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Timely Industry Information as an Assurance Service: Evidence on the Information Content of the Book-to-Bill Ratio

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SUMMARY

Assurance services include independent professional services that improve the quality of information. One such service is the collection of confidential information from participating firms on behalf of an industry association and the release of summarized information to investors. An example of this type of service is the collection of industry-wide information for the Semiconductor Industry Association. The primary output from this process is the monthly release of a ratio of new orders received to chips shipped, known as the book-to-bill ratio.

We evaluate the association between book-to-bill disclosures and common stock prices. Statements in the financial press suggest that the book-to-bill index is an important indicator of future demand in the semiconductor industry. Because changes in the book-to-bill ratio signal impending changes in sales, the index may be relevant information for firm valuation.

Our results suggest that investors in semiconductor firms utilize the book-to-bill ratio in revising their expectations of future cash flows. Specifically, we find (1) that eight of the 36 monthly book-to-bill announcements occurring during 1994 through 1996 produced share price reactions significant at the 10 percent level, and (2) that the price response across the subset of "good news" disclosures is positively related to the change in the book-to-bill ratio.

Key Words: Assurance services, Compilation, Industry statistics.

Data Availability: All data were obtained from publicly available sources.

INTRODUCTION

A key to successful growth of future assurance services is for public accountants to identify performance measures that are useful to decision makers (Thesberg 1996). The monthly release of the book-to-bill ratio (hereafter BTB) by the Semiconductor Industry Association provides an opportunity to examine the significance of the information content of industry-wide order data to investors. If such information is of value to investors, then there may be a market for accounting firms as reputable collectors and distributors of this information (Elliott 1995).

The Semiconductor Industry Association employs Price Waterhouse LLP to collate data from firms, to investigate questionable data submitted by companies, and to calculate the BTB. Because confidential order and sales data must be obtained from participating companies in order to calculate the aggregate industry data there is an opportunity for public accounting firms to design, collect and distribute this type of information. The public accounting firm has

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the credibility to collect and to verify sensitive data, to maintain adequate controls over the confidentiality of the data, and to prepare summarized information for release to interested parties. This would appear to be a service within the definition of assurance services as "independent professional services that improve the quality of information, or its context, for decision makers" (AICPA 1997).

One assurance service of interest to accountants is the ability to provide leading indicators of financial performance (AICPA 1997). The monthly release of the book-to-bill ratio potentially provides information on industry demand to investors that is provided on a more timely basis than quarterly earnings reports. A tradeoff, of course, is that the information is less reliable than that provided in financial statements[1] and that the data is provided only at the industry level, and therefore may not provide value-relevant information for individual firms.

For investors, timeliness is one of the most highly desired attributes of financial data.[2] Because of the nature of accounting data, however, timeliness often is sacrificed for relevance or reliability. With most accounting information systems, for example, the earliest time transactions can be recorded is when an order is placed. Revenue is subsequently recognized at the point of sale and the associated earnings typically are not revealed until the end of the quarter. As a result, the earliest point at which users have access to some sets of potentially value-relevant financial statement information is the quarterly report date.[3]

We address the question of whether more timely monthly information regarding industry orders is deemed value-relevant by investors. Specifically, we examine the information content of the book-to-bill ratio, disclosed monthly by the Semiconductor Industry Association (SIA), the semiconductor industry's primary trade group. The BTB ratio offers an example of a timely disclosure of accounting-based data on an industry-wide basis, by providing an aggregate comparison of new orders to shipments. By construction, BTB ratios above (below) 1.00 are indicative of increasing (decreasing) semiconductor chip orders and, hence, higher (lower) levels of future chip sales. Press reports suggest that the measure is taken by financial analysts to be an indicator of demand for chips and as a "bellwether indicator for technology stocks" (*Wall Street Journal* 1996a).

Our results suggest that investors use BTB information in revising their expectations of future cash flows. We find that 22 percent of the individual BTB ratio announcements made between January 1994 and December 1996 are associated with a stock price response that is significant at the 10 percent level for a portfolio of firms in the semiconductor industry. We also classify BTB releases as being indicative of either "good news" or "bad news," depending on the relation between the current period's index and the previous period's index. Using this specification, we document a significant positive average share price response to "good news" announcements but an insignificant response to "bad news" announcements. Our results are generally consistent with the notion that timely releases of accounting-based data, even on an industry-aggregate basis, are useful to investors.

The release of a single indicator is not a large market for assurance services. Further, we can examine only the observable market reactions to the indicator and not the value added by the public accounting firms involved. On the other hand, the release of the BTB ratio is an observable nonaudit assurance service that provides some evidence about the viability of similar services (Kinney 1987, 1996; Fargher and Gramling 1996).

The remainder of this paper is organized as follows. The next section provides some institutional background regarding the BTB ratio. The third section develops hypotheses regarding the potential information content of BTB news releases. We then describe the sample

[1] For example, one press report quotes industry analysts as stating that "investors are only dimly aware of the ratio's shortcomings" (*Wall Street Journal* 1996a).

[2] Refer to AIMR (1993) and FASB (1978) for discussions of the need for timeliness.

