

# Equity Investing in the Age of Intangibles<sup>1</sup>

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Several recent papers [Arnott, Campbell, Kalesnik & Linnainmaa (2020), Amenc, Goltz & Luyten (2020), and Lev & Srivastava (2019)] have investigated the impact of the increase in relative importance of intangible assets compared to physical assets on US value strategies. They adjust book to price (B/P) ratios to account for the biases caused by unrecorded intangible capital but concur that the decline in the effectiveness of valuation-based investment strategies in the US cannot be attributed to the structural economic changes generated by intangibles or the failure of accounting standards to adapt to those changes. Li (2020) has extended their work to a few other countries, including UK, Japan, Continental Europe and Asia ex-Japan.

Our paper does not predict whether or when the performance of US value strategies will recover, advocate the use of one or more preferred value measures, or recommend adjustment of valuation ratios to compensate for omitted intangibles in the quest for higher stock returns. Instead, it offers a way to adapt traditional equity investment analysis to handle the effect of variations in intangible intensity across firms and industries and extends the US research on this topic to the world's fourteen largest international economies, including eight of the developed markets studied by Li (2020), and six emerging markets. It shows that the relationship between financial variables and contemporaneous stock prices has weakened so much for high intangible intensity companies in both the US and abroad that investors can no longer afford to ignore the changes in the economic environment created by intangibles.

Global accounting standards require companies to expense, rather than capitalize the amounts spent on activities that create intangible capital. This results in a systematic and persistent understatement of the book value of equity. Some of the other value metrics such as earnings to

price (E/P) and cash flow to price (CF/P) that can be used to identify value stocks are also affected by accounting distortions. This is because costs incurred for creation of intangible capital are expensed immediately, whereas the corresponding revenues/cash inflows that they generate typically occur over one or more future periods, resulting in a mismatch<sup>2</sup> between expenses and revenues on income statements. For example, Lev and Sougiannis (1996) show that in the Chemicals and Pharmaceuticals industry, an initial outlay on research and development that is immediately expensed can beneficially impact revenues and earnings for up to nine years. Moreover, capitalized intangible assets also affect reported earnings over long periods as they are gradually amortized (expensed), though amortization practices vary by intangible type and by industry and country. Among our sample of international firms used in this paper, the proportion of capitalized intangible assets (excluding goodwill) relative to total assets increased from 0.2% to 2.2%, while for US firms it rose from 2.75% to 6.12% between 1992 to 2018, presumably with a corresponding impact on intangible amortization expense.

Arnott et al. and Amenc et al. show that adjustments to book value to account for the effect of intangibles do improve the return prediction ability of B/P ratios for US companies and Li confirms the same is true for companies in several international markets. Nevertheless, Arnott et al. concede “...*this improved measure of value has also recently suffered a large drawdown, and post-2007 is still not as good as S/P or E/P. Perhaps intangibles-adjusted B/P is still missing something important.*” They also suggest... “*It will be an interesting topic for future research to gauge which metrics perform best in producing a better HML value factor or in predicting future corporate profits, and whether optimal settings for these metrics vary by industry, sector, or*

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<sup>2</sup> The mismatching may be more acute for business entities that are in early stages of their life cycle, when spending on activities that create intangible assets (e.g. research & development or customer acquisition) is high.

*country.*” We complement their work in these areas by exploring other measures of value and the variation in those measures across industries and countries. We propose a composite measure of intangible intensity that captures the inter-industry variation in the financial statement impact of three types of intangible capital: intangible assets reported on the balance sheet (excluding goodwill), innovation capital, and organization capital. Using this composite to classify industries into high and low intangible intensity groups we analyze the contemporaneous relationship between (a) stock prices and (b) book values and earnings within each intangible intensity group, for both US and international companies.

We find that within the high intangible intensity group, the combined value relevance of book value and earnings has declined for both US and international companies. In contrast the value relevance of these variables for the low intangible intensity group has remained stable in the US and increased internationally over the same period. We show that the divergence in the value-relevance of book value and earnings between the high and low intangible intensity groups is greater for international companies, and it has increased more in international markets. Our results are especially important for international equity investors seeking to build investment strategies that account for the impact of intangible intensity on valuation ratios and other financial metrics used to assess the profitability, quality, growth, and risk characteristics of firms.

## 1. Motivation

Intangibles and their inadequate accounting can affect value, as well as other known risk factors such as asset growth or debt-equity ratios, and via their impact on reported earnings, profitability characteristics such as return on equity as well. The adjustments to B/P ratios suggested by

Arnott et al., Amenc et al. and Li provide no information on this issue. Our broader examination of whether the rise of intangibles has influenced the relationship between fundamental financial variables such as book value and earnings and contemporaneous stock prices can provide additional insights to investors on these aspects. Thus, our research is motivated by both the potential effect of intangibles on equity valuation ratios that link book values and earnings to the intrinsic value of companies via the Ohlson (1995) residual income valuation model, as well as the possible effect of intangibles on other investment metrics of importance to equity investors.

Prior US research evidence on how investments in intangible capital impact the value relevance of book value and earnings is inconclusive. Lev & Gu (2016) show that correlations between contemporaneous stock prices and both book value and earnings have dropped due to increasing investments in intangible capital. However, Barth, Li, and McClure (2018) argue that while the value relevance of certain items such as net income has declined, the aggregate value relevance of the “accounting amounts” they examined<sup>3</sup> has remained unchanged from 1962-2014. Collins, Maydew & Weiss (1997) conclude that the combined value relevance of earnings and book value of intangible intensive firms in the US did not decline over the 1953-1993 period, while Ciftci, Darrough, & Mashruwala (2014) infer the opposite from their analysis of a similar set of firms between 1975-2007. Core, Guay, & Buskirk (2003) examine the same issue over the 1975-1999 period for a broad sample of firms and for subsamples they consider to be emblematic of the “New Economy”. They find that the explanatory power of their model deteriorated in the New Economy subperiod (1995-1999) for all types of firms. These conflicting findings from prior

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<sup>3</sup> In addition to net income and book value, accounting amounts in their study included cash flow from operations, cash, total assets, intangible assets, sales, sales growth, R&D expenses, advertising expense, cost of goods sold, capital expenditures, other comprehensive income, and special items.

research indicate that the magnitude and direction of the influence of intangibles on the value relevance of book value and earnings is unclear and it is possible that in the US, the correlation between stock prices and these two financial variables may have fluctuated over time.

International evidence about the impact of intangible intensity on the value relevance of book value and earnings has been extremely scarce and generally limited to two specific countries: UK and Australia. Silva (2012) showed that in the UK, book value is a better share price predictor for low intangible-intensive industries while earnings have greater efficacy in high intangible-intensive industries. Goodwin and Ahmed (2006) found that during the pre-AIFRS period when both expensing and capitalization of intangibles was permitted, the value relevance of earnings for Australian firms decreased but the decline was less pronounced for firms which recognized intangible assets (“capitalizers”). A significantly higher proportion of the capitalizers belonged to intangible-intensive industries. Fraser, Tarbert and Tee (2009) demonstrated that in the UK, the share price reaction to disclosures of interim reports, preliminary earnings reports, and annual reports to shareholders was less significant in sectors where the investment in intangible assets was relatively high, indicating lower value relevance of financial variables for intangible intensive firms.

Thus, the conclusions of past research on the value relevance of book value and earnings in US markets are mixed and do not extend beyond 2012. We use evidence from more recent time periods to re-examine this issue and assess if changes in the value-relevance of book value and earnings due to the increase in intangible intensity of companies observed in the US also extend to international markets.

Past (univariate) approaches focusing on specific types of uncapitalized expenditures that create intangible capital do not permit measurement of the aggregate effects of corporate spending on different types of intangible capital<sup>4</sup> and evaluation of inter-industry differences arising from the combined influence of such spending on valuation ratios or other investment metrics. Some researchers [e.g. Israel, Laursen and Richardson (2020)] recommend intra-industry valuation of companies to account for differences in the types and amounts of intangible capital on equity valuation across industries. Our composite intangible intensity measure offers investors an alternative way to capture the financial statement effects of variations in intangible capital across industries and compare their differential effects. We demonstrate that our intangible intensity measure is consistent over time and across the US and international investment universes in its ability to do so.

Research on this topic also faces indeterminate data hurdles. Arnott et al. use firm-level estimates of intangible capital provided to them by Peters and Taylor (2017) to adjust the book values of US companies. Amenc et al. make similar adjustments themselves using long histories of financial data and certain specific data items (e.g. the US Bureau of Economic Analysis's industry-specific R&D depreciation rates, the year of companies' founding etc.). Due to limited international research on this subject it is unclear if enough breadth and history of fundamental and macroeconomic data is available to permit making such adjustments in all or most international markets.<sup>5</sup> Using financial statement and market data from both developed and

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<sup>4</sup> Intangible capital items can include computerized information, innovation (including both scientific R&D & nonscientific discovery and development [Corrado, Hulten, and Sichel (2005)]), human resources [Pantazis and Park (2009)], organizational competencies [Lev and Radhakrishnan (2005)], customer franchise [Bonacchi, Kolev, and Lev (2015)] and brand values [Barth, Clement, Foster, and Kasznik (1998)].

<sup>5</sup> Li (2020) makes similar arguments and shows that at least in developed international markets, book value can be successfully adjusted without relying on the complex procedures suggested by Peters and Taylor.

emerging international markets, we demonstrate that it is feasible to build the intangible intensity metrics that we propose, and these metrics are robust enough for use in financial statement analysis and stock valuation of both US and international companies.

## 2. Intangible Intensity Metrics

Our composite measure of intangible intensity is constructed from three components: (1) Total Intangible Assets reported on the balance sheet, excluding goodwill (2) Research & Development (R&D) Expenses, and (3) Sales, General, & Administrative (SG&A) Expenses. We discuss the reasons for the choice of these three components of intangible intensity and their measurement procedure below. We use our composite measure to determine the intangible intensity of firms in all industries, except Banks, Insurance and Diversified Financials, in both the US and abroad. We exclude these three industries from our analysis because the three metrics we use to gauge intangible intensity are impacted by the atypical financial reporting practices of these industries.<sup>6</sup> For example, due to the nature of their business, banks bundle and report several types of operating expenses in the category of Sales, General & Administrative Expenses, and globally, almost no banks or insurance companies disclose R&D expenses.

