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The pricing of acquired intangibles

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ABSTRACT:
This paper investigates the value relevance of acquired intangible assets using a comprehensive hand-collected dataset for 1,647 publicly listed US-firms from 2002 to 2018. This dataset allows us to disentangle acquired intangible assets into different classes (e.g., tech-, customer-, contract-, and marketing-intangible assets) and their respective economic lifetimes (i.e., definite vs indefinite useful lives) to test their relevance for equity investors. We predict and find positive associations for nearly all intangible assets, however with different economic significance. In particular, tech- and customer-related intangible assets are priced by equity investors. Furthermore, we find that definite intangible assets are more relevant than indefinite intangibles. These results are helpful for firms and their equity investors to understand the economic impact of intangible assets. Finally, the findings are particularly important for regulators given the recent proposition of the Financial Accounting Standards Board to subsume customer-related intangible assets and non-compete agreements into goodwill. While our results suggest that customer-related intangible assets are priced significantly by equity investors, this is not the case for non-compete agreements.

Key words: Intangible assets, business combinations, equity pricing, valuation, standard setting

JEL Codes: G14, G32, M40, M41

Data availability: Data is available from the public sources cited in the text

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I. INTRODUCTION

The accounting for intangible assets remains one of the most debated topics among accounting practitioners and academics.[1] At the core of this debate is the extent to which recognized intangible assets provide relevant information that is also reliable to financial statement users, particularly investors. The purpose of this study is to investigate how net amounts of acquired intangible assets are reflected in security prices for 1,647 firms. In particular, we provide evidence of whether intangible assets are more or less value relevant depending on their nature (e.g., tech, customer, contract, and marketing) and economic lifetime (i.e., definite vs. indefinite).

Intangible assets are becoming an increasingly larger share of firms' assets, particularly those acquired during a business combination. This has led the Financial Accounting Standards Board (FASB) and International Accounting Standards Board (IASB) to reexamine standards on acquired intangible assets to assess whether acquired intangible asset amounts are verifiable (FASB, 2019; IASB, 2020). Although many internally generated intangibles such as research and development (R&D) and advertising expenditures are expensed, acquired intangible assets are capitalized in the statement of financial position. Intangible assets can be acquired either through business combinations or individually by purchasing, e.g., patent rights or FCC licenses. Statement of Financial Accounting Standards No. 141 (SFAS 141), *Business Combinations*, substantially changed the accounting for acquired intangibles, resulting in billions of dollars of intangible value being added to acquirers' statements of financial position (McInnis and Monsen, 2021). However, many critics contend that accounting amounts for acquired intangibles are unreliable for equity investors because intangibles are difficult to value. This difficulty stems from the fact that they are unique and lack an appropriate set of "comparables" against which to benchmark their fair values,

[1] Throughout we use the terms "intangible assets" and "intangibles" interchangeably.

markets for them are highly illiquid, and because of private information about unobservable inputs for intangibles acquired in business combinations (Koonce et al. 2020). As a result, reported intangible amounts are subject to managerial discretion that can result in a great deal of uncertainty regarding their true underlying value to the acquiring firm. Because of concerns that some acquired intangible amounts are difficult to verify, the Boards' deliberations include proposals to subsume certain individual intangible assets, such as customer related intangible assets and non-compete agreements, into goodwill.

In response to its current reexamination and its request for comment on its Exposure Draft, *Identifiable Intangible Assets and Subsequent Accounting for Goodwill* (2019), the Board received over 100 comment letters from financial statement preparers, valuation and industry experts, and academics with different opinions on current standards and how best to improve them.[2] Although the comment letters reveal a wide variation in opinions regarding what changes, if any, are necessary to improve intangible asset accounting, there is little evidence to support whether accounting amounts of acquired intangibles are useful for equity investors. In addition, in recent years acquired intangible assets have become one third of the average merger and acquisition (M&A) deal value, adding billions to the statement of financial position of acquirers (Lys and Yehuda, 2016; Beneish et al. 2020; King et al. 2021; McInnis and Monsen, 2021), and are a major determinant of merger success. Despite its importance for firms, investors, and standard setters, accounting research on this topic is limited, especially with regard to post transaction values of acquired intangibles. The purpose of this study is to fill the void by investigating if acquired intangible amounts are value relevant for equity investors and, if so, whether they have different

[2] The invitation to comment can be found following the link: https://www.fasb.org/jsp/FASB/Document_C/DocumentPage?cid=1176172950529&acceptedDisclaimer=true. Comment letters can be found following the link: https://www.fasb.org/jsp/FASB/CommentLetter_C/CommentLetterPage&cid=1218220137090&project_id=2019-720&page_number=1.

pricing characteristics with regard to their nature and economic lifetime. Investigating the valuation implications of different approaches to accounting for acquired intangible assets can help inform the FASB as it assesses the merit of various positions under consideration.

Our sample comprises net amounts of acquired intangible assets from financial statements relating to 16,508 firm-year observations from 1,647 firms. Our sample period starts in 2002, the first year SFAS 141 was applied, and ends in 2018. We obtain *net amounts* of acquired intangible assets disclosed in the notes section of annual financial statements, including information on acquired intangibles based on their economic lifetime (i.e., definite vs. indefinite) and their different classes as proposed by both US Generally Accepted Accounting Principles (US GAAP) and International Financial Reporting Standards (IFRS) (e.g., tech-, customer-, contract-, and marketing-intangibles). Our sample firms' market capitalization comprises at least 50% of the total market capitalization of US stock market's total capitalization in each year.

To address our research question, we follow prior value relevance research and employ a generalized system of the Ohlson (1999) model (Barth et al. 1999). This framework extends the basic Ohlson (1995) model by modeling earnings components such as accruals. In addition, it allows us to isolate the relation between acquired intangible assets and stock prices by applying a linear information dynamic structure that specifies each intangible asset coefficient as a function of each intangible asset's relation to abnormal earnings and its own time-series properties. This well-established research design requires a time-series of firm-level data and thus cannot be applied to assessments of value relevance of fair values of intangible assets based on purchase price allocations at date of acquisition (King et al., 2021; McInnis and Monsen, 2021). We estimate our model using a seemingly unrelated regression design (Zellner, 1968; Zellner and Huang, 1962; Greene, 2012), employing both year and industry fixed effects. We estimate our system over the entire period, 2002 to 2018, and for the pre- (fiscal years 2002 - 2008) and the post SFAS 141 revision period (2009-2018) as a fully interacted model to test for differences in coefficients between the two periods.

The subperiod analyses permit us to assess whether there is a change in value relevance of acquired intangible assets following revision of SFAS 141 in 2007. The FASB issued a revised SFAS 141 version (SFAS 141R) that increases disclosure requirements for impairment tests of goodwill and other indefinite intangibles and mandates the capitalization of in-process R&D.[3] One of the main reasons for revising SFAS 141 was concern regarding the lack of guidance regarding assignment of intangible assets into particular classes, e.g., tech and customer, as well as the determination of their respective useful lives as definite or indefinite (Andrews et al., 2009). Preparers were not satisfied with existing guidance on how to account for these assets and investors expressed concern that it was difficult to assess their valuation implications. The FASB partly addressed these concerns by providing additional guidance and requiring capitalization of acquired in-process R&D with the expectation that the revision would lead to an improvement in reporting quality (FASB, 2014). By examining separately the pricing characteristics of acquired intangibles in the pre- and post-SFAS 141 revision periods, we can assess whether the revision was associated with an improvement in reporting quality. In particular, our examination permits us to assess whether the valuation coefficients of acquired intangibles differ between the two periods, and therefore potentially shed light on the question whether the FASB-intended improvement was perceived as such by equity investors.

We begin our study by investigating the value relevance of definite and indefinite acquired intangible assets. In particular, we assess whether the coefficients of definite and indefinite intangible assets are both statistically and economically different from zero and from each other.

[3] Prior to the revision, in-process R&D was expensed because of high uncertainty whether the purchased project would be completed (FASB, 2007).

A key motivation for this test is to assess whether application of managerial discretion affects an asset's value relevance. In particular, whereas definite intangibles are amortized, indefinite intangibles are subject to annual impairment testing, which requires managerial discretion. Findings from our tests reveal that although both definite and indefinite intangible assets are statistically significant in explaining stock prices, definite intangible assets have significantly larger valuation coefficients. These findings are consistent with investors discounting indefinite intangibles relative to definite intangibles when valuing a firm's equity, which suggests that investors find recognized amounts for indefinite-lived assets to be less reliable. Findings regarding the pre- and post SFAS 141 revision periods reveal that coefficients for definite and indefinite intangibles significantly decline after the revision of SFAS 141. This finding suggests that the provision of more disclosures about valuation methods and inputs led to revised expected cash flow and/or risk assessments yielding an overall downward revision in investors' assessments of the value of definite- and indefinite intangibles. To identify the prevalent channel regarding the downward revision in coefficients, we use our generalized Ohlson (1999) framework to test whether autoregressive parameters associated with each intangible asset are lower in the post SFAS 141 revision period relative to pre-period. Findings reveal that persistence parameter estimates in the pre- vs post period generally are not significantly different, which suggests that observed decreases in valuation relevance coefficients are attributable to investors revising their risk assessment upwards rather than downward revisions in expected cash flow.

We next extend our analyses by investigating the value relevance for four different intangible asset classes, i.e., tech-, customer-, contract-, and marketing-related intangible assets. By doing so, we follow the classification scheme provided by the FASB and separate our intangible asset amounts into these four major categories. We predict and find positive associations with stock prices for all four intangible asset classes. Consistent with prior research on business combinations and innovation (e.g. Bena and Li, 2014), purchased tech-related intangible assets have the largest valuation coefficients among all intangible assets. This suggests that investors believe acquired tech intangibles such as patents or trade secrets are likely to bring the greatest benefits to the firm. As with tests relating to aggregate definite and indefinite intangibles, we find that the revision of SFAS 141 is associated with a decrease in valuation coefficients for tech intangibles. Customer-, contract-, and marketing intangibles are also relevant in valuing equities, but they exhibit lower valuation coefficients compared to tech intangibles. Again, consistent with our prior results, we find significantly lower coefficients for the post-period, which is consistent with the provision of more information about acquired intangible asset categories leading investors to revise downward intangible asset valuations as a result of higher risk assessments. Moreover, these results are consistent with investors viewing costumer-, contract-, and marketing intangibles as having generally shorter economic lives and lower risk-adjusted economic payoffs than tech-related intangibles.

Next, we test whether the valuation characteristics of the four intangible asset classes differ depending on whether they are classified as having definite and indefinite useful lives.[4] Consistent with our results for aggregated intangible assets, we find that tech- and contract intangibles with definite lives have higher valuation coefficients than those with indefinite lives. The analysis of tech intangibles with regard to their economic lifetime is more subtle, because the split into definite and indefinite useful lives for tech intangibles is only available in the post SFAS 141R revision period because SFAS 141R required for the first time the recognition of in-process R&D as an indefinite asset. Taken together the findings indicate that each intangible asset class acquired—regardless of economic life—is value relevant to equity investors.

[4] We cannot disaggregate customer intangibles into definite and indefinite because they only have a definite lifetime.

Lastly, to provide evidence on the question of whether particular acquired intangible assets identified by the FASB should be subsumed into goodwill, we separately investigate the value relevance of two intangible assets—customer-related intangible assets and non-compete agreements (NCA).[5] In 2014, *Accounting Standards Update (ASU) No. 2014-18, Business Combinations*, allowed *private* firms to subsume both intangible groups into the goodwill. In a recent discussion paper, the FASB states that it is considering extending this standard update to *public* firms (FASB, 2019), with the implication that valuations of customer intangibles and NCAs are too unreliable for them to be recognized separately. Consistent with our prior results, we find customer-related intangible assets are positively and significantly associated with equity prices. However, we find no association between NCAs and stock prices. These results provide empirical support for continuing to recognize customer-related intangibles recognized separately from goodwill because they provide value-relevant information to investors.

Our paper contributes to two strands within the accounting literature. First and most importantly, we contribute to the long-standing debate about the relevance and reliability regarding the role of intangible assets for equity investors. Although there is a substantial literature on the costs and benefits of capitalizing internally generated intangible assets (Lev and Sougiannis, 1996; Kimbrough, 2007; Banker et al. 2019), empirical evidence on acquired intangible assets is scarce, mainly because of data availability (Lev, 2018). Whereas McInnis and Monsen (2021) and King et al. (2021) investigate the profitability forecasting ability and value relevance of fair values of acquired intangibles in business combinations only at the time of acquisition, we investigate the value relevance of net amounts of acquired intangibles over a long period from 2002 to 2018 using firm panel-data that includes fair values of intangibles from business combinations and individual

[5] Non-compete agreements represent employee restrictions that prohibit departing employees from joining or starting a competing enterprise (Starr et al. 2020). NCAs belong to the broad class of marketing intangibles.

transactions that reflect amortization and potential impairments. Furthermore, because our sample data also include information regarding the economic life for various intangible asset classes, we can address how these intangible asset characteristics affect how investors value intangible assets, and therefore enable us to provide direct evidence regarding the current debate on modifying intangible asset accounting.

Second, we contribute to the debate on the usefulness of historical costs vs. fair value amounts in standard setting. Although there is a large literature that examines the value relevance of fair values for financial instruments (e.g. Barth et al. 1996; McInnis et al., 2018), less is known about the value relevance of non-financial assets, and in particular intangible assets. Although McInnis and Monsen (2021) and King et al. (2021) provide evidence of forecasting or value relevance of fair values from purchase price allocation data regarding customer and trademark intangibles, we extend these studies by showing that net amounts of many acquired intangible assets are value relevant for equity investors over time, i.e., at each annual reporting dates subsequent to the acquisition date.

The remainder of the paper is organized as follows. Section II discusses the institutional framework, related literature, and our predictions. Section III presents our research design, section IV describes our hand collected sample and data, and section V presents our results. Finally, section VI provides concluding remarks.

II. INSTITUTIONAL BACKGROUND, RELATED LITERATURE AND PREDICTIONS

2.1 Institutional Background

Accounting for intangible assets is one of the most controversial topics among practitioners and academics. Standard setters define intangible assets as non-financial assets that lack physical substance (ASC 350, IAS 38). Although many internally generated intangibles such as research and development (R&D) and advertising expenditures are expensed when incurred, acquired intangible assets from individual transactions or business combinations are capitalized on the statement of financial position and amortized or tested for impairment over time. Below, we provide a brief review of the current accounting model for acquired intangible assets, as well as a summary of views regarding their recognition.

In 2001, the FASB issued two standards, SFAS 141 and 142, which substantially changed intangible asset accounting. Notably, SFAS 141, which updated the accounting for business combinations, requires most acquired intangibles be recognized as assets (Guo et al. 2019). Prior to SFAS 141, firms could apply either the pooling of interest or the purchase method for accounting of acquired businesses depending on the target's condition and the form of payment. The "pooling of interests" method does not require acquirers to restate internally generated intangible assets of the target. As a result, under this method, acquired intangibles were not capitalized on the statement of financial position of the acquirer. The option to account for an acquisition using the pooling of interest or the purchase method created incentives for firms to select a specific accounting method (Robinson and Shane, 1990; Ayers et al. 2001). Many acquirers chose pooling of interest, which does not recognize acquired target´s intangible assets, and therefore avoids amortization expenses in subsequent years' income. Apart from business combinations, only individually acquired intangibles were recognized at their historical cost (ASC 350).