[3] Previous literature (Stober 1993; Bernard and Noel 1991) has examined the usefulness of inventory and accruals in predicting future earnings, but these studies still rely on quarterly data to predict future quarter earnings.

selection procedure and empirical method, followed by the results of our empirical tests. We then discuss implications of our findings with respect to the market for the provision of information, and conclude with a summary of our findings and implications for future research.

BACKGROUND

The book-to-bill ratio is compiled monthly by Price Waterhouse LLP on behalf of the Semiconductor Industry Association (SIA)[4] based on surveys of firms that manufacture semiconductors. The numerator of the BTB ratio represents a seasonally adjusted, three-month moving average of new orders received, while the denominator represents a seasonally adjusted, three-month moving average of chips shipped. A BTB ratio of $1.10 indicates, therefore, that $1.10 in new orders have been received for every $1 of chips shipped, which ordinarily would be interpreted as a positive signal regarding future industry sales levels.

The accounting firm collects data from a voluntary sample of companies on the fifth business day of the month. The SIA issues a press release containing the preliminary estimate of the index for the previous month between the ninth and the twelfth of each month. The news release is made from California and is picked up on the newswire. The release of the BTB ratio was reported in the *Wall Street Journal* on the following day for all releases during 1995 and 1996, and for ten of the 12 releases in 1994. The *Wall Street Journal* typically reports the value of the BTB index for the month, a definition of the index, and the change from the previous month's index. In addition, comments are sometimes solicited from firms in response to the release of the index. For example, a spokesman for Advanced Micro Devices responded to a decline in the index by stating that "the stock market murders all chip stocks but the industry is fundamentally sound" (*Wall Street Journal* 1996a). The SIA does not typically include the name of the accounting firm in the BTB press release.

The first release of the BTB ratio is technically a preliminary figure that is frequently adjusted by a small amount in the following month. However, it is the preliminary figure which attracts the primary news coverage and which would be expected to convey the most new information to the market. The adjustments to the preliminary BTB announcements were not found to be associated with stock returns and are not considered further in this study.

Chandra et al. (1997) find a significant correlation between changes in the BTB and subsequent changes in quarterly earnings. Chandra et al. (1997) also find significant stock price movements on BTB release dates. Our study is similar to that of Chandra et al. (1997) and the results of both studies are generally consistent in finding that the BTB announcements do provide information to investors. While Chandra et al. (1997) focus on the impact of the BTB release on the stock prices for a small sample of semiconductor manufacturers, our study examines the broader industry-wide information effects for firms in the semiconductor, semiconductor components and technology areas.

DEVELOPMENT OF HYPOTHESES

The disclosure of estimates of industry demand for a product would seem to be relevant to firm value. Information on the demand for a firm's product appears to satisfy the definition of relevance by "improving decision-makers' capacities to predict or by confirming or correcting their earlier expectations" (FASB 1980, paragraph 51). To the extent that new orders received exceed orders shipped, the ratio provides a measure of the direction and magnitude of the growth in demand for semiconductor chips. Furthermore, to the extent that the ratio predicts changes in future cash flows, the ratio provides more timely pricing information than subsequent quarterly sales or earnings information. If the BTB ratio provides value-relevant information to investors on a timely basis, then we would expect to find a significant market reaction to releases of the BTB ratio.

While it may appear obvious that a measure of changes in demand for semiconductors should impact the value of firms manufacturing

[4] For background on the Semiconductor Industry Association refer to Procassini (1995).

semiconductors, there are several reasons to question the usefulness of the information. First, because the information is only available on an industry-wide basis, it may not be sufficient to alter a specific firm's price. Along the same lines, a presumption of value-relevance would require us to assume that aggregate monthly order fluctuations materially affect the long-term value of individual stocks. Furthermore, the ratio includes only American sales and orders that account for only about 30 percent of world demand. Finally, and perhaps most importantly, even if BTB information is both timely and relevant, such characteristics are not sufficient for the data to consistently influence firm value. The information must also be reliable, which FASB (1980) Concept Statement No. 2 defines as the quality that "assures that information is reasonably free from error and bias and faithfully represents what it purports to represent." An industry survey of firm orders is not comprehensive and is not verifiable, so its reliability must be questioned as well.[5]

Given the reasons to believe that the provision of the BTB ratio is of interest to investors, and the reasons to question the relevance and/or reliability of the ratio, we believe that empirical research can provide evidence regarding the net effect of these factors on market prices. The general hypothesis, stated in the null form, is that there is no association between announcements of the BTB ratio and stock prices. Consistent with our use of an event study methodology we specifically examine two directional hypotheses, stated in the alternate form:

H1a: Share prices of semiconductor firms respond positively to increases in the book-to-bill ratio.

H1b: Share prices of semiconductor firms respond negatively to decreases in the book-to-bill ratio.

SAMPLE SELECTION AND RESEARCH METHOD

Sample Selection

Book-to-Bill Announcements

We use all of the monthly BTB ratio announcements occurring between January 1994 and December 1996, resulting in a sample of 36 BTB announcement dates. Announcements occurring after April 1994 are taken from the *PR Newswire* (which is the day prior to the publication of related stories in the *Wall Street Journal*). The announcement dates for January 1994 through March 1994 are taken from disclosure in the *Wall Street Journal.* Because the announcements are deliberately timed to be released after the NYSE closes, and consistent with previous event studies, we define the *Wall Street Journal* announcement date as event day zero. We study a two-day event period covering the *Wall Street Journal* announcement date and the previous day, on which the newswire release was made, as event day minus one.

