech firms. Furthermore, they find little support for the hypothesis that the value relevance of financial information has more strongly declined for high-tech than for low-tech firms. Overall, they come to the conclusion that earnings continue to summarize value relevant information to approximately the same extent for both high-tech and low-tech firms.

In a study published in the same accounting journal, Lev and Zarowin (1999) document a significant decline in the value relevance of financial information over the period 1978 – 1996, employing price- and return value relevance regressions[36]. According to them, this deterioration in value relevance is due to the failure of the accounting system to adequately reflect the impact of change on a firms' operations and economic reality: "*The large investments that generally drive change are immediately expensed while the benefits of change are recorded later and are not matched with the previously expensed investments. Consequently, the fundamental accounting measurement process of periodically matching costs and revenues is seriously distorted, adversely affecting the informativeness of financial information*" (Lev and Zarowin 1999, p. 354). To provide evidence for this argument, Lev and Zarowin (1999) examine shifts in R&D spending of firms, using the extent to which firms spend resources on R&D as a proxy for the innovativeness (likelihood of change) of firms. They argue that it

[35] The SIC codes of these industries are code 48 (electronic components and accessories), SIC 73 (business services), SIC 87 (engineering, accounting, R&D and management related services), SIC 282 (plastics and synthetic materials), SIC 283 (drugs) and 357 (computer and office equipment).

[36] Although Lev and Zarowin (1999) find a decline in the usefulness of financial information, their results are likely biased since they use no scale effects (Brown et al. 1999) in their regressions. The decline in value relevance during their sample period might thus be considerably higher. (see Brown et al. 1999) and the results are therefore likely biased downwards.

is not a high level of investments in intangibles (R&D) per se that affects the value relevance of financial information, but the change of the investment rate in intangibles. When a firm spends every year the same amount on R&D, the immediate expense or capitalization and amortization of R&D leads to the same results in terms of value relevance of earnings. According to Lev and Zaorwin (1999), it is thus not the level but the change in R&D spending that causes the value relevance of earnings to decline. To test this hypothesis, they divide their sample in four subsamples based on their level and direction of change in spending on R&D: "high-high" firms, "low-low firms", "low-high" firms and "high-low" firms. Their tests reveal that firms in the "low-high" subsample experienced a sharp decline in terms of value relevance during the sample period. Further, they show that business change and R&D spending are related by examining the annual average R&D intensity of firms in the different subsamples. Summing up, they conclude that the increasing rate of change is related to the intangible intensity of a firm (approximated by R&D spending) and that an increase in R&D intensity is related to the declining value relevance of earnings.

Note the difference in approach between the study of Lev and Zarowin (1999) and, for instance, the study of Lev and Sougiannis (1996). Though both studies focus on the impact of R&D on the value relevance of financial information, the implications of the results are different. Lev and Sougiannis (1996) directly measure the consequences of the capitalization of R&D. These results cannot be generalized due to the narrow scope of the study. The study of Lev and Zarowin (1999) categorizes firms in different groups based on R&D expenditures and changes in R&D spending. Then, they examine whether the decline in value relevance of the fundamental accounting numbers over the years seems related to the growing importance of intangible assets (proxied by shifts in R&D spending). They use R&D spending as a measure for firms that are more (high R&D spending) or less (low R&D spending) innovative. The results of the price- and returns regressions for the different groups based on R&D spending do not only capture the relation between R&D spending and the value relevance of financial numbers, but also other factors that are likely cohered with innovative firms, including other types of intangible assets (think of brands, employee skills, patents, etc.). Therefore, the results of this study provide evidence for the relation between intangible assets and the value relevance of financial information on a more general basis.

Core at al. (2003) find mixed evidence on the relation between intangible assets and the value relevance of financial information. Their research is based on the assumption that the rising importance of the internet has triggered a new economy period ("NEP") in the latter half of the 1990s in which equity valuation is different from earlier periods. They examine the ability of traditional financial indicators, such as earnings and book value, to explain equity valuation in a broad sample of firms so they can examine whether there is a significant difference between time periods. To mitigate the risk that the results are driven by the specific characteristics of high-tech and young firm, which form an increasing part of the total sample over the years, they divide their sample into different subsamples. The "high-tech" sample is based on the classification scheme of Francis and Schipper (1999). Their

results show that the traditional explanatory variables of equity value remain applicable for firms in the NEP, but that there is greater unexplained variation. Although the ability of financial information to explain firm value decreased around the NEP, this decline does not appear to be due to a decline in the usefulness of financial information since the relation between firm value and financial information has remained very stable during the 1990s. Therefore, the authors argue that the greater variation in firm value seems to be caused by uncorrelated, omitted variables. These results apply to all subsamples including the high-tech sample.

In a somewhat related study, Dontoh et al. (2004) examine the relation between value relevance and "non-information-based trading". They define non-information-based trading as "*trading activities for a reason other than revisions in investors beliefs about the fundamental value of the stock*" (Dontoh et al. 2004, p. 799). They assume that value relevance is lower in the presence of non-information-based trading because this type of trading injects "noise" into stock prices. Therefore, if non-information-based trading has increased over time, this would result in a declining value relevance. Their main hypothesis is that the declining pattern in R^2s is at least partially caused by increased non-information-based trading. Consistent with the studies of Brown et al. (1999) and Lev and Zarowin (1999), they find a decreasing trend in value relevance. The trend is negatively associated with non-information-based trading, suggesting that the declining trend could be caused by the increase in non-information-based trading. Then the real point of interest for this study. Dontoh et a. (2004) test whether the impact of non-information-based trading differs for intangible-intensive and non-intangible-intensive firms. To determine differences in value relevance between the two types of firms, they partition their sample in subsamples based on market-to-book ratios. Firms with higher market-to-book ratios are assumed to be more intangible-intensive. Their results show that the negative association between the declining trend in value relevance and non-information-based trading is more pronounced for firms in the intangible-intensive subsamples. These findings suggest that non-information-based trading rather than the (inadequate) accounting treatment of intangible assets is responsible for differences in value relevance between the two types of firms.

More recently, Balachandran and Mohanran (2011) examined the association between conservatism and the value relevance of financial information over the period 1975 through 2004. They use two measures for conservatism, a measure of the extent to which book values are biased downwards (BR-CONS) and a measure of the downward bias in book values that results from the most commonly observed conservative accounting practices (C-score). They divide their sample in different groups, based on the level of, and growth in conservatism, and try to link the declining value relevance to increasing conservatism. The groups are "low-steady", "low-increasing", "high-steady" and "high-increasing". They use three approaches to measure value relevance: both explanatory power models and the portfolio returns model, all estimated with controls for different industries and losses (negative earnings). In their time trend regressions a control variable for the dissimilar behavior of the stock market during the dot-com crisis is included. The results of the various regression models reveal that for

most years the value relevance of accounting numbers is slightly lower for firms with higher levels of conservatism than for firms with lower levels. However, the authors find little support for the claim that increasing conservatism drives the decline in value relevance. This research is closely related to research into the impact of the intangible intensity of firms since the conservatism measures are partly driven by the conservative treatment of intangibles. Moreover, Balachandran and Mohanram (2011) replicate the tests of Francis and Schipper (1999) and Lev and Zarowin (1999) with the measures for conservatism rather than the proxies used in the original studies. Confirming their own findings, these results are inconsistent with increasing conservatism driving the decline in value relevance.

4.4.3 Concluding remarks

Previous studies concerning the trend in value relevance in relation to accounting for intangible assets document generally a declining trend in the value relevance of financial information over time (sample periods between 1970 and 2004). Empirical accounting research tries to link this declining pattern in value relevance to the growing importance of intangibles. By the use of proxies, studies try to provide evidence on the impact of the presence of high amounts of unrecorded intangible assets on the value relevance of financial information on a (more) general basis. However, the empirical evidence for the relation between intangible assets and the value relevance of financial information to investors is mixed and rather thin. Moreover, most studies do not control for scale effects in an appropriate way which makes it hard to interpret the results of the price value relevance regressions.

In addition, most studies fail to adequately mitigate the risk that the results are driven by correlated, unobserved factors. The approach is in almost all discussed studies the same: the sample is split up in different groups (based on industry, conservatism levels, market-to-book ratios or R&D spending) and value relevance regressions are performed for the different groups. The impact of (accounting for) intangible assets on the value relevance of financial information is then evidenced by the difference in the trend of the declining value relevance between the constructed groups. However, there may be significant differences between the groups, besides the unrecorded intangible asset intensity, resulting in biased test-statistics. Examples include the occurrence of losses, nonrecurring items, acquired intangible assets or other firm- or industry-specific characteristics. Moreover, it is likely that some external factors, think of certain taxes or the “dot-com bubble” affect firms which are likely to have high (low) unrecorded intangible assets differently. Though some studies take a number of these factors into account (e.g. Collins et al. 1993 or Balachandran and Mohanram 2011), the likelihood that the results are driven by such factors is not minimized. The results of the studies addressed in this section are thus likely biased or at least not fully accurate.

Another difficulty with the methodology of the major part of the discussed studies is the “narrow” view they take on. The main goal of the aforementioned studies is to assess whether the financial information of interest explains the same percentage of the variation in stock prices (returns), measured by the R^2, over time. The sole use of the R^2 as measure for value relevance leaves lots of (interesting)

questions unanswered. Because the R^2 of a regression model is a relative measure, for most studies[37] there cannot be inferred from the discussion of the results what the origin is for changes in value relevance over time. In addition, most studies (besides Francis and Schipper 1999) fail to formerly address their definition and measurement approach of value relevance. Is value relevance measured as the total variation in equity market value that is explained by the accounting information, regardless of shifts in that variation, or is value relevance defined as the relative ability of accounting information to explain equity market value compared to competing information sources? The study of Balachandran and Mohanram (2011) takes into account the dissimilar behavior of the stock market during the internet bubble, which suggests that they favor the second interpretation. Moreover, Francis and Schipper (1999) and Balachandran and Mohanram (2011) both employ an alternative measure for value relevance: the portfolio returns model. According to their studies, this model has as greatest advantage that it controls for changes in market volatility over time. This argument is also in line with the second view on value relevance. However, they fail to address other (non-competing) factors that are likely to affect value relevance. For example, Dontoh et al. (2004) show that non-information-based trading activities affect value relevance. This finding suggest that under the second interpretation of value relevance, there should be controlled for non-information-based trading as well because non-information-based trading does not "compete" with financial statement information for market share. Because the impact of non-information-based trading on value relevance differs for intangible-intensive and non-intangible-intensive firms, inferences about the impact of the accounting treatment of intangibles on value relevance are likely biased if there is not properly controlled for this factor. Yet most studies do not control for either periods of crises, changing market volatility over time or non-information-based trading, suggesting that these studies follow the first interpretation of value relevance. These studies are therefore not able to conclude which factors are responsible for intertemporal changes in value relevance. The view on value relevance is thus not consistent in the literature which makes it hard to compare and interpret the results. Also, conclusions drawn based upon the findings of these studies are not always consistent with the practiced interpretation and measure of value relevance[38].

4.5 Conclusion

The literature review (see table **(II)** for an overview) shows that there are still ambiguities surrounding the relation between the value relevance of financial information and intangible assets. Studies focusing on specific intangibles, such as R&D, goodwill or software, provide some evidence that these types of intangibles are value relevant to investors, indicating that the current accounting treatment of internally generated intangibles might distort the usefulness of financial information. Also,

[37] An exception is the study of Cole et al. (2003). They investigate explicitly whether the change in value relevance is caused by changes in the underlying relation between the variables of interest or by other factors. However, the study of Collins et al. (2003) is no "real" value relevance study in the traditional sense because the main topic of interest is equity valuation.

[38] For instance, Lev and Zarowin (1999) argue that the inadequacy of the accounting system to reflect change causes value relevance to decline. They interpret their empirical evidence as consistent with the view that the current accounting treatment of intangible assets distorts value relevant. However, they take on the "first view" on value relevance and control for none of the discussed factors. Their conclusion is therefore not well-founded.

studies focusing on one specific industry (the telecom or internet industry) reveal that the current accounting treatment of intangible assets negatively affects the value relevance of financial information in these industries. These findings suggest that the accounting treatment of intangibles does affect the value relevance of financial information. However, due to the narrow scope of these studies, it is hard to generalize the results, meaning that, based upon these findings, it is not suitable to draw conclusions on the relation between (accounting for) intangible assets and the value relevance of financial information on a more "general basis". Yet studies that measure (or, proxy for) intangible assets in a more comprehensive manner are generally not proficient linking the two variables of interest to each other. This stream of literature attempts to provide evidence on the relation between the growing importance of intangible assets in the US economy and the decline in value relevance of financial information to investors, to gain insight in the relation between the two on a more general basis. Though there is generally consensus in the discussed literature over the decline in value relevance over the years, most studies are not able to provide evidence that this change is related to the growing importance of intangible assets or closely related factors.

Overall, prior literature is thus not able to convince that there is a relation between the intangible intensity of firms and the value relevance of financial information in the US on a general basis. Also, there is little known about the extent to which the value relevance of financial information is affected by the current accounting treatment of intangible assets. Further, most studies do not assess the origin for differences in the value relevance models, while the R^2 is not an absolute but a relative measure. Last, most studies fail to adequately control for the risk that the results are biased due to other, correlated factors or due to scale effects. Hence there are several opportunities for further empirical research.

Table (II) Overview of empirical studies				
Author(s)	Object of study	Sample	Methodology	Main findings
Section 4.3: Studies on specific types of intangible assets and specific industries				
Lev and Sougiannis (1996)	Value relevance of R&D adjusted book values and earnings (R&D capitalization)	1975 – 1991; varies	Association between adjusted earnings and book values for R&D capitalization and stock returns (prices)	Significant association between firm's R&D capital and subsequent stock returns (prices)
Mohanan (2005)	Value relevance of financial information and the growing conservatism for, and growth in, R&D	1988 – 1998; varies	Association between accounting conservatism for R&D, growth in R&D and equity market value.	Capitalization leads to a significant increase in value relevance when a firm has high future R&D growth and high conservatism
Aboody and Lev (1998)	Value relevance of capitalized software costs	1987 – 1994; 163 firms engaged in software development	Association between stock returns (prices) and financial information and the predictive ability of capitalization with respect to subsequent earnings	Investors forecasts are positively associated with the intensity of software capitalization, indicating that software capitalization provides value relevant information
Jennings et al. (1996)	Value relevance of purchased goodwill	1982 – 1988; 259 firms	Association between purchased goodwill and equity market value	There is a significant, strong association between purchased goodwill and equity market value
Hirschey and Richardson (2004)	Value relevance of patents quality	1989 – 1995; 267 firms High-tech	Association between patent quality and stock prices	Various scientific measures of patent quality have a positive and significant effect on stock prices

Amir and Lev (1996)	Value relevance of financial information in the telecom industry	1983 – 1993; 14 firms US telecom industry	Panel data analysis of impact of financial information on stock prices	Financial information is largely value irrelevant on a stand-alone basis
Trueman et al. (2000)	Value relevance of financial information for internet firms	Varies; 63 firm US internet firms	Association between earnings (components) and equity market value.	Insignificant association between earnings and market value. However, the earnings component "gross profits" is significantly associated with stock prices.
Section 4.4: studies regarding the growing importance of intangible assets and the decline in value relevance				
Collins et al. (1997)	Value relevance of financial information over time	1953 – 1993; 119,398 obs.	Price value relevance regressions with controls for intangible-intensity, losses, size and nonrecurring items	The value relevance of earnings and book value is higher for intangible-intensive than non-intangible-intensive firms
Francis and Schipper (1999)	Value relevance of financial information in low- and high-tech industries	1952 – 1994; varies	Price -, returns -, and portfolio returns value relevance regressions for firms in low- and high-tech industries	High-technology firms have not experienced a greater decline in value relevance of financial information than low-technology firms
Lev and Zarowin (1999)	Value relevance of financial information for R&D intensive firms and non-intensive firms	1978 – 1996; varies	Price – and returns value relevance regressions. Also, the (changes in) investments in R&D are examined and linked to the change in value relevance.	Rate of R&D expenses has increased during the sample period and this growth seems related to the decline in value relevance of financial information
Brown et al. (1999)	The effect of scale on the R^2s in cross-sample comparisons	1958 - 1997	Price value relevance regressions with different controls for scale	After controlling for scale effects, the value relevance of financial information has declined significantly during the sample period

Core et al. (2003)	Value relevance of financial information in the New Economy Period ("NEP")	1975 – 1999; 108,943 obs.	Examine differences in fit of their price value relevance regression model with proxies for growth across the sample period (e.g. for "old" and "new" economy period)	Traditional financial variables remain applicable to firms in the NEP, although there is greater unexplained variation
Dontoh et al. (2004)	Value relevance of financial information in the presence of non-information-based trading	1983 – 2000 34,070 obs.	Examine the association between the measure for non-information-based trading and value relevance (measured with the price value relevance model). Regressions are performed for subsamples based on market-to-book ratios.	Non-information-based trading is associated with the declining trend in value relevance. The negative association is more pronounced for firms in the intangible-intensive subsamples.
Balachandran and Mohanram (2011)	Value relevance of financial information and increasing accounting conservatism	1975 – 2004; 100,984 obs.	Price -, returns -, and portfolio returns regressions with controls for losses, certain years and industries. Regressions performed for various groups based on the level of conservatism.	No evidence that firms with increasing conservatism exhibit a greater declines in value relevance.

Chapter 5 Methodology

5.1 Introduction

This section discusses the research design constructed to find an answer to the research question of this thesis: "*Does the intangible intensity of firms affect the value relevance of financial information to investors?"* The first section discusses the measures for value relevance and intangible assets. Section 5.3 focuses on factors that are likely to affect value relevance. Section 5.4 specifies the hypotheses and discusses the models in more detail. The next section elaborates on the variables put to use and the last section encompasses the conclusion. The sample selection, results of the empirical tests and the limitations of the analyses are discussed in the next chapter.

