Value-Relevance of Accounting Information for Intangible-Intensive Industries and the Impact of Scale Factor

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Abstract

Prior research suggests that accounting information is not useful when valuing firms with large amount of intangibles (Amir and Lev (1996)). However, using R^2 from regression of earnings and book values on prices, Collins et al. (1997) (hereafter CMW) find that value-relevance for intangible-intensive industries is as high as not intangible-intensive. An explanation for the discrepancy between Amir and Lev (1996) and CMW is that the high value-relevance for intangible-intensive industries documented by CMW is due to not controlling for the differences in scale (Brown et al. (1999)). Consistent with this explanation, we find that, once we control for scale factor, R^2 is approximately 30% lower for intangible-intensive than not intangible-intensive industries. In addition, we find that the intertemporal decline in value-relevance for all industries documented by Brown et al. (1999) is due to intangible-intensive industries suggesting that intangible-intensive industries are substantially affecting the evolution of characteristics of financial reporting system as a whole.

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I. Introduction

In this paper we investigate the value-relevance of accounting information for intangible-intensive and not intangible-intensive industries. US GAAP does not allow the capitalization of research and development (R&D) expenditures and most of other intangibles, while it allows the capitalization of capital of expenditures.[1] The asymmetric treatment of intangibles has been heavily criticized in prior literature. Amir and Lev (1996) argue that financial accounting information is of limited usefulness to investors when valuing technology and pharmaceutical companies that invest heavily in intangibles. However, CMW find that value-relevance of accounting information for intangible-intensive industries is as high as not intangible-intensive. Similarly, Francis and Schipper (1999) also did not find economically significant difference in value-relevance of accounting information between high-tech and low-tech industries. Consequently, the evidence in CMW is not consistent with the arguments in Amir and Lev (1996). One explanation given by Lev and Zarowin (1999) for this discrepancy is that the expensing of R&D expenditures *on average* should not necessarily lead to lower value-relevance for intangible-intensive industries. They state that if firms in intangible intensive-industries are *on average* in R&D steady state, accounting information *on average* should not be distorted for them.

[1] Lev (2001) R&D is the most important intangibles. Thus, we will primarily focus about the accounting treatment of R&D in our arguments.

We try to shed light on the conflicting evidence in prior literature about the informational deficiencies for intangible-intensive firms. We use data from Compustat and CRSP between 1975 and 2006 available in 2008 tapes. We first explore whether the earnings and book values for intangible intensive industries are distorted for intangible-intensive industries. We find that the mean earnings (book values) are 62% (20%) greater under capitalization than that under expensing of R&D for intangible-industries, suggesting that accounting information in intangible-intensive industries is on average heavily distorted. An alternative explanation for the high value-relevance for intangible-intensive industries documented by CMW is omitting a variable from the regression which is correlated with variables included. Brown et al. (1999) argue that lack of control for the variation in scale factor might bias the R^2 from regression of prices with earnings and book values. They analytically show that CV (coefficient of variation) of scale factor is positively related to R^2 from price regressions. Following the arguments in Brown et al. (1999), we find that the CVs of scale factor proxies are 27%-32% larger for intangible-intensive industries than not intangible-intensive.

We then explore the impact scale factor on value-relevance of accounting information. Without including CVs of scale factor proxies, consistent with CMW, we did not find any significant difference in value-relevance between intangible-intensive and not intangible-intensive industries (R^2s for both groups are around 58-60%). However, when we include CVs of scale factor proxies, we find that R^2 for intangible-intensive is 18% less than not intangible-intensive industries, suggesting that R^2 is 30% (18%/60%) smaller for intangible-intensive industries. In addition, to explore the impact of capitalization on value-relevance, we adjust earnings and book values to eliminate the impact of expensing of R&D, we find that the difference between two industry groups decline by one third to 11.80%, indicating that indeed expensing reduces value-relevance to some extent.

Brown et al. (1999) document that the increase in value-relevance of accounting information documented by CMW and Francis and Schipper (1999) is due to increase CV of scale factor over time and once we control for it, the value-relevance declines intertemporally. We investigate whether the intertemporal decline in value-relevance of accounting information for all firms documented by Brown et al. (1999) is driven by intangible-intensive industries. Consistent with this expectation, we find that there is no statistically significant decline in value-relevance of accounting information for not intangible-intensive industries, whereas there is a significant decline for intangible-intensive.

The findings in this paper have important implication for the debate about the accounting treatment of intangible assets and the information environment for intangible-intensive industries. Intangible-intensive companies are playing an unprecedented role in US economy in the last three decades. Chan et al. (2001) state that technology-based firms and pharmaceutical industry together account for 40% of the value of the S&P500. Considering the enormous role played by intangible-intensive firms in today's economy, an important issue is whether the current accounting system satisfies the informational needs of investors with respect to intangibles. In fact SEC recently announced a proposed schedule to adopt International Financial Reporting System (IFRS) in the US which allows capitalization of development costs (IAS 38). The findings in this paper suggest that indeed the accounting information is less useful for intangible-intensive industries and raise the possibility that switching to IFRS might improve value-relevance for intangible-intensive industries.

Our paper also contributes to the literature investigating the intertemporal trends in value-relevance of accounting information. Brown et al. (1999) document an intertemporal decline once we control the variation in scale factor. Core et al. (2003) document a substantially low value-relevance in recent "New Economy" sub-period, 1995-1999. However, it is not clear whether the decline in value-relevance in the new economy sub-period is temporary or permanent. We show that intertemporal pattern for all industries documented by Brown et al. is due to intangible-intensive industries and that the low value-relevance in the new economy sub-period is temporary and it reverts back to its prior levels after 2002.

This paper also contributes to the recent line of research which indicates that intangible-intensive firms are increasingly affecting the overall characteristics of the information produced by financial reporting system. Darrouh and Ye (2007) underline the importance unrecorded intangibles in resolving the puzzling negative relationship between market values and earnings for loss firms. Similarly, Franzen et al. (2007) documents the impact of unrecorded R&D on measures of distress risk such as Altman z-score. These studies suggest intangible-intensive firms increasingly affecting characteristics of financial reporting system as a whole. We contribute this line of research by documenting that when it comes to intertemporal trends in value-relevance of accounting information, intangible-intensive firms also play a significant role. In fact, given the recent evidence by Dichev and Tang (2008) that there is a decline in matching of revenues and expenses, intangible-intensive firms might be also responsible for this decline as well.

The rest of the paper is organized as follows. Section 2 provides the literature review and research questions. Section 3 presents research design and section 4 sample description and descriptive statistics. Section 5 presents results and finally section 6 concludes the paper.

2. Literature Review and Research Questions

2.1. Value-relevance of Accounting Information for Intangible-intensive Industries

In today's economy intangible assets play a role as important as physical and financial assets. Federal Reserve economist Nakamura states that "U.S. companies spend annually on intangibles is on par with total corporate investment in physical assets."[2] The growing importance of intangibles in the economy in the last three decades attracted the attention of academia to issues related to these assets. An important type of intangible asset is R&D. Prior research documents that R&D expenditures are associated with future earnings, suggesting that these expenditures have future benefits like other assets (Lev and Sougiannis, 1996). However, Generally Accepted Accounting Principles (U.S. GAAP) do not treat R&D expenditures as assets, and require them to be expensed as incurred. Several researchers raise concern about the usefulness of financial information due to expensing of R&D. Even though R&D is immediately expensed, the benefits associated with R&D are realized much later and are not matched previously expensed R&D expenditures. Consequently, the primary accounting principle of matching revenues with expenses is seriously distorted (Lev and Zarowin, 1999).

Amir and Lev (1996) argue that while intangible assets contribute to the market value of these firms, current accounting rules do not allow recording these assets. Consequently information provided in financial statements is not useful to investor when valuing the firms with large amounts of intangible assets. Amir and Lev (1996) find that

[2] Lev (2001)

earnings, book values and cash flows are largely irrelevant on a stand-alone basis when valuing companies in the cellular telephone industry. They further state that "the accounting measurement and reporting system is ill-equipped to provide value-relevant information in emerging high-tech industries, such as wireless communications. However, they did no explore whether their results apply to all intangible-intensive industries. However, CMW document that the R^2 from regression of earnings and book values on prices is slightly greater for intangible-intensive industries than not intangible-intensive industries. Similarly, Francis and Schipper (1999) show that high-tech firms have similar value-relevance compared to low-tech firms. Thus, the arguments in Amir and Lev (1996) are in conflict with the evidence provided by CMW and Francis Schipper (1999).

One explanation provided by Lev and Zarowin (1999) for the discrepancy between Amir and Lev (1996) and CMW is that accounting numbers *on average* are not distorted for intangible-intensive industries. They argue that in steady R&D state environment, the immediate expensing of R&D will result in the same earnings as those based on R&D capitalization. They further state that "it is only when the investment rate on intangibles changes over time that reported earnings based expensing will materially differ from economics earnings based on capitalization." However, they do not clarify whether firms in intangible-intensive-industries are on average in steady R&D state or whether accounting information for firms in intangible-intensive industries are on average distorted.

Another recent study in value-relevance on accounting information for intangible-intensive firms is Monahan (2005). He investigates whether adjusting accounting numbers for expensing of R&D improves value-relevance (i.e. R^2). He finds that capitalization leads to statistically significant increase in value-relevance only when a firm has high future R&D growth and high conservatism (i.e. he measures conservatism with the intensity of R&D capital to total asset ratio). However, he does not take into account the impact of CV of scale factor when making comparisons across groups. Moreover, he does not investigate the differences neither in value-relevance nor intertemporal pattern in value-relevance between intangible-intensive and not intangible intensive industries.