SFAS 141 and 142 eliminated the pooling of interest method and require acquirers to use the "purchase method" only. Under the purchase method, acquiring firms restate all of the target's assets and liabilities to fair value and record the residual of net assets and the purchase price as goodwill. For intangible assets, this means that acquirers have to identify and estimate fair values of the target's assets. Intangible assets are identifiable when they are contractible (contractual or legal criterion) or separable from the entity (separability criterion) (ASC 805 and 820). A purchased patent is an identifiable intangible asset because it is contractible given its legal nature and can be sold individually. In contrast, merger synergies are not identifiable intangible assets because they are not contractible and cannot be separated from the firm. Taken together, passage of SFAS 141 resulted in acquiring firms adding billions of dollars of intangible assets in the form of intellectual capital onto the statement of financial position (McInnis and Monsen, 2021). Although a benefit of this standard to financial statement users, particularly investors, lies in an increase in information about intangible assets, it also creates a cost by introducing measurement errors of these newly recognized assets on the statement of financial position (Kanodia et al., 2004; McInnis and Monsen, 2021). Although standard setters provide guidance on recognizing and valuing intangibles from business combinations (FASB, 2001; FASB 2014), fair values of identifiable intangibles still have to be estimated based on the application of unverifiable assumptions and managerial discretion.

At the end of 2007, the FASB revised SFAS 141 to improve reporting and disclosure requirements regarding the accounting for business combinations. This revision resulted in notable changes in accounting for business combinations. With regard to acquired intangibles, SFAS 141R mandates acquiring firms to capitalize in-process R&D (IPRD) as an indefinite intangible asset until the completion or abandonment of the purchased R&D project. Before the revision, IPRD was the only intangible that was excluded from the capitalization requirement. Expensing of IPRD has been justified, given that it cannot reliably stated whether unfinished technology can be completed by the purchasing firm (Healy et al. 2002).

In response to concerns raised by private firms about the appropriate measurement along with high costs of valuing acquired intangible assets, the FASB relaxed acquired intangible asset accounting for private firms in 2014 by issuing *Accounting Standards Update (ASU) No. 2014-18*, *Business Combinations*. Many private firms raised concerns that costs associated with valuing certain intangible assets such as certain customer-related intangibles and non-compete agreements

(NCA) outweigh the benefits for recognizing them separately (FASB, 2014). For example, firms claimed that entities can reduce costs for valuing and auditing of these two intangibles when they were allowed to be subsumed into the goodwill. As a consequence, Statement *ASU No. 2014-18* permits private firms to subsume those two intangible assets into the goodwill.[6]

Currently, the FASB is debating whether this accounting update should be applicable to public firms as well and issued a proposal to discuss an extension of current accounting standards update from *private* to *public* entities (FASB, 2019). In response to its request for comment on its Exposure Draft, *Identifiable Intangible Assets and Subsequent Accounting for Goodwill*, the Board received over 100 comment letters from financial statement preparers, valuation- and industry experts, and academics with different opinions on current standards and how best to improve them.[7] Proponents of the current accounting model suggest that "measurement of recognized intangible assets is generally reliable and auditable" (Houlihan Loukey, 2019). Opponents contend that the valuation of certain acquired intangible assets is associated with high valuation costs for firms and estimated amounts are not useful for investors. In particular, fair values of acquired intangible assets from business combinations need to be estimated and audited, which creates higher monitoring costs for financial statement preparers compared to tangible assets. Moreover, evidence suggests that managers exploit their discretion, which can lead them to overstate valuations for indefinite intangibles to boost short-term earnings (Shalev et al. 2013; Koonce et al. 2020). Several firms even propose to subsume certain intangibles into goodwill, which is not amortized but instead is subject to impairment.[8]

[6] This accounting standards update also permits private firms to amortize goodwill rather than subject goodwill to annual impairment testing (FASB, 2014).
[7] Comment letters can be found following the link: https://www.fasb.org/jsp/FASB/CommentLetter_C/CommentLetterPage&cid=1218220137090&project_id=2019-720&page_number=1.
[8] For example, in its comment letter, T-Mobile proposes that the standard setters should "consider a model in which finite lived intangible assets are subsumed in goodwill."

2.2 Related Literature and Predictions

The purpose of this study is to investigate the value relevance of acquired intangible assets. Regarding the value relevance of internally generated intangibles such as R&D, extant accounting research provides a mixed message. Although some studies provide evidence of relevance of intangible assets for investors and suggest that standard setters should allow the capitalization of R&D expenditures (e.g. Lev and Sougiannis, 1996), other studies (e.g., Healy et al., 2002) counter that unverifiable intangible amounts decrease the informativeness of financial statement amounts. Because acquired intangible assets result from a market transaction, many, including the FASB and IASB, express the belief that measurement of acquired intangibles from business combinations is likely to be more reliable—and therefore more informative to financial statement users—than measurement of internally generated intangibles. However, others contend that acquired intangibles are no more likely to be of limited usefulness to financial statement users because measurement of acquired intangibles is based on unverifiable estimates of their future payoffs (Kanodia et al. 2004).

As a first step towards addressing whether recognized acquired intangible amounts are potentially useful to financial statement users, including investors, McInnis and Monsen (2021) investigates the cash flow forecasting ability of acquired intangible asset fair values from business combinations using a proprietary database relating to approximately 3,500 distinct business combinations. The same database is used by King et al. (2021) to investigate the importance of intangible asset fair values at the date of acquisition in explaining stock prices using a value relevance framework. Ewens et al. (2020) measures off-balance intangible assets using disclosures from purchase price allocations collected from 10-K's, 10-Q`s, and 8-K's. An important feature of those three studies is that they use fair values from the purchase price allocation of M&A deals. This feature limits the generalizability of the studies' findings for three reasons. First, examining value relevance of fair values of acquired intangibles at dates beyond the acquisition date is limited without adjusting acquisition date allocation amounts for subsequent amortization and impairments. Moreover, prior literature suggests that stock prices of acquirers are inflated within the year of acquisition, which might confound inferences in a value relevance setting (Harford, 2005; McInnis and Monsen, 2021).[9] Second, only 81 percent of public deals are disclosed within firm reports (Ewens et al. 2020). Thus, significant amounts of intangibles acquired through public and most importantly private business combinations likely are excluded, and it is unclear whether valuation properties of the data used in these studies generalize to all acquired intangibles. Third, intangible assets can also be acquired individually and not as part of a business combination. Although this is a minor source of acquired intangibles for firms in some industries, for firms in industries such as telecommunication, intangible assets acquired individually by, e.g., purchasing FCC licenses (e.g., radio, television, wire, satellite, and cable licenses) are a significant portion of their value. In contrast, our study examines the value relevance of net amounts of all acquired intangibles, including those from private deals and those acquired individually, and at all dates rather than just at the acquisition date. Thus, our study's setting differs from that of these previous studies by investigating properties of *net amounts* of acquired intangible assets disclosed in financial statements rather than at the properties of acquired intangibles at acquisition dates. We evaluate the usefulness of those net amounts using a value relevance framework (Barth et al., 2001). In our setting, we attribute value relevance to accounting amounts of acquired intangible assets that

[9] Both King et al. (2020) and McInnis and Monsen (2021) acknowledge possible limitations in their studies' research design, including the fact that examining using price allocation data does to address value relevance of acquired intangibles limits such an analysis to the date of acquisition and not subsequent dates. McInnis and Monsen (2021) addresses this limitation by employing a research design that explores the benefits of incorporating intangible assets in forecasting operating income. However, standard setting questions generally relate to empirical tests in equity markets because equity investors are the main recipient of financial statements (Barth et al., 2001). Time series variation on the firm level, however, is critical for studies on acquired intangible assets as post-merger equity prices are inflated, which distorts inferences (Harford, 2005; McInnis and Monsen, 2021).

are significantly positively associated with equity market values, i.e., those with positive valuation coefficients (Amir et al. 1993; Barth et al., 2001).

We begin by investigating the value relevance of definite and indefinite intangible assets. Definite intangible assets are amortized over their economic lifetime (ASC 350). Economic lifetime can either be determined by a contract- or legal period. For instance, the economic lifetime of patents is given by their duration until expiration date. King et al. (2021) finds initial evidence in the context of the study's organic and wasting intangible asset design that definite intangible assets are value relevant for equity investors.[10] In contrast, indefinite intangible assets are not amortized over the economic lifetime, and are subject to annual impairment testing. The most common indefinite intangible is goodwill. Although there is a substantive literature on goodwill accounting (e.g., Li and Sloan (2017); Glaum et al. (2018)), less is known about other indefinite intangible assets. Other indefinite intangible assets can be acquired trademarks, licenses and purchased in-process research and development (IPRD). On the one hand, we might expect indefinite intangibles not to be value relevant because their accounting amounts are subject to greater measurement error arising from managerial discretion. For instance, CEOs that are closer to retirement and have bonus packages linked to firm's earnings performance allocate a greater proportion to indefinite intangible assets (Shalev et al. 2013). Additionally, untimely recognition of impairment losses could make net amounts unreliable to equity investors. On the other hand, indefinite intangibles such as a trademark can be valuable for firms as their payoffs last longer than payoffs from definite intangible assets. Thus, we test for the value relevance of definite and

[10] King et al. (2021) define "wasting intangibles" as "separable from the firm with legally defined contractual lives". According to them, technology- and contract intangibles belong within this category. Organic intangibles, on the other hand, are defined as intangibles with "significant expenditures to enhance/maintain its value". This category is the sum of customer- and marketing intangibles.

indefinite intangible assets separately and formulate the following hypothesis, stated in terms of the null, with regard to definite and indefinite intangibles:

Hypothesis 1a: Valuation coefficients for definite and indefinite intangible assets are not significantly different from zero.

Next, we investigate whether valuation coefficients differ before and after the revision of SFAS 141. The revision of SFAS 141, effective for the fiscal years after 2008, aims to improve the accounting for acquired intangibles in business combinations. In particular, the revision is designed to provide more guidance on valuation inputs and models used, especially for indefinite intangibles. The revision of SFAS 141 also enhanced impairment test disclosures to resolve uncertainties for equity investors. Conducting our valuation tests separately for sample years before and after the revision could provide evidence on the effectiveness of this mandate if we find altered and more significant coefficients for those intangibles likely most affected by the standard's revision. For instance, we could find higher coefficients when more disclosures improve the overall information quality about acquired intangible assets (Barth, 1991). This effect would be attributable to a better risk assessment of acquired intangibles. On the other hand, we could find lower coefficients for definite and indefinite intangibles within the post period in case investors revise their expected cash flows downwards based on the new disclosure regime. Therefore, size and magnitude of the estimated coefficients will depend on which effect is more prevalent. Hence, we test the following hypothesis (stated in terms of the null):

Hypothesis 1b: Valuation coefficients for definite and indefinite intangible assets do not change after the revision of SFAS 141.

Next, we investigate the value relevance of different intangible asset classes. In their frameworks, both the FASB and IASB define five intangible asset classes: tech, customer, contract, marketing and artistic.[11] Relevance for investors of intangible asset classes can differ depending on their duration and reliability of their underlying future payoffs.

The first category, tech-related intangible assets (or tech intangibles) include patents, developed technology or software and are core factors that affect a firm's competitive position within its industry. Internally generated tech-related intangible assets, which roughly are approximated in many prior studies by R&D expenditures and patents, are believed to be among the most valuable assets within a firm (e.g. Lev and Sougiannis, 1996; Hall et al. 2005). Empirical evidence for the relevance of acquired tech intangibles, however, is rather mixed. On the one hand, research shows that acquired technology such as patents are a major source of merger synergies and ex-post stock returns (Bena and Li, 2014; Beneish et al. 2020; Guo et al. 2019). On the other hand, McInnis and Monsen (2021) finds no association between fair values of acquired tech intangibles and future operating income, suggesting that accounting amounts of tech intangibles are not forecasting relevant because of their high unreliability.

The second category consists of customer-related intangible assets (or customer intangibles). This group contains items such as customer lists and -relationships and customer-ordered backlog. Customer-related intangibles are a significant part of each M&A deal volume (Beneish et al. 2020). Bauman and Shaw (2018) provides empirical evidence for a sample of 200 firms that acquired customer intangibles are value relevant. McInnis and Monsen (2021) finds that customer intangibles contain predictive ability for future cash flows even up to five years after acquisition. In contrast, Dikolli et al. (2007) suggests that the importance and value of customer intangibles depends critically on industry specific characteristics such as varying switching costs

[11] Artistic-related intangible assets represent plays, books, paintings, pictures, and song records. In our investigation, we abstract from artistic-related intangibles since there are rather concentrated among a few subindustries and rather of low economic relevance for firms (Guo et al. 2019). Thus, artistic intangibles are included within the category "other." See the appendix for more information.

for customers. Many practitioners even contend that customer intangibles are associated with higher valuation costs and provide low benefits to equity investors.[12]

The third category, contract-related intangible assets (or contract intangibles), contain many non-customer contractual relationships such as franchises, licenses, management agreements, favorable leases, and water-, land- and emission rights. Galasso et al. (2013) and Kim-Gina (2018) provide descriptive evidence that licenses are a valuable avenue to acquire intellectual capital. Apart from licenses, a few industry-specific studies investigate the importance of contract intangibles such as airport landing rights or franchises (Bonacchi et al. 2015; Olbrich et al. 2009). However, we are unaware of any study investigating value relevance of this whole category across a broad sample.

The last category comprises marketing-related intangible assets (or marketing intangibles), which consists mostly of trademarks and tradenames, brands, mastheads, and non-compete agreements. Prior research documents that internally generated brands are positively associated with stock prices (Barth et al., 1998, Kallapur and Kwan, 2004; Vitorino, 2014). Furthermore, acquired trademarks are associated with higher synergies (Beneish et al., 2020; Hsu et al. 2018). However, McInnis and Monsen (2021) finds only a weak association between fair values of trademarks and future profitability of the combined firm. Among practitioners, several firms such as LSC Communications suggest in their comment letters to the FASB that acquired trademarks could even be subsumed into the goodwill because they "carry little future cash flow[s] apart from the business processes that built that trade name."[13]

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[12] For instance, Exelon Inc. claims that these assets do not provide any "useful information to investors as they are not typically sold separately" (Exelon, 2019).

[13] See link for comment letter of LSC Communications Inc.:
https://www.fasb.org/cs/BlobServer?blobkey=id&blobnocache=true&blobwhere=1175836064236&blobheader=application%2Fpdf&blobheadername2=Content-Length&blobheadername1=Content-Disposition&blobheadervalue2=1522933&blobheadervalue1=filename%3DINTANGGW.ITC.081.LSC_COMMUNICATIONS_SEE_LISTED.pdf&blobcol=urldata&blobtable=MungoBlobs.

Taken together, we formulate the following hypothesis with regard to tech, customer, contract, and marketing (again stated in terms of the null):

Hypothesis 2a: Tech-, customer-, contract, and marketing intangibles valuation coefficients are not significantly different from zero.

Next, we investigate valuation coefficients for those intangible asset classes before and after the revision of SFAS 141. The revision should be, in particular, relevant for tech intangibles because it mandates capitalization of acquired in-process research and development (IPRD) expenditures. The revision will likely also alter valuation coefficients for other intangible asset classes (customer, contract, marketing) because it should provide more guidance on valuation inputs and models used. Coefficients can be either higher or lower than in the pre-period depending on the expected cash flow/risk assessment of equity investors. In particular, coefficients can be higher for the post period if the additional guidance reduces risk, while lower coefficients apply that cash flow expectations are better assessable. Our hypothesis is the following (stated in terms of the null):

Hypothesis 2b: Valuation coefficients for tech-, customer-, contract-, and marketing intangibles do not change after the revision of SFAS 141.

