The Effects of Information System Investment in Banking Industry

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<Abstract>

The statistical analyses of RCSS were quite opposite to the popular propositions concerning to information technology revolution over Japanese banking systems. At first, one of the propositions is that computer hardware and software investment has a quite large effect to the economic value of banks comparing with the small effect in the manufacturing industry. This proposition is incorrect. These numbers are not different with the effect of US manufacturing industry. Therefore, there is no difference over the industry during IT revolution. Second, Solow's Productivity Paradox is not true in Japan. In other words, in Japanese banking industry, there is no Productivity Paradox at all. Third, US estimation of management scientists concerning computer investments effect was over estimation from the stand point of statistical scientists. There is no difference between US and Japan concerning social effect of IT revolution depending with the RCSS estimation including software assets in the total assets of computers. Therefore, Japanese banking industry is not follower of US banking industry concerning information technology. The analysis of RCSS, information investment of Japanese banking industry is one of the best qualities among the OECD countries. This is quite unpopular message to this miserable economy of Japan. Of course, Japanese banks need a large scale of money in order to develop new monetary production and data mining technique using large scale of accumulation of custom data. Moreover, they need more investment to the security policy of the information network. However, this is not IT investment. This is the investment to the human capital. They need more personnel cost to IT revolution.

1. Introduction

Japanese 11 nation wide banks in 1995 have changed into 5 groups in 2002. Although the regional banks are keeping the number of 64, the members of Second Regional Banks Association have been decreasing from 65 to 56 at the beginning of this period.

The Japanese banking industry suffering with bad credits has been in the age of restructuring. This kind of severe management situation occurred also in the US banking industry during the second half of 1980s.

The main reason of recovering in US banking industry which has been in a critical situation was the long run expansion of US economy during 1990s. Moreover the management of the industry understood that the information technology had been the new clear competitive condition. Therefore, they are expanding their investments of computer hardware and software and also the employment of computer technicians. They say that these are the second main reasons of the propensity of the industry. However, is this popular explanation true from the stand point of the scientific analysts?

The macro economists in the United States have been skeptical to the positive effect of information technology investment towered total factor productivity and labor productivity from 1980 to the beginning of 1990s. In 1993, an economist group leading by Professor Erik Brynjolfsson at MIT finally succeeded a positive analysis which proved that IT investment has a positive effect of increasing firms' value measured with total issued stocks and labor productivity, with using micro data of individual firms.

This kind of micro data analysis of IT investment is quite few in Japan. However, the Institute of Social Information Research at the University of Tokyo and the Research Institute of Fujitsu are doing the micro data analysis in manufacturing industry and service industry.

On the other hand, the positive analyses of IT investment in banking industry were very few in 1990s all over the world. Ukai (1997) and Prasad and Harker (1997), a discussion paper of Wharton School of Pennsylvania University, were the first researches of this industry.

2. RCSS Project on Japanese Banks

The Research Center of Socio Network Strategies, RCSS, at Kansai

University has been compiling the data of information system investment of Japanese banks by the mailing questionnaires and answers, and its interviews with the chief information officers in banks.   This research project started in 1995 with the economists, accounting scholars and computer scientists at Kyoto University, Kobe University, Waseda University and Financial Information System Center, Tokyo.   Academic information is disclosed on the internet.
(http://www.rcss.kansai-u.ac.jp)

The micro data of RCSS is enclosing computer software investment along with computer hardware investment.   This is the first characteristics of RCSS which has not seen in the research of MIT depending with US public database. They are also enclosing labor cost related to the development and operating cost of computer system.   That is the second characteristics of RCSS which has not also seen in the research of MIT depending with US public database.

In Japan, there are few banks which are focused on their computer investment in one independent section on the financial reports to the stock market. Therefore, the economists must collect the scattering data of IT investment over these financial reports and make consistent data in order to analyze of IT investment.

In 1997, RCSS published   Ukai（1997）which found that system development cost of banks was tend to increase with their loan and total asset. These two findings are statistically correct.

2-1   System Development Cost vs. Loan

Ukai（1997）described three cross section regression equation over thee period, as follows.