### Identifiable Intangible Assets

We refer to a company's total capitalized intangible assets except goodwill, as *identifiable* intangible assets. In theory, any intangible assets reported on the balance sheet are already included in book value. Even so, we include them as a separate component in our composite

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<sup>6</sup> We note that of the 236,008 (411,330) firm-year observations in our US (international) sample for which ubiquitous financial statement items such as Total Assets were available in the Xpressfeed database, 63,602(46,160) firm-year observations were for companies in the Banks, Diversified Financials and Insurance industries.



intangible intensity measure for three reasons. First, accounting criteria for capitalization of expenditures that can create intangible capital are inconsistent. For example, in the US the cost of internally developed patents is required to be written off (i.e., expensed on the income statement), but if the ownership of those unrecorded patents is subsequently transferred due to a corporate acquisition or merger, they must be capitalized on the balance sheet of the acquirer at their fair value. Therefore, ignoring capitalized intangible assets could understate the aggregate level of intangible intensity for companies that have grown through acquisitions rather than organically. At the collective level, industries that have gone through periods of consolidation would appear to be less intangible intensive. Second, we aim to compare the effects of intangible intensity on the value relevance of financial variables in the US and international markets. Hence cross-country differences in accounting standards that govern the choice of expensing versus capitalizing expenditures incurred to create intangible assets and any change in those standards over time can lead to similar problems. For example, some researchers have found changes in the value relevance of capitalized intangible assets pre and post IFRS, and across subsamples of companies that made different financial reporting choices in regimes where both expensing and capitalization were permitted.<sup>7</sup> Third, research evidence from around the globe demonstrates that several types of intangible expenditures that were capitalized and reported on the balance sheet were value relevant, both in aggregate and individually. Relevant papers include Oliveira, Rodrigues and Craig's (2010) examination of Portuguese firms, studies by Ritter & Wells (2006) and Dahmash, Durand & Watson (2009) on companies in Australia, and Lev and Aboody (1998)

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<sup>7</sup> In the pre-IFRS reporting regime, certain countries (including Australia, UK and France) permitted both expensing and capitalization of research and development expenditures. Oswald, Simpson, and Zarowin (2017) found differences in (a) the value relevance of the capitalized versus expensed development costs in the pre-IFRS regime and (b) changes in value relevance of R&D expenditures before and after IFRS adoption for UK firms that switched from expensing to capitalization. Jaafar (2011) shows that the adoption of AIFRS (Australian-equivalent IFRS) led to an increase in the value relevance of identifiable intangible assets.

who evaluated the equity market effect of capitalized software development costs in the US. For these reasons, we include capitalized identifiable intangible assets in our intangible intensity composite.

We exclude goodwill from our measurement of the capitalized intangible assets for two reasons. First, our primary objective is to examine the stock market effects of various forms of intangible capital investments that have gained in importance due to the rapid transformation in corporate investment and business models during the past few decades; in contrast, goodwill is an accounting by-product of business combinations. Second, prior evidence regarding the value relevance of goodwill is mixed. Findings vary not only across the US and international equity markets but also for different time periods within the same market due to differences in goodwill writeoff rules that have led to subjective assessments of the impairment in the fair value of goodwill. Managerial discretion in applying goodwill valuation rules has further exacerbated the problems that affect accurate measurement of goodwill [Dahmash, Durand and Watson (2009)].

#### Research & Development Expenses

US accounting standards require the cost of both research and development (R&D) to be expensed but IFRS is a bit less restrictive, allowing the capitalization of development costs if certain criteria are met. In-process R&D (consisting of R&D assets acquired in business combinations or asset acquisition transactions) can also be capitalized. We capture the effect of in-process R&D on financial statements in our first intangible capital metric, identifiable intangible assets, discussed above. Although US accounting rules that require R&D costs to be expensed have remained consistent since 1974, international accounting guidance on this subject

exhibits considerable variation and has continued to evolve<sup>8</sup>, with different countries edging into greater conformity with the US at an uneven pace as they move to IFRS. Both international and US research evidence indicates that research and development expenditures create intangible innovation capital that is reflected in equity market values. This includes Ahmed and Falk (2006) who examined Australian companies, a study of firms in France, Germany, UK and the US by Zhao (2002) and Smith, Percy and Richardson's (2001) findings from the Australian and Canadian markets. Lev and Sougiannis (1999) estimated the R&D capital of a sample of more than 800 US manufacturing companies, of which about half belonged to five highly intangible intensive industries (Chemicals & Pharmaceuticals, Machinery & Computer Hardware, Electrical & Electronics, Transportation Vehicles, and Scientific Instruments). They demonstrated that adjusting earnings and book values of firms for the capitalized value of R&D makes those variables more value relevant.

#### Sales, General & Administrative Expenses

Lev and Radhakrishnan (2005) have described organization capital as the set of “unique systems and processes employed in the investment, production, and sales activities of the enterprise, along with the incentives and compensation systems governing its human resources.” They used annual sales, general and administrative (SG&A) expenses reported in income statements to estimate changes in companies' organization capital and showed that such changes explain differences between the market and book value of equity of US firms. Eisfeldt and Papanikolaou (2013) used SG&A expenses to estimate the stock of organization capital for a sample of U.S.

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<sup>8</sup> For example, Lee and Lee (2020) state that in South Korea, R&D expenditures were classified as either ordinary or extraordinary prior to 1999, depending on the characteristics of the activities; R&D expenditures that occurred in the ordinary course of business were expensed while those not meeting this criterion were capitalized.

firms and concluded that firms with a greater ratio of organization capital to book assets exhibit higher annual average market returns. Using an industry-relative measure of SG&A expenses, Angelopoulos, Giamouridis, and Vlismas (2012) show that intangible organization capital is helpful in prediction of stock returns for US companies. However, comparable results for international companies are very sparse. Tronconi and Marzetti (2011) report a positive link between an SG&A-based measure of organization capital and certain financial performance metrics for European companies. Since the validity of SG&A expenses as a proxy for intangible organization capital has been confirmed by multiple studies, we use the same approach.

We note that Arnott et al. (2020) and Amenc et al. (2020) consider only 30% of the total SG&A expenses reported on income statements to be a capitalizable intangible asset. Our research is unaffected by this design choice because we use SG&A expenses to rank and classify companies according to their organization capital instead of attempting to assess its value relevance or adjust book values by the amount of unrecorded organization capital.

#### Other Types of Intangible Capital

Two other financial statement items, advertising expenses and labor costs, have also been posited to create intangible capital. Advertising expenses are considered to be a gauge of intangible brand capital, and labor costs are regarded as an indicator of intangible human capital. We do not include these in our composite measure of intangible capital for the reasons discussed below.

Both US and international evidence corroborating the value relevance of advertising expenditures [e.g. Shah and Akbar (2008), and (Shah, Stark and Akbar (2009) for UK

companies)] is weak.<sup>9</sup> Moreover, Govindrajan, Rajgopal, Srivastava, and Wang (2019) show that in the US, advertising has stayed constant at very low levels compared to expenditures on other forms of intangible capital such as R&D since the 1980s.<sup>10</sup> Finally, advertising expense is a sub-component of sales and marketing expenses, which are included in the aggregate SG&A expenses figure usually reported in income statements. Since we use aggregate SG&A expenses to represent organizational capital in our intangible intensity composite, either sales and marketing expenses, or ideally advertising expense should be excluded from the aggregate SG&A expense figure to avoid “double counting” of advertising expense in the composite. However, most firms do not disclose either of these items separately. Due to lack of convincing evidence about its value relevance and practical difficulties related to its measurement we do not include intangible brand capital in our composite measure of intangible intensity.

Prior evidence supporting the value-relevance of human capital includes Angelopoulos et al., who report that long-short portfolios based on an industry-relative human capital measure provide statistically significant risk adjusted returns for only the first year after portfolio formation, and Pantzalis and Park (2009), who find that arbitrage portfolios based on a market valuation measure of intangible human capital provide excess returns for just small firms. Edmans (2011) considers employee satisfaction to be a type of intangible asset and demonstrates that for a limited number of firms (the “100 Best Companies to Work For in America”), it is positively correlated with shareholder returns. He acknowledges that the firms in his sample are

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<sup>9</sup> Most prior studies on this subject [e.g. Bublitz and Ettredge (1989)] agree that the life of brand value assets created by advertising expenditures is no more than one to two years.

<sup>10</sup> In unreported results, we found that for our sample of US firms, advertising expenditures dropped from about 3.6% to 1.6% of total revenues, while R&D expenditures rose from about 9.5% to over 14% during the 1994-2018 period.

unusually large and exhibit notably better earnings performance and in fact, not all of those firms are publicly traded, which further limits data availability. Moreover, a common theme underlying all studies in this area is that unlike R&D and SG&A expenses that link intuitively to innovation capital and organization capital respectively, investments in human capital are notoriously difficult to measure, prompting researchers to use indirect, output-based estimates. Since investments in intangible human capital assets are difficult to quantify and data to estimate such investment is hard to obtain in all 15 markets studied, we do not include them in our intangible intensity composite, but it remains a topic for future investigation.

### 3. Data and Methodology

Our sample consisted of companies based in countries that were ranked among the top fifteen in the world by their 2018 GDP, according to the World Bank.<sup>11</sup> We obtained the requisite financial and market data for these companies from the Standard & Poor's Xpressfeed database. We used data for fiscal years between 1994-2018 because that database is very sparsely populated in pre-1994 periods, especially for international companies. For each year we included firms that reported the required financial data items (described below) for an annual financial reporting period that ended during that year. For our value relevance tests we used stock price data up to the end of 2019. We retained small and loss-making companies in our sample since prior research [Darrrough and Ye (2007), Collins et al. (1997), Joos and Plesko (2005)] indicates that such companies are often persistently unprofitable entities that tend to invest more heavily in R&D activities which create intangible capital, compared to larger and profitable firms.

