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Comparing the value revelance of R&D reporting in Germany: standard and selection effects

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Discussion Paper
Series 1: Economic Studies
No 36/2005

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ISBN 3–86558–092–0

Abstract:

On the basis of accounting and market data for firms and groups listed on German stock exchanges between 1997 and 2003, we show that the value relevance of R&D information under German accounting standards can be superior to that provided by US-GAAP and IAS. The results, obtained while dynamically controlling for partial freedom of firms to choose a standard in a modified Q model, show that the risk of IAS/US-GAAP misinforming investors during "bear market" periods is more relevant than their comparative advantage over the prudence principle of the German Commercial Code in "bull market" periods. Using the approach chosen for this study, it is possible not only to draw a clear dividing line between standard and selection effects but also to disentangle them along theoretical lines more clearly than in earlier studies.

Keywords: Accounting standards, standard selection, R&D, value relevance, Germany

JEL-Classification: D82, M40, M41, K11

Non Technical Summary

The financial importance of companies' own research and development (R&D) activity for their market value has been increasing for years, as has the intensity of the academic debate on the best type of accounting treatment for this phenomenon. Some US studies find that the usefulness of accounting information to investors has diminished over the past few decades. From a theoretical perspective, this is attributed to the strongly conservative nature of accounting practices. Along those same lines, others argue that the future-oriented capitalisation of R&D expenditure in the balance sheet provides more relevant investor information than expensing it in the income statement and that it is therefore theoretically preferable. These theoretical discussions and empirical findings impact on the fundamental debates about the comparative usefulness of different accounting standards for assessing the relationship between firms' market values and book values. Whereas IAS permits the theoretically preferable option of capitalising own intangible goods, US-GAAP does not. Several continental European national accounting standards seem conceptually less useful in terms of equity valuation. However, the question of the comparative capability of each standard to account adequately for intangible assets is highly significant in both theory and practice, especially as, in Europe, EU Council Regulation 1606/2002 has made it mandatory for corporate groups in all EU member states to prepare their consolidated financial statements using the IFRS or IAS beginning on 1 January 2005.

The main question this article seeks to answer is this: which accounting standard makes the greatest contribution to explaining firms' market value in terms of the accounting treatment of intangibles? By implication, this leads directly to the follow-up question: should such a standard effect ultimately be regarded as an incentive effect for companies to choose a particular standard? This study, based on a primary set of accounting and market data for firms listed in Germany between 1997 and 2003 and using a tailored econometric design, seeks to generate empirical evidence to support the above thesis. In the context of our research design, we do find signs of differences between US-GAAP, IAS and German GAAP regarding the accounting treatment intangible assets – which is consistent with earlier research. Unexpectedly, however, our

study finds that German accounting rules appear to present investors with a more realistic picture. From a statistical and theoretical perspective, we attribute this to the fact that German GAAP, with its emphasis on the prudence principle and strict “lower of cost or market" principle, prevents the presentation of overinvestment engendered by unfounded earnings expectations. In addition, we find weak statistical evidence that, for firms listed in Germany, this relative overvaluation of firms is more strongly correlated with US-GAAP than with IAS. Finally, the results show that the model needs to take account of selection bias and distinguish between bull and bear market phases in order to identify standard and incentive effects.

Nicht technische Zusammenfassung

Seit Jahren nimmt die finanzielle Bedeutung von hauseigener Forschung und Entwicklung für den Marktwert von Unternehmungen zu, und mit ihr die wissenschaftliche Diskussion, wie die Rechnungslegung diesem Phänomen begegnen soll. Einige US-amerikanische Studien kommen zu dem Ergebnis, dass der Nutzen von Rechnungslegungsinformation aus Investorensicht über die vergangenen Dekaden abgenommen hat. Dies wird aus theoretischer Sicht auf die stark konservative Rechnungslegungspraxis zurückgeführt. Entlang derselben Überlegung argumentieren andere Autoren, dass die zukunftsorientierte Aktivierung von FuE Aufwendungen in der Bilanz relevantere Information an die Investoren vermittelt als die Abschreibung in der GuV, mithin aus theoretischer Sicht zu bevorzugen ist. Diese theoretischen Erörterungen und empirischen Befunde haben Auswirkungen auf die fundamentalen Debatten hinsichtlich der komparativen Tauglichkeit von Rechnungslegungsstandards zur Beurteilung des Zusammenhangs zwischen Markt- und Buchwerten von Unternehmen. Während die IAS die theoretisch präferierte Aktivierungsmöglichkeit für selbsterstellte immaterielle Güter ermöglichen, lassen US-GAAP die letztere nicht zu. Weniger tauglich erscheinen schließlich aus einer theoretischen „equity valuation“ Sicht mehrere der nationalen kontinentaleuropäischen Rechnungslegungsstandards. Sowohl aus theoretischer als auch aus angewandter Sicht ist die Frage nach der komparativen Standardtauglichkeit für intangible Vermögensgegenstände jedoch hochgradig bedeutsam, zumal aus europäischer Sicht, die EU-Verordnung 1606/2002 mit Beginn

des Jahres 2005 für den Konzernabschluss IFRS oder IAS in allen Eu-Mitgliedssaaten zwingend vorschreibt.

Die zentrale Frage, die diesem Artikel zugrunde liegt, ist welcher Rechnungslegungsstandard hinsichtlich der Bilanzierung von intangiblen Vermögenswerten den höchsten Beitrag zur Erklärung des Marktwertes von Unternehmen liefert? Die implizit direkt damit verknüpfte Frage lautete: ist ein solcher Standardeffekt letztlich als Anreizeffekt der Unternehmen für die Wahl des Standards zu betrachten? Auf Basis eines originären Datensatzes zu Rechnungslegungs- und Marktdaten in Deutschland börsennotierter Firmen zwischen 1997 und 2003 sowie unter Verwendung eines maßgeschneiderten ökonometrischen Designs versuchte die vorliegende Studie empirische Evidenz für die oben erwähnten Fragestellung zu generieren. Im Rahmen unseres Forschungsdesigns finden wir – konsistent mit früheren Studien – Hinweise auf Unterschiede der relativen value relevance von US-GAAP, IAS, und HGB im Hinblick auf immaterielle Vermögensbestandteile. Unerwarteterweise erscheinen die deutschen HGB in unserer Studie jedoch tauglicher, Investoren realitätsnah zu informieren; dies führen wir aus statistischer wie theoretischer Sicht darauf zurück, dass die vom Vorsichtsprinzip und strengen Niederstwertprinzip getriebenen German GAAP einen Missbrauch dergestalt erschweren, Überinvestitionen abzubilden, die durch ungerechtfertigte Ertragserwartungen zustande kommen. Des Weiteren finden wir aus statistischer Sicht schwache Hinweise darauf, dass für in Deutschland börsennotierte Unternehmen diese relative Überbewertung von Unternehmen höher mit einer Rechnungslegung nach US-GAAP als nach IAS korreliert ist. Des weiteren zeigen die vorliegenden Ergebnisse, dass bei der Modellierung die Berücksichtigung von Selektion und eine Separierung der Marktphasen in eine Hausse- und Baisse-Phase notwendig ist um standard- und anreizspezifische Effekte zu identifizieren.

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Comparing the Value Relevance of R&D Reporting in Germany: Standard and Selection Effects*

1 Introduction

This study is motivated by the ongoing discussion about the comparative suitability of different accounting standards regarding their R&D value relevance (see Lev and Zarowin, 2004). The debate that blends aspects from R&D accounting literature and the research on standard vs. selection effects is comprehensively summarized in section 2. As we will show, conclusive empirical evidence for the allegation that international accounting standards (IAS and US-GAAP) are superior to German accounting standards with respect to R&D reporting from an equity valuation perspective is missing. Not only theoretically, but also practically speaking, the question of the comparative capability of each standard for intangible assets, however, is highly significant, especially in Europe. Here, the EU Council Regulation 1606/2002 has made it mandatory for groups to prepare their financial statements using the IFRS or IAS in all EU member states beginning on 1 January 2005.

In this paper we investigate which accounting standard – IAS, US-GAAP, or German GAAP – shows the highest value relevance for intangibles (particularly self-created R&D). We will show that the assertion regarding a superior value relevance of market-oriented accounting standards with respect to R&D does not hold if a) selection vs. R&D sub-standard effects are economically and statistically clearly identified in a dynamic setting, b) fixed effects of firms are captured, and c) data for a complete business cycle are analyzed (Hausse and Baisse phase). We will build on Bartov et al. (2004) to study the link between the market values of listed groups in Germany and their book values using the German "natural" accounting experiment of comparing standards within one jurisdiction. Unlike the cited authors, we will focus exclusively on immaterial assets, and, for the reasons mentioned above, will also distinguish between self-created R&D and purchased assets. We will argue theoretically (see 2.3) that this

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focus on an accounting sub-segment also has the advantage in that the difference between standard and selection effects can be shown more distinctly in economic terms. We will statistically model the latter in a similar manner to the cited authors. Unlike the above studies, however, we model companies' selection at specific points in time, thereby capturing potentially distorting effects caused by entering and exiting firms or by changes, over time, in incentive structures for changing standards (!). While our design theoretically also enables the display of additional distorting effects caused by companies that change their standards multiple times, these latter distortions appear to be a rather theoretical, however.[1] Another significant advantage of our chosen approach, however, is that, in the second stage, we can use panel econometric effects while taking into account firm-specific effects. Finally, the third key difference in the design of our research is in our choice of observation period. Unlike the authors mentioned above, whose data are confined to the 1998-2000 period, we study the 1997-2003 period, i.e. the most symmetrical possible period on either side of the 2000 stock market crash in Germany.[2] This third difference seems fundamental and significant for using the link between market values and book values to determine the value relevance of balance sheet information. Balance sheet information may be regarded as relevant precisely if market players can use it to form realistic income expectations; this is measurable ex post if market values and balance sheet information were correlated for a given time period. If market players' income expectations have changed during a given period, this must also be reflected in the contemporary correlation with balance sheet information if the latter is to be adjudged relevant. There is no doubt today that the market values of German companies between 1997 and 2000 were based on market players' at times sharply exaggerated profit expectations. Many of these enterprises, particularly in the Neuer Markt sector, failed to live up to their promise. From 2000 to 2003 prices plummeted, and many income expectations underwent corrections. However, studies based only on the correlation between the market value of German enterprises between 1997 and 2000 and book values – especially those in the Neuer Markt segment – are, by

[1] Leuz and Verrechia (2000) show impressively that the choice of standard is associated with a considerable commitment that makes a flip-flop unlikely. A KPMG (2000) study demonstrates this empirically.