2.2. The Impact of Scale Factor on Value-Relevance

Brown et al. (1999) provide theoretical evidence about the impact of scale factor on value-relevance. In a regression of earnings on prices R^2 shows how much of the variation in price can be explained by the variation in EPS. Hence, R^2 seems to be reasonable measure of value-relevance. Brown et al. (1999) argue that comparison of R^2s among different groups might be misleading if R^2 is also affected by scale. To illustrate the impact of scale on R^2, we present the notation from Brown et al. (1999). Let us assume following linear bivariate relationship between $\boldsymbol{z} = (z_1,\dots z_n)$ and $\boldsymbol{w} = (w_1,\dots w_n)$.

$$z_i = a + b\, w_i + e_i \qquad (1)$$

Equation (1) is free of scale. In this model z_i can be considered as value of a stock at the end of a period and w_i, the EPS in the period. In equation (1), R^2 represents the explanatory power of independent variable. On the other hand, a researcher usually can merely observe scale-affected data. To observe the impact of scale now assume that data is affected by a scale factor, $\boldsymbol{s} = (s_1,\dots s_n)$, then equation (1) becomes:

$$s_i\, z_i = a\, s_i + b\, s_i\, w_i + s_i\, e_i \qquad (2)$$

Brown et al. (1999) show that R^2 of the estimated relationship between z and w is affected is affected by both the variation in s, scale-factor and variation in w. An example for scale differences provided by Brown et al. (1999) is Berkshire Hataway, with a share price of $45,000 and IBM, with a share price of $100. Researchers, such as CMW, usually regress prices on accounting data such as EPS do not control for the impact of scale effect. Thus, they estimate following model.

$$y_i = \alpha + \beta x_i + g_i \quad (3)$$

Where

$y_i = s_i z_i$, $x_i = s_i w_i$, and $g_i = s_i e_i$,

In equation (3), as_i is omitted, compared to equation (2), which would lead to correlated omitted variable problem. Brown et al. (1999) show that omitting scale factor in the above equation will bias not only the coefficient estimates but also the R^2 from the regression. Moreover, they analytically show that there is a positive relationship between R^2 and CV of scale factor. The stock splits share repurchases are endogenous corporate choices which affect scale factor. In addition, differences in ROE and payout ratios also affect scale factor. Thus, they suggest that when making comparisons among different groups of interest based on R^2, one has to control for scale. One way they suggest to control variation in scale is regressing R^2 from the price regression on CV of scale factor proxies such as CV of price and book value.

2.3. Intertemporal Patterns in Value-Relevance of Accounting Information

There have been recent arguments that historical cost financial statements lost value-relevance because of the shift from an industrialized economy to a high-tech, service-oriented economy (CMW). CMW provided several reasons for the intertemporal decline in value-relevance of accounting information. One reason they suggest is that there is an increase in the number of intangible-intensive firms over time. Given the argument in Amir and Lev (1996) that accounting information is less value-relevant for firms in intangible-intensive industries, the intertemporal increase in the number of intangible-intensive firms should lead to intertemporal decline in value-relevance of accounting information. The other reason is the increase in the number of firms reporting loss and increase in nonrecurring items over time. Elliot and Hanna (1996) and Hayn (1995) suggest that negative earnings and nonrecurring items can adversely affect the value-relevance of earnings. Based on this motivation, CMW investigates the intertemporal pattern in value-relevance of accounting information over 41 years between 1953 and 1993. Contrary to the above claims, they find that the combined value-relevance of earnings and book values increase over past 40 years rather than decline. They, however, find that value-relevance of bottom line earnings has declined over time having been replaced by an increase in value relevance of book values. Francis and Schipper (1999) also provide similar intertemporal increase in value-relevance of accounting information.

Brown et al. (1999) on the other hand, argue that the intertemporal increase in combined value-relevance of earnings and book values documented by CMW is due to scale effect which acts as a correlated omitted variable. They use CV of share price and book value per share as proxy for CV of scale factor and document that, once we control for scale factor, there is in fact an intertemporal decline in combined value-relevance of earnings and book values. They also argue that the increase in value-relevance documented in prior studies is due to increase in CV of scale factor. However, Brown et al. (1999) do not investigate the intertemporal pattern in value-relevance for intangible-intensive and not intangible-intensive industries separately. Core et al. (2003) document a decline in value-relevance of accounting information in the period between 1995 to 1999, which they call "New Economy" sub-period, compared to earlier years. However, their data ends in 1999. Thus, it is unclear whether the decline in value-relevance in the new economy period is temporary or permanent. A recent study by Dichev and Tang (2008) documents that there is an intertemporal increase in mis-matching of revenues with expenses and this mismatching leads to decline in persistence and predictability of earnings. They further conjecture that the intertemporal decline in value-relevance of earnings documented by CMW and Francis and Schipper et al. (1999) might be due to increase in mis-matching of revenues and expenses. However, they do not explore the validity their conjectures.

2.4. Research Questions

As suggested in the above sections there is an apparent discrepancy between the arguments in Amir and Lev (1996) and CMW. One explanation for this discrepancy, as suggested by Lev and Zarowin (1999), is that accounting information *on average* is not distorted for intangible-intensive industries. Thus, our first research question is whether accounting information, namely earnings and book values, is *on average* distorted for intangible-intensive industries. If accounting information is not distorted *on average* for intangible-intensive industries, then it is reasonable not to find any difference in value-relevance between two groups.

Second, we compare the value-relevance of accounting information and incremental value-relevance for earnings and book values for intangible-intensive and not intangible-intensive industries over our sample period to see whether indeed value-relevance is similar for both groups as suggested by CMW. They use data between 1953 and 1993, whereas we use data over 1975 and 2006. Investigation of the issue in the period after 1993 is important because the technology boom is realized especially after second half of 1990s. Third, we investigate how capitalization of R&D would affect the total value-relevance and incremental value relevance of earnings and book values. To the extent that expensing reduces value-relevance, we should observe significant increases in value-relevance of accounting information when we capitalize R&D.

Fourth, we investigate how scale factor affects the differences in value-relevance of accounting information between intangible-intensive and not intangible-intensive industries. It might be possible that the discrepancy between the evidence in CMW and arguments Amir and Lev (1996) about the value-relevance of accounting information for intangible-intensive industries might be due to lack of control for variation in scale factor. Firms in intangible-intensive industries operate in a highly volatile business environment. Chan et al. (2001) suggest that the R&D expenditures are associated with volatility of stock returns. Kothari et al. (2002) suggest that the variability of earnings for R&D expenditures is four and a half times greater than that for capital expenditures. Thus, variation in scale factor might be greater for intangible-intensive industries, which then might lead to higher R^2 for these industries. The last question we investigate is how intangible-intensive industries affect the intertemporal trends in value-relevance documented in prior literature. Specifically, we explore whether there is a difference in intertemporal pattern in the total and incremental value-relevance of earnings and book values between intangible-intensive and not intangible-intensive industries after controlling for variation in scale.

3. Research Design

Our measure of value-relevance is R^2 from the regression of prices on earnings and book values consistent with CMW. While value-relevance is also measured by return regressions, we focus on price regression as returns are scale-free and our focus in this study is the impact of scale factor on value-relevance of accounting information. However, return regressions might be affected from other types of correlated omitted variables such as growth (Collins and Kothari, 1989). We first replicate CMW with our sample and try to see whether there is a significant difference in value-relevance between intangible-intensive and not intangible-intensive industries. We estimate the following price regressions separately for intangible-intensive and not intangible-intensive industries.

$$P_{it} = \alpha_0 + \alpha_1 EPS_{it} + \alpha_2 BVPS_{it} + \varepsilon_{it} \quad (4)$$

$$P_{it} = \alpha_0 + \alpha_1 EPS_{it} + \varepsilon_{it} \quad (5)$$

$$P_{it} = \alpha_0 + \alpha_1 BVPS_{it} + \varepsilon_{it} \quad (6)$$

Where:

P_{it} is share price for firm i three months after fiscal year-end in year t adjusted for stock splits using adjustment factor from CRSP.

EPS_{it} is earnings per share for firm i in fiscal year t (it is calculated as net earnings (NI from Compustat) divided by number of shares outstanding (CSHO from Compustat).

$BVPS_{it}$ is book value per share (it is calculated as book value of equity (CEQ from Compustat) divided number of shares outstanding).

If intangible-intensive industries have lower value-relevance compared to not intangible-intensive industries, the R^2 from the above price regressions should be lower for these industries. CMW did not find any economically significant difference in R^2 between intangible-intensive and not intangible-intensive industries with all of these models. Consistent with CMW, we use cross-sectional regressions and calculate the t-statistics based on variation of annual coefficient estimates using Fama and McBeth (1973) procedure. To investigate the impact of capitalization on value-relevance, we also estimate the above models using earnings and book values adjusted for expensing of R&D. We use straight line amortization with five years of useful life as suggested by Chan et al. (2001) to calculate earnings and book values under capitalization. If expensing of R&D leads to distortion in accounting information and hence, decline in value-relevance, we should observe significant increase in value-relevance under capitalization of R&D.

