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Shinozaki, Akihiko
Graduate School of Economics, Kyushu University : Pofessor

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Akihiko Shinozaki*

Introduction

The major result of recent empirical studies related to the impact of information technology on economic growth has been the sure knowledge that information technology has contributed to the surge in productivity and its consequent economic growth witnessed in the U.S. since the mid-1990s.[1] A driving force to that radical change in the U.S. has been the massive investment in information technology since the early 1990s. As a result, the popular belief in the "Solow paradox," derived from Solow's famous quip, "You can see the computer age everywhere but in the productivity statistics,"[2] has disappeared. Instead, an undisputed acknowledgement of the "new economy" has taken root in the U.S.

Japan, in contrast, experienced its "lost decade" in the 1990s, when business investment was sluggish and the economy grew at only 1.3 percent annually. The matter in question in this contrast between Japan and the U.S. is whether Japan's investment in information technology has contributed to its economic growth, and how information network industries, the dynamos of the "new economy," have performed in the Japanese economy over the last few decades.

To address these questions, we first measure Japan's economic growth and the contribution of information technology based on Solow's growth accounting method. Then, we outline the periodic changes in Japan's productivity and IT investment to analyze whether both, the new economy as well as the "Solow paradox," have been true for Japan. We also investigate information network industries to elucidate the reasons for and causes of Japan's stagnant economic performances in the era of the

* Professor, Graduate School of Economics, Kyushu University, Japan.

[1] For detailed arguments, see Brynjolfsson and Hitt, "Paradox Lost?"; Oliner and Sichel, "Resurgence of Growth"; Jorgenson, "Information Technology"; Stiroh, "Information Technology"; Jorgenson, et al., "Retrospective Look"; Oliner, et al. "Explaining a Productive Decade."

[2] See Solow, "We'd Better Watch Out." Until the early 1990s, most empirical studies of the U.S. economy found no evidence of a positive correlation, and some found negative correlation, between IT and productivity (U.S. Department of Labor, *Integrating Technology*). Therefore, it is likely that the "Solow paradox" was prevalent then.

"new economy." Through these analyses, we consider the feasibility of a resurgence in Japan's economic growth in the era of the information technology revolution.

II. Measurement of Economic Growth and Contribution of Information Technology

Analytical Framework

For these analyses, we use a growth accounting method pioneered by Robert M. Solow.[3] This method is based on the framework of a neoclassical production function to estimate the contributions to output per hour derived from increases in capital assets per hour worked and total factor productivity (TFP), where TFP is estimated as a residual for technological or organizational improvements that increase output for a given amount of input.

Equation (1) presents the basic concept of a growth accounting method with capital assets divided into IT and non-IT assets, where IT assets include not only computer hardware but also software and network infrastructure. One reason for this is that intangible assets, in recent times, have been gaining in importance. Secondly, remarkable innovations have now engineered the convergence of computers and telecommunications equipment, as in:

$$(1)\quad Q=TK_o^{\alpha}K_i^{\beta}(hrL)^{\gamma},$$

where α, β, and γ respectively represent income shares of inputs such that $\alpha+\beta+\gamma=1$. Furthermore, Q is the private output, T is the TFP, K_o represents non-IT capital assets, K_i denotes IT capital assets, hr represents the work hours per employee, and L is the number of employees. Consequently, eq. (1) can be transformed to

$$(2)\quad \dot{Q}-\dot{hrL}=\dot{T}+\alpha(\dot{K}_o-\dot{hrL})+\beta(\dot{K}_i-\dot{hrL}),$$

where a dot over a variable indicates the rate of change expressed as a log difference. In eq. (2), $\dot{Q}-\dot{hrL}$ represents changes in output per hour, or average labor productivity, $\dot{T}$ represents changes in TFP, and $\dot{K}-\dot{hrL}$ represents changes in capital assets per hour worked, which is referred to as capital deepening. The capital deepening portion is further divided into the contribution of IT assets and that of other non-IT assets in eq. (2).

[3] Solow, "Technical Change."

The basic equation shown above must be adjusted for the business cycle effect. Productivity is well known to be so pro-cyclical that the structural trend of productivity must be distinguished from business-cycle-related changes of productivity. The utilization rate of capital assets is used in this paper as a proxy for business cycle effects in order to remove the influence of the business cycle from the labor productivity. Therefore, eq. (1) can be modified to

$$(3)\ Q = T(pK_o)^{\alpha}(pK_i)^{\beta}(hrL)^{\gamma},$$

where p is the utilization rate of capital assets assuming that the utilization rate is homogeneous for each asset. Then, eq. (3) can be transformed to the expression shown below:

$$(4)\ \dot{Q}-\dot{hrL}=\dot{T}+\alpha(\dot{K_o}-\dot{hrL})+\beta(\dot{K_i}-\dot{hrL})+(\alpha+\beta)\dot{p}.$$

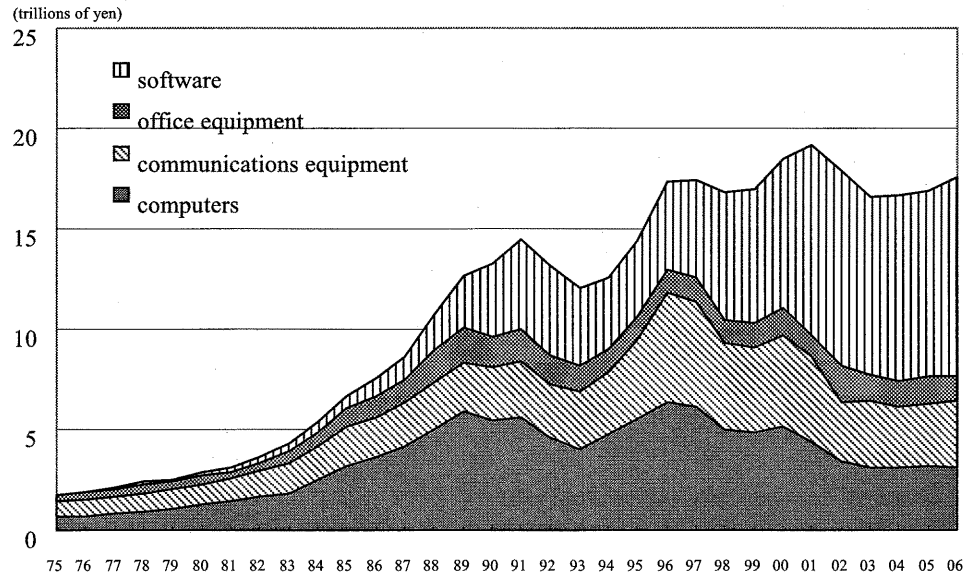
Here, we can measure the contributions to changes in labor productivity, or output per hour, through decomposition into four factors: TFP ($\dot{T}$), non-IT capital assets per hour worked (capital deepening of non-IT: $\dot{K_o}-\dot{hrL}$), IT capital assets per hour worked (capital deepening of IT: $\dot{K_i}-\dot{hrL}$), and the utilization rate of capital assets ($\dot{p}$) as a proxy of the business cycle effect.

