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What financial and non-financial information on intangibles is value-relevant? A review of the evidence

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What financial and non-financial information on intangibles is value-relevant? A review of the evidence

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Abstract—This paper evaluates what we have learned about the relevance and reliability of financial and non-financial information on intangibles from the value-relevance literature. Because value-relevance studies do not easily allow judgments about the reliability of information on intangibles, and this is an issue of central interest, this paper takes a rather wide look across a range of literatures to try to piece together some indirect evidence on both relevance and reliability. The evidence from a package of value-relevance and triangulation studies suggests research and development (R&D) is generally not reliably measured and may be less relevant in some contexts than others as well (e.g. established versus growth firms). Further purchased goodwill and some non-financial measures of brands and customer loyalty do not appear to be reliably measured. While a large number of financial and non-financial information is value-relevant, it is difficult to make categorical judgments about most other items, as differences in value-relevance could be due to different relevance or reliability, or both. Several rich areas for future research include designing direct tests of reliability, focusing on settings where intangibles are changing due to shocks, finding new economic benchmarks to test reliability, and studying the impact of accounting discretion and factors such as strategy and capabilities on value-relevance tests of information on intangibles. Two regulatory issues arising from this review paper are the gap in the reporting of separate line items of expenditures on intangibles; and the possibility that giving management discretion, with regulatory guidance, to report intangibles might facilitate more value-relevant information on intangibles.

Key words: value-relevance, intangibles, accounting regulation

1. Introduction

This paper evaluates what we have learned about the relevance and reliability of financial and non-financial information on intangibles from the value-relevance literature. The paper provides a rather wide-ranging view across the literatures in several disciplines, including economics, accounting, and management. This approach is motivated by the difficulty of testing for reliability using the value-relevance design. Since the reliability of information on intangibles for valuation is an issue of central interest, this paper provides an indirect, second-order assessment of reliability by piecing together the evidence from a large number of studies with different research questions and designs, and different measures of intangibles information and value.

Information is value-relevant when it is associated with investors' valuation of the firm as reflected in the firm's stock price. However, intangibles are generally unverifiable and uncertain by nature. Regulators and some researchers therefore hold reservations about *financial* disclosures on intangibles, including the costs and benefits to the firms, and the reliability for investors.[1] Value-relevance studies provide some insights on these concerns. If the information items of interest are significantly *associated* with the information set

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[1] For example, the Financial Accounting Standards Committee of the American Accounting Association commented on the Financial Accounting Standards Board's *'Proposal for a New Agenda Project: Disclosure of Information about Intangible Assets Not Recognized in Financial Statements, August 17'*, September 28, 2001: 'If the FASB is to step in and (say) mandate the disclosure of certain information on intangibles, a question that seems relevant is: why have firms chosen not to disclose this information voluntarily. One answer is that there are likely to be costs associated with such disclosures, including both costs associated with measuring intangibles and proprietary costs of disclosing such information to competitors. Another answer may be that the benefits of these disclosures are not very large, perhaps because these disclosures are not very informative to investors due to low relevance or imprecise measurement. Whatever the case, it seems to us that the relatively low levels of voluntary disclosure in the intangibles area raise the possibility that disclosures in this area do not provide net benefits.'

that was used by investors to value the company, we can infer that the information is *relevant* (either directly or indirectly in a confirmative sense) for valuing the company. This statistical association with stock price also suggests that the information is *reliable* enough to be value-relevant. However, there are limits to what can be learned about reliability. Conclusions from value-relevance studies are not reliable if important factors are left out of the tests. We cannot tell whether investors actually *used* the information item of interest or whether one accounting method is optimal relative to another, or easily understand *why* information is value-relevant. Overall, it is difficult to directly test reliability and only a few studies do this.

Intangible investment is increasingly viewed by some as an important category of investment.[2] This view reflects an increasing tendency for technology to be embodied in intellectual property (IP) and labour where previously it resided in fixed assets. Without a long and comprehensive financial data series, however, it has proved impossible to conclusively test this hypothesis. At a more fundamental level, it is easy to argue that expenditures on intangibles are important because the stock of physical resources is finite and economic activity can only be sustained by the application of intellectual inputs (Webster, 1999). This presents a *prima facie* case for the value-relevance of at least some of the firm's expenditures on intangibles and the non-financial information bearing on the value and uncertainty associated with these expenditures.

Intangibles are also at the centre of an information gap that arises from the forward looking and uncertain nature of economic activity. In fact, all of the firm's investments, tangible and intangible, are uncertain by definition, since investment expenditures are outlays made in *anticipation* of future benefits (Fisher, 1930). However, while tangible assets tend to be standardised with control rights and a predictable stream of inflows, intangible assets tend to be heterogeneous and uncertain and subject to long development periods without control rights (Webster, 1999). This uncertainty engages managers and investors in a constant search for information to improve their foresight and decisions. Management have a central role in generating estimates of the future as they design and execute their firm's strategy (Knight 1921, Part III). These estimates embody a range of expectations about investor and consumer behaviours and wider economic conditions; and they are partially (and imperfectly) revealed in Generally Accepted Accounting Principles (GAAP) financial reports and the firm's interactions with the business environment.

In this paper, the literature is organised into six categories of intangibles that relate to the firms' core value drivers and five different measurement approaches that reflect the influence of GAAP, researcher defined intangibles and non-financial input and output metrics. The review in this paper indicates that expenditures on R&D are value-relevant but appear to be less reliable than tangible items and to vary in the ability to signal future benefits. Purchased goodwill and some non-financial measures of brands and customer satisfaction are usually value-relevant but do not appear to be reliable indicators of future benefits. A wide variety of other financial and non-financial information on intangibles is value-relevant. However it is difficult to know whether variation in the size of the regression coefficient is due to differences in relevance or reliability, or both. Overall, it is difficult to obtain robust tests of reliability and addressing this gap is a key area for future research.

One gap in financial information that is evident from the review in this paper is the reporting of separate line items of expenditures on intangibles in the income statement. It is often argued that value creation is reflected in earnings. However, earnings are a summary number that is not necessarily useful for addressing the question of *how value is created*. For this purpose, information about value driving expenditures is relevant. There is also evidence that accounting regulators might better facilitate value-relevant disclosures on intangibles if they give discretion to management to report their firm's economic reality.

Section 2 begins with some background on the classification and economic properties of intangibles. Section 3 provides an overview of studies that examine the value-relevance of financial and non-financial information relating to intangibles. These sections consider how we might interpret this evidence in the light of wider economic conditions and other factors, such as omitted variables relating to the firm's competencies and strategy. Section 4 concludes with a discussion of what we have learned from the value-relevance tests, along with research design issues and some directions for future research.

2. Background

This section outlines the categories of intangibles used to structure the review in this paper, the economic properties of investments in intangibles, and the design of value-relevance studies, including a discussion of the concepts of relevance and relia-

[2] This trend has been ascribed to authors including the following (see Webster 1999): Kendrick (1972), Caves and Murphy (1976), Magee (1977), Grabowski and Mueller (1978), Reekie and Bhoyrub (1981), Rugman (1981), Hirschey (1982), Caves (1982), Cantwell (1989), and Abramovitz (1993).

bility, which are the focal point of the value-relevance literature.

2.1. Classification of intangibles

The literature review in this paper canvasses a broad range of studies from the accounting, economic and management literatures. Papers included in the study are not exhaustive but are representative of the research questions and research designs observed in the different areas of study. The papers are classified according to six categories of intangibles as follows:

Technology resources
1. R&D expenditures and related IP

Human resources
2. Human capital

Production resources
3. Advertising, brands and related IP
4. Customer loyalty
5. Competitive advantage
6. Goodwill

These six categories of intangibles relate to three broad categories of the firm's resources: technology, human, and production resources.[3] Category one, R&D expenditures and the IP offshoots, such as patents, are aimed at developing technology, which is defined as a body of knowledge about how to do or make something (Metcalfe, 1998). Category two, human capital, relates to the resource generated by investing in employees. Categories three–six (advertising, brands and related IP; customer loyalty; competitive advantage; and goodwill), relate to production resources the firm has generated or acquired from prior periods' intangible investments. These six categories overlap, but, in the big-picture view, relate to the three broader elements of the firm's activities and resources, as outlined above. The six categories of intangibles are not exhaustive. Arguments can be made that other categories, such as environmental and social responsibility, are also important. The rationale for what is included is the need to be selective given the large numbers of papers but at the same time provide an accurate account of the types of information that researchers have studied.

These six categories of intangibles are further partitioned according to five measurement categories.

1. Management reported assets (financial measures);
2. Researcher estimated assets (financial measures or non-financial metrics);
3. Annual expenditures (financial measures);
4. Input metrics (e.g. non-financial metrics, such as the number of scientists);
5. Output metrics (e.g. non-financial metrics, such as the number of patents).

The measurement categories reflect (1) the economics of the value creation processes and the researchers and practitioners' interests in the identification of value drivers and their empirical measures; (2) the influence of GAAP on the reporting of intangibles and the research problems of interest to practitioners and researchers; and (3) the influence of management discretion.

Annual expenditures and management reported assets

The logical starting point for researchers and investors is to identify how much has been spent on intangibles and the types of activities and rents involved. Once this information is known, rates of return from different types of expenditures can be computed, illuminating some of the drivers of firm performance.

However, this financial data is not available under current GAAP. Further, the factors that cause expenditures to give rise to future rents are not fully understood and change over time. In addition, management do not necessarily think in terms of 'intangibles' and do not always have incentives to voluntarily provide expenditures data of this type (e.g. for competitive reasons). Line item disclosures of expenditures on intangibles are therefore primarily limited to R&D with some research on advertising and labour costs where possible (e.g. advertising costs have not been available in the UK and are only patchily disclosed in the US). Hence, the research able to be undertaken on *annual expenditures on intangibles* is limited to a narrow range of expenditures.

Management reported assets are also limited under GAAP due to regulators' concerns about the reliability and verifiability of these items.[4] The relevance of the information for evaluating performance and value is seldom disputed. Reliability is the regulator's concern: does the recorded number reflect expected future benefits and what is the probability these expected benefits are realisable? As a result of these concerns, GAAP is conservative. This conservatism manifests as a two-way classification, *acquired assets* and *internal*

[3] Researchers have come up with a variety of classifications of intangibles which are often bundled under the label of 'intangible capital'. See, for example, Abernathy and Clarke (1985), Webster (1999), Commission of the European Communities (2003), Ashton (2005), and Hunter, Webster and Wyatt (2005).

[4] *Relevant information* has predictive value and/or confirmatory value, and therefore has the ability to influence the economic decisions of users and is provided in time to influence those decisions. *Reliable information* is free from deliberate bias and material error and is complete. If information is reliable then GAAP maintains that it can be depended on to faithfully represent what it purports to represent or could reasonably be expected to represent.

expenditures, from which only the acquired intangibles can usually be recorded as assets.[5] This limits the research able to be undertaken on internally generated intangible assets. There are insights available on the value-relevance of *management reported assets* of both types (acquired and internal) from settings and time periods where GAAP allowed more liberal reporting of intangible assets (e.g. Australia, prior to the 2005 adoption of international accounting standards, or Ely and Waymire (1999), who study New York Stock Exchange listed companies allowed to report intangibles in the 1927 pre-SEC era).

Researcher estimated assets, and input and output metrics

Due to gaps in financial reporting under GAAP, to attempt the difficult task of studying optimal accounting methods, or to study the value drivers, some financial and non-financial measures of intangibles have to be *estimated by the researchers* themselves (e.g. the construction of R&D assets from R&D expenditures in Lev and Sougiannis, 1996. or the managerial skills measure in Abdelkhalik, 2003). Researchers studying value creation processes also focus on *input* or *output metrics* such as the number of scientists associated with the company (input metric: see Darby, Liu and Zucker, 1999) or patent metrics as a measure of technological innovation (output metric: see Hall, Jaffe and Trajtenberg, 2005).

In summary, Table 1 in the appendix summarises the literature using the six intangibles categories and five measurement classifications. The studies are also grouped on the value-relevance measure employed by the researcher: stock price levels, stock returns or financial performance measures. Percentages of firms with significant coefficients for the financial or non-financial information on intangibles and coefficients that are smaller than those on other tangible assets in the test (as only a rough guide to reliability) are provided in the body of the table.

We now briefly look at the economics of intangibles in the next section to get a feel for the properties that impact the relevance and reliability of information relating to intangibles.

2.2. Economic properties of intangibles

Expenditures on intangibles are usually investments since they are made in anticipation of future benefits (Fisher, 1930). Expenditures such as R&D and advertising may be employed directly in production to generate innovations and product market share. In addition, these expenditures can also give rise to intermediate (produced) assets, which are used in production. For example, intellectual property (IP) outputs are used in production to generate future rents in various ways, such as through the ability to charge a price premium or control costs. R&D and advertising can generate patents, trademarks, brands or designs that provide property rights over innovations or generate market share and thereby permit the firm to appropriate the expected benefits from the earlier R&D and advertising investments.

There are complex lead-lag relations between early investments, intermediate (produced) assets, capital investments to produce the goods, and future expected benefits that are challenging for researchers to observe and model. Successful investments generate a range of intangible assets and future rents for the firm right across the value chain. But not all of the firm's outlays are successful in creating value.

From the investors' perspective, stock price reflects the capital market's expectation of the firm's future cash flows from the firm's investments. Investor expectations are formulated from a diverse set of information. This information set presents some problems for investors and managers. Chief among these is the fact that this set can never be complete because the future is uncertain.[6] The available information is imperfect and not held as a complete unit. Instead, the information exists as 'dispersed bits of incomplete and frequently contradictory knowledge' in the hands of individuals (Hayek, 1945: 519).

> 'At the bottom of the uncertainty problem in economics is the forward-looking character of the economic process itself. Goods are produced to satisfy wants; the production of goods requires time, and two elements of uncertainty are

[5] Under the previous UK standard, FRS 10 *Goodwill and Intangible Assets*, which is now superseded by IFRS 3 *Business Combinations*, intangible assets are non-financial fixed assets that do not have physical substance but are identifiable and are controlled by the entity through custody or legal rights (para. 20). Internally developed intangible assets can be capitalised if there is control and a readily ascertainable market value. According to FRS 10, 'readily ascertainable market value' is the 'value of an intangible asset that is established by reference to a market with a homogenous population of assets and the market is active as evidenced by frequent trades for that population of assets.' Since active markets of this type generally do not exist for intangibles, only acquired intangibles can be routinely capitalised. SSAP 13 *Accounting for Research and Development* allows capitalisation of development costs only if future benefits are virtually certain. The International Accounting Standards Board in IAS 38 *Intangible Assets* has asymmetric rules for acquired intangibles and internal expenditures on intangibles. Under IAS 38, there is a presumption that acquired intangible assets are measured reliably and are therefore capitalisable assets. However, to be treated as assets, internal expenditures on intangibles must pass six additional tests as set out in IAS 38 paragraph 57.

[6] Shackle (1974: 3) points out that managers do not actually *know* their circumstances in the sense of having complete or perfect information; there is a '… lack of knowledge, unlike actuarial probability calculations which require substantial knowledge' (Shackle as cited in Ford (1994: 82); see Knight, 1921).

> introduced, corresponding to two different kinds of foresight which must be exercised: First, the end of productive operations must be estimated from the beginning. It is notoriously impossible to tell accurately when entering upon productive activity what will be its results in physical terms, what (a) quantities and (b) qualities of goods will result from the expenditure of given resources. Second, the wants which the goods are to satisfy are also, of course, in the future to the same extent, and their prediction involves uncertainty in the same way. The producer, then, must estimate (1) the future demand which he is striving to satisfy and (2) the future results of his operations in attempting to satisfy that demand.' Knight (1921, III.VIII.8)

The extent of the problem for managers depends on factors such as the technical difficulty of the firm's products and processes, the extent to which the firm's assets and routines are standardised and predictable versus non-standard and unpredictable, and the strength of property rights (Dosi, 1988). Investors have the problem of decision making under uncertainty, which is compounded by information asymmetry between managers and investors, and among investors themselves. Investors also have different levels of sophistication and incentives to search for value-relevant information. Some investors are therefore more informed than others. These information asymmetries are exacerbated by the natural optimism of managers about their firm's prospects.