Suffix i: period of mailing questionnaires and answers: 1995, 1996, and 1997
System Development Cost: DC_i（100milion yen）
Loan: K_i（100milion yen）

$$DC_1 = 0.006309K_1 - 35.76 \qquad (1)$$
$$(11.80)$$
$$n=20, \ Adj.R^2 =0.87, \ P<0.01$$

$$DC_2 = 0.001832K_2 + 55.45 \qquad (2)$$

$$(6.27)$$

n=23, $Adj.R^2 = 0.63$, P<0.01

$$DC_3 = 0.010706K_3 - 41.35 \qquad (3)$$

$$(31.80)$$

n=15, $Adj.R^2 = 0.98$, P<0.01

It concluded that the coefficients of banking loans to computer investment have bee increasing from 1995 to1997. Therefore, one billion yen increasing of banking loans reduced ten million computer system investments in a large sense in 1997.

2-2 System Development Cost vs. Total Asset

Suffix i: period of mailing questionnaires and answers: 1995, 1996, and 1997
System Development Cost: DC_i (100milion yen)
Asset: A_i (100milion yen)

$$DC_1 = 0.00414_1 - 30.78 \qquad (4)$$

$$(13.53)$$

n=20, $Adj.R^2 = 0.90$, P<0.01

$$DC_2 = 0.0012A_2 + 56.52 \qquad (5)$$

$$(6.48)$$

n=23, $Adj.R^2 = 0.65$, P<0.01

$$DC_3 = 0.0073A_3 - 42.99 \qquad (6)$$

$$(33.81)$$

n=14, $Adj.R^2 = 0.98$, P<0.01

It concluded that the coefficients of banks total assets to computer investment have bee increasing from 1995 to1997. Therefore, one billion yen increasing of banking loans reduced seven million computer system development costs in a large sense in 1997.

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2-3 System Development Cost vs. Total Employee

Suffix i: period of mailing questionnaires and answers: 1995, 1996, 1997
System Development Cost: DC_i (100milion yen)
Total number of Employee: L_i

$$DC_1 = 0.076785L_1 - 96.17 \quad (7)$$
$$(12.87)$$
n=20, $Adj.R^2$=0.89, P<0.01,

$$DC_2 = 0.044588L_2 - 19.08 \quad (8)$$
$$(8.28)$$
n=23, $Adj.R^2$=0.75, P<0.01,

$$DC_3 = 0.227698 \, L_3 - 309.44 \quad (9)$$
$$(13.57)$$
n=23, $Adj.R^2$=0.92, P<0.01,

It concluded that the coefficients of banks total employees to computer investment have bee increasing from 1995 to1997. Therefore, one increasing of banking employee reduced 22 million computer system development costs in a large sense in 1997.

2-4 Management Strategies and Investment Behavior

Ukai (1997), moreover, added management strategy dummy variables of D_i to the simple regressions from (1) to (6).

If D=0, banks are dependent to the Central Bank and the Ministry of Finance.
If D=1, banks are independent to the Central Bank and the Ministry of Finance.

$$DC_i = a + bX_i + \hat{b} D_i X_i \quad (10)$$

$$DC_1 = 0.004473K_1 + 0.002822D_1K_1 - 26.95 \quad (11)$$
$$(9.63) \qquad\qquad (5.57)$$
adjR²=0.95

$$DC_1 = 0.003045A_1 + 0.001517D_1A_1 - 22.31 \quad (12)$$

$$(9.33) \qquad (4.34)$$

adjR²=0.95

$$DC_1 = 0.060664L_1 + 0.023663D_1L_1 - 86.43 \qquad (13)$$
$$(10.76) \qquad (4.32)$$

adjR²=0.94

$$DC_2 = 0.0013K_2 + 0.001726D_2K_2 + 40.32 \qquad (14)$$
$$(5.45) \qquad (4.24)$$

adjR²=0.80

$$DC_2 = 0.00088A_2 + 0.001063D_2A_2 + 44.61 \qquad (15)$$
$$(5.40) \qquad (4.06)$$

adjR²=0.80

$$DC_2 = 0.035129\,L_2 + 0.030898\,D_2L_2 - 47.16 \qquad (16)$$
$$(9.42) \qquad (5.83)$$

adjR²=0.90

$P<0.01$ for all from (11) to (16)

It concluded that independent chief information officers tended to invest computer system to their own banks more aggressively than the others.

