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Value Relevance of Earnings, Book Value, Revenue, and R&D

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ABSTRACT

This paper examines the valuation of the high-tech industries, especially those high-tech loss firms, during the 1990-1999 pre-2000 market melt-down and from 2000 to 2012 after the melt-down. We find evidence, within the high-tech sector, of the anomalous relation between negative earnings and stock prices as reported by earlier research. We also find evidence demonstrating the persistence of the anomalous price-earnings relation after adding book value of equity in the model. Within the high-tech sector, our test results reject the claim that the abnormal price-earnings relation is due to model misspecification (missing value relevant variables) and inclusion of book value into the valuation model eliminates the abnormal relation. Our empirical test results demonstrate that sales revenues and R&D expenses, instead of earnings and book value, are highly value relevant in the valuation of high-tech firms, especially loss-making firms, both before and after year 2000 market crash.

Keywords: value relevance, high-tech valuation, book value, R&D

INTRODUCTION

This study explores the abnormal price-earnings relation for the high-tech sector and the relevance of revenues, book value, and R&D expenses in the valuation of high-tech industry, especially those loss firms. The negative price-earnings relation for loss-making firms raises questions about the validity of the assumption of a positive and homogeneous relation between price and earnings, as expressed by the simple earnings capitalization model (Jan and Ou 1995; Burgstahler and Dichev 1997). A significant negative coefficient on earnings means that the more negative a firm's earnings is, the higher its stock prices, which makes no economic sense. We examine this abnormal price-earnings relation and the role of book value in loss firm valuation within the high-tech sector. Consistent with our hypothesis, we find evidence for both the pre-2000 stock market meltdown of the 90s and post-2000 years up to 2012 that the abnormal price-earnings relation exists for not just the loss-making high-tech firms alone, but all high-tech firms in general. We also find evidence that the inclusion of book value in the regression model does not eliminate the abnormal price-earnings relation in the high-tech sector, contrary to the finding of Collins et al (1999). It suggests that the role of book value in stock valuation, especially loss firm valuation, is not universal. At least for high-tech sector, earnings are not value relevant. The value relevance of book value is limited, if significant at all.

We further examine the relevance of revenues and R&D expenses in the valuation of high-tech industry. Revenue is believed to be harder to "manage." R&D expenses must be fully expensed, according to SFAS #2. Evidence from our empirical tests indicates that both revenues and R&D expense are value relevant for high-tech firms, suggesting that the market rewards investment in R&D and regard the accounting losses as transitory if high-tech loss firms have large expenditures for R&D.

This study adds to the current literature of loss firm valuation by focusing on the high-tech sector, and examines the value relevance of earnings, book value, revenues and R&D expenses. The remaining part of the paper is as follows. Section II is a literature review. Section III describes the sample selection and data. Section IV and V report and discuss the test results on the anomalous negative price-earnings relation and the value relevance of book value, sales and R&D expenses. Section VI is a summary and conclusion.

VALUE RELEVANCE OF REVENUES AND R&D

The negative price-earnings relation for firms that report losses, as documented by Jan and Ou (1995), raises questions about the validity of the assumption of a positive and homogeneous relation between price and earnings, as expressed by the simple earnings capitalization model. A negative coefficient on earnings for loss firms means that the bigger is a firm's loss, the higher is its stock price. Hayn (1995) suggests that the price-earnings relation may not be homogeneous and losses are regarded by the market as transitory. Collins et al. (1999) find evidence that including book value of equity in the simple earnings capitalization model eliminates the negative relation. They argue that book value of equity is a proxy for expected normal future earnings, which is especially important for loss firms regarding

valuation.

For the high-tech industry, current earnings may be hardly value relevant, so is book value of equity. Hayn (1995) argues that for high-tech growth industries, earnings may not be a proxy of future operating potentials. Current earnings may be distorted by expensing large R&D and intangibles that renders current earnings irrelevant to firms' valuation. By the same token, book value of equity may not be as value relevant, either. High-tech companies do not often have substantial book value because of the big investment in intangibles and R&D, the latter of which must be fully expensed. The role of book value of equity will be substantially reduced, in regard to high-tech firm valuation.