What economists have learned about production and growth is important for value-relevance studies because information is value-relevant only if it is capable of reflecting some aspect of the firm's economics. For example, we expect expenditures on training to be value-relevant if the expenditures are associated with increases in the skills and productivity of employees. Economists find that expenditures on intangibles are important for building the firm's capabilities to exploit emerging opportunities and meet profitability goals (Cohen and Levinthal, 1989).[7] These expenditures help to differentiate the firm's value creating activities and routines so they are hard for rivals to copy and help reduce the number of uncontrolled factors impacting the firm's operations (Webster, 1999). As a result, intangibles are contingent by nature and intrinsically exposed to economic states. For example, the benefits from training staff are contingent on the state of the labour market as well as the firm's own ability to attract, retain and motivate the employees.

Expenditures on intangibles are distinguished from tangible investments based on the heterogeneous and non-standardised nature of intangible investments (Webster, 1999). Heterogeneity and standardisation are a function of how often tasks have been performed before and the ease of copying. Plant, property and equipment are relatively standardised compared with payments for intellectual inputs from employees and payments for produced intangible assets from outside the firm. The outputs produced from the intellectual inputs of employees, and intangible assets purchased from outside the firm, are more difficult to control and predict compared with the outputs from machines (Webster, 1999).

A further source of uncertainty is the inability to assign property rights over people and over some types of assets (e.g. R&D). The value is often tied up with people who cannot be owned or attributable to rents that are easily dissipated by rival firms (e.g. brands) (Webster, 1999). Property rights over intangible investment may be unavailable for extended periods while a project is developed. By contrast, investment in tangible assets occurs when the company is ready to produce products.

In summary, the economic properties of intangibles reflect several fundamental uncertainties, including an intrinsic exposure to changing economic states, an unstandardised and heterogeneous nature, and difficulty obtaining property rights. Expenditures on intangibles are therefore *less reliable* by definition compared with tangible assets. Accordingly, while *financial* information on intangibles is likely to be relevant for valuing the firm, it is less likely to be reliable, especially in the earlier stages of the investment. *Non-financial* information is likely to be value-relevant if it is sufficiently salient to the firm's economic reality and precisely measured to be informative about the earnings effects of the firm's interaction with its environment.

2.3. Relevance, reliability and value-relevance tests

value-relevance studies test for an association between information items of interest and a stock price or financial measure of value, for example, the market value of equity, stock returns or future earnings. The tests rely on stock market efficiency.[8]

[7] The intangible investment is not confined to R&D but involves a bundle of expenditures and activities of different types, including strategic planning, design, feasibility, development, production, marketing, distribution, advertising, customer service, management of intellectual property portfolios, and building of organisation and information infrastructures and routines (Abernathy and Clark, 1985).

[8] The assumptions include (see Lev and Ohlson, 1989: 297–298): prices in the pre-disclosure economy are unbiased estimators of the prices in the post-disclosure economy; individuals have homogeneous information and identical beliefs about the implications of the intangibles information; and the economy is efficient in the sense that more information is (Pareto) better than less information so that nobody is worse off while additional trading on the information would make some better off.

The regressions used for value-relevance tests *associate* the value-relevance measure on the left-hand side of the equation with the information items of interest and other variables on the right-hand side of the equation.

Market value of equity = (1)
$b_0 + {}_{b1}$Book value of equity +
b_2Earnings +
b_3Information of interest + *error*

Stock return = (2)
$b_0 + b_1$Earnings +
b_2Change in Earnings +
b_3Information of interest + *error*

Financial performance = (3)
$b_0 + b_1X$ +
b_2Information of interest + *error*

The existence of a statistical association is determined by looking at the estimated regression coefficients, the '*b*'s in equations (1)–(3) and testing whether they are significantly different from what was expected. If the test statistic is significant, we can infer that the information of interest is *associated* with the value-relevance measure on the left-hand side.

2.3.1. What can be inferred?

We can infer that the information item of interest *is associated with the information set that investors used* to value the firm's equity, and the information item is therefore value-relevant. But there are at least two things we cannot infer. First, we cannot infer that investors actually *used* the information of interest to value the firm. Second, we cannot infer from the statistical test alone that the information of interest causes the level of market value, changes in stock price, or financial performance. The statistical test only tells us whether the value-relevance measure and the information of interest are statistically associated.

It is also difficult to infer optimal accounting policies from value-relevance tests. Holthausen and Watts (2001) argue this is because value-relevance tests provide a statistical association that is not backed up by theory and modelling of the underlying links between accounting, standard setting and value.

A factor adversely impacting the inferences available from value-relevance studies is the problem of omitted correlated variables. That is, factors of varying importance that are associated with the left- and right-hand side variables are not included in the equation. For example, Holthausen and Watts (2001) point out that expected future rents are omitted from value-relevance regressions. Omissions like this can distort the '*b*' coefficients in equations (1)–(3) and lead to erroneous conclusions. One common problem is the effect of differences in firm size on the test results. Size differences can produce significant results that have little to do with the intrinsic attributes of the item of interest. For example, a significant test for the '*b*' coefficient on goodwill might just show that large companies have more goodwill.

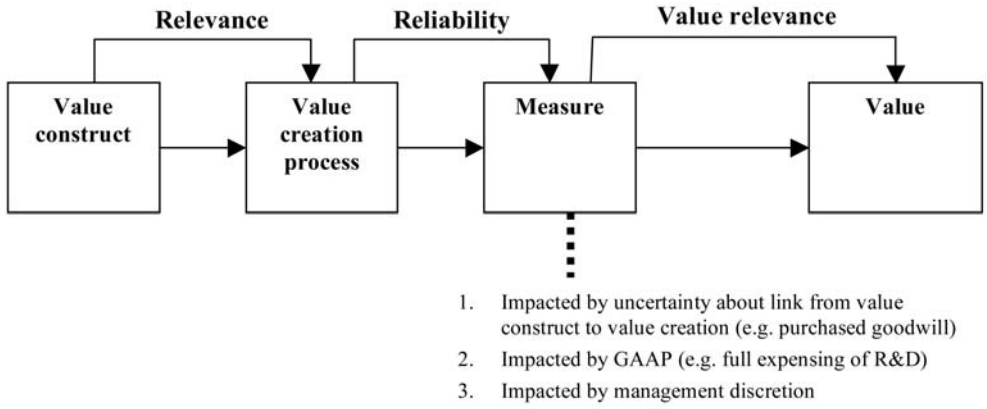
There are also trade-offs in the choice of the value-relevance measure. Shevlin (1996) points out that, for investment variables, the sign is more intuitive in the stock levels regression compared with the stock returns model. That is, an unexpected *change* in investment can be good or bad news, but a significant association for the total amount of the investment (e.g. R&D expenditures) is expected to be positively related to value-relevance metrics. Further, there may be little change in the variable of interest in a narrow return interval (e.g. change in stock price over a quarter or a year). For example, customer satisfaction for an established brand company such as Coca-Cola might be highly value-relevant in a stock price levels regression but the value might change very little on an annual basis. Finally, *financial measures* are limited to the extent that they do not reflect the capitalised value of the expected benefits from intangible assets. We need to consider the impact of these trade-offs in drawing conclusions from value-relevance studies.

2.3.2. Concepts of relevance and reliability in value-relevance studies

Value-relevance tests are joint tests of relevance and reliability (e.g. Barth et al., 2001). However, it is difficult to infer the amount of 'value-relevance' that is due to relevance and the amount that is due to reliability.

Figure 1 graphically depicts the relevance and reliability concepts. Conceptually, relevance relates to two aspects of the underlying economics of the investment. The first is a value construct of some kind, such as expenditures on R&D or acquisition of goodwill. The second is the process by which value is expected to be created (e.g. the R&D is expected to produce value by generating a new large pharmaceutical molecule to be used in a drug with a known purpose). Relevance of information is decreasing to the extent that the value creation process is ill-defined. An example is purchased goodwill, which is a residual from a commercial transaction that relates to an unspecified value creation process. When the relevance link is weak (as defined in terms of an ill-defined value creation process), such as in the case of purchased goodwill, then the next link in the value-relevance chain, the reliability link, is also going to be weak. This way of thinking benchmarks reliability against the uncertainty of the value creation process. That is, it is going to be difficult to measure something that defies definition in terms of how the value is going to be created.

Figure 1



In Figure 1, a *reliable* measure is capable of conveying information about the future benefits expected to flow from an underlying investment. Usually, the measure relates to a quantum of expenditure, but the measure can (less commonly) be a revaluation amount. Reliability refers to two links. The first is the relevance link. For reliable measurement, there must be a reasonably well defined value construct link to a known value creation process. Second, a measure is required that is capable of reflecting the economic substance of the value construct and process. An example of a measure that falls down at the reliable measurement stage is R&D expenditures. Specifically, the individual firm aggregates various types of expenditures into their R&D measure and has a good idea of the value creation process. However, for external parties to the firm, the R&D expenditures number reported in the income statement are too general to convey highly reliable information to investors about value creation and expected benefits. This is because the R&D aggregates expenditures relating to different kinds of *undisclosed* value constructs and value creation activities, not all of which are going to lead to expected future benefits. Hence, conceptually, the R&D expenditures provide relevant information about value creation, but the measure is not a reliable indicator of future rents.

Reliability is affected by a number of factors. One is *GAAP rules*. For example, as discussed, the aggregate nature and full expensing of R&D expenditures adversely impacts the reliability of the R&D measure. A second factor is economic *uncertainty*, which adversely impacts reliability if it causes the link from the value construct to value creation to be ill-defined (e.g. there is uncertainty about how basic research will generate value) and/or generates uncertainty about the probability of future benefits. Reliability is also affected by a third factor, *management discretion*. The effect is positive if management have incentives to communicate credibly with investors and potentially negative if management's interests are not aligned with shareholders' interests.

To distinguish relevance and reliability effects in value-relevance studies, and to obtain a direct test of reliability, it is necessary to develop the relevance and reliability links in setting up the study. This is a difficult task. One of the few studies that do this is Healy, Myers and Howe (2002). They simulate financial accounting data for a sample of 500 pharmaceutical companies. Simulation ensures that the value creation process, the R&D expenditures, and the firm value are known. As a result, Healy et al. (2002) are able to examine the value-relevance of R&D accounted for in different ways under GAAP, as well as the effects of economic uncertainty and management discretion.

Another way to think about reliability is to compare the regression coefficient for the intangible item with the size of the coefficient for more reliable assets. As a rough guide, we expect more reliable information to have a larger coefficient. However, this comparison is difficult because size difference in the '*b*' coefficients could be due to differences in relevance or reliability, or both. Very few of the value-relevance studies directly address the question of reliability.

As a second-best alternative, we can get some indirect insights by selecting a wide range across the literature from different disciplines (e.g. economics, accounting, management, and marketing) to let the overlapping nature of the studies tell the story. This is the approach taken in the review following in Section 3.

3. What information on intangibles is value-relevant?

Section 3 reviews a cross-section of the literature organised according to the six categories of intangibles: R&D and related IP; advertising, brands and related IP; customer loyalty; human capital; competitive advantage; and goodwill. Each category of intangibles is reviewed according to the five types of measures that were introduced in Section 2.1.

3.1. R&D and related IP

This section considers R&D and its IP output, mainly comprising patents. IP refers to the laws governing creations of the mind, including inventions, literary and artistic works, and symbols, names, images, and designs used in commerce. The two categories of IP are *industrial property* (patents, trademarks, copyright, designs, circuit layouts, and plant breeder's rights) and *copyright* (literary and artistic works, such as novels, poems and plays, films, musical works, drawings, paintings, photographs, sculptures, and architectural designs).[9] IP is designed to grant a short-term monopoly so the entrepreneur can capture value from their investments.[10]

Most research focuses on patents because patents measure knowledge creation.

Expenditures on successful R&D give rise to product and process innovations and a product pipeline to ensure a sustainable earnings stream into the future and value. R&D expenditures are inputs that also give rise to IP outputs, which may comprise patents, trademarks and designs. IP is employed in production to produce goods and services, help appropriate expected benefits due to the short-term monopoly, and potentially support a price premium.

3.1.1. R&D and IP – management reported assets

R&D and IP are important factors of production, particularly for high-technology companies (Griliches, 1990), but are not routinely capitalisable under GAAP in most countries (e.g. usually expensed under IAS 38 *Intangible Assets*). On the one hand, *producing* technology engages the firm in relatively unstructured and uncertain problem-solving activities (Dosi, 1988). *Adopting* technology also engages firms in costly problem solving and learning activities. The uncertainty associated with R&D and the associated projects leads to full expensing of R&D. Financial statements of R&D intensive companies usually do not fully capture the economics of these activities.

Consistent with this idea, Kwon (2001) finds management reported GAAP numbers are less value-relevant for high-technology firms than for low-technology firms. His evidence suggests that this difference is due to the greater impact of GAAP accounting conservatism in high-technology firms compared with low-technology firms.

Consistent with uncertainty about future economic benefits, Wyatt (2005) finds that R&D assets are not significantly associated with stock returns in the Australian setting. This evidence is from the time period prior to the 2005 adoption of international financial reporting standards (IFRS) in Australia. At that time, companies were allowed to capitalise applied R&D expenditures, but it was not mandatory. There was no accounting standard for identifiable intangible assets at the time. As a result, management had wide discretion to choose not to record R&D assets and instead record a wide array of other intangibles assets that are much more informative about the value creation process.[11] In contrast to the lack of R&D asset value-relevance, Wyatt finds that the identifiable intangible assets are significantly positively related to stock returns. Her evidence further suggests that the identifiable intangible assets are significantly associated with technological factors driving the firm's production function. However, the R&D assets are not. This finding suggests why the R&D assets are not value-relevant.[12]

By contrast, Deng and Lev (1998) find R&D-in-process assets purchased and valued as part of an acquisition are value-relevant. They use a sample of 400 companies acquiring R&D in-process assets in the years 1985–1996. Both Wyatt (2005) and Deng and Lev (1998) use contemporaneous

[9] See http://www.wipo.int/about-ip/en/. Recent IP developments also include technological protection measures (TPM) and digital rights management (DRM). TPMs are used in material such as sound recordings, films and computer software, as well as electronic artistic and literary works (e-books). DRM is technology used to control access to digital works or devices, to protect copyright in those works or the works used on the devices. For example, the iTunes store incorporates DRM into its music, to restrict copying. There is no known evidence on the value-relevance of these IP.

[10] IP is designed to 'create a market for knowledge by assigning property rights to innovators which enable them to overcome the problems of non-excludability while at the same time, encouraging the maximum diffusion of knowledge by making it public' (Geroski, 1995: 97). See Griliches et al. (1987); Trajtenberg (1990); Austin (1993); Hall et al. (2001).

[11] To outsiders of the firm, R&D *expenditures* are a bundle of unknown expenditures with unknown links to future benefits. R&D *assets* are only marginally more defined: while capitalisation of assets is a signal of future benefits beyond the current period, the aggregate nature of R&D precludes investors making precise links between the expenditures and value creation in the absence of other information about the firm's R&D success rate.

[12] Wyatt (2005) finds that management's choice to record intangible assets is associated with the strength of the technology affecting the firm's operations, the length of the technology cycle time, and property rights-related factors that affect the firm's ability to appropriate the investment benefits. These effects are more important than other contracting and signalling factors consistent with the underlying economics operating as a first-order effect as envisaged by GAAP.

stock return as their value-relevance measure. The main points of difference are the economic significance of the acquired R&D-in-process assets, which represent an average 75% of the acquisition cost. By contrast, the R&D assets reported by Australian companies are internal expenditures that comprise an average of 1% (median 0%) of the firms' total assets. Further, compared with the US companies, the Australian companies had discretion to report more informative intangible assets, reducing the need to communicate with investors via the more uncertain R&D assets.

The US Financial Accounting Standards Board (FASB) has required full expensing of R&D costs since 1974 (Statement of Financial Accounting Standards No. 2). In a break from this strict standard, the FASB issued Statement of Financial Accounting Standards (SFAS) No. 86 *Accounting for the Costs of Computer Software to be Sold, Leased, or Otherwise Marketed* in August 1985, which allows the capitalisation of software development costs once technological feasibility of the software is established. Givoly and Shi (2007) examine the capitalisation of software development costs by IPO firms. They test and find capitalisation is associated with lower underpricing of the stock on the first day of trading. They interpret this as evidence that the capitalisers are subject to less uncertainty about the success of their software investments but do not test whether these capitalised costs and lower underpricing predict future performance. An open question is whether capitalised software is enough information to distinguish the prospects of the newly listed software companies that face significant technological and competitive pressures in the industry, without the benefit of a minimum efficient scale.