Third, we investigate the value relevance of our four different intangible asset classes disaggregated into definite and indefinite-live intangible assets. This allows us to assess whether the value relevance of assets within each asset class is affected by whether assets are classified as having a definite or indefinite life. For instance, customer- and contract intangibles are of rather short duration in comparison to tech- and marketing intangibles. Thus, different economic lifetimes create uncertainties with regard to their future payoffs. Thus, we test the following hypothesis (stated in terms of the null):

Hypothesis 3a: Valuation coefficients for tech- customer-, contract-, and marketing intangibles disaggregated into definite and indefinite intangibles are not significantly different from zero.

Next, we investigate valuation coefficients for disaggregated intangible asset classes before and after the revision of SFAS 141. A particular interesting property of this test is the evaluation of the capitalization of in-process R&D (IPRD) after the revision of SFAS 141. Deng and Lev (2006) investigates whether IPRD should be recognized as an asset or expensed and provides evidence of a significant positive association between the values of in-process R&D and acquiring firms' cash flows supporting the recognition of IPRD as an asset. On the other hand, Cheung et al. (2020) finds no empirical evidence that the capitalization of IPRD in 2008 led to lower information asymmetries for IPRD acquirers relative to non-IPRD acquirers. For other indefinite intangibles such as contract- and marketing intangibles, we predict that the revision alters valuation coefficients as firms should provide more guidance on valuation inputs and models used for indefinite intangibles. In particular, coefficients can be higher for the post period if the additional guidance reduces risk, while lower coefficients apply that cash flow expectations are better assessable. Thus, we test the following hypothesis (stated in terms of the null):

Hypothesis 3b: Valuation coefficients for tech-, customer-, contract-, and marketing intangibles disaggregated do not change after the revision of SFAS 141.

Lastly, we investigate one critical aspect of the current FASB proposal, the inclusion of two particular intangible asset groups into goodwill, namely customer intangibles and non-compete agreements (NCAs). In 2014, the FASB passed *Accounting Standards Update (ASU) No. 2014-18*, *Business Combinations*, allowing *private* companies to subsume customer intangibles and non-compete agreements (NCAs) into goodwill. With the passage of this *ASU No. 2014-18*, the FASB stated that customer-related intangibles and non-compete agreements "will continue to provide decision-useful information to the users of private company financial statements while providing a reduction in the cost and complexity associated with the measurement of certain identifiable intangible assets" (FASB, 2014). Currently, the FASB is considering extending this rule change to apply to public firms. As noted earlier, proponents of this accounting proposal contend that the valuation of these intangible assets is associated with higher costs for monitoring and auditing for financial statement preparers.

Non-compete agreements (NCAs) are employee restrictions that prohibit departing employees from joining or starting a competing enterprise (Starr et al., 2020).[14] Although the use of NCAs for employees has increased in recent years for firms in many industries (Starr et al., 2020), valuation experts contend that NCAs provide little to no benefits to investors. However, there is no direct evidence on the valuation relevance of non-compete agreements. Several studies, however, find indirect evidence for the importance of non-compete agreements exploring different enforcement regimes (Aobdia, 2018; Ertimur et al. 2018; Glaeser, 2018). For example, managers pursue riskier innovative activities (Samila and Sorenson, 2011; Conti, 2014) when NCAs are enforceable, which could result in a better competitive advantage position and higher market values in the case of innovative success. Thus, our hypothesis with regard to customer intangibles and non-compete agreements is the following (stated in terms of the null):[15]

Hypothesis 4: Customer intangibles and non-compete agreements are not significantly different from zero.

[14] Non-compete agreements are a subcategory of marketing intangibles.
[15] We do not test for a change in SFAS 141R, because customer intangibles and non-compete agreements were not subject of major changes. Hence, there is no hypothesis 4b.

III. RESEARCH DESIGN

3.1 Baseline model

Following Barth et al. (1999) and Barth et al. (2005) we test our predictions in a generalized version of the Ohlson (1999) model. The basic model comprises the following four equations:

$$Abearnings_{t+1} = Abearnings_t + Accruals_t + BVE_t + e_{1t+1} \quad 1)$$
$$Accruals_{t+1} = Accruals_t + BVE_t + e_{2t+1} \quad 2)$$
$$BVE_{t+1} = BVE_t + e_{3t+1} \quad 3)$$
$$MVE_t = BVE_t + Abearnings_t + Accruals_t + e_{4t+1} \quad 4)$$

Equation (1) models the autoregressive process for abnormal earnings, in which *Abearnings* represent earnings less a normal return on equity book value (*BVE*). Equation (2) models the accrual process. Both equations (1) and (2) include book value of equity (*BVE*), which allows the effects of conservatism to manifest themselves (Feltham and Ohlson, 1995; 1996) and relaxes the assumption that the cost of capital is a predetermined cross-sectional constant (Barth et al. 1999; 2005). Equation (3) models the information dynamics of the book value of equity as an autoregressive process. This equation preserves the triangular information structure of the generalized version of Ohlson's (1999) model, which permits the equity valuation equation coefficients in equation (4) to be expressed as functions of the autoregressive and forecasting equation coefficient in equations (1) through (3). Equation (4) models our main equation of interest, the valuation equation. Market value of equity can be explained by book value of equity, abnormal earnings, and accruals. Below, we expand the basic system of equations to include acquired intangibles to test our main predictions. For the baseline model and each of the adjusted models described below, the equity valuation coefficients can be freely estimated, i.e., unconstrained, or estimated in a constrained system that imposes the implied relations between the valuation coefficients and the autoregressive and forecasting equation coefficients.

3.2 Value relevance of definite and indefinite intangible assets

We adjust the baseline Ohlson (1999) model to allow testing our predictions. For our first set of predictions, we extend the baseline model by including acquired definite- and indefinite intangible assets. In particular, first, we extend the abnormal earnings- and earnings component equations by definite and indefinite intangible assets. Second, we append autoregressive processes for both definite and indefinite intangible assets to preserve the triangular information structure. Third, we model market value of equity as a composition of book value, abnormal earnings, earnings components, and definite and indefinite intangible assets. Thus, our adjusted model comprises the following six equations (*System 1*):

$$
\begin{aligned}
Abearnings_{t+1} &= \alpha_1 + \omega_{11} Abearnings_t + \omega_{12} Accruals_t + \omega_{13} BVE\_adj_t + \omega_{14} Def\_\mathrm{int}_t + \omega_{15} Indef\_\mathrm{int}_t + e_{1t+1} && 1a) \\
Accruals_{t+1} &= \alpha_2 + \omega_{22} Accruals_t + \omega_{23} BVE\_adj_t + \omega_{24} Def\_\mathrm{int}_t + \omega_{25} Indef\_\mathrm{int}_t + e_{2t+1} && 1b) \\
BVE\_adj_{t+1} &= \alpha_3 + \omega_{33} BVE\_adj_t + e_{3t+1} && 1c) \\
Def\_\mathrm{int}_{t+1} &= \alpha_4 + \omega_{44} Def\_\mathrm{int}_t + e_{4t+1} && 1d) \\
Indef\_\mathrm{int}_{t+1} &= \alpha_5 + \omega_{55} Indef\_\mathrm{int}_t + e_{5t+1} && 1e) \\
MVE_t &= \alpha_6 + \beta_1 BVE\_adj_t + \beta_2 Abearnings_t + \beta_3 Accruals_t + \beta_4 Def\_\mathrm{int}_t + \beta_5 Indef\_\mathrm{int}_t + e_{6t+1} && 1f)
\end{aligned}
$$

We adjust equity book values by subtracting acquired intangible assets (*BVE_adj*). The key variables of interest, *Def_int* and *Indef_int*, are net amounts of definite and indefinite intangible assets. Equations (1c) to (1e) model *BVE_adj*, *Def_int* and *Indef_int* as autoregressive processes. Equation (1f) models our valuation equation containing *Def_int* and *Indef_int*. Based on H1a, we test whether the *Def_int and Indef_int* coefficients are significantly different from zero.

3.3 Value relevance of tech, customer, contract, and marketing intangible assets

For our second set of predictions, we extend the baseline model and include tech-, customer-, contract-, and marketing-related intangible assets in the same manner as specified above. To testing our predictions relating to H2a, our model comprises the following nine equations (*System 2*):

$$
\begin{aligned}
Abearnings_{t+1} &= \alpha_1 + \omega_{11} Abearnings_t + \omega_{12} Accruals_{2t} + \omega_{13} BVE\_adj_t + \omega_{14} Tech_t + \omega_{15} Customer_t && 2a)\\
&+\omega_{16} Contract_t + \omega_{16} Marketing_t + \omega_{17} Other_t + e_{1t+1} &&\\
Accruals_{t+1} &= \alpha_2 + \omega_{22} Accruals_t + \omega_{23} BVE\_adj_t + \omega_{24} Tech_t + \omega_{25} Customer_t + \omega_{26} Contract_t && 2b)\\
&+\omega_{27} Marketing_t + \omega_{28} Other_t + e_{2t+1} &&\\
BVE\_adj_{t+1} &= \alpha_3 + \omega_{33} BVE\_adj_t + e_{3t+1} && 2c)\\
Tech_{t+1} &= \alpha_4 + \omega_{44} Tech_t + e_{4t+1} && 2d)\\
Customer_{t+1} &= \alpha_5 + \omega_{55} Customer_t + e_{5t+1} && 2e)\\
Contract_{t+1} &= \alpha_6 + \omega_{66} Contract_t + e_{6t+1} && 2f)\\
Marketing_{t+1} &= \alpha_7 + \omega_{77} Marketing_t + e_{7t+1} && 2g)\\
Other_{t+1} &= \alpha_8 + \omega_{88} Other_t + e_{8t+1} && 2h)\\
MVE_t &= \alpha_9 + \beta_1 BVE_t + \beta_2 Abearnings_t + \beta_3 Accruals_{2t} + \beta_4 Tech_t + \beta_5 Customer_t && 2i)\\
&+\beta_6 Contract_t + \beta_7 Marketing_t + \beta_8 Other_t + e_{6t+1} &&
\end{aligned}
$$

We include *Tech*, *Customer*, *Contract*, and *Marketing* as independent variables in the first two autoregressive processes (equation (2a) and (2b)). Additionally, we model each intangible class as an additional autoregressive process (equation (2c) to (2h)). For intangibles, which we cannot assign to one of these categories, we include a variable *Other* as both an independent variable and an autoregressive process in our model.[16] Equation (2i) models the valuation equation with our main variables of interest. In particular, we test whether the *Tech*, *Customer*, *Contract*, and *Marketing* coefficients are significantly different from zero.

3.4 Value relevance of disaggregated intangible assets

Third, we extend our baseline model for the previous four intangible asset classes (tech-, customer-, contract-, and marketing) disaggregated into definite and indefinite economic lifetimes. Customer intangibles are usually of definite lifetime, which is why we model them as one process only. Below, we present the adjusted equation system with the following twelve equations that we use to test H3a (*System 3*):

[16] Further information on the inclusion of items and representativeness of this category are provided within the sample and data section.

$$\begin{aligned}
Abearnings_{t+1} &= \alpha_1 + \omega_{11} Abearnings_t + \omega_{12} Accruals_{2t} + \omega_{13} BVE_adj_t + \omega_{14} Tech_Def_t + \omega_{15} Tech_Indef_t + \omega_{16} Customer_t && 3a) \\
&\quad + \omega_{17} Contract_Def_t + \omega_{18} Contract_Indef_t + \omega_{19} Marketing_Def_t + \omega_{_10} Marketing_Indef_t + \omega_{_11} Other_t + e_{1t+1} && \\
Accrual_{t+1} &= \alpha_2 + \omega_{22} Accrual_t + \omega_{23} BVE_adj_t + \omega_{24} Tech_Def_t + \omega_{25} Tech_Indef_t + \omega_{26} Customer_t + \omega_{27} Contract_Def_t && 3b) \\
&\quad + \omega_{28} Contract_Indef_t + \omega_{29} Marketing_Def_t + \omega_{_20} Marketing_Indef_t + \omega_{_21} Other_t + e_{2t+1} && \\
BVE_adj_{t+1} &= \alpha_3 + \omega_{33} BVE_adj_t + e_{3t+1} && 3c) \\
Tech_Def_{t+1} &= \alpha_4 + \omega_{44} Tech_Def_t + e_{4t+1} && 3d) \\
Tech_Indef_{t+1} &= \alpha_5 + \omega_{55} Tech_Indef_t + e_{5t+1} && 3e) \\
Customer_{t+1} &= \alpha_6 + \omega_{66} Customer_t + e_{6t+1} && 3f) \\
Contract_Def_{t+1} &= \alpha_7 + \omega_{77} Contract_Def_t + e_{7t+1} && 3g) \\
Contract_Indef_{t+1} &= \alpha_8 + \omega_{88} Contract_Indef_t + e_{8t+1} && 3h) \\
Marketing_Def_{t+1} &= \alpha_9 + \omega_{99} Marketing_Def_t + e_{9t+1} && 3i) \\
Marketing_Indef_{t+1} &= \alpha_{10} + \omega_{_101} Marketing_Indef_t + e_{10t+1} && 3j) \\
Other_{t+1} &= \alpha_{11} + \omega_{_111} Other_t + e_{11t+1} && 3k) \\
MVE_t &= \alpha_{12} + \beta_1 BVE_t + \beta_2 Abearnings_t + \beta_3 Accrual_{2t} + \beta_4 Tech_Def_t + \beta_5 Tech_Indef_t + \beta_6 Customer_t && 3l) \\
&\quad + \beta_7 Contract_Def + \beta_8 Contract_Indef_t + \beta_9 Marketing_Def_t + \beta_{10} Marketing_Indef_t + \beta_{11} Other_t + e_{12t+1} &&
\end{aligned}$$

Equation (3l) models the valuation equation with our main variables of interest. In particular, we test whether the *Tech_Def*, *Tech_Indef*, *Customer*, *Contract_Def*, *Contract_Indef*, *Marketing_Def*, and *Marketing_Indef* coefficients are significantly different from zero.