5.2 Variable construction

5.2.1 Value relevance measure

As explained in chapter 2, the value relevance literature distinguishes three common ways to measure value relevance: the price value relevance model, the returns value relevance model and the portfolio returns model. This study makes use of a modified version of the price value relevance model based on the model of Ohlson (1995). The price value relevance model is selected as a starting point because the model relates equity value to both book value and earnings[39]. As the focus of this study is on the combined value relevance of book value and earnings ("the fundamental accounting numbers"), this model is a logical choice. Moreover, all studies relating the growing importance of intangible assets to the decline in value relevance elaborated on in section 4.4 make use of (an adjusted form of) the price model. This enables me to put the results of this study in perspective and to build upon the findings of prior literature. Recall that the basic price value relevance model is shown by the following equation:

$$P_{it} = \alpha_0 + \alpha_1 BV_{it} + \alpha_2 E_{it} + \varepsilon$$

where P_{it} is the stock price per share of company *i* three months after fiscal year end *t*, BV_{it} is the book value of equity per share of company *i* at the end of fiscal year *t*, E_{it} represents the earnings per share of company *i* at the end of fiscal year *t* and the disturbance term ε.

Relative association studies examine then the explanatory power (adjusted R^2)[40] of the regression model to see how much variation in equity value is explained by the accounting information. Hence, the explanatory power of the model is used as a measure for value relevance. See, among others, Francis and Schipper (1999), Lev and Zarowin (1999) and Balachandran and Mohanram (1999).

[39] Chapter 2 has addressed the difficulties associated with the price value relevance models and the other value relevance models. Because all three value relevance models face certain disadvantages, there is no superior model determined in the literature in terms of both economics and econometrics. The choice for the price value relevance model over the other two models is among other based upon the type of research (with price level regressions there can be determined what is reflected in equity value), the desire to study the value relevance of both book values and earnings and the economic intuitive behind the price model. See chapter 2 for a detailed discussion of the three value relevance models.

[40] For brevity, from here on there is referred to the adjusted R^2 with "R^2" or explanatory power.

These studies take the magnitude of the slope coefficients of value relevance metrics thus not explicitly into account. However, because the R^2 is a relative measure, a lower R^2 of the model reveals just that a lower percentage of the variation in equity market value can be explained by the model, not whether the lower explanatory power is caused by a lower association between the accounting numbers of interest and equity market value or due to other factors. According to Kothari and Shanken (2003); "*recognizing how different factors influence the slope is crucially important in economic interpretations of the results from value relevance research*" (Kothari and Shanken 2003, p. 70). Therefore, in this study, a wide view is adopted and both the R^2s of the regressions models and the coefficients on the fundamental accounting numbers are taken into account.

Chapter 2 also elaborated on the disadvantages associated with the use of the price value relevance model. Most of these problems are addressed and resolved in prior value relevance literature. The first difficulty related to the price model is the "scaling problem" (see chapter 2 and 4). The bias due to differences in firm size can be mitigated by including the coefficient of variation of scale in the model or by deflating the individual observations by a proxy of scale (Brown 1999). This study uses a scaled version of the model to prevent a bias due to scaling problems. The scaling factor decided on is discussed in more detail in section 5.3. Another difficulty associated with the price model is that an important assumption underlying the ordinary least square regression does not seem to hold. The distribution of the error terms of price regressions tends to be highly skewed instead of following a normal distribution (Ye 2007). This problem is mitigated by the use of a scaling factor combined with winsorizing of all (independent) variables included in the regression models. Moreover, if necessary, robust standard errors are used in the regression estimates. These proceedings enhance the quality of the (OLS) regression estimates. Also, many argue that an uncorrelated, omitted variable reduces the explanatory power of the price model. This argument is based on the finding that "prices lead earnings" (Kothari and Zimmerman 1995), meaning that the market anticipates a portion of future earnings changes (Kothari and Sloan 1992). The price model misses an uncorrelated variable that would explain the variation in market value due to anticipated components of future periods' earnings changes. Though the explanatory power of the model might be reduced due to this missing variable, the estimated coefficients of the model are not biased since there is assumed that the unobserved variable is not correlated with the other explanatory variables in the model. Altogether this leads to the conclusion that the most critical shortcomings of the model can be resolved and that there can be expected that the model results in unbiased test statistics. Is seems thus appropriate to use the price value relevance model to address questions of value relevance.

5.2.2 Measuring intangible assets

As the databases with US data do not contain information about the total investments in internally generated intangible assets, it is necessary to use a proxy to determine if firms have high or low investments in, and, accordingly a high or low stock of, non-recognized intangible assets. Two proxies

for the intangible asset intensity of firms will be used. The first proxy is the industry classification of Francis and Schipper (1999) because this measure is highly intuitive. Yet because of the critical shortcomings associated with this industry based metric another measure is utilized. This measure is a ratio based on total R&D spending. With the use of both measures there is ensured that the results of this study depend not solely on the applied intangible asset measure which enhances the robustness of the results.

5.3.2.1 SIC code classification

The industry classification follows the definition of Francis and Schipper (1999) of high-tech industries, which is based on the extent to which firms in these industries are likely to have significant unrecorded intangible assets. The classification scheme is employed in several other studies in the accounting and finance literature, including Chen et al. (2002), Core et al. (2003) and Zhang and Zheng (2011), and is considered pretty accurate. An overview of the industry classification can be found below in table (**III**)[41].

Table (III)

High-technology industries	
2830	Drugs
3570	Computer and office equipment
3600	Electrical machinery and equipment, excluding computers
3610	Electrical transmissions and distribution equipment
3620	Electrical industrial apparatus
3630	Household appliances
3640	Electrical lighting and wiring equipment
3650	Household audio, video equipment, audio receiving
3660	Communication equipment
3670	Electronic components, semiconductors
3680	Computer hardware
4810	Telephone communication
7370	Computer programming, software, data processing
8730	Research, development, testing services

There are some important disadvantages related to the industry approach of Francis and Schipper (1999). First, firms are categorized based on industry, not on the amount of investments in unrecorded intangible assets on an individual level. Because some firms may be classified as high-tech while they have a low stock of unrecorded intangible assets and vice versa, a bias in the results may occur. Secondly, the classification scheme does not perfectly categorize firms over time: an industry that is widely considered high-tech in the first part of the sample may become more like a low-tech industry

[41] Two tests are performed to check whether the classification of high-tech and non high-tech industries ("low-tech") seems feasible for the sample. Following Francis and Schipper (1999), to assess whether the classification of high-tech industries captures the construct of unrecognized intangible assets, ratios of R&D spending (measured by total R&D spending divided by total assets) and market-to-book value of the high-tech subsample and the low-tech subsample are compared. For the division to be sufficient there must be a significant difference between the two subsamples, indicating that the R&D spending and market-to-book ratios of high-tech firms are significantly higher during the sample period than that of non high-tech firms.

in the second part (Core et al. 2003). Moreover, to the extent that the errors in the classification scheme vary over time, the tests will be biased towards the finding of significant changes in the regression model over the sample period (Core et al. 2003). These two biases will be mitigated by the use of a relatively short sample-period (15 years). Last, with the industry based metric only the impact of the level of the intangible intensity of firms can be explored, not the change in intangible intensity. Hence an additional measure for value relevance will be exercised.

5.2.2.2 R&D spending

In previous studies the total expenditure on R&D is used to determine firms whether firms are likely to have a high or low stock of unrecorded intangible assets. An example of a study using this line of classification is the research of Lev and Zarowin (1999). Total spending on R&D is a rather logical choice because R&D spending encompasses a large share of total spending on internally generated intangible assets. In addition, R&D data is widely available since US firms are required to disclosure their total expenditure on R&D (see section 4.3). One advantage of the R&D based proxy over the industry approach is that the classification is based on firm level instead of industry level. Moreover, both the level and change in R&D spending can be measured. Lev and Zarowin (1999) point out that when the rate of R&D spending is constant over time (R&D spending is in a "steady state"), reported earnings are invariant to the accounting treatment of R&D. Because under these circumstances, earnings will be the same regardless of R&D is capitalized and amortized or immediately expensed as incurred. Lev and Zarowin (1999) investigate the impact of the change in R&D spending, hypothesizing that an increasing investment rate is R&D is associated with declining value relevance. By examining measures based on the level and both the level and change in R&D spending, a more comprehensive view on the impact of a firm being intangible-intensive on the value relevance of earnings is provided.

Two sets of groups will be formed based on the ratio of R&D spending. The first group consists of deciles portfolios based on the level of R&D spending as percent of total assets ("R&D ratio"). The first decile represents firms with no R&D spending and the tenth decile represents the firms with the highest R&D ratio. The second group consists of four subsamples, based on both the level and change in R&D spending. First, firms are classified as intangible-intensive or non-intangible-intensive based on the level of R&D spending measured as percent of total assets. Following Lev and Zarowin (1999), the threshold level[42] is set on one percent, meaning that firms with R&D spending $\geq$ 1 percent of total assets are likely to have high unrecorded intangible assets ("high"). Firms are expected to have a low stock of unrecorded intangibles ("low") if the R&D intensity is below 1 percent. Following the

[42] There is decided to use a threshold level (and thus not relative R&D ratios) for this classification because there are many firms in the sample with zero R&D spending. Due to the high count of "zero's", a relative measure will classify firms with approximately zero R&D spending as relative intangible-intensive (because approximately zero is larger than zero), while these firms are not necessarily intangible-intensive.

approach of Balachandran and Mohanram (2011)[43], two additional subsamples are formed based on change in R&D spending. The change in R&D spending is measured by estimating firm-specific trends in the level of R&D spending. A trend-based approach is used because R&D spending can be unstable over short time periods. The trend is measured for a firm in year t by running firm-specific regressions, with R&D spending in years t-2 to t as the dependent variable and year as the independent variable. Based on the average trends, firms are classified as "increasing" or "decreasing". The abovementioned procedure results thus in four subsamples: firms with "low and decreasing "low and increasing", "high and decreasing" and "high and increasing" R&D spending.

Note the shortcomings related to the R&D proxy for intangibles. First, firms are classified based on the level of (and change in) investments in R&D, not on the level of (and change in) investments in unrecorded intangible assets. By the use of a R&D proxy the total expenditure on unrecorded intangible assets may be underestimated (or overestimated) for certain firms or even certain industries which may bias the results[44]. Also, R&D spending is an input-metric, not an output metric. Therefore, the measure fails to capture variations in the efficiency of the innovative process (Canibano et al. 2000). It is possible, and maybe even plausible, that investors put more weight on out-put measures, such as patents, than on input measures. Because the output measures capture the success of innovative activities instead of the expense on it. Last and most important, the results of regressions with this measure of intangibles are based on one business activity, namely investments in R&D. Though this measure may for some firms be representative for the investment activities in intangible assets as a whole, i.e. for the extent to which firms rely on intangible assets instead of tangible capital, this is probably not true for all of them.

5.3 Factors that affect value relevance

Previous value relevance studies have determined several factors that have an effect on value relevance. To prevent that conclusions are drawn upon biased test statistics, there needs to be controlled for these factors. Also, there are factors that are likely to affect firms which rely more heavily on unrecorded intangible assets in a different way than firms that rely less on intangible capital. There should be controlled for such factors as well, because without these controls, inferences from the regression models may be driven by these unobserved factors rather than by the factors of interest[45].

[43] Balachandran and Mohanram (2011) focus not on R&D spending but on conservatism. However, their study provides a more precise approach to construct an increasing and steady/decreasing group than the study of Lev and Zarowin (1999). Lev and Zarowin (1999) split their sample period into three sub periods and compare the R&D intensity in the "recent period" (last six years) to the R&D intensity in the 'early period" (first six years). Firms are then classified by the direction of change in R&D intensity into four categories.

[44] Soete and Verspagen (1990) point out that R&D carried out in service industries in general, and in software development firms in particular, is badly captured in statistics.

[45] Note that the objective of this study is not to maximize the fit of the price value relevance model. All variables added to the price value relevance model are included to measure the impact of the intangible intensity of a firm in an unbiased manner. Therefore, the model is only adjusted for factors that are likely to distort the regression results and for factors that are likely to have a dissimilar impact on intangible-intensive and non-intangible-intensive firms.

Losses; Hayn (1995) is the first to document that firms reporting negative earnings have smaller earnings response coefficients and lower regression R-squares than firms reporting positive earnings. Hayn (1995) attributes these differences to the abandonment option shareholders have (losses are not expected to continue into perpetuity because shareholders can always liquidate the firm) and the transitory nature of losses (losses are not expected to persist). In addition, Easton (1999) shows with a scatter-plot of earnings and returns that there is a non-linear relation between these two variables. There is a strong positive relationship between earnings and returns when earnings are positive and there is a much weaker relationship when earnings are negative. To control for losses, an interaction term and indicator variable are included in the price model. The indicator variable for losses equals one (1) if the earnings of firm i in year t are negative in year t and zero (0) otherwise. By including both an indicator variable for losses and an interaction term (indicator losses * earnings) in the regression models, the intercept and slope coefficients of positive earnings and negative earnings are allowed to differ. These control variables avoid that the results of the regression models are biased due to the non-linearity of earnings. Moreover, it is likely that firms that rely more heavily on intangible assets experience more often and also greater losses than firms that rely less on intangible capital due to the more uncertain nature of intangible-intensive firms. The implementation of these control variables in the models prevents thus that the results of the price regressions and time trend regressions (see section 5.4) are driven by differences in the occurrence of losses rather than by differences in the intangible intensity[46] of firms or the pattern of value relevance over time.

Firm size: as explained in chapter 2 and 4, differences in firm size render between-sample comparison of R-squares invalid, unless controls are used for differences in the scale factor's coefficient of variation (Brown et al. 1999). In accounting research, variation in size (or scale) is generally a problem because large companies typically have larger values than smaller companies. Scaling is thus done to exclude variation in the variables of interest that is not related to the research question (Veenman 2011). Feasible proxies for scale are (lagged) market value of equity, (lagged) book value, (average) total assets (Dontoh et al. 2004) or the use of the coefficient of variation of scale (see chapter 4 and Brown et al. 1999). All price equations employed in this thesis are deflated by average total assets (total assets$_t$ + total assets$_{t-1}$)/2). An advantage of this deflator is that the results of the price regressions are easier to interpret than regressions scaled by total market value or book value because these factors are already included in the price value relevance regression model as (in)dependent variables. Moreover, scaling by average assets yields relatively normal distributions of the variables of interest so the deflator seems to fit the data (see chapter 6).

[46] Recall that the intangible intensity of firms refers to the extent to which firms are likely to have high amounts of internally generated intangible assets which are not recognized under US GAAP. For brevity, there is referred to firms which are likely to have a high stock of unrecorded intangibles as "intangible- intensive firms".

Special items; prior value relevance studies have shown that earnings including special items are less value relevant than "core" earnings excluding special items (Elliot and Hanna 1996). These findings are consistent with the view that special items represent "low quality earnings" or transitory income items (Collins et al. 1997). Elliot and Hanna (1996) show empirically an increasing propensity of firms to report special items across time. The bias that might occur due to the dissimilar value relevance of special items compared to "core earnings" is twofold. First, if intangible-intensive and non-intangible-intensive firms differ significantly in the propensity of reporting special items, differences in the value relevance of financial information between the two types of firms may be driven by the occurrence of nonrecurring items rather than the impact of the accounting treatment of intangibles. Secondly, if the propensity of firms to report special items has actually increased over time, it suggests that the time trend regressions (which are used to detect the trend in value relevance over time, see section 4.4.3) may be biased downwards to the result that value relevance is decreasing due to increased reporting of special items. To detect these biases, in some price regression models and time regression models a control variable for "special items" is included. The details of this control variable are further addressed by the discussion of the models employed in this thesis.

Young firms; research has shown that "young" firms may have informational problems that influence equity valuation. According to Collins et al. (1997), the market value of start-up firms depends mainly on growth potential, not on current earnings since current earnings are not a reliable proxy for future earnings of such firms. Along the same line, Core et al. (2003) argue that the value relevance of accounting numbers is lower for start-up firms due to the higher uncertainty of future cash-flows. It is reasonable to assume that there are more "high-tech[47]" start-up firms than "low-tech" start-ups since there is presumed that the importance of intangible assets has increased during the sample period. It is thus important to control separately for the "age" of a company in the value relevance regressions. If not, the informational problems caused by the age of the firm may be falsely attributed to the problems associated with the intangible intensity of a firm. Due to the requirement that at least two lagged years of data are available (the data is necessary to measure the trends in R&D spending), recent IPOs and firms which are delisted within three years from its IPO data are eliminated from the sample. This mitigates the risk that the results are driven by the start-up firms.

Leverage: finance literature has determined a relation between the characteristics of a firm's assets and its capital structure. It is assumed that asset tangibility and leverage are positively related because tangible assets are both readily collateralized and liquidated or redeployed at market value (see e.g. Williamson 1988 and Rajan and Zingales 1995). Valuation of intangible assets is more ambiguous and accordingly, intangible assets are more difficult to liquidate or redeploy. It is therefore reasonable to assume that firms that rely more heavily on intangible capital are less levered. Also,

[47] With "high-tech" firms there is referred to firms that rely heavily on intangible assets and with "low-tech" firms there is referred to firms that rely more on tangible capital.

prior literature has shown that there is a relation between financial leverage and stock returns (prices). For example, Dimitrov and Jain (2009) document a negative association between changes in financial leverage and (risk-adjusted) stock returns. These findings suggest that changes in financial leverage affect the value relevance of a firm's book value and earnings because changes in leverage cause (or seem at least related to) share price reactions while this information is not incorporated in earnings and/or book value. There can thus be assumed that value relevance is lower in the presence of (high) changes in financial leverage. To prevent that the results of the price and/or time trend regressions models are driven by differences in the capital structure of tangible-intensive and non-intangible-intensive firms, some price value relevance and time trend regression models include a control variable for changes in leverage. Following Dimitrov and Jain (2006), financial leverage is defined as the sum of long-term and short-term debt divided by total assets. The change in financial leverage is then measured as the difference between the ending and beginning financial leverage for a certain year. Further details of this control variable are addressed by the discussion of the applicable models, see sections 4.4.1 to 4.4.3.

Time effects: last, time effects are added to some price value relevance models to control for external influences which are correlated with other regressors. Year dummies are broadly used in empirical analysis to control for, for instance, the changing macro-economic conditions or stock market levels during a sample period. The use of time effects prevents that the results are driven by dissimilar behavior of the stock market during the dot-com crises, changing debt-market conditions or dissimilarities due to financial crises. These year dummies may capture other important, maybe unexpected, influences as well.