For a sample of computer programming and prepackaged software firms surviving for at least three years, Aboody and Lev (1998) find the software assets reported under SFAS No. 86 are value-relevant. However, only 25% of the *total* software development costs are capitalised by these firms. Eccher (1998) suggests one explanation for this is the *working model* approach to software development where software is completed (technically feasible) late in the development period, resulting in few capitalisable costs. The firm's software development strategy therefore appears to be relevant to a full interpretation of value-relevance tests for software costs.

A further issue examined by Aboody and Lev (1998) is the petition by *The Software Publishers Association* in 1996 to abolish SFAS No. 86. Aboody and Lev suggest this petition was motivated by increasingly negative effects of the accounting standard on earnings, in a maturing industry. However, they also find higher analyst earnings forecast errors for capitalisers compared with expensers, which suggests there is some attribute of the capitalising firms that makes their earnings harder to predict compared with expensing firms. Given there is more information in capitalised intangible assets for growth compared with steady state firms, one possibility is the capitalisers are growth firms that are more risky than the expensing firms.

Ken Wasch, president of *The Software Publishers Association*, sheds some light on the risk issue. He argues there is significant uncertainty even at the point of technical feasibility about the success of the software 'due to factors such as the ever-increasing volatility in the software marketplace, the compression of product cycles, the heightened level of competition and the divergence of technology platforms' (Aboody and Lev, 1998: footnote 3).

Economic studies show these factors do impact the firm's success rate and performance (e.g. Audretsch, 1995). For example, Agarwal and Gort (2001) find the average cycle time from an idea to a viable product has decreased from 33 years in 1900 to 3.4 years in 1967–1986. Further, as the cycle time decreases, costs and the level of competition escalates (Scherer, 1966; Graves, 1989; Ittner and Larcker, 1997).[13] In the US telecommunications industry, Banker, Chang and Majumdar (1995) find increasing competition is associated with declining profitability. Consistent with technological innovation and competition conditions impacting the success rate of R&D, the value-relevance of R&D varies across time periods and industries (Hall, 2000) and across technological sectors (Greenhalgh and Rogers, 2006).[14] Cohen and Klepper (1992), among others, show there are usually only a small number of high performing R&D companies in an industry. Consistent with this evidence, Ceccagnoli, Arora, Cohen and Vogt (1998) find that differences in the firms' capabilities affect their ability and incentives to generate innovations from R&D and absorb the innovations of rivals (i.e. take advantage of rivals' R&D). Several studies find financial leverage is negatively related to the level of R&D consistent with a life-cycle effect (Bernstein and Nadiri, 1982; Hall, 1991).

[13] Examples of additional organisational competencies leading to shorter cycle times and superior performance are the use of cross-functional teams, customer involvement in the innovation process, advanced design tools, and higher quality of resulting products (see Ittner and Larcker, 1997).

[14] Hall (1993a, 1993b) finds the late '60s and '70s were periods of higher valuation of R&D in capital markets, which declined abruptly during the eighties in the United States. It is generally held this decline relates to company restructuring and the declining value of R&D assets due to rapid technical change in particular industries, including electrical equipment, computing, electronics and scientific instruments (i.e. R&D benefits were relatively short-lived).

In summary, R&D and IP are not commonly reported as assets by managers under GAAP, and, therefore, evidence on value-relevance is limited. Assets found to be reliable enough to be value-relevant include independently valued R&D-in-process, capitalised IP, as part of the identifiable intangible assets voluntarily recognised by Australian firms, and capitalised software R&D under SFAS No. 86. R&D assets are not value-relevant in the Australian setting, when companies could report more informative identifiable intangibles, which are presumably more reliable than R&D assets (i.e. some of the identifiable intangibles are output from successful R&D). No other specific inferences about reliability are possible from this evidence. Finally, a range of factors are important for understanding the probable success and hence reliability of R&D, including cycle time-based competition, industry structure, firm-specific capabilities, life-cycle stage, and technology-conditions.

3.1.2. R&D and IP – researcher estimated asset

The US FASB has been sceptical about the reliability of R&D. In SFAS No. 2 *Accounting for Research and Development Costs* (para. 41), the FASB states that a 'direct relationship between research and development costs and specific future revenue generally has not been demonstrated'. Lev and Sougiannis (1996) examine this proposition by estimating the R&D assets and amortisation that would have been reported by US companies had they been allowed to capitalise R&D. They restate the earnings and book value of shareholders' equity using these estimates of R&D assets and amortisation and find the (*pro forma*) R&D assets are value-relevant. They also find an association with future period stock returns, suggesting that the *pro forma* R&D is relevant but not that reliable. This forward relation leads them to conclude that R&D intense stocks either are mispriced because investors do not understand conservative accounting or attract a risk premium due to the uncertainty associated with the R&D outcomes.

The risk premium conclusion is consistent with Boone and Raman's (2001) evidence that R&D intensive firms have higher bid-ask spreads compared with less R&D intensive firms. Chambers, Jennings and Thompson (2002) argue that, if the full expensing effects of R&D on the financial statements mislead investors, then excess returns earned from trading strategies associated with R&D intensive firms may be reduced or eliminated by alternative R&D accounting policies that better reflect the expected future benefits of R&D activities. They tested this hypothesis, and their evidence suggests the ability to earn excess returns from trading on R&D intensive companies is not due to GAAP-induced mispricing. The excess returns may therefore be a risk premium consistent with the economic properties discussed in Section 2.2. Lev, Sarath and Sougiannis (2005) also provide evidence that the firms with a high growth rate of R&D relative to their profitability are systematically undervalued. Both the risk and mispricing conclusions are consistent with R&D being a relevant but not reliable indicator of expected inflows from R&D. It is possible that the risk is at least partly due to the aggregate nature of R&D, where the firm bundles a range of expenditures whose identity and links to future benefits are not visible to outsiders.

The studies reviewed so far suggest that R&D is reliable enough to be value-relevant in general. However, as discussed at the beginning of Section 3, it is difficult to obtain direct tests of the reliability of R&D using stock price or financial measures as an economic benchmark.

One of the few studies able to provide direct insights on the reliability of R&D is Healy, Myers and Howe (2002). They use a simulation model for a pharmaceutical company to generate 32 years of data for 500 companies from formation to steady state. Parameters from these processes are used to construct a cash flow model and financial statements. The model simulates the drug discovery (R&D input) process (year 1), to commercial launch of a series of products (year 14), to maturity and expiry of patent (26 years), using underlying costs, probabilities of success and revenues. The model allows for some of the dynamic aspects of the industry, for example, drugs that are significant innovations, average or commercially unsuccessful drugs, rivals' competitive entry with competing drugs, and next generation drugs. The economic value of the simulated R&D firm is known, and the imposition of different accounting rules gives insights into the relevance and reliability of R&D.

Using the simulation data, Healy et al. (2002) investigate the relevance and reliability of R&D under three methods of accounting: (1) immediate expensing; (2) full cost capitalising of all R&D except basic research and expensing over the life of the drug once in commercial production; and (3) successful efforts made in capitalising successful drugs and writing down those found to be unsuccessful. They find the successful efforts method of accounting for R&D is most value-relevant. However, their tests suggest there are large measurement errors in the financial accounting data under all the accounting methods examined. Hence, their study suggests the R&D is relevant but not that reliable due to economic uncertainty about the success rate of the individual company's R&D.

In summary, researcher estimated R&D assets are reliable enough to be value-relevant. However, R&D assets are also associated with *future* stock

returns, suggesting investors do not find expected benefits from R&D reliable enough to fully impound in this year's (contemporaneous) stock price. Healy et al.'s (2002) evidence is consistent with R&D assets being relevant but not a reliable indicator of future rents. The Healy et al. paper is one of the very few able to provide direct evidence on reliability. An important area for future research is one that devises research designs capable of both distinguishing between relevance and reliability and provides direct tests of reliability.

3.1.3. R&D and IP – annual R&D expenditures

Annual expenditures on R&D related IP are not routinely reported. However, R&D expenditures are available from surveys and as a result of accounting standards in some countries, for example, the US standard SFAS No. 2 *Accounting for Research and Development Costs* and the R&D data from the *Industry R&D Survey* conducted by the US Census Bureau and National Science Foundation. Using these data sources, a large number of studies find a positive significant relationship between R&D expenditures and investors' valuation of the firm as reflected in stock price.[15] However, while R&D is generally value-relevant, taken as a package, the evidence below suggests R&D expenditures are not that reliable as an indicator of the timing and magnitude of future benefits. In particular, investors do not appear to find it easy to evaluate the future earnings implications of the R&D expenditures, consistent with the uncertainty properties of intangibles outlined in Section 2.2.

One reason R&D expenditures are not reliable indicators of future rents is that these outlays do not directly *produce* a stream of revenues from the sale of products. Conceptually, earnings from R&D are more variable because R&D involves search and discovery and problem-solving activities whose success is uncertain (Dosi, 1988). Using the variability of future earnings (variance of realised annual earnings over five years) as the dependent variable, Kothari et al. (1999) provide evidence that the benefits from R&D expenditures are more variable, and hence less reliable, than the benefits from capital expenditures for a sample of over 50,000 firm-year observations for 1972–1992. Kothari et al. find a coefficient on current R&D expenditures about three times the coefficient on current capital expenditures (controlling for leverage and firm size). Amir et al. (2002) find that this greater future earnings variability effect is largely confined to firms in more R&D intensive industries and not to other industries.

Some doubt exists over the completeness of the measures of R&D expenditures. Hansen and Serin (1997) show that R&D expenditures are a hidden cost in some low-technology industries, for example, process innovation costs that are not separately reported but are bundled with production costs in manufacturing. Further, companies do not disclose what types of expenditures are actually included in their R&D expenses. Some expenditure included in R&D has more direct implications for future earnings and earnings variability compared with other expenditures.

Overall, this evidence on the greater variability of earnings from R&D is consistent with the different purposes of the R&D and capital investments: R&D produces innovations while capital expenditures produce products that embody the innovations. This relation has been demonstrated empirically using Granger causation tests (Lach and Schankerman, 1989; Lach and Rob, 1996). That is, R&D comes first and fixed capital investment comes later, once fixed assets are needed to produce the goods ready to sell to customers. Further, current R&D includes soon-to-be successful as well as some (potentially a lot of) unsuccessful expenditures, which suggests fairly clearly that evaluating R&D expenditures alone, in the absence of information about the probability of success, will not provide a lot of insights on value.

Sougiannis (1994) provides indirect evidence on the reliability of R&D expenditures for a sample of 573 US firms engaged in R&D between 1975 and 1985. Sougiannis estimates two equations capturing (1) the R&D association with earnings, and (2) the R&D association with market value.[16] Sougiannis finds one dollar of R&D is associated with a two-dollar gross profit increase over a seven-year period and a five-dollar increase in market value. However, he finds only the current R&D expenditures are positively and significantly associated with the firm's market value of equity. By contrast, past R&D is unrelated to the market value of equity. This result suggests no more benefits are expected from the past R&D,

[15] See Ben Zion (1978); Ben Zion (1984); Griliches (1981); Hirschey (1982); Connolly, Hirsch and Hirschey (1986); Jaffe (1986); Ettredge and Bublitz (1988); Bublitz and Ettredge (1989); Chan, Martin and Kensinger (1990); Connolly and Hirschey (1990); Griliches, Hall and Pakes (1991); Shevlin (1991); Hall (1993a); (1993b); Johnson and Pazderka (1993); Megna and Klock (1993); Chauvin and Hirschey (1994); Sougiannis (1994); Lev and Sougiannis (1996); Deng and Lev (1998); Stoneman and Toivanen (1997); Aboody and Lev (1998).

[16] Earnings and price are endogenous in this specification: (1) (Earnings after tax & before extraordinaries, advertising and R&D expense) = f (net capital stock measured as inflation adjusted items: PPE+inventories+intangibles+other investments, advertising; and current and lagged R&D expenditures); (2) Price/BV equity = f (book value equity, abnormal earnings adjusted for R&D expensing and tax, R&D tax shield, current R&D costs, lagged R&D outlays). From this analysis he derives (a) the total effect of past and current R&D on earnings, (b) the indirect effect of R&D on stock price through earnings, and (c) the direct effect of R&D on stock price.

meaning none of the past R&D are assets and all the benefits have already been received, which seems implausible. A more plausible alternative explanation is that investors are *uncertain* about the probability of future benefits from the *past* R&D. Overall, Sougiannis' evidence suggests R&D is value-relevant, but the time series of R&D is not a reliable predictor of future rents.

Green et al. (1996) cast doubt on the value-relevance of R&D expenditures in the UK setting for 1990, 1991 and 1992. They find the R&D expenditures are significant in 1991 but are not reliably value-relevant in 1990 and 1992. However, their dependent variable is the *difference* between the market value and book value of shareholders' equity (MVE-BVE). This variable provides a test of the relations between R&D and the *excess* market value over the book value of assets, not the *level* of the firm's market value of equity. This *excess* may not fully capture investors' expectations of the lead/lag relations between R&D and the expected benefits. Further, this excess variable is regressed on earnings, current R&D expenses plus a number of control variables, some of which are likely to be correlated with (proxy for) the level of R&D expenses or the risk of the R&D, leading to a value-irrelevance result.[17] More recent UK evidence for 1990–1994 (Stark and Thomas, 1998) and 1990–2001 (Akbar and Stark, 2003) finds that R&D is value-relevant in the UK setting.

Another explanation for the Green et al. (1996) results is a lack of power due to under (or no) reporting of R&D expenditures by the UK firms. Stoneman and Toivanen (1997) encounter this problem in their UK study. They employ a research design that allows for sample selection bias due to the non-reporting of R&D. For 1989–1995, they find R&D is value-relevant for UK firms. The valuation multiple ranges between zero and 4.3, and they find the multiple varies over time and across the firms.

One further issue in the UK setting, for R&D value-relevance studies prior to 1996, is the UK GAAP impact on reported intangibles. Companies predominantly wrote off goodwill to an equity account in this time period but were able to report identifiable intangibles such as brands. If the goodwill write-offs significantly understate intangible assets, then it is possible that regression coefficients on assets in the model could be biased due to omitted correlated variables. Shah, Stark and Akbar (2007) consider the issue of omitted advertising costs in the UK studies of the value-relevance of R&D. Advertising cost data had not been available in the UK until the advent of the ACNielsen MEAL data. This organisation monitors media outlets and assigns standard costs to advertising activities. Using this data to control for advertising costs, Shah et al. (2007) find R&D is (positively) value-relevant in the UK for all firm size groups and for manufacturing and non-manufacturing sectors, as well as the R&D intense pharmaceutical, biotechnology, electronics, and electrical equipment sectors.

Several studies examine factors that impact the value-relevance of R&D expenditures. One important factor is the project stage. For example, Shortridge (2004) provides evidence that the track record of *new drug approvals* conditions the relation between R&D and stock price for a sample of US pharmaceutical companies. Hand (2001) finds investors expect more successful outcomes from *more intense R&D* and find more information in R&D for *growth firms* rather than established biotechnology firms. Investors therefore appear to understand that the information in R&D about future benefits varies according to the firm's life-cycle and project stage.[18]

A further issue in interpreting the R&D studies is the model specification. In contrast to other accounting studies, Hand (2001) uses a Cobb-Douglas function (commonly used in economic studies) which allows for the diminishing marginal return from R&D. More generally, Hall and Kim (1999) report that non-linear and log-linear functional forms best approximate the R&D relation with stock price. A survey of the economic literature suggests the likely reason for non-linearity is technological and firm life-cycles, and the changes in returns to investment at inflection points in the cycles (Geroski, 2000). This non-linearity is corroborated by accounting studies that suggest the relation between earnings, as a summary measure including R&D and other expenditures, and stock returns is non-linear (Cheng et al., 1992; Freeman and Tse, 1992; Das and Lev, 1994; Subramanyam, 1996).

In summary, taken together, the evidence in this section from a variety of different research designs, including the earnings variability tests, suggests R&D expenditures reflect information that is value-relevant. However, the information is not as reliable in reflecting future benefits as the information conveyed by expenditures on tangible assets. Several plausible explanations are canvassed. The dominant factor is the role of R&D which relates to future rents rather than current production revenues. Current R&D also includes both value-relevant successful and value-irrelevant unsuccessful

[17] Green et al. (1996) control variables comprise market share, concentration, debt-to-equity, average industry debt-to-equity, square of the difference between debt-to-equity of firm and industry, and annual variability of stock market returns.