Next, we explore the impact of CVs of scale factor on value-relevance. Consistent with Brown et al. (1999), we use book value per share, BVPS, and share price, P as proxies for scale factor. We augment Brown et al. (1999) model and regress the R^2 generated from the estimation of equations (4), (5) and (6) on CVs of scale factor proxies.

$$R^2_{pt} = \beta_0 + \beta_1 \, INT_{pt} + \beta_2 \, CV\_P_{pt} + \beta_3 \, CV\_BVPS_{pt} + \varepsilon_{pt} \quad (7)$$

Where,

R^2_{pt} is R^2 from estimation of equation (4) or (5) or (6) for group p in year t (there are two groups: intangible-intensive and not intangible-intensive).

INT_{pt} is an indicator variable which equals one for intangible-intensive group and zero for not intangible-intensive. The industries in intangible-intensive group as defined as by CMW are: SIC codes 282 plastic and synthetic materials; 283 drugs; 357 computer and office equipment; 367 electronic components and accessories; 48 communications; 73 business services; 87 engineering, accounting, R&D and management related services. Not intangible-industries are all industries except intangible-intensive industries.

CV_P_{pt} is coefficient of variation of share price for group p in year t (it is calculated as standard deviation of share price divided by absolute value of mean).

CV_BVPS_{pt} is coefficient of variation for book value per share for group p in year t (it is calculated as standard deviation of book value per share divided by mean).

Both dependent and independent variables are calculated in each year for each group. The R^2 from the full model, equation (4), shows the combined value-relevance of earnings and book values. We repeat our analysis using R^2 from equation (5) and (6) to explore the value-relevance of earnings and book value only. The coefficient estimate of INT in equation (7) shows the difference in R^2 between intangible-intensive and not intangible-intensive industries after controlling for CV_P and CV_BVPS. If the high R^2 for intangible-intensive industries is due to bias in R^2 caused by CV of scale factor, the R^2 should be significantly lower for these industries in equation (7), once we control for CVs. Thus, we expect INT to have negative sign. Consistent with CMW, we also investigate incremental value relevance of earnings and book values for each group. To generate incremental R^2 for earnings (book value), we deduct R^2 generated from regression of book value (earnings) in equation 5 (6) from total R^2 from equation 4.

$INCR\text{-}R^2_{Et} = R^2_{Tt} - R^2_{Bt}$

$INCR\text{-}R^2_{Bt} = R^2_{Tt} - R^2_{Et}$

Where, R^2_{Et} (R^2_{Bt}) is R^2 for earnings generated from equation 6 (5) in year t and R^2_T is total R^2 from equation 4. $INCR\text{-}R^2_{Et}$ ($INCR\text{-}R^2_{Bt}$) is incremental R^2 for earnings (book value) in year t. Next, we investigate the intertemporal pattern in value-relevance of accounting information for intangible-intensive and not intangible intensive industries. We estimate the following models.

$$R^2_t = \beta_0 + \beta_1 \, TIME_t + \beta_2 \, CV\_EPS_t + \beta_3 \, CV\_BVPS_t + \varepsilon_t \quad (8)$$

$$R^2_{pt} = \beta_0 + \beta_1 TIME_{pt} + \beta_2 INT_{pt} + \beta_3 INT_{pt}{*}TIME_{pt} + \beta_4 CV\_EPS_{pt} + \beta_5 CV\_BVPS_{pt} + \varepsilon_{pt} \quad (9)$$

where

$TIME_{pt}$ is year t minus 1975 for group p.

The coefficient estimate of TIME is equation (8) indicates the intertemporal pattern in value-relevance of accounting information for all industries before separating them into two groups. Brown et al. (1999) suggest that there is an intertemporal decline in value-relevance of accounting information once we control for CV of scale factor. Thus, we expect TIME to be negative. Next, we estimate equation (9) to explore the intertemporal pattern in value-relevance for intangible-intensive and not intangible-intensive industries separately. The coefficient estimate of TIME is equation (9) indicates the intertemporal pattern for not intangible-intensive industries, whereas the interaction term, INT*TIME, shows the difference in intertemporal pattern between intangible-intensive and not intangible-intensive industries. If the intertemporal decline in value relevance is greater (smaller) for intangible-intensive than not intangible-intensive industries, the coefficient estimate of INT*TIME should be negative (positive). We also estimate equations (8) and (9) using INCR-R^2_{Et} and INCR-R^2_{Bt} as dependent variable to explore the intertemporal pattern in the incremental R^2 from earnings and book values.

4. Sample Selection and Descriptive Statistics

4.1. Sample Selection

Our sample consists of firm-year observations from CRSP and Compustat between 1975 and 2006. The sample period of CMW starts from 1953 and that for Brown et al. start from 1958. Our focus is comparison of value-relevance of intangibles-intensive with not intangible-intensive industries, while their focus is primarily exploring the intertemporal pattern in value relevance of accounting information over last four decades. SFAS No. 2, which requires expensing of R&D expenditures, has been enacted in October 1974. Consistent with, many studies related to R&D such as Lev and Sougiannis (1996) and Chan et al. (2001) have a sample period starting from 1975. Besides the impact of intangible-intensive industries on overall economy was very small before 1970s. Thus, it is reasonable to expect the expensing of R&D have little effect on the value-relevance of intangible-intensive industries prior to 1975. Our sample extends until 2006 because we use price available three months after fiscal year.

Consistent with CMW and Brown et al. (1999), we delete the firm-year observations with book value of equity (CEQ from Compustat) and total assets (AT from Compustat) greater than zero. We also exclude the observations at top and bottom 1.5%

of earnings-to-price, book-value-to-market value, absolute value of one-time items as a percent of net income before one-time items and observations with studentized residuals greater than four in any of the yearly regressions in equations (4-6). We have 152,871 firm-year observations. 33,493 of these observations are from intangible-intensive industries, while 119,378 are from not-intangible-intensive industries. We use intangible-intensive industry definitions from CMW.

4.2. Descriptive Statistics

We first present descriptive statistics in Table 1 to see the sample characteristics for intangible-intensive and not intangible-intensive industries. The mean and median values of share price, earnings per share, book value per share, all are smaller for intangible-intensive industries relative to not intangible-intensive group. These results indicate that intangible-intensive industries are systematically different compared to not intangible-intensive industries. As expected, the mean (median) R&D expense to asset ratio, RDAS, for intangible-intensive industries is 10.80% (4.80%) substantially greater compared to 1.80% (0%) that for not intangible-intensive industries. There is also similar difference between two groups with RDCAPS, R&D capital to asset ratio. In addition, intangible-intensive industries have larger market value of equity, greater absolute magnitude of one-time items and more frequent losses.

5. Results

5.1. Distortion in Accounting Information

We first investigate whether intangible-intensive industries are in steady R&D state as suggested by Lev and Zarowin (1999). We plot the median R&D expense to total asset ratio in Figure 1a for intangible intensive-industries.[3] We report only intangible-intensive industries because the median R&D spending is zero for not intangible-intensive industries. Figure 1a shows that there is an intertemporal increase in the median R&D intensity intangible-intensive industries. Specifically, R&D spending per dollar of assets increases substantially over time from 1.3% in 1975 to 7.5% in 2003. Figure 1b plots median R&D capital to asset ratio for intangible-intensive industries. If firms in intangible-intensive industries are in steady R&D state, R&D capital should not grow across time because R&D expense under expensing should be approximately equal to amortization expense under capitalization. However, figure 1b indicates that there is a substantial growth in R&D capital over time. Overall, both figure 1a and b indicate that R&D spending in intangible-intensive industries is *on average* growing over time and they are not in R&D steady state.

Next, we explore the distortion in financial information. Lev and Zarowin (1999) argue that earnings under capitalization represent economic earnings. Thus, it is reasonable to assume that the differences in accounting numbers between expensing and capitalization of R&D should reflect the distortion in the reported accounting numbers. Our measure of distortion for EPS is earnings per share under capitalization (EPSAJ) minus earnings per share (EPS) and divided by absolute value of earnings per share [(EPSAJ – EPS)/abs(EPS)]. Similarly for book value, it is book value per share under capitalization (BVPSAJ) minus that under expensing (BVPS) divided by book value per share [(BVPSAJ – BVPS)/BVPS].

[3] The results are even stronger with mean value. However, consistent with Franzen et al. (2007), we report median values because medians are not affected from outliers as means.

The mean (median) EPS in Table 1 is 0.362 (0.143), while the mean EPSAJ, is 0.585 (0.251), indicating that the mean (median) distortion in EPS is 62% (75%). The mean (median) BVPS is 6.118 (3.683), while the mean (median) BVPSAJ, is 7.372 (4.656), which suggests that the mean (median) distortion in BVPS is 20% (26%). These results are not consistent with the arguments in Lev and Zarowin (1999) suggesting that earnings and book values reported in financial statements *on average* are distorted for intangible-intensive industries.

We also explore if there is an intertemporal pattern in the distortion of financial information for firms in intangible-intensive industries. As documented in figure 1, R&D intensity is growing for firms in these industries. This growth should lead greater distortion in recent years compared to earlier years. In figure 2a we plot the median distortion in EPS. The distortion in EPS grows from 10-20% in 1970s to 150-200% in late 1990s. The growth is substantial in 1990s but it also very unstable in this period because the numerator, EPS, is very small in 1990s which leads to very large percentage differences. In Figure 2b we plot distortion in BVPS. The distortion grows from 10-15% in 1970s to 35-40% in 2000s. The growth in distortion of BVPS is more stable compared to that for EPS because for BVPS the numerator is quite large. However, both with EPS and BVPS, figure 2 shows that the distortion in accounting information grows over time as the economy shifts toward intangible assets. On the other hand, there is not such growth in distortion for firms in not intangible-intensive industries. Overall, figure 1, and 2 reveals the intertemporal pattern in distortion of accounting numbers, suggesting that the explanation given by Lev and Zarowin (1999) for the discrepancy between Amir and Lev (1996) and CMW is not supported by data.