Sample of Firms in the Semiconductor Industry

To identify firms in the semiconductor manufacturing industry we initially selected a sample of 97 firms listed on Compustat as having an SIC code of 3674. This industry grouping includes semiconductor and related component manufacturing. To the extent that the BTB ratio has broader ramifications for software firms and other firms in related industries, the results associated with our sample of firms will underestimate the information content of the book-to-bill announcements.[6] By restricting our sample to include only semiconductor firms, that is the firms most directly influenced by the BTB index, we provide a more powerful test of the information content of the announcements. This category does however include some firms that are not directly involved in chip manufacture and this could reduce the power of our tests.

Of the 97 firms initially identified 73 have sufficient returns data available from CRSP for the three-year period required by our tests.[7] In

[5] For theoretical discussion of why it may be Pareto-preferred for firms to exchange information of an unknown demand parameter refer to Kirby (1988).

[6] We also examined a sample of 140 firms categorized by I/B/E/S as being involved in the manufacture of semiconductor or related activities. The results were consistent with the results reported.

[7] To be included in the final sample, firms must have at least 50 percent non-missing daily returns for the entire period from January 1, 1994 to December 31, 1996.

order to reduce the impact of outliers on the regression residuals, we subsequently exclude three firms with systematic risk (beta) greater than three standard deviations from the sample mean, resulting in a sample of 70 firms.

Although our tests only rely on the time series of returns for a portfolio of the sample firms, we provide descriptive statistics as background information regarding the type of firms included in the sample portfolio. Table 1 provides descriptive statistics for our sample firms for fiscal year-end 1994. This sample of firms in the semiconductor industry mostly contains relatively small firms (median sales $95 million). To the extent that these firm's prices suffer from nonsynchronous trading, our tests are biased against finding a

TABLE 1
Descriptive statistics

Variable	Mean	Median	25% Quartile	75% Quartile
Panel A: Characteristics of Firms in the Sample (n=70 firms)				
Total Sales ($ Millions)[a]	675.04	95.45	35.45	223.32
Market value ($ Millions)[b]	1173.43	125.73	34.18	899.79
Net Income ($ Millions)[c]	80.34	4.69	0.79	31.70
Total Liabilities/Assets[d]	0.39	0.36	0.24	0.49
Long-Term Debt/Assets[e]	0.08	0.05	0.01	0.12
Return on Assets[f]	0.03	0.08	0.02	0.13
Beta[g]	1.30	1.08	0.68	1.97
Panel B: Distribution of Daily Returns Used in Statistical Tests (n=779 days)				
Portfolio of sample firms[h]	0.174%	0.196%	–0.571%	1.017%
CRSP Value-weighted market index	0.069%	0.083%	–0.232%	0.423%
Panel C: Distribution of Industry Data (n=36 months)				
Book-to-bill ratio[i]	1.052	1.085	0.980	1.140
Change in book-to-bill ratio	0.006	0.013	–0.035	0.049
Monthly sales[j]	3.336	3.335	2.770	3.835
Monthly orders	3.494	3.205	2.895	4.080

[a] Compustat data item #12 for fiscal year-end 1994 for the sample of 70 firms in the semiconductor and component manufacturing industry (SIC 3674).
[b] Compustat data items (#25 * #199).
[c] Compustat data item (#172).
[d] Compustat data items (#181 / #6).
[e] Compustat data items (#9 / #6).
[f] Compustat data items (#172 / #6).
[g] Beta parameter from market model estimated from January 1, 1994 to December 31, 1994.
[h] The return on an equal-weighted portfolio comprising the 70 firms in the sample.
[i] Book-to-bill ratio as announced in the initial monthly press release and reported in the *WSJ*.
[j] Sales and orders in billions as announced by the Semiconductor Industry Association in the monthly book-to-bill press releases.

timely reaction to BTB announcements.[8] Consistent with the sample containing relatively small firms, the mean beta (1.3 for 1994) is above the market average. However, the mean beta estimate for 1995 is 2.1, suggesting that the market model assumption of beta stationarity is not appropriate. We therefore include a dummy variable for the year in the extended market model equation to control for the shift in average beta between 1994 and 1995.[9] The sample also includes a few larger, established firms causing some skewness in the sample distribution of firm size, sales and net income. This cross-sectional skewness does not directly influence our tests except in our choice of an equal weighting of firms when forming the portfolio of sample firms to mitigate the influence of the few large firms in the sample.

Research Method

Event Study for Multiple Events Clustered in Calendar Time

Tests of significance in traditional event studies typically rely on the assumption that disturbances in the returns generating process are cross-sectionally independent. Our study includes 36 event dates that are the same across all firms; therefore, it is inappropriate to assume that the returns do not covary. This problem is analogous to that found in studies of announcements regarding proposed changes in accounting standards. We therefore follow a methodology similar to that used by Hughes and Ricks (1984) and Espahbodi et al. (1995) to account for the cross-sectional dependence between firm returns. We also control for the significant shift in equity beta occurring during 1995, as mentioned in the previous section.