[2] Leuz (2003) and Daske (2005), in their studies, likewise cover periods before and after the stock market crash in Germany, but should be regarded as complementing our study because they look at different questions.

definition, incapable of studying such adjustments in expectations on balance sheets. In addition, they run the risk of overly generalising results stemming from a purely rising segment of a stock market cycle to the whole segment of the cycle. However, the real test of the usefulness of balance sheet information (from an equity valuation perspective at least), is whether it contemporaneously provides helpful explanations for market values in a time of changing expectations among market players.[3] We will run this experiment for sources of information on intangible assets using different accounting standards for the 1997-2003 period within a single jurisdiction: Germany.[4]

Our main empirical finding shows that R&D reporting according to IAS and US-GAAP for groups listed on the German stock markets between 1997 and 2003 potentially misled investors more drastically than R&D reporting according to German GAAP did. Firms that used IAS and US-GAAP showed negative (!) market value correlations during the Baisse Phase (2000-2001) that most likely reflect prior overinvestment. Next to its empirical findings, our paper contributes methodologically by suggesting a test design that better allows disentangling (sub-)standard and selection effects than was possible before.

The rest of the article is structured as follows. Section 2 will show how our study fits into the current research environment, and we will also discuss what we regard as the most important prior research. This combination will present us with the hypotheses which, along with the design of our research, we will present in Section 3. Section 4 describes the data and the multivariate estimation results, which will be discussed extensively in Section 5. Section 6 summarises the key findings and provides an outlook.

2 Related prior research

In terms of the stated objective, our work is at a crossroads of various lines of research on the current science of accounting practices. This is the meeting point for issues regarding accounting practices for research and development, the standard debate on the

[3] In empirical business cycle research, complete business cycles are used (e.g. Kose, Otrok and Whiteman 2003), while empirical research on monetary transmission uses as many interest rate cycles as possible (e.g. Christiano, Eichenbaum and Evans 1998).

[4] See Leuz (2003) for a similar line of argument regarding the need to run robustness checks for phases of rising and falling stock prices alike.

pros and cons of IAS, US-GAAP and German GAAP, and the attendant theories about how to select enterprises for selected accounting forms and content. All of these theoretical lines involve the use by empirically active scholars of "the German case" as a natural accounting experiment. Finally, theoretical thinking on the value relevance of accounting information is also significant. We will accordingly present a brief picture of where our work fits into the framework of earlier research.

2.1 R&D accounting

The apparent absence of a correlation between a company's (historical) R&D costs and the resultant future earnings led the Financial Accounting Standard Board (FASB), in 1974, to require the immediate expensing of R&D costs in the financial statement. The claim was that immediate expensing would increase the objectivity of accounting information without any sacrifice regarding the relevance of the information.

During the 1970s, 1980s and 1990s, however, the significance of industrial R&D continued to rise sharply round the world. In the late 1990s, accounting scholars began to address this phenomenon with a series of academic papers devoted to the relevance of accounting information. In their review article, Holthausen and Watts (2001) cite 62 studies which address the question of the value relevance of R&D information by studying the link between the market value and the book value of companies. There were 60 such papers published in the 1990s, 43 of which in 1995 or later. Since space limitations prevent us from comparing all the studies here, we have settled on a selection. In undertaking this selection, we have attempted to choose those studies in which lines of thinking that are central to our hypothesis are mentioned for the first time and at the same time tested comprehensively.

Lev and Sougiannis (1996) demonstrate that, when looking at the decades following the FASB's 1974 decision, there is a significant intertemporal association between firms' R&D capital and subsequent earnings. On the basis of their results for the 1975-1991 period, the authors call for a new look at the issue of the balance sheet treatment of R&D information and cast doubt on the assertion that expensing in the financial statement is objectively preferable to balance sheet capitalisation. From an investor's perspective, Lev and Zarowin (1999) underscore the advantageousness of capitalising R&D costs in the balance sheet by showing, in their sample of US

enterprises for the 1978-1996 period, that the usefulness of expensed R&D costs to investors had declined in the past few decades. Ely and Waymire (1999), by indicating that there was no link between companies' market value and intangible assets in the 1920s, show that the reduction in the usefulness of accounting information on intangible assets is a "recent" phenomenon and not one that has been known for a long time. For the software capitalisation case, Aboody and Lev (1998) reach the same result for their sample of 163 software companies between 1987 and 1995. Chan et al. (2001), too, indirectly confirm the results of the above-mentioned studies by failing to find any association between information on purely expensed R&D costs and their relevant market values for US companies at selected points in time between 1975 and 1995. From an empirical point of view, the above studies, at least for US firms, confirm the supposition that the rise in the firm value of intangible capital over the past few years requires that R&D information be taken into account in the balance sheet in such a manner that investors can obtain information on relevant future earnings from R&D. At the same time, they justify the move to capitalise R&D costs against the background of the desired objectivity.

The above studies are given theoretical support by, among others, the simulations performed by Healy et al. (2002), which, at least for the stylised research process in the pharmaceutical industry, show that the successful-effort model for R&D is much superior to the cash-expense model.

Given that one of the key differences between IAS and US-GAAP is precisely the option of capitalising R&D expenses for self-created intangible goods, the results impact on the debate regarding the comparative usefulness of international accounting standards. Since German accounting rules do not provide for the separate inclusion of R&D expenses in the financial statement when using the "total cost" procedure and also expressly forbid the capitalisation of self-created intangible assets,[5] but at the same time German companies have the option of using IAS or US-GAAP to prepare their financial statement, these studies show the special importance of this subject for Germany.

[5] Exception: firms which prepare their financial statements using the "cost of sales" accounting method may include R&D costs as a separate item in the financial statement.

2.2 Standard effects

Fifty-four of the studies cited by Holthausen and Watts (2001) explicitly state that they are partly motivated by a desire to contribute to the standard setting debate. As the authors of this article critically explain, most of the cited studies assume, at least implicitly, that the "equity valuation" theory justifies using the association between market value and book value to make inferences about the usefulness of accounting standards. Holthausen and Watts (2001) argue that looking purely at equity, however, is not enough for a definite drawing of inferences. For our subsequent primary arguments, and in the subsequent overview of the literature, we will take account of the arguments put forward by Holthausen and Watts (2001) by making allowances for the limited meaningfulness of the measurement of market value through book value. At the same time, we are also (like others) conducting a "relative association study" (see Holthausen and Watts 2001) and, in the following, will therefore set ourselves apart from, above all, those corresponding predecessor studies that are the most similar to our approach.

Zhao (2002) compares the relative "value relevance" in France, Germany, the United Kingdom and the United States. For the 1990-1999 reporting period, his results indicate that the expensing of R&D costs in Germany and the United States offer greater informative value to investors and that the capitalization of R&D in France and the UK increases the value relevance of R&D accounting. The results therefore indicate that the comparative usefulness of accounting standards for R&D decreases steadily from IAS/UK and French standards to US-GAAP to German GAAP. Irrespective of the study's contribution, it suffers from several flaws, some of which the author himself acknowledges. One of the study's limitations for the comparison of standards is that the observation figures for R&D expensing at German firms are very low. One reason may be the lack of industry focus, but another might lie in the fact that (in most cases) only purchased R&D is listed on the balance sheet according to German GAAP, but not self-created R&D (see above). All in all, the quality of the underlying data in the Zhao study is not entirely transparent, and the specific problems associated with alternative accounting methods (self-selection) in the various countries do not appear to have been captured econometrically. Finally, it does not help matters much for the discussion on the comparative usefulness of standards that Zhao's results were obtained across

geographical, cultural and legal borders and could potentially be distorted by contingency variables (see Pope and Walker, 1999, and Ali and Hwang, 2000). This accounting standard-independent non-comparability of accounting practices across national borders, to which the umbrella term "reporting environments" is applied, implies that the effects of accounting standards should optimally be studied on the basis of data of companies reporting within one and the same jurisdiction. The fact that, since 1997, German groups have been given the option to prepare their financial statements according to German GAAP, US-GAAP or IAS (see also Leuz and Verrecchia, 2000, Leuz, 2003, and Daske, 2005) means that the study of the association between data from consolidated financial statements and the market values of listed German enterprises is therefore a unique opportunity to study the standard-related effects. Bartov et al. (2004) are the first to make use of this natural experiment.[6] After controlling for partial freedom (self-selection) of enterprises to choose different standards in a treatment model, the authors show that there are no accounting standard-specific relevance effects between US-GAAP and IAS in terms of the information, but that information provided by IAS and US-GAAP are more strongly correlated with the firms' market value than German GAAP information.

Although the results produced by Bartov et al. (2004) are already much more robust than those of Zhao, for several reasons, in our opinion, they still do not permit a provisional assessment of the relative usefulness of accounting standards for R&D. Empirically, this is because (1) they do not explicitly examine R&D data, (2) the selection for enterprises (Stage 1) is mapped in a time-invariant manner and their contribution to explaining the market value (Stage 2) is reported without taking into account firm-specific effects, and (3) only data for the 1998-2000 period are available. What appears more fundamental from a theoretical perspective, however, is the criticism by Ball et al. (2004) of all previous studies that it is ultimately hardly possible to make a clear distinction between incentive and standard effects if enterprises are completely free to choose a standard. In the following section, we revisit the debate on selection and then explain why, theoretically, we think that it should still be possible to

[6] The term "first" here refers to the discussion on comparing standards from an equity valuation perspective. Leuz and Verrechia (2000) and Leuz (2003) already use the special features of the German institutional environment in earlier studies but against a different background. Daske's study (2005) is not directly comparable, either.

measure an R&D-specific standard effect and how one might go about modelling the selection in an econometrically optimal fashion. In the last part of the section, we will show why the reporting period should be extended for measuring the relevance of market values.

2.3 Selection

It seems to be generally recognised in empirical terms that executives sometimes consciously, and sometimes unconsciously, make decisions to select an accounting standard in their companies. Fields et al. (2001) summarise the determinants of these decisions under the following: agency costs, information asymmetries, and externalities for outsiders. Examining the comparative usefulness of accounting standards needs to take account of these effects, and even if only from an "equity valuation" viewpoint. Yet even if we control for companies' incentive structures in a theoretically well-founded manner and using extensive statistics, this is still no guarantee that the empirical results will allow us to draw a clear distinction between the existence of selection and standard effects per se. The following outline of the key studies on Germany as a "natural experiment" are intended to make this clear and, at the same time, to show why this study can provide additional important information.