5.4 Price value relevance models

The literature review in chapter 4 revealed that there remain a lot of unanswered questions regarding accounting for intangible assets and value relevance. Previous empirical accounting studies provide convincing evidence for the value relevance of specific types intangible assets, such as in Lev and Sougiannis (1996) and Hirschey and Richardson (2004), or for the impact of the accounting treatment of intangible assets in one specific industry, such as in Amir and Lev (1996). However, studies regarding the two variables of interest on a more general basis find mixed evidence on the relation between them. In addition, most of these studies fail to control in an adequate manner for scale effects or the influence of unobserved, correlated factors. Also, there is little known about the extent to which the accounting treatment of intangible assets (negatively) affects value relevance. Last, the pure focus on the R^2s of the value relevance regression models leaves aside the valuable information offered by the other regression parameters. This study addresses these ambiguities. The next sections detail the five hypotheses that will be tested empirically and the corresponding models.

5.4.1. Method I – Hypothesis I and II

5.4.1.1 Hypothesis I

The first question of interest is whether there is a relation between (accounting for) intangible assets and value relevance in general. That is, to examine if, and if so, to what extent, the existence of a firm's high investments in non-recognized intangible assets affects value relevance. The expectation is that the value relevance of financial information is lower for firms with high investments in, and accordingly a high stock of, unrecorded intangible assets than for firms which rely less on intangible capital. The underlying assumption for this belief is that due to the inadequate accounting treatment, i.e. the expense instead of capitalization, of internally generated intangible assets, financial statements fail to provide a true and fair view of the underlying economic reality of the firm, and consequently, investors turn to other sources to base their investment decisions on. The percentage of variation in equity market value that can be explained by financial statement information (measured by the R^2) is then thus less severe, resulting in the conclusion that the value relevance of financial information is lower in the presence of high unrecorded intangible assets. This line of reasoning is explicitly based on the studies of Collins et al. (1997), Francis and Schipper (1999) and Lev and Zarowin (1999). The first hypothesis that will be examined is therefore: "*the value relevance of financial information to investors is lower for firms that rely more heavily on unrecorded intangible assets than for firms that rely less heavily on unrecorded intangible assets*".

The following approach is followed to test the first hypothesis. Differences in value relevance between the two types of firms can be detected by estimating the price model for different groups. Note that the question of interest at this moment is whether there exists a difference in value relevance (measured by the R^2) between the two types of firms, not what causes the difference. The basic price value relevance model will be estimated for the (a) subsamples based on the industry classification ("high-tech and low-tech firms"), (b) the portfolios based on the level of R&D spending and (c) the four subsamples based on both the level and change in R&D spending. The price model already includes the indicator variable for losses and the interaction term (DL *E, IA) because without these variables the models are likely to provide biased test-statistics due to the non-linearity of earnings. The following regression model is thus estimated for the three types of groups:

$$MV_{it} = \alpha_0 + \alpha_1 BV_{it} + \alpha_2 E_{it} + \alpha_3 DL_{it} + \alpha_4 IA_{it} + \varepsilon_{it}$$

where MV_{it} is the market value of company *i* three months after the end of fiscal year *t*, BV_{it} represents book value of equity of company *i* at the end of fiscal year *t*, E_{it} represents the earnings of company *i* at the end of fiscal year *t*, DL in indicator variable for losses equaling one (1) if earnings are negative and zero (0) otherwise, IA is the interaction term (DL * E) and the disturbance term ε. All variables are deflated by average total assets ((total assets fiscal year t + total assets fiscal year t-1)/2).

Subsequently, there is tested how the explanatory power of earnings (including separate controls for losses) and book values varies across the portfolios. To test whether the R^2 of the price model

varies across the different "groups" (subsamples or portfolios), the R^2s are regressed on the "group" rankings.

$$R_j^2 = \varphi_0 + \varphi_1 G_j + \varepsilon_j$$

where R_j^2 represents the explanatory power of the price model in "group" *j* and G represents the groups (subsamples or portfolios) *j* (1 to N).

5.4.1.2 Hypothesis II

Following on from the first hypothesis, it is important to determine whether differences in value relevance between intangible-intensive and non-intangible-intensive firms are actually related to firms being intangible-intensive. It is possible that firm- or industry specific characteristics, besides the presence of high amounts of unrecorded intangible assets, are able to explain differences in terms of value relevance. Moreover, unobserved external effects that vary across time may affect value relevance. If there is not appropriately controlled for these factors in the value relevance models, the results may be biased towards the conclusion that there is a significant difference between the two types of firms due to the intangible intensity, while it is not the intangible intensity that causes the divergence in value relevance but other factors that are correlated with being intangible-intensive. The second hypothesis is thus: "*the difference in value relevance between intangible-intensive and non-intangible-intensive firms cannot be explained by observable variables other than the presence of high unrecorded intangible assets*".

Section 5.3 has identified two factors that are likely to affect intangible-intensive and non-intangible-intensive firms in a different manner: changes in leverage (Dimitrov and Jain 2009) and special items (Elliot and Hanna 1996; Collins et al. 1997). By adding control variables for special items and changes in leverage to the price model, there is prevented that the results are driven by these factors rather than by the intangible intensity of firms. Also, macro-economic factors, such as the dot-com crisis, inflation or the financial crises, probably alter the results of the price regressions. To control for external events or trends that influence the outcomes of the model, year dummies are included in the price regressions. Nearly all closely related studies do not control for time effects, though Balachandran and Mohanram (2011) include a dummy variable for the dot-com crisis in their time trend regressions. The modified price value relevance model to test hypothesis II is then as follows:

$$MV_{it} = \alpha_0 + \alpha_1 BV_{it} + \alpha_2 E_{it} + \alpha_3 DL_{it} + \alpha_4 IA_{it} + \alpha_5 SI_{it} + \alpha_6 \Delta L_{it} + \alpha_7 Y_{it} + \varepsilon_{it}$$

where all variables are as defined before and SI represents the reported special items as percent of earnings of company *i* at the end of fiscal year *t*, ΔL represents the change in financial leverage of company *i* at the end of fiscal year *t* and Y represents the indicator variables for the fiscal years 1 to N.

5.4.2 Method II – Hypothesis III

A question closely related to hypothesis I and II is what causes differences in value relevance. Recall that value relevance under method I is measured by the R^2 of the price model, i.e. the total ability of the accounting numbers incorporated in the model to explain variation in equity market value. A lower R^2 does not necessarily imply that the association between equity market value and a financial statement number (say earnings) is lower. Recall the measurement of the (adjusted) R^2 of a regression model: the adjusted R^2 compares the unexplained variance of the model with the total variance of the data, adjusted for the number of explanatory terms in the model (Brooks 2008). The R^2 is thus a relative measure, not an absolute one. Therefore, for two subsamples, earnings and market value can be associated to the same extent (the magnitude of the coefficients on earnings is thus the same), while at the same moment the explanatory power of one of the models is lower (Kothari and Shanken 2003)[48]. The sole use of the R^2 as a measure for value relevance provides thus no information about the association (the estimated slope coefficients) between the accounting numbers and firm prices. An interesting question is therefore whether the extent to which accounting numbers are associated with equity market value differs for intangible-intensive and non-intangible-intensive firms. There can then be inferred whether differences in value relevance (measured by the R^2) occur due to differences in the association between the accounting numbers and equity market value or due to other factors. Just as by hypothesis I, it is expected that the association between the fundamental accounting numbers and equity market value is lower for intangible-intensive than for non-intangible-intensive firms due to the conservative accounting treatment of intangible assets (see e.g. Lev and Zarowin 1999 or Francis and Schipper 1999). The third hypothesis is therefore: "*the association between the fundamental accounting numbers and equity market value is lower for firms that rely more heavily on intangible assets than for firms that rely less heavily on intangible assets*".

To test this hypothesis, the magnitude of the coefficient on the variables of interest is examined rather than the R^2 of the regression model. Price value relevance regressions with dummy variables which indicate whether firms are likely to have high (low) unrecorded intangible assets are estimated. A negative coefficient on the indicator variables implies that the association between financial information and equity market value is lower (with the % magnitude of the coefficient) for firms with high unrecorded intangible assets, holding everything else constant. Two sets of regression are carried out. The first model is the basic price value relevance with indicator variables for intangible intensity. In a second set of regressions, control variables for special items, change in leverage and time effects are included in the model to prevent that the results are driven by these factors.

Model 1: $MV_{it} = \alpha_0 + \alpha_1 BV_{it} + \alpha_2 DH*BV_{it} + \alpha_3 E_{it} + \alpha_4 DH*E_{it} + \alpha_4 DL_{it} + \alpha_5 DH* DL_{it} + \alpha_6 IA_{it} + \alpha_7 DH*IA_{it} + \varepsilon_{it}$

[48] The explanatory power of a regression model is affected by the slope, the variability of the independent (accounting) variables and/or the residual variability of the dependent variable (market value) (Kothari and Shanken 2003).

Model 2: $MV_{it} = \alpha_0 + \alpha_1 BV_{it} + \alpha_2 DH*BV_{it} + \alpha_3 E_{it} + \alpha_4 DH*E_{it} + \alpha_4 DL_{it} + \alpha_5\ DH*\ DL_{it} + \alpha_6 IA_{it} + \alpha_7 DH*IA_{it} + \alpha_8 SI_{it} + \alpha_9 DH*SI_{it} + \alpha_{10} L_{it} + \alpha_{11} DH*L_{it} + \alpha_{12} Y_{it} + \alpha_{13} DH + \varepsilon_{it}$

where all variables are as defined before and DH represents the indicator variable which equals one if the firms are likely to have high unrecorded intangible assets and zero otherwise. Regressions with three types of indicator variables are performed: a dummy variable based on (a) the industry classification (dummy equals one if "high-tech" and zero if "low-tech"), (b) the level R&D spending (dummy equals one if R&D spending ≥ 0,01 total assets and zero otherwise) and (c) the change in R&D ratios (dummy equals if the investment rate increases and zero otherwise).

5.4.3 Method III – Hypothesis IV

The fourth question of interest is whether there is a relation between the growing importance of intangible assets and changes in value relevance over time (measured by the R^2s of the model). Prior research has shown that the value relevance of financial information in the US has declined over the past decades (sample periods between 1970 and 2004), despite the great effort of accounting standard setters, and there is often referred to the growing importance of intangibles (or related factors) as the most reasonable explanation. However, the empirical evidence on the relation between the accounting treatment of intangible assets and the decline in value relevance is mixed and rather thin. See Collins et al. (1997), Francis and Schipper (1999), Lev and Zarowin (1999) and Balachandran and Mohanram (2011) for examples. Nonetheless, if intangible assets are responsible for the documented decline in value relevance, there can be expected that the declining trend has continued after 2004 because the importance of intangibles to the US economy and companies has continued to increase from that moment on (Corrado et al. 2009). Following a wide range of prior literature, the fourth hypothesis is therefore: "*There is a relation between the growing importance of intangible assets and the declining trend in value relevance".*

The method followed to test the fourth hypothesis is based on the study of Collins et al. (1997) [49]. In line with the traditional view, value relevance is measured with the R^2 of the regression model. Testing of hypothesis IV requires four steps. First, the intertemporal changes in value relevance must be determined. In order to do so, the basic price value relevance model will be estimated for each sample year:

$MV_{it} = \alpha_0 + \alpha_1 BV_{it} + \alpha_2 E_{it} + \alpha_3 DL_{it} + \alpha_4 IA_{it} + \varepsilon_{it}$ (*model 1*)

[49] An alternative approach would be to use a regression model with cross-sectional fixed effects. By the use of such a model, there can be tested in a relatively unbiased manner whether an increase in intangible intensity within a firm causes value relevance to decline. The evidence on the relation between accounting for intangible assets and value relevance is then estimated in a direct manner. However, the sample (see chapter 6) consists of too few firms that experience a real change (low R&D spending to high R&D spending) during the sample period. Therefore, the use of a so called difference-in-difference approach is not feasible.

After that, the pattern of the R^2s is considered. Studies concerning related objects generally estimate time trend regressions to determine trends in value relevance[50] (see e.g. Collins et al. 1997, Francis and Schipper 1999, Lev and Zarowin 1999 and Balachandran and Mohanram 2011). If the coefficient on the trend measure is statistically significant and positive (negative), there can be inferred that the value relevance of financial information has increased (decreased) over the years. If the coefficient is not statistically significant there can be inferred that there is no trend in value relevance over the years.

$$R_t^2 = \varphi_0 + \varphi_1 T_t + \varepsilon_t \qquad \textit{(model 2)}$$

where R_t^2 is the explanatory power in fiscal year *t* and T_t represents the fiscal years (1 to n).

Subsequently, there must be explored whether the intangible intensity in the sample has increased significantly over time. As proxy for the annual intangible intensity in the sample, the mean value of R&D spending as percent of total assets of all sample firms in year (t) is used. The trend in R&D spending is verified with a regression model with the mean annual values of R&D spending as the dependent variable and the years "T" as independent variable.

$$M_t = \varphi_0 + \varphi_1 T_t + \varepsilon_t \qquad \textit{(model 3)}$$

where M represents the measure for intangibles in fiscal year *t* and T_t represents the fiscal years.

Last, there needs to be examined whether the declining trend in value relevance is related to the increasing trend in intangible intensity in the sample. This can be done by performing a time trend regression including the intangible intensity measure. Also, control variables for the items specified in section 5.3, special items and change in leverage, are added to the model to prevent that the declining trend in value relevance is driven by changes in these factors. Moreover, because the test consists of a sample comparison across years, there are two additional factors that needs to be controlled for: the dot-com bubble and market volatility.

Dot-com bubble; prior research has shown that during the dot-com bubble period the market has behaved in a less rational manner than before or after the crisis (Morris and Alam 2012). Following Balachandran and Mohanran (2011), an indicator variable is added to the time trend regressions to control for the effect of the dot-com crisis, which effect is likely larger for firms that rely strongly on intangible assets than for firms that rely less on intangible capital, given that the dotcom crisis is fueled by the rise of internet companies and high-tech firms in general. The dummy variable equals one (1) for the years 1998, 1999 and 2000 and equals zero (0) otherwise. By including this dummy in

[50] In the basic time trend regressions, I put no controls for market volatility, the dot-com crisis (see hereafter) or other factors because I want to measure the shifts in value relevance over time, regardless of the source. Differences in value relevance may be driven either by factors that "compete" with financial statement information for market share or by something else (Francis and Schipper 1999). Because most studies, see e.g. Lev and Zarowin (1999), Francis and Schipper (1999) and Core et al. (2003), do not control for any factors in their time trend regressions, this makes the results of the first time trend regressions more comparable with the results of prior research. All control variables are included in the second time trend regression model (model 4) to examine whether intertemporal changes in value relevance can be explained by these factors.

the time trend regressions, there is ensured that the results are not driven by dissimilar behavior of stock prices during the dot-com crisis.

Market volatility S&P 500; an important disadvantage of the basic price value regression model is that potential changes in market volatility over time is not taken into account (Francis and Schipper 1999). The explanatory power of the price value relevance model is biased downwards (upwards) if the market volatility increases (decreases) over time while the absolute amount of value relevant information stays constant. To control for changing market volatility over time, an index based on the level of the S&P 500 three months after fiscal year[51] end is included in the time trend regressions. This index indicates the percentage change in price of the securities included in the index.

The final model tests thus whether the decline in value relevance can be explained by changes in the unrecorded intangible intensity (M) across time, while there is ensured that the results are not caused by changes in the reporting of special items across time, changes in financial leverage across time, the dissimilar behavior of the stock market during the dot-com crises or changes in market volatility across time. The final model is then as follows:

$$R_t^2 = \varphi_0 + \varphi_1 T_t + \varphi_2 SI_t + \varphi_3 Bubble_t + \varphi_4 V_t + \varphi_5 \Delta L + \varphi_6 M_t + \varepsilon_t \qquad \textit{(model 4)}$$

where all variables are as defined before and SI represents the control variable for special items (the mean value of special items as percent of earnings in year *t*), ΔL represents the change in leverage (the mean value of changes in financial leverage in year *t*), Bubble is the indicator variable for the dot-com crisis (which equals one in the years 1998, 1999 and 2000) and V is the index included to control for market volatility.

5.5 Sensitivity check

The data gathered to test the hypotheses of this study consists of both cross-sectional (firms) and time-series (years) elements. This type of data is called "panel data". The panel is unbalanced, meaning that the number of time-series observations is not the same for each cross-sectional unit due to missing observations. Panel data analysis is in some respects superior over time-series and/or cross-sectional analysis. One of the main advantages of panel data is that the effects of unobserved cross-section specific variables can be treated as fixed constants ("fixed effects") over time (Brooks 2008).

Because the panel is highly unbalanced (see section 6.2.2), most tests in this study are carried out without making use of the specific features of panel data. However, from an economical point of view, it is rather logical that firm-specific characteristics affect the market value of a firm. This would imply that the results of this study are biased due to time-invariant, firm-specific characteristics that affect a firm's equity market value. To test whether the main findings of this study alter under the fixed effects

[51] The index is based on stock price volatility three years after fiscal year end because market value in the price regressions is also measured three months after fiscal year end.

approach, price value relevance models with fixed effects will be estimated. The fixed effects capture all the time-invariant firm specific characteristics that affect the dependent variable (market value) of the model cross-sectionally. The fixed effects model mitigates thus the likelihood that correlated, unobserved time-invariant variables drive the results of the analysis (Brooks 2008). To measure the fixed effects in a reliable manner, there must be enough time-series variation for each sample firm. A balanced sample will be composed by deleting all firms from the sample which have not the maximum number of observations. This selection procedure is therewith at once the main drawback of this approach: due to the selection criteria a selection bias and survivorship bias occur.

Just as under method 1, the price value relevance models will be estimated for the different subsamples and portfolios. Three forms of the price value relevance model will be estimated with the constant sample so the results of the three tests can be compared. The results of the first model (see below) reveal whether the value relevance of firms in the constant sample differs from firms in the total sample. The second model includes (only) the fixed effects so the impact of the fixed effects can be individually appreciated. In the third model, the control variables for reporting on special items, changes in leverage and time effects are included, jointly with the fixed effects, to examine whether differences in value relevance exist after controlling for these factors.