In typical studies of clustered announcements, each news event relates to a different information release (e.g. Hughes and Ricks 1984; Espahbodi et al. 1995). However, our announcements contain a consistent measure, the BTB ratio, and we can therefore examine a specification of the above pooling announcements based upon whether the announcement is perceived to be "good news" or "bad news." In this specification our study includes two-event-period coefficients—one measuring the average abnormal return associated with positive news announcements and one measuring the average abnormal return associated with negative news announcements.

In order to partition announcements into those involving "good news" and those involving "bad news," certain assumptions must be made regarding the market's expectation of the BTB index. Based on the BTB reporting style (i.e., the index is adjusted monthly) and the fact that much accounting-based information reasonably approximates a random walk process, we use the previous month's BTB ratio as a proxy for the market's expectation for the current period's index. The BTB does not appear to follow a random walk in the period that we examine, however we find that stock price reactions are more closely associated with the random walk model that is consistent with the news story reporting than alternate models assuming predictable time-series components. To the extent that analysts can anticipate changes in the ratio in advance of the release of the index, this would reduce the power of our tests to identify the market's reaction to unexpected changes in the index.[10] Specifically, we estimate the model:

$$\bar{R}_t = \alpha + \beta_1 R_{mt} + \beta_2 (D95 \times R_{mt}) + \gamma_1 D_{Good,t} + \gamma_2 D_{Bad,t} + \varepsilon_t \quad (1)$$

where the dependent variable represents the portfolio (i.e., average) return on day t across the sample firms, and R_{mt} represents the CRSP value-weighted market return on day t. To control for the observed shift in equity beta, D95 is equal to one for all days during 1995 and 1996, and equal to 0 for all days during

[8] Similar results to those reported are obtained if a leading and lagging market index is included in the model (Scholes and Williams 1977) to allow for possible measurement error in beta due to nonsynchronous trading. Because the results are similar we report only the more parsimonious model.

[9] The beta for 1996 is 1.6. Addition of a variable for the shift in average beta in 1996 does not materially alter the results and hence we report the more parsimonious model without a 1996 shift parameter.

[10] The methodology to calculate the BTB ratio was altered in early 1995 to reduce the impact of seasonality and hence our simple expectation model would be expected to be less accurate prior to this period.

1994. $D_{Good,t}$ ($D_{Bad,t}$) takes the value one where the announced BTB ratio increases (decreases) over the prior month, and zero otherwise.

To examine the consistency of the stock price response to the BTB announcements during the period of our study, we use a second specification with a separate coefficient for each of the 36 event dates. In this specification there are 36 event-period coefficients measuring the average abnormal return associated with BTB news announcements.

Specifically, our empirical model is:

$$\bar{R}_t = \alpha + \beta_1 R_{mt} + \beta_2 (D95 \times R_{mt}) + \sum_{k=1}^{36} \gamma_k D_{kt} + \varepsilon_t \quad (2)$$

where D_{kt} represents 36 indicator variables each set equal to one on days −1 and 0 relative to each of the 36 BTB ratio announcement dates, and equal to zero on all other days. We use indicator variables to indicate the BTB release dates in the initial specification, rather than the actual change in the BTB, to avoid the need to assume a particular expectation model. In this framework, the coefficients on the announcement period indicator variables (γ_k) measure the average abnormal returns associated with each of the BTB announcements (k=36).

EMPIRICAL RESULTS

Event study

Table 2 presents the results of our analysis of the 36 BTB announcements. Panel A includes all 36 BTB announcements, classifying each announcement as either "good" or "bad." The average abnormal return associated with "good news" disclosures is positive and significant, while the average abnormal return associated with "bad news" disclosures is negative but not significantly different from zero. Announcements of increases in the BTB ratio appear to have a greater impact on prices. A null hypothesis of equal coefficients on the good news and bad news events can be rejected at the alpha level of 10 percent (F = 2.63).

In panel B of table 2, we estimate a restricted form of the model that only includes announcements of the largest increases and decreases in the BTB ratio. We only include the changes in the BTB that exceed 5 percent. By examining only the largest changes in the BTB ratio this specification should provide a more powerful test of the information content of the more newsworthy announcements. The average abnormal return associated with "best news" announcements is positive and significant, and is also larger than that associated with mere "good news" announcements. Again the coefficient on the bad news announcements is negative and not significantly different from zero. A null hypothesis of equal coefficients on the good news and bad news events can not be rejected (F = 2.57, probability > F is 0.109).

Panel C of table 2 tests for an association between the magnitude of the changes in the BTB and the magnitude of portfolio returns. Our findings here suggest, again, that investors value BTB disclosures. The average abnormal return is positively associated with changes in the BTB for announcements of increases in the BTB. Consistent with the previous specifications we fail to find significance for the announcements of decreases in the BTB. A null hypothesis of equal coefficients on the good news and bad news events can not be rejected (F = 2.01, probability > F is 0.156).

As is typical with studies examining equity returns data, the residuals from the regressions reported in table 2 depart from normality. Although the Durbin-Watson test statistics fail to indicate significant autocorrelation, we cannot reject the null of serial independence in the residuals (using Ljung-Box tests at longer lag lengths). Our t-statistics could potentially be biased upwards. We therefore estimate a GARCH model which encompasses an autocorrelation correction and is more robust to departures from normality (see Connolly 1989; Bollerslev et al. 1992). Panel D of table 2 reports the parameter estimates using a GARCH(1,1) model. The ARCH and GARCH terms in the variance equation are found to be significantly different from zero. Consistent with the ordinary least squares estimates we find that the coefficient on increases in the BTB is positive and significant, but we fail to find a significant reaction to decreases in the BTB.