Dataset and Overview of IT Investment in Japan

All datasets described in this paper are taken from officially published statistics compiled by government ministries or research institutes: Output data and overall capital input data from the Cabinet Office, labor input data from the Statistics Bureau of the Ministry of Internal Affairs and Communications, utilization rates from the Ministry of Economy, Trade and Industry, and contributions of information technology assets from InfoCom Research, Inc.

Before carrying out growth accounting analysis, it will be useful to review Japan's IT investment history. As Figure 1 illustrates, the total investment in information technology amounted to 18 trillion yen (150 billion US dollars) in 2006, which accounted for 3.5 percent of the nominal Gross Domestic Product, (GDP), and 22.0 percent of the total nonresidential fixed investment. The volume of investment in software technology, approximately 9.9 trillion yen (83 billion dollars), was larger than that in hardware, which amounted to 7.7 trillion yen (64 billion US dollars). Even until the late 1990s, the volume of investment in hardware, including computers, communications, and office equipment, was greater than that in software. As for

Figure 1: Japan's Nominal Investment in IT



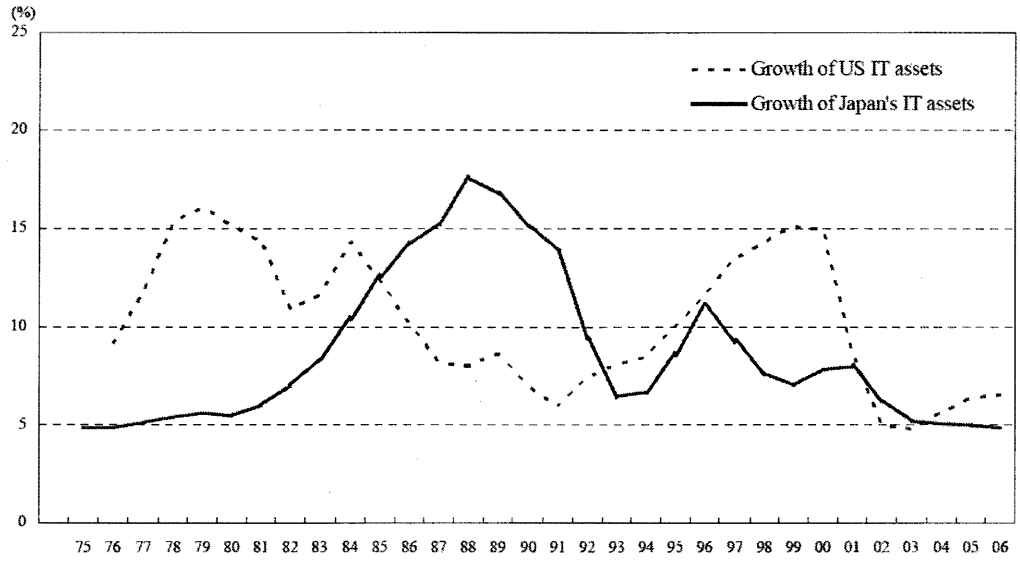
Source: InfoCom Research, *InfoCom ICT.*

investment in computers, it was for a time the largest component of IT investment. Now, however, the figure stands at just 3.1 trillion yen (25 billion US dollars), less in fact than the current investment in communications equipment, which amounts to 3.3 trillion yen (28 billion US dollars).

Several characteristics are evident from Figure 1. Firstly, a long-run investment boom in the late 1980s; secondly, decreased technology investment in the early 1990s and a cyclical fluctuation from the mid-1990s to the late 1990s; thirdly, the end of the downward trend and a slight sign of recovery in hardware investment in the early 2000s is apparent; and finally, there has been notable expansion of software investment since the late 1990s. It must be emphasized that Japanese private business sectors aggressively invested in "legacy" types of technology based on mainframe computers with closed switched network systems in the 1980s, but they were much less prepared to invest in the new open-network technology of the 1990s.

In Japan, deregulation of the telecommunications market had just begun in 1985, a time when banking industry leaders were enthusiastic about enhancing online transaction systems based on "legacy" technology: little attention was paid to the

Figure 2: Growth of IT Assets and Non-IT Assets



Source: InfoCom Research, *InfoCom ICT* and U.S. Department of Commerce NIPA tables.

"Solow paradox." Consequently, they successfully adopted "legacy" information systems while U.S. firms were confronting the productivity paradox.

The Japanese IT investment boom, however, ended abruptly in the early 1990s when new types of open-network technology surged throughout the world; mainframe computers were being downsized to personal computers and the internet was rapidly spreading worldwide. By that time, Japan's investment in information technology had shown repeated cyclical fluctuations, which had marked the decade.

That pattern of change of investment trends—the boom in the 1980s and the slump in the 1990s—affected the accumulation of information technology assets. Figure 2 shows that the annual growth rate of Japan's IT capital assets accelerated up to 18 percent in the 1980s. Nevertheless, the rate of increase fell away drastically in the early 1990s and has never since achieved the highs of the 1980s. Indeed, it is much more helpful to examine the case of the U.S. The rate of accumulation of Japan's IT assets jumped to more than double of the U.S. rate in the latter 1980s; it then slid, and by the end of the 1990s Japan's rate of accumulation of IT assets was lower than that of the U.S. Therefore, it can be concluded that Japan missed a window of opportunity to ride a dynamic wave of information technology innovation that swept through the 1990s, whereas the U.S. made the most of the opportunity and reaped the benefits of the internet revolution.