Leuz and Verrechia (2000), Leuz (2003), and Bartov et al. (2004) map the institutional options for Germany in a detailed fashion by modeling the choices open to German groups in a segment-specific fashion (for the official and regulated markets: German GAAP or US-GAAP or IAS; for the Neuer Markt, US-GAAP or IAS).[7] At the content level, too, the selection specifications chosen here seem to be guided by theory. Explanatory variables such as the return on assets, the percentage of intangible goods, debt, the firm size and a cross-listing dummy are designed to map the determinants of the decision as well as is permitted by the availability of data.

At the econometric level, both Leuz and Verrechia (2000) as well as Bartov et al. (2004) use standard selection models (Heckman 1979), i.e. the selection process is modelled in two stages – in the first stage, a probit model captures the selection decision, and in the second stage, the main regression is estimated. The study by Bartov

[7] See Leuz and Verrechia (2000) and Bartov et al. (2004) for detailed descriptions of the freedom of choice.

et al. (2004), despite referring only to the 1998-2000 period, still addresses the problem of firms that change standards. The authors use a treatment model to take account of the effect of such firms which switch standards within the reporting period.

Within the framework of this research design, both studies show that, if the results are looked at only from a statistical perspective, no more standard effects can be observed for the Neuer Markt after controlling for self-selection. However, Bartov et al. (2004) find that, for the official and regulated market, US-GAAP and IAS, according to a purely significance-related criterion, show a standard-specific higher value relevance, which is robust to selection, than German GAAP.

Despite the fact that reality is presented in a manner that takes adequate account of institutional structures, is convincing in terms of content and uses extensive statistics, interpreting the apparently clear results of the above studies is, from a theoretical perspective, much less trivial, especially for the case of the apparent lack of standard-specific differences between US-GAAP and IAS balance sheets of companies listed on the Neuer Markt in terms of information quality (Leuz 2003). As Leuz (2003) mentions himself, his findings permit exactly two interpretations. Either there are standard-specific differences, in which case these differences are not noticeable in varying information quality between IAS and US-GAAP financial statements, to the extent that this is measurable in terms of the reduction in information asymmetry. Or, there are no standard-specific differences, and it is firms' incentive structures which are driving the findings.

It is precisely this scope for interpretation left by previous work that underscores the need to revisit two key questions. The first question is an outgrowth of the second option of interpretation presented by Leuz (2003b) and is fundamentally theoretical. What reason should there be for standard effect per se to play a role (for a critique of precisely this assumption see Ball et al 2004)? The circularity argument, which posits that standard-specific differences influence firms' incentives for choosing a standard, and that standard and selection effects are therefore inseparable, is positively overwhelming. But even if it were possible to resolve this circularity argument, what would a suitable empirical model for distinguishing the two types of effects look like? Although one-size-fits-all answers to the two questions are difficult to find, we still

think that, for selected parts of a standard – such as R&D accounting – the circularity argument can be refuted and empirically unambiguous (identified) models for separating standard and selection effects can be estimated. This is because even if (!) a firm's choice of a certain standard could be attributed entirely to a firm's incentives to utilise the aggregated characteristics of this standards (e.g. with regard to reducing information asymmetry or from an equity valuation perspective), i.e. no aggregated standard effect were to exist per se (as this would be wholly equivalent to the incentive effect), it is still possible that individual, selected aspects of the standards are not consistent with the overall incentive structure. In terms of the initial question posed by our study, this would also mean that the existence of a statistically significant R&D-specific value relevance effect, controlling for company self-selection for the choice of a standard, would, in precisely that situation, not be an "incentive artifact" but a "true (sub)-standard effect" if the R&D-specific picture of the firm does not have a key impact on the decision to choose a standard.[8] In their studies, Spanheimer and Koch (2000), however, have alluded to the fact that it is precisely these "experimental" preconditions which were in place for the groups in the German official and regulated market in the late 1990s. And that is exactly why we believe that it is not already theoretically impossible for the sub-element of R&D accounting chosen by us, based on our firm data (see below) to clearly identify a sub-standard effect per se. It is questionable, however, which estimation model is also capable of statistically uniquely distinguishing between R&D-specific standard and other overall incentive effects. We are not convinced that the econometric specifications chosen in earlier studies make maximum use of the heterogeneity inherent in the data in order to draw a clear line between firms' choice of standard and the "residual" standard effects. It is true that the Heckman approach is a standard approach for modelling selection bias and permits us to simultaneously explain the contribution of an explanatory variable to the relevance of the standard effect and the selection effect. The disadvantage of this, however, is that, if the classic Heckman model is used, the entire time-variability of the data is sacrificed. For one thing, this means that the time-dependency of firms' change of accounting standard is not captured. This seems critical to us insofar as motives for changing

[8] The existence of such an effect would also call into question the above-mentioned complementarity of the various elements of the standard.

standards or for choosing a given accounting standard prior to an IPO could already have changed in the 1998-2000 period owing to the strong rise in stock prices. This problem associated with the time-dependency of the changeover (first stage in the two-stage model) is accompanied by the entry-and-exit problem encountered when studying the association between market and book values (in the second stage) and the loss of the option of displaying firm-specific effects (second stage). If we follow the call by Fields et al. (2001, p. 300) to use empirical testing alternatives to the standardised procedures in order to detach standard effects and selection effects, then, for a comparative study of accounting standards in Germany, the above situation makes it appear wise to apply a design in which the selection equation is estimated year-specifically in the first stage and an association between market and book values studied in a fixed-effects panel in the second stage. The strength of such a model should be reflected, in particular, if the reporting period is extended, thereby accentuating the effect of differences between a pooled cross-sectional analysis and a panel analysis. However, it is precisely such an extension of the reporting period which seems desirable against the background of the relevance of the research design, as will be explained in the following section. Before moving on to 2.4, however, we shall defend the choice of our design against allegations of potential weaknesses. One alleged weakness of our approach is that selection and standard effects are no longer estimated completely simultaneously but instead, in some cases, sequentially. At this point we recall, however, that since the selection equation is estimated as the first equation, the results we have found should, in a pinch, take better account of the misgivings held by critics of the standard effect (e.g. Ball et al. 2004). In the first stage (selection equation), the entire variability of the R&D variable is initially available for mapping the standard effect, yet in the second stage (standard effect) only that part of the variability not already given via Mill's ratio.

2.4 Relevance

In their work, cited extensively in the foregoing, Holthausen and Watts (2001) explain in detail why the relevance of accounting information cannot be measured solely in terms of its contribution to explaining market values. To follow the authors' arguments, associative valuation studies are, at best, suited for testing the relevance of balance sheet information from an equity valuation standpoint. Even if we confine ourselves to this

perspective, however, other conditions need to be met in order to perform a relevance test. At this juncture, we will also discuss the fundamental work on the association between market values and book values done by Brainard and Tobin (1969). It is extremely relevant to the empirical analysis to use a reporting period with at least one complete cycle (of rising and falling prices), since, theoretically, asymmetrical reactions are also possible for these phases. Only by analysing at least one cycle will it be possible to reasonably test for potential symmetry characteristics. In empirical business cycle research and in the analysis of the monetary transmission process, it is regarded as desirable for data to, in an optimum case, comprise long periods covering several cycles.[9]

What the above remarks mean for a comparative study of different accounting standards within Germany is that the association between market values and book values should optimally be studied across a period from 1997 to 2003. Within this period, where all accounting standards were already in parallel use in Germany, the stock prices of companies listed in Germany underwent a strong upward and downward trend, and expectations regarding future earnings had to be corrected multiple times.

3 Hypothesis development and the research design

As presented at the beginning, we do not know of any study bridging the gap between the R&D accounting literature and the study of standard-specific effects using an empirical study design which takes due account of all key contingencies (selection bias, reporting environment). For the reasons discussed at the start, we regard this as a key gap in the research, with considerable consequences for practitioners.

However, there are important prior contributions that have provided empirical evidence on individual parts of the whole context. We combine these elements to reach the following hypotheses. Since the papers have already been discussed extensively in the foregoing, in this section we will only briefly point out their key findings as they relate to the formation of our hypotheses.

[9] See footnote 4.

Hypothesis 1:

If we look at the value relevance of intangible assets of groups listed on German exchanges, there appears to be a "spurious" standard-specific difference between IAS and US-GAAP which vanishes after controlling for partial freedom of choice (self-selection) of enterprises.

We obtain Hypothesis 1 by looking at Leuz and Verrechia (2000), Zhao (2002) and Bartov et al. (2004) in conjunction. Leuz and Verrechia as well as Bartov et al. indicate a levelling off of the standard specific effects of the simultaneous controlling for self-selection (which is consistent with Fields et al. 2001); Zhao's results, however, indicate that the general (ie across all types of assets) trend found in Bartov et al. should also be visible for intangible goods. Focusing on the subgroup that exclusively comprises immaterial assets permits us to make a clear distinction, not only econometrically but also theoretically (see 2.3), between standard and selection effects.

Hypothesis 2:

If we look at the value relevance of intangible assets of groups listed on German exchanges, we find that, after controlling for companies' self-selection, there are standard-specific differences which cause IAS/US-GAAP to have a higher value relevance than German GAAP.

Hypothesis 2 once again unites the studies of Zhao and Bartov et al., which, in this point, do not contradict one another.

Hypothesis 3:

The effect assumed by Hypothesis 2 should generally be detectable in times of both rising and falling stock prices, but more strongly in times of falling stock prices than in phases of rising stock prices.

Hypothesis 3 harks back to the fundamental assumption made by all papers on the measurement of the relevance of information based on market data (Brainard and Tobin), but also takes account of the empirical findings of the accounting literature (see Holthausen/Watts, p. 40), which, using "earnings" variables, find a higher contemporary correlation between balance sheet data and market values in falling market periods than in rising market periods (see Kothaari and Zimmermann 1995).