5.2. Value-Relevance of Accounting Information

Table 2 reports the mean coefficient estimates from the above price regressions in equations (4-6). The first three columns report the estimation results of full model, equation (4). The mean coefficient estimate for EPS for intangible intensive industries is 5.337, while it is 4.626 for not intangible-intensive industries. The difference in coefficient estimates is statistically significant (*p-value* of the difference <0.01). There is even greater difference in the coefficient estimates for BVPS, which is 0.916, for intangible-intensive industries and 0.608, for not intangible-intensive (*p-value* of the difference <0.01). Moreover, there is not a statistically significant difference in R^2 between intangible-intensive and not intangible-intensive industries. The R^2 is 0.576 for intangible-intensive industries, while it is 0.606 for not intangible-intensives. These results are consistent which CMW.[4]

The next two columns report the mean coefficient estimates of equation (5), where we include only EPS in the regression. Consistent with CMW, the R^2s for both groups are lower compared to the full model in equation (4); they are 47.4% and 53.3% for intangible-intensive and not intangible-intensive industries, respectively and the difference between two groups is around 6%, which is marginally significant (*p-value* of the difference = 0.08). The next two columns report the mean coefficient estimates for equation (6). The R^2 for intangible-intensive industries is 50.1%, while it is 51.2% for not intangible-intensive industries. The difference between both groups is 1.1%, much smaller compared to the regression with EPS only in equation (5). Incremental R^2 from earnings is 9.40%, greater than that for book value for not intangible-intensive industries.

[4] In Table 4 CMW report that the R^2 is 50-51% in the period between 1953 to 1972, while it is around 60-75% in period between 1972 and 1993. This is consistent with their main results that value-relevance of accounting information is increasing over time.

However, the oppositve is true for intangible intensive industries (i.e. Incremental R^2 from earnings is 8.5%, lower than 10.20%, for book value for intangible-intensive). Overall, Table 2 is consistent with CMW that there is not an economically significant difference in value-relevance of accounting information between intangible-intensive than not intangible-intensive industries.

Table 3 presents the results of price regressions in equations (4-6) using adjusted book values and earnings under hypothetical capitalization of earnings. Neither R^2, nor the coefficient estimates of EPSAJ and BVPSAJ in equation (4') is much different than those with unadjusted numbers in Table 2. However, The R^2 in EPSAJ only regression in equation (5') for intangible-intensive increases to 51.10% compared to that of 47.40% in Table 2 (In untabulated results we find that increase in R^2 is marginally significant). On the other hand, there is not much change in the R^2 for not intangible-intensive firms compared to those in Table 2. Hence adjusting earnings makes an economically significant increase in the R^2 for only intangible-intensive firms. There is also only 0.50-0.70 increase in the R^2 for BVPSAJ only regression in equation (6') suggesting that adjusting book value for expensing of R&D does not make much improvement in value-relevance for both groups. The last two columns show the impact of adjustment on the incremental R^2 for earnings and book values. While there is not much change in the incremental R^2 from earnings, the incremental R^2 from book value declines significantly for intangible-intensive industries (i.e. it is 7.10% in table 3 after adjustment versus 10.20% in Table 2 before adjustment; a 30% decline). In fact, the incremental R^2 from earnings after adjustment exceeds that from book value for intangible-intensive industries while opposite was true before the adjustment. The adjustment of earnings and book values does not lead to much increase in total R^2 suggesting that the decline in incremental R^2 from book value is substituted by increase in R^2 common to earnings and book value. To further investigate the impact of distortion in accounting numbers in value-relevance, in untabulated analysis, we divide intangible-intensive industries into four groups, high and low based on the distortion in earnings and also high and low groups based on distortion in book value. We estimate equation (4) to see how the R^2 varies across the groups. We find that R^2 is the lowest in the group with high distortion and high book value per share (i.e. the R^2 for high, high group was 38%, almost 20% lower than that in Table 2). Moreover, we find that, consistent with Table 3, the distortion in EPS is much stronger in affecting value-relevance than distortion in BVPS.

5.3. The Impact of Scale Factor on Value-Relevance

In this Section we investigate whether there are any systematic difference in scale factor between intangible-intensive and not intangible-intensive industries which might affect the value-relevance of accounting information documented in Table 2. Consistent with Brown et al. (1999), we use book value per share, BVPS, and share price, P as proxies for scale factor. Panel A of Table 4 presents the mean and median for CV of scale factor proxies. The mean value of CV_P, the CV of share price is 1.408, while it is 1.110 for not intangible-intensive industries, which suggests a 27% (=(1.408-1.110)/1.110) difference between two groups. The mean value of CV_BVPS, CV of book value per share for intangible industries is 1.294, while it is 0.964 for not intangible-intensive industries, again suggesting that CV of BVPS is 32% (=(1.294-0.964)/0.964) larger for intangible-intensive industries. The differences in CV of scale factor proxies raise possibility that the primary reason for high R^2 for intangible-intensive industries documented in Table 2 might be lack of control for scale factor.

The estimation results of equation (7) where dependent variable is R^2 from the full model are in Panel B of Table 4. When we do not include the CV of scale factor proxies, there is only 3.0% difference between intangible intensive and not intangible-intensive firms and the difference is not statistically significant. We include in the regression only one scale factor proxy at a time to see the impact of each one separately. First, we only include CV of share price, CV_P. The coefficient estimate of INT is -0.087 (*p-value*<0.01). The next column shows the estimation results when we include only CV_BVPS. The coefficient estimate of INT is -0.148 (*p-value*<0.01), larger than the estimation with CV_P. The last column shows the estimation results of equation (7). The coefficient estimate of INT is -0.181 (*p-value*<0.01), larger than the estimation results with any of CVs alone, suggesting that each of the scale factor proxy has incremental explanatory power. Given that the R^2 for not intangible-intensive firms reported in Table 2 is around 60%, the value-relevance of combined earnings and book values is 30% lower for intangible-intensive than not intangible-intensive industries after controlling for scale factor proxies (=18% / 60%). Overall, the results in panel B of Table 4 suggest that the discrepancy between Amir and Lev (1996) and CMW is due to correlated omitted variable in the form of scale factor. Panel C presents the results when the dependent variable is R^2 generated from EPS alone regression in equation (5). The coefficient estimate of INT increases from -6.10% to -21.90%, when we control CV scale factor. Hence, the largest difference in R^2 between intangible-intensive and not-intangible-intensive industries is realized for EPS alone regression. Panel D reports the results when the dependent variable is R^2 from equation (6) where the BVPS alone is the regressor. The coefficient estimate of INT increases from -0.90% to -19.0%, when we control CV scale factor.

Table 5 presents the results of equation (7) when we use R^2 generated from adjusted book values and earnings as dependent variable. Panel A indicates the mean value of CV of adjusted book value BVPSAJ is 1.242 for intangible-intensive firms, much larger than 0.974, that for not intangible-intensive firms, suggesting that adjusting book value for expensing does not make much of a difference in the cross-sectional volatility of scale factor. Panel B indicates that even after adjusting for earnings and book values there is a 11.80% difference in value-relevance in the full model between intangible-intensive and not intangible-intensive industries. In untabulated results we find that the decline in the coefficient estimate of INT from -18.10% to -11.80% is statistically significant (*p-value*<0.01). Hence, adjusting for expensing of R&D reduces the difference between intangible-intensive and not intangible-intensive industries by one-third. However, the difference is still large raising the possibility that accounting alone may not be the only reason for the large difference (An alternative explanation is that our hypothetical adjustment produce noisy proxies for earnings and book values under capitalization). The coefficient estimate of INT is 16.50% in Panel C when the dependent variable is R^2 from EPSAJ only regression, suggesting that adjusting earnings reduces the difference in R^2 by 5.40% (i.e. from 21.90% to 16.50%). There is also a 3.10% decline in the coefficient estimate of INT in Panel D when the dependent is R^2 from BVPSAJ only regression. Thus, the improvement in value-relevance in EPSAJ only regression is larger than BVPSAJ only regression confirming the evidence in Table 1 that the distortion in EPS due to expensing is larger than that for BVPS. Overall, Table 5 indicates that adjusting earnings based on a hypothetical capitalization scheme improves value-relevance of earnings and book values but does not eliminate the difference in R^2 between two groups completely.