Table 1: Economic Growth, Labor Productivity, TFP, and the Contribution of IT

	76-80	81-85	86-90	91-95	96-00	01-05	changes from previous five years				
	a	b	c	d	e	f	b-a	c-b	d-c	e-d	f-e
Growth rate of output	4.8	3.3	5.0	1.6	0.9	1.5	-1.5	1.6	-3.3	-0.7	0.5
Growth rate of labor input	1.4	0.9	1.3	-0.3	-0.5	-0.8	-0.4	0.3	-1.5	-0.3	-0.3
Output per hour	3.4	2.4	3.7	1.9	1.5	2.3	-1.1	1.3	-1.8	-0.4	0.8
Business cycle effect	1.2	-0.0	0.3	-0.8	0.1	0.3	-1.2	0.3	-1.1	0.9	0.2
Fundamental trend	2.3	2.4	3.4	2.7	1.4	2.0	0.1	1.0	-0.7	-1.3	0.6
Capital deepening	1.7	1.5	1.8	1.6	1.0	0.8	-0.2	0.3	-0.2	-0.5	-0.3
of non-IT assets	1.6	1.3	1.3	1.2	0.6	0.4	-0.3	0.0	-0.1	-0.6	-0.2
of IT assets	0.1	0.2	0.4	0.3	0.4	0.4	0.1	0.3	-0.1	0.1	-0.0
Total factor productivity	0.6	1.0	1.6	1.2	0.4	1.2	0.4	0.7	-0.5	-0.8	0.8
Addendum											
[Income shares (percentage)]											
α share Ko	31.1	29.6	29.8	25.5	22.3	21.7	-1.6	0.2	-4.3	-3.2	-0.6
β share Ki	1.9	1.9	3.0	3.6	4.5	5.9	-0.0	1.1	0.6	0.9	1.4
γ share Lh	66.9	68.5	67.3	71.0	73.2	72.4	1.6	-1.3	3.7	2.2	-0.8
[Annual growth rate of inputs]											
dKo	6.5	5.3	5.7	4.5	2.2	1.0	-1.2	0.4	-1.2	-2.3	-1.3
dKi	5.3	8.9	15.8	9.0	8.6	5.9	3.6	6.9	-6.8	-0.4	-2.7
dU	3.5	-0.1	0.9	-2.6	0.2	0.8	-3.5	0.9	-3.5	2.8	0.6

Source: Author's calculation.

Japan's Economic Performance before and after the "Lost Decade"

Based on the formula and dataset described above, we can analyze the long-run economic performance of Japan and the contribution therein of information technology. Table 1 shows results of measurements of economic growth since the second half of the 1970s, with labor productivity shown in terms of hourly output. The first line in the table traces the growth rate of the entire economy; the third line shows the productivity growth rate as a result of the first line (growth rate of output) minus the second line (growth rate of labor input). The fourth and fifth lines show this productivity growth rate coupled with the business cycle effect and the fundamental trend, respectively.

Japanese macroeconomic performance has changed drastically over the last three decades. Figures in the first line illustrate the transformation well. The economy enjoyed a powerful boom in the late 1980s and plunged into a deep slump in the 1990s. The annual growth rate in the early 1980s was a healthy 3.3 percent; by the late 1980s the rate had climbed to a vigorous 5.0 percent. This growth was accompanied by a rapid advance in labor productivity. Output per hour rose at an annual rate of 2.4 percent in the early 1980s and at a robust 3.7 percent in the late 1980s. This improvement was not driven by a cyclical effect in those days, but rather by a fundamental trend of productivity improvement. More precisely, it was driven by the surge in TFP and capital deepening of IT assets.

In the 1990s, however, the economy plunged into a deep slump, especially in the second half of the decade. The economy grew at a mere 1.3 percent annually during the 1990s (1.6 in the first half and 0.9 in the second half of the decade) with sluggish

improvement in productivity. The growth rate of the economy was less than one-third of the rate achieved in the late 1970s or late 1980s, and less than half of the rate realized in the early 1980s. This sluggishness is also apparent in the productivity figures. The fundamental trend of output per hour rose at 2.7 percent annually in the early 1990s and at an even poorer rate of 1.4 percent in the late 1990s. The trend of productivity growth fell sharply in the latter 1990s, by two percentage points from that in the late 1980s. In fact, the TFP also fell by more than one percentage point. These figures well represent the stagnant economic condition that is often referred to as the "lost decade" of the Japanese economy.

Nevertheless, the economy finally seemed to show some signs of recovery in the early 2000s when Japan underwent several important reforms under the Koizumi Administration. Although the aggregate growth rate of the economy was one and half percent in the first half of the 2000s, the figure was mainly due to the decreasing trend of labor input, which reflected the private business sector's efforts at downsizing and restructuring during the period. As far as the fundamental productivity trend was concerned, it was Japan's productivity that had bailed the country out of the depths of its slump of the late 1990s. The productivity trend has recovered by 0.6 percentage points from 1.4 percent to 2.0 percent since 2001, mainly due to the resurgence of the TFP. The annual growth rate of TFP, which plunged to 0.4 percent in the late 1990s, has improved by 0.8 percentage points to 1.2 percent now: This compensates somewhat for the weak contribution of capital deepening. The resurgence of the TFP reflects the recovery of aggregate efficiency in the Japanese economy.

Neither a "Solow Paradox" Nor a "New Economy" in Japan

In the discussion presented in this subsection, we specifically address the contribution of information technology to productivity improvement and the resultant economic growth. As Table 1 illustrates, capital deepening, which reflects business investment, largely accounts for the improvements in labor productivity in each period. For example, the growth rate of productivity trends during 1976–80, 1981–5, 1986–90, 1991–5, 1996–2000, and 2001–2005 were, respectively, 2.3, 2.4, 3.4, 2.7, 1.4, and 2.0 percent (see the fifth line of the table), of which capital deepening contributed 1.7, 1.5, 1.8, 1.6, 1.0, and 0.8 percentage points, respectively (see the sixth line of the table).