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<sup>11</sup> In descending order of GDP, the top fifteen countries in the world are USA, China, Japan, Germany, UK, France, India, Italy, Brazil, Canada, Russia, Republic of Korea, Australia, Spain, and Mexico. See The World Bank 2018 GDP Ranking (2019) for a complete ranking of all countries in the world.

For each company, we computed three metrics of intangible intensity: (1) Total intangibles assets excluding goodwill, relative to total assets (2) Research & Development Expenses relative to Total Revenues, and (3) Sales, General & Administrative Expenses<sup>12</sup> relative to Total Revenues.<sup>13</sup> Figures A1 and A2 in the Appendix present changes in the data availability for these metrics over time in the US and international universes, respectively. As the first of our three intangibility metrics are derived from balance sheet items and the other two from income statement items, the presentation in Figures A1 and A2 is structured accordingly.

Except for some narrowly focused studies in Australia and UK, past research on this topic has primarily examined US companies so our work adds to this literature by reporting on the relative availability of data to construct the abovementioned three metrics of intangible intensity in both the US and fourteen other countries. Table A1 in the Appendix provides some summary information about the availability of such data separately for developed and emerging countries. We note that *on average*, the information required to compute capitalized intangible assets was available for 52% (67%) of the firms in the US (International) universe of firms that reported total assets, and 33% (32%) of all US (International) firms disclosed information about goodwill. SG&A expenses were available for 97% (95%) of US (International) firms, while data on R&D expenses was available for 31% (30%) of US (International) firms that reported total revenues.

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<sup>12</sup> We note that Xpressfeed reports R&D Expenses and SG&A Expenses as separate components of the income statement item Other Operating Expenses. Our three metrics should have non-negative values and their intensity cannot be computed if the scaling variable (Total Assets or Total Revenues) is missing or zero. Such cases (amounting to less than 0.4% of all available firm-year observations) were treated as data errors and excluded from our sample.

<sup>13</sup> Relative rankings for intangible intensity based on measures using alternative variables (total assets or total expenses) to scale R&D expenses and SG&A expenses were similar and are not reported for brevity.

Given our focus on inter-industry differences in intangible intensity, in Figures A3 and A4 we also provide information about the availability of the requisite data items at the industry level for the US and other countries respectively. Most of the previous work on this subject has focused on *specific* types of intangible capital (primarily, innovation capital created by R&D activities), one at a time. A drawback of such univariate approaches is that innovation capital dominates in certain industries such as pharmaceuticals because its existence is widespread and its magnitude is large, but in other industries different types of intangible capital may be more significant and value relevant. Investors who prefer to hold broadly diversified portfolios rather than a narrow selection of companies from specific industries can gain comprehensive insights about the effects of intangible capital investment using our intangible intensity composite to make investment decisions for all types of companies. By aggregating the impact of the main types of intangible capital that the literature has linked to stock prices and returns, the composite enables investors to classify and compare companies belonging to different industries on common ground.<sup>14</sup> We expect that the availability of financial data for computation of each of our three intangible capital metrics will vary by the nature of a company's business, which may in turn depend on its industry membership. Figures A3 and A4 confirm this conjecture.

For every year during our sample period, we compute the median intangible intensity across all firms within each of 21 four-digit GICS industries excluding Banks, Insurance and Diversified Financials, for each of our three intangible intensity metrics. Next, we rank these 21 industries annually according to their median intangible intensity, independently on each of the three

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<sup>14</sup> However, we recognize that this is an imperfect approach. Within the four-digit GICS classifications that we use, intangible intensity can vary at the sub-industry level; for example, within the Utilities sector, wind and solar power utilities are likely to differ from those that rely on fossil fuels and nuclear energy. A more granular industry classification approach can yield additional insights but comes at the expense of reduced industry-level sample sizes.



metrics. Finally, we combine every industry's annual ranks on the three intangible intensity metrics to obtain its equally weighted composite intangible intensity rank for that year.<sup>15</sup> We thus calculate a set of 21 annual composite intangible industry ranks for each of the 25 years in our sample period. We apply this procedure independently to the US and international universes, obtaining two sets of ranks. In Table 1, we present the 25-year average composite intensity rank of each industry for the two investment universes. We use these average composite ranks to classify the ten lower ranked industries into the low intangible intensity category and the remaining eleven higher ranked industries into the high intangible intensity category. The ordering of industries according to their 25-year average composite intangible intensity ranks is remarkably similar across the two universes. Indeed, except for two differences (Energy and Retail), the set of high and low intangible intensity industries in the US and abroad is identical.

To evaluate the consistency of the US and international composite intangible intensity rankings, in Table 2 we calculate and present the Kendall's coefficient of concordance (a W-statistic with a chi-square distribution) for each of the 25 years in our sample and note that for all years, the W-statistics are highly significant.<sup>16</sup> When we divided our 25 year study period into two subsamples: 1994–2006 and 2007–2018, we found similar results across the two subperiods that were also consistent with the full sample results. For investors, the implication of the findings reported in Table 2 is that the composite measure of intangible intensity that we propose in this paper is built upon intangibility metrics that are pervasive. It can be used to classify industries by

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<sup>15</sup> We acknowledge that our assumption that all sources of intangible capital are equally important contributors to intangible intensity is subjective. Our three metrics of intangible capital have different useful lives and they differ in the amount and timing of the cash flows they generate. Accurate measurement of these attributes would enable assignment of more appropriate (unequal) weights to different sources of intangible capital.

<sup>16</sup> We require at least three companies in an industry for estimation of median intangible intensity, and intangible intensity medians for at least two of the three metrics to be available for computation of the composite intangible intensity in any year.

their intangible intensity both in the US and internationally in similar fashion – an important consideration for investors who wish to use it to construct global investment strategies or compare factor performance across investment universes.

In addition to cross-universe consistency, we also evaluate the consistency of the annual intangible intensity ranks across industries over time within each investment universe for each of the three intangible intensity metrics and for the intangible intensity composite. We again rely on Kendall's concordance statistic to compare the relative annual intangible intensity ranks for the 21 industries over our 25-year sample period, with slight exceptions for the intensity of R&D expenses due to lack of sufficient data for certain industries in early years, details about which are provided in Table 3. Regardless, the results in Table 3 show that for each of three types of intangible capital, and for the intangible intensity composite, relative industry ranks have remained very stable over time at statistical levels of confidence exceeding 99%. Since the pace of evolution of intangible intensity among industries and various types of intangible capital varies, this is an important finding. The time series persistence of our composite measure of intangible intensity provides assurance that investment strategies based on the choice or weighting of factors that drive investment returns according to intangible intensity are likely to be stable and replicable.

#### 4. Combined Value Relevance of Book Value and Earnings

We use our composite intangible intensity measure to study the effect of investments in intangible capital on the value relevance of book value and earnings, since these two financial variables are often used to construct valuation ratios as well as other financial metrics that

investors use to evaluate the profitability, quality, growth, and risk characteristics of firms. Prior studies on this issue have defined intangible intensity in an ad hoc manner, typically fixating on intangible innovation capital created by research and development activities and ignoring the identifiable intangible assets reported on the balance sheet. This is because most previous researchers have adopted the following definition of intangible intensity initially proposed by Collins et al. (1997):

*“Note that intangible intensity does not refer to the presence of large amounts of recorded intangibles because the concerns raised in the literature relate more to unrecorded intangibles. Consequently, we define firms as intangible intensive when their production functions likely contain large amounts of unrecorded intangibles. We recognize that any such classification is somewhat ad hoc. We define intangible-intensive as being firms in the two-digit SIC codes 48 (electronic components and accessories), 73 (business services), and 87 (engineering, accounting, R&D and management related services); and three-digit SIC codes 282 (plastics and synthetic materials), 283 (drugs), and 357 (computer and office equipment).”*

However, since the time when the Collins et al. (1997) study was conducted, the relative importance of other types of intangible capital, especially organization capital, has grown and additional intangible intensive industries like Media and Entertainment with new types of intangible capital such as subscriber lists have emerged. Moreover, as Lev and Gu (2018) show, corporate investment in intangible assets has increased so much faster than the investment in tangible assets that since the mid-1990s it has overtaken the latter. As discussed in Section 3, ignoring intangibles already recorded on the balance sheet may lead to a misleading or inconsistent intangible intensity-based classification of industries. Therefore ranking and

classifying industries by intangible intensity based on a broader set of intangible intensity metrics over an investment universe that is more diverse than before is warranted and it may lead to conclusions about inter-industry variations in the combined value relevance of book value and earnings that differ from prior work.

Oddly, the limited *international* research in this area cited above has also relied on the above-quoted Collins et al. (1997) categorization of intangible intensive industries initially conceived for the *US* universe to separate industries into high and low intangible intensity groups. Hence the implications of using our proposed composite intangible intensity measure to study the effects of intangible intensity on the value relevance of book value and earnings in the international universe are unknown and deserve further investigation.

Following previous research, we also use regression analysis to investigate the impact of intangible intensity on the value relevance of earnings and book values. For each investment universe, we regressed contemporaneous share price on net income per share and book value per share for companies in each intangible intensity category based on their industry membership and the industry classification shown in Table 1. For all sample firms, we obtained book values, net income, and the outstanding number of shares for each fiscal year between 1994-2018. We also extracted the month-end share price for the month in which the financial report containing book value and net income became publicly available based on the filing dates for those reports provided by Xpressfeed. To match book value and net income with contemporaneous share prices, we excluded observations for which the month-end date of the share price was more than six months beyond the end of the annual fiscal period covered by the financial report. We

estimated all regressions annually and computed the r-squared values for each regression; higher r-squared values denote greater explanatory power, i.e. more combined value relevance for net income and book value. We hypothesize that (a) if investments in intangible capital impact the value relevance of financial statements of companies in the high intangible intensity group more unfavorably, the combined r-squared of book value and earnings should be lower for that group, and (b) if the adverse effect of intangible capital investment on the value relevance of earnings and book value for high intangible intensity companies has intensified over time, regression r-squared values for the high intangible intensity group should gradually decline, diverging below that for the low intangible intensity group.