What will be value relevant financial variables for high-tech industries? One promising candidate is sales. Sales are much harder to "manage." The explosion in high tech stocks forced investors to look for ways to value companies with lots of potential, but no earnings. Davis (2002) investigates the market's response to revenue and revenue announcements and whether the value relevance of revenue differs when Internet firms report grossed-up or barter revenue. His results indicate that revenue announcements are highly associated with 3-day market returns and provide information incremental to that contained in earnings announcements. Callen et al. (2008) find empirical evidence that revenues of loss firms are value relevant whereas their earnings are not value relevant. Chandra and Ro (2008) examine the role of revenues in valuing firms beyond earnings and find that the role of revenues is pervasive and greater and the role of earning is smaller in general, and their finding is not limited to any specific industry or extreme earnings news or loss situations.

High-tech firms often have big investments in intangible assets and large R&D expenditures. Lev and Sougiannis (1996) demonstrate a significant inter-temporal association between firms' R&D capital and subsequent stock returns, suggesting either a systematic mispricing of the shares of R&D-intensive companies, or a compensation for an extra-market risk factor associated with R&D. Aboody & Lev (1998) conclude that software capitalization summarizes information relevant to investors. Joos and Plesko (2005) They find the investors price loss firms differently in regard to with or without an R&D component. For loss-making firms containing R&D, investors value R&D component as an asset and the non-R&D component as a transitory loss. Investors do not value loss firms homogeneously.

HIGH-TECH SAMPLE AND SUMMARY STATISTICS

The sample for the high-tech companies includes industries such as drug, computer, communication equipment, telecommunication, computer programming, software, and data processing. Table 1 is a description of the industries in the sample in the three-digit SIC code.

TABLE 1
High-Tech Industries Sample*

283	Drugs
357	Computer and Office Equipment
360	Electrical Machinery and Equipment, Excluding Computers
361	Electrical Transmissions and Distribution and Equipment
362	Electrical Industrial Apparatus
363	Household Appliances
364	Electrical Lighting and Wiring Equipment
365	Household Audio, Video Equipment, Audio Receiving
366	Communication Equipment
367	Electronic Components, Semiconductors
368	Computer Hardware (Including Mini, Micro, Mainframes, Terminals, Discs, Tape Drives, Scanners, Graphics Systems, Peripherals, and Equipment)
481	Telephone Communications
737	Computer Programming, Software, Data Processing
873	Research, Development, Testing Services

*The three-digit SIC codes and names of the industries are reported. Industries are selected based on, among other reasons, whether firms in the industry are likely to have significant intangible assets, reported or unreported. (Jennifer Francis and Katherine Schipper, 1999)

We incorporate all firm-year observation during 1990 to 2012 in the Standard and Poor's COMPUSTAT CD-ROM active and research databases. The research file is included in the study to mitigate survivorship bias. All variables in this study are measured on a per share basis. Firm-year observations are eliminated of which (1) stock

price three months after the fiscal year end is missing or negative, (2) earnings flow per share data is missing, (3) sales per share is missing or negative, (4) beginning of year book value of equity is missing, and (5) research and development expense data is missing. The sample selection and data treatment of this study follows Collins et al. (1999). We delete firm-year observations with negative cum-dividend price or negative sales per share because negative price or sales do not make economic sense.

Table 2a and 2b report the descriptive statistics for the selected sample. PRICE is cum-dividend price of the firm's stock price three months after the end of the fiscal year t plus its dividend per share for year t. EPS is the reported net income per share after taxes but before extraordinary items for year t. BV is the total beginning of year book value of equity for year t divided by the total number of common shares outstanding. SALE is the firm's total sales revenues, at year t divided by the total number of common shares outstanding. XR&D is the total research and development expense for year t divided by the total number of common shares outstanding.

There are a total of 13,203 usable high-tech firm-year observations from 1990 to 1999, and 18,669 firm-year observations from 2000 to 2012, after the data selection process. Compare the pre-2000 market meltdown data of 1990 – 1999 with post-2000 market meltdown data of 2000 – 2012, the mean stock price drops from a mean of $21.88 to $13.88, or 37%. Sales revenue per share declines from a mean of $11.91 to $7.69, or 35%. R&D expense per share is down from a mean of $1.56 to $1.00, or 36%. The percentage of loss-making firms goes up. Of all the usable firm-year observations, there are 6,381 or 48.33% loss firm-year observations from 1990 to 1999, compared with 10,778 or 57.73% loss firm-year observations from 2000 to 2012. The data shows a boom era of high-tech industries and a more somber one after year 2000 bubble burst.