$MV_{it} = \alpha_0 + \alpha_1 BV_{it} + \alpha_2 E_{it} + \alpha_3 DL_{it} + \alpha_4 IA_{it} + \varepsilon_{it}$ *(model 1)*
$MV_{it} = \alpha_0 + \alpha_1 BV_{it} + \alpha_2 E_{it} + \alpha_3 DL_{it} + \alpha_4 IA_{it} + \upsilon_{it}$ and $\upsilon_{it} = \mu_i + \varepsilon_{it}$ *(model 2)*
$MV_{it} = \alpha_0 + \alpha_1 BV_{it} + \alpha_2 E_{it} + \alpha_3 DL_{it} + \alpha_4 IA_{it} + \alpha_5 SI_{it} + a_6 \Delta L_{it} + a_7 Y_{it} + \upsilon_{it}$ and $\upsilon_{it} = \mu_i + \varepsilon_{it}$ *(model 3)*

where all variables are as defined before and the disturbance term (υ_{it}) is decomposed in an entity-specific component (μ_i) which accounts for the effects of omitted variables that are specific to the individual firms whilst staying constant over time ("the fixed effects") and the remainder disturbance term that varies over time and entities (ε_{it}).

5.6 Variables

The sample will be gathered from the Compustat and the Center for Research in Security Prices (CRSP) databases. Data will be collected for the (data) years 1995 – 2010[52]. All variables are defined consistent with prior literature. Earnings is Earnings Before Extraordinary Items (Compustat item # 18), Book value is Common Equity Total (Compustat item # 60), Total Assets (Compustat item # 6), and R&D expense (Compustat item # 46). The change in leverage is calculated by dividing the sum of long-term debt (Compustat item # 9) and short-term debt (Compustat item # 34) by total assets (Compustat item # 24). The index is the S&P composite index (in percent) which comprises the level of the S&P 500 composite index return at the end of the month (in this case, the set date is three months after fiscal year end of company *i*), gathered from the CRSP database. Finally, stock prices

[52] A firm-year is defined consistent with Compustat data conventions, which means that the data year is the year in which the majority of the months in the fiscal year fall.

three months after fiscal year (t) end are derived from the CRSP database. Market value of equity (market capitalization) is then calculated as the stock price three years after fiscal year end multiplied by the number of shares outstanding at that moment (also derived from the CRSP database).

5.5 Conclusion

This section has discussed the measures for value relevance and intangible assets, several factors that are likely to affect value relevance, the hypotheses development and the corresponding regression models to test these hypotheses. Two proxies for intangible assets and three different methods are put to use to address question of value relevance. In total, four hypotheses will be examined so a comprehensive answer to the research question will be obtained. Moreover, an alternative approach is adopted to assess whether the results hold after controlling for the individual heterogeneity of firms. The next chapter discusses the results of this research design.

Chapter 6 Empirical results

6.1 Introduction

This chapter discusses the empirical results of this study. The next section explains the sample selection procedure and elaborates on the descriptive statistics. Section 6.3 discusses the results of the models explained in chapter 5. Subsequently, the most important findings are addressed and compared to prior literature. Section 6.5 discusses the main limitations of this study. Conclusions are presented in the last section.

6.2 The sample

This section details the sample selection process, the sample distribution and the descriptive statistics of the sample. To maintain comparability across the results of the different models, all tests are based on the same final sample. An exception is made for the sensitivity checks performed in section 6.4 which make use of a constant sample. The specifics of the samples gathered for this test will be discussed in section 6.4.

6.2.1 Sample selection

The sample of firm year data comes from the Compustat and CRSP databases. The initial sample consists of all firm data available in the merged CRSP/Compustat database for the period 1995 – 2010. All financial firms (SIC codes 6000 – 6999) are excluded from the sample[53] because of the unique characteristics of these firms. Financial firms have a minimal level of operating assets and are subject to additional regulatory requirements that potentially affect value relevance (Ahmed et al. 2000). To prevent a (potential) bias in the results due to these dissimilar characteristics, all financial firms are thus excluded. This procedure is in line with prior literature (for an example see Core et al. 2003). Further, all firm observations for which not all necessary data (stock price, earnings, book value, total assets) is available in Compustat and/or CRSP are excluded[54]. Also, following previous value relevance studies, firms are required to have a positive book value of equity[55] (see e.g. Core et al. (2003) and Balachandran and Mohanram 2011). In addition, to estimate the firm-specific changes in intangible intensity (changes in R&D) data must be available for at least two lagged years. Due to this requirement, all firms with less than three years of data available are eliminated from the sample. Though both surviving and non-surviving firms[56] are part of the sample to avoid a survivorship bias, a

[53] The Compustat database shows two SIC codes: the current sic code "sic" and the historical sic code "sich". The sic and sich code of a firm can differ because the focus of a firm's core business may change over time (Veenman 2011). To avoid a bias in the results due to the presence of former financial firms in the sample, first, all firms with a sich code between 6000 and 6999 are excluded from the sample. Next, all firms with (current) sic codes between 6000 and 6999 are deleted.

[54] Following prior literature, missing values for R&D, Goodwill, Intangible assets, etcetera are set to zero (see, for instance Core et al. 2003).

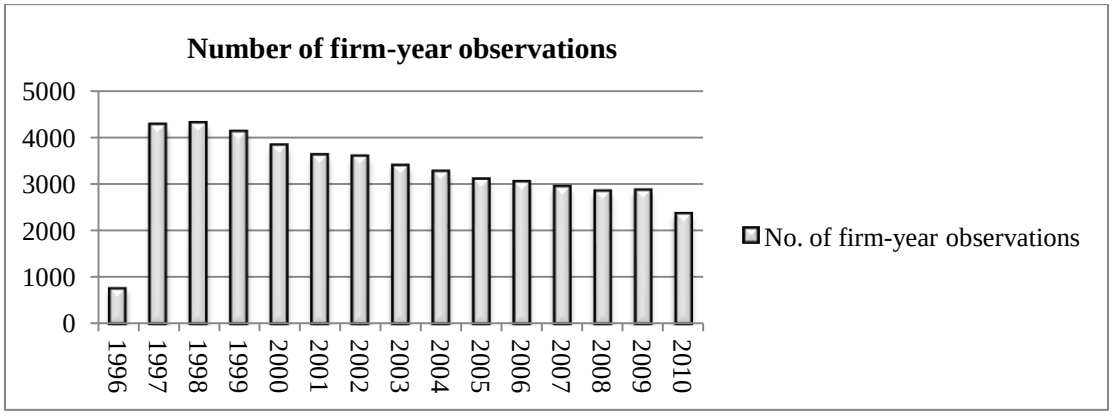
[55] Because Core et al. (2003) show that, although the explanatory power of their model and the precision of their tests is reduced, the tenor of the results is not affected by this deletion, this deletion seems appropriate.

[56] For example, a firm that was publicly traded from 2000 – 2005 but failed in 2006 is included in the sample.

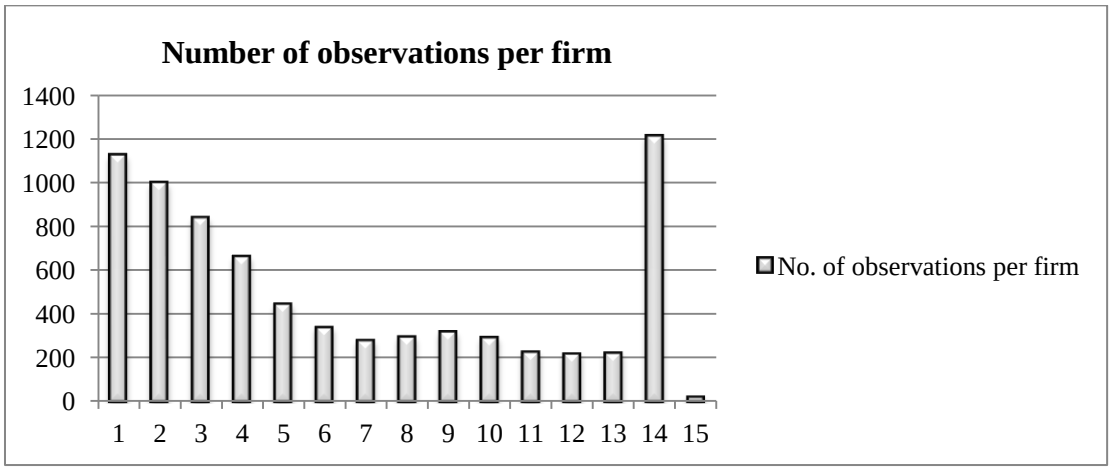
minor survivorship bias may occur due to this additional requirement. In appendix (**i**) an overview can be found with the results of the sample selection procedure. The selection procedure leaves a final sample of 48,122 observations.

6.2.2 Sample distribution

As shortly explained in chapter 5, the structure of the sample of this study is panel. Panel data comprises both time-series (years) and cross-sectional (firms) elements. A balanced panel has the same number of time-series observations for each cross-sectional unit while an unbalanced panel has a different number of observations for cross-sectional units due to missing observations (Brooks 2008). The dataset in this thesis is unbalanced because "surviving", "non-surviving" as well as "start-up firms' are part of the sample. Not all firms have thus observations during the whole sample period because firms did not yet exist for part of the sample period or were delisted during the sample period[57]. The graphs below show the panel structure.



Graph 1 Number of observations per sample year[58]

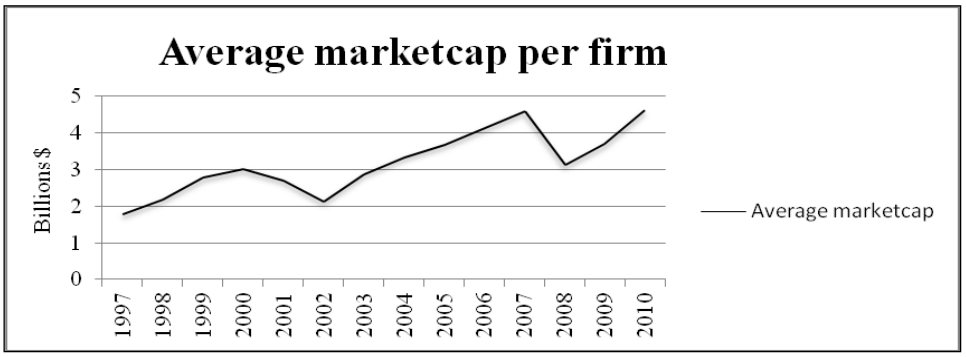


Graph 2 Total number of observations per firm

[57] There are various reasons that a firm can be delisted. Think of bankruptcy, mergers, acquisitions, taken a firm private, etc.

[58] The small number of observations in 1996, and accordingly the small number of firms that has 15 firm years of data available, is caused by the sample selection procedure: the sample is selected based on the date of the annual reports, starting on the first of January in 1995. Therefore, in the first year, there are observations for fiscal year 1994 for firms with fiscal year end in the beginning of the calendar year (until the 31th of May) while these observations are not available for firms reporting in the second part of the calendar year.

Both graphs reveal something about the panel structure of the sample. First, it can be inferred that the number of firm-year observations has decreased during the sample period (graph **1**). The dot-com crises (1998 – 2000), the consequences thereof and the financial crises (2007 – now) are probably to some extent the reason for this decline. Further, the pattern in the graph with the number of observations per firm indicates that there are relatively few firms that exist during the whole sample period. The number of operating firms in the market changes relatively quickly: about 1100 firms are present for only one year[59] and only 1214 firms exist during the whole sample period. Though the two periods of crises in the 20th century explain part of this variation, this is probably not the whole story. The substantial variation in the market can also be explained by the restructuring activities that have taken place in US markets over the past decades. To illustrate this point, graph **3** shows the average market capitalization[60] per firm for every sample year.



Graph 3 Average market capitalization per firm for each sample year

In contrast to the number of firms, which has strongly decreased during the sample period, the market capitalization per firm has substantially increased over time. Taken as a whole, the total market capitalization in 2010 (10,800 billion) is significantly higher than in 1997 (7,530 billion). These statistics suggest that the considerable variation in the number of operating firms per year is at least partially caused by the consolidation of industries and other restructuring activities. Overall, it can be concluded that the data is a highly unbalanced panel. There is great variation in the number of reporting firms per year (highest of 4233 in 1997 and lowest of 2334 in 2010) and the average number of firm year observations is five (the maximum number is 14 or 15, depending on the firm's fiscal year end). Due to these characteristics of the panel, most of the tests in this study are conducted without making use of the specific features of panel data[61].

[59] Firms reporting one year are firms that have actually three years of firm data available during the sample period. However, due to the requirement that at least two lagged years are available to calculate the trends in R&D reporting, two years of data are deleted from the sample (see section 6.2.1). The same line of reasoning applies to all other firm years.

[60] Marketcap is calculated as the price at fiscal year end multiplied by the common shares outstanding at fiscal year end.

[61] Overall, panel data are better suited to dynamic adjustment and to measuring effects that are undetectable in pure cross-sections or time-series data. By using panel data, one is better able to control for the effects of missing or unobserved variables represented by the disturbance term (Oliveira et al. 2010; Brooks 2008). Examples of panel data models are the fixed and random effects model. For the sensitivity checks (see section 6.4), a constant ("balanced") sample is constructed so the fixed effects model can be estimated.

6.2.3 Descriptive statistics

The final sample is thus a panel with 47,794 observations. To mitigate the influence of outliers, all (in)dependent variables (besides the indicator variables) are winsorized at the 1 percent and 99 percent levels by year. Also, R&D ratios are winsozired at the 1 and 99 percent levels by year because the average of this ratio is used in some regression models. Winsorizing of these variables prevents that the outcomes of the regression models are the result of some extreme values (Veenman 2011). The table below shows the means, medians, standard deviations and minimum and maximum values of all the variables of interest. All variables in the upper half of the table are deflated by average total assets. For all variables, values after winsorizing are displayed.

Table IV Descriptive statistics

Variables: Market value is the market capitalization of firm *i* three months after the end of fiscal year *t*, book value is common value of equity at the end of fiscal year *t*, earnings represents positive earnings at the end of fiscal year *t*, losses represents negative earnings at the end of fiscal year *t* and change in leverage is calculated as the change in financial leverage (long term debt plus debt in current liabilities divided by average total assets) in fiscal year *t*. All variables in the upper half of the table are scaled by average total assets. Special items represents special items as percent of earnings in fiscal year *t*, the index represents the percent of change of the S&P 500 composite index return three months after fiscal year end *t* and the R&D ratio represents R&D spending as percent of total assets in fiscal year *t*.

Variable	Mean	Median	St. dev.	Min.	Max.	Skewness	Kurtosis
Market value	1.5213	0.9551	1.7184	0.0537	9.3086	2.5390***	10.2940***
Book value	0.5360	0.5259	0.2456	0.0211	1.1230	0.1265***	2.427***
Earnings	0.07233	0.0579	0.0580	0.0000	0.3108	1.5509***	5.9870***
Losses	-.2106	-.1173	0.2369	-.9378	-.0001	-1.5320***	4.6595***
Δ Leverage	0.0050	0.0000	0.0916	-.8304	0.8589	0.9315***	12.8186***
Special items	0.0519	0.0000	0.9261	-4.456	3.8521	-.4611***	14.2798***
Market volatility index	1.1772	1.1694	0.1902	0.7351	1.5492	-.2611***	2.4946***
R&D ratio	0.0564	0.0000	0.1120	0.0000	0.6531	3.1228***	14.1242***

The table reveals that some variables are highly skewed, despite the winsorization. Especially the distribution of the variable "market value" differs in mean and median values, indicating that the distribution of this variable is far from normal. The distribution of all variables is tested for normality based on the skewedness and the kurtosis of the distribution. The skewedness measures whether the distribution trails off in one direction or another. A normal distribution has skewness zero. If the skewness is greater (lower) than zero, the distribution is positively (negatively) skewed. The skewed test for normality reveals that all variables have a skewed distribution (H_0 = skewness = zero, rejected for all variables at 1 percent significance level). The kurtosis measures how thick the tails of the distribution are. A normal distribution has a kurtosis of 3. A value beneath 3 means that the tails are too thick and a value of greater than 3 means that the tails are too thin. Just as by the skewed test for normality, the kurtosis test for normality indicates that the distribution of all variables is not normal (H_0 = kurtosis = 3, rejected for all variables at 1 percent significance level). Based on Brooks (2008), a

skewed distribution has little consequences for a large sample size and there are no special remedies[62] to correct for this problem besides removing outliers from the sample. Because further winsorizing and/or deletion of outliers will reduce the informativeness of the sample no further actions are undertaken[63]. Moreover, the influence of potential outliers is already mitigated by the use of a large sample (48,122 observations).

Next, the correlation between the variables is examined. Because the correlation is a measure of the association between two variables, the correlation matrix below gives a primarily (univariate) indication of the value relevance of the independent variables (Oliveira et al. 2010). Two types of correlations are displayed: Pearson's correlation coefficients which are based on actual values and Spearman's rank coefficient which are based on the ranks of the data. The underlying assumption for the Pearson's correlation coefficients is that the variables have a normal distribution, while for Spearman's correlations no such assumption is necessary (Heij et al. 2004). Because the distribution of all variables in the sample is non-normal, the Spearman correlation coefficients are leading in the interpretation. Table **V** shows the spearman correlation coefficients (above the diagonal) and the Pearson correlation coefficients (below the diagonal) for the pooled sample.