The r-squared values obtained from our annual regressions are plotted in Figures 1 and 2 for the US and international universe respectively, and they tend to support our hypothesis, though the inference is weaker for US companies. Overall, our findings are consistent with the results of comparable analyses conducted by Ciftci et al. (2014) and Core et al. (2003) for US companies. First, from Figures 1 and 2 we detect a declining linear trend for the value relevance of earnings and book values among companies in the high intangible intensity group in both the US and international universes over the full sample period. Second, we note a sharp drop in the value relevance of these financial variables for both intangible intensity groups during the 1995-1999 “New Economy” period in both investment universes.<sup>17</sup> Thus our more objective and comprehensive methodology for classifying industries into low or high intangible intensity categories leads to conclusions that are comparable to those from previous research for

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<sup>17</sup> According to Core et al. this period was marked by several unusual economic developments, including large stock market returns, high valuations, and increased productivity driven by the declining price of computing power, and investments in information technology & modern manufacturing facilities that benefit from information technology.

companies in the US. We believe that our paper is the first to document that similar relationships between intangible intensity and the value relevance of earnings and book values also exist for international companies.

Nevertheless, we also note some differences in results from analogous past research on US companies. Figure 1 indicates that the value-relevance of book value and earnings for companies in the low intangible intensity group has increased from 2009 onwards; this relatively recent period was not included in the Ciftci et al. and Core et al. studies. For companies in the high intangible intensity group, a similar upswing is visible beginning in 2014.

To evaluate the statistical significance of the change in r-squared values over time, we conducted two types of tests. First, to determine the trend of annual r-squared values we computed the Theil-Sen slope<sup>18</sup> of each of the four sets of 25 r-squared values (i.e. for the two intangible intensity groups in each investment universe), and the related z-statistic for each slope estimate. These are reported in Table 4. For the US universe, the trend is strongly negative and statistically significant for the high intangible intensity group and slightly positive but insignificant for the low intangible intensity group. The 95% confidence intervals for the two trend estimates do overlap slightly (see footnote 19). Taken together, these findings imply that in the US, the combined value relevance of book value and earnings has decreased over time for companies in the high intangible intensity group, but this has not occurred for companies in the low intangible intensity group. For the international universe, the z-statistic for the trend of the combined value

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<sup>18</sup>The Theil–Sen estimator [Theil (1950), Sen (1968)] is a non-parametric technique for estimating a linear trend by choosing the median of the slopes of all lines through pairs of points in the sample. This procedure produces a (statistically) efficient estimator which is insensitive to outliers. It can be significantly more accurate than a non-robust simple linear regression (least squares) approach for skewed and heteroskedastic data.

relevance of earnings and book value is negative but statistically insignificant for the high intangible intensity group, but positive and significant for the low intangible intensity group. Further, we note that the 95% confidence intervals for the trend of r-squared values for the high intangible intensity group and the low intangible intensity group do not overlap.<sup>19</sup> The non-overlapping confidence intervals allow us to infer that the difference between the slight downward trend for the high intangible intensity group and the upward trend for low intangible intensity group is statistically meaningful.

R-squared values for the international universe plotted in Figure 2 show a steady decline in the combined value relevance of book values and earnings for the high intangible intensity companies versus a gradual increase in value relevance for low intangible intensity companies beginning 2006. The increasing divergence between the high and low intangible intensity groups for international companies from 2006 onwards may be due to the standardization of accounting policies governing the capitalization of intangibles after the widespread adoption of IFRS in 2005. In the pre-IFRS period, legacy accounting standards in several countries, notably Australia, France, and UK permitted both capitalization and expensing of the costs incurred to create intangible capital assets. Goodwin and Ahmed (2006), and Oswald, Simpson, and Zarowin (2017) provide evidence that in the more permissive pre-IFRS regime, capitalization was informative to investors for companies that were more intangible intensive. IFRS adoption compelled international companies to hew more closely to US accounting provisions, which tend to prohibit capitalization of intangibles. Scaling back the capitalization option may have caused

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<sup>19</sup> For the international universe, the 95% confidence intervals for the high and low intangible intensity groups are (-0.005, 0.004) and (0.005, 0.012) respectively. For the US universe, the 95% confidence intervals for the high and low intangible intensity groups are (-0.011, 0.000) and (-0.002, 0.007) respectively.

the informativeness of book values and earnings to drop after implementation of IFRS, especially for highly intangible intensive international companies. From Figure 1, a clear divergence in value relevance for high and low intangible intensity industries in the US universe is evident after 2008 but the magnitude of the difference between the two groups fluctuates over time. Figures 1 and 2 also highlight the differences between the high and low intangible intensity groups in how the combined value relevance of book value and earnings changed during and immediately after the "New Economy" period. They indicate that for both US and international companies, the value relevance of book values and earnings fell more sharply for high intangible intensity industries during the dotcom bubble years of 1995-1999, but as noted by Core et al. and Ciftci et al., this may have been due to temporary over-optimism about firms that represented the New Economy. Further, for international companies the extraordinary increase in intangible investment in the mid and late 1990s seems to have reversed course in 2000, leading to a correspondingly greater rebound in value relevance for high intangible intensity industries. For US companies that period of excessive optimism seems to have been longer, the decline in value-relevance more gradual and the subsequent rebound more muted, occurring over a shorter period.

To gain assurance that the above empirical findings are not driven by a few industries in either of the two intangible intensity groups, or by systematic inter-industry differences in the relationship between the fundamental financial variables and stock prices, we conducted an additional test.

We regressed the contemporaneous share price on net income per share and book value per share for companies within each of the 21 industries and estimated the time trend of the 25 annual R-squared values for each industry. For each of the two investment universes (US and international), we then calculated the correlation between the 21 industry time trends and the



corresponding 25-year average composite intangible intensities for the 21 industries. We found that for the US (international) universe the correlation between the time trend of R-squared values and composite intangible intensity across all 21 industries, was -0.59 (-0.62). Both these correlations are significant at the 99% level of confidence. They confirm the existence of a strong negative relationship between intangible intensity and the value-relevance of book value and earnings across industries around the world.

In addition to the above analysis of the trend of r-squared values for each intangible intensity group, we employed the methodology in Ciftci et al. (2014) to test for differences in the combined value relevance of book value and earnings between the high and low intangible intensity groups. For each investment universe we estimated the following panel regression of the 25 annual r-squared values for both intangible intensity groups together. We used dummy variables to designate time, intangible intensity, the interaction of time and intangible intensity, and included certain scale control variables that are described below.

$$R_{gt}^2 = a + b_1 TIME + b_2 INT\_D_h + b_3 INT\_D_h * TIME_t + b_4 CV\_P_{gt} + b_5 CV\_BVPS_{gt} + e_{gt}$$

In this regression,

- $R_{gt}^2$  is the r-squared for the regression of share price on earnings & book value for each year (t) & intensity group (g)
- TIME is a variable with values between 1 and 25 depending on the year of the regression
- INT\_D<sub>h</sub> is a variable with value of 1 if the r-squared is for an observation in the high intangible intensity group, otherwise 0

$INT\_D_h * TIME_t$  is equal to value of  $INT\_D_h$  multiplied by TIME

$CV\_P_{gt}$  is the coefficient of variation of share price for each year (t) & intensity group (g)

$CV\_BVPS_{gt}$  is the coefficient of variation of book value per share for each year (t) & intensity group (g)

$e_{gt}$  is the regression error for each year (t) and intensity group (g)

Ciftci et al. and Brown, Lo, and Lys (1999) emphasize that r-squared values are not comparable across regressions conducted on subsamples of firms due to differences in scale. To control for such differences, they recommend that certain additional independent variables be included when combining or comparing regression results for different samples of firms or time periods. In fact, Ciftci et al.'s replication of the Collins et al. study including controls for differences in scale yielded an opposite conclusion about the combined value relevance of book value and earnings. Therefore, we also include the two independent scale control variables in our panel regressions, the coefficient of variation of share price and the coefficient of variation of book value per share, as suggested by Brown et al. However, our results for regressions that did not include the scale control variables were qualitatively similar and are not reported for sake of brevity.

Regression results for both the international and the US universe are reported in Table 5. The coefficient  $b_3$  for the variable  $INT\_D_h * TIME_t$  is of particular interest as it captures the difference in slopes between the low and high intangible intensity groups. For both the international and the US universes, these regression coefficients are negative and statistically significant, at confidence levels exceeding 99% and 93% respectively. This finding indicates that

for both international and US companies, the slope of r-squared values representing the combined efficacy of book value and earnings in explaining contemporaneous share prices, has been dropping over time for the high intangible intensity group relative to the low intangible intensity group.<sup>20</sup> This is visually depicted in Figures 1 and 2 and confirms our previous analysis of the non-parametric trend of r-squared values.<sup>21</sup> Finally, from Figures 1 and 2 we also conclude that the declining linear trend of the (combined) value relevance of book value and earnings for high intangible intensity companies has been slightly greater in the US than internationally. Over the full period of our study, the r-squared of the regression fell by about 30% (from 0.55 to 0.385) for the high intangible intensity group of US companies as opposed to a 22% drop (from 0.75 to 0.585) for the high intangible intensity group of international companies. To our knowledge, the findings we report here for international companies constitute a new contribution to the literature since no past studies have examined how intangible intensity affects the relationship between financial statement variables and stock prices across multiple countries.

## 5. Conclusions

Earnings and book values are of interest to investors because these variables underlie two corresponding valuation ratios, earnings to price and book to price, that form the basis of popular value investing strategies, as well as other types of investment strategies based on the

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<sup>20</sup> We repeated the analyses in Table 4 and Table 5 on a full “global” sample of companies. For this we combined US and international companies in the high intangible intensity groups, added an indicator variable to distinguish whether a particular company belonged to the US or international universe, and ran our primary annual cross-sectional regression of stock price on book value and earnings for this “global” sample of high intangible intensity companies, obtaining 25 r-squared values. We repeated the same procedure for the low intangible intensity companies. The Sen’s slopes (z-statistics) for the high and low intangible intensity groups were -0.00 (0.26) and 0.007 (3.10) respectively and the coefficient (t-statistic) for  $INT\_D_h * TIME_t$  was -0.007 (-3.49).