[18] Liu (2007) finds the firm's life-cycle is an omitted variable in commonly used discretionary accrual models, with the inferences from earnings management studies changing once life-cycle is included in the models. Anthony and Ramesh (1992) show that the stock price response to accounting performance measures, sales growth and capital investment is a function of firm life-cycle stage.

expenditures. While the projects are incomplete and success rates are not known, the R&D is not reliable as an indicator of value. It is possible that R&D is also less relevant in some circumstances (e.g. less relevant for established than for growth firms). Hence, evaluating R&D expenditures with probable success rate indicators is important to get insights on relevance, reliability and value. Some information that is relevant to this task includes new drug approvals for pharmaceuticals, more intensive R&D, and growth firms' R&D.

Finally, it is not clear from the evidence to date that reporting the aggregate, R&D expenditures, as a separate line item in the income statement is all that informative about value creation. Outsiders do not know what is included in R&D and whether the inclusions relate directly to future rents. It is possible to identify more informative categories of expenditures for separate line item reporting and as inputs to valuation (Hunter, Webster and Wyatt, 2007).

3.1.4. R&D and IP – input metrics

The firm's production function is conditioned on the state of science and technological knowledge (Jorgenson, 1989). To test the impact of technology as a conditioning factor on the value-relevance of R&D and IP, Greenhalgh and Rogers (2006) condition their analysis on an augmented version of Pavitt's (1984) technology sectors, comprising the following:

1. Supplier-dominated manufacturing and mining: usually smaller firms with weak in-house R&D and engineering capabilities and innovations coming from equipment and materials suppliers;
2. Production- and scale-intensive: large firms producing standard materials or durable goods;
3. Production-intensive, specialised suppliers: machinery and instruments, tending to be smaller technologically specialised firms;
4. Science-based: electronics, electrical and chemicals, usually large firms with in-house R&D-based technology but the basic science is produced elsewhere;
5. Information-intensive: includes finance, retail, communications, publishing, with in-house software or systems development, with purchases of IT hardware and software;
6. Software-related firms: computer software and services.

Using the log of the market value of equity as the dependent variable, Greenhalgh and Rogers find the magnitude of the coefficient on R&D varies substantially across technology sectors. It is lowest for '6. Software' followed by '4. Science' (which spends 45–55% of the total R&D across all six sectors). The highest coefficient is for '2. Production- and scale-intensive' and '5. Information-intensive'. The 'Science' sector result is probably due to the average 20-year lag from an idea to a successful science innovation (Stephan, 1996). Including (total asset deflated) patent and trademark data in the regressions does not affect these coefficients. They find the UK patents are less value-relevant than the European Patent Office patents. Trademarks generally have positive and significant coefficients in each sector. They find the most competitive technological sectors have the lowest market value of R&D. Within the most competitive technology sector (science-based manufacturing), firms with larger market shares (proxying for lower competition) have higher R&D valuations.

Matolcsy and Wyatt (2008) use patent metrics aggregated to the technology sector level (within industries) as technology input metrics, to test whether the association between the market value of equity and current earnings is conditional on the technology conditions. Three technology conditions (within the industry dominating the firms' operations) are considered: the success rate of past technological investments, technology complexity, and the technology development period. Using the market value of equity deflated by sales, they find the technology condition-earnings interactions are value-relevant. The results hold across a range of high-, medium- and low-technology industries consistent with the predicted pervasive effects of technology conditions on the firms' operations. The three technology conditions also predict future earnings, which is a pre-requisite for value-relevance.

In summary, the value-relevance of R&D varies substantially across technology sectors, suggesting technology conditions impact the success rate and hence expected rents from R&D. It is difficult to know whether this is due to variation in value-relevance or reliability, or both of these. Measures of the technological innovation success rate, cycle time, and links to science in a technology sector condition the relations between current earnings and the market value of equity, suggesting the pervasive impact of technology on performance and value.

3.1.5. R&D and IP – output metrics

Patents are output metrics which are used as measures of invention and/or protection arising from IP laws (Lanjouw et al., 1998). The distribution of patents is substantially skewed to low value patents.[19] Researchers also find the rate of decline

[19] Patent protection is reduced by the capacity of imitators to 'invent around' a patent, by the difficulties actually securing patents on some innovations, and by the problem that patents can disclose information sufficient to facilitate imitators' development of variants of the basic technology; and these problems are typically viewed as greater for process innovations than for product innovations (see Geroski, 1995).

in the value of patents is also much higher than the rate for most physical assets (Cockburn and Griliches, 1988; Schankerman and Pakes, 1986; Pakes, 1986; Schankerman, 1991). Therefore, variation in the use and value of IP renders simple counts of patents not very useful for valuation purposes (Griliches, 1990).

Early studies found patents are value-relevant incrementally to a measure of intangible capital computed from past R&D expenditures (e.g. Griliches, 1981; Pakes, 1985; Cockburn and Griliches, 1988; Megna and Klock, 1993). Greenhalgh and Rogers (2006) find patents are incrementally value-relevant to R&D for UK firms for 1989–2002.

Following the early work using count measures, researchers found *patent renewal* and *patent family size* are useful for computing quality weights for patent count data (Lanjouw et al., 1998). Rather than simply count patents, the patents are partitioned into groups according to the age the patent is allowed to lapse, or by the set of countries in which patent applications were filed. Serrano (2006) also examines the *decision to sell patents* as a measure of value. Bessen (2007) develops and tests a more complex model that gives an upper bound estimate of the value-relevance of patents to the firm. His results are qualitatively similar to the valuation results using the renewal and selling measures. Bessen (2007), among others, finds that chemical and pharmaceutical patents are more valuable than patents in other industries.

Citation analysis is a measurement approach which provides a quality weighting to augment simple count measures of IP (Narin, 2000). High citations to scientific research papers, and from current to prior issued patents, indicate important scientific and technological inventions. For example, a US patent has eight or nine 'References Cited – US patents' on its front page, two references cited to foreign patents, and one to two non-patent references. These references link the patent to the related prior art (related patented invention) and also limit the claims of the current issued patent. Like the patent distribution, the citation distribution is skewed. For example, Narin (2000) reports that for patents issued in 1988, and cited in the next seven years, half the patents are cited two or fewer times, 75% are cited five or fewer times, and only 1% of the patents are cited 24 or more times.

Studies linking citations to the market value of equity find citations to prior patents, and to scientific papers, are value-relevant. For example, Hall, Jaffe and Trajtenberg (2005) find patent citations are incrementally value-relevant over R&D to assets, patents to R&D, and assets, for a sample of companies from 1963 to 1995. They find one additional citation per patent is associated with a 3% higher stock price, unanticipated citations have a stronger effect on stock price, and citations to the companies' own prior related patents are more valuable than external citations. Hirschey, Richardson and Scholtz (1998) also find patent metrics computed from patent count and citation data are incrementally value-relevant to earnings, book value of shareholders' equity, R&D expenditures and *pro forma* R&D capital.

Another factor to consider is the value implications from the strategic use of IP. Cohen, Nelson and Walsh (2000) provide large sample survey evidence that firms patent for more reasons than direct protection of profits. Firms use patents to prevent rivals from patenting related inventions (e.g. blocking rivals' patents by chemical firms), the use of patents in negotiations (e.g. by telecommunications companies) and the prevention of law suits. Other strategies used with or instead of IP to protect profits from invention include secrecy, lead time advantages, and complementary marketing and manufacturing capabilities. In fact, Cohen et al. find that secrecy and lead time are generally more important than patents for protecting the profits of manufacturing firms.

Schankerman and Noel (2006) investigate the proposition that 'strategic patenting' raises the costs of innovating for rival firms, using two output metrics to proxy for strategic patenting activities: *patent portfolio size*, which they argue affects bargaining power in patent disputes, and the *fragmentation of patent rights*, which increases the costs of enforcement. Consistent with these strategies increasing their own inventive activity and own benefits from invention, they find these metrics are positively associated with innovation activity and with the market value of equity, for a sample of software firms in the period 1980–99.

Henkel and Reitzig (2007) study patent blocking whereby firms patent solely with the intent of blocking other companies' R&D-related innovations. They show that patent blocking is a viable strategy in competitive, higher technology industries, if the 'blockers' focus on inventions that they can easily invent around and where the 'blocking patent infringements' (that the 'blocker' issues against rivals' related patents) are more readily upheld in court.

By contrast, McGahan and Silverman (2006) find, in circumstances where a technological breakthrough creates investment opportunities for all firms in the industry, the positive effects of additional knowledge and opportunities outweighs the negative impact of the patent blocking strategy. Hence, the significance of invention appears to interact with the strategic use of IP to influence performance and firm value.

In summary, patent metrics that are quality weighted, such as using citations to prior patents,

are reliable enough to be value-relevant and are more value-relevant than simple patent counts. It is unclear whether this effect relates to more relevance or reliability or more of both. Output measures of strategic patenting are value-relevant.

3.2. Advertising expenditures, brands, and IP

Brands and trademark (IP) assets are output from prior investments in advertising and expenditures associated with product development and trademark registration. They generate value through market power and signalling of product and, possibly, seller attributes. These assets can be exchanged and operated independently of specific human capital. For example, newspaper businesses with mastheads can be sold and operated independently of the parties who developed the mastheads.

3.2.1. Advertising expenditures, brands, and IP – management reported assets

Prior to the FRS 10 issue in 1998, when brand recognition was allowed in the UK, Muller (1999) finds the UK firms capitalised their brands to meet financial ratio-based rules set by the London Stock Exchange (LSE). These LSE rules waive shareholder approval for acquisitions below certain financial thresholds. For a sample of 33 UK companies for 1988–1996, Muller (1999) reports the firms had previously written off their purchased goodwill, and now with a weak balance sheet, put capitalised brands onto their balance sheets to avoid the costly LSE rules. Hence, the motivation for capitalising the brands is not to communicate with investors, at least, as a first order effect.

Despite this motivation, Kallapur and Kwan (2004) find the goodwill and identifiable intangibles of UK companies, including brands and publishing titles, are reliable enough to be value-relevant. Their firms' median brand assets are a large 44% of the book value of shareholders' equity. However, Kallapur and Kwan provide further evidence suggesting that the value-relevance of the brands was adversely affected by incentives to (1) avoid LSE rules requiring shareholder approval for large acquisition or disposal transactions; and (2) reduce leverage. They conclude the brands are value-relevant but their reliability varies with managements' financial reporting motivations.

In summary, management reported brands prior to 1998 in the UK were reliable enough to be value-relevant. However, the brands were less value-relevant and/or less reliable for firms capitalising for agency reasons. It is not clear which of these is descriptive.

3.2.2. Advertising expenditures, brands, and IP – researcher estimated assets

Seethamraju (2000) constructs measures of internally generated US brand names, from the intensity of advertising expense, and finds these estimates are value-relevant. Hence, this evidence suggests brands valued by external parties using publicly available expenditures data are reliable enough to be value-relevant.

3.2.3. Advertising expenditures, brands, and IP – annual advertising expenditures

There is a positive relationship between advertising expenditures and stock price.[20] However, some studies find a significant association only for expenditures on non-durable goods.[21] In tests relating advertising to sales, researchers find advertising is associated with current rather than future sales, which suggests the benefits are short-lived (e.g. Boyer, 1974; Clarke, 1976; Grabowski, 1976; Lambin, 1976). Netter (1982) examines whether firms spend too much on advertising, leading to a weak relation with stock price. He finds the *advertising of competitors* reduces the effectiveness of *non-durable* producers' advertising outlays. Hence, advertising generates value conditional on product type and competition conditions.

The economics of advertising suggests advertising is linked to value creation through the processes of new product development and adoption. As summarised by Nakamura (2005), advertising helps consumers to learn more quickly about the existence and properties of new products, thereby facilitating the flow of benefits and financial rewards from innovation to the producers and consumers. Since new products have increased in economic importance, this suggests the importance of advertising as a continuing long-run investment.

Advertising has another potentially important benefit. These costs are often packaged as a joint product with entertainment, such as free-to-air radio and television. Borden (1942) shows that about half of the total advertising costs in 1937 went to fund entertainment including live artists and leases of phonographs. In relation to the side benefits of advertising, Noll et al. (1973) estimate the value of the rise of television to consumers at about 5.1% of household income in 1969.

What determines the longevity of advertising benefits? Nakamura (2005) suggests longevity is a function of product innovation and adoption. Berndt et al. (1994) provide insights on this issue. They decompose advertising expenditures to separate out *industry-expanding* investment from *rivalry inducing* expenditures. They focus on the

[20] See, for example, Hirschey (1982), Hirschey and Weygandt (1985), and Chauvin and Hirschey (1993).

[21] See Peles (1970), Abdel-khalik (1975), Ettredge and Bublitz (1988), Bublitz and Ettredge (1989), and Hirschey and Weygandt (1985).

market for ulcer drugs (H2-antagonist drugs: Tagamet, Zantac, Pepcid and Axid). For the rivalry inducing component, they find advertising costs and industry sales are negatively related in circumstances when the number of products on offer in the industry is increasing. Advertising costs under these conditions depreciate at a fast annual rate of 40%. By contrast, the *industry-expanding* component appears to have an almost zero rate of depreciation.

In summary, advertising expenditures are value-relevant in the short term but the evidence is mixed for the long term. It is possible the mixed evidence is due to a lack of value-relevance for companies spending too much on advertising. Alternatively, the mixed evidence could be due to uncertainty about future benefits and hence lack of reliability. It is not clear from the evidence, which is descriptive. Another possibility is gaps in the modelling of the costs and benefits of advertising. In particular, the theory suggests insights on value creation may come from modelling the context of the links between advertising expenditures and market value of equity, focusing on the effects of product innovation and adoption and joint product costs and benefits. These gaps in the literature call for studies of the long-term effects of advertising expenditures, which have been less common to date due to problems obtaining data, along with gaps in our understanding of consumer behaviour (Vakratas and Ambler, 1999).

3.2.4. Advertising expenditures, brands, and IP – input metrics

Franses and Vriens (2004) point out the amount of money companies allocate to advertising often surpasses the companies' after tax profits, but still it is not known whether these investments pay off or not. They argue the reason for this gap is incomplete knowledge about what advertising does in the marketplace and list four factors that are important for understanding the returns to advertising inputs:

1. The process by which advertising affects consumers and leads to brand awareness, brand image, brand consideration, brand choice, and sales;
2. How the effects of advertising are spread out over time;
3. The role of different advertising media (for example, TV versus print advertising), how differentially efficient these vehicles are, how their interaction may lead to synergy effects; and
4. The role and impact of competitive advertising.

These factors suggest the range of input metrics that are relevant to estimates of value creation and longevity of benefits from advertising, for example, consumer purchasing, repeat business and switching metrics, firms' advertising strategies, including the frequency and magnitude of efforts, media use metrics, experience and search attributes of products, and the interaction effects with the purpose of advertising (e.g. market share growth, and price premium support).

One area of research having some success in modelling strategy impact on value are studies of optimal scheduling of advertising over time. One example by Dube, Hitsch and Manchanda (2004) is a study of a pulsing strategy in which the firm advertises in sharp, intensive bursts. They develop a dynamic programming framework and find that pulsing is the optimal strategy for the industry sector they study.

Aside from the modelling method employed, the success of the Dube et al. model is due to high-quality input metrics, which contrasts with other studies in this area that use the available, patchy advertising expenditures. The data is Scantrac level scanner data for frozen entrée foodstuff, comprising weekly sales, prices and advertising levels for each brand in 18 cities over 155 weeks. Advertising level is measured using gross rating points rather than dollars, which captures household average exposures to advertising in various markets per week. The long weekly series and the benchmark rating data allows pulse behaviour to be tested (i.e. this is not easy to do with annual or quarterly data and raw dollars). Interestingly, their results suggest continuous advertising is sub-optimal.

In summary, quality input data relating to consumer behaviour and firms' advertising strategies over time are important for measuring and understanding how advertising creates value for the firm. The evidence suggests that it is important to study advertising expenditures in the context of strategy and consumer behaviour to get insights on value creation. An example of such an insight relates to advertising strategy for which there is evidence that continuous advertising rather than a pulsing advertising strategy can destroy value.