Table V Correlation matrix

Pearson/Spearman

	MV	BV	Earn	ΔLev	SPI
MV	1.0000	0.5340	0.3242	-.0916	-.1266
BV	0.4330	1.0000	0.2491	-.1134	-.0566
Earn	-.0537	0.1402	1.0000	-.0208	-.3174
ΔLev	-.0489	-.1437	-.1324	1.0000	.0729
SPI	-.0370	-.0301	-.0916	.0172	1.0000

The correlation matrix shows, in line with expectations, a strong positive correlation between book value and market value. The association between earnings and market value is less clear: the Spearman correlation and Pearson correlation differ both in sign and magnitude. This dissimilarity is caused by the non-linearity of earnings. As explained in chapter 5, prior research has shown that there is a non-linear relationship between market value and earnings due to losses. For this reason, the dummy variable for losses and the interaction term are added to the price value relevance models. For the relation between earnings and prices, the Spearman coefficient, which does not assume linearity, provides thus a more reliable measure. Changes in leverage and special items are, as expected, negatively related to market value. Furthermore, the association between all independent variables is far below 0.8 (0.8 is often considered as a critical value, see e.g. Lewis-Back 1993). There is at first sight thus no reason to be concerned that there is a problem of multicollinearity.

[62] A common solution is the use of logarithmic regressions. However, because some of the variables (especially earnings, which is a core variable in the analysis) have a negative sign, this solution is not feasible.

[63] In case of concerns about normality, robust regressions can be estimated for which the standard errors do not assume normality. This solution, which also resolves heteroskedasticity problems, will be discussed in more detail in section 6.3.

6.3 Empirical results

6.3.1 Hypothesis I and II

Recall the first hypothesis: *"the value relevance of financial information to investors is lower for firms that rely more heavily on unrecorded intangible assets than for firms that rely less heavily on unrecorded intangible assets".* To explore differences in value relevance between firms that are more or less likely to have high amounts of unrecorded intangible assets, the basic price value relevance model is estimated for different subsamples and portfolios. As explained in chapter 5, the subsamples based on the industry classification and the portfolios based on the level of R&D spending try to capture the extent to which firms are likely to have significant unrecorded intangible assets. In addition, the subsamples based on both the level and change in R&D spending are formed to test the conjecture of Lev and Zarowin (1999) that only increasing R&D spending results in a lower value relevance.

Before running the regression models with the subsamples based on the "high-tech" and "low-tech" industries, there needs to be checked whether the industry classification captures the construct of intangible intensity. The results of this check can be found in appendix (**ii**). Firms in the "high-tech" sample spent on average 14,84 % of total assets in R&D whereas firms in the "low-tech" sample spent 2,39% (total sample 6,23%). Also, the average market-to-book ratio is approximately 4 for firms in the "high-tech" sample and around 2,5 for firms in the "low-tech" sample. A simple t-test confirms that the ratios differ significantly between the two types of firms, corroborating the feasibility of the division of the sample.

Also, there is determined whether the fundamental assumptions underlying the ordinary least square (OLS) regression model hold. The two most important conjectures are the assumption of homoscedasticity (the variance of the error terms is constant) and lack of correlation (the errors are uncorrelated with each other, either cross-sectionaly or over time) (Brooks 2008). Violation of these assumptions does not affect the coefficients of the regression model (the coefficient estimates are still unbiased), but they are inefficient (the standard error estimates could be wrong). Positive serial correlation in the residuals results in overstated t-statistics, leading in too many cases to the conclusion that the explanatory variable is an important determinant of variation in the dependent variable, i.e. is statistically significant. Moreover, if positive autocorrelation is present, the true error variance is underestimated which results in inflated R-squares. Hence any inferences made based upon test statistics that suffer from serial correlation and/or hetereoskedasticity could be misleading (Heij et al. 2004). Tests are conducted to detect whether the error terms are heteroskedastic and/or correlated. The results (see appendix **iii**) reveal that the error terms are both heteroskedastic and highly correlated. To

gather more efficient estimates, all regressions are carried out with robust standard errors clustered by firm[64]. The results of this approach are tabulated in table **VI.**

Table VI Equation: $MVit = \alpha_0 + \alpha_1 BV_{it} + \alpha_2 E_{it} + \alpha_3 DL_{it} + \alpha_4 IA_{it} + \varepsilon_{it}$

Coefficients and adjusted R^2s from price value relevance regressions estimated for the whole sample and different subsamples or portfolios. The first measure for intangible intensity is based on the industry classification of Francis and Schipper (1999). Firms are classified as "high-tech" or "low-tech" based upon the industry they belong to. The second measure is based on R&D spending as percent of total assets. The first percile covers the firms with zero spending on R&D and the tenth percile covers firms with the highest R&D spending as percent of total assets. The third measure is based on both the level and change in R&D ratios: the subsamples consist subsequently of firms (I) with low, decreasing R&D spending (<0.01 % total assets), (II) low and increasing R&D spending, (III) high and decreasing R&D spending (IV) high and increasing R&D spending[65]. All regressions are performed with robust standard errors clustered by firm. ***, ** and * indicate that the coefficients are significantly different from zero at the 1%, 5% and 10% level, respectively.

	NO #	α_0	$\alpha_1 BV_{it}$	$\alpha_2 E_{it}$	$\alpha_3 DL_{it}$	$\alpha_4 IA_i$	Adj. R^2
Pooled	48,122	-.5791***	2.2870***	11.7376***	0.3198***	-14.6039***	33,32
Industry-based classification							
High-tech sample	33,937	-.3821***	1.7305***	11.5597***	0.2304***	-14.2448***	36,56
Low-tech sample	14,185	-.5794***	2.7576***	12.3883***	0.3299***	-15.0617***	24,94
R&D ratios (level)							
Percile 1 - 5	24,242	-.2814***	1.3685***	12.1285***	0.2398***	-13.7068***	40,39
Percile 6	4,632	-.1997***	1.4665***	10.2936***	0.2109***	-12.2293***	37,60
Percile 7	4,812	-.3607***	1.6859***	13.6118***	0.3186***	-15.4112***	37,51
Percile 8	4,812	-.3632***	2.2712***	12.4469***	0.2408***	-14.0192***	27,58
Percile 9	4,812	-.1756	2.3817***	13.0945***	0.2973***	-14.5557***	22,44
Percile 10	4,812	-.1113	3.3054***	8.2379***	0.0186	-10.6378***	17,21
R&D ratios(level and change)							
Subsample I	25,899	-.2778***	1,3884***	11.9434***	.2382***	-13.5191***	40,04
Subsample II	1,146	-.1667*	1,5788***	8.5319***	.1388*	-9.6786***	41,78
Subsample III	9,712	-.4880***	2.6042***	11.4822***	0.3775***	-14.9792***	28,38
Subsample IV	11,365	-.6031***	2.4295***	13.5939***	0.4167***	-16.1556***	22,94

The table reveals that earnings and book value are value relevant to investors. The pooled regression results in an R^2 of 33,32 percent, indicating that book value and earnings (when there is separately controlled for losses) are able to explain 33,32 percent of the variation in equity market value[66]. All coefficients in the pooled regression are significant at the 1 percent level. The high coefficient on earnings is noteworthy. The coefficient indicates that, holding all else constant, a dollar change in earnings is associated with an increase in market value of approximately 11.5 dollar. The

[64] These standard errors are thus corrected for both heteroskedasticity and cross-sectional correlation (Veenman 2011). Also, the potential problems due to the non-normality of the distribution are mitigated because robust regressions have standard errors that do not assume normality and equal variances.

[65] The average trend in R&D ratios is for both groups (increasing and steady/decreasing significantly different from zero). Therefore, the groups are named "increasing" and "decreasing".

[66] The measures (R^2) for value relevance are considerably lower than the measures of most other US studies considering comparable subjects (see e.g. Lev and Zarowin 1999, Francis and Schipper 1999 and Balachandran and Mohanram 2011). These differences are likely caused by the use of average total assets as a proxy for firm size instead of the use of per share values. To confirm this belief, all regressions in this section are also estimated with per share values (instead of variables scaled by average total assets). The R-squares of these regressions are considerably higher (around 50 – 70 percent, depending on the model used). However, because regressions with per share values are likely biased upwards (see chapter 4 and 5), the regressions estimated with the values scaled by average total assets are preferred. The estimated R^2s are in line with the study of Core et al. (2003), who use book values as deflator in their regression models.

magnitude of the coefficient seems a bit suspicious. To check whether the results depend on the selected scaling factor (total average assets), the regressions are carried out with total assets or book value as deflators[67]. These regressions (not tabulated) confirm the findings on the coefficients exhibited in table **VI**. Moreover, the coefficients on earnings estimated in studies concerning related subjects are along the same line. Core et al. (2003) report on average a coefficient of 9.58 on earnings, Morris and Alam (2012) report coefficients between 10.935 and 11.078 and also Collins et al. (1997) find coefficients on earnings around 8.5. Since these studies use other scaling proxies to correct for differences in firm size (book values and per share values, respectively) than this study, it is unlikely that the findings are biased due to the selected scale proxy. In addition, the similar results of other studies indicate that the estimates of the regressions are not caused by modeling errors. However, the extent to which earnings and market value are associated is remarkable. A potential explanation for the strong association between earnings and market value is that earnings are correlated with an unobserved variable that is also positively associated with equity market value. The coefficient estimates on earnings are then positively biased.

There can also be derived from the table that the relevance of earnings is higher (measured by the magnitude of the coefficient) than the relevance of book value. This is in line with the expectations since earnings are included in the model to provide information about a firm's future performances whereas book value proxies for the firm's current value (Canibano et al. 2000). It is thus expected that earnings and book value fulfill a different role in equity valuation. The coefficient on DL denotes the difference in intercept (+ 0.3189) for firms reporting losses. The significance of this coefficient confirms the importance of this additional intercept. The intercept for "loss firms" is thus -.2593 instead of -.5791 (intercept for firms with positive earnings). The coefficient on the interaction term (dummylosses * earnings)[68] measures the difference in earnings' slope for profit and loss firms. The negative coefficient on IA indicates that the slope of earnings for loss firms is substantially lower. The association (slope) between market value and earnings is -2.87 when firms report losses rather than positive earnings[69]. Although these findings confirm the non-linear relation between earnings and losses, the results are somewhat surprising. The negative coefficient on losses indicates that, holding everything else constant, stock prices reflect the expectation of investors that large losses are followed by higher future cash flows (indicated by the higher price of equity market value) than small losses[70]. Though these findings seem rather counterintuitive, it is consistent with prior research (see e.g. Collins et al. 1997 and Core et al. 2003). There is often referred to the transitory nature of losses as explanation for the negative relation between losses and equity market value (Hayn 1996). Though the omission of an unobserved, correlated variable (for instance, exceptional high expenditures on R&D

[67] The danger of using a single-variable scaling factor is that the scaling by itself induces a bias.
[68] Recall that both an indicator variable and interaction term are included in the model so both the level and slope of loss firms are allowed to differ.
[69] The same result can be obtained by performing regressions separately for the "loss sample" and "profit sample". The coefficient on "earnings" is then around -2.87 and 11.8, respectively.
[70] Two negatives yields a positive.

or other growth related items in loss years) might also be a reasonable explanation (Collins et al. 1999).

Then the real question of interest. Confirming the first hypothesis, the evidence suggests that there is a substantial difference in value relevance, measured by the R^2s, between firms that are likely to have high amounts of unrecorded intangible assets and firms that rely more on tangible capital. The difference in R^2s between the subsamples (portfolios) reveals that the explanatory power is substantially lower (higher) for the subsamples (portfolios) that contain the intangible-intensive firms. Especially the regressions with the ten deciles show great differences in R^2s: for firms with zero R&D spending, 40,39 % of the variation in equity market value is explained by earnings (losses) and book value, whereas for firms with the highest R&D spending as percent of total assets the accounting numbers are only able to explain 17,21 % of the variation in equity market value. Regressions of the R^2s of the different subsamples (portfolios) on the "groups" (subsamples or portfolios) confirm that the R^2s differ significantly across the groups (appendix **iv**[71]) and the negative trends confirm the negative relation between firms being intangible-intensive and value relevance.

Note that the findings of this test are not fully in line with the argument of Lev and Zarowin (1999). They argue that earnings are invariant to the accounting treatment of intangibles if spending on intangibles is in "a steady state". Building upon this argument, they expect only differences in value relevance if firms have a changing investment ratio in R&D. The findings for the subsamples (I to IV) do not confirm this argument. The value relevance of combined earnings and book value is substantially lower for firms in the "high spending" groups than for firms in the "low spending" groups, despite whether or not the investment ratio is increasing. Moreover, the value relevance for the "low and increasing" subsample is slightly higher than the value relevance for the "low and decreasing" sample. The difference in R^2s between the two samples with high R&D spending is significant, but it is also possible that firms in the "high and increasing" group have on average higher unrecorded intangible assets than firms in the "high and decreasing group"[72], due to the increasing investment rate in R&D. There are two alternative explanations for these findings. First, the "steady state" argument does not hold, so earnings are not invariant to the accounting treatment. Secondly, the possibility exists that intangible-intensive firms are valued in a different manner than their non-intangible-intensive counterparts, despite the current (increasing or decreasing) investment rate in R&D.

Next, the second hypothesis "*the difference in value relevance between intangible-intensive and non-intangible-intensive firms cannot be explained by observable variables, other than the presence of high unrecorded intangible assets*" is addressed. Section 5.3 has identified two factors that are likely to influence the two types of firms in a dissimilar manner. If there is not properly controlled for these

[71] The R^2s of the subsamples based on the industry classification are not regressed on the subsamples because there are only two groups.
[72] A comparison of the means of the R&D ratios for both subsamples (see table VII) confirms this suggestion.

factors, the results may be biased towards the conclusion that the value relevance of financial information for intangible-intensive and non-intangible-intensive firms differs significantly due to the intangible intensity of firms, while it is not the intangible intensity and the corresponding accounting problems that cause these differences, but other firm (or industry) specific characteristics. The table below shows the means of several variables for the four subsamples based on both the level and change in R&D. The subsamples based on the industry classification (appendix **v**) and the portfolios based on the level of R&D spending (not tabulated) show a similar construct. These values give a primarily indication whether differences in value relevance between the two types of firms are likely to be caused by differences in these items.

Table VII

Comparison of mean values[73] for the four subsamples based on the level and change in R&D spending as percent of total assets. For all variables besides Δ leverage, the H_0 of equal means is rejected at the 1 % level (one-way anova test). For Δ leverage there is no indication for a significant difference between groups.

Variable	Low and decreasing	Low and increasing	High and decreasing	High and Increasing
Observations	25,899	1,146	9,712	11,365
Market value	1.0782	1.1050	2.2667	1.9360
Book value	0.4786	0.4816	0.6421	0.5818
Earnings	0.0164	0.0270	-.0253	-.1231
R&D ratio	0.0030	0.0054	0.0989	0.1694
Market-to-book ratio	2.4329	2.4642	3.8837	3.7462
Δ Leverage	0.0052	-.0000	0.0047	0.0050
Special items	0.0496	0.0308	0.0232	0.0840

The table reveals that, on average, firms with high R&D spending report losses rather than positive earnings. Also, there can be inferred that, on average, firms with increasing R&D spending report more often special items than their counterparts with decreasing R&D spending. Further, it is noteworthy that firms with high R&D spending have on average higher book values than firms with low R&D spending. The difference can partly be explained by the recorded intangible assets of these firms (after correcting for intangibles, the difference is .10 lower). Last, the difference in average market-to-book ratios between the subsamples with low and high spending of R&D confirms that the subsamples likely capture the construct of unrecorded intangible assets[74].

To assess whether differences in the explanatory power of the price model for intangible-intensive and non-intangible-intensive firms can be explained by differences in reporting on special items and/or

[73] Note that the tabulated market value divided by book value does not result in the tabulated market-to-book ratio. The variable "market value" in the table is based on the mean scaled market capitalization three months after fiscal year end, whereas the market-to-book ratio is calculated with the mean market capitalization at fiscal year end.

[74] Though it is common knowledge that the difference between the market and book value of a company consists of more than just unrecorded intangible capital, the market-to-book ratio gives an indication of the intangible-intensity of firms. In the accounting literature there is widely presumed that a large part of the difference between market value and book value of a firm can be explained by intangible capital. Amir and Lev (1996) illustrate this point by showing that the median market-to-book ratio of US cellular companies, which is considered an intangible-intensive industry, equals 12. That is more than five times the corresponding ratio of industrial companies.

changes in financial leverage, the price regressions are carried out with these control variables. Also, the time effects are included in the model to control for external influences affecting value relevance. The results are tabulated in appendix **(vi).** Though the pattern of the R^2s follows the same construct, the differences between intangible-intensive and non-intangible-intensive firms in terms of value relevance are much smaller than the differences reported in table 6. For example, the R^2 of portfolio 1 is now 42,44 (formerly 40,39) and the R^2 of portfolio 10 is now 27,84 (formerly 17,21). Similar results are obtained for the subsamples based on the industry classification and the subsamples based on the level and change in R&D spending. The variation in the results of the two types of models is mainly caused by the year dummies. The year dummies are statistically significant in almost all sample years. In addition, the coefficients on the dummies shows that they have real economic implications. The great importance of the year dummies can likely partly be contributed to the two periods of crisis throughout the sample period: the dot-com crisis in 1998 – 2000 and the financial crisis (2007 – now). Also, the year dummies may pick up inflation. The impact of the other two control variables (special items and change in leverage) seems limited. Only the variable "special items" is significant for all subgroups and there are no great differences between groups (looking at the coefficients) in the extent to which special items are relevant. Though there can be inferred that reporting of special items affects to a greater extent intangible-intensive firms. Overall, the R^2s of the models are still lower for the intangible-intensive subsamples (portfolios) than for the non-intangible-intensive subsamples. Regressing of the R^2s of the different subsamples (portfolios) on the "groups" (subsamples or portfolios) confirms that the R^2s differ significantly across the groups (appendix **vii**).

Altogether, the results in this section point towards the conclusion that the value relevance of financial information is significantly lower for firms that rely more heavily on intangible assets than for firms that rely more on tangible capital. The findings hold when the control variables for changes in leverage, special items and time are included in the model. The first two hypotheses are thus confirmed.

6.3.2 Hypothesis III

Recall the third hypothesis: "*the association between the fundamental accounting numbers and equity market value is lower for firms that rely more heavily on intangible assets than for firms that rely less heavily on intangible assets*". The question of interest is thus not whether the R^2s of the price value relevance model differ for intangible-intensive and non-intangible-intensive firms, but whether the association between the accounting numbers and equity market value (measured by the magnitude of the slope of the coefficient on earnings and book values) differ significantly.

