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AN EXPLORATORY STUDY OF THE IMPACT OF INFORMATION TECHNOLOGY INVESTMENT ANNOUNCEMENTS ON COMPANIES' VALUES IN JAPAN

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Abstract

This paper presents the results of an exploratory study that examined a possible connection between investments in Information Technology and changes in the market value of companies in Japan. The event-study methodology, which focuses on the change of stock price as a result of announcements about Information Technology investments, was applied. The main contribution of this project was to examine the connection between Information Technology investments and their perceived business value in Japan, where relatively little research on this topic was conducted. The results indicate that in Japan, the stock market may respond in different ways to similar announcements about investments in Information Technology.

Keywords: Event-study methodology, information technology investment announcements, information technology paradox, market value, productivity paradox

Introduction

Productivity, simply defined as output per unit of input, is perhaps the most popular measure of economic performance. It is widely known and indisputable that long-term productivity has increased. Often, these permanent gains in productivity are attributed to utilizing ever-new technologies. In other words, through constantly developing and embracing new technologies, the world economy at large has been able to generate more output while consuming fewer resources. While the strategic importance of Information Technology (IT) as a production factor has increased dramatically since the 1950's when this term was coined (Leavitt and Whisler, 1958), it is not clear which portion of productivity gains could be directly attributed to IT.

Some researchers argue that investment in IT will result only in marginal gains in productivity at best. Others expect to discover that such productivity gains exist, but are difficult to measure because they are intangible in their nature (Brynjolfsson and Hitt, 1998; Pohjola, 1998). Others claim to find strong evidence of productivity gains because of IT (Barua et al., 1995; Brynjolfsson and Hitt, 1996; Mukhopadhyay et al., 1995). Others call to stop the debate because they claim that productivity, developed in the early days of manufacturing, is not a good indicator of economic performance (Brynjolfsson, 1993; Jarvenpaa and Ives, 1990; Panko, 1991); although it continues to be a good indicator in the case of traditional manufacturing, it does not hold true for other industries, and is therefore a poor universal standard.

However, the academic debate about this topic, often called the "Productivity Paradox" or "IT Paradox" continues. Proof of the academic fascination surrounding the "Productivity Paradox" is evident in the great number of publications, reports, and workshops related to the topic (Kohli and Sherer, 2002a; Kohli and Sherer, 2002b). Most of these academic works, however, focus on North American companies, while a substantially smaller number of publications focus on the "Productivity Paradox" in Europe. Only a highly limited number of publications deal with the "Productivity Paradox" in Asia. This is surprising, given the fact that Asia is known for its dynamic growth and large economies, such as that of Japan, which is the second largest in the world.

This exploratory study focuses, therefore, on this topic and examines the potential impact of IT investments in Japan. The major objective of this paper is to present preliminary findings gained by using event-study methodology. Since this project is still in progress, most of the findings are preliminary in their nature and need to be validated through more extensive studies.

Literature Review

Overview

There have been many studies that examined the relationship between IT and productivity at the economy level. However, most findings have been inconclusive (Barua et al., 1995; Ko and Osei-Bryson, 2002; Mukhopadhyay et al., 1995).

This lack of consensus among academics is often attributed to problems with obtaining the necessary data (Hitt and Brynjolfsson, 1996). To conduct studies related to the "Productivity Paradox," researchers face problems with collecting data because in most cases specific information about the amount of IT investments is not disclosed in common financial statements. Therefore, it is always difficult to obtain the specific size or type of the IT investment in a particular company.

Lack of data may explain why only a highly limited number of publications deal with the "Productivity Paradox" in Asia, where obtaining financial information represents even a greater challenge. In one of a few studies, Kraemer and Dedrick (1994) specifically focused on the Asian region, including Japan. In other study focusing on G7 countries, Schreyer (2000) examined the contribution of information and communication technologies to gains in productivity in Japan. Those studies concentrated on contribution of IT investments to productivity gains at the economy at-large level, however.

Comparison to Other Relevant Research

At the firm level, the event-study methodology enables researchers to overcome problems of obtaining a reliable financial data. The event-study methodology focuses on fluctuation in stock prices related to announcements and is based on the assumption that stock prices adjust to new information (Fama et al., 1969; McWilliams and Siegel, 1997). By using the event-study methodology, researchers were able to contribute significantly to the existing knowledge about the economic impacts of IT investments for particular companies (Chatterjee et al., 2002; Dos Santos, 1993; Im et al., 2001; Oh and Kim, 2001).