3.2.5. Advertising expenditures, brands, and IP – output metrics

Trademarks are intermediate output measures that are potentially valuable when firms use them to signal desirable product attributes to consumers, thereby reducing information asymmetries between sellers and buyers (Landes and Posner, 1987). Trademarks may create value by motivating the firm to invest in quality products (Mendonca, Pereira and Godinho, 2004) and engage in innovation activity and the building of brand value and barriers to entry (Schmalensee, 1978).

Consistent with trademarks generating value, Greenhalgh and Rogers (2006) find trademarks are

incrementally value-relevant to R&D and patents for UK firms for 1989–2002. They find the trademarking firms experience 10–30% higher productivity compared with non-trademarking firms. Further, trademarking activity, and the intensity of trademarking, is associated with larger differences in the market value of equity and productivity among firms in the services industries compared to manufacturing firms.

Barth et al. (1998) test the value-relevance of output measures of brand values from Financial World's (FW) annual brand value surveys.[22] For a sample of 595 US firm-years with brands valued between 1991 and 1996, Barth et al. (1998) find the FW brand values (changes in brand values) are significantly positively associated with the market value of equity (stock returns). The FW brand values are incrementally value-relevant (for market value of equity) to advertising expense, operating margin, growth, market share, recognised brand assets, and analysts' earnings forecasts. The FW sample is not random. It is dominated by large, profitable companies in food and tobacco, chemicals and allied products, rubber, plastic, leather, and glass industries, and under-represented by financial services. Whether brands in general can be valued as successfully is unclear.

In summary, trademarks are value-relevant and appear to be particularly significant value drivers for firms in services industries with a significant but lower impact in manufacturing. The evidence does not distinguish whether this effect relates to lower relevance or reliability, or both. A possible impact of trademarking activity is to motivate the firm to engage in further value-creating product and brand innovations. While this might be motivated by the desire to build the trademark value, there is the potential for feedback effects for the firm's R&D outlays, which may build additional value in the future via the product pipeline and brands. While brands do not have IP rights attached, they are value-relevant for large profitable companies, suggesting they are significant indicators of market power. It is not known whether the independent valuations of brands used by Barth et al. (1998) could be successfully undertaken for firms in general at the same level of reliability.

3.3. Customer loyalty

A number of studies examine whether customer satisfaction measures relating to the firm's product markets are value-relevant. The impetus for this research is marketing studies that propose customer satisfaction is a key value driver because it reflects information about customer retention, price elasticity reduction, brand and reputation effects (Anderson et al., 1994). Further, there is evidence that companies value and track this data (Ross and Georgoff, 1991). There is some overlap between the value represented by brands and customer loyalty assets, although no known studies examine how this might relate to the propensity to create value (e.g. does the interaction between these two constructs generate synergies for the firm?).

3.3.1. Customer loyalty – management reported assets

GAAP standards do not provide for the reporting of customer loyalty assets.

3.3.2. Customer loyalty – researcher estimated asset

A lot of the evidence on the value-relevance of customer loyalty comes from survey-based output metrics produced by researchers, research institutes, or the firms themselves (e.g. Ittner and Larcker, 1998). The evidence from the survey metrics is mixed in part because the survey data is collected by different companies and organisations using different instruments, subjects, and time periods, which makes the results of the studies hard to interpret (Boyd et al., 2004).

By contrast, Gupta et al. (2004) provide evidence on the contribution of customers to value using primarily publicly available information. They provide novel evidence that the long-term value of the firm's customer base is a good proxy for the market value of equity. They first develop a model to value the firm's long-term customer base using the following information: a forecast of customers to be acquired in the future, average customer acquisition costs, profit margin per customer, and customer retention rate. These customer value drivers comprise both financial and non-financial information, some of which are inputs to value (e.g. acquisition costs) and some are outputs to value (e.g. customer retention). Estimates from the customer valuation model are close to the market value of equity for three (Capital One, Ameritrade, E*Trade) of the five firms considered (the measure undervalues Amazon and eBay, which many analysts believed were over-valued at the time).

Consistent with other studies, Gupta et al. (2004) find *customer retention* has the biggest impact on customer value, in the order of 3 to 7% for a 1% increase in retention. By contrast, *profit margin*

[22] FW reports value estimates, sales, and operating margins for individual brands, by industry, as well as the percentage change in the brand value from the previous year. Brand strength multiples for each brand, obtained from Interbrand, are a weighted metric computed from seven components: (1) Leadership (maximum 25 points); (2) Stability (maximum 15 points); (3) Market (maximum 10 points); (4) Internationality (maximum 25 points); (5) Trend (maximum 10 points); (6) Support (maximum 10 points); and (7) Protection (maximum 5 points).

per customer has a 1% impact on customer value while the *cost of acquiring customers* has a 0.02 to 0.3% effect on value. Further, they find a strong interaction effect between the cost of capital and retention rate. Specifically, the value of customers in the *high retention–low cost of capital* context is 2.5 to 3 times the value in the *low retention–high discount rate* setting. This finding suggests high cost of capital companies would benefit more from customer retention rather than containment of customer acquisition costs.

In summary, issues relating to the reliability of customer loyalty measures are a possible explanation for the mixed value-relevance evidence for measures obtained from survey data. Estimates of the long-term value of the firm's customer base, and the specific drivers of this value (e.g. customer retention), suggest this is an important policy area for firms which warrants further research.

3.3.3. Customer loyalty – annual expenditures

Annual expenditures on customer loyalty are not generally reported as separate line items in GAAP financial statements.

3.3.4. Customer loyalty – input metrics

One input that is a driver of customer loyalty is the quality of customer service. Decreasing levels of customer service have been cited as a cause of competitive decline (Roach, 1991). To provide evidence on the *information content* of the firms' actions to change their quality of customer service, Nayyar (1995) employs an event study. This design has the capacity to indicate whether investors actually used the information, subject to the researcher adequately controlling for competing information. Nayyar argues that if improving customer service leads to improved performance, then actions that improve customer service should be valued positively by the stock market when the actions are announced. Using news reports from business news databases, he identifies actions by firms relating to changes in customer service over 1981–1991. Action (inputs) relate to four customer service objectives: (1) *risk of purchase*; (2) *purchasing cost*; (3) *ease*, *convenience*, *cost of use*; and (4) *personalisation*. Nayyar finds that increases (decreases) in customer service are positively (negatively) valued by the stock market, as reflected in cumulative abnormal returns in the event window. The strongest effects are for *reducing the risk of purchase* (appearance of facilities and guarantees) and *purchasing cost* (customer service outlets, credit terms, computer links to buyers, and operating hours).[23]

Like customer satisfaction, *consumer switching costs* (brand loyalty) give the firm market power over repeat purchasers. These costs make the firm's current market share an important determinant of future profits and value (Klemperer, 2005). Examples of factors that give rise to switching costs include frequent flyer programs, computer component compatibility, and the cost to learn to use another brand.

The effects of consumer switching cost on firm value are ambiguous. Benefits from high customer retention may be off-set if switching costs increase product prices over time to the point where it is viable for consumers to switch brands. Switching costs can discourage new entry to the industry and generate inertia in product and process innovation by reducing the firm's incentives to differentiate their products, thereby reducing competition. The extent of the value created for the firm from consumer switching costs therefore depends on a careful analysis of the competing effects.

In summary, there is evidence that an input to customer loyalty, changes in customer service quality, is associated with cumulative changes in unexpected stock returns. Firms have incentives to create switching costs for consumers to build market share. The challenge for researchers is to define and collect or construct concrete input measures for tracking and studying customer loyalty components.

3.3.5. Customer loyalty – output metrics

Ittner and Larcker (1998) find that a customer satisfaction output metric for a large telecommunications firm (survey of 2,491 from a total of 450,000 customers) is significantly positively and non-linearly associated with customer retention, revenue and revenue-change measures. Tests for business unit customer satisfaction metrics from 73 retail banks (different metric to above) suggest an indirect effect on accounting performance by attracting new customers, consistent with the bank's strategic goal. However, while Ittner and Larcker (1998) find another output metric from the American Customer Satisfaction Index (ACSI) survey is associated with the market value of equity, the relation is not consistent (significant in transport, utility, communication; insignificant in durable and non-durable manufacturing and financial services; significant and negative in retailing). The ACSI metric gives rise to a positive announcement effect (on stock price) suggesting the index conveys information to investors. The index

[23] As compared with less valuable actions to change the *ease, convenience, and cost of use* (customer service department, technical assistance, toll-free numbers, discretionary comfort features) or the *personalisation of products* (computer to customise products, capacity to meet unique needs). Specific customer service actions viewed most favourably by the stock market are improved guarantees, increased operating hours, greater customer service outlets, and better computer links to buyers.

is also positively significantly associated with forecasted residual earnings, suggesting some of the value is impounded in earnings.

The ACSI is one of the more standardised surveys generating output metrics. It is a national economic indicator managed by the National Quality Research Center and the American Society of Quality. The 15 questions in the survey are organised by four variables: perceived quality, customer expectations, perceived value and customer satisfaction. The customer satisfaction measure is computed from three of the questions relating to overall satisfaction, confirmation of expectations and comparison with the ideal.

Jacobson and Mizik (2007) find the ACSI measure is only value-relevant for computer and internet firms. Jacobson and Mizik (2007) use an annual stock returns specification. The stock returns test looks at relevance in terms of whether this year's change in customer satisfaction is associated with this year's changes in stock price, whereas the stock price levels test does not refer to a narrow time frame. These stock return tests suggest the customer satisfaction measure may not change enough to be value-relevant on an annual changes basis but is value-relevant in a wider time frame. Alternatively, the stock returns test potentially lacks the power to detect value-relevance and/or the ACSI metric is noisy.

Consistent with a forward-looking value creation effect, Banker et al. (2000) find the non-financial measures of customer satisfaction, *likelihood a customer will return to the hotel* and *customer complaints*, are significantly positively and negatively, respectively, associated with future financial performance (business unit revenues and operating profit) for a hotel chain. This data is collected by the hotels. Their evidence suggests that customer satisfaction is related more to long-term rather than short-term performance. Further, they find that changes in management incentive contracts to include these non-financial performance (output) metrics leads to improvements in both financial and non-financial performance.

In summary, precise component level measures of customer loyalty such as in Banker at al. (2000) would help us to understand what drives customer satisfaction in different industries and how to measure the composite output indexes more precisely.

3.4. Competitive advantage

Two literatures relevant to understanding the sources of competitive advantage include the industrial organisation model of competitive advantage focusing on industry (e.g. Porter, 1980; 1985) and the resource-based model of competitive advantage focusing on firm-specific factors (e.g. Wernerfelt, 1984; Barney, 1991; 2001). Studies from these literatures suggest that both firm-specific and industry effects have a role in explaining value creation. However, firm-specific effects dominate industry-specific effects (Rumelt, 1991). According to Barney (1991) value is created from firm-specific endowments when they are valuable, rare, inimitable and difficult to substitute.

Early research focused primarily on financial information to study competitive advantage. However, some researchers believe that the strategic activities that generate (or destroy) value are not formally captured in the traditional categories of financial information. This has motivated researchers to expand their efforts beyond a *financial* focus to study *strategic* sources of competitive advantage. The evidence reviewed in this section suggests that investors refer to a range of GAAP and non-GAAP information relating to the firm's capabilities and strategy to value the firm's stock. This literature identifies a range of competencies that are possible omitted variables from value-relevance studies.

3.4.1. Competitive advantage – management reported assets

Consistent with a greater emphasis on non-financial measures of the firm's intangible value since the mid-1990s, some managers have embraced a broader *strategic focus* on *how* their firm creates value. This involves identifying, measuring and managing the value drivers of customer value, organisational innovation, and shareholder wealth (Ittner and Larcker, 2001). Measurement techniques range from unstructured checklists of diverse financial and non-financial measures to structured methods such as the balanced scorecard, economic value measurement (EVA, residual income or abnormal income), causal business modelling, and environmental uncertainty models.

Proponents of the unstructured checklist of measures argue that using diverse sets of financial and non-financial measures decreases the risk that managers fail to consider relevant dimensions of their firm's performance (Lingle and Schiemann, 1996). Proponents of the structured methods argue that these techniques are useful for identifying successes and failures relating to the firm's strategy and its fit with the organisation's objectives (Simons, 1991; Stewart, 1991; Stern et al., 1995; Gates, 1999; Kaplan and Norton, 1992; 1996; 2001). Structured performance measurement is predicated on the theory that performance measures must be aligned with and contingent on the firm's strategy and value drivers to be useful in promoting value creation (e.g. Langfield-Smith, 1997).

Campbell et al. (2002) test and find evidence consistent with the proposition that the balanced

scorecard technique can be used to identify problems and highlight causes and solutions relating to the firm's operating strategy. However, their analysis, using data from a convenience store chain, suggests that this result only holds if the analysis is conditioned on the firm's competencies (i.e. takes into account the fit between the strategy and the skills of the workforce). Their analysis reveals that a poor fit between strategy and employee capabilities caused the convenience store chain's strategy to be ineffective.

By contrast, Biddle et al. (1997) find traditional accounting measures are more value-relevant than the structured economic value added measures. In the financial services industry, Ittner et al. (2003) find that the structured measurement approaches, the balanced scorecard, economic value measurement, and causal business modelling are associated with higher measurement system satisfaction by users within the firm. But these three approaches are not associated with higher accounting or stock price performance. Instead they find the firms using an unstructured approach, comprising a wide variety of financial and non-financial input and output measures, earn higher stock returns compared with firms with similar strategies or value drivers that do not use the unstructured approach.

In summary, there is mixed evidence on the value-relevance of unstructured and structured methods of measuring value added. It is possible this is partly due to omitted conditioning variables, such as the firm's competencies (Campbell et al., 2002). Another question is how well the methods capture the firm's value-creating processes. Aligned to this is a lack of data on the measures that are actually *used* by managers and purpose or objective of the measures (Ittner and Larcker, 2001). The lack of data is due to the proprietary nature of this type of data, along with the diversity of competencies and strategies in use, which makes it difficult for researchers to obtain robust results.

3.4.2. Competitive advantage – researcher estimated assets

Gjerde et al. (2007) examine the value-relevance of three sources of competitive advantage: *industry-based* competitive advantage and two *firm-specific, resources-based* competitive advantages relating to profitability and risk. Using abnormal stock returns as the valuation variable, and showing consistency with other studies, Gjerde et al. (2007) find the firm-specific advantage is three to four times more value-relevant than the industry specific advantage. Further, they find these two effects are interdependent.

3.4.3. Competitive advantage – annual expenditures

Spending that leads to *information technology (IT) capabilities* has been linked to firm value although with mixed results. Dewan and Min (1997) provide evidence that IT capital is a net substitute for both physical capital and labour in all sectors of the economy using a Computerworld survey of spending by US companies on information systems from 1988 to 1992. Earlier, Brynjolfsson (1993) and Wilson (1993) could not find evidence that IT contributed to firm productivity. Their results were rationalised by higher productivity losing out to lower entry barriers, industry inefficiencies and competition (Hitt and Bryjolfsson, 1996). However, later studies using firm-level data suggest that IT capabilities are related to positive investment returns (Lichtenberg, 1995; Hitt and Brynjolfsson, 1996) and to the stock price-based measures (Bharadwaj et al., 1999; Brynjolfsson et al., 2002). Anderson et al. (2006) employ financial data from the Y2K spending in IT, in contrast to the prior studies, which primarily use survey data. They find opportunistic improvements in the firms' IT capabilities (costs were bundled with the Y2K spending) are associated with higher contemporaneous stock price and higher future profits. What is unclear in this literature is the impact of omitted correlated intangibles, i.e. many sources of intangible value go unrecognised under GAAP.

3.4.4. Competitive advantage – input metrics

Darby et al. (1999) test the value-relevance of the input measure, *ties to star scientists*, for biotechnology firms. Darby et al. (1999) argue that *ties to star scientists* is valued by investors due to the investors' ability to observe related indicators of the firm's intellectual human capital, such as the number of scientists, how many have PhD degrees, where they did their graduate work, and the size of the firm's R&D. They develop a valuation equation based on an option-pricing model that embeds a dynamic jump process. This jump process involves changes in the firm's assets and value whenever the intellectual human capital, in this case the ties to star scientists, generate technological successes. They find that increases in *the ties to star scientists* metric is associated with higher market valuation of the firm but at a decreasing rate. For the average firm (relative to industry), there is a 7.3%, or $16m increase, in the market value of a firm per scholarly article written by, or with, a star scientist compared with a firm with no articles in academic journals.