5.4. Intertemporal Pattern in Value-Relevance

The results of intertemporal regression of equation (8) and (9) are in Table 6. Panel A shows the results when the dependent variable is total R^2 from the full model. The first column shows the estimation of equation (8) where we do not separate the industries into intangible-intensive and not-intangible-intensive groups. The coefficient estimate of TIME is -0.005 negative and significant (*p-value*<0.01). This result is consistent with Brown et al. (1999), which documents a decline in value-relevance for the period of 1958-1996. The magnitude of decline is greater compared to Brown et al., probably because we are covering the period after 1975.[5] The next column shows the coefficient estimates of equation (9) without control variables. The coefficient estimate of TIME is -0.002, statistically insignificant, suggesting that there is not a statistically significant decline in value-relevance for not intangible-intensive industries. The coefficient estimate of INT*TIME is -0.006 (*p-value*<0.01), suggesting that the decline in value-relevance for intangible intensive industries is 6 basis points greater than not intangible-intensive. The last two columns show the estimation results of equation (9). The coefficient estimate of TIME is -0.002, statistically insignificant, and INT*TIME is -0.007 (*p-value*<0.01), suggesting that including CV of scale factor proxies slightly increases the magnitude of decline in value-relevance for intangible-intensive industries. Moreover, the sum of the coefficients TIME and INT*TIME is -0.009 (*p-value*<0.01), which confirms that there is a statistically significant decline in value-relevance for intangible-intensive industries. Overall, Panel A of Table 6 indicates that there is not a statistically significant decline in value-relevance for not intangible-intensive industries

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[5] As shown in Brown et al. (1999) Figure 3(a), the total R^2 from the full model is lower in the period before 1975. However, when we repeat our analysis using the sample period of 1958-1996, the slope coefficient in our estimation for all industries is -0.003, similar to show reported in Brown et al (1999).

and that the decline documented by Brown et al. (1999) for all industries is primarily driven by intangible-intensive industries. CMW document that R^2 from full model in equation (4) is attenuated when we account for one-time items, size and losses. In table 1, we show that the frequency of losses is greater; market value of equity is larger and one-time items are larger in absolute magnitude for intangible-intensive industries than those for not intangible-intensive, indicating that the intertemporal pattern in value relevance largely is affected by intangible-intensive industries.

Panel B documents intertemporal pattern in incremental R^2 from EPS. There is no statistically significant intertemporal trend for all industries.[6] However, when we separate the industries into intangible-intensive and not, we find that there is a statistically significant decline in incremental R^2 from EPS for intangible-intensive industries, while there is no statistically significant trend for not intangible-intensive industries. Dichev and Tang (2008) documents a decline in matching of revenues and expenses and argue that intertemporal decline in value-relevance of earnings documented by CMW might be due to intertemporal decline in matching. Given that expensing of R&D leads to decline in matching, the results here are consistent with Dichev and Tang's conjecture that decline in value relevance of earnings might be due to increase in mismatching probably due to intangible-intensive industries.

Panel C reports the intertemporal pattern in incremental R^2 from BVPS. There is an intertemporal increase for all industries as reported in the first column. However, when we separate industries into intangible-intensive and not, we see that the increase is

[6] CMW documents a decline in the incremental R^2 from earnings. However, their estimation period starts at 1953. Incremental R2 from earnings is quite high in 1950s and 1960s ; start to decline after 1963 and becomes quite low in mid 1970s. Hence different results documented here is due to different sample periods. In fact they also show in their Figure 1(a) that in the period between 1975 and 1993, the incremental R2 is quite flat.

0.4% larger (i.e. the increase for intangible-intensive firms is 0.1+0.4=0.5) for intangible-intensive industries. Moreover, when we control for CV of scale factor proxies, there is not statistically significant increase for not intangible-intensive industries. Overall, Panel B and C suggest that the intertemporal pattern in the incremental R^2 from earnings and book values in CMW is realized primarily in intangible-intensive industries, while there is not statistically significant trend for not intangible intensive industries.

5.5. Robustness Checks

We also perform several robustness checks. In untabulated results we also run equation (7) for high and low R&D intensity firms. More specifically, we drop non-R&D firms from the estimation. Low R&D intensity firms are those in the first three quartiles of R&D capital to assets ratio and high R&D intensity firms are those in the top. We find that the difference in R^2 from price regressions between high and low R&D groups is 3.90%, statistically insignificant, (*p-value*=0.22) without controlling CV of scale factor proxies. However, when we include the CV of scale factor proxies, the difference between high and low R&D groups becomes 20%, statistically significant at 1% level. These results suggest that when we define intangible-intensity based on R&D intensity, the results are similar.

In addition, we include additional control variables in the estimation of equation (7). CMW suggest that the intertemporal increase in value-relevance of accounting information is due to increase in frequency of extraordinary items, proportion of the firms that report losses and decline in average inflation adjusted market value of equity over time. We augment equation (7) by adding ONE, the mean value of absolute value of one-time items as a percentage of core net earnings in year t, LOSS, the percentage of firms that have core net income less than zero in year t and SIZE, the natural log of mean inflation-adjusted market value of equity of firms in year t. We find that both INT in equation (7) is still negative and statistically significant at 1% level, suggesting that the differential value-relevance for intangible-intensive industries is not eliminated with the inclusion of these variables.

6. Conclusion and Future Research

Prior research suggests that accounting information is not useful when valuing firms with large amount of intangibles (Amir and Lev, 1996). However, CMW find that value-relevance for intangible-intensive is as high as not intangible-intensive industries. An explanation for this discrepancy is that the high value relevance for intangible-intensive industries documented by CMW is due to lack of control for scale factor (Brown et al., 1999). We find that once we control for CV of scale factor, the value-relevance for intangibles-intensive industries is substantially lower than not intangible-intensive industries. In addition, adjusting earnings and book values for expensing of R&D reduces the difference in value-relevance between intangible-intensive and not intangible-intensive industries by one-third but does not completely eliminate it. Moreover, we find that adjusting earnings has greater impact on value-relevance of earnings than book value consistent with greater distortion in earnings. We also find that the decline in value-relevance for all firms documented by Brown et al. (1999) is due to intangible-intensive industries while there is no such decline for not intangible-intensive.

An extension of this study might investigate what are the underlying reasons for higher variability of scale factor among intangible-intensive industries. Several reasons for high variability of scale factor might be size differences, more volatile operating performance and greater mismatching of revenues and expenses among intangible-intensive industries than others. Another venue for future research is to investigate factors that affect value-relevance when using return regressions. Return regressions are free of scale, hence scale might not be the omitted variable causing high value-relevance in return regressions. However, intangible-intensive firms have higher growth opportunities which might affect the value-relevance in return regressions for these firms.

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Figure 1a

Median Value of R&D Expense to Asset Ratio across Time for Intangible-Intensive Industries

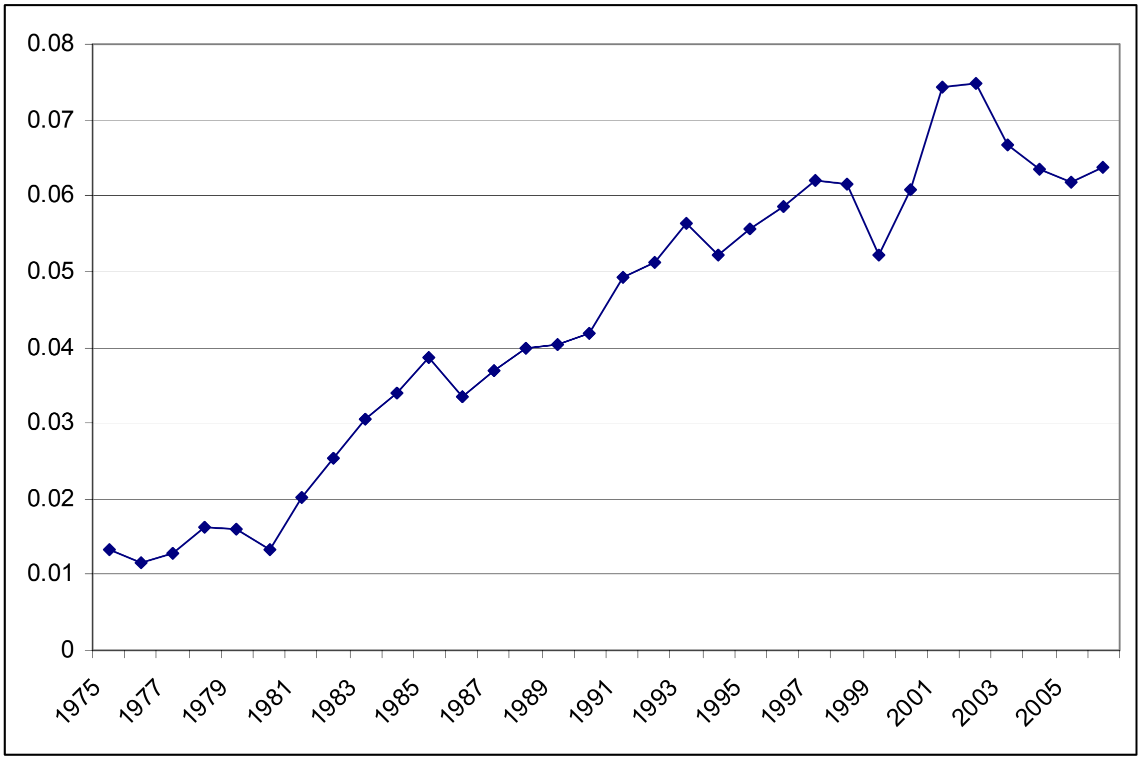

Figure 1b

Median Value of R&D Capital to Asset Ratio across Time for Intangible-Intensive Industries