Before the second approach is applied, the results of the price value relevance models for the different subsamples (portfolios) tabulated in table **VI** are examined from a different point of view. If you take a closer look at the coefficients on earnings and book values reported in the table, the results seem to contradict the findings on the R^2s. While the R^2s show a declining pattern, the coefficients on

both book values and earnings (losses) shift in the opposite direction. For all three subsamples (portfolios), the association between book values and market value is considerably higher for firms that are in the intangible-intensive subsamples than for firms that are in the subsamples which are not determined intangible-intensive. Moreover, the extent to which earnings and equity market value are associated seems to shift in the same direction, although the pattern is in this respect less clear (the coefficients on earnings in the 10th percile and 3th subsample are inconsistent with the view that the association between earnings and market equity value is higher for firms that rely more heavily on intangible capital).

The higher coefficients on book values for the intangible-intensive subsamples seem surprisingly at first. After all, a major motivation for this study is the concern that financial statements fail to provide a true and fair view on the firm's current performance (represented by a firm's book value) in the presence of high unrecorded intangible assets. An explanation for the high coefficients might be that intangible-intensive firms report more frequently losses and other non-recurring items. Collins et al. (1997) document that in the presence of high losses or other non-recurring items, the value relevance of book values (earnings) increases (decreases). According to them, the role of book values is under such circumstances twofold: book value provides information about both future performances and the abandonment/liquidation option (the abandonment option becomes more relevant when firms report losses or are in financial distress). Table **VII** shows that firms in the intangible-intensive subsamples report on average losses (instead of positive earnings). Moreover, on average, intangible-intensive firms report higher special items. These sample characteristics are thus consistent with the explanation of Collins et al. (1997).

The higher coefficient on earnings for intangible-intensive firms can be explained by the fundamental role of earnings in equity valuation: earnings are intended to reflect future value, generated by both recognized and unrecognized intangible assets. Because the future profits of intangible-intensive firms likely depend on investments in (internally generated) intangible assets (which are generally not reflected in the balance sheet) rather than on investments in tangible capital, earnings are the primary source of information about a firm's performance for intangible-intensive firms. The foregoing arguments may seem to contradict each other at first. However, the results of the regressions are not based on an individual level but on pooled level. Therefore, it is possible that the arguments regarding the relation between non-recurring items and the higher value relevance of book values hold for some firms in the intangible-intensive sample, while for other intangible-intensive firms the value relevance of earnings is higher due to the superior role of earnings in equity valuation.

The results discussed thus far provide only indirect evidence on the differences in coefficients on earnings and book values for intangible-intensive and non-intangible-intensive firms. The table below shows the results of the price regression model constructed to assess differences in the coefficients directly.

Table VIII Equation: $MV_{it} = \alpha_0 + \alpha_1 BV_{it} + \alpha_2 DH*BV_{it} + \alpha_3 E_{it} + \alpha_4 DH*E_{it} + \alpha_4 DL_{it} + \alpha_5 DH* DL_{it} + \alpha_6 IA_{it} + \alpha_7 DH*IA_{it} + \varepsilon_{it}$

Price value relevance regression model with indicator variables for intangible-intensive firms (DH). Three indicator variables are used: an indicator variable based on (a) the industry classification (1 is high-tech and 0 is low-tech), (b) the level of R&D spending (1 is R&D ratio $\geq$ 1, 0 otherwise) and (c) the change in R&D spending (1 is increasing rate, 0 is decreasing). For all variables, interaction terms are included in the model. Regressions are performed with robust standard errors clustered by firm. ***, ** and * indicate that the difference is significantly different from zero at the 1%, 5% or 10 % levels, respectively.

Variables	Model 1 Industry classification	Model 2 Level of R&D spending	Model 3 Change in R&D spending
Intercept	-.38199***	-3832***	-.5538***
Book value	1.7305***	1.3967***	2.1969***
Interaction term (DH *BV)	1.0271***	1.1907***	.2008**
Earnings	11.5597***	11.7631***	11.5259***
Interaction term (DH*E)	.8285	.55179	1.2892***
Losses	.2304***	.2323***	.2660***
Interaction term (DH * DL)	0.0995	.1455***	.1204***
Interaction term (DL * E)	-14.23384***	-13.3360***	-14.6688***
Interaction term (DH * IA)	0.8168	-.1751**	-.7316
Dummy DH	-.9751***	-.3014***	-.0203
NO # observations	48,122	48,122	48,122
Adj. R^2	35,25	35,90	33,56

The significant coefficient on the interaction term "DH * BV" for the subsamples based on intangible intensity (model 1 and 2) suggests that, holding everything else equal, the slope on book value is 1.0271 (1.1907) higher for intangible-intensive firms than for non-intangible-intensive counterparts. This finding verifies thus the results on the coefficients reported in table **VI**. The interaction terms on losses and the interaction term for losses are both significant in the second model, indicating that also the intercept and slope for losses differ for intangible-intensive and non-intangible-intensive firms, although to a limited extent. Model 3, which is based on changes in R&D rather than on the level of R&D spending, yields somewhat dissimilar results. The coefficient on book value is higher than in the other two models and the coefficient on the interaction term (DH *BV) indicates that the slope on book values for firms with increasing R&D spending differs significantly from the slope of firms with decreasing R&D spending, but the difference is only 0.2008. The difference between the results of model 1,2 and 3 in this respect is likely attributable to the fact that the group with decreasing R&D spending encompasses a great portion of the intangible-intensive firms in the sample. Further, the significant, positive coefficient on the interaction term "DH*DL" in model 3 indicates that earnings have a higher association with equity market value if R&D spending is increasing. This finding confirms the widely held assumption that earnings are better able to reflect future performances of firms which growth potential strongly depends on internally generated intangible assets.

The results obtained alter somewhat if there is controlled for special items, changes in leverage and time effects (Appendix **viii**). The differences in coefficients on book values between intangible-intensive and non-intangible-intensive firms are in all three regression models substantially lower, though still significant. Moreover, the other interaction effects with the "intangible intensity dummy" render almost all insignificant. Further, it can be inferred that special items are negatively associated with equity market value. The coefficient on the interaction term (DH * SI) is significant and negative in all three models, indicating that the value relevance of intangible-intensive firms is to a greater extent affected by the reporting of special items than the value relevance of non-intangible-intensive firms. The coefficient on change in leverage is negative, but is only significant in the second model. Just as under method 1, most of the variation in the results between the models with and without the control variables can be contributed to the impact of the year dummies. The coefficients on the year dummies are most pronounced in the years "1999", "2002" and "2008", suggesting that the dummies capture the impact of the dot-com crisis and the financial crisis.

Hence the results of the adjusted price value relevance model support the findings of the regressions tabulated in table **VI**. The following conclusions can be drawn from these findings. The overall ability of earnings and book value to explain market value is lower for intangible-intensive than for non-intangible-intensive firms. However, the association between book value and equity market value is significantly higher for intangible-intensive firms than for firms that are assumed to rely more on tangible capital. The extent to which earnings and market value are associated seems not to differ between the two types of firms. Though controlling for special items, leverage and time partly offsets the significant differences in the coefficients on the fundamental accounting numbers for intangible-intensive and non-intangible-intensive firms, there is still no sign that the coefficient on book values and/or earnings is smaller for the former type.

It can be concluded that the lower explanatory power of the price value relevance model for the intangible-intensive subsamples does not appear to be due to a lower association between market value and the fundamental accounting variables, but due to the greater variation in market value remaining unexplained by the model. See also Core et al. (2003), who obtain similar results, although their research question and corresponding research design differs. As explained in the literature review, there are several explanations for differences in the R^2s of a regression model because the R^2 is a relative measure. First, it is possible that the R^2 is lower for intangible-intensive firms due to higher variability in stock prices. In a discussion of a somewhat similar topic[75], Kothari and Shanken (2003) argue that a firm's large growth opportunities may contribute to the lower explanatory power of price value relevance models because prices are forward looking and historical cost financial numbers do not reflect the consequences of changing expectations of growth in current financial statements. It is plausible that intangible-intensive firms have higher growth expectations than non-intangible-intensive

[75] Korthari and Shanken (2003) discuss the findings of Core et al. (2003), who document a decline in value relevance during the "new economy period".

firms, which increases the variability of prices and accordingly lowers the explanatory power of the price model[76]. An alternative explanation is offered by Dontoh et al. (2004). They argue that the "noise" injected into stock prices by non-information-based trading reduces the R^2s of the regression models. Moreover, they find that the impact of non-information-based is more pronounced for intangible-intensive firms than for their non-intangible-intensive counterparts. Non-information-based trading may thus explain part of the difference in the ability of the fundamental accounting numbers to explain equity market value between two types of firms. Further, the lower explanatory power of the price value relevance model for the intangible-intensive firms might also be caused by one or more unobserved, uncorrelated variables. Examples include R&D spending, spending on advertisement and other intangible assets or an omitted variable that would explain the variation in market value due to anticipated components of future profits (the "price leads earnings assumption", Kothari and Zimmerman 1995, see also chapter 2 and 5). Also, lower quality of earnings (earnings contain more "noise") reported by intangible-intensive firms might also be an explanation (Morris and Alam 2010).

Overall, the evidence supports thus not the conclusion that the association between equity market value and the fundamental accounting variables is lower for intangible-intensive than for non-intangible-intensive firms. The third hypothesis can therefore not be confirmed.

6.3.3 Hypothesis IV

Testing of hypothesis IV, *"the growing importance of intangible assets is related to the declining value relevance in the US",* requires four steps. Consecutively, there needs to be determined (a) how the value relevance of financial information has changed over time, (b) if there is a significant trend in the change in value relevance (c) if intangible assets are increasingly important for firms and (d) whether there is a relation between the trend in value relevance and the growing importance of intangible assets. The basic price value relevance model is estimated for all sample years to determine the intertemporal changes in value relevance. The trend in value relevance over time can then be found by regressing the adjusted R^2s of the price model on a time trend (T). The estimated models and corresponding results can be found in table **IX**.

Contrasting my expectations, the sign of the (initial) time trend is positive. The significant trend indicates that value relevance (measured by the. R^2s) has slightly increased over time. Prior US research concerning sample periods between 1970 and 2004 generally document a decrease in value relevance over time. These opposing results are likely caused by heterogeneity in the sample periods. Table **IX** shows that value relevance has strongly declined in the period around the dot-com crisis (1998 – 2002). Because most studies concerning related objects study samples based on financial data

[76] Note that the year dummies only account for factors that affect all firms in the sample in the same way but varies across time. There is thus not accounted for (individual) stock price volatility of firms in the model.

until 2000 (with an exception for Balachandran and Mohanram 2011, they study the period 1975 – 2004) instead of 2010, the trend in R^2s is different[77].

Table IX $MV_{it} = \alpha_0 + \alpha_1 BV_{it} + \alpha_2 E_{it} + \alpha_3 DL_{it} + \alpha_4 IA_{it} + \varepsilon_{it}$

$R_t^2 = \varphi_0 + \varphi_1 T_t + \varepsilon_t$

The price value relevance regression model is estimated for all years in the sample period. Then, a time trend regression is carried out, with the R^2s of the years as the dependent variable and time as independent variable. All regressions are performed with robust standard errors. ***, ** and * indicate that the difference is significantly different from zero at the 1%, 5% or 10 % levels, respectively.

	No # firms	Adj. R^2
1996	749	38,22
1997	4,255	37,61
1998	4.280	29,63
1999	4,101	40,75
2000	3,812	32,79
2001	3,605	33,14
2002	3,581	32,84
2003	3,378	44,02
2004	3,235	41,53
2005	3,092	29,28
2006	3,034	39,03
2007	2,930	34,50
2008	2,835	30,19
2009	2,858	40,48
2010	2,349	35,12
Trend	0.0014***	

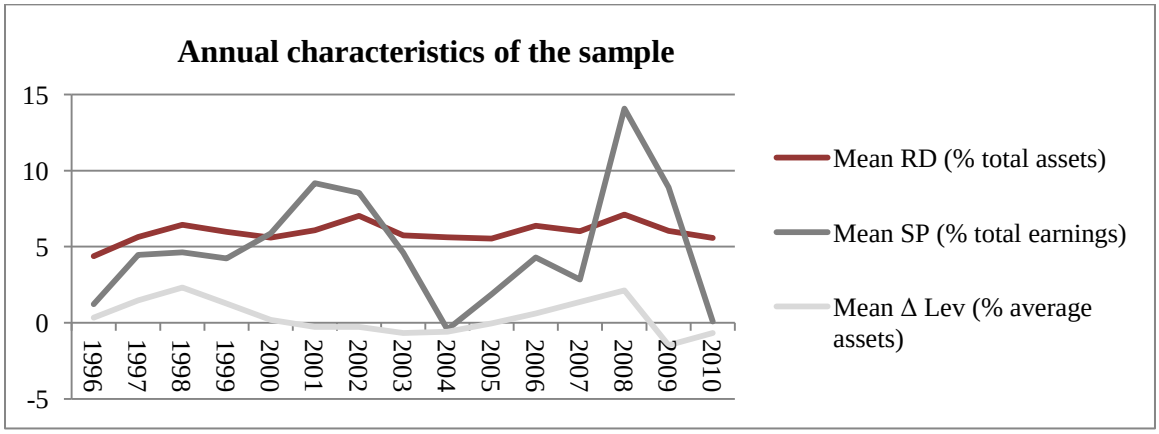
Even though value relevance has slightly increased over time, it cannot be ruled out that there is a negative relation between the intangible intensity in the sample across time and value relevance. The R^2s tabulated in table **IX** reveal no clear pattern and while the time trend is statistically significant, the coefficient is very small, indicating that it has trivial meaning. The possibility exists that intertemporal changes in value relevance across time can be explained by differences in intangible intensity across time. This theory can be tested by performing a time trend regression including a measure for the intangible intensity in each sample year. As proxy for the annual intangible intensity in the sample, the mean value of R&D spending as percent of total assets of all sample firms in year (t) is included in the model. To prevent that the results are driven by other factors than the intangible intensity, other yearly characteristics of the sample are added the model.[78] The control variables in the model are "special

[77] In a somewhat related study, Morris and Alam (2012) also report that value relevance has strongly declined around the dot-com crises, but reversed course and increased following the collapse of the bubble. These results are thus in line with the findings of this study.

[78] The results with this proxy for intangible intensity provide only information about the impact of the intangible intensity per firm, not for the economy as a whole (i.e. the impact of both the increasing intangible intensity per firm and increasing percentage of intangible-intensive firms). Because the number of intangible-intensive firms has stayed relatively constant

items" (the mean value of special items as percent of earnings in year t), "change in leverage" (the mean value of changes in leverage as percent of total average assets in year t), an indicator variable for the bubble period (which equals one in the years 1998, 1999 and 2000) and an index for market volatility.

Before going to the results of the second time trend regression model, there needs to be checked whether R&D spending, reporting on special items and changes in leverage vary across time (graph 4). After all, if these items are constant over time, it is highly unlikely that they are responsible for intertemporal changes in value relevance. The trend in R&D spending is, as expected, small but positive[79]. In the years 1998, 2002 and 2008, three peaks are visible. The pattern of reporting on special items is highly unstable and seems related to the dot-com crisis and the financial crisis. Both in 2000 – 2002 and 2007 – 2009, reporting on special items has increased significantly. The increasing changes in leverage can be explained by the excessive borrowing of firms in the periods prior to the bubble burst (1996 – 1998) and the credit crisis (2004 – 2008). The declining pattern in between is likely caused by the tight credit markets as a results of the bubble burst.



Graph 4 Temporal pattern of means R&D spending, Special Items and Δ in leverage

Graph 4 reveals that the items of interest vary significantly across time. Now there can be tested whether changes in the explanatory power of the price value relevance model across time can be explained by changes in the mean ratios of R&D spending, reporting on special items or changes in leverage. The indicator variable for the dot-com bubble and the index for market volatility prevent that the results are driven by the dissimilar behavior of the stock market during the bubble burst or by increasing (or decreasing) market volatility over time. Table **X** tabulates the results of the time trend regressions. The control variables are one by one added to the model (model 1 to 5) so the impact of the control variables can be appreciated individually.

over time (45 % of the whole sample is "intangible-intensive", i.e. R&D spending as percent of Total assets > 0.01), there is decided to use a proxy that only captures the average change in R&D spending per firm.

[79] A regression with the mean annual values of R&D spending as percent of Total assets as dependent variable and time (years) as independent variable confirms that the trend is significant at the one percent level.

Table X Equation: $R_t^2 = \varphi_0 + \varphi_1 T_t + \varphi_2 M_t + \varphi_3 Bubble_t + \varphi_4 V_t + \varphi_5 L + \varphi_6 SI_t + \varepsilon_t$

Time trend regression with the R^2s of the different years as the dependent variable and the time trend (t) and various year characteristics of the sample, an indicator variable for the dot-com crisis (equals one in the years 1998, 1999 and 2000 and zero otherwise) and an index (V) which represents a proxy for market volatility as dependent variable. Regressions are performed with robust standard errors. ***, ** and * indicate that the difference is significantly different from zero at the 1%, 5% or 10 % levels, respectively.

	Model 1	Model 2	Model 3	Model 4	Model 5
Intercept	-4.27***	-4.92***	-2.712***	1.9978***	1.3451***
Time (T)	.0024***	0.0027***	.0014***	-.0000***	-.0004***
Intangible assets (M)	-4.619***	-5.089***	-4.1669***	-2.4303***	-1.6445***
Dummy Bubble		-0.014***	-.0322***	-.0260***	-.02245***
Market volatility (V)			.0065***	.0088***	.0067***
Δ Leverage (Δ L)				-1.7685***	-1.7800***
Special items (SI)					-.2338***
Adj. R^2	31,78	40,02	44,93	55,84	57,15

The coefficient on intangible assets (M) is in all models significant and negative, indicating that an increasing intangible intensity in the sample reduces the overall ability of earnings and book values to explain equity market value. The control variables "special items" and "change in leverage" are significant and negative. Moreover, both variables reduce the coefficient on M substantially. These findings imply two things. First, reporting on special items and changes in leverage have, as expected, both a negative impact on the explanatory power of the price value relevance model. Moreover, on average, a higher intangible intensity is in one way or another correlated with the reporting of higher special items and also greater changes in leverage[80]. A simple spearman correlation matrix (not tabulated) confirms these findings. However, based on the results of these simple models it is not possible to determine the cause for this correlation (is the intangible intensity associated with the reporting of higher special items or are both items associated with the same third factor, for instance, macroeconomic events?). This question is beyond the scope of this research and remains thus unanswered.