Although the overall contribution of capital deepening seems to have changed little, the composition of such capital deepening has shifted substantially. Capital deepening of IT assets has gained in influence, from 0.1 in the late 1970s to 0.4 in the late 1980s. Capital deepening of IT assets has remained almost unchanged since then (see the eighth line of the table), whereas non-IT assets have become less important,

Table 2: Acceleration of the U.S. Economy and the Contribution of IT

	1959–73	1973–95	1995–2006		difference		
	(a)	(b)	(c)	95-2000 (d)	(b)-(a)	(c)-(b)	(d)-(b)
Output per hour	2.8	1.5	2.6	2.7	-1.3	1.1	1.2
Capital deepening	1.4	0.9	1.4	1.5	-0.5	0.5	0.6
of IT assets	0.2	0.4	0.8	1.0	0.2	0.4	0.6
Labor quality	0.3	0.3	0.3	0.2	0.0	0.0	-0.1
Total factor productivity	1.1	0.4	1.0	1.0	-0.7	0.6	0.6

Source: Jorgenson et al., "Retrospective Look."

Note: Figures might not add precisely because of rounding.

going from 1.6 to 0.4 percent (see the seventh line of the table). The surge of IT capital deepened in the late 1980s, reflecting the increased importance of information technology (see increase of income share in addendum of Table 1) and the faster growth in information technology assets (see growth rate of input in addendum of Table 1).

In the first half of the 1990s, however, the capital deepening of IT assets had somewhat lessened; since then the figures have remained almost unchanged, accounting for one-fifth of the 2.0 percent growth in the productivity trend during the 2000s. During the same period, the capital deepening of non-IT assets became remarkably less productive, falling from 1.3 percent in the late 1980s to 0.4 in the early 2000s. Consequently, the extent of impact of IT assets on the economy now matches that of non-IT assets.

The matter at hand, however, is not a comparison of IT assets with non-IT assets; our focus will be on the analysis of periodic changes in IT assets in terms of their contribution to productivity improvement and the resultant economic growth. The last five columns of Table 1 present some important data in this regard. Acceleration of the TFP (see the ninth line) and the contribution from IT assets (see the eighth line) are described as periodic changes in each of the five periods. The remarkable fact is that the changes in TFP and contribution of IT capital assets went in the same direction until the mid-1990s, instead of moving in opposite directions. This characteristic differs starkly with the fact that the growth rate of TFP and the contribution of IT assets ran in opposite directions in the U.S. until the mid-1990s (Table 2). In the U.S.,

therefore, "economists were puzzled as to why productivity growth was so slow despite the widespread use of information technology."[4] That was, demonstrably, the "Solow paradox."

The Japanese economy is a study in contrasts. For example, during 1981–5, TFP increased by 0.4 percentage points from the previous five-year period with a 0.1 percentage point contribution from IT capital assets. There was a 0.7 percentage point TFP growth with a 0.3 percent contribution from IT capital assets during 1986–90; and a -0.5 percentage point TFP growth with a -0.1 percentage point IT capital assets contribution during 1991–5. Accordingly, TFP was positive when capital deepening of IT capital assets contributed positively, and TFP was negative when IT capital assets contributed negatively. In other words, we never saw the "Solow paradox" in Japan before the mid-1990s.

Conversely, no manner of clear correlation has been shown between TFP and the contribution of IT assets since the second half of the 1990s. For example, during 1996–2000, TFP decreased by 0.8 percentage points from the previous five years, with a 0.1 percentage point positive contribution of IT capital assets; during 2001–2005, there was a 0.8 percentage point growth in TFP with an unchanged contribution (-0.0 percent point) IT capital assets. Therefore, it seems that the larger changes of TFP, from 1.2 to 0.4 to 1.2, were never affected by capital deepening of IT assets, which remained almost unchanged during those periods. It follows that we can see neither the "Solow paradox" before the mid-1990s nor the "new economy" after the mid-1990s in Japan. These observations are in marked contrast to those of the U.S., where the "paradox" was noticeable before the mid-1990s, as was the "new economy" after the mid-1990s.

Seen in the light of the description presented in the above subsection, it seems reasonable to conclude that the former observation (lack of a "Solow paradox") represents successful investment in "legacy" information technology in the 1980s, and the latter observation (lack of a "new economy") represents unsuccessful investment in open-network technologies of the internet in the 1990s. The most useful investigation is therefore an examination of the major reasons that resulted in the Japanese economy failing to reap the benefits of the information technology innovations in the 1990s. The following section will address those reasons.

[4] Baily, "New Economy," 4.

III. Changes and Developments in Information Network Industries

In the discussion presented in this section, we devote specific attention to the Japanese information network industries, or IT-producing industries, and investigate the background against which to view the missed opportunities of the 1990s.[5] We also examine the successful aspects of Japanese industries, specifically the telecommunications market, where a ray of hope has emanated in recent times, which could be the harbinger of economic growth in the coming decade.

Although several complicated reasons for Japan's "lost decade" might be apparent now, it is appropriate to look ahead and consider telecommunications and related markets as the most important and influential industries in their role as providers of IT services in the "new economy." For that reason, it seems apt to analyze how industries have changed over the last decades and where they are headed. These analyses will provide useful perspectives on the Japanese economy. For this purpose, we first review the transformation of the industries. Then we examine both unsuccessful and successful aspects of Japanese industries in the following subsections.

Transformation from Telecommunications to Information Networks

Deregulation of the telecommunications market in Japan began in 1985 when the Nippon Telegraph and Telephone Public Corporation was privatized[6] as the Nippon Telegraph and Telephone Corporation (NTT) and the market was liberalized for new startups. Immediately after the deregulation, several new common carriers started their businesses and many new information network service companies joined the market. Accordingly, investment in information technology increased throughout the 1980s, as described in section two. This investment boom, however, did not continue; it ended suddenly in the early 1990s, at a time when the investment boom in the U.S. had just begun.