Amir and Lev (1996) study industry-specific measures of the firms' value drivers for the wireless communications industry. In contrast to other studies, they find the earnings and book value of

shareholders' equity, the two summary measures of the firm's financial performance and position are not value-relevant. However, non-financial input metrics are highly value-relevant for this industry, including a proxy for the firm's expected growth, the *population of potential subscribers*, and a proxy for the firm's expected operating performance, the *penetration ratio of subscribers to the population of potential subscribers*.

Klock and Megna (2000) similarly find that the input metrics, *radio spectrum licenses* and the firm's *potential customer base*, are incrementally value-relevant over advertising and R&D expenditures for firms in the wireless telecommunications industry. In fact, they report that the spectrum license explains over 60% of their market value of equity measure, the Tobin's *q*. Tobin's *q* is the market valuation of the firm's financial claims divided by an estimate of the replacement cost of the assets.

Ethiraj et al. (2005) study the sources of competitive advantage for a large Indian software company with about 90% of revenues from exports. Their dataset includes information on revenues, cost, factor inputs, capability measures, various project characteristics, such as size, client industry, and development platform, all measured at the project level. Ethiraj et al. test and find that two sets of firm-specific capabilities are important sources of competitive advantage for firms in the software development industry: *client specific capabilities* and *project management capabilities*. Using non-financial and financial measures, they find that the firms develop these capabilities through learning-by-doing as well as sustained investment. Further, the two types of capabilities contribute heterogeneously to value creation. That is, the two capabilities are present in different proportions across the software firm's projects, cost different amounts of money and provide different levels of benefits. If capabilities such as these interact with investment to impact firm value, then value-relevance tests might need to understand key capabilities to generate valid models.

The value-relevant non-financial information set relating to competitive advantage and future prospects changes over time. Stephan et al. (2007) compare the changing value-relevant information set for firms in the biotechnology industry over two financing windows, 1989–1992 and 1996–2000. In the earlier period, 1989–1992, biotechnology firms going public for the first time (IPOs) comprised IP and research capabilities but few marketable products. The likelihood of success was a function of the number of products in clinical trials, the reputation of underwriters, intellectual property, alliances, and linkages with university-affiliated scientists who won a Nobel Prize.

In the later period – 1996–2000, biotechnology industry was more established, now comprising a large stock of IP, as well as research alliances, and products in clinical testing. Stephan et al. (2007) find the most striking difference between the two time periods relates to the value attached to the firm's association with a Nobel laureate. This value fell from $20.4m in the 1989–1992 period, when there was little other information to signal the firm's prospects, to zero in the later 1996–2000 period.

In summary, the sources of *firm-specific* competitive advantage canvassed in Section 3.4.4 refer to the firm's industry, technology, and business model. This is consistent with the Gjerde et al. (2007) evidence that firm-specific and industry sources of competitive advantage are interdependent. The factors reviewed in this section appear to be robustly value-relevant, consistent with core value driver status. The discussion in this section highlights the importance of identifying core value drivers to ensure that all important sources of value are included in the tests.

3.4.5. Competitive advantage – output metrics

Researchers have studied the contribution of brands to firm value using non-financial output metrics from surveys of customers. While financial measures of brands are usually value-relevant, as discussed earlier, the evidence from these qualitative measures is not so convincing. For example, Mizik and Jacobson (2006) investigate whether five qualitative attributes of brands – *energy, differentiation, relevance, esteem*, and *knowledge* – are value-relevant. Their constructs and measures come from the Young and Rubicam brand survey.[24] Out of the five attributes, only *energy* (future ability to generate benefits) and *relevance* (relevance of the brand to the customer) are value-relevant. Interpreting this study is difficult. For example, it is not clear whether Mizik and Jacobson's lack of results for three of the five brand attributes is due to: (1) problems with the five attributes (e.g. are these really the key factors and are they sufficiently precise to be useful empirically?); (2) problems with the customer responses (e.g. customers have different perceptions of what the 50 questions are asking them); or (3) problems with the way the five attributes are created from the 50 survey questions.

Rajgopal et al. (2003) find competitive advantage output metrics relating to *network advantages* from *website traffic* are incrementally value-relevant over earnings and the book value of shareholders' equity. They provide evidence that the inputs that drive the network advantages are the

[24] The Young and Rubicam brand asset valuator model is discussed in Fudge (2005).

firm's *affiliate referral program* and *media visibility*. Rajgopal et al. (2003) also find the network advantage is positively associated with financial analysts' one- and two-year ahead earnings forecasts, providing further support for their value-relevance results.

Hand (2000) employs a log-log linear regression, rather than the more common ordinary least squares estimator, to examine the value-relevance of *web traffic* metrics for internet companies incrementally to *economic* variables, including the book value of shareholders' equity, forecasted one-year ahead earnings and forecasted long-run earnings growth (and other supply and demand variables). This type of regression describes a relationship of diminishing returns – i.e. increases in web traffic at low levels (high levels) of web traffic – are associated with large (much smaller) increases in stock price. Hand (2000) finds the economic variables dominate the web traffic output metrics. Only the *number of unique visitors to the firm's website* metric is value-relevant. The metrics that are *not* value-relevant include the *number of page views, hours at the website, and average age and income of visitors*. Hand's (2000) study suggests that econometric issues relating to the dispersion of the data and the function used to model the relations between web traffic metrics, economic data, and firm value can impact the results.

Firm-specific information advantages arising from *networks* have been linked to stock price. Aral and Van Alstyne (2007) argue that the *network* metrics are associated with stock price performance because the networks provide access to novel information. They find evidence consistent with this proposition using output metrics for network advantage, comprising a ten-month panel of email communication patterns, message content, and performance data from a medium-sized executive recruiting firm. They also find an upper limit on network benefits arising from diminishing marginal productivity returns to novel information, consistent with theories of bounded rationality, and cognitive and information overload.

Aral and Weill (2007) provide evidence that the prior mixed results relating to the benefits from *IT capabilities* are due to omitting *strategy* from the analysis. They argue that investments in different IT assets are guided by the firms' strategies (e.g. cost leadership or innovation). That is, the IT assets deliver value along dimensions consistent with the underlying strategy. To provide insights on this hypothesis, they test the association of IT assets, IT capabilities, and strategy inputs, with four dimensions of performance: market valuation, profitability, cost, and innovation. Aral and Weill's (2007) results suggest that the financial investment in IT is not value-relevant. However, the *combination* of IT investment and IT capabilities drives differences in firm performance and is value-relevant.

In summary, non-financial brand measures of brands appear on the strength of the results in this section to be less reliably measured compared with the financial measures used by Barth et al. (1998) discussed earlier. The studies in this section suggest that other information is important, in addition to the financial information, for understanding the contribution of financial information to performance and value. Further, the non-information interacts with the financial information rather than entering the model additively. For example, not conditioning the IT investment on the firm's IT capabilities and strategy provides an incomplete picture of the value generated by the IT investment and capabilities. Two issues of importance for designing and interpreting value-relevance studies are therefore the heterogeneity of firm-specific capabilities and their interdependence with the firm's strategic choices (Barney, 1991; Rumelt, 1984; Wernerfelt, 1984).

One final issue that relates generally to the competitive advantage literature is the apparent lack of a conceptual framework for the building blocks and purposes of competitive processes. For example, the broad approach (e.g. balanced scorecard) seems more relevant to the purpose of strategy evaluation than to the purpose of firm valuation. This lack of structure may explain the proliferation of studies, targeting a wide range of capabilities and actions, which have been unable to generate robust or generalisable evidence.

3.5. Human capital

Employees create value for the firm by applying their intellectual inputs and manual efforts in the workplace. Human capital assets are heterogeneous and therefore less predictable compared with physical assets. However, investments in labour assets appreciate rather than depreciate with time (Webster, 1999). The incentive that this creates for employers to invest in human capital is mitigated by the employer's inability to own employees and variation in the employees' commitment and reliability. This puts some of the incentives for education and training onto the employee.

There is a view that human capital is increasing in importance as a factor of production because new technologies are now more likely to be embodied in intangibles and labour rather than solely in fixed capital (Kendrick, 1972; Webster, 1999). A number of studies suggest the increasing and often specialised skill set required to participate in some occupations leads to a division (partitioning) of labour into periodic inputs (current expenses) and long-term assets (e.g. Webster, 1998). This trend suggests human capital is important for value

creation, particularly in high-skilled sections. Irrespective of property rights issues relating to human capital, firms requiring skilled labour to compete would be expected to have strong incentives to invest in attraction, retention and motivation of their human capital.

3.5.1. Human capital – management reported assets

Despite anecdotal evidence that a proportion of human capital is an asset, no attempt is made to identify or report these items under GAAP.

There has been a long-running debate on the question of whether to capitalise labour compensation costs as an intangible asset. One suggested approach, similar to capital lease accounting, is to report the discounted present value of estimated compensation costs as a non-current asset and a liability (Lev and Schwartz, 1971). The idea is that a going concern investing in plant, property and equipment commits to future compensation costs for the life of those assets. Expenditures on employees therefore reflect expected benefits and a liability to make continuing payments. This idea has not been adopted, and human capital assets are not reported under GAAP.

3.5.2. Human capital – researcher estimated asset

In a series of papers, Rosett (2001, 2003) provides evidence on the value-relevance, financial policies, and equity risk implications of implementing capitalisation of human capital. Rosett (2001) computes a human capital liability from the present value of expected compensation costs in union labour contracts in the spirit of Lev and Schwartz (1971). In an earlier working paper (Rosett, 1997), he finds the corresponding human capital asset is significantly positively associated with the market value of equity. In Rosett (2001), he finds the increase in leverage from the human capital liability is positively associated with measures of the firm's equity risk. Tests on industry sectors suggest the asset/liability measures are crude for R&D and knowledge intensive industries, where the proportion of value generated from intellectual inputs is greater (i.e. where the partitioning of labour on the basis of skill levels would be greatest).

Rosett (2003) focuses on the equity investment risk and corporate financial policy implication of the firm's liability for the human capital intangible asset. Because labour is costly to adjust in the short run, he argues that the firm has a fixed obligation to pay cash to labour, creating an off-balance-sheet intangible liability similar to a lease. This liability creates a form of financial leverage risk he calls *labour leverage* risk (total employment deflated by the market value of equity) and *labour cost leverage* (compensation costs deflated by the market value of equity). He predicts and finds the labour leverage measures are positively correlated with equity investment risk, and negatively correlated with leverage and dividend payout consistent with managers taking human capital risk into account when setting financing and dividend policies.

Lajili and Zeghal (2006) construct *human capital productivity* (marginal product of labour estimated from labour and training expenditures and production function regressions) and an *efficiency indicator* (marginal product of labour minus average industry labour costs) and relate these to stock price performance. Risk-adjusted abnormal returns are computed for portfolios sorted by size, labour-cost disclosure status, and the human capital indicators. They find higher levels of total labour expenditures, workforce productivity, and efficiency is generally associated with higher abnormal returns. Hence, labour costs voluntarily disclosed in financial statements are potentially useful for evaluating human capital assets and value.

Abdel-khalik (2003) constructs a measure of *managerial skills* for executives on the Board of Directors. He employs a latent index regression that comprises a set of *personal variables* (experience, risk preference, and value of owned shares) and a set of *firm-specific* variables (past profit and growth, organisational complexity, and operating risk). The predicted values from the latent variable regression are the measure of *managerial skill*. Abdel-khalik finds these predicted values are value-relevant.

Disclosures relating to managements' stock option incentives are a human capital-related investment that has been tested for value-relevance. For example, Landsman et al. (2004) find the employee stock option (ESO) related costs are value-relevant. However, Landsman et al. (2004) provide evidence which suggests that only one of the four accounting methods for equity-based incentives results in accounting numbers that accurately reflect the dilution effects of ESOs on shareholder value. This method involves the grant date recognition of an asset and a liability and subsequent marking-to-market of the liability. Landsman et al. report that this method is the most value-relevant of the four accounting methods. The other three less value-relevant methods are non-recognition (APB 25), recognition of only the stock option expense (SFAS 123), and recognition of only a stock option asset – as in the FASB's Exposure Draft: Share Based Payment (2004).

Measurement of dilutive effects is an issue. Li and Wong (2004) use a warrant-pricing model to jointly allow for the dilutive and shareholder value impact of employee stock options and use this in equity valuation. They find the market value of eq-

uity is overstated by 6% if the dilutive features of stock options are ignored. A larger bias exists for heavy users of stock options, small firms, and R&D-intensive firms.

In summary, the evidence suggests human capital assets measured using contract and non-financial and financial input data are value-relevant. Managers appear to take the (off-balance sheet) liabilities into account when setting financing and dividend policies, and these liabilities are positively associated with equity risk. Investments in human capital productivity and efficiency are also value-relevant as are measures of managerial skills and their stock option compensation (although the measurement of stock options and dilutive effects is difficult). An area requiring future research is how to more precisely measure human capital assets and liabilities to take skill level into account.

3.5.3. Human capital – annual expenditures

GAAP has a limited role in the reporting of labour costs. Labour costs data is collected by National Statistical Bureaus in their annual surveys. Separate reporting of the *expenditures* paid to employees is envisaged under IAS 1 *Presentation of Financial Statements* (paragraphs 86–95).[25] Despite this expectation, there is no evidence of widespread reporting of labour expenditures under GAAP. Separate reporting of labour expenditures is voluntary in the US. There is a requirement to disclose employee costs and number of employees under the UK Companies Act.[26] Overall, the GAAP data on labour costs appears to be limited.

In the US setting, Ballester et al. (2002) use a more fully specified regression based on Ohlson (1995), compared to Rosett's (1997) working paper discussed above, to examine the proportion of US labour costs that are value-relevant. Separate identification of labour costs in US financial statements is voluntary and they find only about 10% of all US Compustat firms disclose these costs. Of these disclosed costs, only about 16% are value-relevant, with an amortisation rate of 34% per year. Possibly the human capital measures would yield more power in the tests if the labour costs could be disaggregated to separate out higher and lower specificity human capital assets (e.g. skilled/unskilled or partitioning according to scientist/engineer/management/sales).

In the spirit of the earlier discussion on the value of skilled labour, Hansson (2004) predicts there is a value premium associated with human capital that distinguishes the stock performance of value and glamour stocks. He finds that the *dispersion in wage growth* between value and growth stocks explains a large proportion of the differences in stock returns. The intuition for this result is that the value stocks are less exposed to shocks in rents to human capital. Hansson also finds that differences in the *labour force characteristics* between value and growth stocks are value-relevant.

Despite considerable corporate opposition, and concerns about the reliability of fair value estimates of stock option expense, accounting standards now require corporations to recognise expenses relating to grants of stock options to employees – IFRS 2 *Share-Based Payment* and FASB SFAS 123 (revised 2004). Equity-based compensation is now measured at fair value on grant date, based on the estimated number of awards expected to vest, and allocated as an expense over the vesting period.

Frederickson, Hodge and Pratt (2006) conduct an experiment to study how stock option expense recognition affects the valuation decisions of sophisticated financial statement users. The subjects are 220 business school alumni with an average of 11 years' experience in financial analysis and 16 years' accounting-related work experience. Seventy-nine percent are Certified Public Accountants. An initial *ex ante* reliability assessment by the subjects is updated based on four questions relating to a comparison of *stock option expense* earnings versus *no expense* earnings. Frederickson et al. predict and find (1) users consider stock option expense recognised under a FASB mandate is more reliable than stock option expense voluntarily recognised by management; (2) users consider stock option expense voluntarily recognised on the income statement is more reliable than stock option expense disclosed in the footnotes; and (3) users invest more in a firm that voluntarily recognises stock option expense than in a firm that discloses the expense in the footnotes, even though voluntary recognition reduces reported net income. The results of this study suggest users perceive that stock option grants give rise to expenses and impound this information in firm value accordingly. Further, users behave as if accounting regulation sets the ground rules for credible disclosure, and recognition signals reliability (as opposed to disclosure in the notes).

In summary, human capital measures computed from labour costs are value-relevant. However, researchers find these costs are only very sparsely disclosed and the costs are not sufficiently disaggregated to provide precise measures of the human capital assets. Behavioural research suggests accounting regulation of stock options has created

[25] Paragraph 91 labels these expenditures 'employee benefits' which are defined in IAS 19 *Employee Benefits* to include all benefits provided to employees in return for employee services.