<sup>21</sup> The coefficient on the TIME variable is positive and significant for both the US and international regressions, indicating that the combined value relevance of earnings and book value has increased for companies in the low intangible intensity group for the time period and sample of firms included in our study.

profitability, quality, growth, and risk characteristics of firms. However, the efficacy of value investing strategies has fallen precipitously in recent years. A possible reason for this shift could be that the volume and variety of corporate expenditures on activities that create intangible capital have increased, albeit unevenly, over time and across different industries but financial reporting standards have failed to keep up with such structural economic changes. Our primary conclusion is that intangible capital intensity is in fact related to changes in the value relevance of earnings and book values, as reflected in the power of these financial variables to explain contemporaneous movements and cross-sectional variation in stock price during the 1994-2019 time period of our study for the firms in our global sample.

To investigate the value relevance of earnings and book values, we propose and validate a composite measure of intangible intensity that captures the financial statement impact of three types of intangible capital: intangible assets reported on the balance sheet (excluding goodwill), innovation capital created by research and development expenditures, and organization capital resulting from sales, general & administrative expenses. We first show that our composite intangible intensity measure is consistent over time and across the US and international investment universes in its ability to rank and classify industries by their intangible intensity. We then analyze the contemporaneous relationship between stock price and the two financial variables of interest, book value per share and net income per share for two subsamples of companies. These subsamples are formed based on the intangible intensity of the industry to which the companies belong. We hypothesize and find a decline in the combined value relevance of earnings and book value of companies in the high intangible intensity group in both the US and the international universe, but not for companies in the low intangible intensity group.

Our approach to this issue differs from Arnott et al. (2020), Amenc et al. (2020) and Li (2020) who attempt to adjust book values for the impact of unaccounted intangible capital and Angelopoulos et al. (2012) who estimate industry-relative intangible intensity for firms within each industry. Though such methods can compensate for biases in valuation metrics that result from inadequate accounting of intangible capital, company level estimates of intangible capital may be volatile and fraught with measurement error. The industry-level methodology for gauging intangible intensity that we use in this paper can mitigate both problems. Moreover, industry level measures of intangible intensity can capture macroeconomic aspects of intangible intensity such as industry concentration [see Crouzet and Eberly (2019)] and product market competition [see Gu (2016)] that industry-relative estimates of the intangible intensity of individual companies are unable to incorporate. Nevertheless, we acknowledge that all these alternatives are imperfect ways to address this important but complex issue.

Our conclusions hold for both US and international companies in the largest fourteen economies of the world. Importantly, our conclusions about the impact of intangible intensity on the value relevance of earnings and book value are stronger for international companies in that the divergence between the low and high intangible intensity groups of industries is greater and has continued to increase over time. For investors who aim to build and use value investing or other types of strategies that rely on book values and earnings, the implication is that such strategies may benefit from taking variations in intangible intensity into account. However, our primary objective in this paper is to measure intangible intensity and establish that it is relevant for investors as a step towards building a robust and consistent investment framework. Therefore we

do not attempt to investigate if value investors can enhance the return prediction ability of their valuation models or whether equity investors (in general) can improve their assessments of the profitability, quality, growth, and risk of firms by accounting for cross-sectional variations in intangible intensity, but leave these issues to future research.

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TABLE 1  
Average Composite Intangible Intensity Ranks

USA		Intangible Intensity	International	
Industry	Average Composite Rank		Industry	Average Composite Rank
Utilities	3.84	Low	Real Estate	4.20
Real Estate	4.13	Low	Transport	4.29
Energy	4.49	Low	Auto	6.13
Transport	4.78	Low	Capital Goods	6.91
Materials	5.89	Low	Utilities	7.04
Food Retail	6.10	Low	Materials	7.07
Auto	7.44	Low	Consumer Durables	7.39
Capital Goods	8.99	Low	Beverage/Food/Tobacco	7.63
Beverage/Food/Tobacco	9.92	Low	Food Retail	8.84
Consumer Durables	10.12	Low	Retail	9.40
Retail	10.81	High	Semiconductors	10.41
Commercial Services	11.45	High	Energy	11.00
Consumer Services	11.51	High	Tech. Hardware/Equipment	11.04
Semiconductors	12.32	High	Commercial Services	11.85
Tech. Hardware/Equipment	13.43	High	Consumer Services	12.04
Household/Personal Goods	14.55	High	Household/Personal Goods	16.47
Health Equipment/Services	16.29	High	Telecom Services	16.67
Telecom Services	16.64	High	Media/Entertainment	16.77
Media/Entertainment	18.56	High	Software	17.64
Software	18.71	High	Health Equipment/Services	17.68
Pharma/Biotech/Life Sciences	19.85	High	Pharma/Biotech/Life Sciences	19.61

Notes:

Twenty-one (4-digit GICS) industries excluding Banks, Diversified Financials, and Insurance are ranked independently in the USA and international universes. For each industry, this table shows the average composite intangible intensity rank, which is computed as the average of 25 annual composite intangible intensity ranks. For each industry, the annual composite intangible intensity rank is the average of its intensity ranks for the following three intangible intensity metrics: (1) Intangible Assets (excluding Goodwill)/Total Assets (2) Research and Development Expenses/Total Revenues, and (3) Sales, General & Administrative Expenses/Total Revenues. For each metric, ranks are annually assigned to industries based on the relative industry median values of that metric.

TABLE 2  
Consistency of USA & International Composite Intangible Intensity Ranks

<b>Year</b>	<b>W statistic</b>	<b>chi-square</b>	<b>p-value</b>
1994	0.86	34.34	0.02
1995	0.82	32.85	0.04
1996	0.79	31.50	0.05
1997	0.80	31.99	0.04
1998	0.85	34.15	0.03
1999	0.88	35.23	0.02
2000	0.93	37.20	0.01
2001	0.90	35.95	0.02
2002	0.90	35.80	0.02
2003	0.90	36.16	0.01
2004	0.92	36.83	0.01
2005	0.94	37.41	0.01
2006	0.92	36.94	0.01
2007	0.90	36.15	0.01
2008	0.94	37.64	0.01
2009	0.94	37.58	0.01
2010	0.94	37.59	0.01
2011	0.94	37.66	0.01
2012	0.96	38.32	0.01
2013	0.93	37.38	0.01
2014	0.97	38.75	0.01
2015	0.94	37.51	0.01
2016	0.97	38.74	0.01
2017	0.95	38.05	0.01
2018	0.97	38.62	0.01

Notes:

For each year, this table shows the consistency of the composite intangible intensity ranks between the USA and international universes for the twenty-one (4-digit GICS) industries shown in Table 1. For each industry, the annual composite intangible intensity rank is the average of the intensity ranks for the following three intangible intensity metrics: (1) Intangible Assets (excluding Goodwill)/Total Assets (2) Research and Development Expenses/Total Revenues, and (3) Sales, General & Administrative Expenses/Total Revenues. For each metric, ranks are annually assigned to industries based on the relative industry median values of that metric. Consistency of the intangible intensity ranks between universes is evaluated based on the Kendall's coefficient of concordance (a W-statistic with a chi-square distribution). The null hypothesis for each year is that the composite intangible



intensity ranks of industries have no correlation across the USA and international universes ( $W = 0$ ). The alternate hypothesis for each year is that the composite intangible intensity ranks of industries are identical across the USA and international universes ( $W = 1$ ). p-values for each year are based on observations for twenty-one (4-digit GICS) industries.

TABLE 3  
Consistency of Intangible Intensity Ranks Over Time

	USA				International			
	Intangible Assets excl. Goodwill	R&D Expenses	Sales, General & Admin. Expenses	Composite	Intangible Assets excl. Goodwill	R&D Expenses	Sales, General & Admin. Expenses	Composite
W statistic	0.88	0.90	0.96	0.94	0.79	0.91	0.92	0.89
chi-square	442.37	406.20	481.84	470.88	394.69	365.63	462.75	443.40
p-value	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Notes:

For each investment universe (USA and International), this table shows the consistency of annual industry ranks for the following three intangible intensity metrics: (1) Intangible Assets (excluding Goodwill)/Total Assets (2) Research and Development Expenses/Total Revenues, and (3) Sales, General & Administrative Expenses/Total Revenues and the consistency of annual composite intangible intensity ranks. For each of the twenty-one (4-digit GICS) industries shown in Table 1, the annual composite intangible intensity rank is the average of the intensity ranks for these three intangible intensity metrics. For each metric, ranks are annually assigned to industries based on the relative industry median values of that metric.

Consistency of the intangible intensity ranks over time is evaluated based on the Kendall's coefficient of concordance (a W-statistic with a chi-square distribution). The null hypothesis is that within each investment universe, industry ranks have no correlation across years ( $W = 0$ ). The alternate hypothesis is that within each investment universe, industry ranks are identical across years ( $W = 1$ ). For both the US and International universes and all intangible intensity metrics except R&D Expenses, p-values are based on 25 annual observations for all industries. For R&D Expenses intensity in the international universe, 24 observations were available for the Consumer Services, Real Estate, and Telecom Services industries, and 19 observations were available for the Food Retail industry. For R&D Expenses intensity in the US universe, 22 observations were available for Food Retail and Transport industries.

TABLE 4  
Trend of R-squared Values from Annual Regressions of Share Price on Book Value per share &  
Net Income per share

	USA		International	
	Low Intangible Intensity	High Intangible Intensity	Low Intangible Intensity	High Intangible Intensity
Sen's Slope	0.003	-0.006	0.007	-0.001
z-statistic	1.10	-1.94*	4.65**	-0.30

Notes:

This table shows the non-parametric estimate of the linear trend (Sen's slope) of the 25 annual r-squared values obtained from the cross-sectional regression of share price on book value per share & net income per share. This slope is the median of the slopes of all lines through pairs of points (i.e. pairs of r-squared values) in the sample. For each of the two investment universes (US and international), the Sen's slope is estimated separately for the high and low intangible intensity groups using the set of r-squared values obtained from annual cross-sectional regressions within each intangible intensity group.