To test hypotheses 1 to 3, we have designed a research strategy that departs from the "classic" Q model (Brainard and Tobin, 1969) but has, in many ways, been tailored to the existing estimation problems. Like Griliches (1981) and many subsequent papers (Cockburn and Griliches, 1988, Megna and Klock, 1993, Bloom and van Reenen, 2000, and Hall et al. 2000), we assume an additively separable linear market value function at firm level.[10] This model assumes that the marginal shadow value V_{it} of assets is equally distributed across the firms in a sample. Equation 1 formalises the association

$$V_{i,t} = q_i \cdot \left(A_{it} + \gamma \cdot K_{it}\right)^o \tag{1}$$

,

where A_{it} denotes the nominal tangible assets and K_{it} nominal intangible assets. Through logarithmisation. by transposing Equation 1 and under constant returns to scale $(o = 1)$, we obtain Equation 2,

$$log\left(\frac{V_{i,t}}{A_{i.t}}\right) = log\, Q_{i,t} = log\, q_i + log\left(1 + \gamma \frac{K_{it}}{A_{it}}\right) \tag{2}$$

,

which, using the simplification $\log(1+x) \approx x$ for small values of x in numerous empirical studies, can already serve as the basic framework for estimating Tobin's Q. The latter simplification, however, does not appear justified for the data being examined in this paper. In line with Greene (2003, pp. 165-166), we linearise the model and transpose Equation 2 to the general estimation equation 3:

[10] That sets this approach apart from price and return models which are typically estimated in the reduced form with a smaller theoretical foundation. Kothari and Zimmermann (1995) give an overview of these models and discuss their pros and cons.

$$y_{it} = \alpha_i + f\left(x_{it} \cdot \beta\right) + \varepsilon_{it} = \alpha_i + f\left(x_{it} \cdot \beta^0\right) + \frac{\partial f\left(x_{it} \cdot \beta^0\right)}{\partial \beta^0}\left(\beta - \beta^0\right) + \varepsilon_{it} \quad (3)$$

,

where

$$y_{it} = log\left(\frac{V_{it}}{A_{it}}\right), f\left(x_{it} \cdot \beta\right) = log\left(1 + \gamma \frac{K_{it}}{A_{it}}\right)$$

and

$$\frac{\partial f\left(x_{it} \cdot \beta^0\right)}{\partial \beta^0} = \frac{\frac{K_{it}}{A_{it}}}{1 + \gamma^0 \cdot \frac{K_{it}}{A_{it}}}$$

The aim here is to estimate the equation using a fixed effects approach (within estimator) in which the disturbance term ε_{it} is decomposed into a fixed effect (η_i), a time effect (τ_t) and a stochastic disturbance term (υ_{it}).

Rearranging Equation 3 gives us Equation 4

$$y_{it}^* = y_{it} - f\left(x_{it} \cdot \beta^0\right) = \alpha_i + \frac{\partial f\left(x_{it} \cdot \beta^0\right)}{\partial \beta^0}\left(\beta - \beta^0\right) + \varepsilon_{it} \quad (4)$$

,

in which now the coefficient $\left(\beta - \beta^0\right)$ is estimated. Equation 4 therefore allows us to indirectly calculate the being sought for pooled cross-section data and pooled panel data alike.[11]

While Equation (4) would be a suitable estimation equation in a scenario where firms cannot choose between different standards, it clearly falls short in a world where self-selection matters. In the recent past, it has therefore become accepted practice to use two-stage Heckman selection models (Heckman, 1979) to disentangle standard and selection effects. Those approaches model the selection in the first stage and seek to capture standard-specific effects in the second. Thus, before estimating an Equation originating from Equation (4) in the second stage, in order to take account of potential distortions caused by self-selection, in a first stage we therefore also estimate a Heckman selection model (Heckman, 1979) like other authors before us. According to the approach of Bartov et al. (2004), mainly variables that are not already included in the Q model are entered into this equation, except for R&D information.

$$q_i^s = \alpha_0 + \beta_1 \text{ Cash Flow}_i + \beta_2 \text{ Size}_i + \beta_3 \text{ Intangibles}_i + \beta_3 \text{ Leverage}_i + \eta_{it} \quad (5).$$

Here, the variable Cash Flow is the quotient of cash flow and tangible assets, Size the logarithm of total assets, Intangibles the quotient of intangible assets and tangible assets, and Leverage the quotient of liabilities and total assets. Along with these balance sheet variables, we also took account of sector dummies based on the Wirtschaftszweigessystematik WZ93.[12]

While this paramaterization of the first stage of the Heckman model resembles that of our earlier works, the fact that we use panel econometrics in the second stage (and hence deviate from the classic Heckman selection model) is not trivial. In the Appendix we therefore show in detail that (and under which assumptions) our approach is econometrically identified. At this point of the paper we shall only mention that the use of panel econometric methods when estimating Equation (4) as the second stage of a modified Heckman model renders it necessary to define time-variant and invariant

[11] Here, Equation 4 is repeatedly estimated iteratively until the coefficient $\left(\beta - \beta^0\right)$ converges to zero. The value of the real γ from Equation 3 can then subsequently be calculated.

[12] The official system used by Germany's Federal Statistical Office.

Mill's ratios in the first stage. We do this by independently estimating Equation (5) – our first stage – for all reporting years used.

For the test of the hypotheses (bringing standard and selection issues together), the estimation Equation (4) is then finally enlarged by adding the inverse Mill's ratio (estimated in Stage 1) and an additional variable that distinguishes between observations using different standards. Finally, the estimation equation is enlarged such that all proxies for intangible assets can be estimated in the joint model (n=1: German standard; n=2: US-GAAP; n=3: IAS). Equation 6 reflects the association:

$$y_{it}^{*} = y_{it} - \sum_{n=1}^{3} f\left(x_{n,it} \cdot \beta_n^0\right) = \alpha_i + \sum_{n=1}^{3} \frac{\partial f\left(x_{n,it} \cdot \beta_n^0\right)}{\partial \beta_n^0}\left(\beta_n - \beta_n^0\right) + \delta \cdot Mill's_{it} + \lambda \cdot FinState_{it} + \varepsilon_{it} \qquad (6).$$ [13]

It has to be noted, however, that the coefficients $\beta_1 - \beta_3$ in Equation 6 can no longer be interpreted completely structurally.[14]

4 Empirical results – sample, description, statistical inference results

4.1 Data

The present data set was generated using information from various sources of data. The annual accounts information is based on the Hoppenstedt firm database, which provides detailed annual accounts information for firms using either German GAAP, IAS or US-GAAP to prepare their financial statements. For the analysis, firms meeting the following conditions were chosen:

- Existence of a group financial statement
- The group is in one of the following sectors: manufacturing, data processing and/or the provision of economic services.
- Market information (prices and number of debt instruments) is available.

[13] Since there is currently no statistical software for estimating this equation, an algorithm was independently developed using the Stata 8 software package.

[14] If our goal were a structural interpretation of the coefficients $\left(\beta_1 - \beta_1^0\right)$, $\left(\beta_2 - \beta_2^0\right)$ and $\left(\beta_3 - \beta_3^0\right)$ from estimation 6, this would mean that, theoretically, we would be assuming a multiplicative association of different intangible assets. This does not seem realistic.

This selection resulted in 563 firms with a total of 2,785 observations for the 1997-2003 period. The empirical analysis was conducted owing to potential selection effects for different market segments. Of these, 358 firms (1,960 observations) are in the official and regulated market and 205 (825 observations) are in the Neuer Markt.

The stock prices and number of securities were obtained using Datastream. Market information on firms was collected in line with the Hoppenstedt firm database standards. The prices used were those on the last trading day in the calendar year. The information on the number of securities contains stock denominations and the associated correction factors. The market value of a firm is then the product of the corrected price and the number of securities.

The variables used here were generated according to the following approach. The variable used in the first stage are the quotient of cash flow and tangible assets, the quotient of intangibles and tangibles, the quotient of liabilities and the balance sheet total and the logarithm of the balance sheet total. The market value of a firm i at time t is produced by the market value of the firm's capital, defined as the product of the number of shares of diversified ownership and the stock price, as well as the book value of liabilities. Tobin's Q is the quotient of market values and tangible assets (capital stock). The capital stock variables are needed at recovery cost for tangible and intangible assets. The perpetual inventory method is used to calculate these variables separately for each of the three accounting methods from the asset grid. Regarding the capital stock of intangible assets, it should be noted that German GAAP statements only include concessions, property rights and licences, whereas IAS and US-GAAP statements also include capitalised development costs.

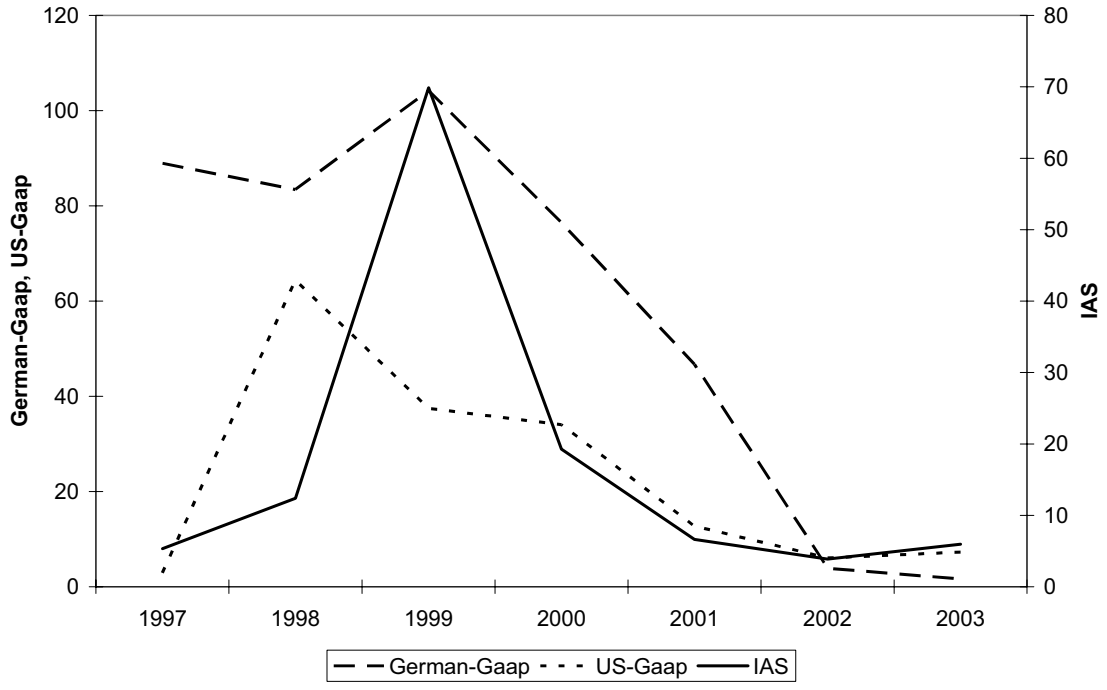
Since, during the observation period, some firms changed their accounting methods, relevant indicator variables which give an indication of the accounting method used to prepare financial statements for each individual observation were declared. During the period under review, 146 firms switched from German GAAP to IAS, 60 from German GAAP to US-GAAP, 7 from IAS to US-GAAP and 11 from US-GAAP to IAS. According to an empirical study by Spanheimer and Koch (2000) based on a survey, given motives for switching from German GAAP to an international accounting standard were, in particular, international comparability, increased transparency and

capital market expectations (of improved investor information). R&D transparency is not mentioned as an incentive.