3.5 Testing the FASB proposal regarding a change in intangible asset accounting

Lastly, we test our predictions for one aspect of the recent FASB proposal to extend intangible asset accounting of *private* firms to public entities. To test the usefulness of this approach for public firms, we separate non-compete agreements (*NCA*) from other definite marketing intangibles (*Marketing_def_ex*) to test H4 (*System 4*):

$$Abearnings_{t+1} = \alpha_1 + \omega_{11} Abearnings_t + \omega_{12} Accruals_{2t} + \omega_{13} BVE\_adj_t + \omega_{14} Tech\_Def_t + \omega_{15} Tech\_Indef_t + \omega_{16} Customer_t$$
$$+\omega_{17} Contract\_Def_t + \omega_{18} Contract\_Indef_t + \omega_{19} Marketing\_Def\_ex_t + \omega_{19} NCA_t + \omega_{\_10} Marketing\_Indef_t + \omega_{\_11} Other_t + e_{1t+1} \qquad 4a)$$

$$Accrual_{t+1} = \alpha_2 + \omega_{22} Accrual_t + \omega_{23} BVE\_adj_t + \omega_{24} Tech\_Def_t + \omega_{25} Tech\_Indef_t + \omega_{26} Customer_t + \omega_{27} Contract\_Def_t$$
$$+\omega_{28} Contract\_Indef_t + \omega_{29} Marketing\_Def\_ex_t + \omega_{\_20} NCA_t + \omega_{\_20} Marketing\_Indef_t + \omega_{\_21} Other_t + e_{2t+1} \qquad 4b)$$

$$BVE\_adj_{t+1} = \alpha_3 + \omega_{33} BVE\_adj_t + e_{3t+1} \qquad 4c)$$

$$Tech\_Def_{t+1} = \alpha_4 + \omega_{44} Tech\_Def_t + e_{4t+1} \qquad 4d)$$

$$Tech\_Indef_{t+1} = \alpha_5 + \omega_{55} Tech\_Indef_t + e_{5t+1} \qquad 4e)$$

$$Customer_{t+1} = \alpha_6 + \omega_{66} Customer_t + e_{6t+1} \qquad 4f)$$

$$Contract\_Def_{t+1} = \alpha_7 + \omega_{77} Contract\_Def_t + e_{7t+1} \qquad 4g)$$

$$Contract\_Indef_{t+1} = \alpha_8 + \omega_{88} Contract\_Indef_t + e_{8t+1} \qquad 4h)$$

$$Marketing\_Defex_{t+1} = \alpha_9 + \omega_{99} Marketing\_Def\_ex_t + e_{9t+1} \qquad 4i)$$

$$NCA_{t+1} = \alpha_{10} + \omega_{\_101} NCA_t + e_{9t+1} \qquad 4j)$$

$$Marketing\_Indef_{t+1} = \alpha_{11} + \omega_{\_111} Marketing\_Indef_t + e_{10t+1} \qquad 4k)$$

$$Other_{t+1} = \alpha_{12} + \omega_{\_121} Other_t + e_{11t+1} \qquad 4l)$$

$$MVE_t = \alpha_{13} + \beta_1 BVE_t + \beta_2 Abearnings_t + \beta_3 Accrual_{2t} + \beta_4 Tech\_Def_t + \beta_5 Tech\_Indef_t + \beta_6 Customer_t$$
$$+\beta_7 Contract\_Def + \beta_8 Contract\_Indef_t + \beta_9 Marketing\_Def_t + \beta_{10} NCA + \beta_{10} Marketing\_Indef_t + \beta_{11} Other_t + e_{12t+1} \qquad 4m)$$

Our variables of interest in the equity valuation equation (4m) are *Customer* and *NCA*, in which we test whether their coefficients are significantly different from zero.

3.6 Estimation of equations

We estimate our four systems using two procedures. First, we estimate each system as an unconstrained model imposing no linear information structure on intangible asset coefficients. Second, we follow Ohlson (1999) and impose a linear information structure on each intangible asset in the valuation equation. Valuation multiples of each intangible asset are therefore determined by the underlying information dynamics in the autoregressive processes. This constrained estimation allows intangible asset coefficients to not only include the concept of value relevance, but also the persistence and forecasting ability of each intangible asset for abnormal earnings and accruals processes. For our first system (*system 1*) this means that signs and magnitudes of definite intangible assets and indefinite intangibles in equation (1f) depend on the signs and magnitudes of particular coefficients in equations (1a) through (1e). We derive our constrained estimators within the online appendix C.[17]

For our predictions concerning the SFAS141 revision, we estimate our constrained system as a fully interacted model. This allows us to investigate how the revision of SFAS 141 manifested in intangible asset coefficients. We include both year and industry fixed effects in each equation and specification. Consistent with prior literature, we define industry fixed effects following the Fama-French 49 classification (King et al. 2021).

Abnormal earnings, $Abearnings_t$, equals $NI_t - rBVE_{t-1}$, where *BVE* is equity book value and net income *NI* is income before extraordinary items and discontinued operations. Following prior literature, we set the discount rate, *r*, equal to 12% as it represents the long-term return on equities (Dechow et al. 1999; Myers, 1999; Barth et al. 1999). Also consistent with prior literature, we define *Accruals* as the difference between net income and operating cash flows (Barth et al. 1999). We winsorize our dependent and independent variables on 1^{st} and 99^{th} percent level on both time- and industry dimension (Fama-French 12 industry) to mitigate potential outlier effects (Barth et al. 1999). Further, we scale our variables by shares outstanding to mitigate potential scale bias and heteroscedasticity (Barth and Kallapur, 1996; Barth and Clinch, 2010). Scaling also mitigates non-stationarity concerns in our autoregressive processes (Qi et al. 2000).

Following Barth et al. (1999), we estimate systems 1 through 4 using a seemingly unrelated regression design (Zellner, 1962; Zellner and Huang, 1962; Greene, 2012), which permits regression errors to be correlated across equations.

[17] For the sake of parsimony we do not provide additional appendices for the derivation of the constrained equity valuation coefficients for Systems 2 through 4. They are available upon request.

IV. SAMPLE AND DATA

We construct our sample by first obtaining accounting- and stock price data from Compustat and CRSP from 2002 until 2018. Our sample begins for fiscal year 2002 because this is the first year for which SFAS 141 and 142 became effective. We require firms to have non-missing equity book values, total assets, stock prices, operating cash flows, and net income. Additionally, we restrict our sample to firms with total assets of more than $10 million to avoid any influence of small firms (Barth et al. 1999). Consistent with prior research, we use a three-month lag window to make sure that new financial statement information is incorporated into equity prices (e.g. McInnis et al. 2018). Lastly, we require a minimum of three observations per firm because we use lagged abnormal earnings in our estimations.

Next, we hand collect acquired intangible asset *net amounts* from the notes of annual financial statements obtained from the SEC Edgar webpage. To avoid any collection bias towards a certain industry, we choose firms across all industries. We identify industries using the Fama-French (1997) 12-industry classification. Within each industry, we sort the merged Compustat/CRSP sample by market capitalization. Our sample includes those firms within each industry with the largest market capitalization comprising at least 50% of the total industry market capitalization.

We obtain net amounts of acquired intangible asset using a keyword search for words such as "intangible asset", "purchased intangible", and "intangibles" to identify relevant sections of a financial statement, and collect *net amounts* of purchased intangible assets. If net amounts are missing, we calculate net amounts by subtracting accumulated amortization and impairments from disclosed gross amounts. Importantly, we only collect net amounts of intangibles that we can clearly identify as being purchased. Firms sometimes allocate capitalized internally generated software - or patent costs (from legal fees) into the notes about intangible assets in their annual reports. We read each note about intangible assets carefully to make sure that we do not collect these items as they do not relate to our research question. Unfortunately, some firms are not completely transparent about their disclosure of all acquired intangible asset amounts. First, a few firms aggregate several acquired intangible assets into a position called “other intangible assets” restricting the collection of all acquired intangible amounts with full transparency. A second difficulty arises when firms add different intangible asset classes together.[18] Both concerns are mitigated by the fact that these concerns relate to only a small subsample of our overall sample. We include these amounts as a variable denoted *Other* in our estimating equations and note that *Other* is less than six percent of the total amount of intangibles acquired on average.

Table 1 Panel A presents our sample composition based on Fama-French 12 industry classifications. Our sample includes 16,508 firm year observations relating to 1,647 firms.[19] Industries with the largest concentrations of firm-year observations are Equipment firms (17.62%), Health firms (12.16%), and Shop firms (12.77%).

(Insert Table 1 about here)

Panel B presents descriptive statistics for the variables we use in our regressions. The mean (median) market capitalization for our sample firms is \$10,316 million (\$2,218 million). Our average firm has \$128 million in marketing-, \$92 million in customer-, \$86 million in tech-, and \$84 million in contract-intangibles. Panel C, which presents both Pearson and Spearman correlation of our variables, reveals that many variables are highly correlated, which is consistent with prior valuation studies (e.g., Barth et al. 1999).

[18] For example, a few firms provide an aggregated position called “patents and trademarks,” i.e., adding tech- and marketing intangibles together.

[19] In 2017, our sample represents more than 65 percent of total market capitalization of the US-stock market.

V. RESULTS

5.1. Definite and indefinite intangible assets

(Insert Table 2 about here)

Table 2, Panel A, presents findings for System 1. Columns 1 and 2 present findings for the full sample based on unconstrained and constrained estimations. Columns 3a and 3b present pre- and post-SFAS 141 revision period coefficients based on a constrained estimation that includes a post-indicator variable and its interaction with all regression variables. Column 3c presents the coefficient differences between the pre and post- SFAS 141 revision periods. Magnitudes and signs of the *BVE_adj*, *Abearnings*, and *Accruals* coefficients are similar to those in prior research using the Ohlson (1999) valuation framework (Barth et al. 1999).[20]

Regarding our first research question, the findings in Columns 1 and 2 reveal that the coefficients for definite intangible assets, *Def_Int*, 2.538 and 2.537, are positive and significantly different from zero.[21] Findings in Columns 3a through 3c reveal that the *Def_Int* coefficient is significantly larger in the pre-period by 0.152. This result indicates that the revision of SFAS 141 in 2008 altered valuation implications for definite intangibles, and suggests that investors use more precise disclosures about valuation models and valuation inputs to revise cash flow expectations (risk assessment) of definite intangibles downward (upward), which leads to lower coefficients. To identify the prevalent channel regarding the downward revision in coefficients, we propose a test of the persistence parameters for each intangible asset in our generalized Ohlson (1999) framework. In particular, we test autoregressive parameters of *Def_Int* of pre- against post- SFAS 141 revision periods to investigate changes in persistence. Table 2, Panel B, reports coefficients for pre- and

[20] In particular, consistent with prior research, we find statistically significant coefficients with correct signs in all our autoregressive processes (Barth et al. 1999).
[21] Throughout we use a five percent significance level under a one-sided alternative when we have a signed prediction and under a two-sided alternative otherwise.

post- SFAS 141R autoregressive parameters with Wald tests for their difference. For *Def_Int*, we find a significant downward revision in persistence. This result is consistent with the revision of coefficients of definite intangibles are attributable to investors revising downward cash flow expectations and potentially increasing their risk assessment of definite intangibles.

The findings in Columns 1 and 2 reveal that the coefficients for indefinite intangible assets, *Indef_Int*, 0.864 and 0.403, also are positive and significantly different from zero. The noticeably smaller valuation coefficient based on the constrained estimation yields more sensible estimates when we specify each intangible asset coefficient as a function of its relation to abnormal earnings and its own time-series properties. Indefinite intangible asset coefficients are, as expected, smaller and significantly so than those for definite intangibles. That is, investors regard definite intangible asset valuations as more precise than those for indefinite intangibles. Taken together, the findings in Columns 1 and 2 indicate that we can reject hypothesis 1a that definite and indefinite intangible assets are valuation irrelevant.

The findings in Columns 3a-3c also reveal a significant decline in the indefinite intangible coefficients after the revision of SFAS 141. In particular, the *Indef_Int* coefficient is significantly smaller in the post-SFAS 141R period by 0.048. The coefficients in Table 2, Panel B, further indicate no significant change in persistence, which is consistent with investors not revising downward expected cash flows in the post-period. Thus, our results suggest that increased disclosure in the post-SFAS 141R period led investors to increase their risk assessments of indefinite intangible assets, which resulted in lower valuation coefficients. Therefore, we can reject hypothesis 1b that the valuation relevance of indefinite intangible assets did not change in the post-SFAS 141R period.

5.2 Tech, customer, contract, and marketing intangible assets

(Insert Table 3 about here)

Next, we present findings regarding the value relevance for different intangible asset classes, tech, customer, contract, and marketing intangibles. Table 3, Panel A, presents findings for System 2, with the same column structure as in Table 2, Panel A. Regarding our variables of interest, we find significantly positive coefficients for *all* intangible asset classes. For tech intangibles, the unconstrained and constrained coefficients are 4.647 and 4.628. These findings are consistent with prior research on internally generated R&D and purchased innovation in business combinations showing that tech intangibles are highly relevant in equity pricing (Lev and Sougiannis, 1996; Hall et al. 2005; Bena and Li, 2014). Although prior research findings suggest that tech fair values measured at acquisition date do not seem to predict future payoffs (McInnis and Monsen, 2021), our findings suggest that comprehensively measured *net amounts* of acquired tech intangibles are value relevant for equity investors. As with the Table 2 findings relating to aggregate definite and indefinite intangibles, the tech intangible coefficient is significantly smaller in the post- SFAS 141R period. The decline of 0.442 and an insignificant change in *Tech*'s persistence parameter (Chi² test statistic is 0.88, p-value 0.349) suggests that investors used the additional disclosures to revise their risk assessment upwards, yielding an overall downward revision in the value of tech intangibles.

The customer intangibles coefficients from the unconstrained and constrained estimations, 2.480 and 2.015, are significantly positive. These results are consistent with the findings in McInnis and Monsen (2021) and Bauman and Shaw (2018) showing that customer intangible amounts contain valuable information for future payoffs. As with tech intangibles, the customer intangible coefficient is significantly smaller in the post- SFAS 141R period. The decline of 0.313 and insignificant results in our persistence test (Chi² test statistic is 0.28; p-value 0.597) is consistent with our prior results that investors find the more precise disclosures relevant to revise risk assessment leading them to value customer intangibles less highly.

The significantly positive coefficient for contract intangibles, 0.705, suggests they are value relevant for equity investors. This finding is consistent with the findings in Galasso et al. (2013) and Bonacchi et al. (2015), both of which focus on the importance of licenses and franchises in the pharmaceutical- and retail industry. We significantly extend these studies and find that contract intangibles are value relevant for a large sample of firms.

Lastly, marketing intangibles are also positive and significantly priced across every column. Consistent with Kallapur and Kwan (2004), and McInnis and Monsen (2021), we find that net amounts of acquired marketing intangibles are value relevant. Marketing intangibles are even significant in all time specifications. Regarding a change in pricing after SFAS 141 revision, we observe a significant decline in relevance (coefficient change is –0.090, p-value < 0.001). Additionally, findings in our persistence tests in Table 3, Panel B, suggest that investor cash flow expectations were revised upwards in the post-period. Finding that the associated value relevance coefficient is smaller in the post-period suggests that the effect of increased risk adjustment dominates the positive revision in cash flows. Again, these findings are consistent with investors finding more precise disclosures of valuation methods and inputs about marketing intangibles useful to revise fair values estimates downwards.

Taken together, all four intangible asset classes are value relevant for equity pricing. Results suggest that equity investors value *net amounts* of all acquired intangible asset classes. Particularly, *Tech* assets such as patents and developed technologies are highly relevant consistent with the recent increase in tech mergers (Lin and Wang, 2016). Therefore, we can reject hypothesis 2a for each intangible asset class. Regarding hypothesis 2b, our coefficients show that equity investors significantly revise their valuations downward for all intangible asset classes. Our persistence tests additionally suggest that investors use a higher disclosure level for an upward revision in risk assessment of each intangible asset class (tech, customer, contract, marketing).

5.3 Disaggregation of intangible assets in definite- and indefinite-life intangible assets

Next, we present findings in which we disaggregate our four intangible asset classes into definite and indefinite intangible assets. The main aim of this disaggregation is to investigate whether equity investor price intangible asset categories differently pending on their economic lifetime. Table 4 presents the findings.