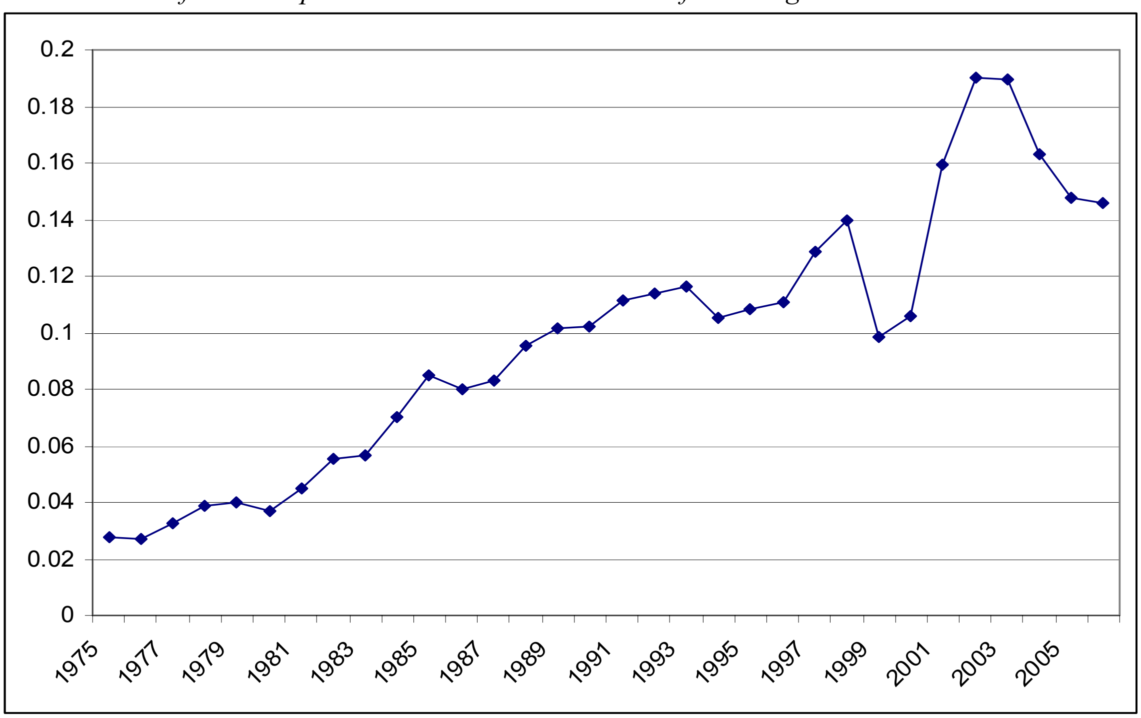

Figure 2a

Median Value of Distortion in EPS across Time for Intangible-Intensive and Not Intangible-Intensive Industries. Distortion in EPS = [(EPS_adj – EPS)/abs(EPS)]

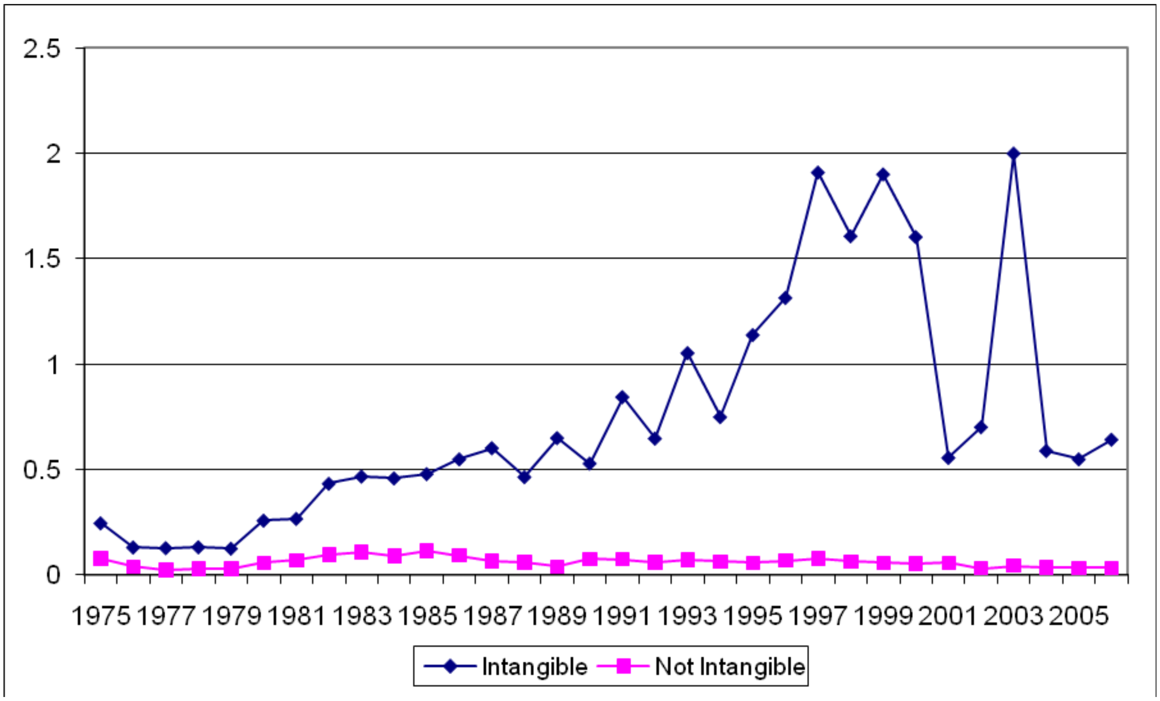

Figure 2b

Median Value of Distortion in BVPS across Time for Intangible-Intensive and Not Intangible-Intensive Industries. Distortion in BVPS = [(BVPS_adj – BVPS)/BVPS]

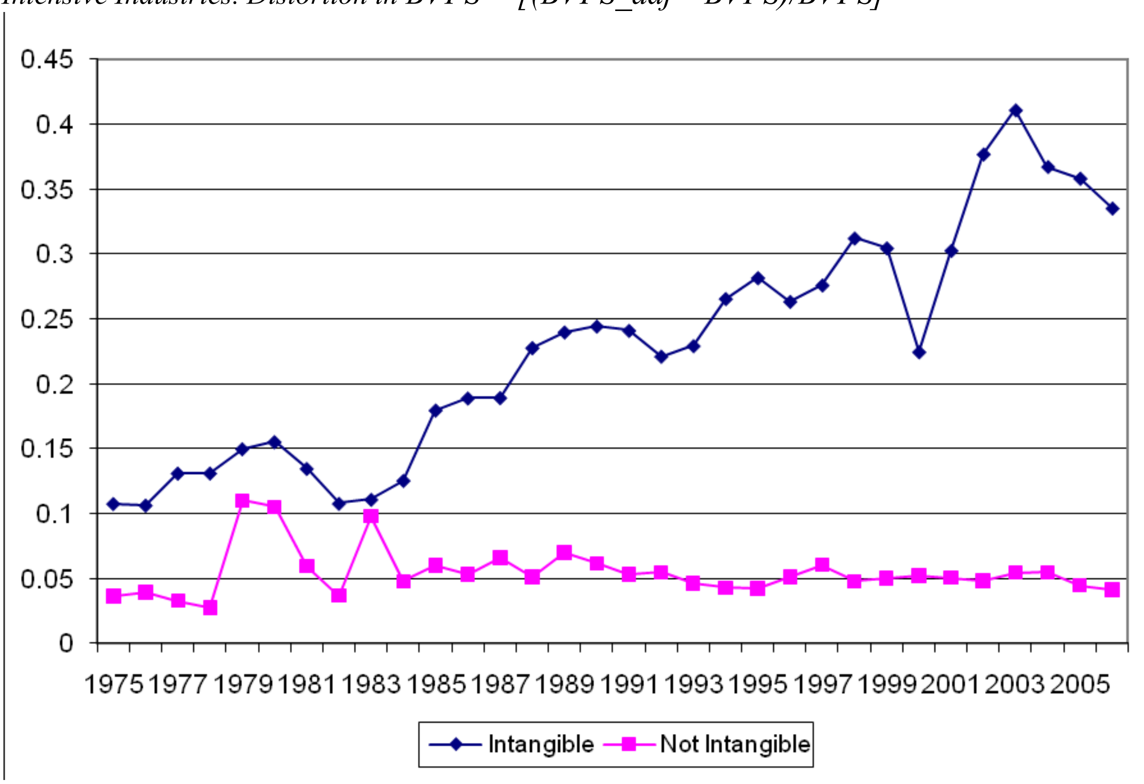

Figure 3

The R^2 for Annual Regressions of Price on Book Value and Earnings for Intangible-Intensive and Not Intangible-Intensive Industries