4.2 Descriptive statistics

In the early 1990s, all market segments in Germany saw their stock prices rise tremendously. Towards the end of that decade, stock prices underwent distinct corrections, leading to a considerable reduction in the market value of companies listed on stock exchanges. Figure 1 shows the market to book ratio of the companies in the sample and highlights the trend that took place during the reporting period. A breakdown of the sample into the various accounting systems shows that the subsamples differ from one another. The slide in stock prices, however, can be retraced completely independently of the accounting system in question. It must be observed, though, that companies using international standards to prepare their financial statements have a much greater variance. In addition, the size of each subsample changes owing to market entries and exits[15] as well as changes in accounting standards.

Figure 1. Average values of the market to book ratio (total sample)



[15] Note that entry and exit phenomena also explain why in Figure 1 the stock market crash date seemingly does not have its peak in the year 2000 exactly.

Figure 2 shows the average trend of the variables used to estimate the selection model. The variables included in the estimation are geared towards the work of Bartov et al. (2004). These variables illustrate, in particular, the financial difficulties encountered by companies as the 1990s neared their end. Cash Flow, which is regularly cited as a measure of a company's profitability, diminished significantly during the period of stock price corrections. The average ratio of intangibles to tangibles fell continuously starting in 2000; however, this tends to be attributable to an increase in tangible assets. Average corporate indebtedness declined slightly beginning in 2001. The reason for this is that the sample is composed of relatively young companies, whose balance sheet totals are growing more strongly relative to liabilities.

Figure 2. Average values of the explanatory variables for the selection equation (total sample)

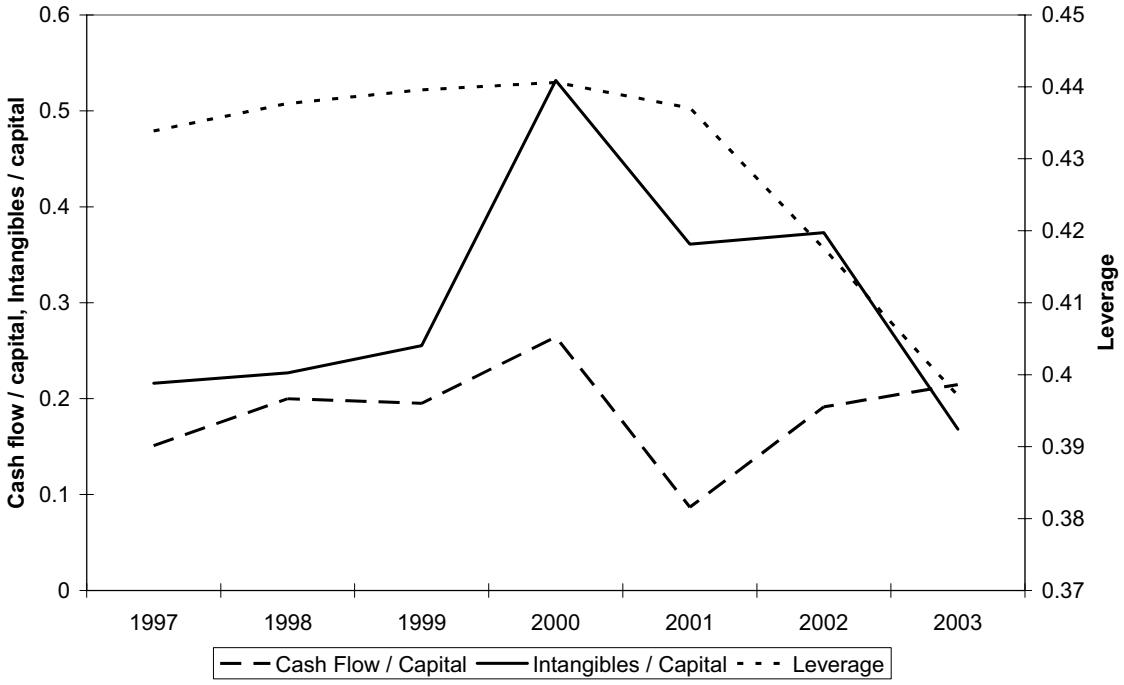


Table 1 provides a detailed description of the data used and illustrates the relative heterogeneity of the data. Unlike other empirical studies, what is particularly striking in this case is the extremely large value for the ratio between the market value and tangible assets (fundamental value). This is partly due to overvaluation on the Neuer Markt. The ratio of intangibles to tangibles, at an average of 2, may be regarded as very high. With the percentage share of concessions and capitalised production costs averaging 0.7

(IAS), 0.5 (US-GAAP) and 0.2 (German GAAP), it may be assumed that the funds were used to take over other companies (or participating interests in these companies).

Table 1. Descriptive statistics (overall sample)

	Obs.	Mean	St.dev.	Median	Lower percentile	Upper percentile
Market value / tangible assets	2476	50.2610	626.4569	2.3281	0.2161	338.8730
Intangible assets / tangible assets (German GAAP)	1386	2.0667	56.3923	0.0866	0.0005	14.1658
R&D assets / tangible assets (German GAAP)	1386	0.1646	0.9408	0.0366	0	2.3047
Intangible assets / Assets (US-GAAP)	457	1.7372	3.2989	0.6042	0	16.1554
R&D assets / tangible assets (US-GAAP)	457	0.4957	1.2776	0.1242	0	4.8344
Intangible assets / Assets (IAS)	768	1.9930	3.2999	0.5350	0	17.1083
R&D assets / tangible assets (IAS)	768	0.7196	1.9886	0.1531	0	8.7273
Cash flow / tangible assets	2476	-4.2249	131.0530	0.1411	-16.3389	4.5289
Liabilities / total assets	2476	0.3546	0.2322	0.3453	0	0.8651
Log total assets	2476	18.9147	1.8637	18.6136	15.3993	24.6093

Legend for Table 1:

The random sample for the period from 1997 to 2003 comprises firms from the official market, the regulated market and the Neuer Markt. Market values are calculated based on the last available price within a year. On the whole, information is available on 564 firms, 315 of which use German GAAP, 212 IAS and 140 US-GAAP. There were 224 documented changes of accounting standard during the reporting period. Tangible assets, intangible assets and R&D assets are calculated using the perpetual inventory method and are based on historical costs. R&D assets are composed of concessions and capitalised own work. Cash flow is the sum of annual surplus and depreciations.

4.3 Multivariate analysis

Whereas the descriptive statistics were dedicated to describing simple phenomena and plausibility testing, in this section we will present our findings regarding the detailed hypotheses. In the following chapter we will discuss the findings in detail.

Tables 2 to 4 show numerous regression results which we will discuss selectively in the following. We use the following abbreviations in Tables 2 to 4. German, US-GAAP and IAS correspond to the ratio of tangibles to intangibles using each respective standard. Standard D1 and Standard D2 are dummies for each respective accounting standard and control for a change in the standard. The Mill's Ratio results from the

selection equation. In Table 4, (H) is the bull market period and (B) the bear market period. What all estimates have in common is that, on the left-hand side, the Tobin Q is used. Each of the tables is split up into three main columns and two main rows. The main columns represent the three combinations of various market segments for which we replicate our estimates. The first column pools companies from all market segments. The second contains only companies listed on the official and regulated market, and the third column contains exclusively Neuer Markt companies. Given the different characteristics of the companies being studied and the various options for choosing an accounting standard depending on the market segment, this appears to be an important distinction. Within the segments, we finally estimate different specifications in which the stocks of intangibles are modelled/aggregated (details given elsewhere). The two main lines of Tables 2 to 4 differ in that, in the first main line, only self-created intangibles are used to form R&D stocks, whereas the second contains all of the company's intangibles. The key difference between Tables 2, 3 and 4, finally, lies in the modelling of selection bias (not modelled in Table 2 but modelled in Tables 3 and 4) and in the distinction between the timing effects before and after the 2000 stock market crash (modelled only in Table 4).

With regard to Hypothesis 1, we will look at the differences between companies using IAS and those using US-GAAP in terms of coefficients first in Table 2 (without modelling self-selection) and then in Table 3 (in which self-selection is modelled).

Leaving out the possibility of companies systematically choosing either IAS or US-GAAP, a look at the results in Table 2 shows that, if we look at all segments (column 1) and focus on intangibles produced inhouse, a standard-specific difference between IAS and US-GAAP does emerge. A test of coefficient equality confirms this assumption (test of differences IAS/US-GAAP: Prob > F=0.0000). However, none of the other specifications in Table 2 appears to support this finding, an impression which is confirmed by detailed tests of coefficient equality. In other words, we do not find any apparent standard effect when looking at the official and regulated market or the Neuer Markt in isolation.

Table 2. Results without selection bias

	All segments			Official and regulated market			Neuer Markt
	I	II	III	I	II	III	III
Panel A: R&D assets							
Constant	1.00	0.43	2.10	0.33	0.38	0.38	2.74
	(0.07)***	(0.21)**	(0.25)***	(0.06)***	(0.07)***	(0.15)**	(0.52)***
German Gaap	-0.07	0.12		0.18	0.25		
	(0.10)	(0.16)		(0.17)	(0.21)		
US-Gaap	-0.28		-0.13	-0.20		-0.16	-0.02
	(0.02)***		(0.06)**	(0.25)		(0.26)	(0.11)
IAS	-0.08	-0.09	-0.06	0.09	0.11	-0.13	-0.05
	(0.03)***	(0.02)***	(0.04)	(0.16)	(0.17)	(0.22)	(0.03)
Standard D1	-0.07	0.30		0.11	0.03		
	(0.07)	(0.21)		(0.06)*	(0.06)		
Standard D2	0.31	0.37	-0.56	0.41	-0.25	1.15	-0.24
	(0.12)***	(0.22)*	(0.22)**	(0.11)***	(0.18)	(0.26)***	(0.26)
Obs	2233	1843	1037	1610	1488	440	586
Firms	440	357	244	291	274	99	141
R-squared	0.28	0.16	0.34	0.09	0.08	0.17	0.59

Table 2 continued.