Information technology, during the course of the 1990s, progressed further and changed its nature from simple high-performance automatic transaction machinery to effective business communications tools. Standard systems before the 1990s were

[5] See addendum in this paper where we analyze IT-using industries to address the puzzle of "neither a Solow paradox nor a new economy in Japan."

[6] This is not a perfect privatization but a kind of quasi-privatization because NTT retains special semi-governmental status under the NTT Law that obligates the government to hold at least one-third of NTT's shares. Moreover, NTT does not have a free hand in their business. It confronts several constraints in its management under the law. Those constraints include not only obligations of universal service but also government's approval related to business plans, organizational structures, corporate governance, appointment of top management, etc.

Figure 3: Mutation in the State of Technology and Network Businesses

Periods	~ 1980s Legacy network age	1990s Transforming age	2000s	2010s? ~ Ubiquitous network age
Technologies	Analog	Digital		
	Wired only	Wired + Wireless (FMC)		
	Narrowband			Broadband
	Copper Cable Line	(xDSL)		FTTH
	Switched network	TCP/IP, Router		(Next Generation?)
	Telephony	Internet		
Major Contents	Voice	Low Volume Data (text)	Medium Volume Data (picture)	**Extra-high Volume Data (video)**
Charge	Charge on Access Time & Distance	Flat Rate (Stay Online)		New Business Model?
Computers	Mainframe Computer	Personal Computer		Ubiquitous Computer

Source: Adams, et al., *Accelerating Japan's Economic Growth* with modifications.

mainframe computers combined with exclusive network systems that were customized by each firm, whereas personal computers were merely supplemental stand alone equipment in offices. On the other hand, personal computers connected with open network servers became dominant during the 1990s; that is, computers and communications technologies seamlessly converged and became practical business tools in offices.

Without doubt, an extremely important driver behind this change was the internet, with its underlying digital technologies of Transmission Control Protocol/ Internet Protocol (TCP/IP) and router network systems, which triggered sweeping transformations not only in the information network system architecture but also in the business management of the telecommunications industry. As Figure 3 illustrates, telephony networks and expensive switched network systems became "legacy" systems in the data communications network. Instead, the new network system based on an inexpensive router technology dominated the data communications network all over the world. This technological shift eventually affected market conditions and business models in the telecommunications industry.

Telecommunications Market in the "Lost Decade"

Unfortunately, the Japanese telecommunications industry did not keep pace with this technological transformation. As the industry's basic concepts remained rooted in the legacy telephony age, arguments concerning the telecommunications industry were mainly focused on issues related to the reorganization or breakup of NTT and its group of companies. A major reason for these biased arguments is that the NTT Law was scheduled for review in 1990 in order to facilitate a market that was pro-competition. That deadline, however, was extended twice: To 1995 and then to 1997. These postponements wasted precious time in the rapidly changing digital age. The resultant reorganization of NTT in 1999 still seems tentative and imperfect, while technologies and market conditions have been thrusting and changing with conviction.

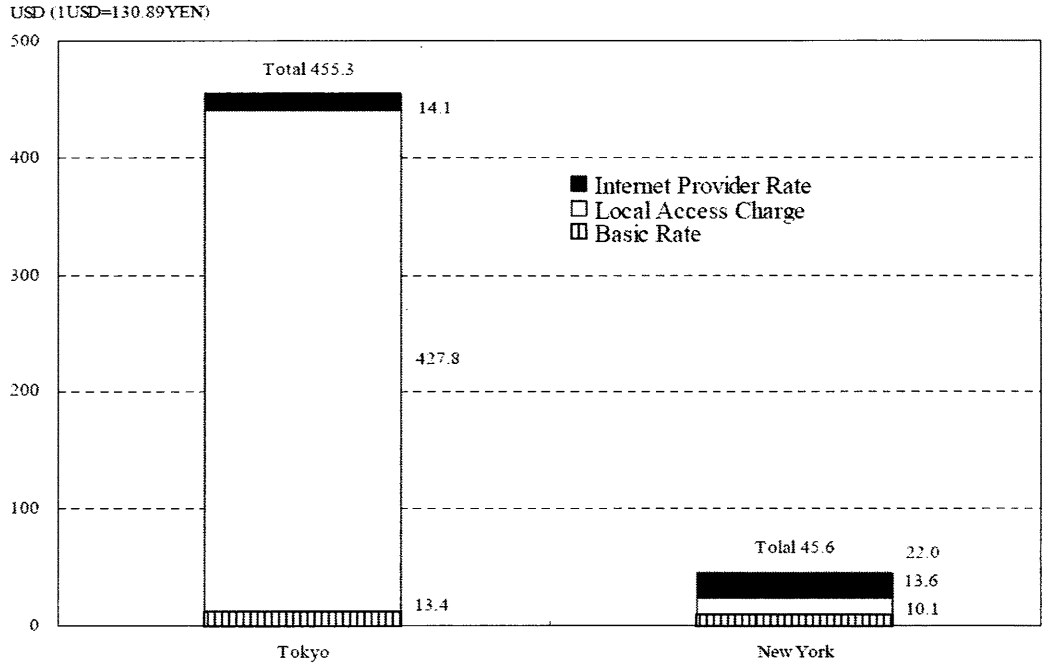
After all, the fundamental business model of the market did not change during the 1990s. This state of affairs had a partial, yet significantly, effect on the slowdown in the transition into the internet-based information age. It seems reasonable to infer that NTT adhered to switched network systems instead of the router network systems of the TCP/IP technology because NTT had invested much in the expensive switched network system for a long period of time and had built a fine-tuned charging formula based on their switched network system. In fact, NTT continued to assess charges according to a specific tariff that depended on access time and distance, while the rest of the world was going the other way.[7]

These business models served as huge impediments that prevented Japanese businesses from garnering the benefits of the information technology revolution. In the internet-based information age, it is necessary that network users be able to "stay online" and pay according to a "flat rate" formula, which was a radical departure from NTT's business models of the 1990s. Under their business models, network users were charged such that they had to pay a dime every three or five minutes for local access, in addition to a monthly basic charge of 13 dollars. As a result, network users were charged 455 dollars a month if they stayed online all day. As Figure 4 depicts, the use of the internet was ten times as expensive in Japan as it was in the U.S. even though Japanese internet providers offered lower rates than U.S. providers.