Table 3 presents the results of our analysis of the 36 individual BTB ratio announcements

TABLE 2
Results for the Model with Book-to-Bill Announcements
Partitioned by Good News/Bad News

Panel A: All Announcements of the BTB Ratio

$$\overline{R}_t = \alpha + \beta_1 R_{mt} + \beta_2 D95.R_{mt} + \gamma_1 D_{Good,t} + \gamma_2 D_{Bad,t} + \varepsilon_t$$

Regression Coefficient	Parameter Estimate	t-statistic
α	0.0003	0.84
β_1	1.4626	19.64**
β_2	0.5905	3.72**
γ_1 (Good news)	0.0037	2.09*
γ_2 (Bad news)	–0.0003	–0.18
n	779	
Adjusted R^2	0.44	
Model F-statistic	149.75	
Durbin-Watson	1.61	

Panel B: Major Changes in the BTB Ratio Only: The Extreme Best and Worst Changes in BTB Ratio

$$\overline{R}_t = \alpha + \beta_1 R_{mt} + \beta_2 D95.R_{mt} + \gamma_1 D_{Best,t} + \gamma_2 D_{Worst,t} + \varepsilon_t$$

Regression Coefficient	Parameter Estimate	t-statistic
α	0.0004	1.10
β_1	1.4600	19.57**
β_2	0.593	3.73**
γ_1 (Best)	0.0045	1.76*
γ_2 (Worst)	–0.0019	–0.61
n	779	
Adjusted R^2	0.44	
Model F-statistic	149.34	
D-W	1.60	

Panel C: The Association Between the Magnitude of Changes in the BTB Ratio and the Magnitude of Portfolio Returns

$$\overline{R}_t = \alpha + \beta_1 R_{mt} + \beta_2 D95.R_{mt} + \gamma_1 (D_{Good,t} \cdot \Delta BTB_t) + \gamma_2 (D_{Bad,t} \cdot \Delta BTB_t) + \varepsilon_t$$

Regression Coefficient	Parameter Estimate	t-statistic
α	0.0003	0.864
β_1	1.4614	19.64**
β_2	0.5896	3.72**
γ_1 (Increases in BTB)	0.0775	2.50**
γ_2 (Decreases in BTB)	0.0149	0.49
n	779	
Adjusted R^2	0.44	
Model F-statistic	150.70	
D-W	1.61	

(Continued on next page)

TABLE 2 (Continued)

Panel D: The Association Between the Magnitude of Changes in the BTB Ratio and the Magnitude of Portfolio Returns Using a GARCH(1,1).

$$\overline{R}_t = \beta_0 + \beta_1 R_{mt} + \gamma_1 (D_{Good,t} \cdot \Delta BTB_t) + \gamma_2 (D_{Bad,t} \cdot \Delta BTB_t) + \varepsilon_t$$

$$\sigma^2_{\varepsilon,t} = \varpi + \alpha_1 \varepsilon^2_{t-1} + \alpha_2 \sigma^2_{\varepsilon,t-1}$$

Regression Coefficient	Parameter Estimate	Prob. (one-tailed)
Mean Equation:		
Intercept (β_0)	0.1184	<.001**
Beta (β_1)	1.4573	<.001**
Increases in BTB(γ_1)	0.5259	0.008**
Decreases in BTB(γ_2)	0.3341	0.900
Variance Equation:		
Intercept(ω)	0.0058	0.110
GARCH term(α_1)	0.9560	<.001**
ARCH term (α_2)	0.0398	<.001**
N	777	

* Significant at p<=0.05.

** Significant at p<=0.01(one-tailed).

Definition of variables:

R_t = the return for a portfolio of the sample firms from the semiconductor industry.

R_{mt} = the return on the CRSP value-weighted market index.

D95 = 1 during 1995, and 0 during 1994.

D_{GOOD} = 1 for days –1 and 0, relative to positive BTB change announcements; D_{GOOD} = 0 for all other days.

D_{BAD} = 1 for days –1 and 0, relative to negative BTB change announcements; D_{BAD} = 0 for all other days.

D_{BEST} = 1 for days –1 and 0, relative to 9 BTB announcements with increases > 5%; D_{BEST} = 0 for all other days.

D_{WORST} = 1 for days –1 and 0, relative to 6 worst BTB change with decreases > 5%; D_{WORST} = 0 for all other days.

ΔBTB_t = the change in the BTB in month t.

(equation (2) above). For the primary sample of 70 firms in the semiconductor industry, we find five of the announcements to be associated with significant share price responses at the alpha level of 5 percent, and a further three announcements to be significant at the alpha level of 10 percent.[11] The evidence in table 3 is weakly consistent with the notion that investors find BTB disclosures to be value-relevant and that expectations regarding future cash flows are revised in accordance with the direction of changes in the BTB index.

