IT Innovations in IT Industries: Does IT pay off?

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Abstract

In the classroom, students tend to ask the question: why do we need to study information technology (IT)? In the real business world, corporate decision-makers constantly ask the question: why do we need to invest in IT? Does it pay off? In this paper, we investigate how the stock market values a firm's IT innovations in order to gain competitive advantage. In other words, we examine the role of IT innovations in the stock market valuation of a firm's expected future cash flows. Our findings indicate that firms that are IT innovators are valued higher than their industry competitors. Clearly, IT innovations seem to pay off in the stock market. In this way, we show that learning IT skill sets in the classroom is important for undertaking IT innovations in the real business world.

Keywords: Information technology, IT innovation, IT education, market value, intangible assets

1. INTRODUCTION AND RESEARCH CONTEXT

A common question students tend to ask in the classroom is why we need to study this and that. It is no exception that IT educators are often faced with similar questions: "why do we need to study information technology (IT)?" "Why do we have to learn Data Flow Diagrams?" "My major is Finance/Business Administration/Accounting. Why do I have to learn MIS?" In the real business world, corporate decision-makers constantly ask similar questions such as: "why do we need to invest in IT?" "Could IT innovations translate into to competitive advantages?" "Is there any market value for IT innovations? In other words, does it pay off?" It is documented that IT decision makers in the real corporate world tend to be under-investing in IT.

There is significant scholarly interest in understanding the relationship between IT investments and firm performance. However, findings to date remain mixed: while some studies find a positive relationship between IT investments and firm performance (Banker et al, 1990, Brynjolfsson and Hitt 1995, 1996; Lichtenberg 1995; Dewan and Min 1997; Bharadwaj et al. 1999, Stratopoulos and Dehning 2000), others fail to find any significant relationships at all. The earlier literature on the relation between IT and productivity finds an absence of a positive relation between spending on IT and produc-

tivity or profitability. This inconclusive result from these earlier studies is what Strassman (1990) and Loveman (1994) called "IT productivity paradox". In an age where management carefully weighs the costs and benefits of every discretionary investment dollar, finding evidence of the returns on IT investments is critical.

The main problem for these inconclusive results is that most studies measure firm performance in terms of accounting profits and returns such as return on equity (ROE), return on assets (ROA), and return on investments (ROI). These accounting measurements capture only the snapshot of one point in time of a firm's past or existing rather than future expected financial performance. Moreover, it is well-known that these accounting returns can be easily manipulated by managers via their earnings management.

"It has been 500 years since Pacioli published his seminal work on accounting and we have seen virtually no innovation in the practice of accounting just more rules none of which has changed the framework of measurement"Wired Magazine (see Standfield 2005).

More bluntly, Robert Howell, professor at the Tuck School at Dartmouth points out:

"The income statement, balance sheet, and statement of cash flow are about as useful as an 80-year-old road map" (see Standfield 2005).

More importantly, the intangible value that comes with IT innovations cannot be easily captured in accounting terms. According to Alan Greenspan, Federal Reserve Board Chairman, "There are going to be a lot of problems in the future as accounting is not tracking investments in knowledge assets." (Standfield, 2005). Thus, previous researchers have yet to examine whether the stock market is able to capture the potential and future intangible assets associated with IT innovations.

In order to answer these questions for our students in the classroom and business leaders in the real world, we examine the true market value of IT innovations as perceived by the stock market. We empirically investigate whether the intangible assets that are inherent within the IT innovations can be captured by the stock market investors who measure a firm's value not by its past or existing performance but by their expected risk-adjusted future cash flow.

The remainder of the paper is organized as follows: Section two describes our data; section three outlines the research method employed; section four provides a view of the results of our tests and a discussion of the implications of those results. We conclude with a discussion of the contribution of the paper to the extant IT teaching and research.

2. THE DATA

From *InformationWeek* 500 survey, we collected 10 years (1994-2003) of IT innovations ranking data for the top 500 most innovative corporate users of information technology. The rationale for using the data from the *InformationWeek* 500 survey is that this data source has been used extensively in other similar and rigorous academic studies (Brynjolfsson and Hitt 1996; and Lichtenberg 1995). According to *InformationWeek,* the companies that are selected into the *InformationWeek's* top 500 ranking are the top companies that are distinguished by crisp and efficient technology strategies that cut costs and optimize productivity. To obtain a spot in this annual ranking of the *InformationWeek* 500, companies must demonstrate a pattern of technological, procedural, and organizational innovation. The selection process entails identifying and ranking the companies after an extensive mail, phone, and fax study. Senior IT executives are surveyed on their organizational priorities and spending plans for the year ahead. Thus, *InformationWeek* provides a reasonable data source on corporate IT innovations.