Assuming "all-day" use might not be realistic, but even if the internet were used during business hours, from 9 a.m. to 5 p.m., it was still too expensive, costing 10–15 dollars a day for local access only. In contrast, the benefits of network externalities could have been attained if all users, from consumers to producers, from small firms to big-name corporations, were able to access a network at a reasonable rate. Unlike

[7] In November 2004, NTT finally announced its long-run business strategy of converging all of their businesses into IP-based network businesses by 2010 (see section 3-4 in this paper).

Figure 4: Rate of Stay-Online Internet Use as of 1999



Source: Cabinet Office, *Kozo kaikaku*, Figure I–2, 3.

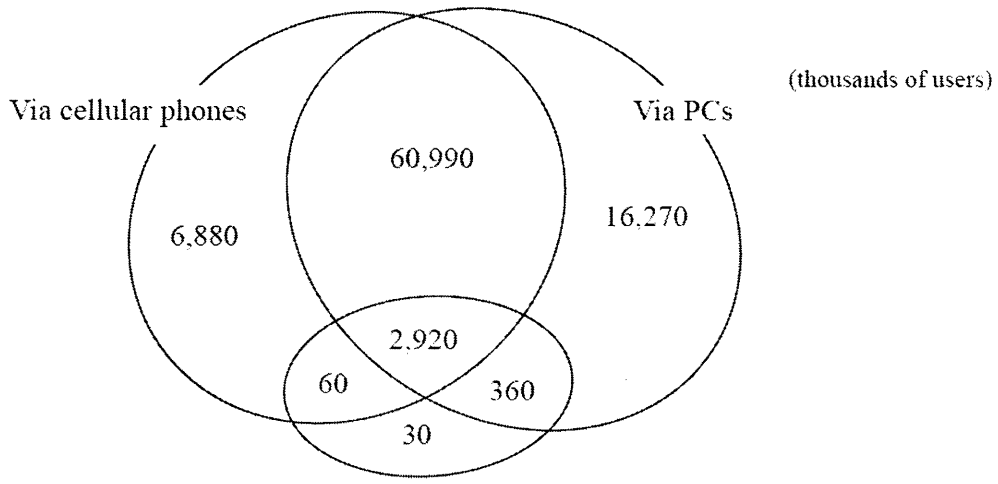
large companies, which were able to afford a leased line, small business proprietors, independent contractors, and individual consumers were able to access networks only via dial-up connections in those days. It may be concluded, therefore, that in the 1990s the Japanese telecommunications industry did not provide appropriate access services whereby every user could stay online and gain the benefits of network externalities.[8]

Successful Areas Even during the "Lost Decade"

In spite of the facts recounted above, the telecommunications market did not miss out on all opportunities in the 1990s. A thin ray of promise was visible even in the "lost decade" of the economy. One of the most outstanding areas has been the wireless network market, where the world's most progressive combination of technologies, in cellular telephones and internet websites, has been seen in Japan. The cellular phone

[8] In the mid-1990s, there were 6.5 million private business establishments of which small businesses run by sole proprietors, not incorporated, amounted to as many as 3.5 million. On the other hand, only 60 thousand firms employed 100 employees or more. Furthermore, about 1 million incorporated establishments employed only four or fewer employees. Therefore, it is important to consider small businesses rather than big-name corporations when we examine the benefits of network externalities.

Figure 5: Number of Internet Users in Japan (as of the End of 2006)



Source: Ministry of Internal Affairs and Communications, *Joho tsushin hakusho.*

Table 3: Expansion of the Cellular Telephone Service Market in Japan

Year	Number of users (millions of users)	Market size (trillions of yen)	Remarks
1979	Service started	-	By former governmental NTT
1992	:	:	NTT Docomo spun-off
1993	2.2	0.9	
1994	4.3	1.3	Deregulation & digital service started
1995	11.7	2.8	
1999	:	:	Internet access service started
2003	86.7	5.8	
2005	93.6	8.6	Figures for 2005 are estimated

Sources: Information and Communications Statistics Database, Ministry of Internal Affairs and Communications.

business is now no longer a "telephone" industry but a new "*keitai*"[9] industry, which combines mobile terminals with internet access services.

According to the Ministry of Internal Affairs and Communications, the number of internet users in Japan had reached 88 million, approximately two-thirds of the total population, by the end of 2006 (Figure 5). Importantly, 71 million of these people

[9] "*keitai*" is shorthand for "*keitai denwa*," literally "portable telephone."

use mobile telephones to connect to the internet, which is not much less than the 81 million people who use PCs to connect; 64 million people use both.

Unlike the wired network market, the wireless network market has been extremely competitive because the cellular telephone service is relatively new. Although analog wireless services were first offered in 1979 as portable car phones by the formerly government-owned NTT, the expansion of the "*keitai*" industry began in the mid-1990s when deregulation ushered in digital technology innovation. The market size was minuscule before 1993: The number of users was approximately two million and the market size was just 900 billion yen (7.5 million US dollars). Business opportunities, however, expanded when the government lifted various restrictions in the early 1990s. New businesses entered the market and invested heavily in wireless network infrastructure, R&D, and the marketing of various new services. Consequently, the market is now extremely competitive in comparison with the wired network service market. By the end of 1995, within two years of deregulation, the number of users had reached 10 million; and the market size had expanded rapidly to 2.8 trillion yen (23 billion US dollars).