Nonetheless, the findings provide an answer to the third question of interest: "*is there a relation between the growing importance of intangible assets and the declining trend in value relevance?"* The simple answer is no. The value relevance of financial information has increased during the sample period. Hypothesis IV can thus not be confirmed. However, it can be inferred that there is a negative relation between intertemporal changes in value relevance across time and the intangible intensity in the sample. These findings confirm thus the negative relation between the intangible intensity of firms and value relevance.

An additional note should be made regarding the findings of the first time trend regression. The inconsistency of the results with reported findings of previous studies, such as in the study of Balachandran and Mohanram (2011), might also be induced by the practiced "definition and

[80] Graph 4 shows that the tree items follow indeed somewhat the same pattern, especially R&D spending and Δ in leverage

measurement" of value relevance. As explained in chapter 5, there are no controls for the dot-com crisis and market volatility included in the "basic time trend model" because the purpose of this regression analysis is to measure shifts in the explanatory power of the model over time, regardless of the source. These shifts can thus either be caused by factors that are "competing" with financial information for market share (Francis and Schipper 1999) or by other factors, such as the increasing market volatility over time or irrational behavior of the stock market throughout periods of crises. If there is controlled for market volatility and the dot-com crises in the basic time trend regression model, the time trend becomes significant and negative (-.0015). These findings emphasize the importance of formally addressing the definition and measurement of value relevance. Also, the question whether the explanatory power of a regression model can be properly interpreted as value relevance becomes even more pronounced.

6.4 Sensitivity checks

To confirm the robustness of the results of this study, another statistical approach is adopted. Price value relevance regressions with cross-sectional fixed effects are estimated to test whether the main findings of this study hold after controlling for individual heterogeneity of firms. A balanced panel is constructed for these tests so there is enough time-series variation to estimate the firm-specific fixed effects in a reliable manner. The sample is composed by deleting all firms from the sample which have not the maximum amount of observations[81]. This additional requirement reduces the sample to 17,341 observations (1,237 firms). Given that the original sample contains 114,441 observations and the average number of observations per firm is only five years, the findings of the tests performed with the constant sample clearly suffer from a selection bias and survivorship bias.

Before estimating the modified price value relevance models, there needs to be assessed whether the fixed effect approach is feasible for this sample. Therefore, for all subsamples and portfolios, a "redundant fixed effects test" and "Hausman test" is performed. The first test examines whether the fixed effects (μ_i) differ per cross-section. If the null-hypothesis is rejected ($H_0=(\mu_1=\mu_2=\mu_3:=\mu)$, i.e. the firm fixed effects differ not per cross-section), the fixed effects model can be used because there exists unobserved cross-sectional heterogeneity in the sample (Heij et al. 2004). Otherwise, the fixed effects model is not feasible and an OLS regression estimation is preferred. In addition, for each subsample a 'Hausman test' is performed to test whether the fixed or random effects model is more appropriate. If the null-hypothesis (H_0 (Corr(μ,X)=0), i.e. the unique errors (μi) are not correlated with the regressors) is rejected, the fixed effects model is feasible. Both tests (the results for the pooled sample are tabulated in appendix **ix**) confirm the validness of the fixed effects approach for all subsamples.

The tests carried out under the first method are replicated with modified versions of the price value relevance model. For the purpose of comparison, the results of three models are tabulated (see appendix **x**): the basic price value relevance model (model 1), the price value relevance model

[81] The maximum number of observations is 14 or 15, depending on the fiscal year end. See also section 6.2.2.

including firm fixed effects (model 2)[82] and the price value relevance model including firm fixed effects and other control variables (model 3). The estimates of the first model indicate that the R^2s of the basic model for the constant sample are higher than the R^2s for the whole sample (table **VI**). These findings are in line with the results of Lev and Zarowin (1999), who make also use of a constant sample alongside with their total sample. The increase in the R^2s seems to be because of an increase in the association between earnings and market value, indicating that earnings are more value relevant for firms with extending operating histories. This finding is consistent with the idea that (relatively) young firms have informational problems which are less important for more established firms (e.g. Core et al. 2003). The coefficients on book value are in the main lower compared to the results tabulated in table **VI**, which is in line with previous research because the "abandonment option" for firms in the constant sample is less relevant (due to the smaller chance of financial distress and the more certain nature of "older" firms) and book values are more closely associated with the abandonment option than earnings (Collins et al. 19997).

Further, the results of the second model suggest that the extent to which earnings and equity market value are associated is positively biased. The difference between the coefficient on earnings for model 1 and model 2 shows the impact of controlling for firm-specific, time-invariant characteristics on the coefficient on earnings. For almost all (sub)samples, the coefficient on earnings is more than 5 points lower after controlling for firm fixed effects. Earnings are thus positively correlated with certain time-invariant, firm-specific characteristics. Furthermore, the results of the models (2 and 3) reveal that differences in value relevance between intangible-intensive and non-intangible-intensive firms continue to exist after controlling for firm-specific, time-invariant characteristics, time-varying control variables (special items and changes in leverage) and time effects. The pattern of the R^2s is on the main similar as the results tabulated in table **IV** and appendix (**vi**), although for all models the differences between intangible-intensive and non-intangible-intensive firms are smaller. Because the fixed effects may also (partially) capture the impact of firms being intangible-intensive (depending on whether the intangible intensity of firms is in "a steady state"), it cannot be inferred what causes differences in value relevance from these tests. Last, it is noteworthy that the pattern of the coefficients on book values also follows the same construct as the pattern of the regression models without fixed effects: The association is higher for intangible-intensive than for non-intangible-intensive firms and holds after controlling for special items, changes in leverage and time effects, though the difference becomes smaller. The coefficients on earnings show, in accordance with the findings in section 4.3.2, a less clear pattern.

Though the results of the basic model show that the value relevance of more established firms (the "constant sample") differs from the value relevance of firms in the total sample, there are no real signs that the results regarding the impact of the fixed effects approach cannot be generalized. Therefore, it

[82] The "redundant fixed effects test" and the "Hausman test" are performed for all subsamples and the results (not tabulated) confirm that the fixed effects approach is valid.

can be inferred that the coefficients on earnings in all reported regressions are likely positively biased due to correlated, firm-specific factors. Though the extent to which is quite uncertain given the dissimilar characteristics of firms in the total sample. Further, the findings of this check are consistent with the documented difference in value relevance between firms in the intangible-intensive and non-intangible-intensive subsamples. Also, the coefficients on book value are still higher for the former type of firm. The pattern of the coefficients on earnings is less clear. These findings are all consistent with the main conclusions of sections 4.3.1 and 4.3.2.

6.5 Limitations

The findings of this study are subject to a number of limitations and should be interpreted with caution. First, the proxies for the intangible-intensity employed in this study are no perfect measures for the intangible-intensity of firms. As explained in chapter 5, the main disadvantage of the industry classification is that firms are classified based on the industry they belong to rather than on the amount of investments in unrecorded intangible assets on an individual level. The main disadvantage related to the measures based on R&D ratios is that firms are classified according to one business activity, namely R&D spending, which is not necessarily representative for a firm's investments in unrecorded intangible assets on the whole. Therefore, other measures for the intangible intensity of firms may lead to different findings. Also, only one of the available measures for value relevance is employed. The use of the other two models (the returns model and portfolio returns model) might provide other insights. In addition, it is possible that the intangible intensity of firms is correlated with other (time-varying) factors that are not observed in this study. Further, the results of the analyses may suffer from a selection bias and survivorship bias due to several restrictions and the requirement that firm data must be available for two lagged years. Last, the results of this study may also be influenced by the two episodes of crises, and the corresponding dissimilar behavior of the stock market, in the period under study. The findings of this study may therefore not be representative for other time periods.

6.6 Conclusion

This chapter discussed the empirical evidence of this study on the relation between the intangible intensity of firms and value relevance. Several conclusions can be drawn from its findings. First, given the "traditional" interpretation of value relevance, "the total variation in equity market value that is explained by the accounting information incorporated in the regression model, regardless of the nature of differences in that variation" the evidence suggests that the value relevance of financial information is significantly lower for firms that rely heavily on intangible assets than for firms that rely more on tangible capital. These results hold for all proxies for the intangible intensity of firms. The results of the tests with the control variables for special items, changes in leverage and time ensure that the results are not induced by these factors rather than the intangible intensity of firms. Moreover, the findings of the sensitivity check confirm the robustness of the results. In addition, the results of

method II show that the intertemporal pattern in value relevance can partly be explained by changes in the intangible intensity across sample years, indicating that there is a negative relation between the intangible intensity of firms and value relevance. These results are also robust to controlling for several other factors, including changes in market volatility (on the whole) and the dissimilar behavior of the stock market during the dot-com crisis. Though these last two control variables and the year dummies are actually not required under the "traditional" interpretation of value relevance, these items are included to prevent that the results are driven by these items rather than by factors relevant for the research question of this thesis[83].

The empirical evidence suggests that the value relevance of financial information is significantly lower for intangible-intensive than for non-intangible-intensive firms. Therefore, the research question of this thesis ("*does the intangible intensity of firms affect the value relevance of financial information*?") can be positively answered. However, not all finding are in line with the expectations. A major motivation for this study is the concern that the value relevance of intangible-intensive firms is lower due to the (inadequate) accounting treatment of intangible assets. Based upon the findings of method I and method III, it seems logical to conclude that the accounting treatment of intangible assets negatively affects value relevance. After all, there are significant differences in terms of value relevance between intangible-intensive and their non-intangible-intensive counterparts, and these differences cannot be explained by observable factors such as reporting of special items, losses, changes in leverage or macro-economic factors. Moreover, the evidence on the negative relation between the intangible intensity across years and value relevance, after controlling for several sample characteristics, market volatility and the bubble period, results in the same conclusion. However, the evidence of the second method seem to point in another direction. The association between the fundamental accounting numbers and equity market value (measured by the coefficients on book value and earnings, respectively) is significantly higher (or at least not lower) for firms in the intangible-intensive subsamples than for firms in the non-intangible-intensive subsamples. Contrasting the concerns of many academics, book values and earnings are thus not irrelevant in explaining equity market value for firms with high unrecorded intangible assets, but continue to summarize information relevant to investors to the same extent as for "normal" firms. These results are not altered after controlling for losses, reporting of special items, changes in leverage or the influence of macro-economic (and other yearly) factors. It is thus likely that other factors than the current expense instead of capitalization of intangible assets (the "inadequate accounting treatment of intangible assets") explain the reported differences in value relevance between the two types of firms. Potential

[83] The regressions with the control variables provide thus also some evidence for differences in value relevance if value relevance is interpreted as "the relative ability of accounting information to explain equity market value compared to competing information sources", though the evidence is not conclusive. Because the results of this study are likely (partly) driven by unobserved factors that are not "competing" with financial information for market share (such as stock price volatility or noise due to non-information-based trading) besides the items already controlled for, it cannot be inferred without doubt whether differences in value relevance between the two types of firms are caused by differences in value relevance on "a stand-alone basis" or by other factors.

explanations for the lower R^2s documented for firms in the intangible-intensive subsamples are a higher stock price volatility due to higher growth opportunities (Kothari and Shanken 2003), more noise in stock prices due to non-information-based trading (Dontoh et al. 2004) or the impact of unobserved, uncorrelated variables, such as disclosures regarding R&D and advertisement spending. Overall, the evidence suggests that the fundamental accounting variables are still applicable for intangible-intensive firms, though there is greater variation remaining to be explained by other factors. Future research should determine if the documented difference in value relevance is due to the greater relative importance of "competing" information sources for intangible-intensive firms, indicating that the value relevance of the fundamental accounting variables is lower for such firms on a stand-alone basis, or that the differences are caused by factors which are in principal non-competing in nature.

Chapter 7 Conclusion and recommendations

7.1 Summary and conclusions

Value relevance research has been a major area in empirical accounting research for the last 40 years. Motivated by the main objective of financial reporting as identified by the FASB and IASB, to provide useful information to investors, lenders and other creditors, value relevance studies empirically test the "usefulness" of financial information. Under the measurement view, financial information is termed value relevant if it captures or summarizes the information actually used by investors (Francis and Schipper 1999). That is, there is a significant association between the accounting numbers of interest and market based metrics. Because most value relevance studies concentrate on the usefulness of accounting numbers from the perspective of investors, valuation models are generally employed to address questions of value relevance. The empirical models most commonly used in the value relevance literature are the price-, returns-, and portfolio returns model. Because these models face all their own advantages and disadvantages, it depends on the research question, dataset and research design which model is preferred.

A wide range of research has shown that financial information is value relevant to investors, although to a more limited extent than expected (Lev 1989). A more recent concern is whether the lack of accounting recognition of intangible investments as assets negatively affects the value relevance of the fundamental accounting numbers. Under US GAAP, most investments in internally generated intangible assets are expensed as incurred. Due to this conservative accounting treatment, many academics presume that in the presence of high amounts of unrecorded intangible assets investors are unable to make efficient allocation decisions based on the information provided in financial statements. This suggests that investors turn to other sources than firm's financial statements to base their investment decisions on, indicating that the value relevance of financial statement information is lower for firms which rely more heavily on intangible assets compared to firms which depend more on tangible capital. Building forth upon this argument, there is often assumed that value relevance on the whole has declined because intangible assets are increasingly important for US companies (see e.g. Lev and Zarowin 1999, Francis and Schipper 1999).

Although the discussed studies in chapter 4 generally agree upon the decline in value relevance over the years, most studies are not able to link this decline to the growing importance of intangible assets or (closely) related factors. In addition, most studies fail to adequately control for (correlated) factors that may affect the results. Studies regarding specific types of intangible assets and studies concerning specific, intangible-intensive industries report some evidence consistent with the view that the current accounting treatment of intangibles negatively affects value relevance (e.g. Aboody and Lev 1998 and Trueman et al. 2000). However, due to the narrow scope of these studies, the results cannot be generalized. Overall, prior literature is not able to convince that the hypothesized relation between the accounting treatment of intangibles and value relevance exists.

A complicating factor in the review of the empirical accounting literature is the practiced measure of value relevance: the explanatory power of the (price- and returns) value relevance models. The explanatory power of a regression model is not an absolute measure, but a relative one, which makes it hard to compare explanatory power across samples or across years (see e.g. Brown et al. 1999 and Kothari and Shanken 2003). It cannot be inferred from the results of most studies whether changes (or differences) in value relevance occur due to changes (or differences) in the slope estimates or differences in the variability in the (in)dependent variable(s). Moreover, most researchers only implicitly addresses the precise content of the practiced definition of value relevance, though the findings and corresponding interpretation of the results strongly depend on whether value relevance is defined as "the total variation in equity market value that is explained by the accounting information" or as "the relative ability of accounting information to explain equity market value compared to competing information sources". Conclusions drawn based upon the empirical results of these studies are therefore not always consistent with the research design.

This study addresses most of these ambiguities by adopting a more comprehensive and more thorough approach to address questions of value relevance. Using a variety of models and specifications, the empirical evidence suggests that the value relevance of the fundamental accounting numbers is lower for firms that rely more heavily on intangible assets than for firms that rely more on tangible capital. This conclusion is not altered after controlling for losses, reporting of special items and changes in leverage, three factors that are recognized by prior literature to be related to both value relevance and intangible intensity. The findings hold also after controlling for time effects and firm fixed effects. In addition, the results show that the intertemporal pattern in value relevance can partly be explained by changes in the intangible intensity across sample years, indicating that there is a negative relation between the intangible intensity of firms and value relevance. These results are also robust to controlling for several factors, including changes in market volatility (on the whole) and the dissimilar behavior of the stock market during the dot-com crisis. Therefore, the empirical evidence suggests that the research question of this thesis "*does the intangible intensity of firms affect the value relevance of financial statement information*" can be positively answered.

However, based upon the findings of this study, it cannot be concluded whether the current accounting treatment of intangible assets under US GAAP is responsible for the divergence in value relevance between intangible-intensive and non-intangible-intensive firms. As explained, the motivation for this study is the concern that accounting numbers prepared in accordance with US GAAP are less relevant for intangible-intensive firms due to the conservative accounting treatment of internally generated intangible assets. The evidence on the coefficients shows that the lower value relevance for intangible-intensive firms does not appear to be due to a lower association between market value and the fundamental accounting numbers, but due to the greater variation in equity market value remaining to be explained by other factors. The association between the fundamental accounting numbers and equity market value (measured by the coefficients on book value and

earnings, respectively) is (combined) significantly higher for intangible-intensive than for their non-intangible-intensive counterparts. Book values and earnings are thus not irrelevant in explaining equity market value for firms with high unrecorded intangible assets, but continue to summarize information relevant to investors to the same extent as for firms that are not intangible-intensive. These findings suggest that the differences in value relevance between the two types of firms are likely attributable to one or more unobserved independent variables, higher noise due to non-information-based trading or greater volatility in the stock prices. Future research should determine which factor is responsible for the differences in value relevance and whether or not this factor is an information source "competing" with financial statement data for market share.

7.2 Suggestions for further research

Many opportunities for further research exist. First, the nature for differences in value relevance between intangible-intensive and non-intangible-intensive can be further explored. There are to my best knowledge only two studies that explicitly focus on the economic determinants of the magnitudes of the coefficients on the fundamental accounting variables in relation to the explanatory power of the value relevance models[84] (Kothari and Shanken 1999 and Gu 2007), while these provide valuable information. Further, alternative measures for the intangible intensity of firms can be tested to see whether the main findings of this study hold for these measures. In addition, it would be interesting to examine (with a "difference-in-difference approach") whether an increase in intangible intensity within a firms causes value relevance to decline. For this test, alternative samples or other proxies for the intangible intensity of firms are necessary because the sample gathered for this thesis consists of too few firms that experienced a "real change" in R&D spending during the sample period to test this conjecture in a reliable manner. Finally, a last note regarding the concept of value relevance. Further research should take the difficulties associated with the current definition and measurement of value relevance more properly into account. Maybe the most important "value relevance" question today is whether the current definition(s) and measurement(s) of value relevance are still suitable or that a better concept is necessary.