2-5 RCSS Panel Data Analyses

Ukai and Watanabe (2001) statistically examined how much the increasing investment in IT system capital contributed to the firms' value measured with total stock issued.   They conducted panel data analysis in order to exclude the bias of firms' characteristics and to understand true tendency of the banking industry. However they only used the banks' data of 1995, 1996 and 1998 expertised from the questionnaires of RCSS.

They concluded that one yen increasing of computer capital reduced 26 yen increasing of firms' capital value with the adjustment of the difference among several assets and to summing up the value of computer hardware and software. These results are very similar to Brynjolfsson's results of ten in US manufacturing industry and service industry.   His maxim value was twenty and the minimum

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value was five.

Table.1 Capital Contributions to the Firms' Value

	Loan	System Asset I	Individual Effect	$adj.R^2$
Fixed Effects	1.723102	26.7037		0.998019
t-value	(1.38066)	(2.28269)		
p-value		p<0.1		
Random Effects	1.69482	17.6712	-4197.40	0.998081
t-value	(75.7276)	(2.25644)	(-3.50348)	
p-value	p<0.01	p<0.05	p<0.01	
33 Banks, 3 years, N=58				
Houseman Test: Chi Sq(2)=1.1927, P-value=0.5508, random effect model				
F test: F(32,23)=5.94109, P-value=0.103				

Ukai and Watanabe (2001) tried Houseman test to their panel date, but could not find fixed effect of investment behavior among the banks over the estimated years.

Ukai and Takemura (2001) also statistically examined how much the increasing investment of the computer software asset contributed to the firms' value measured with total stock issued. In their paper, they collected the data from the public financial reports based on the Article 24 of Security Dealing Act of Japan. This is quite different with the approach of Ukai and Watanabe (2001). They also defined their computer software as an intangible asset which was described as the most important factor of firms' productivity in the Brynjolfsson's research in the second half of 1990s.

They found out that one yen increasing of software asset per capital of total employees has strongly statistically related to the 18 yen increasing of the firms' value measured with total stock issued per capital.

They also tried Houseman test to their panel date, and found out that the fixed effect of investment behavior among the banks over the estimated years. This contradiction of Houseman test between total computer and software investments suggested that hardware computer investments had no effect to the market value of firms any more even in 1990ies.

Table.2 Balanced Panel Data Analysis of Software Asset

	Loan	System Asset III	Standard	Operating Time	Individual Effect	$adj.R^2$
Fixed Effects	1.177	18.061	50.687	-1.157		0.997
t-value	(16.915)	(2.128)	(3.578)	(0.489)		
p-value	p<0.01	p<0.05	p<0.01			
Random Effects	1.439	11.355	23.939	-3.796	99.677	0.978
t-value	(28.162)	(1.366)	(1.786)	(-1.668)	(1.955)	
p-value	p<0.01		p<0.10		p<0.05	
13 banks, 7 years, N=91						
Houseman Test: Chi Sq(3)=34.764, p-value=0.000, fixed effect model						
F test: F(12,73)=37.604, p-value=0.000						

2-5   IT Capital Elasticity to Production

Ukai and Kitano (2002) estimated several production functions of Japanese main banks during 1997 – 2000. They estimated computer investment of Japanese main banks excluded the Bank of Tokyo-Mitsubishi from the data of IBM Japan in 2001, and management reengineering plans issued to Administration Agency of Banking Industry in Japan and financial reports published to the stock market authority. They also estimated labor input and production from these financial reports. The production was deduced from the stock of their loans and the labor investment reduced from the total number of employees of each bank and the total capital was reduced from mobile assets and non-mobile assets on the each financial report.

Ukai and Kitano (2002) estimated that the IT capital elasticity of labor productivity increased from 0.2 to 0.3 during the period from 1998 to 2000. It is that the one percent increasing of IT capital was strongly related to the 0.2 increasing of labor productivity in 1998 and to the 0.3 percent increasing of one in 2000. This estimation is quite similar to the value of 0.1 of US macro economy derived from the research of Professor Shinozaki at Kyushu University and RCSS. Shinozaki(1999) used the data of the US Department of Commerce from 1984 to 1994.