(Insert Table 4 about here)

Regarding our third set of predictions, we find consistent results for many of our formed predictions. For tech intangibles, we find positively significant coefficients for both definite (*Tech_Def*) and indefinite (*Tech_Indef*) life intangible assets. *Tech_Indef* is mostly comprised of in-process R&D, which is why *Tech_Indef* is only observable after the passage of SFAS141R. Before revising SFAS 141, in-process R&D was the only acquired intangible that was excluded from the mandate for recognition. Consistent with Deng and Lev (2006), our results suggest that in-process R&D is a highly relevant item in equity valuation and recognition on the statement of financial position provides useful information. Importantly, however, *Tech_indef* is much less relevant in the constrained estimation relative to the unconstrained estimation. While having a coefficient of 15.162 (p-value<0.001) within our unconstrained estimation, imposing a linear information structure reduces *Tech_indef* to a more sensible estimate of 2.839 (p-value<0.001). Unconstrained estimations do not take into account the time series properties of indefinite tech intangibles and their potential forecasting abilities for abnormal earnings and accruals. This result underscores why imposing a linear information model is crucial to determine value relevance for intangible assets.

Regarding customer intangibles, we find results that yield similar inferences to those as in Table 3, Panel A. For contract intangibles, the findings reveal significantly positive coefficients for both definite and indefinite contract intangibles. The findings also reveal that definite contract are more relevant than indefinite contract intangibles, which is consistent with prior findings that aggregate definite intangibles are more relevant than aggregate indefinite intangibles. Lastly, we find positive and statistically significant coefficients for indefinite marketing intangibles. For definite marketing intangibles, however, we find mixed results. This can be attributable to that fact that definite marketing intangibles contain several intangibles such as definite trademarks and non-compete agreements (*NCA*) that provide low economic benefits and due to low enforcement and not be in use. We test for value relevance of *NCA*s separately within our fourth system below. Taken together, the Table 4 findings lead us to reject hypothesis 3a for most intangible assets investigated.

Consistent with the findings in Table 2 and 3, we also find significant decreases in valuation coefficients regardless of intangible class or economic lifetime (except *Contract_indef* and *Marketing_def*). Persistence tests again suggest that the lower valuation coefficients in the post-period is attributable to investors' higher risk assessments rather than downward revisions in cash flow expectations. Therefore, we can reject hypothesis 3b.

5.4 Evaluation of FASB proposal

(Insert Table 5 about here)

Lastly, we provide a direct test for one aspect of the recent FASB proposal to extend the change for acquired intangible asset accounting from private to public firms. As noted above, many preparers claim that customer intangibles and non-compete agreements (*NCA*) are too costly to value by equity investors. To conduct this test, we separate *NCA* from other *Marketing_def* to investigate their relevance.

Table 5, which presents the findings, reveals an economically and statistically significant coefficient for customer intangibles, which confirms our results from our two prior tests (see also Dikolli et al. 2007; Bauman and Shaw, 2018; McInnis and Monsen, 2021). More importantly, we find no significant coefficients for *NCAs* across all specifications. These results are consistent with several claims of valuation experts and preparers that the capitalization of acquired non-compete agreements provides no decision relevant information for equity investors. Therefore, we can reject hypothesis 4 with regard to *Customer* intangibles, but not for *NCA*s. Taken together, the results across all our specifications suggest that customer intangibles should not be subsumed into goodwill because they carry decision useful information.

5.5 Additional tests

(Insert Table 6 about here)

We validate our findings through three additional tests of tests, with findings presented in the online Appendix B. First, we estimate each system using operating cash flows instead of accruals (Barth et al., 1999). Results, presented in Appendix B, Table B1-B4, yield the same inferences as those based on the accruals-based system. Second, we re-estimate our tests using two different discount rates for abnormal earnings, eight and ten percent. Untabulated results yield the same inferences as those on the twelve percent discount rate. Third, we follow Barth et al. (1999) and estimate our equation system on an industry level. We do this because Sandner and Block (2011), among others, suggests that valuation implications may differ between industries. In particular, we re-estimate our research design on an industry level using the Fama-French-12 industry classification including year fixed effects (Fama and French, 1997, Barth et al., 1999). Table 6 presents findings within industry estimations, wherein for the sake of parsimony we only include definite and indefinite intangible assets. Coefficients reveal mostly the same inferences as those based on the tabulated findings in which we pool observations across industries using industry fixed effects. Notably for definite intangible assets (indefinite intangibles), the findings reveal significantly positive coefficients in eleven (ten) out of twelve industries, and coefficients for *Def_int* are higher than *Indef_int* in eight industries confirming our prior results from Table 2.

VI. SUMMARY AND CONCLUDING REMARKS

This study examines the value relevance of acquired intangible assets in equity valuation. In particular, we investigate value relevance of different specifications of acquired intangible assets on stock prices. We base our analysis on an adjusted Ohlson (1999) valuation framework in line with Barth et al. (1999, 2005). We predict and find that net amounts of acquired intangibles are positively priced in equity markets. First, we find that both definite and indefinite intangible assets are positively associated with stock prices demonstrating a high relevance for equity investors. Second, we investigate four different intangible asset classes: tech-, customer-, contract-, and marketing intangibles. Other categories such as customer-, contract-, and marketing intangibles are also value relevant, yet, not as economically relevant as tech intangibles. Third, we disaggregate our four intangible asset classes into definite and indefinite intangible assets and find positive associations for definite and indefinite intangibles. Fourth, our empirical findings speak against the recent FASB proposal for subsuming customer intangibles and non-compete agreements into goodwill. While we find no associations between non-compete agreements and stock prices, we find significantly positive coefficients for customer-related intangibles. Our results imply that subsuming customer-related intangible assets into the goodwill would lead to a loss of relevant information for equity investors.

Overall, our study answers recent calls from both academics and standard setters (FASB and IASB) to investigate the usefulness of acquired intangible asset amounts. Our study is based on the most comprehensive dataset for acquired intangible asset classes tracking their post-acquisition values over time. Eventually, our paper directly speaks to potential losses in decision-relevant information for equity market participants when changing accounting for acquired intangible assets.

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Table 1. Sample composition and descriptive statistics

Panel A: Sample Composition

Industry	N	Firms	Percentage
Nondurables	1651	171	10.00%
Durables	696	73	4.22%
Manufacturing	1544	131	9.35%
Energy	806	80	4.88%
Chemical	816	78	4.94%
Equipment	2908	290	17.62%
Telephone	821	104	4.97%
Utilities	621	51	3.76%
Shops	2108	198	12.77%
Health	2007	225	12.16%
Finance	719	67	4.36%
Other	1811	179	10.97%
Sum	**16508**	**1647**	**100%**

Panel B: Descriptive statistics

Industry	Mean	Median	25%	75%	95%	99%	SD
MVE	10316.09	2218.32	546.50	8407.15	47946.84	147092.77	24123.62
BVE_adj	3322.25	609.06	143.44	2180.50	15089.00	44968.00	12235.81
Abearnings	100.74	1.50	-47.11	111.85	1221.24	3747.00	800.82
Accruals	-475.97	-86.05	-352.44	-13.77	57.70	445.00	1199.32
CFO	991.54	199.45	34.81	771.00	4820.00	13570.00	2344.40
Def_Int	332.68	18.00	0.00	163.90	1754.00	5117.00	1074.53
Indef_Int	222.65	0.00	0.00	21.50	830.00	6609.00	1049.39
Tech	85.63	0.00	0.00	8.60	326.00	2234.00	449.52
Tech_Def	74.51	0.00	0.00	7.55	285.71	1920.00	368.97
Tech_Indef	5.76	0.00	0.00	0.00	0.00	169.69	50.42
Customer	92.46	0.00	0.00	28.81	533.00	1641.00	288.30
Contract	84.23	0.00	0.00	1.12	372.00	2083.65	438.51
Contract_Def	28.01	0.00	0.00	0.00	142.00	710.00	121.60
Contract_Indef	40.02	0.00	0.00	0.00	29.82	1520.41	293.95
Marketing	128.20	0.00	0.00	24.00	575.26	3089.00	541.11
Marketing_Def	14.77	0.00	0.00	1.12	76.00	377.41	62.01
Marketing_Indef	104.28	0.00	0.00	2.50	458.59	2828.00	476.25
NCA	0.49	0.00	0.00	0.00	1.55	12.80	3.51
Other	30.18	0.00	0.00	4.35	164.40	591.55	113.04

Panel C: Pearson and Spearman correlations:

	(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*	*(9)*	*(10)*	*(11)*	*(12)*	*(13)*	*(14)*	*(15)*	*(16)*	*(17)*	*(18)*	*(19)*
MVE (1)		0.766	0.364	-0.624	0.866	0.461	0.201	0.187	0.179	0.140	0.185	0.131	0.115	0.037	0.199	0.080	0.132	-0.091	0.369
BVE_adj (2)	0.666		0.175	-0.525	0.730	0.299	0.039	0.115	0.110	0.077	0.119	0.042	0.056	-0.038	0.087	0.044	0.028	-0.068	0.281
Abearnings (3)	0.493	0.133		0.021	0.380	0.125	0.075	0.033	0.032	-0.005	0.039	0.005	0.010	-0.012	0.109	0.040	0.080	-0.002	0.146
Accruals (4)	-0.647	-0.529	-0.036		-0.754	-0.322	-0.148	-0.089	-0.086	-0.090	-0.112	-0.128	-0.103	-0.079	-0.114	-0.030	-0.075	0.074	-0.247
CFO (5)	0.880	0.659	0.439	-0.833		0.438	0.225	0.121	0.117	0.098	0.184	0.151	0.121	0.078	0.214	0.082	0.155	-0.072	0.360
Def_Int (6)	0.538	0.197	0.187	-0.409	0.506		0.379	0.534	0.528	0.215	0.639	0.365	0.367	0.082	0.538	0.447	0.310	0.153	0.579
Indef_Int (7)	0.438	0.120	0.195	-0.299	0.434	0.470		0.152	0.124	0.279	0.256	0.314	0.150	0.413	0.640	0.116	0.818	0.026	0.283
Tech (8)	0.380	0.076	0.150	-0.262	0.330	0.706	0.303		0.980	0.358	0.413	0.056	0.094	-0.092	0.278	0.347	0.087	0.087	0.161
Tech_Def (9)	0.383	0.080	0.150	-0.271	0.337	0.698	0.279	0.966		0.279	0.416	0.055	0.093	-0.093	0.277	0.356	0.081	0.092	0.152
Tech_Indef (10)	0.237	0.037	0.088	-0.136	0.186	0.531	0.233	0.735	0.621		0.083	0.011	0.032	-0.043	0.055	0.091	0.003	-0.022	0.055
Customer (11)	0.328	0.202	0.074	-0.270	0.327	0.534	0.307	0.164	0.201	-0.006		0.146	0.126	0.064	0.483	0.478	0.263	0.269	0.224
Contract (12)	0.300	0.127	0.085	-0.301	0.341	0.370	0.653	0.138	0.160	0.030	0.279		0.868	0.491	0.190	0.125	0.128	0.062	0.100
Contract_Def (13)	0.240	0.101	0.087	-0.225	0.246	0.334	0.216	0.123	0.128	0.105	0.146	0.471		0.094	0.171	0.143	0.096	0.071	0.067
Contract_Indef (14)	0.219	0.088	0.050	-0.260	0.282	0.256	0.644	0.103	0.127	-0.015	0.274	0.863	0.121		0.071	-0.007	0.097	0.018	0.076
Marketing (15)	0.376	0.117	0.191	-0.209	0.348	0.414	0.709	0.166	0.153	0.134	0.289	0.225	0.201	0.178		0.634	0.751	0.279	0.279
Marketing_Def (16)	0.277	0.101	0.094	-0.190	0.246	0.440	0.260	0.249	0.268	0.150	0.382	0.115	0.115	0.093	0.422		0.119	0.496	0.098
Marketing_Indef(17)	0.347	0.104	0.182	-0.179	0.319	0.347	0.716	0.124	0.111	0.095	0.268	0.230	0.202	0.184	0.964	0.262		0.053	0.234
NCA (18)	0.000	-0.003	0.002	0.000	-0.001	0.022	-0.015	-0.015	-0.014	-0.015	0.074	0.005	0.057	-0.013	0.010	0.111	-0.004		-0.062
Other (19)	0.431	0.217	0.217	-0.295	0.408	0.501	0.310	0.234	0.222	0.183	0.171	0.216	0.104	0.185	0.296	0.160	0.281	-0.011	

Table 1 provides descriptive statistics for the variables used in this study. Panel A presents time and industry composition of our sample. We define industry levels using Fama-French 12 industry classifications. Panel B presents descriptive statistics for independent and dependent variables. All amounts are denoted in $ million. Panel C presents univariate Pearson (below the diagonal) and Spearman (above) correlations between our used variables in this study. All variables are defined in Appendix A.

Table 2 Panel A: Valuation equation of definite and indefinite intangible assets

		1	***2***	***3a***	***3b***	***3c***
		Unconstrained estimation	***Constrained estimation***	***Constrained estimation***		
		complete sample (2003-2018)	***complete sample (2003-2018)***	***pre-SFAS R (2003-2008)***	***post-SFAS R (2009-2018)***	***Difference pre and post SFAS R***
VARIABLES	***Prediction***	*MVE*	*MVE*	*MVE*	*MVE*	
BVE_adj	+	1.287	1.277	1.127	1.329	0.202
		(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Abearnings	+	6.946	7.080	5.053	7.526	2.473
		(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Accruals	-	-3.109	-3.355	-1.922	-3.492	-1.570
		(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Def_Int	+	2.538***	2.537***	3.326***	3.174***	-0.152
		(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Indef_Int	+	0.864***	0.403***	0.652***	0.604***	-0.048
		(0.000)	(0.000)	(0.000)	(0.000)	(0.003)
Time FE		YES	YES	YES	YES	
Industry FE		YES	YES	YES	YES	
R-Squared		0.569	0.566	0.582		
F-Test		1728.20 (0.000)	1257.17 (0.000)	1423.34 (0.000)	1382.05 (0.000)	
Observations		16,508	16,508	16,508	16,508	

Table 2 Panel B: Change in persistence parameter tests between pre- and post- SFAS 141R period

	Def_int (ω_{44})	*Indef_int*(ω_{55})
Pre coefficient (System 1)	1.059	0.947
Post Coefficient (System 1)	0.977	0.937
Difference Pre – Post	-0.082	-0.010
Wald Test Difference	65.69	1.74
p-value Difference	(0.000)	(0.187)

Table 2 Panel A reports estimated coefficients including our variables of interest: definite (*Def_int*) and indefinite (*Indef_int*) intangible assets (equation 1(f) of system 1). Columns 1 and 2 present coefficients from unconstrained and constrained estimations over the entire sample period (2003-2018). Constrained estimators are derived and presented in Appendix C. Column 3a and 3b present coefficients from constrained estimations for the pre- and post SFAS 141R revision periods, 2003-2008 and 2009-2018. Coefficients for column 3a and 3b are estimated using a fully interacted model that uses indicator variables for the pre- and post- SFAS 141R revision periods. Column 3c presents differences between pre- and post SFAS 141R-coefficients. Two-tailed p-values are reported in parentheses below each coefficient for the null of zero. ***, **,* indicate 1%, 5%, and 10% significance levels of Wald tests for differences between *Def_int* and *Indef_int* coefficients. All regressions include year indicator variables (Time FE) and Fama-French 49 industry indicator variables (Industry FE). R-Squared represents the fit of the valuation equation based on the seemingly unrelated regression (SUR) – estimator. F-Test presents the Chi²-test statistic for the sum of *Def_int* and *Indef_int* being equal to 0. We scale all variables by shares outstanding. Table 2 Panel B reports estimated coefficients of the change in persistence parameters between pre and post SFAS 141R period. We report both pre- and post SFAS 141R persistence parameters for *Def_int* and *Indef_Int*. We test the difference with a Wald Test. Two-tailed p-values are reported in parentheses below each coefficient for the null of zero.