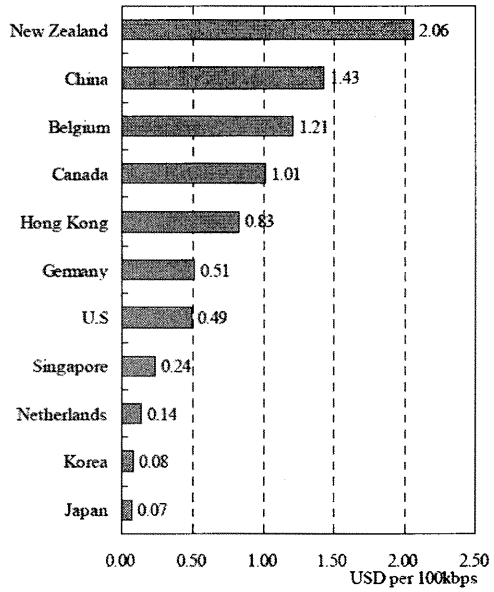
In such competitive market conditions, the Japanese mobile phone network has improved with the adoption of digital technology. In 1999, Japan led the world in starting internet access services. Today, more than 100 million people have signed up for mobile phones, and the market has expanded to about nine trillion yen (74 billion dollars). Some 70 million of these users, as described above, also use their devices to access the internet. Although the rapid growth of the *keitai* industry has consumed a portion of the once-dominant wired telecommunications market, the result was never zero-sum. The total market size, including both wired and wireless telecommunications, doubled during the ten years following the 1993 deregulation of the wireless network market in Japan.

Breakthrough via e-Japan Strategy

Another area that has, since 2001, shown promising trends is the broadband network market. Over the last five years, the Japanese government has put together aggressive policy packages that have produced positive outcomes in information network industries. The Koizumi administration had, in the years since coming to power in 2001, demonstrated the leadership necessary to promote investment in information technology with the "e-Japan Strategy" policy packages. As policymakers came to realize the importance and dynamic potential of information technology, they launched the e-Japan Strategy in 2001, setting aggressive goals for Japan and aiming to be a

Figure 6: Broadband Access Rate per 100 kbps

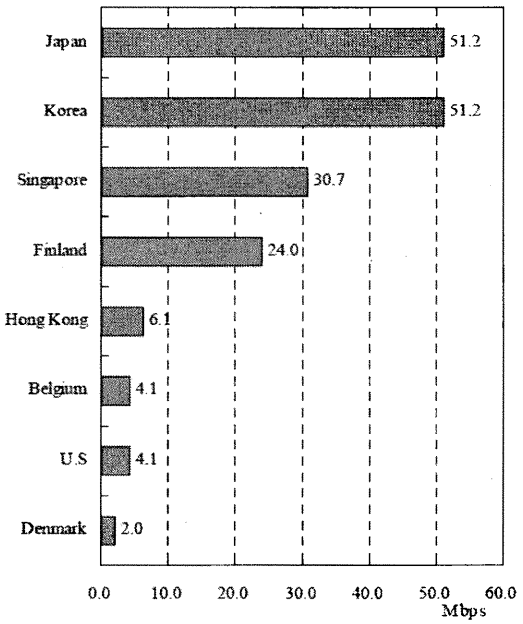
(as of 2006)



Source: ITU Internet Report 2006, 170-173.

Figure 7: Broadband Access Speed

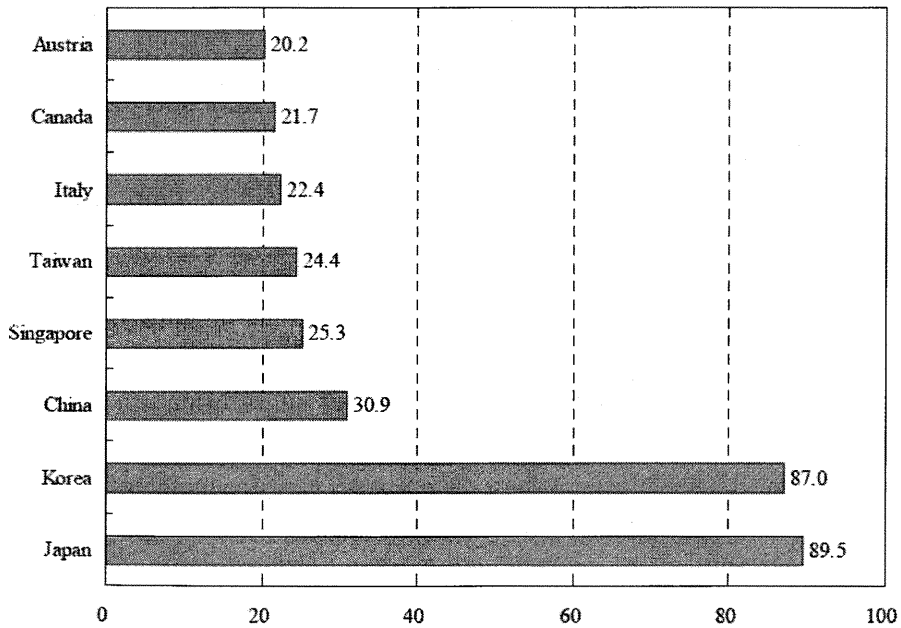
(as of 2006)



Source: ITU Internet Report 2006, 170-173.

Figure 8: Internet Access via Cellular Telephone (Percentage of Total Cellular Telephone Users)

(as of September 2003)



Source: Cabinet Office, *Kozo kaikaku*, Figure I–8, 7.

leading country within five years in the field of high speed network infrastructure and their effective use.

This policy mix seems to have been successful in some areas. The highest levels of broadband and wireless communications infrastructure are now available in Japan at the lowest service rates in the world (Figures 6, 7, and 8). As for the wired broadband market, the government strongly supported new businesses by enforcing a pro-competition legal framework allowing several newcomers to start up businesses and begin competing with NTT in the ADSL market. The Ministry of Posts and Telecommunications (now, reorganized into the Ministry of Internal Affairs and Communications), the regulating authority of the telecommunications industry, provided guidelines that put pressure on NTT to open its wired access network to newcomers. In addition, the Fair Trade Commission strictly enforced the Anti-trust Law in the ADSL market.

Although Japan had failed to transform its telecommunications business from a switched network system to an internet access system during the 1990s, the broadband and mobile internet access system has allowed Japan the chance to get back into the action in the 2000s (see Figure 3 again). Since 2004, the NTT has been transforming all its businesses into IP-based network services and is enthusiastic about investing in optical fiber bundle infrastructure. Now Japan is ready to expand into new frontiers of the broadband, mobile, and ubiquitous computing network age. We should therefore not be too pessimistic about the growth potential of the Japanese information network market in spite of the fumbles of the 1990s. We should instead be hopeful that Japan responds well to the huge opportunities in the next-generation networks of the broadband, mobile, and ubiquitous network industries that are certain to come its way.