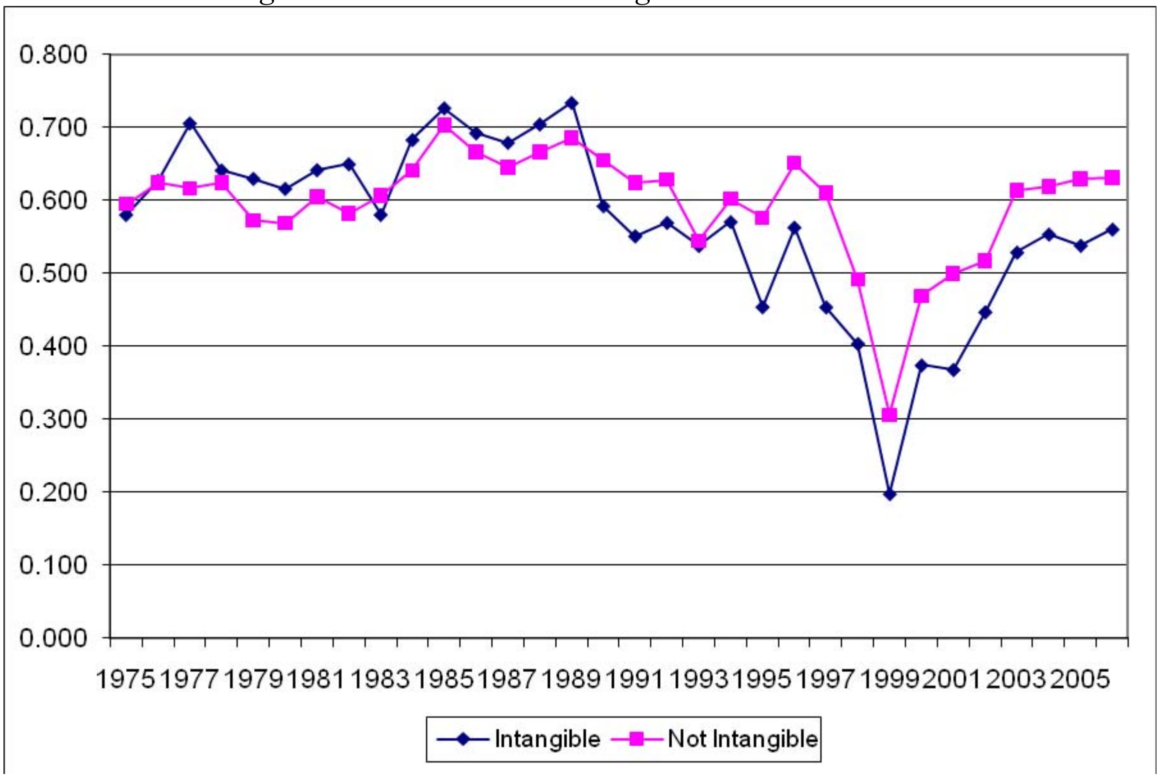

Table 1

Descriptive Statistics for Intangible-Intensive and Not Intangible-Intensive Industries [a, b]

Panel A: Descriptive Statistics (N=152,871)

Variables [e]	MEAN Intangible	MEAN Not Intangible	MEAN p-value of difference [c]	MEDIAN Intangible	MEDIAN Not Intangible	MEDIAN p-value of difference [d]
P	14.815	17.211	0.00	8.710	13.375	0.00
EPS	0.362	1.193	0.00	0.143	0.823	0.00
EPSAJ	0.585	1.252	0.00	0.251	0.869	0.00
BVPS	6.118	11.583	0.00	3.683	8.364	0.00
BVPSAJ	7.372	12.123	0.00	4.656	8.788	0.00
RDAS	0.103	0.018	0.00	0.048	0.000	0.00
RDCAPS	0.250	0.044	0.00	0.105	0.000	0.00
ONE	-0.079	-0.052	0.00	0.000	0.000	0.00
LOSS	0.392	0.193	0.00	0.000	0.000	0.00
MV	1,733	1,149	0.00	100	99	0.60
ONEP	0.319	0.240	0.00	0.000	0.000	0.00

Notes:

[a] The sample consists of firm-year observation in CRSP and Compustat between 1975 and 2006 with book value of equity and total assets greater than zero. We exclude the observation at top and bottom ranked at 1.5% of earnings-to-price, book-value-to-market value, absolute value of one-time items as a percent of net income before one-time items and (3) observations with studentized residuals greater than four in any of the yearly regressions of price on earnings, price on book value, price on earnings and book value. Intangible-intensive industries contain 33,493 firm-year observations, while there are 119,378 firm-year observations for not intangible-intensive industries.

[b] Intangible industries are SIC codes 282 plastic and synthetic materials; 283 drugs; 357 computer and office equipment; 367 electronic components and accessories; 48 communications; 73 business services; 87 engineering, accounting, R&D and management services. The rest of industries are included in not intangible-intensive group.

[c] p-value of t-statistics for the difference between intangible-intensive and other firms (two-sided).

[d] p-value of z-stat based on Wilcoxon rank sum test for the difference between intangible-intensive and other firms (two-sided).

[e] **Definition of Variables:**

P is share price three month after year-end in year t adjusted for stock splits. EPS is earnings per share of in year t calculated as Net Income (NI) divided by the number of shares outstanding (CSHO from Compustat). BVPS Book value per share in year t calculated as book value of equity (CEQ from Compustat) divided by the number of shares outstanding. RDAS is R&D expense (XRD from Compustat) to total asset (AT from Comupstat) ratio. RDCAPS is R&D capital to total asset ratio. ONE is one-time items per share calculated as one-time items (i.e. sum of extraordinary items (XI from Compustat), discontinued operations (DISC from Compustat) and special items (SPI from Compustat)) divided by the number of shares outstanding. LOSS is frequency of loss. A firm is considerd to be a loss firm if core earnings (net income (NI from Compustat) minus one-time items) is less than zero. MV is market value of equity; calculated as share price times shares outstanding three months after fiscal year end both from CRSP. ONEP is absolute value of one-time items as a percentage of core earnings.

Table 2

Value-Relevance of Accounting Information for Intangible-Intensive and Not Intangible-Intensive Industries [a, b]

	Equation (4)			**Equation (5)**		**Equation (6)**		**(A) – (C)**	**(A) – (B)**
	a_1	**a_2**	**(A) R^2**	**b_1**	**(B) R^2**	**c_1**	**(C) R^2**	**INCR-E** [d]	**INCR-B** [d]
Not Intangible-Intensive	4.626 (33.75)	0.608 (19.41)	0.606	7.464 (38.68)	0.535	0.904 (29.24)	0.512	0.094	0.071
Intangible-intensive	5.337 (22.09)	0.916 (14.01)	0.576	8.702 (41.15	0.474	1.303 (31.49)	0.491	0.085	0.102
Difference (p-value of t-stat) [c]	0.00	0.00	0.42	0.00	0.08	0.00	0.51	0.13	0.01

Notes:

[a] Intangible-intensive and not intangible-intensive industries and variable definitions are in Table 1.

[b] This table presents the mean coefficient estimates from cross-sectional estimation of equation (4) to (6). The t-statistics are calculated based on the variation of annual coefficient estimates based on Fama&McBeth (1973) procedure. T-statistics are reported in parentheses.

[c] p-value of t-statistics for the difference between intangible-intensive and other firms (two-sided).

$$P_{it} = a_0 + a_1\ EPS_{it} + a_2\ BVPS_{it} + \varepsilon_{it} \qquad (4)$$

$$P_{it} = b_0 + b_1\ EPS_{it} + \varepsilon_{it} \qquad (5)$$

$$P_{it} = c_0 + c_1\ BVPS_{it} + \varepsilon_{it} \qquad (6)$$

[d] **Definition of Variables:**

INCRE-E (INCRE-B) is incremental R^2 from EPS (BVPS). INCRE-E (INCRE-B) is generated by deducting the R^2 for book value (earnings) in equation 6 (5) from total R^2 in equation 4.

Table 3

Value-Relevance of Accounting Information with Adjusted Earnings and Book Values [a, b]

	Equation (4')			Equation (5')		Equation (6')		(A) – (C)	(A) – (B)
	a_1	a_2	(A) R^2	b_1	(B) R^2	c_1	(C) R^2	INCR-E [d]	INCR-B [d]
Not Intangible-Intensive	4.522 (33.39)	0.591 (18.73)	0.613	7.340 (34.18)	0.541	1.088 (28.34)	0.519	0.094	0.072
Intangible-intensive			0.582	8.345 (46.39)	0.511	1.300 (31.18)	0.496	0.086	0.071
Difference (p-value of t-stat) [c]	0.00	0.00		0.00		0.00		0.17	0.85

Notes:

[a] Intangible-intensive and not intangible-intensive industries and variable definitions are in Table 1.

[b] This table presents the mean coefficient estimates from cross-sectional estimation of equation (4') to (6'). The t-statistics are calculated based on the variation of annual coefficient estimates based on Fama&McBeth (1973) procedure. T-statistics are reported in parentheses.

[c] p-value of t-statistics for the difference between intangible-intensive and other firms (two-sided).

$P_{it} = a_0 + a_1 \text{ EPSAJ}_{it} + a_2 \text{ BVPSAJ}_{it} + \varepsilon_{it}$ (4')

$P_{it} = b_0 + b_1 \text{ EPSAJ}_{it} + \varepsilon_{it}$ (5')

$P_{it} = c_0 + c_1 \text{ BVPSAJ}_{it} + \varepsilon_{it}$ (6')

[d] **Definition of Variables:**

INCRE-E (INCRE-B) is incremental R^2 from EPS (BVPS). INCRE-E (INCRE-B) is generated by deducting the R^2 for book value (earnings) in equation 6 '(5') from total R^2 in equation 4.