Table 3 Panel A: Valuation equation disaggregated into tech, customer, contract, and marketing intangibles

		1	***2***	***3a***	***3b***	***3c***
		Unconstrained estimation	***Constrained estimation***	***Constrained estimation***		
		complete sample (2003-2018)	***complete sample (2003-2018)***	***pre-SFAS R (2003-2008)***	***post-SFAS R (2009-2018)***	***Difference pre and post SFAS R***
VARIABLES	***Prediction***	*MVE*	*MVE*	*MVE*	*MVE*	
BVE_adj	+	1.276	1.274	1.139	1.307	0.168
		(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Abearnings	+	6.920	7.016	4.953	7.568	2.615
		(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Accruals	-	-3.129	-3.369	-1.898	-3.589	-1.691
		(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Tech	+	4.647	4.628	5.680	5.238	-0.442
		(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Customer	+	2.480	2.015	3.174	2.861	-0.313
		(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Contract	+	1.146	0.705	0.805	0.713	-0.092
		(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Marketing	+	1.370	1.235	1.410	1.320	-0.090
		(0.000)	(0.000)	(0.000)	(0.000)	(0.002)
Other	+	5.234	1.115	6.563	6.240	-0.323
		(0.000)	(0.010)	(0.000)	(0.000)	(0.010)
Time FE		YES	YES	YES	YES	
Industry FE		YES	YES	YES	YES	
R-Squared		0.572	0.568	0.584		
F-Test		1795.52 (0.000)	1291.86 (0.000)	1260.75 (0.000)	1389.16 (0.000)	
Observations		16,508	16,508	16,508	16,508	

Table 3 Panel B: Change in persistence parameter tests between pre- and post- SFAS 141R period

	Tech(ω_{44})	*Customer(ω_{55})*	*Contract(ω_{66})*	*Marketing(ω_{77})*
Pre coefficient (System 2)	0.996	0.978	0.961	0.966
Post Coefficient (System 2)	1.008	0.985	0.997	1.003
Difference Pre – Post	0.012	0.007	0.036	0.037
Wald Test Difference	0.88	0.28	43.81	19.39
p-value Difference	(0.349)	(0.597)	(0.000)	(0.000)

Table 3 Panel A reports estimated coefficients including our variables of interest: tech- (*Tech*), customer- (*Customer*), contract- (*Contract*), and marketing-related (*Marketing*) intangible assets (equation 2(i) of system 2). Columns 1 and 2 present coefficients from unconstrained and constrained estimations over the entire sample period (2003-2018). Constrained estimators are derived and presented in Appendix C. Column 3a and 3b present coefficients from constrained estimations for the pre- and post SFAS 141R revision periods, 2003-2008 and 2009-2018. Coefficients for column 3a and 3b are estimated using a fully interacted model that uses indicator variables for the pre- and post- SFAS 141R revision periods. Column 3c presents differences between pre- and post SFAS 141R-coefficients. Two-tailed p-values are reported in parentheses below each coefficient for the null of zero. All regressions include year indicator variables (Time FE) and Fama-French 49 industry indicator variables (Industry FE). R-Squared represents the fit of the valuation equation based on the seemingly unrelated regression (SUR) – estimator. F-Test presents the Chi²-test statistic for the sum of *Tech*, *Customer*, *Contract*, and *Marketing* being equal to 0. We scale all variables by shares outstanding.Table 3 Panel B reports estimated coefficients of the change in persistence parameters between pre and post SFAS 141R period. We report both pre- and post SFAS 141R persistence parameters for *Tech*, Customer, Contract, and *Marketing*. We test the difference with a Wald Test. Two-tailed p-values are reported in parentheses below each coefficient for the null of zero.

Table 4 Panel A: Valuation equation disaggregated into economic lifetimes (definite and indefinite) per asset class (tech-, customer, contract-, marketing intangibles)

		1	***2***	***3a***	***3b***	***3c***
		Unconstrained estimation	***Constrained estimation***		***Constrained estimation***	
		complete sample (2003-2018)	***complete sample (2003-2018)***	***pre-SFAS R (2003-2008)***	***post-SFAS R (2009-2018)***	***Difference pre and post SFAS R***
VARIABLES	***Prediction***	*MVE*	*MVE*	*MVE*	*MVE*	
BVE_adj	+	1.258	1.263	1.114	1.299	0.185
		(0.000)	(0.000)	(0.000)	(0.000)	(0.009)
Abearnings	+	8.642	7.050	4.961	7.548	2.587
		(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Accruals	-	-2.601	-3.475	-1.980	-3.641	-1.661
		(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Tech_Def	+	3.748***	3.957	5.627	5.014	-0.613
		(0.000)	(0.000)	(0.000)	(0.000)	(0.010)
Tech_Indef	+	15.162***	2.839		5.711	
		(0.000)	(0.002)		(0.000)	
Customer	+	2.629	2.157	3.297	3.014	-0.283
		(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Contract_Def	+	3.023***	2.394***	3.165***	2.759***	-0.406
		(0.000)	(0.000)	(0.038)	(0.000)	(0.000)
Contract_Indef	+	0.874***	0.362***	0.662***	0.648***	-0.015
		(0.000)	(0.000)	(0.000)	(0.000)	(0.640)
Marketing_Def	+	2.530*	0.392	1.606	1.333	-0.273
		(0.001)	(0.565)	(0.061)	(0.085)	(0.114)
Marketing_Indef	+	1.253*	1.194	1.226	1.158	-0.069
		(0.000)	(0.000)	(0.000)	(0.000)	(0.023)
Other	+	5.083	4.709	6.626	6.272	-0.353
		(0.000)	(0.000)	(0.000)	(0.000)	(0.004)
Time FE		YES	YES	YES	YES	
Industry FE		YES	YES	YES	YES	
R-Squared		0.570	0.564	0.582		
F-Test		387.51 (0.000)	145.25 (0.000)	283.46 (0.000)	273.27 (0.000)	
Observations		16,508	16,508	16,508	16,508	

Table 4 Panel B: Change in persistence parameter tests between pre- and post- SFAS 141R period

	Tech_Def(ω_{44})	*Customer(ω_{55})*	*Contract_Def(ω_{66})*	*Contract_Indef(ω_{77})*	*Marketing_Def(ω_{88})*	*Marketing_Indef*
Pre coefficient (System 3)	0.971	0.982	0.989	0.969	0.947	0.958
Post Coefficient (System 3)	0.978	0.981	0.970	0.958	0.958	1.013
Difference Pre – Post	0.007	-0.001	-0.019	-0.011	0.011	0.055
Wald Test Difference	0.47	0.01	4.03	3.40	1.33	37.46
p-value Difference	(0.493)	(0.910)	(0.045)	(0.065)	(0.248)	(0.000)
Wald Test of sum of persistence changes of definite intangibles (Tech_def, Customer, Contract_Def,Marketing_Def)		0.02 (0.900)				
Wald Test of sum of persistence changes of indefinite intangibles (Contract_Indef, Marketing_Indef)		16.07 (0.000)				

Table 4 Panel A reports estimated coefficients including our variables of interest: definite tech- (*Tech_def*), indefinite tech- (*Tech_indef*), customer- (*Customer*), definite contract- (*Contract_def*), indefinite contract- (*Contract_indef*), definite marketing- (*Marketing_def*), and indefinite marketing-related (*Marketing_indef*) intangible assets (equation 3(l) of system 3). Columns 1 and 2 present coefficients from unconstrained and constrained estimations over the entire sample period (2003-2018). Constrained estimators are derived and presented in Appendix C. Column 3a and 3b present coefficients from constrained estimations for the pre- and post SFAS 141R revision periods, 2003-2008 and 2009-2018. Coefficients for column 3a and 3b are estimated using a fully interacted model that uses indicator variables for the pre- and post- SFAS 141R revision periods. Column 3c presents differences between pre- and post SFAS 141R-coefficients. Two-tailed p-values are reported in parentheses below each coefficient for the null of zero. ***, **,* indicate 1%, 5%, and 10% significance levels of Wald tests for differences between *Tech_Def* and *Tech_Indef*, *Contract_Def* and *Contract_Indef*, and *Marketing_Def* and *Marketing_Indef* coefficients. All regressions include year indicator variables (Time FE) and Fama-French 49 industry indicator variables (Industry FE). R-Squared represents the fit of the valuation equation based on the seemingly unrelated regression (SUR) – estimator. F-Test presents the Chi²-test statistic for the sum of our variables of interests being equal to 0. We scale all variables by shares outstanding. Table 4 Panel B reports estimated coefficients of the change in persistence parameters between pre and post SFAS 141R period. We report both pre- and post SFAS 141R persistence parameters for *Tech_Def*, *Customer*, *Contract_Def*, *Contract_Indef* , *Marketing_Def* and *Marketing_Indef*. We test the difference with a Wald Test. Two-tailed p-values are reported in parentheses below each coefficient for the null of zero. Wald Test of the sum presents the Chi²-test statistic for the sum of definite and indefinite intangible assets being equal to 0.

Table 5: Valuation equation of customer related intangibles and non-compete agreements

		1	**2**	**3a**	**3b**	**3c**
		Unconstrained estimation	***Constrained estimation***	***Constrained estimation***		
		complete sample (2003-2018)	***complete sample (2003-2018)***	***pre-SFAS R (2003-2008)***	***post-SFAS R (2009-2018)***	***Difference pre and post SFAS R***
VARIABLES	***Prediction***	*MVE*	*MVE*	*MVE*	*MVE*	
BVE_adj	+	1.259	1.263	1.115	1.299	0.184
		(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Abearnings	+	6.925	7.048	4.995	7.584	2.589
		(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Accruals	-	-3.199	-3.473	-1.975	-3.639	-1.664
		(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Tech_Def	+	3.749***	3.874	5.610	4.996	-0.614
		(0.000)	(0.000)	(0.000)	(0.000)	(0.010)
Tech_Indef	+	15.160***	3.107		5.722	
		(0.000)	(0.001)		(0.000)	
Customer	+	2.648	2.160	3.305	3.033	-0.273
		(0.000)	(0.000)	(0.000)	(0.000)	(0.635)
Contract_Def	+	3.045***	2.402***	3.186***	2.782***	-0.404
		(0.000)	(0.000)	(0.030)	(0.000)	(0.000)
Contract_Indef	+	0.876***	0.370***	0.666***	0.651***	-0.015
		(0.000)	(0.003)	(0.000)	(0.000)	(0.615)
Marketing_Def_ex	+	2.507	0.921	2.162	1.866	-0.296
		(0.001)	(0.198)	(0.015)	(0.022)	(0.078)
NCA	+	-4.154	-10.530	-12.082	-11.676	0.406
		(0.675)	(0.103)	(0.199)	(0.151)	(0.857)
Marketing_Indef	+	1.247	1.184	1.221	1.151	-0.071
		(0.000)	(0.000)	(0.000)	(0.000)	(0.021)
Other	+	5.072	4.647	6.573	6.218	-0.355
		(0.000)	(0.000)	(0.000)	(0.000)	(0.004)
Time FE		YES	YES	YES	YES	
Industry FE		YES	YES	YES	YES	
R-Squared		0.571	0.567	0.582		
F-Test		387.74	155.56	281.91	274.63	
		(0.000)	(0.000)	(0.000)	(0.000)	
Observations		16,508	16,508	16,508	16,508	

Table 5 reports estimated coefficients including our variables of interest: customer-related intangible assets (*Customer*) and non-compete agreements (*NCA*) (equation 4(m) of system 4). Columns 1 and 2 present coefficients from unconstrained and constrained estimations over the entire sample period (2003-2018). Constrained estimators are derived and presented in Appendix C. Column 3a and 3b present coefficients from constrained estimations for the pre- and post SFAS 141R revision periods, 2003-2008 and 2009-2018. Coefficients for column 3a and 3b are estimated using a fully interacted model that uses indicator variables for the pre- and post- SFAS 141R revision periods. Column 3c presents differences between pre- and post SFAS 141R-coefficients. Two-tailed p-values are reported in parentheses below each coefficient for the null of zero. ***, **,* indicate 1%, 5%, and 10% significance levels of Wald tests for differences between *Tech_Def* and *Tech_Indef*, *Contract_Def* and *Contract_Indef*, and *Marketing_Def_ex* and *Marketing_Indef* coefficients. All regressions include year indicator variables (Time FE) and Fama-French 49 industry indicator variables (Industry FE). R-Squared represents the fit of the valuation equation based on the seemingly unrelated regression (SUR) – estimator. F-Test presents the Chi²-test statistic for the sum of our variables of interests being equal to 0. We scale all variables by shares outstanding.

Table 6: Industry regression for definite and indefinite intangible assets

	estimation	*BVE_adj*	*Def_Int*	*Indef_Int*	*Abearnings*	*Accruals*	*N*
Nondurables	***constrained coeff.***	**1.133**	**0.729**	**0.991**	**6.341**	**-2.557**	*1651*
	P-values	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	
	unconstrained coeff.	***1.134***	**0.902**	***1.129***	**6.052**	***-2.173***	
	P-values	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	
Durables	***constrained coeff.***	**1.468**	**2.070**	**0.469**	**3.107**	**-3.816**	*696*
	P-values	*0.000*	*0.000*	*0.092*	*0.000*	*0.000*	
	unconstrained coeff.	**1.394**	**2.931**	**1.263**	**2.735**	**-3.132**	
	P-values	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	
Manufacturing	***constrained coeff.***	**1.231**	**2.380**	**2.002**	**10.209**	**-4.830**	*1544*
	P-values	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	
	unconstrained coeff.	**1.204**	**2.647**	**2.112**	**10.136**	**-4.747**	
	P-values	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	
Oil&Gas	***constrained coeff.***	**1.030**	**5.085**	**6.881**	**2.459**	**-1.797**	*806*
	P-values	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	
	unconstrained coeff.	**1.030**	**3.602**	5.045	**2.466**	**-1.796**	
	P-values	*0.000*	*0.000*	*0.145*	*0.000*	*0.000*	
Chemicals	***constrained coeff.***	**1.224**	**0.997**	**3.141**	**11.909**	**-6.529**	*816*
	P-values	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	
	unconstrained coeff.	**1.260**	**1.626**	**3.592**	**11.895**	**-6.383**	
	P-values	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	
Business & Equipment	***constrained coeff.***	**1.379**	**2.555**	-0.049	**9.149**	**-4.549**	*2908*
	P-values	*0.000*	*0.000*	*0.949*	*0.000*	*0.000*	
	unconstrained coeff.	**1.299**	**3.033**	1.120	**9.140**	**-4.352**	
	P-values	*0.000*	*0.000*	*0.249*	*0.000*	*0.000*	
Telephone & Television	***constrained coeff.***	**0.648**	**1.527**	**0.688**	**3.616**	**-1.644**	*821*
	P-values	*0.000*	*0.000*	*0.000*	*0.000*	*0.006*	
	unconstrained coeff.	**0.732**	**1.531**	**0.953**	**3.255**	**-1.165**	
	P-values	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	
Utilities	***constrained coeff.***	**1.022**	0.367	1.204	**5.514**	**-2.489**	*621*
	P-values	*0.000*	*0.363*	*0.415*	*0.000*	*0.000*	
	unconstrained coeff.	**1.027**	**0.944**	-0.632	**5.449**	**-2.447**	
	P-values	*0.000*	*0.021*	*0.864*	*0.000*	*0.000*	
Shops	***constrained coeff.***	**1.161**	**1.633**	**0.450**	**12.139**	**-7.089**	*2108*
	P-values	*0.000*	*0.000*	*0.040*	*0.000*	*0.000*	
	unconstrained coeff.	**1.147**	**2.071**	**0.790**	**12.167**	**-6.285**	
	P-values	*0.000*	*0.000*	*0.001*	*0.000*	*0.000*	
Health	***constrained coeff.***	**1.977**	**2.736**	**1.382**	**4.951**	**-4.369**	*2007*
	P-values	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	
	unconstrained coeff.	**1.987**	**1.983**	**2.585**	**4.833**	**-4.057**	
	P-values	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	
Finance	***constrained coeff.***	**1.287**	**4.566**	**1.258**	**4.706**	**-0.876**	*719*
	P-values	*0.000*	*0.000*	*0.000*	*0.000*	*0.001*	
	unconstrained coeff.	**1.287**	**3.499**	**1.153**	**4.672**	**-0.881**	
	P-values	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	
Other	***constrained coeff.***	**1.232**	**6.129**	**1.696**	**6.200**	**-1.734**	*1811*
	P-values	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	
	unconstrained coeff.	**1.243**	**5.464**	**2.183**	**6.175**	**-1.622**	
	P-values	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	

Table 6 reports estimated coefficients by industry including our variables of interest: definite (*Def_int*) and indefinite (*Indef_int*) intangible assets (equation 1(f) of system 1). We define industries using Fama-French 12 industry classification. Both constrained and unconstrained coefficients are estimated over the entire sample period (2003-2018). An example of a constrained estimator is derived and presented in Appendix C. Bold numbers indicate significant coefficients on the ten percent level or better. Two-tailed p-values are reported in parentheses below each coefficient significantly different from zero. All regressions include year indicator variables (*Time FE*). We scale all variables by shares outstanding.