Therefore, it appears that the event-study methodology is appropriate for research regarding the issue of IT investments and productivity gains in Japan, where lack of data is often present.

Research Methodology

Sample Selection Procedure

As previously mentioned, the objective of this exploratory research is to investigate the impact of announcements regarding investments in information technology in Japan by analyzing the stock price movements. We searched Lexis-Nexis for announcements about firms investing or planning to invest in new information technology for the thirteen-month period from October 1, 2001 to October 31, 2002.

We concentrated our search on companies traded either on the Tokyo Stock Exchange (TSE), or the Osaka Stock Exchange (OSE), or JASDAQ (NASDAQ Japan). In order to find appropriate announcements, we used queries of IT-related terms as keywords (for example, Enterprise Resources Planning, Supply Chain Management, Customer Relationship Management, network, etc.) for our search. We did not restrict our search to a specific industry, because doing so always resulted in a relatively small number of announcements.

Data Description

After we screened out announcements that were less relevant to the subject of this work, our final sample contained 36 announcements (events), from 32 total articles. This means that in some cases, one article included information about more than one firm announcing IT investment. The largest number of announcements was for the automobile industry (8), followed by the electronics (4) and retail industries (4). We combined the finance industry with the insurance industry, and the shipping industry

with the transportation industry, since they have business characteristics similar to each other. Table 1 presents a breakdown of the announcements by industry type while Table 2 itemizes the distribution of announcements by month. (In Appendix, we listed detailed information for all announcements included in our sample.)

Table 1. Distribution of Announcements by Industry

Industry	Full Sample
Amusement	1
Apparel	1
Automobile	8
Chemical Manufacturer	1
Communication	3
Construction	1
Electronics	4
Financial/Insurance	3
Food	2
Metal	1
Printing	1
Retail	4
Shipping/Transportation	3
Trading	3
Total	36

Table 2. Distribution of Announcements by Month

Year	Month	Full Sample
2001	October	1
	November	1
	December	1
2002	January	1
	February	0
	March	3
	April	3
	May	4
	June	4
	July	0
	August	2
	September	7
	October	9
	Total	36

Statistical Methodology

We examined the stock prices of firms that made IT investment announcements for a period of up to twelve “business days.” (“Business days ” means that we did not count weekends and holidays, since there was no trade in stock exchange markets.) In this way, the period includes the date of announcement, and a maximum of six days before and five days after the announcement date. (The date of the announcement is 0, the day after the announcement is +1, the day before the announcement is -1, and so on.)

First, we calculated the Rate of Return (RR) for the period of the test. The formula for rate of return is as follows:

$$RR_{jxy} = (P_{jy} - P_{j,x-1}) / P_{j,x-1} \quad (1)$$

Where RR_{jxy} = rate of return for firm j for the period of the test from x to y,
 P_{jy} = the closing price of a stock for firm j on the end date of the test period y,
 $P_{j,x-1}$ = the closing price of a stock firm j on the day previous to the beginning date of the test period x.

Next, we computed Simplified Cumulative Abnormal Return for the period of the test by using previously calculated *RRs*. We named the figures calculated “Simplified Cumulative Abnormal Return” or *SCAR*, to distinguish them from the definition of Cumulative Abnormal Return (*CAR*) applied in the Dos Santos et al. (1993) and other similar works (Im et al., 2001; Oh and Kim, 2001). Our proposed method of *SCAR* calculation has the advantage of simplicity, while not suffering from potential problems related to beta calculation (Fama and French, 1992) in the Capital Asset Pricing Model (*CAPM*). For a given period of the test, the *SCAR* is calculated as follows:

$$SCAR_{jxy} = RR_{jxy} - RR_{n225xy} \quad (2)$$

Where $SCAR_{jxy}$ = simplified cumulative abnormal return for firm j for the period of the test from x to y,
 RR_{jxy} = rate of return for firm j for the period of the test from x to y (calculated by using equation (1)),
 RR_{n225xy} = rate of return for Nikkei 225 for the period of the test from x to y (calculated by using equation (1)).

The average of the *SCAR* (*ASCAR*) for full sample is calculated as follows:

$$ASCAR_{nxy} = \sum_{j=1}^n SCAR_{jxy} / n \quad (3)$$

Where $ASCAR_{nxy}$ = average of simplified cumulative abnormal return for the number of firms n for the period of the test from x to y,
 $SCAR_{jxy}$ = simplified cumulative abnormal return for firm j for the period of the test from x to y,
n = the number of firms.