InformationWeek provides IT-related data such as IT innovations rankings, IT budgets, number of IT employees and other IT-related information as part of an annual published survey. We use IT innovations ranking data because data on IT budget and other variables are no longer disclosed on firm level basis from 1998. For each year, we matched each of these 500 top IT innovative firms with its industry peers using six-digit NAICS and four-digit SIC codes.

We selected the computer hardware and software industries as our study samples. The rationale for selecting these two industries is that by providing computer hardware and software, they are the driving force behind all IT innovations. These industries are not only the backbones of information technology infrastructure, but are also ranked at the top of IT innovations among all industries.

We extract market and accounting data from Compustat and CRSP databases, and matched yearly returns, market value, book assets, R&D, and other accounting data to these sampled firms. To minimize the potential effect of outlier observations on the results, variables are winsorized by adjusting all values in the top and bottom percentiles to be equal to their 1st and 99th percentile values.

For the computer hardware industry, we have collected data for 40 publicly-traded companies over 10 year period, which means a total observation of 400 firm years. For the software industry, we have collected data for 287 publicly-traded companies over 10 year period, which means a total observation of 2,870 firm years. Combining the two industries together, we have a total observation of 3,270 firm years.

3. RESEARCH METHOD

To capture IT innovations, we use the annual IT innovations ranking data from the InformationWeek 500.

To measure the intangible value that is inherent in IT innovations but is not recognized by accounting values, we calculate the ratio of a firm's total market value over its total book value. This ratio is a modified Tobin's Q ratio which is used extensively in the finance literature. The Tobin's Q ratio is the ratio of the market value of a firm's assets over the replacement value of its assets. This ratio is developed by James Tobin of Yale University, Nobel Laureate in Economics, who hypothesized that the combined market value of all the companies on the stock market should be about equal to their replacement costs. The Q ratio is calculated as the market value of a firm's assets divided by the replacement value of the firm's assets (Tobin 1969). If the market value reflected solely the recorded assets of a company, Tobin's Q would be one. If Tobin's Q is greater than one, then the market value is greater than the value of the company's recorded assets. This suggests that the market value reflects some unmeasured or unrecorded assets of the company. High Tobin's Q values encourage companies to invest more in capital because they are "worth" more than the price they paid for them. On the other hand, if Tobin's Q is less than 1, the market value is less than the recorded value of the assets of the company. This suggests that the market may be undervaluing the company.

Tobin's Q offers a far more superior measure of the market returns on investment for IT innovations than do the common accounting measurements such as ROA, ROI, and ROE. Tobin's Q captures not only the recorded asset-in-place of the company, but also the market or investor sentiment, the analysts' views of the prospects for the company, as well as market speculations. And most important of all, Tobin's Q captures the intellectual capital of the company that is not reported in the firm's financial statements. In other words, the advantage of using Tobin's Q for measuring the intangible value associated with IT innovations is that Tobin's Q measures the extent to which the market recognizes the firm's *future* rather than the *past* profitability, and in particular, the firm's potential competitive advantage and growth opportunities. Brainard and Tobin (1968), Tobin (1969) and Tobin (1978) suggest that it is through Q that financial markets affect real economic activity.

We compute Tobin's Q for each firm and for each year as follows:

$$\text{Tobin'sQ} = V_i / A_i \quad (1)$$

where

V_i = the total market value of the firm i, (i.e. the sum of the market value of equity, preferred stocks and debt), and

A_i = the book value of firm i's total assets, proxy for firm size.

In sum, we have computed for each year Tobin's Q values for 40 publicly-traded companies in the computer hardware industry, and 287 publicly-traded companies in the computer software industry.

In order to compare stock market performance between the firms that are engaged in heavy IT innovations and their peers, we adopt the independent-samples t-test procedure. Because this procedure tests the mean difference between two independent sample groups, it is therefore appropriate to use this procedure to compare the mean difference of Tobin's Q between the IT innovating firms and the non-IT innovating firms in IT industries so as to investigate whether IT innovators outperforms the non-IT innovators in terms of Tobin's Q.

A series of *t*-tests, frequency tests, and descriptive statistics were run for each year comparing the mean Tobin's Q value between the firms included in the *InformationWeek 500* and their respective industry peers from 1994 to 2003.

4. EMPIRICAL RESULTS

In this section, we present the empirical results for the IT industries.

From the *InformationWeek 500* survey, we have calculated the intangible value and Tobin's Q for those IT innovative firms from various IT industries with an intangible value of over 30 percent of their total market value (See Appendix A). For instance, at the top of the list, Amazon and Ebay have an intangible value close to 90 percent of their total market value with a Tobin's Q of 9.07 and 8.95 respectively. Such a large gap between market investor value and accounting value reiterates the importance of understanding the role of IT innovations in creating a firm's intangible assets.