Appendix to

“The pricing of acquired intangibles”

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A. Variable definitions

Variable	Description	Data source
Dependent and independent variables:		
MVE	Market value of equity calculated with a three-month lag window.	CRSP
Abearnings	Abnormal earnings calculated as the difference between net income and normal earnings. Normal earnings are calculated with previous book value times the discount rate. We use a discount rate of 12 percent (Dechow et al. 1999; Barth et al. 1999).	Compustat
Accruals	Difference between net income to common shareholders and operating cash flows.	Compustat
CFO	Amount of cash flow from operating activities.	Compustat
BVE_adj	Book value of common equity subtracted by total amount of acquired intangible assets.	Compustat / Hand-collected
Intangible asset variables:		
Def_Int	Net amount of acquired definite intangible assets.	Hand-collected
Indef_Int	Net amount of acquired indefinite intangible assets.	Hand-collected
Tech	Net amount of definite and indefinite acquired tech-related intangible assets. This position includes mainly the following items: patents, developed technology, software, in-process R&D.	Hand-collected
Customer	Net amount of customer-related acquired intangible assets. This position includes mainly following items: Customer lists, customer relationships, customer contracts, order backlogs.	Hand-collected
Contract	Net amount of definite and indefinite purchased contract-related intangible assets. This position mainly includes the following items: licenses, contracts, agreements, land- and water rights, emission allowances, landing rights (for airline companies).	Hand-collected
Marketing	Net amount of definite and indefinite purchased marketing-related intangible assets. This position mainly includes the following items: trademarks and tradenames, domain names, mastheads, non-compete agreements.	Hand-collected
Other	Net amount of acquired intangible assets, which are not allocated into one of the four specific categories. For instance, it contains commingled positions as well as artistic intangible assets.	Hand-collected
Tech_Def	Net amount of acquired definite-lived tech-related intangible assets.	Hand-collected
Tech_Indef	Net amount of acquired indefinite-lived tech-related intangible assets. This category consist almost entirely of in-process R&D.	Hand-collected
Contract_Def	Net amount of acquired definite-lived contract-related intangible assets.	Hand-collected
Contract_Indef	Net amount of acquired indefinite-lived contract-related intangible assets. This category consists primarily of licenses and franchises.	Hand-collected
Marketing_Def	Net amount of acquired definite-lived marketing-related intangible assets.	Hand-collected
Marketing_Indef	Net amount of acquired indefinite-lived marketing-related intangible assets. This category is entirely comprised of trademarks.	Hand-collected
Marketing_Def_ex	Net amount of acquired definite-lived marketing-related intangible assets subtracted by acquired non-compete agreements.	Hand-collected
NCA	Net amount of acquired non-compete agreements.	Hand-collected

Table B1 Panel A: Valuation equation of definite and indefinite intangible assets

		1	2	3a	3b	3c
		Unconstrained estimation	***Constrained estimation***	***Constrained estimation***		
		complete sample (2003-2018)	***complete sample (2003-2018)***	***pre-SFAS R (2003-2008)***	***post-SFAS R (2009-2018)***	***Difference pre and post SFAS R***
VARIABLES	***Prediction***	*MVE*	*MVE*	*MVE*	*MVE*	
BVE_adj	+	0.893	0.855	0.844	0.895	0.051
		(0.000)	(0.000)	(0.000)	(0.000)	(0.265)
Abearnings	+	3.987	3.866	3.226	4.158	0.932
		(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
CFO	+	3.409	3.701	2.279	3.833	1.554
		(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Def_Int	+	2.099***	2.200***	2.917***	2.740***	-0.177
		(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Indef_Int	+	0.292***	-0.048***	0.051***	0.033***	-0.018
		(0.000)	(0.443)	(0.537)	(0.659)	(0.285)
Time FE		YES	YES	YES	YES	
Industry FE		YES	YES	YES	YES	
R-Squared		0.587	0.584	0.599		
F-Test		769.20	527.37	642.17	581.78	
		(0.000)	(0.000)	(0.000)	(0.000)	
Observations		16,508	16,508	16,508	16,508	

Table B1 Panel B: Change in persistence parameter tests between pre- and post- SFAS 141R period

	Def_int (ω_{44})	*Indef_int*((ω_{55})
Pre coefficient (System 1)	1.041	0.935
Post Coefficient (System 1)	0,976	0.936
Difference Pre – Post	-0.065	0.001
Wald Test Difference	36.81	0.03
p-value Difference	(0.000)	(0.870)

Table B1 Panel A reports estimated coefficients including our variables of interest: definite (*Def_int*) and indefinite (*Indef_int*) intangible assets (equation 1(f) of system 1). Column 1 presents an unconstrained estimation of coefficients over the entire sample period (2003-2018). Column 2 presents a constrained estimation of coefficients over the entire sample period (2003-2018). An example of a constrained estimator is derived and presented in Appendix C. Column 3a represents pre SFAS 141 revision (2003-2008) estimates, while column 3b shows post revision period (2009-2018) estimates. Coefficients for column 3a and 3b are estimated using a constrained and fully interacted model with indicator variables capturing the pre- and post SFAS 141R revision period. Column 3c presents differences between pre- and post SFAS 141R-coefficients. Two-tailed p-values are reported in parentheses below each coefficient significantly different from zero. ***, **,* indicate 1%, 5%, and 10% significance levels of Wald tests testing definite against indefinite intangible assets. All regressions include year indicator variables (*Time FE*) and Fama-French 49 industry indicator variables (*Industry FE*). R-Squared represents the fit of the valuation equation of the seemingly unrelated regression (SUR) – estimator. F-Test presents the Chi²-test statistic for the sum of *Def_int* and *Indef_int* being equal to 0. We scale all variables by shares outstanding. Table B1 Panel B reports estimated coefficients of the change in persistence parameters between pre and post SFAS 141R period. We report both pre- and post SFAS 141R persistence parameters for *Def_int* and *Indef_Int*. We test the difference with a Wald Test. Two-tailed p-values are reported in parentheses below each coefficient for the null of zero.

Table B2 Panel A: Valuation equation disaggregated into tech, customer, contract, and marketing intangibles

		1	***2***	***3a***	***3b***	***3c***
		Unconstrained estimation	***Constrained estimation***	***Constrained estimation***		
VARIABLES	***Prediction***	***complete sample (2003-2018)*** *MVE*	***complete sample (2003-2018)*** *MVE*	***pre-SFAS R (2003-2008)*** *MVE*	***post-SFAS R (2009-2018)*** *MVE*	***Difference pre and post SFAS R***
BVE_adj	+	0.887	0.849	0.851	0.875	0.024
		(0.000)	(0.000)	(0.000)	(0.000)	(0.650)
Abearnings	+	3.951	3.803	3.132	4.095	0.963
		(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
CFO	+	3.389	3.704	2.261	3.423	1.162
		(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Tech	+	4.031	4.431	5.290	4.825	-0.465
		(0.000)	(0.000)	(0.002)	(0.000)	(0.000)
Customer	+	2.015	1.628	2.717	2.363	-0.355
		(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Contract	+	0.557	0.125	0.192	0.100	-0.091
		(0.000)	(0.198)	(0.080)	(0.316)	(0.000)
Marketing	+	0.786	0.669	0.744	0.674	-0.070
		(0.000)	(0.000)	(0.000)	(0.000)	(0.012)
Other	+	4.156	0.461	5.697	5.474	-0.223
		(0.000)	(0.414)	(0.000)	(0.000)	(0.059)
Time FE		YES	YES	YES	YES	
Industry FE		YES	YES	YES	YES	
R-Squared		0.589	0.585	0.600		
F-Test		990.04 (0.000)	646.32 (0.000)	770.17 (0.000)	693.20 (0.000)	
Observations		16,508	16,508	16,508	16,508	

Table B2 Panel B: Change in persistence parameter tests between pre- and post- SFAS 141R period

	Tech(ω_{44})	*Customer*(ω_{55})	*Contract*(ω_{66})	*Marketing*(ω_{77})
Pre coefficient (System 2)	0.979	0.969	0.958	0.958
Post Coefficient (System 2)	1.008	0.984	0.998	1.003
Difference Pre – Post	0.029	0.015	0.040	0.045
Wald Test Difference	6.12	1.22	50.95	27.61
p-value Difference	(0.013)	(0.269)	(0.000)	(0.000)

Table B2 Panel A reports estimated coefficients including our variables of interest: tech- (*Tech*), customer- (*Customer*), contract- (*Contract*), and marketing-related (*Marketing*) intangible assets (equation 2(i) of system 2). Columns 1 and 2 present coefficients from unconstrained and constrained estimations over the entire sample period (2003-2018). Constrained estimators are derived and presented in Appendix C. Column 3a and 3b present coefficients from constrained estimations for the pre- and post SFAS 141R revision periods, 2003-2008 and 2009-2018. Coefficients for column 3a and 3b are estimated using a fully interacted model that uses indicator variables for the pre- and post- SFAS 141R revision periods. Column 3c presents differences between pre- and post SFAS 141R-coefficients. Two-tailed p-values are reported in parentheses below each coefficient for the null of zero. All regressions include year indicator variables (Time FE) and Fama-French 49 industry indicator variables (Industry FE). R-Squared represents the fit of the valuation equation based on the seemingly unrelated regression (SUR) – estimator. F-Test presents the Chi²-test statistic for the sum of *Tech, Customer, Contract,* and *Marketing* being equal to 0. We scale all variables by shares outstanding. Table B2 Panel B reports estimated coefficients of the change in persistence parameters between pre and post SFAS 141R period. We report both pre- and post SFAS 141R persistence parameters for *Tech*, Customer, Contract, and *Marketing*. We test the difference with a Wald Test. Two-tailed p-values are reported in parentheses below each coefficient for the null of zero.

Table B3 Panel A: Valuation equation disaggregated into economic lifetimes (definite and indefinite) per asset class (tech-, customer, contract-, marketing intangibles)

		1	***2***	***3a***	***3b***	***3c***
		Unconstrained estimation	***Constrained estimation***	***Constrained estimation***		
		complete sample (2003-2018)	***complete sample (2003-2018)***	***pre-SFAS R (2003-2008)***	***post-SFAS R (2009-2018)***	***Difference pre and post SFAS R***
VARIABLES	***Prediction***	*MVE*	*MVE*	*MVE*	*MVE*	
BVE_adj	+	0.863	0.829	0.827	0.860	0.033
		(0.000)	(0.000)	(0.000)	(0.000)	(0.501)
Abearnings	+	3.899	3.751	3.115	4.063	0.948
		(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
CFO	+	3.472	3.814	2.332	2.922	1.605
		(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Tech_Def	+	3.202***	3.602	5.233	4.656	-0.577
		(0.000)	(0.000)	(0.017)	(0.000)	(0.000)
Tech_Indef	+	13.333***	2.464		4.860	
		(0.000)	(0.009)		(0.000)	
Customer	+	2.153	1.758	2.822	2.494	-0.328
		(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Contract_Def	+	2.053***	1.468***	2.299***	1.928***	-0.372
		(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Contract_Indef	+	0.105***	-0.288***	-0.228***	-0.218***	0.010
		(0.434)	(0.029)	(0.183)	(0.580)	(0.741)
Marketing_Def	+	1.420	-0.548	0.725	0.506	-0.218
		(0.047)	(0.447)	(0.426)	(0.538)	(0.193)
Marketing_Indef	+	0.632	0.584	0.527	0.494	-0.032
		(0.000)	(0.000)	(0.000)	(0.000)	(0.277)
Other	+	4.046	4.151	5.785	5.537	-0.248
		(0.000)	(0.000)	(0.000)	(0.000)	(0.037)
Time FE		YES	YES	YES	YES	
Industry FE		YES	YES	YES	YES	
R-Squared		0.588	0.583	0.599		
F-Test		242.70 (0.000)	61.69 (0.000)	131.12 (0.000)	133.48 (0.000)	
Observations		16,508	16,508	16,508	16,508	

Table B3 Panel B: Change in persistence parameter tests between pre- and post- SFAS 141R period

	Tech_Def(ω_{44})	*Customer*(ω_{55})	*Contract_Def*(ω_{66})	*Contract_Indef*(ω_{77})	*Marketing_Def*(ω_{88})	*Marketing_Indef*
Pre coefficient (System 3)	0.963	0.970	0.986	0.967	0.945	0.949
Post Coefficient (System 3)	0.977	0.980	0.969	0.959	0.958	1.013
Difference Pre – Post	0.014	0.010	-0.017	-0.008	0.013	0.064
Wald Test Difference	1.91	0.58	3.24	1.83	2.02	47.94
p-value Difference	(0.167)	(0.447)	(0.072)	(0.177)	(0.155)	(0.000)
Wald Test of sum of persistence changes of definite intangibles (Tech_def, Customer, Contract_Def,Marketing_Def)			0.87 (0.351)			
Wald Test of sum of persistence changes of indefinite intangibles (Contract_Indef, Marketing_Indef)			24.95 (0.000)			

Table B3 Panel A reports estimated coefficients including our variables of interest: definite tech- (*Tech_def*), indefinite tech- (*Tech_indef*), customer- (*Customer*), definite contract- (*Contract_def*), indefinite contract- (*Contract_indef*), definite marketing- (*Marketing_def*), and indefinite marketing-related (*Marketing_indef*) intangible assets (equation 3(l) of system 3). Columns 1 and 2 present coefficients from unconstrained and constrained estimations over the entire sample period (2003-2018). Constrained estimators are derived and presented in Appendix C. Column 3a and 3b present coefficients from constrained estimations for the pre- and post SFAS 141R revision periods, 2003-2008 and 2009-2018. Coefficients for column 3a and 3b are estimated using a fully interacted model that uses indicator variables for the pre- and post- SFAS 141R revision periods. Column 3c presents differences between pre- and post SFAS 141R-coefficients. Two-tailed p-values are reported in parentheses below each coefficient for the null of zero. ***, **,* indicate 1%, 5%, and 10% significance levels of Wald tests for differences between *Tech_Def* and *Tech_Indef, Contract_Def* and *Contract_Indef,* and *Marketing_Def* and *Marketing_Indef* coefficients. All regressions include year indicator variables (Time FE) and Fama-French 49 industry indicator variables (Industry FE). R-Squared represents the fit of the valuation equation based on the seemingly unrelated regression (SUR) – estimator. F-Test presents the Chi²-test statistic for the sum of our variables of interests being equal to 0. We scale all variables by shares outstanding. Table B3 Panel B reports estimated coefficients of the change in persistence parameters between pre and post SFAS 141R period. We report both pre- and post SFAS 141R persistence parameters for *Tech_Def*, *Customer*, *Contract_Def*, *Contract_Indef* , *Marketing_Def* and *Marketing_Indef*. We test the difference with a Wald Test. Two-tailed p-values are reported in parentheses below each coefficient for the null of zero. Wald Test of the sum presents the Chi²-test statistic for the sum of definite and indefinite intangible assets being equal to 0.