TABLE 5

Trend of R<sup>2</sup> Values from Regression of Share Price on Book Value/share & Net Income/share

	USA		International	
	Coefficient	p-value	Coefficient	p-value
a (intercept)	0.992	0.00	1.661	0.00
TIME	0.006	0.00	0.018	0.00
<i>INT_D<sub>h</sub></i>	0.102	0.00	0.093	0.01
<i>INT_D<sub>h</sub> * TIME<sub>t</sub></i>	-0.004	0.06	-0.014	0.00
<i>CV_P<sub>gt</sub></i>	-0.278	0.03	-0.139	0.72
<i>CV_BVPS<sub>gt</sub></i>	-0.208	0.00	-0.627	0.09

Notes:

This table shows the regressions coefficients and their corresponding p-values from the following cross-sectional regression:

$$R_{gt}^2 = a + b_1TIME + b_2INT\_D_h + b_3INT\_D_h * TIME_t + b_4CV\_P_{gt} + b_5CV\_BVPS_{gt} + e_{gt}$$

where,

- $R_{gt}^2$  is the r-squared from the regression of share price on book value per share and net income per share for each year (t) & intensity group (g)
- TIME is a variable with values between 1 and 25 depending on the year of the regression
- $INT\_D_h$  is a variable with value of 1 if the r-squared is for an observation in the high intangible intensity group, otherwise 0
- $INT\_D_h * TIME_t$  is equal to value of  $INT\_D_h$  multiplied by TIME
- $CV\_P_{gt}$  is the coefficient of variation of share price for each year (t) & intensity group (g)
- $CV\_BVPS_{gt}$  is the coefficient of variation of book value per share for each year (t) & intensity group (g)
- $e_{gt}$  is the regression error for each year (t) and intensity group (g)

Figure 1  
USA

R<sup>2</sup> Values from Annual Regressions of Share Price on Book Value/share and Net Income/share for Low and High Intangible Intensity Groups of Companies

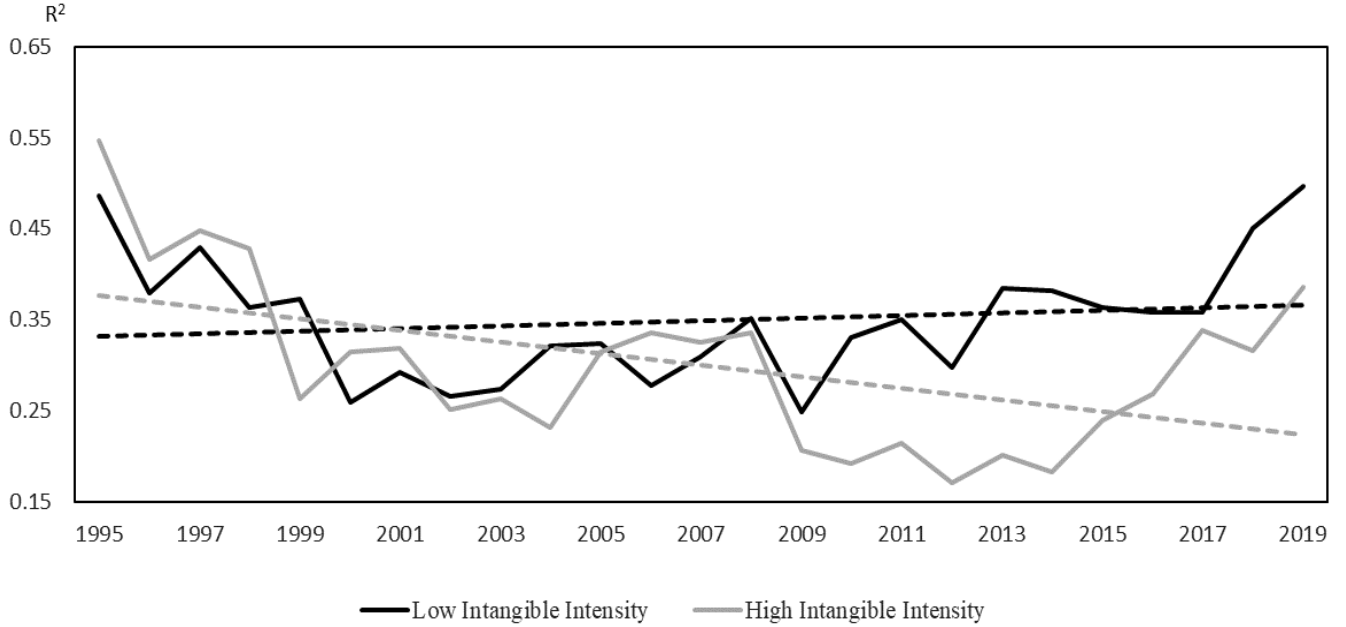
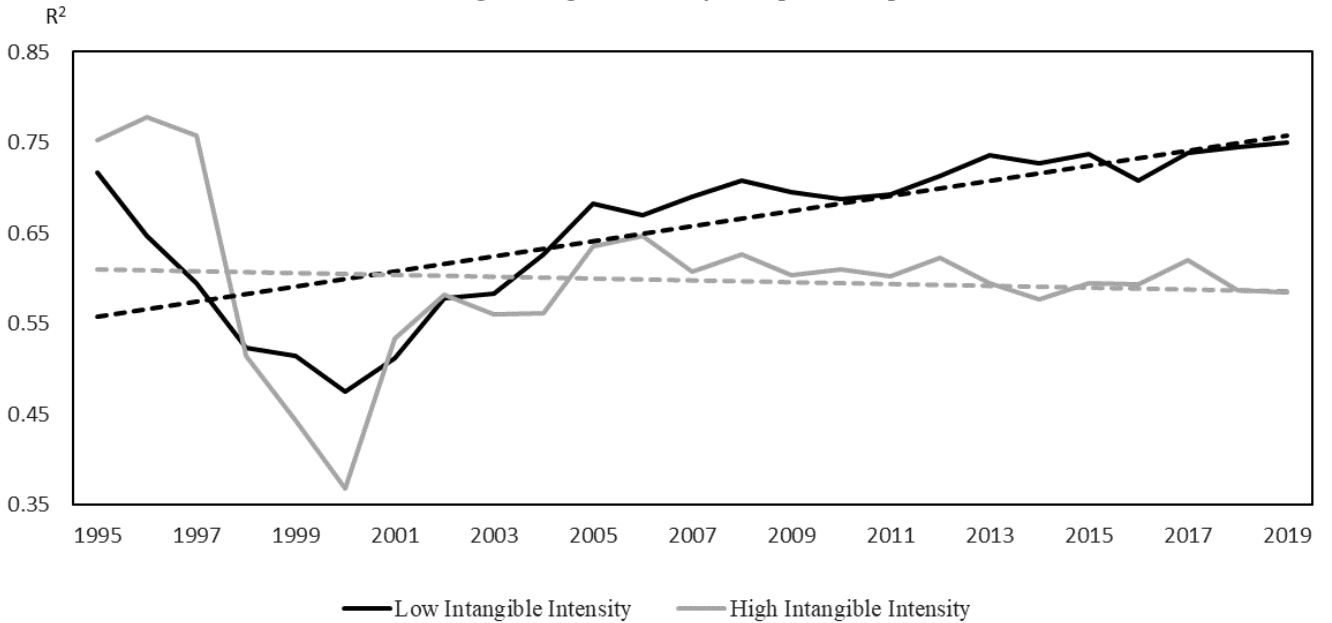


Figure 2  
International

R<sup>2</sup> Values from Annual Regressions of Share Price on Book Value/share and Net Income/share for Low and High Intangible Intensity Groups of Companies



APPENDIX

TABLE A1

Availability of Data Items Required for Computation of Intangible Intensity Metrics by Country  
(Number of firm-years)

	Assets	Total Revenues	Total Intangible Assets	Goodwill	R&D Expense	SG&A Expenses
USA	236,008	245,275	123,180	78,034	76,188	237,294
Developed International Markets						
Australia	34,762	34,862	16,176	9,879	5,377	30,563
Canada	66,162	66,565	20,965	10,814	9,149	63,752
France	15,539	15,578	13,461	11,093	3,400	13,161
Germany	19,225	19,299	15,873	10,318	5,150	17,187
Italy	5,924	5,939	5,377	4,472	1,044	5,214
Japan	78,754	78,806	73,902	22,710	38,347	78,290
Spain	4,210	4,215	3,580	2,316	661	3,848
UK	47,491	47,594	26,504	19,097	8,402	43,837
Total Developed	272,067	272,858	175,838	90,699	71,530	255,852
Emerging International Markets						
Brazil	7,636	7,695	4,437	2,067	875	7,557
China	40,663	40,727	38,612	14,358	19,780	40,585
India	55,537	56,056	25,199	11,037	10,827	54,693
Mexico	2,400	2,419	1,537	1,026	87	2,311
Russia	3,551	3,561	2,624	702	392	3,221
South Korea	29,476	29,514	26,894	11,256	18,475	29,160
Total Emerging	139,263	139,972	99,303	40,446	50,436	137,527
Total International	411,330	412,830	275,141	131,145	121,966	393,379

Notes:

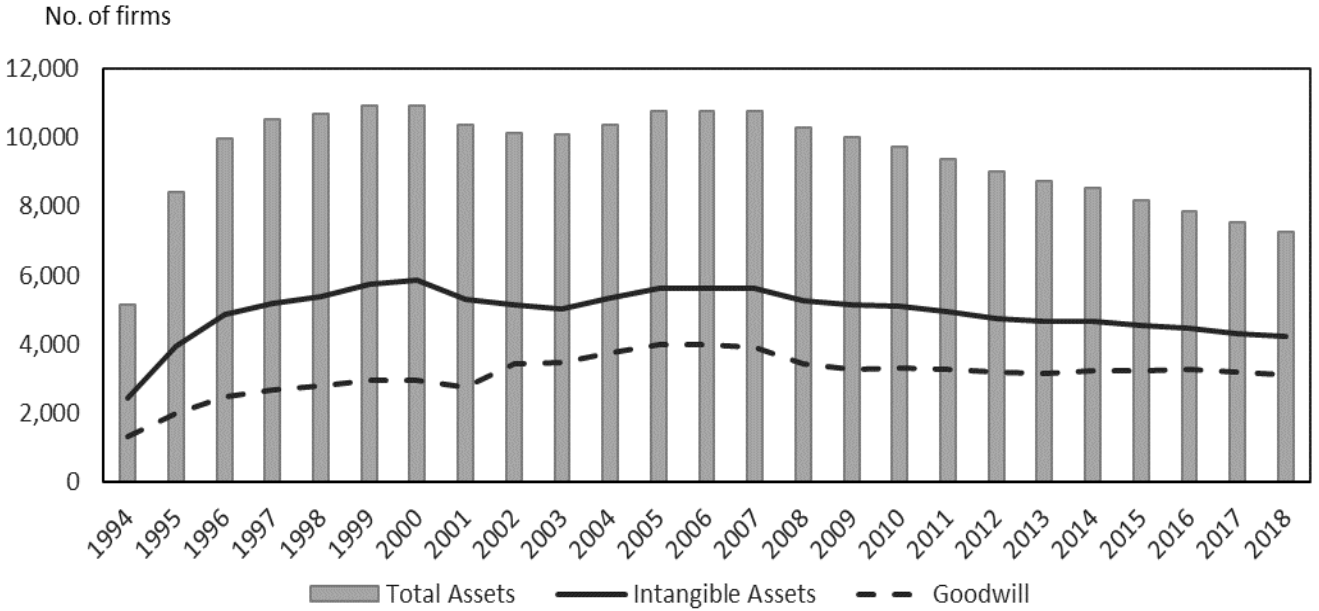
This table shows the number of firm-year observations for which financial statement items required for the computation of three intangible intensity metrics: (1) Intangible Assets (excluding Goodwill)/Total Assets (2) Research and Development Expenses/Total Revenues, and (3) Sales, General & Administrative Expenses/Total Revenues were available. Intangible intensity metrics were computed for each of twenty-one (4-digit GICS) industries excluding

Banks, Diversified Financials, and Insurance. Out of 123,180 (275,141) firm-years in the US (International) universe in which intangible assets were reported, 20,069 (18,905) were for companies in the Banks, Diversified Financials, and Insurance industries. Out of 78,034 (131,145) firm-years in the US (International) universe in which goodwill was reported, 13,102 (10,433) were for companies in the Banks, Diversified Financials, and Insurance industries. Out of 76,188 (121,966) firm-years in the US (International) universe in which research and development expenses were reported, 1,151 (1,499) were for companies in the Banks, Diversified Financials, and Insurance industries. Out of 237,294 (393,379) firm-years in the US (International) universe in which sales, general and administrative expenses were reported, 62,498 (43,226) were for companies in the Banks, Diversified Financials, and Insurance industries.

Figure A1  
USA Firms

Availability of Data Items Required for Computation of Intangible Intensity Metrics by Year

Panel A: Number of Firms for which Balance Sheet Items were Available



Panel B: Number of Firms for which Income Statement Items were Available

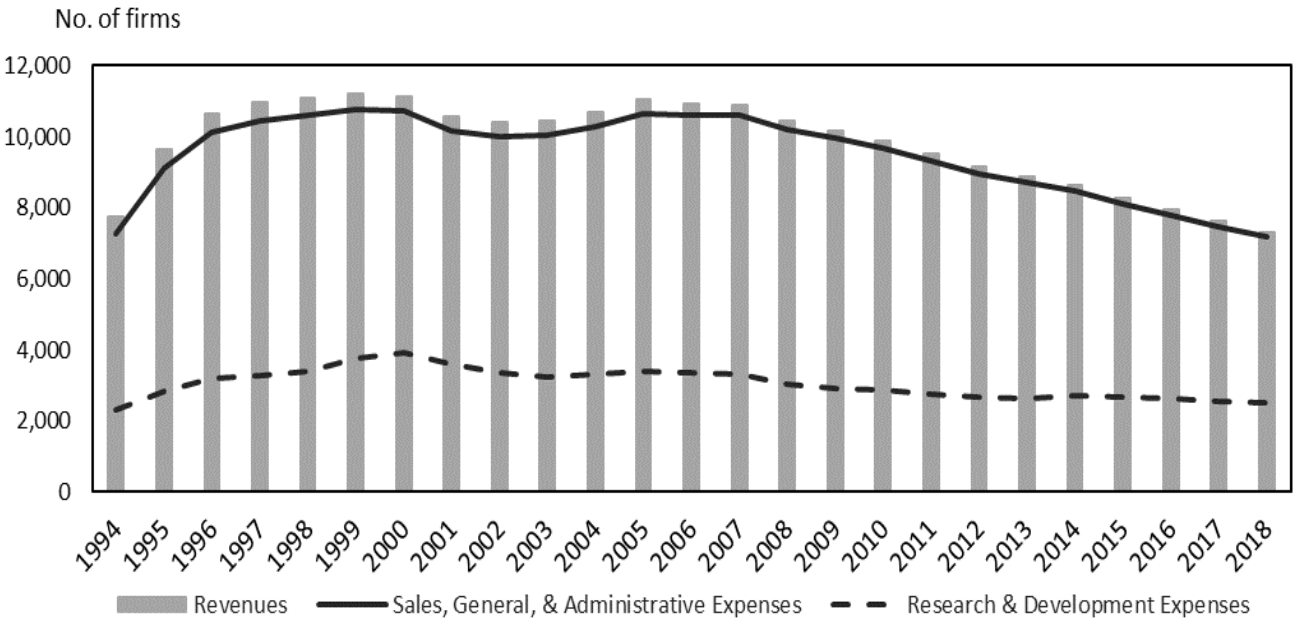
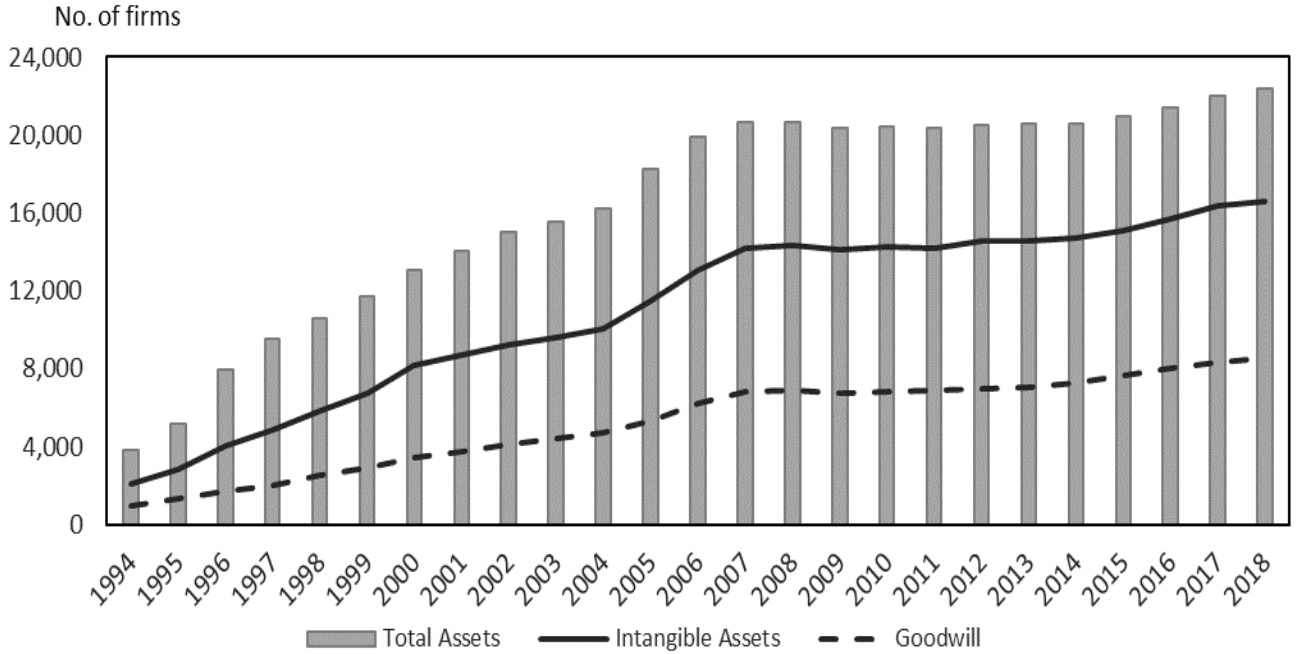




Figure A2  
International Firms  
Availability of Data Items Required for Computation of Intangible Intensity Metrics by Year