TABLE 2a

Descriptive Statistics for Price, EPS, Book Value, Sales, and R&D Expenses

	1990 - 1999 All High-tech Firms				
Variable	N	Mean	Std Dev	Minimum	Maximum
PRICE	13203	21.8845	60.4138	0.0010	959.9970
EPS	13203	-2.5574	24.3677	-924.0000	72.0000
BV	12809	3.8577	31.8160	-741.0000	912.9570
SALE	13203	11.9128	44.4261	0.0010	941.5830
XR&D	13203	1.5591	10.0524	0.0000	643.9260
	1990 - 1999 Profit High-tech Firms				
Variable	N	Mean	Std Dev	Minimum	Maximum
PRICE	6822	19.0888	36.7939	0.0010	819.3750
EPS	6822	0.7863	2.2971	0.0000	72.0000
BV	6631	4.5276	20.5482	-502.7060	846.7500
SALE	6822	13.0938	39.5818	0.0020	883.0540
XR&D	6822	0.8550	2.3186	0.0000	80.1540
	1990 - 1999 Loss High-tech Firms				
Variable	N	Mean	Std Dev	Minimum	Maximum
PRICE	6381	24.8735	78.0247	0.0010	959.9970
EPS	6381	-6.1323	34.6169	-924.0000	-0.0020
BV	6178	3.1386	40.5553	-741.0000	912.9570
SALE	6381	10.6502	49.0509	0.0010	941.5830
XR&D	6381	2.3119	14.2217	0.0000	643.9260

TABLE 2b

Descriptive Statistics for Price, EPS, Book Value, Sales, and R&D Expenses					
	2000 - 2012 All High-tech Firms				
Variable	N	Mean	Std Dev	Minimum	Maximum
PRICE	18669	13.8810945	32.752292	0.001	960
EPS	18669	-1.7702258	20.6145537	-913.2	309.12
BV	18202	3.4841878	30.5819457	-924.4	878.515
SALE	18669	7.688907	24.3132542	0.001	924.151
XR&D	18669	0.9964639	3.6800429	-0.021	222.164
	2000 - 2012 Profit High-tech Firms				
Variable	N	Mean	Std Dev	Minimum	Maximum
PRICE	7891	20.4292072	28.9805935	0.001	794.188
EPS	7891	1.0288212	4.0140702	0	309.12
BV	7760	5.3496309	18.866063	-923.439	341.49
SALE	7891	11.2982145	23.6801973	0.001	760.387
XR&D	7891	0.8374975	1.6456552	-0.008	55.152
	2000 - 2012 Loss High-tech Firms				
Variable	N	Mean	Std Dev	Minimum	Maximum
PRICE	10778	9.086962	34.48036	0.001	960
EPS	10778	-3.81952	26.72799	-913.2	-0.006
BV	10442	2.097879	36.89649	-924.4	878.515
SALE	10778	5.04639	24.43175	0.001	924.151
XR&D	10778	1.112849	4.630772	-0.021	222.164

ABNORMAL PRICE-EARNINGS RELATION

The simple earnings capitalization model is used to study the price-earnings relation for our sample (Jan and Ou 1995).

$$P_t = \alpha + \beta X_t + \varepsilon_t \qquad (1)$$

Where P_t is cum-dividend price of the firm's stock price three months after the end of the fiscal year t plus its dividend per share for year t. X_t is the bottom-line earnings including discontinued operations, extraordinary items, and accounting changes, as in Collins et al (1999). Our evidence confirms the findings of an anomalous negative price-earnings relation for loss firms reported by Jan and Ou (1995) and Collins et al (1999), as shown in Table 3. For high-tech loss firms, the estimated coefficients on earnings are both negative and significant over the 1990-1999 and the 2000-2012 periods. The mean of the estimated coefficient on earnings is -1.24840 with a t-value of -49.93 over the 1990-1999 period and -0.71294 with a t-value of -64.84 over the 2000-2012 period, both significant at the 1 percent level. For profit firms, the estimated coefficient on earnings is both positive and significant throughout the eighteen years from 1990 to 2012.