Panel B: Intangibles							
Constant	1.24	0.36	1.52	0.35	0.07	1.43	3.12
	(0.11)***	(0.21)*	(0.21)***	(0.06)***	(0.17)	(0.22)***	(0.20)***
German Gaap	0.06	0.29		0.29	0.35		
	(0.05)	(0.11)***		(0.10)***	(0.11)***		
US-Gaap	-0.04		-0.01	0.08		0.45	0.01
	(0.01)***		(0.03)	(0.15)		(0.26)*	(0.04)
IAS	-0.03	-0.03	-0.01	-0.06	-0.04	-0.11	0.02
	(0.01)***	(0.01)***	(0.02)	(0.04)	(0.04)	(0.04)***	(0.04)
Standard D1	-0.34	0.29		0.04	0.28		
	(0.11)***	(0.21)		(0.06)	(0.16)*		
Standard D2	-0.24	0.43	0.56	0.31	0.31	-0.96	-0.19
	(0.12)**	(0.22)**	(0.22)**	(0.13)**	(0.17)*	(0.25)***	(0.27)
Obs	2233	1838	1035	1607	1485	437	583
Firms	439	355	243	290	273	98	140
R-squared	0.20	0.17	0.34	0.10	0.10	0.22	0.58

Legend for Table 2:

All calculated coefficients and standard errors are based on a linearised fixed effects estimate using a complete set of time dummies for the 1997-2003 period. *** Significant at the 10% level, ** significant at the 5% level and * significant at the 1% level. Estimates in columns I are based on a modelling of the selection German GAAP vs. US-GAAP/IAS, in II on German GAAP vs. IAS, and in III on IAS vs. US-GAAP. The inverse Mill's ratio is disregarded in the estimates. The logarithm of market value to book value is the dependent variable. In panel A the quotient of licences and capitalised development costs for fixed assets is used for each of the variables German GAAP, US-GAAP and IAS. In panel B the quotient of intangibles and fixed assets is used for each of the variables German GAAP, US-GAAP and IAS. Standard D1 and Standard D2 are indicator variables that reflect a standard change.

Table 3. Results with selection bias

	All segments			Official and regulated market			Neuer Markt
	I	II	III	I	II	III	III
Panel A: R&D assets							
Constant	0.75	4.60	1.63	0.43	0.16	9.01	3.46
	(0.05)***	(0.39)***	(0.22)***	(0.03)***	(0.17)	(8.95)	(0.25)***
German	-0.02	0.12		0.30	0.38		
	(0.12)	(0.17)		(0.20)	(0.24)		
US-Gaap	-0.33		-0.12	-0.15		-0.10	-0.06
	(0.03)***		(0.07)*	(0.27)		(0.28)	(0.10)
IAS	-0.10	-0.10	-0.09	0.06	0.08	-0.61	0.10
	(0.03)***	(0.03)***	(0.04)**	(0.18)	(0.19)	(0.14)***	(0.16)
Mill's ratio	-0.79	-1.41	-0.29	-0.16	-0.04	-1.23	-3.48
	(0.11)***	(0.14)***	(2.11)	(0.08)*	(0.02)*	(1.46)	(1.57)**
Standard D1	5.24	-3.90		1.22	0.24		
	(0.67)***	(0.39)***		(0.51)**	(0.16)		
Standard D2	11.49	-3.01	2.38	2.16	0.36	-8.57	20.93
	(1.53)***	(0.34)***	(12.92)	(1.16)*	(0.18)**	(8.95)	(9.56)**
Obs	2000	1696	820	1503	1407	344	465
Firms	440	357	244	291	274	98	141
R-squared	0.27	0.23	0.40	0.10	0.09	0.28	0.64

Table 3 continued.

	All segments			Official and regulated market			Neuer Markt
	I	II	III	I	II	III	III
Panel B: Intangibles							
Constant	11.65	4.44	1.61	1.89	0.50	0.52	26.01
	(1.56)***	(0.40)***	(0.22)***	(1.18)	(0.10)***	(0.14)***	(9.72)***
German	0.04	0.20		0.27	0.31		
	(0.04)	(0.10)**		(0.10)***	(0.11)***		
US-Gaap	-0.05		-0.02	0.10		0.54	-0.01
	(0.01)***		(0.03)	(0.17)		(0.31)*	(0.03)
IAS	-0.04	-0.03	-0.03	-0.12	-0.11	-0.14	0.05
	(0.01)***	(0.02)*	(0.02)	(0.02)***	(0.02)***	(0.02)***	(0.06)
Mill's ratio	-0.75	-1.36	-0.73	-0.10	-0.02	-1.87	-3.75
	(0.11)***	(0.14)***	(2.13)	(0.08)	(0.02)	(1.42)	(1.58)**
Standard D1	-10.93	-3.79		-1.43	-0.15		
	(1.54)***	(0.40)***		(1.16)	(0.10)		
Standard D2	-6.00	-2.94	5.06	-0.60	-0.40	12.27	-22.62
	(0.89)***	(0.34)***	(13.05)	(0.67)	(0.18)**	(8.71)	(9.65)**
Obs	2002	1691	817	1501	1405	344	461
Firms	439	355	243	290	273	98	140
R-squared	0.24	0.22	0.39	0.15	0.14	0.41	0.64

Legend for Table 3:

All calculated coefficients and standard errors are based on a linearised fixed effects estimate using a complete set of time dummies for the 1997-2003 period. *** Significant at the 10% level, ** significant at the 5% level and * significant at the 1% level. Estimates in columns I are based on a modelling of the selection German GAAP vs. US-GAAP/IAS, in II on German GAAP vs. IAS, and in III on IAS vs. US-GAAP The inverse Mill's ratios are calculated from a time-specific probit estimation at the first stage. This estimation incorporates intangible assets / tangible assets, cash flow / tangible assets, liabilities / total assets, the logarithm of total assets and industry dummies as the explanatory variables. The logarithm of market value to book value is the dependent variable in the second stage. In panel A the quotient of licences and capitalised development costs for tangibles is used for each of the variables German GAAP, US-GAAP and IAS. In panel B the quotient of intangibles and fixed assets is used for each of the variables German GAAP, US-GAAP and IAS. Standard D1 and Standard D2 are indicator variables that reflect a standard change.

Whereas Table 2 yielded only scant evidence of a standard-specific effect between IAS and US-GAAP, however, in direct contrast to the expectation from Hypothesis 1 in Table 3, i.e. after explicitly recognising potential self-selection among firms, several specifications seem to indicate such a standard effect. When looking at exclusively self-created intangibles for the entire sample, coefficient tests confirm a significant difference between IAS and US-GAAP, regardless of whether the dichotomous self-selection of enterprises is modelled between German GAAP and IAS/US-GAAP (all segments, column I; difference test between IAS/US-GAAP: Prob>F=0.0000) or between IAS and US-GAAP (all segments, column III; difference test IAS/US-GAAP: Prob.F=0.0000). In a direct comparison covering only those companies in the official and regulated market that chose from between IAS and US-GAAP, we again confirm, in direct contrast to the expectation from Hypothesis 1, that there is a standard-specific difference which remains even after controlling for companies' self-selection (Official and regulated market, column III; difference test IAS/US-GAAP Prob>F=0.1003). These results also hold, in some cases, for estimations made using all intangible assets.

Hypothesis 2 requires us to look at the differences of the coefficients for intangible assets formed according to IAS and to US-GAAP, on the one hand, and their German GAAP counterparts, on the other. It makes sense, for starters, to describe the results of the supporting regression model (selection bias) prior to the results of the main regression model (standard effect).

In order to study Hypothesis 2 (and 3), in a first step Heckman selection equations were estimated. When estimating the equation under the assumption of a selection between German GAAP, on the one hand, and US-GAAP or IAS, on the other (in tables 3 and 4, each the column labelled I), the Cash Flow and Size variables are negatively correlated, whereas the Intangible and Leverage variables have a positive sign. Successful and large firms, accordingly, tend to choose an international standard to prepare their balance sheets. Indebted firms and firms with a high percentage of intangibles, by contrast, tend to apply German GAAP. Estimation under the assumption of a distorted selection between German GAAP and IAS (in Tables 2, 3 and 4, the column marked II) provides the same empirical result. If the equation is estimated under the assumption of a selection between IAS and US-GAAP, however, no clear empirical

results are found. The signs of the estimated coefficients vary and therefore point to the absence of a systematic correlation.

We can observe the following phenomena with regard to the standard effect. If we observe all segments across the entire reporting period, correct for self-selection, and focus on purely those intangibles that were produced inhouse (Table 3, upper section), only the companies using IAS and US-GAAP to prepare their statements seem to have stocks of intangible assets that correlate significantly with the market value. It appears that the results are robust to the method of modelling the self-selection.[16] With the exception of the estimation in column III for the Neuer Markt, which only compares companies using IAS and US-GAAP to prepare their financial statements, the result is similar if the analysis is extended to cover all of the company's intangibles (under section Table 3). As expected, for all estimations in Table 3, tests of coefficient equality between German GAAP coefficients and the US-GAAP coefficients are to be rejected. Only when examining all of the companies' intangible assets do statistically significant differences crop up between IAS and German GAAP. Interestingly, however – even after modelling potential systematic distortion through the companies' choice of standard – all stocks subject to IAS/US-GAAP have negative (!) signs. This result appears to contradict the expectation according to Hypothesis 2. The negative correlation of the IAS/US-GAAP coefficients and their significant difference to German GAAP coefficients is a sign of a systematically lower value relevance of international/US accounting standards. What is also remarkable is that this effect seems attributable to self-created intangible assets, in particular.

Finally, the results from Table 4 allow us to draw conclusions about the associations suspected to exist in Hypothesis 3.