Results

In our analysis, the market’s reaction to 36 IT investment announcements for the full sample of 35 companies was examined. (One company made two different announcements on the same day). We calculated *ASCARs* over different event windows. In order to better investigate investors’ reactions, we defined a variety of event windows: pre-event (-5, -2), post-event (+1, +5), and others, which included the announcement day. In our effort to reduce other factors which may influence the stock price, we chose event windows close to the announcement day. Table 3 summarizes the market’s reaction to IT investment announcements for the full sample of 35 companies.

In most of the cases, *ASCARs* are negative, but statistically insignificant. Only one window (0, +2) has a relatively negatively significant *ASCAR* (significant at 0.05). Therefore, for the full sample, based on our data, we do not have enough evidence that IT investments are related to a substantial increase in the market value of the firms. These results appear to be consistent with earlier studies (Dos Santos et al. 1993; Im et al. 2001; Oh and Kim, 2001).

As part of additional analysis, we divided the full samples into two groups: the positive IT investment announcements and the negative IT investment announcements. The criterion for inclusion in one of those groups was based on the number of windows with positive *SCARs* for firms. The twenty-one firms with three or more positive *SCARs* were included in the group of positively-received IT investment announcements as depicted in Table 4. The remaining fourteen companies were included in the group of negatively-received IT investment announcements as depicted in Table 5.

Table 3. Average Simplified Cumulative Abnormal Return Around IT Investment Announcement (Full Sample)

Window	Average Simplified Cumulative Abnormal Return (%)	t-value	P-value
(-5, -2)	-0.06	-0.084	0.933
(-5, +5)	-0.58	-0.585	0.562
(-2, 0)	0.21	0.322	0.750
(-2, +2)	-1.05	-1.508	0.141
(-2, +5)	-0.42	-0.420	0.677
(0, +1)	-0.89	-1.631	0.112
(0, +2)	-1.28	-2.292*	0.028
(+1, +5)	-0.57	-0.630	0.533

0: announcement date
 *: significant at 0.05

Table 4. Average Simplified Cumulative Abnormal Return Around IT Investment Announcement(Positive IT Investment Announcements)

Window	Average Simplified Cumulative Abnormal Return (%)	t-value	P-value
(-5, -2)	0.41	0.463	0.648
(-5, +5)	2.56	2.940**	0.008
(-2, 0)	1.42	1.523	0.143
(-2, +2)	1.05	1.479	0.155
(-2, +5)	2.54	2.990**	0.007
(0, +1)	-0.28	-0.412	0.685
(0, +2)	-0.17	-0.301	0.767
(+1, +5)	1.18	1.300	0.208

0: announcement date
 **: significant at 0.01

Table 5. Average Simplified Cumulative Abnormal Return Around IT Investment Announcement (Negative IT Investment Announcements)

Window	Average Simplified Cumulative Abnormal Return (%)	t-value	P-value
(-5, -2)	-0.77	-0.661	0.520
(-5, +5)	-5.31	-3.834**	0.002
(-2, 0)	-1.60	-2.570*	0.023
(-2, +2)	-4.19	-4.890**	0.000
(-2, +5)	-4.88	-3.106**	0.008
(0, +1)	-1.80	-2.043	0.062
(0, +2)	-2.94	-3.032**	0.010
(+1, +5)	-3.19	-2.023	0.064

0: announcement date
 *: significant at 0.05, **: significant at 0.01

For the group of positive IT investment announcements, *ASCARs* are statistically positively significant in the two windows: (-5, +5) and (-2, +5) at the 0.01 significance level. Therefore, for this group of announcements, we assume that the market value of the firms is positively impacted by the IT investment announcements. In other words, the result indicates that investors perceived those IT investments positively.

On the other hand, as presented in Table 5, the fourteen firms with two or fewer positive *SCARs*, which comprise the group of the negative IT investment announcements, show mostly highly negatively significant *ASCARs*. In particular, four windows indicate extremely negatively significant figures: (-5, +5), (-2, +2), (-2,+5) and (0, +2). In this case, we also assume that the market value of the firms is influenced by the IT investment announcements, and the result suggests that investors perceived that IT investments within the firms were negative.

One explanation for these results may be leakage of information prior to the announcement date; a fact also observed in earlier studies (Oh and Kim, 2001). However, we did not investigate this issue further in light of a relatively small sample size. This issue could be addressed in the future studies.