[26] Thanks to Andy Stark for this information. The UK Company Act where this provision was made can be viewed at http://www.opsi.gov.uk/acts/acts2006/ukpga_20060046_en_1, paragraph 411.

value for firms perceived to be appropriately and transparently applying the standard.

3.5.4. Human capital – input metrics

Colombo and Grilli (2005) study how non-financial input metrics of management quality relate to growth. They examine whether *education* and *prior work experience* are key capabilities of the founders of technology companies that determine differences in the firms' growth. For a sample of 506 young Italian companies in manufacturing and services, they find the years of university education in economic and managerial fields, and to a lesser extent in scientific and technical fields, are positively related to growth but education in other fields is not. Prior work experience in the same industry of the new firm is positively associated with growth while prior work experience in other industries is not. Technical work experience of founders rather than commercial work experience determines growth. There are synergistic gains from having complementary capabilities.

Several studies also report human capital management practices are related to higher firm performance (e.g. Huselid, 1995; Ichniowski et al., 1997; Hitt et al., 2001).

Some industries are largely determined by the firm's endowment of intellectual human capital specific to the dominant technology. One of these is biotechnology (Zucker et al., 1998). Hand (2001) examines whether the human capital reflected in employees is value-relevant for biotechnology companies for whom skilled labour comprising bioscientists and bioengineers is an important factor of production. Because the relevant expenditures on hiring, retaining and incentivising employees are not separately reported under GAAP, Hand (2001) employs proxies of human capital inputs – the total number of employees – and the quality of human capital – the ratio of SGA to the number of employees. It is possible these measures are not precise enough to be value-relevant. For example, the number of employees is commonly used to measure firm size in economic studies. Further, the number of employees includes all workers, not just the biotechnology experts who generate the firm's new science and/or technology. The results are consistent with this conjecture. Using a log-log model, neither of these human capital measures are value-relevant. Hand (2001) reports that the GAAP variables (shareholders' equity, retained earnings, treasury stock, revenues, cost of sales, SGA, R&D, and dividends) explain about 70% of stock price.

In summary, some studies employ non-financial input measures of management skills and find they are associated with differences in firm growth. This is an important area for future research given the lack of GAAP disclosures capable of providing insights on the contribution of human capital investments to value.

3.5.5. Human capital – output metrics

Edmans (2007) finds a non-financial output measure of *employee satisfaction*, the companies' scores from the *Best Companies to Work for in America* ranking, is associated with higher stock price performance. This portfolio of firms also outperformed industry, and characteristics matched benchmarks.

Several studies find that output measures of the *firm's reputation* are value-relevant. The idea is that reputation increases the probability that value-relevant information is impounded into stock price (Healy and Palepu, 1993). For example, Black et al. (1999) find reputation rankings based on Fortune's *America's Most Admired Companies* is positively significantly associated with the difference between the market and book value of equity. Hutton and Stocken (2007) examine the effect of *firm reputation for forecast accuracy* on investors' reaction to managements' earnings forecasts using size-adjusted, three-day event window stock returns centred on the earnings release and management forecast. Their measure of forecasting reputation reflects prior forecast accuracy and frequency. They find that a forecasting reputation makes investors more responsive to management forecast news. A forecasting reputation leads to investors' reaction at the management forecast date largely pre-empting their earnings announcement stock response. However, the results suggest that all firms do not build a forecasting reputation because the cost outweighs the benefits when reported earnings do not reach management's forecast.

Using a field experiment that is co-linked to a laboratory experiment, List (2006) finds subjects drawn from a natural marketplace behave in accordance with social preference models in the laboratory experiments. However, in their naturally occurring market settings, their behaviour better approximates self-interest. List finds the incidences of socially orientated behaviours in the marketplace are motivated by reputation concerns. Fisher and Heinkel (2007) study management's motivation for truth-telling and reputation. In their model, management builds reputation when times are good and honesty is affordable, and exploits reputation in times of need. However, competition appears to constrain this potential managerial agency problem. Relying on the US business combination anti-takeover statutes passed between 1985 and 1991 to measure variation in corporate governance states, Giroud and Mueller (2007) find the loosening of corporate governance constraints is associated with negative operating performance and stock price effects only for firms in less competitive industries. Product market competition

thus appears to act as a brake on managerial agency problems, consistent with the view of Alchian (1950), Friedman (1953) and Stigler (1958) that managerial slack cannot survive in competitive industries.

In summary, output measures of employee satisfaction and firm reputation are correlated with value. Agency conflicts may negatively impact the *ex post* propensity for management to act in accordance with good reputation, although competition may constrain this tendency. An area for future research is input measures of reputation from the previous section, as these are important for understanding the 'causes' of reputation.

3.6. Goodwill

There is a long-lived debate over the conceptual underpinnings of goodwill and indeed whether purchased goodwill is an asset. We have so far encountered a lot of literature in this paper that can provide insights on whether or not a firm has valuable goodwill. It seems much more fruitful to look at the earnings and value implications of specific and identifiable drivers of value.

3.6.1. Goodwill – management reported assets

GAAP-purchased goodwill is the difference between the acquisition price of a business or company and the fair value of the identifiable net assets acquired by the acquiring entity (IFRS 3 *Business Combinations*). Most studies find GAAP goodwill is value-relevant (e.g. Chauvin and Hirschey, 1994; McCarthy and Schneider, 1996; Vincent, 1994; Muller, 1994; Jennings, Robinson, Thompson and Duvall, 1996). Vincent (1994) finds the value-relevance relation holds for up to five years after the acquisition of goodwill.

Chauvin and Hirschey (1994) examine the value-relevance of financial information on intangibles for a sample of US companies in 1989–1991. They find GAAP goodwill, net income, advertising, R&D, intangible assets, and tangible assets are value-relevant for *non-manufacturing* companies. These variables are all value-relevant for *manufacturers*, except for the goodwill and intangible assets, possibly because more of the manufacturers' intangible assets are embodied in plant and equipment (Hansen and Serin, 1997). Goodwill is less value-relevant compared with the other intangible assets, suggesting goodwill is less reliably measured. Muller (1994) also finds evidence consistent with this conclusion.

Amir et al. (1993) and Barth and Clinch (1995) examine the value-relevance of the goodwill adjustment from the reconciliation of UK and Australian GAAP to US GAAP. Both studies find the goodwill adjustment is value-relevant. The UK firms predominantly wrote off all goodwill to shareholders' equity prior to 1996. Hence, the goodwill adjustment is the entire goodwill asset that would have been recorded without the write-off to equity. In a separate analysis for the UK firms, Barth and Clinch (1995) find this goodwill adjustment is value-relevant but less so than the other assets.[27]

Goodwill amortisation is not value-relevant (Amir et al., 1993; Vincent, 1994; Muller, 1994; Jennings et al., 1995; Barth and Clinch, 1995). Clinch (1995) suggests this may reflect a perception that some firms' goodwill is not declining in value. It is also conceivable that the useful life cannot be estimated (by managers or investors) and/or that the Henning et al. (2000) over-valuation component (discussed in Section 3.6.2.) distorts the amortisation charge.

Amortisation is now prohibited under international accounting standards and in other jurisdictions. Chambers (2007) examines whether the change from amortisation of goodwill to an annual impairment test under the US standard, SFAS No. 142 *Goodwill and Intangible Assets*, increased the reliability of goodwill and its value-relevance. He finds the annual impairment testing is associated with an increase in value-relevance. However, information appears to be lost as a result of the elimination of systematic amortisation, which is surprising given most studies find amortisation charges are not value-relevant. Possibly, the impairment loss is understated, and this is an omitted variable being picked up in the tests as a decrease in value-relevance that coincides with the cessation of amortisation.

Consistent with this conjecture, Hayn and Hughes (2006) find goodwill write-offs lag behind the economic impairment of goodwill by an average of three to four years. For one-third of their sample, the delay can extend up to ten years. They find their results for the period prior to the introduction of SFAS No. 142 are also generalisable to the goodwill reported under SFAS No. 142. Ramanna and Watts (2007) corroborate this evidence for a sample of firms with indications of impairment. The frequency of *no goodwill impairment* in their sample is about 71%. The propensity not to impair is associated with financial characteristics that relate to higher management discretion from the unverifiable fair-value measures. The evidence therefore suggests that GAAP goodwill under the impairment test regime is value-relevant but not reliably measured.

In summary, purchased goodwill is value-rele-

[27] Emmanuel et al. (2004) argue that for models, which disaggregate an accounting measure like book value of equity into separate components, a significant association with stock price does not necessarily mean the market finds the component is value-relevant. The correct test, they argue, compares the coefficients of the component variables and the remaining book value after the decomposition.

vant but less so than tangible assets and does not appear to be reliably measured. This conclusion is consistent with the concepts of relevance and reliability, and their roles in value-relevance tests, as discussed in Section 2.3 and illustrated in Figure 1.

3.6.2. Goodwill – researcher estimated asset

One explanation for the lower value-relevance of goodwill compared with other intangible assets is that it is over-valued on average, on the balance sheet, relative to investor expectations. Consistent with this idea, Henning, Lewis and Shaw (2000) find an over-valuation component which is negatively associated with stock price. They examine the value-relevance of four components of goodwill: (1) write-up of target firm assets to market value; (2) going-concern value of the target; (3) synergy value created by the acquisition; and (4) over-valuation component. Consistent with the conclusion from the previous section that goodwill is not reliably measured, only the first three components are value-relevant, with the going concern component dominating. Arguably, the synergy component is also difficult to value, and its reliability varies.

3.6.3. Goodwill – annual expenditures, input metrics and output metrics

Annual expenditures that relate to the firm's goodwill are not identified under GAAP standards. Measuring unrecorded intangible assets and their implications for firm value was one of the motivations for *investment opportunity set* (IOS) studies. Smith and Watts (1992), Skinner (1993) and Gaver and Gaver (1993) use various proxies for the firms' IOS and report that the IOS helps explain the firms' accounting-based debt, dividend and management compensation policy decisions.

Disaggregating the IOS and identifying and measuring constituent components is necessary to gain further insights, and the literature reviewed in this paper demonstrates the innovative ways that researchers have tackled this problem. Along these lines, Falk and Gordon (1977) proposed that goodwill be defined as the total value of favourable market imperfections and related government regulations, with purchased goodwill representing the amount one firm pays another firm for the sum of these assets. Their empirical work identifies 21 categories of sources of goodwill under four groupings: imperfections in financial markets, labour markets, product markets, and government regulations. For example, labour market imperfections relate to managerial talent, good labour relations, training programs, and organisational structure of the acquired firm. They point out that goodwill is unobservable, and it is therefore easier to think about sources and measures directly.

4. Conclusions and future research

At the 1996 SEC *Symposium on Financial Reporting and Intangible Assets*, Stiglitz (1996) discussed the importance of accounting (and auditing) for the workings of a capitalist society and markets, and the informational limitations of data from the accounting system, in fact data from any measurement system. He noted that while there is going to be a higher uncertainty associated with valuing intangible assets than other assets, it is a source of major distortion to incentive systems to value intangibles at zero (1996: 17–19).

The main thrust of the value-relevance studies reviewed in this paper is consistent with the views expressed by Stiglitz (1996). There is a strong perception permeating the literature that learning about the firm's investments in intangibles is important for understanding how firms create (or destroy) value. This is consistent with the economics of intangible investments as a key input to the production function.

This study compiles a somewhat voluminous review of a wide cross-section of studies on intangibles information. Such a wide-ranging approach is motivated by the difficulty of judging whether value-relevance is due to relevance or reliability and the difficulty of obtaining direct tests of reliability.

4.1. Main findings

Table 1 summarises the main findings from the literature review. The studies are grouped based on the category of intangibles, the measurement approach, and the value-relevance measure: stock price level, stock returns or financial performance. The measurement categories reflect (1) the economics of the value creation processes and the researcher and practitioners' interests in the identification of value drivers and their empirical measures; (2) the influence of GAAP on the reporting of intangibles and the research problems of interest to practitioners and researchers; and (3) the influence of management discretion.

The subtotals show that the literature is concentrated in the *R&D and IP* category. Within this category, the research is concentrated in the *annual R&D outlay* and the *output metrics* measurement areas. The least work in the *R&D and IP* area has been done in the *input metrics* area, for which there is limited data. What goes in R&D is not disclosed; therefore, it is difficult to know what input metrics would be relevant. The *annual outlay* emphasis reflects the effect of GAAP, which requires most R&D to be immediately expensed. The *output metric* emphasis reflects the interest of researchers and practitioners in alternative, non-accounting ways of measuring the success rate of R&D inputs. It is often argued that the success rate information is there in the form of earnings.

However, it is not always feasible to wait until earnings. Further, earnings is an *output* that is not informative about *how* the value was (or is expected to be) created.

Stock price levels studies dominate the *R&D and IP* category. Comparing the significance and totals columns for the *R&D and IP* category, the information on intangibles always has significant coefficients for the stock level studies. For the stock levels tests, the coefficients on the *R&D and IP* category intangibles tend to be larger than the other assets in the regression. This result is not what one would expect to find. This is an issue for future research: to try to design studies that provide insights on the extent to which this result is due to higher value-relevance versus measurement and research design issues (e.g. omitted variables).

The *R&D and IP* stock returns studies are concentrated in the *management reported* and *researcher estimated assets* areas. The estimated coefficients are not always significant for the stock returns studies. One explanation is that the stock returns window, which is typically annual, is not wide enough to capture value-relevant information in the management reported and researcher estimated R&D assets. Both these types of R&D assets are also subject to potentially significant economic uncertainty relating to the success rate. Consistent with this effect, the existing literature indicates that a dollar of R&D is valued differently across time periods, industries and technologies. It would help investors if the causes of this variation could be identified. There are opportunities to study the rate that R&D contributes to value and the cause of changes in the success rate by focusing on stock return windows in which there is a shock, such as a significant invention (e.g. an important drug that trials successfully). Providing systematic evidence on these phenomena will help to distinguish real effects in value-relevance tests from distortions due to research design issues.

For the *brands and advertising* category, the main focus is the *output metrics* which are the more readily available data. Output metrics relate to an important area of value creation, including constructs such as the long-term customer base value and customer retention. There is much less research in the *researcher estimated* assets and *input metrics* areas, presumably because GAAP rules do not require the reporting of brands and advertising. Also, the advertising expenditures might be viewed as proprietary information by managers. In terms of value-relevance metrics, the *stock price levels* studies dominate the *brands and advertising* area and the estimated coefficients on intangibles in these studies are all significant. For the *output metrics* studies, the coefficients on intangibles items tend to be less that the other assets in the tests, but not for the *management reported* brand and advertising assets, which raises the issue for future research of management reporting incentives and/or research design issues.

For the *customer loyalty* category, *output metrics* dominate. The *output metric* coefficients are all significant and the coefficients tend to be larger than those on the other assets in the regression. This is consistent with the importance of customers to a successful business but could also be due to measurement error or omitted variables. Customer loyalty is an area where there is limited financial accounting data. There is a demand for studies that can provide insights into accounting regulators on the types of financial information relating to customer loyalty that are value-relevant. This type of research requires access to what is currently proprietary financial data. Understanding how customer loyalty is generated and destroyed in different industries is a pre-requisite for identifying value-relevant information on customer loyalty.

For the *competitive advantage* category, there is limited research in the *management reported* and *researcher estimated assets* areas. Not all the coefficients are significant for the *management reported assets* link to *financial performance*. The competitive advantage studies are concentrated in the *annual outlay, input* and *output metrics* categories. But the most work is in the *input metrics* area. The competitive advantage studies are dominated by *stock level* and even more so by *financial performance* studies. The coefficients are all significant and tend to be larger than the coefficients for other assets in the regression. This indicates that either the competitive advantage factors are vitally important or there is measurement error or omitted variables. The competitive advantage literature is one area that would benefit from a general theory that defines and articulates the relevant value constructs, value creation processes and empirical measures. Such a framework is needed to increase the logical validity and reliability of the body of evidence and the generalisability of the results.

The *human capital* category of intangibles has no *management reported assets*, reflecting the impact of GAAP. The stock price studies are spread across the remaining four measurement categories, while the financial performance studies are concentrated in the *input metrics* area. The coefficients are always significant for the human capital information. The coefficients tend to be smaller than other assets in the regression for the *stock levels* but not for the *stock returns* and *financial performance* tests. This result suggests human capital levels *and* changes are both important to firms. The inference is that the human capital contribution to value can change in short time periods. Omitted variables are also a possible cause of the

larger coefficients for the returns and financial performance tests. However, this result is consistent with the theory in this area. There are opportunities to design studies that can help accounting regulators to understand what financial data on human capital is value-relevant. Studies of this type would need access to what is currently proprietary data.