Panel A: Number of Firms for which Balance Sheet Items were Available



Panel B: Number of Firms for which Income Statement Items were Available

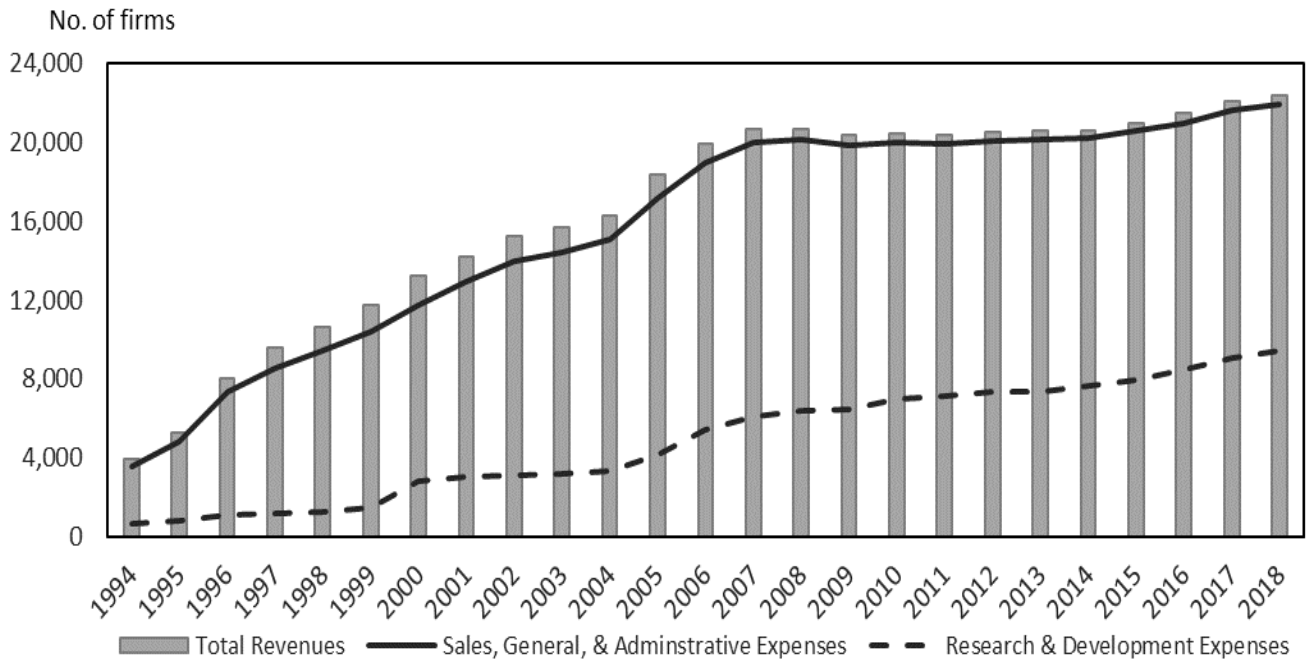
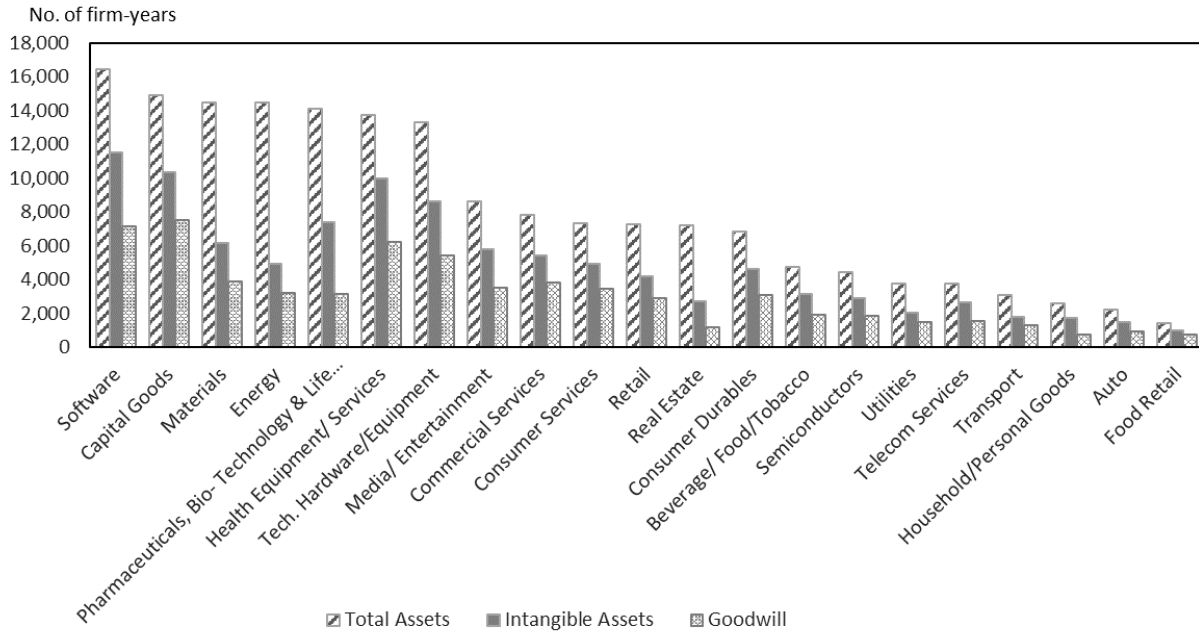


Figure A3

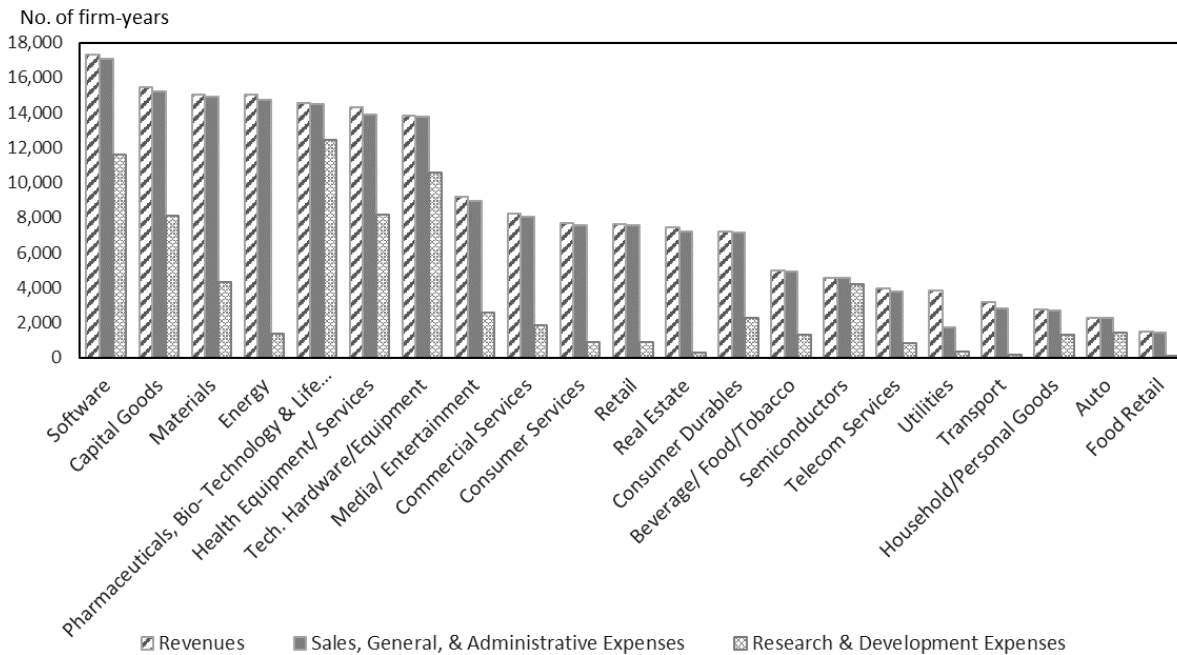
USA Firms

Availability of Data Items Required for Computation of Intangible Intensity Metrics by Industry

Panel A: Number of Firm-Years for which Balance Sheet Items were Available

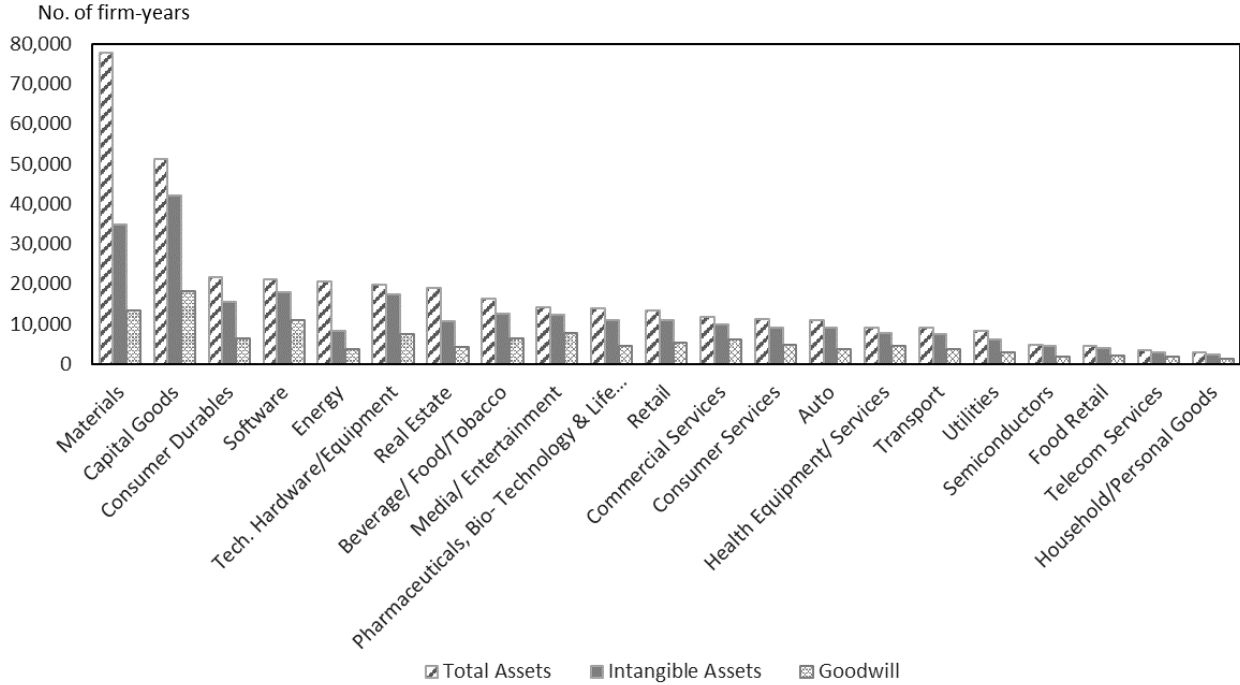


Panel B: Number of Firm-Years for which Income Statement Items were Available



**Figure A4**  
**International Firms**  
**Availability of Data Items Required for Computation of Intangible Intensity Metrics by Industry**

**Panel A: Number of Firm-Years for which Balance Sheet Items were Available**



**Panel B: Number of Firm-Years for which Income Statement Items were Available**