Table B4: Valuation equation of customer related intangibles and non-compete agreements

		1	*2*	*3a*	*3b*	*3c*
		Unconstrained estimation	*Constrained estimation*	*Constrained estimation*		
		complete sample (2003-2018)	*complete sample (2003-2018)*	*pre-SFAS R (2003-2008)*	*post-SFAS R (2009-2018)*	*Difference pre and post SFAS R*
VARIABLES	*Prediction*	*MVE*	*MVE*	*MVE*	*MVE*	
BVE_adj	+	0.864	0.830	0.829	0.861	0.032
		(0.000)	(0.000)	(0.000)	(0.000)	(0.484)
Abearnings	+	3.898	3.751	3.114	4.063	0.949
		(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Cash Flow	+	3.473	3.814	2.328	3.936	1.608
		(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Tech_Def	+	3.198***	3.709*	5.205	4.628	-0.577
		(0.000)	(0.000)	(0.017)	(0.000)	(0.000)
Tech_Indef	+	13.329***	1.744*		4.860	
		(0.000)	(0.072)		(0.000)	
Customer	+	2.172	1.732	2.833	2.518	-0.316
		(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Contract_Def	+	2.073***	1.488***	2.315	1.947	-0.368
		(0.000)	(0.000)	(0.073)	(0.000)	(0.000)
Contract_Indef	+	0.108***	-0.285***	-0.224	-0.214	0.010
		(0.424)	(0.031)	(0.191)	(0.175)	(0.751)
Marketing_Def_ex	+	1.521	0.789	1.433	1.214	-0.220
		(0.036)	(0.918)	(0.130)	(0.164)	(0.177)
NCA	+	-8.493	-14.281	-15.343	-15.292	0.051
		(0.382)	(0.030)	(0.120)	(0.356)	(0.982)
Marketing_Indef	+	0.623	0.570	0.519	0.485	-0.034
		(0.000)	(0.000)	(0.001)	(0.000)	(0.263)
Other	+	4.023	4.115	5.715	5.467	-0.248
		(0.000)	(0.000)	(0.000)	(0.000)	(0.037)
Time FE		YES	YES	YES	YES	
Industry FE		YES	YES	YES	YES	
R-Squared		0.588	0.582	0.599		
F-Test		242.73 (0.000)	56.60 (0.000)	(0.000)	(0.000)	
Observations		16,508	16,508	16,508	16,508	

Table B4 reports estimated coefficients including our variables of interest: customer-related intangible assets (*Customer*) and non-compete agreements (*NCA*) (equation 4(m) of system 4). Columns 1 and 2 present coefficients from unconstrained and constrained estimations over the entire sample period (2003-2018). Constrained estimators are derived and presented in Appendix C. Column 3a and 3b present coefficients from constrained estimations for the pre- and post SFAS 141R revision periods, 2003-2008 and 2009-2018. Coefficients for column 3a and 3b are estimated using a fully interacted model that uses indicator variables for the pre- and post- SFAS 141R revision periods. Column 3c presents differences between pre- and post SFAS 141R-coefficients. Two-tailed p-values are reported in parentheses below each coefficient for the null of zero. ***, **,* indicate 1%, 5%, and 10% significance levels of Wald tests for differences between *Tech_Def* and *Tech_Indef, Contract_Def* and *Contract_Indef,* and *Marketing_Def_ex* and *Marketing_Indef* coefficients. All regressions include year indicator variables (Time FE) and Fama-French 49 industry indicator variables (Industry FE). R-Squared represents the fit of the valuation equation based on the seemingly unrelated regression (SUR) – estimator. F-Test presents the Chi²-test statistic for the sum of our variables of interests being equal to 0. We scale all variables by shares outstanding.

Table B5: Industry regressions for definite and indefinite intangible assets (cash flow design)

	estimation	*BVE_adj*	*Def_Int*	*Indef_Int*	*Abearnings*	*CFO*	*N*
Nondurables	***constrained coeff.***	**0.846**	**0.492**	**0.661**	**4.109**	**2.478**	*1651*
	P-values	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	
	unconstrained coeff.	**0.907**	**0.729**	**0.775**	**4.225**	**2.022**	
	P-values	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	
Durables	***constrained coeff.***	**0.924**	**1.870**	0.006	-0.508	**4.270**	*696*
	P-values	*0.000*	*0.000*	*0.984*	*0.212*	*0.000*	
	unconstrained coeff.	**0.965**	**2.570**	**0.735**	-0.245	**3.467**	
	P-values	*0.000*	*0.000*	*0.018*	*0.552*	*0.000*	
Manufacturing	***constrained coeff.***	**0.676**	**2.218**	**1.734**	**5.810**	**4.935**	*1544*
	P-values	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	
	unconstrained coeff.	**0.668**	**2.045**	**1.512**	**5.843**	**4.767**	
	P-values	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	
Oil&Gas	***constrained coeff.***	**0.810**	**5.148**	6.441	**0.708**	**1.921**	*806*
	P-values	*0.000*	*0.000*	*0.155*	*0.000*	*0.000*	
	unconstrained coeff.	**0.810**	**3.426**	4.252	**0.719**	**1.919**	
	P-values	*0.000*	*0.000*	*0.215*	*0.000*	*0.000*	
Chemicals	***constrained coeff.***	**0.371**	0.460	**3.269**	**4.301**	**6.640**	*816*
	P-values	*0.000*	*0.164*	*0.000*	*0.000*	*0.000*	
	unconstrained coeff.	**0.428**	**0.859**	**2.822**	**4.489**	**6.448**	
	P-values	*0.000*	*0.002*	*0.000*	*0.000*	*0.000*	
Business & Equipment	***constrained coeff.***	**0.717**	**2.386**	**-1.507**	**4.873**	**5.756**	*2908*
	P-values	*0.000*	*0.000*	*0.082*	*0.000*	*0.000*	
	unconstrained coeff.	**0.688**	**2.424**	-0.462	**5.128**	**5.377**	
	P-values	*0.000*	*0.000*	*0.626*	*0.000*	*0.000*	
Telephone & Television	***constrained coeff.***	**0.439**	**1.323**	**0.377**	**2.062**	**1.780**	*821*
	P-values	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	
	unconstrained coeff.	**0.580**	**1.308**	**0.734**	**2.180**	**1.280**	
	P-values	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	
Utilities	***constrained coeff.***	**0.686**	0.147	1.868	**3.062**	**2.800**	*621*
	P-values	*0.000*	*0.723*	*0.218*	*0.000*	*0.000*	
	unconstrained coeff.	**0.693**	**0.671**	-1.115	**3.052**	**2.762**	
	P-values	*0.000*	*0.097*	*0.760*	*0.000*	*0.000*	
Shops	***constrained coeff.***	**0.556**	**0.678**	-0.274	**5.943**	**6.227**	*2108*
	P-values	*0.000*	*0.026*	*0.250*	*0.000*	*0.000*	
	unconstrained coeff.	**0.556**	**1.003**	0.156	**6.075**	**6.111**	
	P-values	*0.000*	*0.000*	*0.503*	*0.000*	*0.000*	
Health	***constrained coeff.***	**1.485**	**4.155**	**2.032**	**0.683**	**4.608**	*2007*
	P-values	*0.000*	*0.000*	*0.000*	*0.031*	*0.000*	
	unconstrained coeff.	**1.546**	**1.441**	**2.094**	**0.931**	**4.174**	
	P-values	*0.000*	*0.000*	*0.000*	*0.003*	*0.000*	
Finance	***constrained coeff.***	**1.105**	**4.417**	**1.169**	**3.843**	**1.431**	*719*
	P-values	*0.000*	*0.000*	*0.001*	*0.000*	*0.000*	
	unconstrained coeff.	**1.108**	**3.373**	**1.036**	**3.817**	**1.416**	
	P-values	*0.000*	*0.000*	*0.001*	*0.000*	*0.000*	
Other	***constrained coeff.***	**0.964**	**6.549**	**1.151**	**4.511**	**2.089**	*1811*
	P-values	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	
	unconstrained coeff.	**0.999**	**5.113**	**1.491**	**4.611**	**1.919**	
	P-values	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	

Table B5 reports estimated coefficients on industry level including our variables of interest: definite (Def_int) and indefinite (Indef_int) intangible assets (equation 1f of our system 1, substituting cash flows for accruals). We define industries using Fama-French 12 industry classification. Both constrained and unconstrained coefficients are estimated over the entire sample period (2003-2018). An example of a constrained estimator is derived and presented in Appendix C. Bold numbers indicate significant coefficients on the ten percent level. Two-tailed p-values are reported in parentheses below each coefficient significantly different from zero. All regressions include year indicator variables (Time FE). We scale all variables by shares outstanding.

Appendix C: Derivation of valuation coefficients for intangible assets

This appendix derives the coefficients in our valuation equation in terms of the other coefficients from the autoregressive equations. The derivation is similar to Ohlson (1999), Barth et al. (1999), and Barth et al. (2005). We demonstrate our procedure using our first system of equations (for hypothesis 1a and b). In the paper, we estimate the following system to investigate value relevance for definite and indefinite intangible assets (*system 1*):

$$
\begin{aligned}
Abearnings_{t+1} &= \alpha_1 + \omega_{11} Abearnings_t + \omega_{12} Accruals_t + \omega_{13} BVE\_adj_t + \omega_{14} Def\_\mathrm{int}_t + \omega_{15} Indef\_\mathrm{int}_t + \tau_t + \tau_{ind} + e_{1t+1} && 1a)\\
Accruals_{t+1} &= \alpha_2 + \omega_{22} Accruals_t + \omega_{23} BVE\_adj_t + \omega_{24} Def\_\mathrm{int}_t + \omega_{25} Indef\_\mathrm{int}_t + \tau_t + \tau_{ind} + e_{2t+1} && 1b)\\
BVE\_adj_{t+1} &= \alpha_3 + \omega_{33} BVE\_adj_t + \tau_t + \tau_{ind} + e_{3t+1} && 1c)\\
Def\_\mathrm{int}_{t+1} &= \alpha_4 + \omega_{44} Def\_\mathrm{int}_t + \tau_t + \tau_{ind} + e_{4t+1} && 1d)\\
Indef\_\mathrm{int}_{t+1} &= \alpha_5 + \omega_{55} Indef\_\mathrm{int}_t + \tau_t + \tau_{ind} + e_{5t+1} && 1e)\\
MVE_t &= \alpha_6 + \beta_1 BVE\_adj_t + \beta_2 Abearnings_t + \beta_3 Accruals_t + \beta_4 Def\_\mathrm{int}_t + \beta_5 Indef\_\mathrm{int}_t + \tau_t + \tau_{ind} + e_{6t+1} && 1f)
\end{aligned}
$$

All variables are defined as in the paper. First, we define **M**, a **5x5** matrix for all coefficients in equations 1a) through 1e), **X**, a 5x1 row vector comprising coefficients of equation 1a), and **Z** = {*BVE_adj*, *Abearnings*, *Accruals*, *Def_int*, *Indef_int*}, a **1x5** column vector comprising variables of interest in valuation equation 1f) of the system. We also define **T** ={0,0,0,0,1}, a 1x5 row vector, and ***α***={0,0,0,0,1}, a 1x5 row vector. Using this notation and following Barth et al. (2005) we solve our equation 1f) conditional on coefficients of **M** for our linear information model in System 1. In particular, market value of equity, *MVE*, can be represented by the following equation in matrix notation (see Ohlson, 1999; Barth et al., 2005):

$$\boldsymbol{MVE_t} = \alpha \boldsymbol{Z_t} = (\boldsymbol{T} + \frac{\boldsymbol{X}}{1+\boldsymbol{r}}[\boldsymbol{I} - \frac{\boldsymbol{M}}{1+\boldsymbol{r}}]^{-1})\boldsymbol{Z_t}$$

For *system 1*, our derivation of *MVE* yields the following theoretical market value equation (equation 1f) explaining market value of equity in terms of coefficients of the other autoregressive equations (equation 1a) through 1e)), where ***α*** is represented by the terms in parentheses:

$$
\begin{aligned}
MVE = {} & \left(\frac{\omega_{11}}{1+r-\omega_{11}}\right) Abearnings \\
& + \left(\frac{\omega_{11}\omega_{12}}{(1+r-\omega_{22})(1+r-\omega_{11})} + \frac{\omega_{12}}{1+r-\omega_{22}}\right) Accruals \\
& + \left(\frac{\omega_{11}(\omega_{13} r + \omega_{12}\omega_{23} - \omega_{13}\omega_{22} + \omega_{13})}{(1+r-\omega_{11})(1+r-\omega_{22})(1+r-\omega_{33})} + \frac{\omega_{12}\omega_{23}}{(1+r-\omega_{33})(1+r-\omega_{22})} + \frac{\omega_{13}}{1+r-\omega_{33}}\right) BV\_adj \\
& + \left(\frac{\omega_{11}(\omega_{14} r + \omega_{12}\omega_{24} - \omega_{14}\omega_{22} + \omega_{14})}{(1+r-\omega_{44})(1+r-\omega_{22})(1+r-\omega_{11})} + \frac{\omega_{12}\omega_{24}}{(1+r-\omega_{44})(1+r-\omega_{22})} + \frac{\omega_{14}}{1+r-\omega_{44}}\right) Def\_int \\
& + \left(1 + \frac{\omega_{11}(\omega_{15} r + \omega_{12}\omega_{25} - \omega_{15}\omega_{22} + \omega_{15})}{(1+r-\omega_{55})(1+r-\omega_{22})(1+r-\omega_{11})} + \frac{\omega_{12}\omega_{25}}{(1+r-\omega_{55})(1+r-\omega_{22})} + \frac{\omega_{15}}{1+r-\omega_{55}}\right) Indef\_int
\end{aligned}
$$

We also derive constrained estimators for the other three systems (*system 2*, *system 3*, and *system 4*) using the same procedure. Derived equations are available upon request. The derivation of the cash flow system works in the same manner with the exception that *Cash flow* is substituted for *Accruals*.

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