Our evidence demonstrates that the abnormal price-earnings relation exists not just for loss firms, for all high-tech firms combined. The estimated coefficient on earnings is negative and significant, contrary to what are reported by Jan and Ou (1995), Hayn (1995), Collins et al (1999), and others. The mean of the estimated coefficient on earnings is -1.17233 with a t-value of -58.15 over the 1990-1999 period and -0.61946 with a t-value of -54.85 over the 2000-2012 period, both significant at the 1 percent level. The result of the estimated coefficient on earnings is another indication that the assumption that there is a positive and homogeneous relation between price and earnings across all industries is doubtful. The abnormal price-earnings relation for not just loss firms, but all firms combined underlines the unique characteristics of high-tech industries. It seems that for high-tech firms, the value relevance of earnings is

a suspect, or even regarded in a negative light by investors and the market.

TABLE 3				
High-Tech: Coefficient Estimates from Regressing Price on Earnings				
$P_t = \alpha + \beta X_t + \varepsilon_t$ (1)				
		All Firms		
Years	Observations	β	t-value	Adj R^2
1990 - 1999	13,203	**-1.17233**	-58.15**	0.2115
2000 - 2012	18,669	**-0.61946**	-54.85**	0.1418
		Profit Firms		
Years	Observations	β	t-value	Adj R^2
1990 - 1999	6,822	**10.68324**	74.32**	0.4545
2000 - 2012	7,891	**2.10091**	27.06**	0.0861
		Loss Firms		
Years	Observations	β	t-value	Adj R^2
1990 - 1999	6,381	**-1.24840**	-49.93**	0.2875
2000 - 2012	10,778	**-0.71294**	-64.84**	0.2871

(Hereafter, * indicates significant at the 10 percent level, while ** 1 percent level.)

Collins et al. (1999) argue that the simple earnings capitalization model is mis-specified because of the omission of value relevant variables. They report that including book value of equity in the valuation model eliminates the negative relation.

$$P_t = \alpha + \beta X_t + \gamma V_{t-1} + \varepsilon_t \quad (2)$$

Where P_t is cum-dividend price of the firm's stock price three months after the end of the fiscal year t plus its dividend per share for year t. X_t is the bottom-line earnings per share including discontinued operations, extraordinary items, and accounting changes, and V_{t-1} is the beginning of year book value per share at year t.

We follow Collins et al. (1999) by including book value of equity in the valuation model for all high-tech firms, and profit and loss firms separately, but our test results are totally different. As reported in Table 4, for high-tech loss firms, the estimated coefficients on earnings remain both negative and significant over the 1990-1999 and the 2000-2012 periods after adding book value into the model. The adjusted R^2s for all tests are virtually the same as the models without book value of equity. The mean of the estimated coefficient on earnings is -1.22264 for the 1990-1999, and -0.72167 for the 2000-2012 periods, both significant at the 1 percent level. For all firms combined, the estimated coefficient is -1.12386 for 1990-1999 and -0.61006 for 2000-2012, both negative and significant at the 1 percent level. Our evidence is in contrary to what are reported by Collins et al. (1999). The results indicate that for high-tech firms book value has very little relevance regarding stock valuation.

TABLE 4						
High-Tech: Coefficient Estimates from Regressing Price on Earnings and Book Value						
$P_t = \alpha + \beta X_t + \gamma V_{t-1} + \varepsilon_t$ (2)						
		All Firms				
Years	Observations	β	t-value	γ	t-value	Adj R^2
1990 - 1999	13,203	**-1.12386**	-54.82**	**0.19553**	13.45**	0.2172