Table 4

The Impact of CV of Scale Factor on Value-Relevance of Accounting Information [e]

Panel A: Descriptive Statistics

	MEAN			MEDIAN		
Variables [e]	**Intangible** [b]	**Not Intangible** [b]	**p-value of difference** [c]	**Intangible** [b]	**Not Intangible** [b]	**p-value of difference** [d]
CV_P	1.406	1.110	0.00	1.405	1.165	0.00
CV_BVPS	1.266	0.956	0.00	1.231	0.931	0.00

Panel B: Regression of R^2 from Equation (4) on CV of Scale Factor Proxies [d]

	I	II	III	IV
INT	-0.030 (-0.94)	-0.087 (-3.36)	-0.148 (-3.84)	-0.181 (-5.45)
CV_P		0.194 (4.30)		0.173 (4.11)
CV_BVPS			0.347 (4.29)	0.319 (4.09)
R^2	0.013	0.247	0.248	0.413

Panel C: Regression of R^2 from Equation (5) on CV of Scale Factor Proxies [d]

	I	II	III	IV
INT	-0.061 (-1.72)	-0.152 (-5.11)	-0.161 (-4.81)	-0.219 (-6.04)
CV_P		0.309 (6.18)		0.288 (5.97)
CV_BVPS			0.418 (5.63)	0.236 (3.03)
R^2	0.054	0.418	0.348	0.482

Panel D: Regression of R^2 from Equation (6) on CV of Scale Factor Proxies [d]

	I	II	III	IV
INT	-0.009 (-1.44)	-0.086 (-3.41)	-0.152 (-4.81)	-0.190 (-7.03)
CV_P		0.221 (5.18)		0.183 (5.42)
CV_BVPS			0.418 (5.63)	0.364 (5.84)
R^2	0.0361	0.247	0.348	0.562

Notes:
[a] Intangible-intensive and not intangible-intensive industries are defined in Table 1.
[b] p-value of t-statistics for the difference between intangible-intensive and other firms (two-sided).
[c] p-value of z-stat based on Wilcoxon rank sum test for the difference between intangible-intensive and other firms (two-sided).
[d] This table presents the mean coefficient estimates from equation (7). T-statistics are reported in parentheses.

$$R^2_{pt} = \beta_0 + \beta_1 \, INT_{pt} + \beta_2 \, CV\_P_{pt} + \beta_3 \, CV\_BVPS_{pt} + \varepsilon_{pt} \qquad (7)$$

[e] **Definition of Variables:**

R^2_{pt}	is R^2 from estimation of equation (4), (5) or (6) for group p in year t (there are two groups: intangible-intensive and not intangible-intensive).
INT_{pt}	is an indicator variable which equals one for intangible-intensive group and zero for not intangible-intensive. The industries in intangible-intensive group as defined as by CMW Not intangible-industries are all industries except intangible-intensive industries.
CV_P_{pt}	is coefficient of variation of share price for group p in year t (it is calculated as standard deviation of share price divided by absolute value of mean).
CV_BVPS_{pt}	is coefficient of variation for book value per share for group p in year t (it is calculated as standard deviation of book value per share divided by mean).

Table 5

The Impact of CV of Scale Factor Proxies on Value-Relevance of Accounting Information with Adjusted Earnings and Book Values [e]

Panel A: Descriptive Statistics

	MEAN			MEDIAN		
Variables [e]	Intangible [b]	Not Intangible [b]	p-value of difference [c]	Intangible [b]	Not Intangible [b]	p-value of difference [d]
CV_BVPSAJ	1.242	0.974	0.00	1.201	0.969	0.00

Panel B: Regression of R^2 from Equation (4') on CV of Scale Factor Proxies [d]

	I	II	III	IV
INT	-0.012 (-0.39)	-0.061 (-2.39)	-0.102 (-3.64)	-0.118 (-4.47)
CV_P		0.167 (3.85)		0.114 (2.79)
CV_BVPSAJ			0.334 (4.91)	0.276 (4.01)
R^2	0.004	0.199	0.286	0.368

Panel C: Regression of R^2 from Equation (5') on CV of Scale Factor Proxies [d]

	I	II	III	IV
INT	-0.030 (-0.89)	-0.111 (-3.89)	-0.135 (-3.82)	-0.165 (-5.41)
CV_P		0.277 (5.74)		0.225 (4.79)
CV_BVPSAJ			0.390 (4.51)	0.270 (3.55)
R^2	0.016	0.361	0.262	0.467

Panel D: Regression of R^2 from Equation (6') on CV of Scale Factor Proxies [d]

	I	II	III	IV
INT	-0.024 (-0.80)	-0.089 (-3.70)	-0.135 (-5.21)	-0.159 (-6.89)
CV_P		0.224 (5.52)		0.161 (4.62)
CV_BVPSAJ			0.416 (6.56)	0.330 (5.70)
R^2	0.014	0.343	0.422	0.574

Notes:
[a] Intangible-intensive and not intangible-intensive industries are defined in Table 1.
[b] p-value of t-statistics for the difference between intangible-intensive and other firms (two-sided).
[c] p-value of z-stat based on Wilcoxon rank sum test for the difference between intangible-intensive and other firms (two-sided).
[d] This table presents the mean coefficient estimates from equation (7). T-statistics are reported in parentheses.

$$R^2_{pt} = \beta_0 + \beta_1\ INT_{pt} + \beta_2\ CV\_P_{pt} + \beta_3\ CV\_BVPSAJ_{pt} + \varepsilon_{pt} \qquad (7')$$

[e] **Definition of Variables:**

R^2_{pt}	is R^2 from estimation of equation (4'), (5') or (6') for group p in year t (there are two groups: intangible-intensive and not intangible-intensive).
INT_{pt}	is an indicator variable which equals one for intangible-intensive group and zero for not intangible-intensive. The industries in intangible-intensive group as defined as by CMW Not intangible-industries are all industries except intangible-intensive industries.
CV_P_{pt}	is coefficient of variation of share price for group p in year t (it is calculated as standard deviation of share price divided by absolute value of mean).
CV_BVPSAJ_{pt}	is coefficient of variation for adjusted book value per share for group p in year t (it is calculated as standard deviation of book value per share divided by mean).

Table 6

The Intertemporal Pattern in Value-Relevance of Accounting Information for Intangible-Intensive and Not Intangible-Intensive Industries [a, b]

Panel A: Intertemporal Pattern in Total R^2 from Equation (4)

Variables [d]	Equation (8)	Equation (9) without control	Equation (9)
TIME	-0.005 (-2.97)	-0.002 (-1.17)	-0.002 (-0.96)
INT		0.060 (1.48)	-0.014 (-0.24)
INT * TIME		-0.006 (-2.65)	-0.007 (-3.07)
CV_P	-0.095 (-1.36)		-0.033 (-0.35)
CV_BVPS	0.181 (2.78)		0.314 (4.40)
R^2	0.2801	0.321	0.492
[d] F-test: TIME + INT * TIME = 0		24.69**	13.44**

Panel B: Intertemporal Pattern in Incremental R^2 from EPS

Variables [d]	Equation (8)	Equation (9) w/o control	Equation (9)
TIME	-0.001 (-0.74)	0.001 (1.71)	0.000 (0.09)
INT		0.006 (0.48)	0.046 (2.48)
INT * TIME		-0.001 (-1.79)	-0.002 (-2.20)
CV_P	-0.003 (-0.23)		-0.045 (-1.58)
CV_BVPS	0.049 (2.55)		0.065 (-2.89)
R^2	0.181	0.119	0.264
[d] F-test: TIME + INT * TIME = 0		0.06	2.61*

Panel C: Intertemporal Pattern in Incremental R^2 from BVPS

Variables [d]	Equation (8)	Equation (9) w/o control	Equation (9)
TIME	0.002 (2.71)	0.001 (2.28)	0.001 (1.48)
INT		-0.003 (-1.68)	-0.043 (-1.76)
INT * TIME		0.004 (4.26)	0.004 (3.87)
CV_P	-0.102 (-1.78)		-0.045 (-1.58)
CV_BVPS	0.136 (3.50)		0.065 (-2.89)
R^2	0.489	0.604	0.6293
[d] F-test:			
TIME + INT * TIME = 0		70.64**	16.28**

Notes:

[a] Intangible-intensive and not intangible-intensive industries are defined in Table 1.

[b] This table presents the coefficient estimates from equations (8) and (9). T-statistics are reported in parentheses.

$R^2_t = \beta_0 + \beta_1 \text{ TIME}_t + \beta_2 \text{ CV\_EPS}_t + \beta_3 \text{ CV\_BVPS}_t + \varepsilon_t$ (8)

$R^2_{pt} = \beta_0 + \beta_1\text{TIME}_{pt} + \beta_2\text{INT}_{pt} + \beta_3\text{INT}_{pt}*\text{TIME}_{pt} + \beta_4\text{CV\_EPS}_{pt} + \beta_5\text{CV\_BVPS}_{pt} + \varepsilon_{pt}$ (9)

[c] F-test results show whether the sum of coefficient estimates of TIME_{pt} + $\text{INT}_{pt}*\text{TIME}_{pt}$ equals zero in equation (9). * and ** shows statistical significance at 10% and 5% respectively, with the F-test.

[d] Definition of Variables:

TIME_{pt}	is year t minus 1975 for group p.
R^2_{pt}	is either R^2 from estimation of equation (4) or incremental R^2 for EPS and BVPS for group p in year t (there are two groups: intangible-intensive and not intangible-intensive).
INT_{pt}	is an indicator variable which equals one for intangible-intensive group and zero for not intangible-intensive. The industries in intangible-intensive group as defined as by CMW Not intangible-industries are all industries except intangible-intensive industries.
CV_P_{pt}	is coefficient of variation of share price for group p in year t (it is calculated as standard deviation of share price divided by absolute value of mean).
CV_BVPS_{pt}	is coefficient of variation for book value per share for group p in year t (it is calculated as standard deviation of book value per share divided by mean).