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$\ln Y = \ln A + \alpha \ln K_i + \beta \ln L$: Production Functions of Japanese Bank I (17)

Y : Loan as Production of Bank

K: Computers reported to the MOF

L: Total number of employee

Table.3 IT Capital Elasticity of Labor Productivity in 19 Japanese Banks

Fiscal year	α	β	constant	$adj.R^2$
1998	0.3045 (1.6851)	1.0002 (3.2522)	0.9313 (0.5114)	0.9002
1999	0.5127 (1.9135)	0.7452 (1.9351)	1.8959 (0.9552)	0.8891
2000	0.5499 (2.1190)	0.7550 (2.0989)	1.6335 (0.9365)	0.9128
2001	0.5879 (2.006)	0.6920 (2.3676)	1.9795 (1.1847)	0.9142

( ) : t Value

3. Implications of RCSS Findings

These four statistical analyses of RCSS were quite opposite to the popular propositions concerning to information technology revolution over Japanese banking systems.

At first, one of the propositions is that computer hardware and software investment has a quite large effect to the economic value of banks comparing with the small effect in the manufacturing industry. This proposition is incorrect. These numbers are not different with the effect of US manufacturing industry. Therefore, there is no difference over the industry during IT revolution.

Second, the Novel Prize laurelled economist Robert Sollow insisted that computer investment has a very small effect to the economic value and productivity of each firm in Sollow(1987). This is the very famous Solow's Productivity Paradox. It is not true in Japan. In other words, in Japanese banking industry, there is no Productivity Paradox at all.

Third, US estimation of management scientists concerning computer investments effect was over estimation from the stand point of statistical scientists.

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There is no difference between US and Japan concerning social effect of IT revolution depending with the RCSS estimation including software assets in the total assets of computers. Therefore, Japanese banking industry is not follower of US banking industry concerning information technology.

The number of branch stores in Japanese private banking institutions is decreasing in 5 percent during the period of 1994 to 1999. On the contrary, the number of automatic teller machines is increasing 28 percent during this period. Moreover, the number of ATMs of Japan Postal Service is increased 62 percent this period. Japan is number one of ATMs per capital all over the world.

The analysis of RCSS, information investment of Japanese banking industry is one of the best qualities among the OECD countries. This is quite unpopular message to this miserable economy of Japan.

Of course, Japanese banks need a large scale of money in order to develop new monetary production and data mining technique using large scale of accumulation of custom data. Moreover, they need more investment to the security policy of the information network. However, this is not IT investment. This is the investment to the human capital. They need more personnel cost to IT revolution.

4. Suggestions to IT Strategy in Japan

The members of RCSS have been interviewing a large number of the top management of Japanese banks about the IT investment in their organizations. Their first impression was that Japanese banks should improve the human capital and organization concerning IT, but IT investment. Every Japanese bank has Chief Information Officer as Board Member of Trustees, however almost all these CIOs have not proper qualities to do modern information technology at all. The CIO should be a computer specialist having PhDs of Computer Science or another information field. On the contrary, there are very few PhD holders in the Board Members or in the executive managers over the Japanese banks.

Of course, top five financial corporations in Japan have several PhD holders among production development sections and information system sections. However, they are all only technicians. They are not the strong members of the top management of the organizations.

The organizations which are facing severe shortage of human capital concerning IT strategies are not only Japanese banks, but also every organization all over Japan. For example, IBM has a title called IBM fellow, which was given to the scientists and technicians conducting original researches. In 2000, IBM fellow

counts 52, but only one of them was Japanese. IBM Japan enjoyed high reputations to educate their employees, however even they are in this miserable situation.

Look at the government sector of Japan. The top officers of IT strategies are less than ten in the Cabinet Office of Japan.

After all, in every organization of Japan, private firms, government and universities, there are enough computers and computer hardware. On the contrary, there are no IT strategies in Japan.

In order to construct proper IT strategies, Japan needs scientific researches about human capital and organization efficiency concerning information technology by doing international comparative studies with their own money. This RCSS project will be one of the best choices of Japanese government.

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