2000 - 2012	18,669	**-0.61006**	-53.66**	**0.04876**	6.67**	0.1438
		Profit Firms				
Years	Observations	β	t-value	γ	t-value	Adj R^2
1990 - 1999	6,822	**10.43442**	68.97**	**0.07630**	4.45**	0.4560
2000 - 2012	7,891	**2.55965**	34.69**	**0.52918**	33.72**	0.2028
		Loss Firms				
Years	Observations	β	t-value	γ	t-value	Adj R^2
1990 - 1999	6,381	**-1.22264**	-47.81**	**0.09350**	4.63**	0.2898
2000 - 2012	10,778	**-0.72167**	-65.15**	**-0.04521**	-5.89**	0.2895

VALUE RELEVANCE OF REVENUES AND R&D EXPENSES

Models (3) and (4) are used to test the value relevance of sales revenues and R&D expenses. Table 4 documents the results of regressing price against sales and R&D expenses respectively:

$$P_t = \alpha + \beta Sale_t + \varepsilon_t \quad (3)$$
$$P_t = \alpha + \beta Sale_t + \gamma XR\&D + \varepsilon_t \quad (4)$$

Where P_t is cum-dividend price of the firm's stock price three months after the end of the fiscal year t plus its dividend per share for year t, $Sale_t$ is sales revenue per share for year t, and $XR\&D_t$ is the total research and development expense for year t divided by the total number of common shares outstanding. Model (3) regresses price on sales alone. The estimated coefficient on sales is both positive and significant for the 1990-1999 and the 2000-2012 periods, either all firms combined, or profit and loss firms separately. For all firms combined, the mean of the estimated coefficient on sales is 0.59115 for 1990-1999, and 0.56352 for 2000-2012, with adjusted R^2 at 19.59 percent and 16.46 percent respectively. For profit firms, the mean of the estimated coefficient on sales is 0.53590 for 1990-1999, and 0.51899 for 2000-2012, with adjusted R^2 at 33.95 percent and 16.21 percent respectively. For loss-making firms, the mean of the estimated coefficient on sales is 0.63829 for 1990-1999, and 0.55496 for 2000-2012, with adjusted R^2 at 16.23 percent and 15.20 percent respectively.

TABLE 5				
High-Tech: Coefficient Estimates from Regressing Price on Sales				
$P_t = \alpha + \beta Sale_t + \varepsilon_t$ (3)				
		All Firms		
Years	Observations	β	t-value	Adj R^2
1990 - 1999	13,203	**0.59115**	55.86**	0.1959
2000 - 2012	18,669	**0.56352**	60.28**	0.1664
		Profit Firms		
Years	Observations	β	t-value	Adj R^2
1990 - 1999	6,822	**0.53590**	58.39**	0.3395
2000 - 2012	7,891	**0.51899**	38.75**	0.1621
		Loss Firms		
Years	Observations	β	t-value	Adj R^2
1990 - 1999	6,381	**0.63829**	34.61**	0.1623

2000 - 2012	10,778	**0.55496**	43.25**	0.1520

Multivariate Model (4) regresses price on sales and R&D expenses. The estimated coefficient on sales remains both positive and significant for the 1990-1999 and the 2000-2012 periods, either all firms combined, or profit and loss firms separately. In addition, the estimated coefficient on R&D expenses remains both positive and significant for the 1990-1999 and the 2000-2012 periods, either all firms combined, or profit and loss firms separately. For all firms combined, the mean of the estimated coefficient on R&D expenses is 2.71152 for 1990-1999, and 3.10916 for 2000-2012, with adjusted R^2 at 30.25 percent and 27.99 percent respectively. For profit firms, the mean of the estimated coefficient on R&D expenses is 4.45591 for 1990-1999, and 3.73448 for 2000-2012, with adjusted R^2 at 37.92 percent and 18.89 percent respectively. For loss-making firms, the mean of the estimated coefficient on R&D expenses is 2.66251 for 1990-1999, and 3.23292 for 2000-2012, with adjusted R^2 at 28.34 percent and 31.68 percent respectively.