Table 1. IT Innovation Computer Hardware: Tobin's Q 1994 - 2003

	Information Week Firms			Industry Peers			Difference		
Year	Mean	Median	St. Dv.	Mean	Median	St. Dv.	Mean	Median	t-stat
1994	2.420	2.334	0.938	1.565	1.742	0.695	0.855	0.592	3.136
1995	3.204	2.682	1.495	1.646	2.121	2.069	1.558	0.561	1.935
1996	5.735	3.645	4.403	2.855	3.240	2.404	2.880	0.405	2.132
1997	7.558	4.677	9.423	3.053	2.263	2.462	4.505	2.414	2.329
1998	17.431	5.104	26.880	4.290	2.168	7.113	13.141	2.936	2.368
1999	9.114	6.894	7.768	3.744	2.193	3.526	5.370	4.701	2.650
2000	8.342	7.011	7.782	2.499	1.389	4.174	5.844	5.623	2.082
2001	5.737	3.601	5.474	1.389	1.322	2.402	4.348	2.279	3.235
2002	4.689	1.671	5.165	1.425	1.229	2.966	3.264	0.442	2.062
2003	5.215	2.040	5.500	1.693	2.267	2.330	3.522	-0.227	2.318
All Years	6.056	4.755	6.724	1.999	2.239	3.396	4.057	2.516	2.319

Figure 1. IT Innovation Computer Hardware: Tobin's Q 1994 – 2003

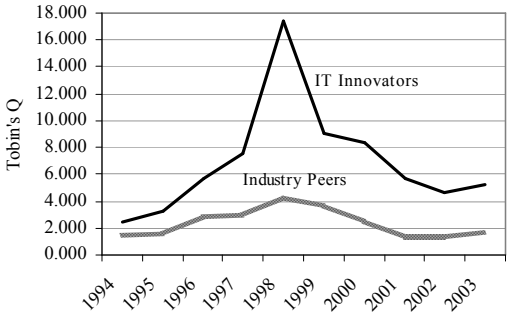

Table 1 shows the empirical results for the hardware industry from 1994 through to 2003. The results show that the mean and median Tobin's Q values are higher for the firms that are selected as IT innovators in the *InformationWeek 500* than for their industry peers and this mean difference is statistically significant for each year. This result indicates that those firms engaged in IT innovations consistently outperform their industry peers in the stock market valuation year after year, even after controlling for firm size.

Figure 1 shows graphically the difference in Tobin's Q between the IT innovative firms in the *InformationWeek 500* and their industry peers in the computer hardware industry. There is a constant gap in terms of Tobin's Q over the study time period between the IT innovators and their industry peers showing that IT innovators consistently outperform their industry peers. The spike in Tobin's Q for the IT innovators in 1998 is due to Dell

which had a booming growth until the year 2000 when IT industries were hard hit from the burst of the ".com" bubble.

Table 2. IT Innovation System Software: Tobin's Q 1994 - 2003

	Information Week Firms			Industry Peers			Difference		
Year	Mean	Median	St. Dv.	Mean	Median	St. Dv.	Mean	Median	t-stat
1994	7.325	7.344	1.536	4.831	3.160	4.122	2.494	4.184	2.320
1995	9.187	9.321	4.275	5.361	4.234	3.850	3.826	5.087	1.851
1996	8.278	9.195	3.059	4.576	2.634	4.973	3.702	6.561	2.152
1997	13.224	14.347	5.526	4.014	2.673	6.160	9.210	11.674	3.170
1998	9.609	7.886	6.966	4.080	2.714	5.033	5.529	5.173	2.060
1999	11.010	9.124	5.264	3.643	3.280	9.081	7.367	5.844	2.495
2000	4.054	2.520	3.666	3.480	1.961	4.607	0.574	0.559	0.487
2001	4.232	3.044	2.356	1.893	1.177	2.520	2.339	1.867	2.105
2002	3.285	3.038	1.398	1.441	1.235	2.836	1.844	1.803	2.601
2003	5.350	4.723	2.176	3.181	2.800	3.790	2.169	1.923	2.016
All Years	4.263	3.539	3.582	2.636	2.296	1.527	1.626	1.243	2.027

Table 2 shows the empirical results for the software industry from 1994 through to 2003. The results show that the mean and median Tobin's Q values are higher for the firms that are selected as IT innovators in the *InformationWeek 500* than for their industry peers and this mean difference is statistically significant for each year except for the year 2000 when the "dotcom" bubble busted. This result indicates that those firms engaged in IT innovations consistently outperform their industry peers in the stock market valuation year after year, even after controlling for firm size.