[16] These results are obtained both when comparing pooled German GAAP/US-GAAP statements with IAS statements and when comparing German GAAP statements with pooled US-GAAP/IAS statements.

Table 4. Results with selection bias and time interaction

	All segments		Official and regulated market		Neuer Markt
	I	II	I	II	III
Panel A: R&D assets					
Constant	0.73	8.38	0.44	0.03	12.82
	(0.05)***	(1.15)***	(0.03)***	(0.17)	(11.09)
German (H)	-0.21	-0.13	0.11	0.04	
	(0.11)**	(0.15)	(0.20)	(0.21)	
German (B)	0.13	0.54	0.56	0.59	
	(0.16)	(0.25)**	(0.27)**	(0.28)**	
US-Gaap (H)	-0.17		-0.25		-1.08
	(0.20)		(0.24)		(0.37)***
US-Gaap (B)	-0.33		-0.16		-0.06
	(0.03)***		(0.28)		(0.10)
IAS (H)	1.19	1.34	-0.60	-0.47	0.18
	(0.35)***	(0.36)***	(0.44)	(0.46)	(0.28)
IAS (B)	-0.08	-0.08	0.02	-0.01	0.09
	(0.04)*	(0.04)**	(0.17)	(0.17)	(0.15)
Mill's ratio	-0.64	-0.53	-0.16	0.02	-1.59
	(0.11)***	(0.08)***	(0.08)*	(0.01)*	(1.80)
Standard D1	4.30	-7.68	0.00	0.38	
	(0.67)***	(1.15)***	(0.00)	(0.17)**	
Standard D2	9.30	-4.67	2.22	0.17	-9.45
	(1.54)***	(0.68)***	(1.18)*	(0.18)	(10.97)
Obs	2000	1696	1503	1407	463
Firms	440	357	291	274	141
R-squared	0.28	0.23	0.10	0.10	0.64
Panel B: Intangibles					
Constant	9.12	7.59	0.44	0.21	24.16
	(1.57)***	(1.17)***	(0.04)***	(0.17)	(11.72)**
German (H)	0.06	0.22	0.30	0.28	
	(0.06)	(0.11)**	(0.12)**	(0.12)**	
German (B)	0.02	0.28	0.29	0.31	
	(0.05)	(0.12)**	(0.11)***	(0.12)***	
US-Gaap (H)	0.16		-0.07		0.03
	(0.10)		(0.17)		(0.08)
US-Gaap (B)	-0.06		0.18		-0.02
	(0.01)***		(0.19)		(0.03)
IAS (H)	0.51	0.62	-0.15	-0.11	0.11
	(0.14)***	(0.15)***	(0.09)*	(0.10)	(0.12)
IAS (B)	-0.03	-0.02	-0.11	-0.12	0.05
	(0.02)	(0.02)	(0.02)***	(0.02)***	(0.06)
Mill's ratio	-0.58	-0.49	-0.11	0.01	-3.46
	(0.11)***	(0.08)***	(0.08)	(0.01)	(1.90)*
Standard D1	-8.40	-7.04	0.85	0.33	
	(1.56)***	(1.15)***	(0.52)	(0.17)*	
Standard D2	-4.55	-4.31	1.53	0.28	-20.86
	(0.89)***	(0.68)***	(1.18)	(0.18)	(11.59)*
Obs	2002	1691	1501	1405	461
Firms	439	355	290	273	140
R-squared	0.27	0.22	0.14	0.15	0.64

Legend for Table 4:

All calculated coefficients and standard errors are based on a linearised fixed effects estimate using a complete set of time dummies for the 1997-2003 period. *** Significant at the 10% level, ** significant at the 5% level and * significant at the 1% level. Estimates in columns I are based on a modelling of the selection German GAAP vs. US-GAAP/IAS, in II on German GAAP vs. IAS, and in III on IAS vs. US-GAAP The inverse Mill's ratios are calculated from a time-specific probit estimation at the first stage. This estimation incorporates intangible assets / tangible assets, cash flow / tangible assets, liabilities / total assets, the logarithm of total assets and industry dummies as the explanatory variables. The logarithm of market value to book value is the dependent variable in the second stage. In panel A the quotient of licences and capitalised development costs for tangibles is used for each of the variables German GAAP, US-GAAP and IAS. In panel B the quotient of intangibles and fixed assets is used for each of the variables German GAAP, US-GAAP and IAS. Standard D1 and Standard D2 are indicator variables that reflect a standard change. The German GAAP, IAS and US-GAAP variables are used time-interactively in panels A and B. H designates the bull-market period from 1997-99 and B the bear-market period from 2000-03.

What makes the results interesting is that, at least to some extent, they bridge the discrepancy between the unexpected findings and the original expectations from Hypothesis 2. In the Table 4 regressions, we break down the correlation between intangible assets and market value not only according to market segment and accounting standard but also into two separate time regimes. Methodologically, we interact the stocks of intangibles with two dummy variables that assume the values 0 or 1 for the period before the stock market crash in Germany (1997-2000) and for the period thereafter (2001-02) assume, conversely, the values 1 or 0; this means we report each stock twice, once for the period before and once for after the bursting of the bubble.

In this study, we “once again” find some of the results of Bartov et al. (2004). A look at the upper section of Table 4 shows that, if we look at all market segments and focus squarely on self-created intangibles, the value relevance of IAS information before the stock market crash is indeed higher than that of German GAAP information (column 2, all segments, German GAAP vs. IAS; Prob>F=0.0002) – a results that is partly consistent with Hypothesis 2 and the first part of Hypothesis 3. Interestingly, this effect does a 180 degree turn precisely for the period after the stock market crash, both regarding the difference between German GAAP and IAS and for the difference between German GAAP and US-GAAP (German GAAP vs. IAS; Prob>F=0.0764, German GAAP vs. US-GAAP/IAS; Prob>F=0.0043). Apparently the post-stock market crash phase dominates all events across the reporting period, as is evidenced by the

results in Table 3. By modelling companies' choice of standard, we once again rule out the possibility of the findings being what might seem to be an appropriate standard-independent selection effect of enterprises in preferring one standard over another one. Here, the panel modelling of self-selection, which takes account of firms' option to choose another accounting standard annually – meaning it also captures a potential standard switch after a stock-market crash! – is particularly important. The relative superiority of German GAAP in presenting information in a market-oriented manner (or, conversely, in its not being able to be misused to overvalue the firm in a non-market-oriented manner) reveals itself distinctly if we limit the scope of our observation to companies in the official and regulated market. For these market segments, in which firms are completely and truly free to choose between German GAAP, US-GAAP and IAS, we see clearly that IAS accounting enables overvaluation, which is not possible under German GAAP. Whereas there are no significant differences between standards in the "bull market" period, the IAS accounting information is negatively correlated, and German GAAP information positively correlated, with the residual market value during the "bear market" period (prior to 2000: German GAAP vs. US-GAAP/IAS; Prob>F=0.1319, German GAAP vs. US-GAAP/IAS: Prob>F=0.2607, after 1999: German GAAP vs. US-GAAP/IAS: Prob>F=0.0690, German GAAP vs. US-GAAP/IAS: Prob>F=0.0384). Like the results in Table 3, the outcome of the estimates for all intangibles varies as well. This already provides evidence of special features concerning the aggregation of intangible assets, which will be discussed in further detail below.

We believe that the findings we have described in the foregoing urgently need to be discussed, something we will try to do adequately in the next chapter.

5 Discussion

As in the preceding chapter, we will use our hypotheses, in the order in which we first raised them, as a backbone for our discussion. We will begin by pursuing both purely scientific, i.e. theoretical as well as empirical and methodological strands, and will then proceed by discussing those aspects that are important to legislators and policymakers, in particular.

First, however, a repeated reminder of how our conclusions result from the possibilities and limitations of our research design is in order. We are consciously conducing the debate on standards from a pure equity valuation perspective and take due account of this restriction in the discussion. The focus on intangibles is likewise intentional, though, for reasons mentioned earlier, we will pay the closest attention to self-created intangible assets (produced inhouse). Irrespective of the fact that it would seem important to have a broader perspective than the equity valuation perspective in order to compare the usefulness of accounting standards, we still hold an assessment of the relevance of information to be a key aspect. And, though R&D information may represent only a cut-out of the information that is relevant for accounting purposes, its significance to investors in modern high-tech companies has still been rising sharply. At the same time, however, it seems plausible to assume that it is precisely companies' choice of standard on the German official and regulated market that is not (yet) driven primarily by the specificity of R&D for each respective standard; therefore the incentive effect and the (sub-)standard effect for R&D do not necessarily have to match and, as a result, seem to be separable.

The survey of listed firms conducted by Spanheimer/Koch (2000) indicates that, international comparability, increased transparency and improved information for international investors are the primary drivers of a decision to change accounting standards. The authors find no evidence of improved accounting of R&D as a reason to switch to, or introduce, an international standard.

Under this assumption, though, there is also no ex ante theoretical circularity of the aggregated incentive effect and the possibilities presented by the standards having to match, which would make incentive and standard effects indistinguishable. Therefore, R&D effects would not automatically have to be called an incentive artifact in the second stage of the design, and they are even to be unambiguously regarded as a standard-specific effect if we control for potential incentives from the R&D area in the first stage. The inclusion of the intangibles variable in the first stage of our research design served precisely the lattermost purpose.

One of the facts we note from looking at the whole study and based on this design is that R&D-specific differences between IAS and US-GAAP do seem to play a role in

Germany, and especially if corrections are made for the possibility of firms' self-selection over the various years in the reporting period. In terms of amount, the US-GAAP coefficient is higher in some estimates than its IAS counterpart, though it is difficult to precisely interpret this finding. If we examine all segments together, however, the R&D information for firms using US-GAAP to prepare their financial statements seems to correlate more strongly with overinvestment than the information for firms using IAS (more details below). This outcome is unexpected and requires discussion. Initially, a reminder is in order: the number of firms using US-GAAP to prepare their statements is small compared to those using IAS. Therefore, the significance of the effect is visible only if the market segments are estimated as a pool, since, in a segmented view, the coefficients for US-GAAP become insignificant. Apart from that, this contradicts earlier work, and this phenomenon requires explanation. It should generally not be ruled out that differences in the methodology and the reporting period of the study influence the results in a manner that we do not capture either theoretically or empirically. If we look closely at the data, however, there is another explanation that seems to us to be plausible, one that is closely associated with a well-known fundamental critique of the Tobin Q model. Though we do not observe any systematic differences regarding the ratio of intangibles to firms' total fixed assets, we do see that the US-GAAP firms are systematically larger than IAS firms. The size difference, as a non-explicitly modelled contingency variable, can very well impact on the results.[17] Share prices of large firms (one prominent example being the T-Online stock) tend to react – ceteris paribus – with less volatility than smaller enterprises.