We used a randomization test (Noreen 1989) to examine the probability of getting eight of the 36 (22 percent) event-day coefficients significant at the 10 percent level by chance. We replicated draws selecting 36 event days at random from the sample series of 779 daily returns. We reestimated the regression model

[11] Our regression diagnostics revealed no significant heteroskedasticity and marginal first-order autocorrelation (Durbin Watson statistic 1.65). Our results are qualitatively unchanged when we correct for autocorrelation using a two-step full transform method.

TABLE 3
Results for Model with 36 Individual Announcements of the BTB Ratio

$$\bar{R}_t = \alpha + \beta_1 R_{mt} + \beta_2 (D95 \times R_{mt}) + \sum_{k=1}^{36} \gamma_k D_{kt} + \varepsilon_t$$

		Semiconductor Firms		All Technology Firms	
Parameter	**Change in BTB**	**Parameter**	**t-statistic**	**Parameter**	**t-statistic**
α		0.000	0.79	0.001	2.07
β_1		1.494	19.96**	1.237	27.68**
β_2		0.575	3.58**	0.215	2.25*
γ_1 (Jan 94)	5.1%	0.009	1.15	0.006	1.36$^{\delta}$
γ_2 (Feb 94)	2.9	0.009	1.08	0.005	1.14
γ_3 (Mar 94)	7.5	–0.002	–0.31	0.001	0.16
γ_4 (Apr 94)	–1.7	–0.012	–1.66*	–0.008	–1.88*
γ_5 (May 94)	0.9	0.000	0.00	0.000	0.11
γ_6 (Jun 94)	0.0	0.000	0.00	–0.001	0.29
γ_7 (Jul 94)	–5.3	0.007	0.92	0.002	0.43
γ_8 (Aug 94)	–3.7	0.014	1.87	0.003	0.64
γ_9 (Sep 94)	0.0	0.009	1.23	0.004	0.89
γ_{10} (Oct 94)	–1.0	–0.002	–0.23	0.003	0.56
γ_{11} (Nov 94)	–5.8	–0.005	–0.67	–0.001	0.22
γ_{12} (Dec 94)	2.1	0.003	0.46	–0.003	0.58
γ_{13} (Jan 95)	6.1	0.004	0.58	0.001	0.24
γ_{14} (Feb 95)	4.8	0.013	1.73*	0.006	1.39$^{\delta}$
γ_{15} (Mar 95)	1.8	0.000	0.00	0.003	0.68
γ_{16} (Apr 95)	1.8	0.007	0.98	0.004	1.00
γ_{17} (May95)	3.5	–0.001	–0.07	–0.003	0.58
γ_{18} (Jun 95)	3.4	–0.008	–1.12	–0.004	0.94
γ_{19} (Jul 95)	–4.1	0.002	0.22	0.007	1.46
γ_{20} (Aug 95)	4.3	0.010	1.39$^{\delta}$	0.003	0.78
γ_{21} (Sep 95)	–3.3	–0.004	–0.51	0.002	0.41
γ_{22} (Oct 95)	–5.9	–0.012	–1.62$^{\delta}$	–0.016	–3.54**
γ_{23} (Nov 95)	6.3	0.003	0.40	–0.000	0.05
γ_{24} (Dec 95)	–3.4	–0.011	–1.43$^{\delta}$	–0.006	–1.35$^{\delta}$
γ_{25} (Jan 96)	–4.4	0.015	2.00	0.007	1.55
γ_{26} (Feb 96)	–14.7	–0.013	–1.74*	–0.008	–1.71*
γ_{27} (Mar 96)	–3.2	0.003	0.37	0.002	0.49
γ_{28} (Apr 96)	–11.1	0.016	2.24	0.010	2.35
γ_{29} (May 96)	–2.5	–0.008	–1.02	0.001	0.29
γ_{30} (Jun 96)	7.6	0.003	0.39	–0.001	–0.28
γ_{31} (Jul 96)	8.3	–0.011	–1.58	–0.011	–2.55
γ_{32} (Aug 96)	–6.6	–0.004	–0.51	0.004	0.80
γ_{33} (Sep 96)	5.9	–0.002	–0.28	–0.005	–1.19
γ_{34} (Oct 96)	10.0	0.025	3.33**	0.007	1.54$^{\delta}$
γ_{35} (Nov 96)	11.1	0.014	1.83*	0.004	0.99
γ_{36} (Dec 96)	4.5	–0.004	0.50	0.003	0.63
n	779			779	
Adjusted R^2	0.445			0.587	
Durbin-Watson	1.64			1.50	

(Continued on next page)

TABLE 3 (Continued)

** Significant at p<=0.01(one-tailed).
* Significant at p<=0.05.
δ Significant at p<=0.10.

Notes and definition of variables:

$\bar{R}_t$ = the return for a portfolio of the sample firms from the semiconductor industry.
R_{mt} = the return on the CRSP value-weighted market index.
D95 = 1 during 1995, and 0 during 1994. This interactive indicator variable controls for an apparent shift in the beta of the sample during the period.
D_{kt} = 1 for days −1 and 0 relative to each of the 36 BTB announcements, and 0 for all other days.

The sample of semiconductor firms includes 70 firms in the semiconductor and component manufacturing industry (SIC 3674).
The sample of "all technology firms" includes 704 firms with the I/B/E/S segment designation for technology.

using each of the draws of pseudo-event days, and counted the number of significant coefficients in the direction of the change in the BTB for each drawing. The probability of getting eight or more coefficients significant at an alpha level of 10 percent is 0.035.