Figure 2. IT Innovation System Software: Tobin's Q 1994 – 2003

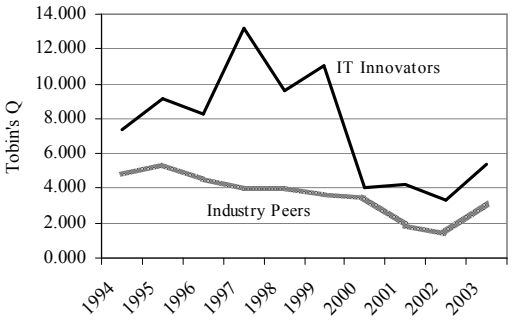

Figure 2 shows graphically the difference in Tobin's Q between the IT innovative firms in the *InformationWeek 500* and their industry peers in the computer software industry. There is a relatively large gap in terms of Tobin's Q over the study time period between the IT innovators and their industry peers showing that IT innovators consistently outperform their industry peers. The gap is especially large from year 1996 through to 1999 till 2000 when the gap narrows down due to ".com" bubble burst. Overall, we find that firms that are engaged heavily in IT innovations outperform their industry competitors.

5. CONCLUSION

In conclusion, our empirical results show that IT innovators selected by the *InformationWeek 500* consistently outperform their respective industry peers in terms of Tobin's Q values and the results are statistically significant.

These findings indicate that IT innovations could potentially upgrade a firm's competitive advantage and create growth opportunities. These intangible values are often ignored in the accounting book but are captured in the forward-looking stock market.

In the real business world, the implication of these findings is not only crucial for investors, but also for corporate decision-makers concerning IT innovations. In the classroom, the implication of these findings highlights the importance of gaining knowledge about IT innovations and keeping up with IT innovations and learning IT skill sets. In this way, we show that it is important that we teach our students up-to-date IT skills and

IT knowledge stock so that our students are better prepare for the real world corporate IT innovations.

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APPENDIX A

IT Innovators listed in the InformationWeek 500 with more than 30% of total market value as Intangible Value

Company	Ticker	Total BV($M)	Total MV($M)	Intangible Value($M)	Intangible Value %	Tobin's Q
AMAZON.COM INC	AMZN	2,162	19,603	17,441	0.89	9.067
EBAY INC	EBAY	5,820	52,090	46,270	0.89	8.950
QUALCOMM INC	QCOM	8,822	50,750	41,928	0.83	5.752
YAHOO INC	YHOO	5,932	30,808	24,877	0.81	5.194
DELL INC	DELL	19,311	89,405	70,094	0.78	4.630
SYMANTEC CORP	SYMC	3,266	14,580	11,314	0.78	4.465
CDW CORP	CDWC	1,312	5,210	3,898	0.75	3.972
CISCO SYSTEMS INC	CSCO	37,107	143,903	106,796	0.74	3.878
PAYCHEX INC	PAYX	3,691	14,038	10,347	0.74	3.803
LEXMARK INTL INC -CL A	LXK	3,450	11,784	8,333	0.71	3.415
NATIONAL SEMICONDUCTOR CORP	NSM	2,245	7,339	5,095	0.69	3.270
APPLIED MATERIALS INC	AMAT	10,312	31,362	21,050	0.67	3.041
INTUIT INC	INTU	2,790	8,369	5,578	0.67	2.999
TEXAS INSTRUMENTS INC	TXN	15,510	44,283	28,773	0.65	2.855
MERCURY INTERACTIVE CORP	MERQ	1,971	4,637	2,666	0.58	2.353
HYPERION SOLUTIONS CORP	HYSL	655	1,530	875	0.57	2.336
BEST BUY CO INC	BBY	8,652	18,463	9,811	0.53	2.134
ACXIOM CORP	ACXM	1,093	2,287	1,194	0.52	2.092
HEWITT ASSOCIATES INC	HEW	1,598	3,293	1,695	0.51	2.061
REYNOLDS & REYNOLDS -CL A	REY	1,124	2,215	1,091	0.49	1.971
I2 TECHNOLOGIES INC	ITWO	430	835	405	0.48	1.940
EMC CORP/MA	EMC	14,093	27,148	13,055	0.48	1.926
WESTERN DIGITAL CORP	WDC	866	1,666	800	0.48	1.923
AGERE SYSTEMS INC	AGR.A	2,388	4,505	2,117	0.47	1.886
CHECKFREE CORP	CKFR	1,587	2,876	1,289	0.45	1.812
NEXTEL COMMUNICATIONS	NXTL	20,510	36,542	16,032	0.44	1.782
EARTHLINK INC	ELNK	827	1,463	635	0.43	1.768
COMPUTER ASSOCIATES INTL INC	CA	11,054	18,729	7,675	0.41	1.694
FIRST DATA CORP	FDC	25,586	43,178	17,592	0.41	1.688
HARRIS CORP	HRS	2,080	3,426	1,345	0.39	1.647
PEROT SYSTEMS CORP	PER	1,011	1,571	561	0.36	1.555
IRON MOUNTAIN INC	IRM	3,892	5,984	2,092	0.35	1.538
APPLE COMPUTER INC	AAPL	6,815	9,916	3,101	0.31	1.455