With regard to the comparative usefulness of IAS, US-GAAP and German GAAP, our results are again a direct challenge to those of earlier research. The clearest result, in statistical terms, that we find for different variants of the self-selection model and for different market segments is that the value relevance of IAS and US-GAAP is lower relative to German GAAP. In particular, the estimates, which show results for the different regimes (before and after the stock market crash) can produce compelling evidence on why our results are different from those of earlier research. Even though differences could already be attributed to the specific selection bias of firms in the panel

[17] NB. The RD model captures firm-specific effects; however, these effects are driven by other characteristics and not just by firm size.

(Table 3), the distinction between "bull market" and "bear market" regimes, however, show clearly that the negative parameters for IAS and US-GAAP across the entire reporting period are particularly influenced by the period after 2000. For the stage of falling stock prices, US and international accounting rules result in a negative correlation of intangible stocks and residual market values, whereas the prudence principle that governs German accounting practices causes the residual market value information to be represented in line with expectations in terms of amounts. Irrespective of the charged nature of the content, the finding is methodologically interesting. Whereas several econometric designs for studying value relevance using the earnings variable (Kothaari and Zimmermann, 1995) find that book values adapt asymmetrically more quickly to market variables for bear-market phases (as opposed to bull-market phases), the research design chosen here, avoiding the earnings variable, cannot confirm the results. Admittedly, from an econometric perspective, the reporting period is a bit too short in order to conclusively assess the dynamics, though.

Although we are convinced that the above results, owing to the chosen research design, present quite clear evidence that R&D-specific standard effects exist, they seem to also present multifaceted points of reference regarding the dynamics of the association between standard effects and firms' incentives.

US-GAAP and IAS, which allow expenditure on self-created R&D to be expensed either in the financial statement or in the balance sheet, and which are more strongly discretionary than German GAAP, have a somewhat greater signalling effect to investors of expected income. Firms that use US-GAAP or IAS to prepare their statements and that are active in the hi-tech sector will – ceteris paribus – have better access to outside funds (something which is also confirmed by the results of the estimations of the selection equations) than firms using German GAAP. Especially in "bull market" periods, this can lead to a capital surplus that culminates in investment which is not necessarily tied to expectations of revenue. In the bear market period, these expectations would have to be corrected sharply, but firms' commitment to high revenues from the "bear market" period creates incentives not to do so at first. A theoretical solution for the firm in order to ostensibly not lower investors' profit expectations but still to present itself more in line with market realities could be to revert to the old standard (German GAAP). An incentive effect which, in the bull

market period, does not determine the choice of standard but is tacitly accepted as a standard effect, and which is the result of the R&D-specific preparation of a balance sheet according to US-GAAP or IAS, can then theoretically act as an incentive for reverting to the previous standard in the bear market period.[18] The above interpretation of our own results seems to obviate the unambiguousness of our own findings, which we defended earlier in the text as standard effects, and seems to agree with Leuz and Verrechia (2000) and Ball et al. (2004), in that a standard's ability to provide investor information ultimately creates incentive effects. For clarifying the apparent contradiction, the decisive argument seems to us to be that the time-variant exogenous factors can lead to the theoretical options which a standard gives a company to present itself, being, at a certain time, either compatible with, indifferent to or opposed to incentives. To distinguish between standard incentive effects and unidirectional incentive effects, it therefore appears to be necessary to take, as a basis, the supposed awareness of managers at the time the choice is made.[19] It therefore always makes sense to us to speak of standard effects in cases where incentive indifference exists at the time the accounting standard is chosen. Ceteris paribus, incentive effects exist if the options of the standard are important when the standard is chosen. Against this backdrop, we wish to underscore once again the importance of dynamically modelling enterprises' choice of standard. It should be remembered that our self-selection model is "close to reality" by reflecting the option, available to the individual firm, of changing its accounting standard at a specific point in time to reflect the external environment. Such multiple standard changes are unlikely, given the high transaction costs of changing standards; however, irrespective of this, our selected approach – unlike time-invariant modelling – allows us to capture the significance of the point in time of the standard change. This changeover can be dictated not only by firm-specific effects but also by exogenous time-variant factors such as the business cycle or also the stock market situation (bull market or bear market).

[18] It is initially unimportant theoretically that these reversions are not observed.

[19] A note in passing: similar definitional problems are commonplace in, for instance, jurisprudence with regard to the establishment of facts, and are likewise resolved by basing them on the consciousness of the agent at the time of the event.

6 Summary

This article sought an answer to the following main question: which accounting standard makes the greatest contribution to explaining firms' market value in terms of the accounting treatment of intangibles? As became obvious in the course of the literature review, another implicit questions was directly associated with this first question question. Namely, whether such a standard effect could ultimately be disentangled from an incentive effect for companies to choose a standard?

Citing the extant literature, we were initially able to show that – irrespective of the large number of already published equity valuation studies (see Holthausen and Watts, 2001) – these are not only intrinsically important questions (see Lev and Zarowin, 1999) but also questions that have remained unresolved and therefore, on the whole, entirely relevant. We delineated the need for a comparative value relevance study focusing exclusively on intangible assets, taking into account the contingencies of the accounting regime (see Pope and Walker 1999, Ali and Hwang 2000), disentangling (sub-)standard and selection effects, capturing firm-specific effects, and looking at data across an entire business cycle. We provided the required theoretical argumentation for why the isolation of R&D-specific standard effects should, in principle, be possible if and when the latter are largely incentive-indifferent for firms when choosing a standard. We furthermore suggested an econometric design that allowed modeling selection effects on panel data to meet the empirical requirements.

This study, based on a primary set of accounting and market data for firms listed in Germany between 1997 and 2003, then sought to generate robust empirical evidence as an answer to the above questions.

The key results can be summarised as follows. In the context of our research design, we do find signs of differences between US-GAAP, IAS and German GAAP accounting standards regarding the value relevance of intangible assets -- which is consistent with earlier research. Unexpectedly, however, our study finds that German accounting rules appear to be better suited to informing investors realistically. From a statistical and theoretical perspective, we attribute this to the fact that German GAAP, with its emphasis on the prudence principle and strict "lower of cost or market"

principle, prevents the representation of overinvestment that could be engendered by unfounded earnings expectations. In addition, from a statistical perspective, we find slight evidence that, for firms listed in Germany, this relative overvaluation of firms is more strongly correlated with US-GAAP than with IAS. Since, however, this result must largely be regarded as a segment-specific effect which, in addition, may well be driven by residual inability of the selected structural model to represent real-life events, we do not put too much stock in the interpretation of this result.

An interpretation of our results that revisits the time-variability in our data ultimately leads us to the conviction that, for distinguishing between standard and incentive effects (see Ball et al. 2004), it is of decisive importance to capture dynamics and to use the (alleged) consciousness of management at the time of the changeover for the interpretation. We conclude that only looking at time-varying contingencies allows us to divide the theoretical options given to a user by a standard into standard-specific options and incentive-specific options, depending on whether certain options were incentive-correlated or not at the time the standard was chosen. In light of all these arguments, our estimations, which explicitly reflect the time of the standard change and control for self-selection, report R&D effects in both bull-market periods and bear-market periods as clearly (primarily) standard effects. The non-reversion to earlier standards in the bear-market periods, in particular, shows that R&D-specific standard effects are, at most, second-order incentive effects. It remains to be noted that this research design has limits that should not be disregarded when looking at the results. For one thing, we have not explicitly modelled the signalling effects of accounting information on firms' stock prices. A reminder of the limitations of value relevance as a criterion for choosing an accounting standard is in order in regard to deriving the normative consequences (see Holthausen and Watts 2001). Irrespective of this, we think it seems appropriate to look at the legislative aspect of our results, as they relate to accounting practices, which are undergoing radical change in Europe. As regards relevance for R&D, we believe one cannot rule out the possibility that the introduction of international standards in Germany may have led to potential disadvantages regarding investor information. Whether these disadvantages seem acceptable when compared with the potential advantages of international standardisation is a further question that must be left to future research. For the IFRC, there is, at the very least, a

need for discussion regarding market-oriented correction – especially the expensing – of intangible assets. We are therefore leaning towards presenting R&D information which is less objective but interpretable for the informed investor in the annex to the balance sheet so that the risk to the less informed retail investors who orient themselves exclusively to the balance sheet is reduced while at the same time providing a forum to disseminate potentially relevant information. In addition, contrary to frequently voiced assertions, US-GAAP and German GAAP are no closer to one another from an investor's point of view regarding intangible assets than IAS to German GAAP – and this should be taken into account in the discussion.

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Appendix

Following Wooldridge (2002, p. 562) our q-model can be formulated by

$$y_{it} = x'_{it}\beta + z'_{it}\delta + \mu_i + u_{it} \tag{A1}$$

Consider for example the choice of IAS $(z_{it} = 1)$ in the selection equation, then

$$E\left[y_{it} \middle| z_{it} = 1\right] = \beta' x_{it} + \mu_i + \omega\lambda_{it} \tag{A2}$$

where

$$\lambda_i = \frac{\phi(\gamma' w_{it})}{\Phi(\gamma' w_{it})} \tag{A3}$$

is the inverse Mill's ratio, which, for the moment, we assume as to be known (e.g. Greene 2003, p. 782). Model (2) can be estimated by using a within-group estimator. Of course, the problem is to consistently estimate the inverse Mill's ratio. To do this we (have) assume that the choice can be modelled by the selection equation.

$$z^*_{it} = w'_{it}\gamma + v_{it} \tag{A4}$$

$$z_{it} = 1 \quad if \; z^*_{it} > 0 \tag{A5}$$

If u_{it} and v_{it} are correlated then u_{it} and z_{it} are also correlated and the inverse Mill's ratio takes account of the (corrected for) endogeneity bias. Additionally we assume that for every i and t the error terms μ_{it} and v_{it} (are identically distributed (i.d.). The variance of v_{it} is (set to unity) 1.

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