[84] Though the concept of "scaling problems" and the corresponding solution is somewhat related, the implications are totally different. The use of a scaling factor prevents that differences in the R^2s are driven by differences in the coefficient of variation in the scale factor. The scaling problem refers thus to biased test-statistics due to differences in scale. By controlling for these effects, there is assumed that the change in R^2s due to actual changes in the underlying economic reality is revealed. The concerns related to the use of the R^2 as the sole measure for value relevance are not based on the argument that changes in R^2s are not driven by real changes in the economic relations, but that changes in R^2s reveal nothing about the origin for this change. Therefore, there is not referred to the literature regarding scale effects (see e.g. Brown et al. 1999).

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General Accepted Accounting Principles

Financial Accounting Standards Board
ABP opinion 17 Intangible assets
FASB SFAC 6 Elements of Financial statements
FASB SFAC 5 Recognitions and measurement in financial statements of business Enterprises.
FASB ASC 350 Intangibles – Goodwill and Other
FASB ASC 730 Research and Development
FASB ASC 805 Business Combinations

Appendix

Appendix (i)		
Sample		
Initial sample	114,441	obs.
Non-USA	12,403	obs.
SICH 6000 - 6999	14,757	obs.
SIC 6000 – 6999	5,232	obs.
Missing book value	9,169	obs.
Negative book value	3,853	obs.
Missing data (other)	1,465	obs.
Deleted data (< 3 years)	3,586	obs.
Deleted data (lagged values)	16,184	obs.
Final Sample	**47,792**	**obs.**

Appendix (ii)

Comparison of mean R&D and market-to-book ratios (t-test). The right column represents the difference between the high-tech and low-tech sample. ***, ** and * indicate that the difference is significantly different from zero at the 1%, 5% or 10 % levels, respectively.

Variable	Total sample	High-tech sample	Low-tech sample	Difference
Observations	48,122	14,185	33,937	
R&D ratio	0.0623	0.1484	0.0239	-.1264***
Market-to-book ratio	3.036	3.9884	2.6388	-1.3496***

Appendix (iii)

Results of Woolridge test for serial correlation and Cook-Weisberg test for hetereoskedasticity. Both tests are suitable for panel data. For brevity, only the results of the tests for the standard errors of the basic price value relevance regression model estimated for the whole sample are displayed. Testing of the residuals of the other models (and subsamples) yields comparable results.

Woolridge test for autocorrelation in panel data
H0: No first-order autocorrelation
Prob> F = 0.0000

Cook-Weisberg test for heteroskedasticity
H0: constant variance
Prob> F=0.0000

Appendix (iv) Equation: $R_j^2 = \varphi_0 + \varphi_1 G_j + \varepsilon_j$

Regressions model with the R^2 for the different subsamples as the dependent variable and the "groups" (G as dependent variable. The standard errors of the regression model are robust. ***, ** and * indicate that the difference is significantly different from zero at the 1%, 5% or 10 % levels, respectively.

	φ_0	φ_1G	Adj. R^2
R&D based measure (portfolios)	.4334***	-.019***	77,51
R&D based measure (subsamples)	.4032***	-.0574***	97,6

Appendix (v)

Comparison of mean values for the total sample, high-tech sample and low-tech sample (t-test). The right column represents the difference between the high-tech and low-tech sample. ***, ** and * indicate that the difference is significantly different from zero at the 1%, 5% or 10 % levels, respectively.

Variable	Total sample	High-tech sample	Low-tech sample	Difference
Observations	48,122	14,185	33,937	-.
Market value	1.5213	2.2084	1.2341	-.9743***
Book value	0.3560	0.5010	0.0021	-.1187***
Earnings	-.0247	0.0061	-.0984	.1045***
R&D ratio	0.0623	0.1484	0.0239	-.1264***
Market-to-book ratio	3.036	3.9884	2.6388	-1.3496***
Δ Leverage	0.0050	0.0046	0.0059	-.0014
Special items	0.0519	0.0418	0.0770	-.03548***

Appendix (vi) Equation: $MVit = \alpha_0 + \alpha_1 BV_{it} + \alpha_2 E_{it} + \alpha_3 DL_{it} + \alpha_4 IA_{it} + \alpha_5 SI_{it} + a_6 \Delta L_{it} + a_7 Y_{it} + \varepsilon_{it}$

Coefficients and adjusted R^2s from price value relevance regressions including controls for special items (SI, measured as special items as percent of earnings), change in leverage (Δ leverage, measured as the change in financial leverage) and time effects (Y). Regressions are estimated for the whole sample and different subsamples or portfolios. The first measure for intangible intensity is based on the industry classification of Francis and Schipper (1999). Firms are classified as "high-tech" or "low-tech" based upon the industry they belong to. The second measure is based on R&D spending as percent of total assets. The first percile covers the firms with zero spending on R&D and the tenth percile covers firms with the highest R&D spending as percent of total assets. The third measure is based on both the level and change in R&D ratios: the subsamples consist subsequently of firms (I) with low, decreasing R&D spending (<0.01 % total assets), (II) low and increasing R&D spending, (III) high and decreasing R&D spending (IV) high and increasing R&D spending. For brevity, the coefficients on the year dummies (1996 to 2010) are not separately tabulated. All regressions are performed with robust standard errors clustered by firm. ***, ** and * indicate that the coefficients are significantly different from zero at the 1%, 5% and 10% level, respectively.

	NO #	α_0	α_1 BV	α_2 E	α_3 DL	α_4 IA	α_5SI	$a_6\Delta L_i$	a_7Y	R^2
Pooled	48,122	-.613***	2.229***	12.129***	.458***	-14.958***	-.116***	.063	Varies	36,21
Industry-based classification										
High-tech sample	33,937	-.354***	1.679***	11.899***	.3539***	-14.540***	-.097***	-.058	Varies	38,77
Low-tech sample	14,185	-.686***	2.668***	12.422***	.447***	-15.099***	-.1256***	0.099	Varies	31,88
R&D ratios (level)										
Percile 1 - 5	24,242	-.268***	1.336***	12.393***	.332***	-13.955***	-.076***	.102	Varies	42,44
Percile 6	4,632	.094	1.439***	10.606***	.331***	-12.485***	-.086***	-.119	Varies	40,40
Percile 7	4,812	-.385*	1.643***	14.048***	.475***	-15.703***	-.0889***	.305	Varies	39,68
Percile 8	4,812	-.596*	2.254***	12.687***	.406***	-14.164***	-.1505***	.137	Varies	31,40
Percile 9	4,812	-.035	2.253***	13.111***	.3994***	-14.600***	-.1205***	.331	Varies	29,96
Percile 10	4,812	-.291	3.087***	8.318***	.096***	-10.836***	-.1108***	-.073	Varies	27,84
R&D ratios(level and change)										
Subsample I	25,899	-.269***	1.357***	12.198***	.331***	-13.768***	-.077***	0.087	Varies	42,10
Subsample II	1,146	.440	1.559***	8.850***	.241*	-9.988***	-.069***	.480	Varies	45,01
Subsample III	9,712	-.711***	2.553***	11.957***	.547***	-15.306***	-.155***	.446**	Varies	32,77
Subsample IV	11,365	-.497**	2.335***	13.722***	.562***	-16.311***	-.123***	-.694***	Varies	29,01

Appendix (vii) Equation: $R_j^2 = \varphi_0 + \varphi_1 G_j + \varepsilon_j$

Regressions model with the R^2 for the different subsamples as the dependent variable and the "groups" (G as dependent variable. The standard errors of the regression model are robust. ***, ** and * indicate that the difference is significantly different from zero at the 1%, 5% or 10 % levels, respectively.

	φ_0	φ_1G	Adj. R^2
R&D based measure (portfolios)	.4447***	-.0143***	81,02
R&D based measure (subsamples)	.4223***	-.0444***	96,13

Appendix (viii) Equation: $MV_{it} = \alpha_0 + \alpha_1 BV_{it} + \alpha_2 DH*BV_{it} + \alpha_3 E_{it} + \alpha_4 DH*E_{it} + \alpha_4 DL_{it} + \alpha_5 DH* DL_{it} + \alpha_6 IA_{it} + \alpha_7 DH*IA_{it} + \alpha_8 SI_{it} + \alpha_9 DH*SI_{it} + \alpha_{10} \Delta L_{it} + \alpha_{11} DH*\Delta L_{it} + \alpha_{12} Y_{it} + \alpha_{13} DH + \varepsilon_{it}$

Price value relevance regression model with indicator variables for intangible-intensive firms (DH) and control variables for special items and change in leverage. Three indicator variables are employed: an indicator variable based on (a) the industry classification (1 is high-tech and 0 is low-tech), (b) the level of R&D spending (1 is R&D ratio ≥ 1, 0 otherwise) and (c) the change in R&D spending (1 is increasing rate, 0 is otherwise). For all variables, interaction terms are included in the model. The control variables added to the model are special items (SI), change in financial leverage (Δ L) and time effects (Y). Regressions are performed with robust standard errors clustered by firm. ***, ** and * indicate that the difference is significantly different from zero at the 1%, 5% or 10 % levels, respectively.

Variables	Industry classification	Level of R&D spending	Change in R&D spending
Intercept	-.4031***	-.1864***	-.3396***
Book value	1.6900***	.9874***	1.5330***
Interaction term (DH *BV)	.9968***	.1806***	.3812***
Earnings	11.9025***	12.5197	11.7802***
Interaction term (DH*E)	.8624	-.0205	.5075*
Losses	.3568***	.3031***	.3146***
Interaction term (DH * DL)	.0703	.0233***	.0881***
Interaction term (DL * E)	-14.5618***	-13.7859***	-13.9931***
Interaction term (DH * IA)	-.8434	-.1135	-.6623**
Special items	-.0963***	-.0622***	-.0817***
Interaction term (DH * SI)	-.0338*	-.0087***	-.0223***
Δ Leverage	.2556	.0861***	.0828
Interaction term (DH * L)	-.1369	-.0081	-.0766
Dummy DH	-.1899	-.0372	-.1084***
Year 1997	.1801***	.1616***	.1674***
Year 1998	-.0403	-.0690	-.0579
Year 1999	.4971***	.4779***	.0495***
Year 2000	.1792***	-.1876***	-.16669***
Year 2001	-.0995**	-.1133***	-.0999**
Year 2002	-.4028***	-.4275***	-.4182***
Year 2003	.2787***	.2493***	.2767***
Year 2004	.02992	.0026	.0334
Year 2005	.1965***	.1680***	.1915***
Year 2006	.1291***	.0969*	.1137**
Year 2007	-.1909***	-.2189***	-.2027***
Year 2008	-.6333***	-.6496***	-.6477***
Year 2009	-.1025*	-.1183***	-.1097*
Year 2010	.0360	0.0069	.0338***
NO # observations	48,122	48,122	48,122
Adj. R^2	38,09	39,42	38,05

Appendix (ix)

Results of the redundant fixed effects and Hausman test for the pooled sample. The results for all subsamples are similar.

Model 2

Redundant fixed effects test

$H_0=(\mu_1=\mu_2=\mu_3:=\mu)$ (fixed effects do not differ per cross-section)

Prob> F = 0.000 (F=8.45)

Model 3

Redundant fixed effects test

$H_0=(\mu_1=\mu_2=\mu_3:=\mu)$ (fixed effects do not differ per cross-section)

Prob> F = 0.000 (F=9.20)

Model 2

Hausman test

H_0: (Corr(μ,X)=0) (difference in coefficients is not systematic, i.e. random)

Prob> χ^2 =0.0000 (χ^2 = 812.65)

Model 3

Hausman test

H_0: (Corr(μ,X)=0) (difference in coefficients is not systematic, i.e. random)

Prob> χ^2 =0.0000 (χ^2 = 821.48)

Appendix (x) Equation: $MVit = \alpha_0 + \alpha_1 BV_{it} + \alpha_2 E_{it} + \alpha_3 DL_{it} + \alpha_4 IA_{it} + \varepsilon_{it}$ *(model 1)*

$MVit = \alpha_0 + \alpha_1 BV_{it} + \alpha_2 E_{it} + \alpha_3 DL_{it} + \alpha_4 IA_{it} + \upsilon_{it}$ and $\upsilon_{it} = \mu_i + \varepsilon_{it}$ *(model 2)*

$MVit = \alpha_0 + \alpha_1 BV_{it} + \alpha_2 E_{it} + \alpha_3 DL_{it} + \alpha_4 IA_{it} + \alpha_5 SI_{it} + a_6 \Delta L_{it} + a_7 Y_{it} + \upsilon_{it}$ and $\upsilon_{it} = \mu_i + \varepsilon_{it}$ *(model 3)*

Price value relevance regressions carried out with different subsamples based on the "constant sample". The first measure for intangible intensity is based on the industry classification of Francis and Schipper (1999). The second measure is based on R&D spending as percent of total assets. The first percile covers the firms with zero spending on R&D and the tenth percile covers firms with the highest R&D spending as percent of total assets. The third measure is based on both the level and change in R&D ratios: the subsamples consist of firms (I) with low, decreasing R&D spending (<0.01 % total assets), (II) low and increasing R&D spending, (III) high and decreasing R&D spending (IV) high and increasing R&D spending. For brevity, the coefficients on the year dummies (1996 to 2010) are not tabulated. All regressions are performed with robust standard errors clustered by firm. ***, ** and * indicate that the coefficients are significantly different from zero at the 1%, 5% and 10% level, respectively. For all (sub)samples, the fixed effects model is feasible based upon the Hausman test and the redundant fixed effect test.

	NO #	α_0	α_1 BV	α_2 E	α_3 DL	α_4 IA	α_5SI	$a_6\Delta L_i$	a_7Y	R^2
Pooled										
Model 1	17,341	-.542***	1.868***	13.957***	.3717***	-17.541***				40,24
Model 2	17,341	-.197**	1.940***	9.385***	.159***	-10.502***				53,01
Model 3	17,341	.027	1.875***	9.352***	.283***	-10.582***	-.050***	0.001	varies	54,63
Industry-based classification										
<u>High-tech sample</u>										
Model 1	13,445	-.313***	1.397***	13.179***	.274***	-16.374***				41,81
Model 2	13,445	.042	1.431***	8.125***	.166***	-8.004				51,48
Model 3	13,445	.226**	1.375***	8.217***	.287***	-8.261***	-.049***	.067	Varies	53,22
<u>Low-tech sample</u>										
Model 1	3,896	-.856***	2.519***	16.326***	.537***	-19.802				34,64
Model 2	3,896	-.701**	2.933***	12.096***	.2411**	-14.396***				47,83
Model 3	3,896	-.101	2.646***	10.893***	.260*	-13.235***	-.038	-.073	Varies	48,85
R&D ratios (level)										
<u>Percile 1 – 5</u>										
Model 1	9,092	-.243***	1.074***	13.712***	.357***	-14.183***				45,65
Model 2	9,092	-.149	1.545***	8.597***	.214***	-8.402***				49,54
Model 3	9,092	.014	1.448***	8.650***	.317***	-8.656***	-.050***	-.005	Varies	52,02
<u>Percile 6</u>										
Model 1	2,070	-.114	1.134***	11.470***	.263***	-12.454***				47,35
Model 2	2,070	.083	1.362***	7.046***	.081	-7.221***				51,28
Model 3	2,070	.601	1.252***	6.941***	.138**	-7.432***	-.030**	-.097	Varies	52,68
<u>Percile 7</u>										

Model 1	2,259	-.371***	1.402***	15.454***	.481***	-18.507***				42,63
Model 2	2,259	-.533**	2.713***	8.120***	.104	-9.718			Varies	37,70
Model 3	2,259	.390	2.565***	8.326***	.237	-10.149***	-.042	-.088		39,62
Percile 8										
Model 1	1,791	-.574*	2.203***	15.342***	.434*	-16.428***				37,12
Model 2	1,791	-.586**	3.09***	10.213***	.214	-10.450***			Varies	32,66
Model 3	1,791	-.681**	2.969***	9.908***	.297**	-10.267***	-.007	.114		37,81
Percile 9										
Model 1	1,406	-.123	1.888***	15.568***	.340**	-17.074***				30,9
Model 2	1,406	-.320	2.792***	10,498***	.327**	-10.003***			Varies	25,96
Model 3	1,406	-.001	2.408***	9.572***	.384**	-9.081***	-.102**	-.275		28,35
Percile 10										
Model 1	723	-.996	3.429***	15.185***	.518	-18.544***				21,04
Model 2	723	.382	2.739***	9.816***	.027	-12.282***		.	Varies	25,44
Model 3	723	.291	2.504***	9.051***	.043	-11.458***	.035	.401		28,73
Subsamples (level and change)										
Subsample 1										
Model 1	9,846	-.233***	1.081***	13.555***	.348***	-14.208***				46,00
Model 2	9,846	-.134***	1.529***	8.590***	.194***	-8.551***			Varies	52,14
Model 3	9,846	.025	1.440***	8.662***	.304***	-8.840***	-.052***	-.016		53,53
Subsample 2										
Model 1	489	-.077	1.284***	9.329***	.217**	-8.884***				49,83
Model 2	489	.221	.974***	7.209***	.246**	-6.899***			Varies	48,36
Model 3	489	5.399***	1.153***	5.769***	.221	-.5791***	.007	-.360		47,69
Subsample 3										
Model 1	3,443	-.711***	2.414***	14.673***	.517***	-19.479***				37,97
Model 2	3,443	-.189	2.399***	9.622***	.137	-12.148***			Varies	49,15
Model 3	3,443	.381	2.275***	9.661***	.307**	-11.970***	-.096***	-.162		46,37
Subsample 4										
Model 1	3,563	-.569***	1.962***	15.856***	.460***	-19.135***				31,78
Model 2	3,563	-.380*	2.603***	9.567***	.179*	-10.775***				34,29
Model 3	3,563	.071	2.434***	8.931***	.208**	-10.395***	.013	-.117		38,40