The results in table 3 are robust to our choice of sample. If we only include the 17 firms with direct involvement in the manufacture of semiconductors (as distinct from related components) and semiconductor manufacture is a major line of business (*Ward's Directory of Businesses, Market Share Reporter*),[12] eight of the announcements are significant. However, there is evidence that the BTB provides information for a broader segment of the semiconductor and components industry in that excluding the 17 firms with the highest exposure to semiconductor manufacture still yields significance for six announcements. These results are not reported for the sake of brevity.

Because press reports suggest that the BTB ratio has information content for technology firms beyond the semiconductor industry, we extended the analysis to consider all firms in the technology segment (as defined by I/B/E/S segment code). Columns five and six of table 3 replicate the results for a broader sample of 704 firms in the technology segment of the market. The results are generally consistent with the results for the semiconductor industry firms alone, with seven events having statistically significant responses to the change in the BTB at the 10 percent significance level. The economic significance is also of interest. The market value of technology firms in our expanded sample is 507 billion dollars at the end of 1994. An announcement day abnormal return of 0.6 percent represents approximately 3 billion dollars.

The daily returns for these firms are relatively volatile. Excluding outliers with returns greater than 10 percent in any one day results in 11 of the 36 events becoming significant. The results are not improved by the use of a more sophisticated expectation model to determine the sign of the news content of each announcement. For example, similar results are obtained if the change in orders component of the BTB is used as the expectation of whether the announcement is good or bad news. Only five announcements are found to be significant using an ARIMA(1,1,0) fitted to the order series as the expectation of the news content.

Predictive Value of the Book-to-Bill Ratio

Press reports suggest that the measure is taken by financial analysts to be an indicator of demand for chips (*Wall Street Journal* 1996a). If the BTB ratio is of value in predicting future demand for semiconductor chips, then we would expect the BTB ratio to be of value in any model of future chip sales. Announcement of sales monthly should help

[12] Similar results are obtained if we use the 22 firms listed in Chandra et al. (1997, appendix A).

analysts to predict future sales. Based upon the accounting relationships and industry ordering lead times, we would expect orders to quickly result in future sales and therefore to be a predictor of future sales.

Table 4 examines two prediction models for predicting monthly semiconductor sales—one using only lagged observations of sales and one using past observations of sales and past observations of orders. To obtain greater power we use BTB data from December 1991 to December 1996 in this test. As can be seen from columns (2) and (3) from table 4, inclusion of the lagged orders results in only a small improvement in the explanatory power of the model in terms of adjusted R^2 or using the Akaike (1969) information criterion (AIC). Columns (4) and (5) of table 4 replicate the prediction model in differences. That is, does the change in orders help to predict the future change in sales? The adjusted R^2 improves from 20.1 percent to 29.9 percent with the addition of the change in orders variable. The order information also adds explanatory power to the model as measured using the Akaike (1969) information criterion (AIC). The first lag of orders would also be included in the model using a forward stepwise selection technique to select variables adding explanatory power to the model.[13]

Recent Developments

Press reports suggest that analysts and executives have become increasingly dissatisfied with the manner in which the BTB data is calculated and used.[14] Dissatisfaction has arisen from the failure to include international data in the BTB and the apparent overreaction to changes in the index that fail to reflect the fundamentals of the industry. For example, one recent article states that "On the first trading days after the ratio was released in some of its weakest months [January, February 1996], investors trashed chip stocks and other tech stocks, sparking big selloffs that rattled the broader market" (*Wall Street Journal* 1996a). While industry executives offered fewer complaints when investors' apparent "overreliance" *benefited* semiconductor firms (i.e., via increased share prices), the point remains that the ratio is used—and perhaps misused—by investors in semiconductor firms.

In response to criticism that the BTB only reflects sales in North and South America, the Semiconductor Industry Association replaced the BTB with the Global Billings Report effective January 1997. The Global Billings Report is still compiled by Price Waterhouse LLP.[15] However, the Global Billings Report only includes sales and not orders. The Semiconductor Industry Association indicated that the order data was much harder to collect on a global basis. From an assurance perspective the change to a global basis highlights the opportunity for international firms to collect worldwide data. Analyst reaction to the change indicated that they believed that the new report did not give "as much insight into the future" and that the industry would have less data available to avoid costly under- or over-production.[16]

Further Discussion

At least one public accounting firm is responding to opportunities to provide assurance in related markets. Arthur Andersen LLP currently compiles data regarding the worldwide BTB ratio for semiconductor capital *equipment* manufacturers, based on data submitted by industry participants on behalf of Semiconductor Equipment and Materials International.[17] More specifically, industry associations can be viewed as potential customers whose assurance needs include the reliable assimilation and distribution of factors influencing firm value such as

[13] The forward selection technique begins with no variables in the model. To be added to the model an F-statistic is calculated reflecting the variable's contribution to the model if it is included. For a variable to be retained in the model it must have a probability level greater than .5. Variables are added in the order of greatest magnitude of contribution to the model. Refer to Judge et al. (1985).

[14] For example refer to "Chip Makers Up in Arms Over Book-to-bill Ratio" *Wall Street Journal* (1996a, A2.)