Conclusions and Future Research

This exploratory study confirms that research issues about productivity gains related to the use of IT are complex. This is especially evident when exploring new fields, such as the "Productivity Paradox" in Japan, where the virtual non-existence of earlier studies is often combined with a lack of data. Our findings suggest a substantial difference in investors' reaction to IT investments in the Japanese stock market. Some announcements appear to be well received, while others lead to decreasing stock prices.

Our study, at least to some extent, suffered from limitations. For example, other internal or external factors may affect the impact of IT investment announcements on the stock prices. In addition, our control period was characterized by a "bear market." During a "bull market" investors' reactions to the same announcements could be different. Once again, because our sample size was a relatively small one, we did not investigate which type of announcements triggers which reaction from investors. We plan to perform such an analysis in the future.

Overall, it could be concluded that more research related to the "Productivity Paradox" in Japan needs to be done. We hope that the preliminary results described in this paper will become a catalyst for future research projects. This would not only benefit researchers looking for new fields of study, but would also help management in Japanese companies to become more successful in a competitive capital market.

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Appendix. Sample Events

No.	Date	Source	Firm	TSE Symbol
1	10/09/01	JCNN	Asahi Breweries	2502
2	11/02/01	Asia Pulse	Toshiba Corp.	6502
3	12/02/01	AFX - Asia	Yamaha Motor Co. Ltd.	7272
4	01/31/02	JCN Newswire	Showa Denko K.K.	4004
5	03/01/02	JCNN	Mazda Motor Corp.	7261
6	03/19/02	Asia Pulse	NYK Line (Nippon Yusen)	9101
7	03/25/02	The Nikkei Weekly	World Co.	3596**
8	04/09/02	Global News Wire - Asia Africa Intelligence Wire Asia Computer Weekly	Toyota Motor Corp.	7203
9	04/09/02	Asia Pulse	Mitsubishi Corp.	8058
10	04/18/02	Global News Wire - Europe Intelligence Wire	Mitsubishi Electric Corp.	6503
11	05/02/02	JCN Newswire	NTT Data Corp.	9613
12	05/07/02	Jiji Press Ticker Service	Toyota Tsusho Corp.	8015
0	05/13/02	The Daily Yomiuri	Toyota Motor Corp.	7203
0	05/13/02	Japan Economic Newswire	Toyota Motor Corp.	7203
15	06/11/02	The Japan Times	Aeon Co., Ltd.	8267
16	06/11/02	The Japan Times	Ito-Yokado Co.	8264
17	06/11/02	The Japan Times	Seiyu, Ltd.	8268
18	06/25/02	Asia Pulse	Nissho Iwai	8063
19	08/08/02	JCNN	KDDI Corp.	9433
20	08/16/02	The Asian Banker Journal	Mizuho Holdings, Inc.	8305
21	09/09/02	The Nikkei Weekly	Mazda Motor Corp.	7261
22	09/09/02	The Nikkei Weekly	Japan Telecom Co.	9434
23	09/20/02	Asia Pulse	Takara Co.	7969
24	09/20/02	The Asian Banker Journal	Mizuho Securities Co., Ltd.	8607
25	09/25/02	Asia Pulse	Hitachi Metals Ltd.	5486
26	09/26/02	Jiji Press Ticker Service	Fuji Fire & Marine Insurance Co.	8763
27	09/30/02	The Nikkei Weekly	Seiyu, Ltd.	8268
28	10/01/02	JCN Newswire	Mazda Motor Corp.	7261
29	10/08/02	Asia Pulse	Toppan Printing Co., Ltd.	7911
30	10/08/02	JCN Newswire	Mazda Motor Corp.	7261
31	10/15/02	The Nikkei Weekly	Matsushita Electric Industrial Co.	6752
32	10/15/02	The Nikkei Weekly	Toshiba Corp.	6502
33	10/15/02	The Nikkei Weekly	McDonald's Holdings Co. (Japan), Ltd.	2702***
34	10/16/02	Jiji Press Ticker Service	West Japan Railway Co.	9021
35	10/18/02	Asia Pulse	Mori-Gumi Co.	1853**
36	10/29/02	The Daily Yomiuri	East Japan Railway Co.	9020

*: Toyota made two different announcements on the same day.

** : OSE (Osaka Stock Exchange)

***: JASDAQ (NASDAQ Japan)