TABLE 5

High-Tech: Coefficient Estimates from Regressing Price on Sales and R&D Expense

$$P_t = \alpha + \beta Sale_t + \gamma XR\&D + \varepsilon_t \quad (4)$$

		All Firms				
Years	Observations	β	t-value	γ	t-value	Adj R^2
1990 - 1999	13,203	**0.39748**	36.86**	**2.71152**	44.27**	0.3025
2000 - 2012	18,669	**0.37202**	39.11**	**3.10916**	51.08**	0.2709
		Profit Firms				
Years	Observations	β	t-value	γ	t-value	Adj R^2
1990 - 1999	6,822	**0.35181**	27.89**	**4.45591**	20.59**	0.3792
2000 - 2012	7,891	**0.33835**	19.48**	**3.73448**	15.97**	0.1889
		Loss Firms				
Years	Observations	β	t-value	γ	t-value	Adj R^2
1990 - 1999	6,381	**0.38344**	20.40**	**2.66251**	32.32**	0.2834
2000 - 2012	10,778	**0.31846**	25.59**	**3.23292**	50.19**	0.3168

Our evidence strongly suggests that sales are more value relevant to the market than negative earnings regarding equity valuation (Dechew 1994; Kothari 2001). The positive association between sales revenues and stock prices, especially for loss companies, indicates that when a company announces a loss for the year, the stock market gives more weight to its sales revenues. Aggressive recognition of revenue could lead analysts and investors to revise upward their estimates for the company's earnings growth rate and drive up a company's stock price. The market's obsession with revenues has not changed since the 2000 bubble burst. Feroz et al (1991) find that 70 percent of SEC enforcement actions issued between 1982 and 1989 involved overstatements of accounts receivable and inventory resulting from premature revenue recognition and delayed write-off, respectively. Weirich and Rouse (2001) report that sixty-two percent of financial fraud cases prosecuted by the SEC in recent years involved revenue recognition. Wu (2002) Palmrose et al. (2004) report that revenue misstatement is the single most common cause for restatement, comprising 50 and 37 percent of their respective samples. Dechow and Schrand (2004) document that over 70% of the 294 SEC Accounting and Auditing Enforcement Releases in their study involves overstated revenues.

High-tech firms often have big spending for R&D which, according to SFAS # 2, must be fully expensed. R&D expense is the single biggest contributor to accounting losses, as demonstrated in TABLE 2. The mean R&D expense per share is $1.56, consisting of 61% of the mean EPS of $-2.56 per share for the 1990-1999 period, and $1.00 or 56% of the mean EPS of $-1.77 for the 2000-2012 period. Our test results as reported in TABLE 5 add evidence to prior research that R&D expenses are value-relevant to investors (Lev and Sougiannis 1996). With the inclusion of R&D expenses in the model, the adjusted R^2 increases substantially as compared with the univariate

model of sales alone. Over the 1990-1999 time period, the adjusted R^2 increases from 19.59 percent without R&D to 30.25 percent with R&D, a 54 percent gain, for all firms combined. For loss firms, the adjusted R^2 increases from 16.23 percent to 28.34 percent, a 75 percent gain. For the 2000-2012 time period, the adjusted R^2 increases from 16.64 percent without R&D to 27.09 percent with R&D, a 63 percent gain, for all firms combined. For loss firms, the adjusted R^2 increases from 15.20 percent to 31.68 percent, a 108 percent gain. The gains for profit firms are moderate at 17 percent. Our data and test results demonstrate clearly the high value relevance of R&D expenses, both in magnitude and significance.

SUMMARY AND CONCLUSION

We examine, in the high-tech sector, the claim of Collins et al. (1999) that the anomalous significantly negative price-earnings relation for loss firms is caused by model misspecification and the inclusion of book value of equity eliminates the anomaly. We investigate the value relevance of earnings, book value of equity, sales, and R&D expenses for high-tech companies during the 1990-1999 pre-2000 period and years 2000-2012 after the market bubble burst. We examine the scenarios of all firms combined, and profit and loss firms separately. Our evidence confirms the anomalous negative price-earnings relation, not just for loss firms, but for all high-tech firms combined, both in the 1990-1999 and the 2000-2012 period, for the high-tech industries.

Our evidence indicates that for the high-tech sector, including book value of equity in the simple earnings capitalization model does not eliminate the negative price-earnings relation for loss firms, nor does it for all firms combined. Our evidence convincingly demonstrates the relevance of sales revenues and R&D expenses in the valuation of high-tech firms in general, and high-tech loss firms in particular.

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