[15] Japanese firms send their data to Tohmatsu and the data is subsequently included in reports of world orders, sales and similar data.

[16] For example refer to "New Chip Index is Off to Rocky Start" *Wall Street Journal* (1996b, A2.)

[17] For details refer to "North American Semiconductor Equipment Industry Posts July 1996 Book-to-Bill," *Business Wire (Lexis Nexis)* 1996.

TABLE 4
The Incremental Explanatory Power of the BTB Order Information in Predicting Future Industry Sales

$$\text{Log(Sales}_t) = \alpha + \beta_1 \text{Log(Sales}_{t-1}) + \beta_2 \text{Log(Sales}_{t-2}) + \beta_3 \text{Log(Sales}_{t-3}) + \beta_4 \text{Log(Orders}_{t-1}) + \beta_5 \text{Log(Orders}_{t-2}) + \varepsilon_t$$

(1) Parameter	(2) Levels of Sales	(3) Levels of Sales	(4) Changes in Sales	(5) Changes in Sales
Intercept	0.024	0.007	0.006	0.005
	(2.02)*	(0.63)	(1.36)	(1.19)
$\text{Log(Sales}_{t-1})$	1.358	0.869	0.381	0.189
	(10.06)*	(5.72)*	(2.80)*	(1.31)
$\text{Log(Sales}_{t-2})$	–0.251	–0.230	–0.008	–0.185
	(1.12)	(1.19)	(0.04)	(0.82)
$\text{Log(Sales}_{t-3})$	–0.124	0.148	0.109	0.192
	(0.94)	(1.17)	(0.79)	(1.45)
$\text{Log(Orders}_{t-1})$		0.282		0.219
		(4.05)*		(2.65)*
$\text{Log(Orders}_{t-2})$		–0.072		0.045
		(0.99)		(0.53)
Adjusted R^2	0.993	0.995	0.201	0.299
AIC	405.7	424.1	405.7	424.08
n	58	58	57	57
Durbin-Watson	2.03	1.98	1.97	2.06

* Significant at the 5% level two-tailed test.
Definition of variables:
Sales_t = Industry sales of semiconductor chips from book-to-bill ratio as announced shortly after the end of month t in the press release over the period December 1991 to December 1996.
Orders_t = Industry orders of semiconductor chips from book-to-bill ratio as announced shortly after the end of month t in the press release.
AIC = Akaike information criterion.
t = statistics in parentheses are provided for descriptive purposes.

the book-to-bill data. The evidence presented in this paper suggests that both the industry and investors would benefit from such services.

The potential for distributing weekly or monthly information is not confined to fast-growing industries such as the semiconductor industry. We examined the types of trade associations currently releasing industry statistics (source: Investor's Business Daily 1996). The information releases by trade associations include: *Oil Stocks and Petroleum Data Weekly Report* issued by the American Petroleum Institute, *Mortgage Applications Index* for the week released by the Mortgage Bankers Association, *Home Resales Report* released by the National Association of Realtors, *Money-Market Mutual Fund Assets Weekly Report* issued by the Investment Company Institute, and the *Purchasing Managers' Index Monthly Report* released by the National Association of Purchasing Management.[18]

SUMMARY AND CONCLUDING REMARKS

The monthly release of the BTB ratio provides an opportunity to examine the information content of accounting data that is provided

[18] For a discussion of the type of information sort by analysts refer to Dempsey et al. (1997, 74).

to investors on a more timely basis than quarterly earnings reports. This type of service falls within Elliott's (1995) vision of assurance services, including the processing of raw information to provide refined information. Because of the nature of accounting data, however, timeliness often is sacrificed for relevance or reliability. It is therefore an empirical question as to whether investors consider this information to be of value.

Our empirical tests suggest that shareholders of semiconductor firms do utilize the BTB ratio in revising their expectations of firm value. We find 22 percent of the BTB announcements are associated with a stock price reaction that is significant at the 10 percent level. We find that portfolio returns around announcements of increases in the BTB ratio are positively associated with increases in the BTB. In contrast, we do not find a significant association between portfolio returns and declines in the BTB ratio.

Given that investors seem to view the data as important, we speculate that a market might exist for accounting firms to provide this type of information. The accounting firm can provide an information-sharing mechanism where individual firms can share proprietary data. By way of comparison, the trade association itself includes former and future employees of firms within the industry and may be at a competitive disadvantage in compiling industry-wide information. Further, users of industry association data might perceive that the association has an incentive to present biased information and so hiring an independent third party might provide useful assurance. The SIA, however appears to make no attempt to advertise the compilation by an independent third party.

This study focused on a specific index in a specific industry. Such research is consistent with Beaver's (1996) observation that research will become increasingly contextual, rather than generic. The generalizability of our results to other industries and other information, however, requires further research. Our primary proposition, that there is a market for more timely information, even if it is less reliable, is readily generalizable to a variety of contexts.

This paper provides only a precursory study to addressing the issues raised by an expanded role for the CPA as originator of information, as contrasted to the role of attesting to information prepared by others. Research is needed to identify the larger market opportunities, the best measurement system for providing this type of information, and to evaluate the role for public accounting firms in measuring, collecting and disseminating this type of information.

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