The goodwill section is fully concentrated in the *management reported assets*, reflecting GAAP, and in the *stock level* studies for reasons which are not clear. There are thus opportunities to study stock return and financial performance implications of purchased goodwill. In particular, does purchased goodwill contribute to future performance and when? Is the purchased goodwill relation with stock returns and financial performance changing over time and how rapidly? There are new research opportunities in the goodwill area arising from the major change in GAAP from amortisation to an annual impairment test, particularly arising from the evidence so far that the purchased goodwill balance is overstated on average.

4.2. Evidence on the reliability of financial and non-financial information

The studies reviewed in this paper taken together suggest the expenditures on R&D and purchased goodwill are value-relevant but are not reliable indicators of the future benefits from the investments. For R&D, management knows *what* expenditures are bundled into R&D and how these expenditures are expected to create value (refer to the value construct-to-value creation link in Figure 1). However, this information is not reliably reflected in the R&D measure partly because R&D bundles successful and unsuccessful efforts, and also because GAAP R&D bundles different, *undisclosed* types of expenditures that have different links to the generation of future benefits. For purchased goodwill, the link between the goodwill value construct and value creation is weak (see Figure 1). This lack of definition means that the accounting measure of goodwill cannot be reliable (see Figure 1 and Henning et al., 2000, in Section 3.6.2). Hence, the goodwill measure is relevant but varies in its reliability, a conclusion which is borne out by the empirical evidence (see Section 3.6). The evidence reviewed in this paper indicates that there is little point trying to evaluate the value implications of R&D by focusing only on the number of R&D dollars spent. Section 3.1 refers to a range of factors that are relevant for evaluating R&D. To date, Henning et al. (2000) is the only known study to suggest how to empirically evaluate the value-relevant and reliable components of purchased goodwill.

It is difficult to make categorical statements about the reliability of most of the other information items in this paper that researchers have studied. In most cases, differences in value-relevance could be due to differences in relevance, in reliability or differences in both relevance and reliability. What makes it a bit easier to make this judgment for R&D is the triangulation by Healy et al. (2002) and Kothari et al. (2002), using designs that provide an economic benchmark with a *known* value against which the R&D can be evaluated. Further, economic theory indicates that R&D is inherently uncertain, providing a strong *a priori* case for the unreliability of R&D as a predictor of future rents.

Given reliable measurement is important to accounting regulators and those users relying on financial accounting information, designing studies to obtain direct tests of reliability is an important area for future research. One approach is to focus on settings where the value of intangibles is known to be changing and employ stock returns to test for value-relevance. Another area for future research is to identify economic benchmarks other than stock price for the realisability of the expected future benefits from intangibles, and incorporate these benchmarks into the value-relevance tests to provide direct insights on reliability. For example, Healy et al. (2002) simulate a *known* firm value which serves as a value-relevance benchmark. Another example is the Matolcsy and Wyatt (2008) study, which examines the value-relevance of current earnings in the context of three different types of technology conditions that are economic benchmarks for expected growth and property rights effects.

4.3. Research design issues

The studies canvassed in this paper also suggest a range of factors that are potentially omitted variables in value-relevance studies. Further, the financial information links to stock price often vary interactively (and hence non-linearly) with factors such as the firm's resource endowments and strategic choices. In some circumstances, the relation between the information item of interest and stock price is increasing (or decreasing) but at a declining rate, a functional form which may be accommodated by a non-linear function. Non-linearities can arise from life-cycle effects, firm specific effects arising from the specialised nature of each firm's production function, firms reporting losses versus profits, and the differing persistence of earnings components (Das and Lev, 1994; Subramanyam, 1996; Lipe et al., 1998; Call et al., 2007). Thompson et al. (2001), provide an economic justification for using a log-linear form to estimate stock value based on accounting information. These model specification issues can be at least partly addressed if researchers carefully articulate the relevance and reliability links that are

illustrated in Figure 1.

Some empirical measures appear to have a large amount of measurement error (Boyd et al., 2004). Examples include non-financial measures of customer satisfaction, brands and human capital that rely on informal survey data, subjective conceptual frameworks, and potentially imprecise, blunt measures such as the number of employees. Where possible, measuring actual inputs and actual value created is preferable to measuring only the perceptions of these quantities obtained from surveys.

4.4. Trading-off management discretion and regulation

An issue for future research is the costs and benefits of management discretion to voluntarily report intangible assets versus regulation. More financial reporting discretion gives managers the opportunity to report their firm's economic reality. However, agency conflicts can arise between stakeholders and managers. Financial reporting may be overly optimistic or in the worst case scenario, misleading. Further, voluntary reporting without a *standardising reporting framework* for intangibles adversely impacts the interpretability of the resulting information. The adverse effects of *no regulation* is evident from the history of 'intangible capital' reporting which so far has a bewildering range of measures but no conceptual framework or clear purpose(s) of measurement (Hunter et al., 2005). Regulation can have economic consequences if the regulations prevent managers reporting the firm's economic reality (Anderson and Zimmer, 1992). Regulation can provide benefits. For example, there is evidence that investors perceive the regulated stock option compensation reporting is more reliable than the unregulated stock option reporting (Section 3.5.3).

There is evidence from the Australian setting that *management discretion* to report intangible assets is associated with the financial reporting of value-relevant identifiable intangible assets. Acquired and internally generated intangibles (but not basic research) could be reported in the Australian setting until the adoption of IFRS in 2005. The evidence suggests the most discretionary items (the least regulated intangibles) are the most value-relevant, which suggests that discretion is associated with a balance of relevance and reliability (Wyatt, 2005). Wyatt finds that R&D assets and purchased goodwill *are not* value-relevant in this setting, where investors know that managers have discretion to report identifiable intangible assets that are more informative about the source of future benefits.

Contrast these results with the evidence (Section 3.1 and 3.6) that R&D expenditures and purchased goodwill *are* value-relevant in countries where management has limited discretion to report more precise indicators of future benefits. For example, the expected source of benefits from brands and licences relates to market power and the source of expected benefits from patents and trademarks are monopolies over a specific invention or mark. But how will purchased goodwill benefit the acquirer? Would this goodwill be value-relevant if managers had more accounting discretion to report on intangibles?

What if regulators give firms discretion to report intangible assets on the balance sheet constrained only by the definition and recognition criteria for assets and the statutory audit? The Australian experience prior to the IFRS adoption in 2005 suggests that market efficiency might continue as before. In the Australian setting, the recognised intangible assets that are the least regulated are the assets that are associated with the firms' underlying economic reality (Wyatt, 2005); recognised intangible assets are associated with the generation of future earnings (Ritter and Wells, 2005); financial analyst following is higher, and earnings forecast errors are lower for firms that recognise intangible assets and have growth opportunities but not for the extremely high or low growth opportunities firms (Matolcsy and Wyatt, 2007). This evidence does not suggest that discretion to report intangibles seriously impacts market efficiency.

Does the asymmetric treatment of acquired and internally generated intangible assets achieve the desired aim of increasing the reliability of reported intangibles? The international standard, IAS 38 *Intangible Assets* assumes acquired intangibles are the most relevant and reliable measures due to a market transaction. However, the conceptual discussion summarised in Figure 1 suggests relevance and reliability are determined jointly, not by mode of acquisition, but by the level of definition of the value construct and value creation process, and the ability of the accounting measure to reflect expectations about value creation. This conceptualisation (discussed in Section 2.3) and the empirical evidence (Sections 3.1 and 3.6) suggest the acquired goodwill and the internal R&D are not reliable indicators of future benefits. Reliability is important when payoffs are specified in terms of accounting numbers (e.g. the measure of earnings available for distribution to shareholders as dividends). This is one reason for the pervasiveness of accounting conservatism. What, if any, are the economic consequences of recording these unreliable assets? How much discretion do managers have in applying these asymmetric rules? What affects their judgment in implementing the IAS 38 asymmetric standards?

Some studies suggest *recognition* in the financial statements is a more reliable signal compared with the alternative of *disclosing* in the notes to the accounts (e.g. Ahmed et al., 2006). Consistent with

this idea, external auditors appear to permit more misstatement in footnotes compared with recognised amounts (Libby et al., 2006). There are opportunities to exploit the differences in GAAP across countries to obtain insights on the effects of accounting conservatism, and recognition versus disclosure, on the value-relevance of financial information relating to intangibles.

Barth et al. (2003) find that recognition of a highly unreliable accounting amount, rather than disclosure, increases the information in stock price if the recognised amount is *relevant* information. From Figure 1, when information is *relevant* the manner of value creation is reasonably well defined and the lack of reliability relates to the inability of the measure (e.g. R&D asset) to precisely reflect the expected value creation. Their study suggests that because of the imprecision effects of aggregation (e.g. bundling expenditures to obtain an R&D number) that basing recognition decisions on reliability alone is too simplistic. Reliability relative to relevance is the key, not reliability on its own. The evidence reviewed in this paper is consistent with the Barth et al. (2003) findings in the sense that the information on intangibles is value-relevant in spite of the obvious problems with reliable measurement.

4.5. Regulatory implications

The general problem of incomplete information discussed in Section 2 suggests that more information is better even if it is uncertain. Accounting regulators have gone the other way, increasingly moving to prevent firms measuring and reporting internally generated intangible assets. However, even unreliable numbers can be useful signals that (unobservable) assets exist, pointing investors in the direction of additional relevant information sources. For example, a patent measured and recorded at £1 on the balance sheet is informative if it signals the existence of a patent for which detailed information is publicly available to anyone who cares to search the public patent office online databases.

One gap in financial reporting that is evident from the review in this paper is the reporting of separate line items of expenditures on intangibles in the income statement. The review suggests there are deficiencies in reporting labour expenditures, advertising and marketing, the components of R&D, and expenditures relating to the generation of customer loyalty, IP, and competitive advantage. If all companies were required to disclose broad categories of expenditures on intangibles (more comprehensively than the narrow R&D series), this might level the playing field and alleviate the risk of unilateral information spillovers.

Financial accounting is only one source of information about intangibles. This paper highlights a range of other non-financial sources of information that are value-relevant. This evidence is consistent with Whisenant (1998), who provides evidence that value-relevance is not solely a function of GAAP. Instead, investors use financial statement analysis techniques and recognised data in the annual report, including the notes to the accounts, to adjust the financial statement information before using it in their valuation models. Investors do not expect financial information to stand alone. A question for future research is to what extent the gaps in the financial reporting on intangibles are already addressed by non-financial sources of information.

Finally, an implication of the evidence reviewed in this paper is that accounting regulators might better facilitate value-relevant disclosures on intangibles if they give discretion to management to report their firm's economic reality (as in the Australian experience). To be interpretable, accounting standards are needed as guidance for managers. To be relevant, the standards need to be benchmarked to the economics of the intangible investments so that compliance means the firms report in accordance with their firm's economics (e.g. the technical feasibility test in SFAS No. 86 *Accounting for the Costs of Computer Software to Be Sold, Leased, or Otherwise Marketed*). Research that identifies which of the firms' expenditures create value, and how, is important for assisting regulators to promulgate economically relevant accounting standards.

Regulators can efficiently oversee the exercise of management's financial reporting discretion using an electronic financial reporting surveillance. An example of a reportedly effective system suggested by Bayley and Taylor (2007) uses fairly simple financial statement analysis techniques that pinpoint firms engaged in the management of GAAP financial statements outside an acceptable bound.

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Appendix

Table 1
Summary of studies with significant findings

Intangibles/ intangible metric	*Value-relevance measure*														
	Stock price levels					*Stock returns*					*Financial performance*				
	Sig.	*Other assets*	*I.A.< O.A.*	*Non-sig.*	*Totals*	*Sig.*	*Other assets*	*I.A.< O.A.*	*Non-sig.*	*Totals*	*Sig.*	*Other assets*	*I.A.< O.A.*	*Non-sig.*	*Totals*
R&D and IP															
Mgt. reported assets	3	2	1	0	3	2	2	2	1	3	1	1	0	0	1
Researcher estimated assets	1	0	0	0	1	3	2	0	0	3	2	1	0	0	2
Annual R&D outlay	5	4	1	0	5	0	0	0	0	0	2	2	0	1	3
Input metrics (e.g. # scientists)	2	2	1	0	2	0	0	0	0	0	0	0	0	0	0
Output metrics (e.g. # patents, citations)	7	5	2	0	7	1	1	1	0	1	2	2	0	0	2
Subtotal	**18**	**13**	**5**	**0**	**18**	**6**	**5**	**3**	**1**	**7**	**7**	**6**	**0**	**1**	**8**
Brands and advertising															
Mgt. reported assets	1	1	0	0	1	0	0	0	0	0	1	1	0	0	1
Researcher estimated assets	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Annual advt. outlay	0	0	0	0	0	0	0	0	0	0	3	0	0	0	3
Input metrics	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Output metrics (e.g. customer rankings)	2	2	2	0	2	1	0	0	0	1	0	0	0	0	0
Subtotal	**3**	**3**	**2**	**0**	**3**	**1**	**0**	**0**	**0**	**1**	**4**	**1**	**0**	**0**	**4**
Customer loyalty															
Mgt. reported assets	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Researcher estimated assets	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1
Annual outlay	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Input metrics	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1
Output metrics	1	1	0	0	1	2	1	0	0	2	2	0	0	0	2
Subtotal	**1**	**1**	**0**	**0**	**1**	**2**	**1**	**0**	**0**	**2**	**4**	**0**	**0**	**0**	**4**

Table 1
Summary of studies with significant findings *(continued)*

Intangibles/ intangible metric	*Value-relevance measure*														
	Stock price levels					*Stock returns*					*Financial performance*				
	Sig.	*Other assets*	*I.A.< O.A.*	*Non-sig.*	*Totals*	*Sig.*	*Other assets*	*I.A.< O.A.*	*Non-sig.*	*Totals*	*Sig.*	*Other assets*	*I.A.< O.A.*	*Non-sig.*	*Totals*
Competitive advantage															
Mgt. reported assets	1	0	0	0	1	0	0	0	0	0	1	0	0	1	2
Researcher estimated assets	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0
Annual outlay	2	2	0	0	2	0	0	0	0	0	4	2	0	0	4
Input metrics (e.g. industry)	2	2	1	0	2	0	0	0	0	0	3	2	0	0	3
Output metrics (e.g. market share)	2	2	1	0	2	1	0	0	0	1	3	1	0	0	3
Subtotal	**7**	**6**	**2**	**0**	**7**	**2**	**0**	**0**	**0**	**2**	**11**	**5**	**0**	**1**	**12**
Human capital (including management quality)															
Mgt. reported assets	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Researcher estimated assets	2	2	1	0	2	1	0	0	0	1	2	2	0	0	2
Annual outlay	1	1	1	0	1	1	0	0	0	1	0	0	0	0	0
Input metrics	1	1	1	0	1	0	0	0	0	0	4	1	0	0	4
Output metrics	1	1	1	0	1	2	1	0	0	2	0	0	0	0	0
Subtotal	**5**	**5**	**4**	**0**	**5**	**4**	**1**	**0**	**0**	**4**	**6**	**3**	**0**	**0**	**6**
Goodwill															
Mgt. reported assets	8	6	3	0	8	2	1	0	0	2	1	0	0	0	1
Researcher estimated assets	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Annual outlay, input and output metrics	0	0	0	0	0	0	0	0	0	0	1	1	0	0	1
Subtotal	**8**	**6**	**3**	**0**	**8**	**2**	**1**	**0**	**0**	**2**	**2**	**1**	**0**	**0**	**2**
Totals	**42**	**34**	**16**	**0**	**42**	**17**	**8**	**3**	**1**	**18**	**34**	**16**	**0**	**2**	**36**

Glossary

Sig.	Significant coefficients on the intangible asset measures or metrics
Other assets	Value of 1 if other assets are included in the regression, and zero otherwise
I.A. < O.I.A.	The value of coefficient for intangible assets is less than the coefficient for other intangible assets
I.A. < O.A.	The value of coefficient for intangible assets is less than the coefficient for other assets
Non-sig.	No significant coefficients on the intangible asset measures/metrics