Promising Trends in the Statistics

The promising trends described above are borne out in the statistics. Takeshi Hiromatsu, Akihiko Shinozaki, and Yusuke Yamamoto conducted input-output analyses and estimated the impacts on production and employment attributable to information network industries, including hardware, software, data processing services, and telecommunications, since 1990.[10] Results were compared with those of the automobile industry, one of Japan's leading sectors. Results of the input-output analyses described above are as follows (Table 4).

Although the final demand for information network industries in 1990 was a mere 40 percent of that of the automobile industry, the demand by 2004 had grown enough to surpass the automobile industry. Moreover, although the value of total production

[10] Hiromatsu, Shinozaki, and Yamamoto, "Joho nettowaku sangyo."

Table 4: Comparison between the ICT and Automobile Industries' Economic Presence

(billions of yen; thousands of employees)

		1990	1995	2000	2004
Final demand	ICT industry	9,170	12,122	20,581	25,513
	Car industry	21,619	19,261	19,479	21,415
Production inducement	ICT industry	16,180	20,595	35,423	41,842
	Car industry	60,539	53,458	54,591	58,968
Value-added inducement	ICT industry	8,186	10,688	17,507	21,078
	Car industry	18,188	16,253	16,166	17,423
Employment inducement	ICT industry	913	1,118	1,750	2,028
	Car industry	2,057	1,789	1,704	1,835
Fixed investment	ICT industry	n.a.	4,685	6,539	4,999
	Car industry	n.a.	2,312	2,213	3,181
Production inducement	ICT industry	n.a.	8,877	12,142	8,802
	Car industry	n.a.	4,292	3,964	5,383
Employment inducement	ICT industry	n.a.	527	726	535
	Car industry	n.a.	262	237	325

Source: Hiromatsu, Shinozaki, and Yamamoto, "Joho nettowaku sangyo."

generated by the information network industries was not even close to that attributable to the automobile industry, the amount of value addition that was engineered by the information network industries surpassed the contribution from the automobile industry. Employment attributable to the information network industries increased from 913 thousand jobs in 1990 to 2,028 thousand jobs in 2004, whereas employment generated by the automobile industry dropped from 2,057 thousand jobs to 1,835 thousand during that period. Also, capital investment in information network industries for 2004 was higher than the figure for the automobile industry; the former resulting in induced production worth nine trillion yen (73 billion US dollars) compared to five trillion yen (45 billion US dollars) for the automobile industry. In addition, employment figures attributable to investment in the information network industry surpassed the corresponding figures for the automobile industry.

The key finding from this analysis is that the induced effects of the information network industries in terms of employment generation and value addition went past those of the automobile industry around the year 2000. The results indicate that the information network industries spent the "lost decade" developing into a core industry that has now become the engine of the Japanese economy. These changes in industrial structure meshed perfectly with the e-Japan strategy that has been promoted strongly in Japan since 2001; Japan now stands at the forefront of global information strategies in mobile, broadband, and ubiquitous network technologies.

IV. Opportunities and Challenges for Japan's New Economy

In this final section, we consider opportunities and challenges that lie ahead for Japan, based on the analyses presented in this paper. Today, information technology continues to change and inspire countries to develop relentlessly. In the 1990s, when Japan had missed the chance to ride the waves of global technological innovation, changes were carried out in the form of significant transformations: From analog to digital; from switched network systems to router (TCP/IP) network systems; from charging according to access time and distance to charging a flat rate; and from intermittent access to continuous presence online (see Figure 3).

A different generation of changes demands the industry's focus today: From narrowband to broadband, from fixed (wired) network to fixed mobile convergence or FMC, from copper cable lines to optical fiber bundles; from low to medium volume data communications to extra-high volume data communications; and from business-oriented computing networks to ubiquitous computing networks such as

home electronics computing networks. Japanese information network industries seem to be keeping pace with these changes even though the contribution of information technology to Japan's aggregate productivity improvement does not yet show up in the growth accounting analysis.

It seems reasonable to suppose that it will take time for these constructive changes to materialize as statistics in the form of accumulation of IT assets and resultant contributions to the resurgence of productivity. In other words, since the growth accounting method is not a forward-looking analysis (rather a fairly backward-looking one), it will be useful to consider the opportunities and challenges for the Japanese economy in the upcoming age of broadband, mobile, and ubiquitous networks before we conduct further studies using statistical measures.

Opportunities in Media Convergence

The ongoing mutations described above imply that the market conditions in the information network industries are transforming further. The number of network users is radically expanding; a variety of gadgets such as music players, cellular phone receivers, personal digital assistants (PDAs), home electronic devices, as well as personal computers are being networked. Furthermore, optical fiber bundles are making it possible for telecommunications networks to carry movies and TV programs, as broadcasting networks or cable television (CATV) networks do. Data transaction volumes are, therefore, soaring.

These new technologies have enabled the downloading *and uploading* of digital-rich content, such as music and video movies, at a reasonable cost. As a result, we now have an alternative medium for transmitting rich content, which earlier could only be broadcast and received via radio or television. This has led to what is termed as "media convergence" in information network industries; the salient implication being that the wall separating telecommunications industries from broadcasting businesses is disappearing, at least in technological terms.

A wide range of related markets seems to be meeting and merging and thereby, converging. Consequently, a huge market, rather than a cluster of small fragmented markets, is emerging in the broadband, mobile, and ubiquitous information age. That emerging single market comprises the markets for broadcasting, telecommunications, content businesses such as animation production and movies, gadget manufacturing such as home electronics, as well as computers (in Japan, *keitai*, which represents the characteristics of mobile, broadband, and ubiquitous technologies, is seen as a potential core of "media convergence").

This trend of "media convergence" develops a huge single market, which subsequently becomes a strong engine for economic growth. Economic theory supports this view. Adam Smith, considered by some to be the founder of modern economics, argued that the size of the market determines the depth of labor division, and the depth of labor division defines the level of productivity, which is the most important factor in economic growth. Therefore, the expansion of an information network market that eliminates barriers through technological innovation can increase Japan's economic growth through increased productivity.

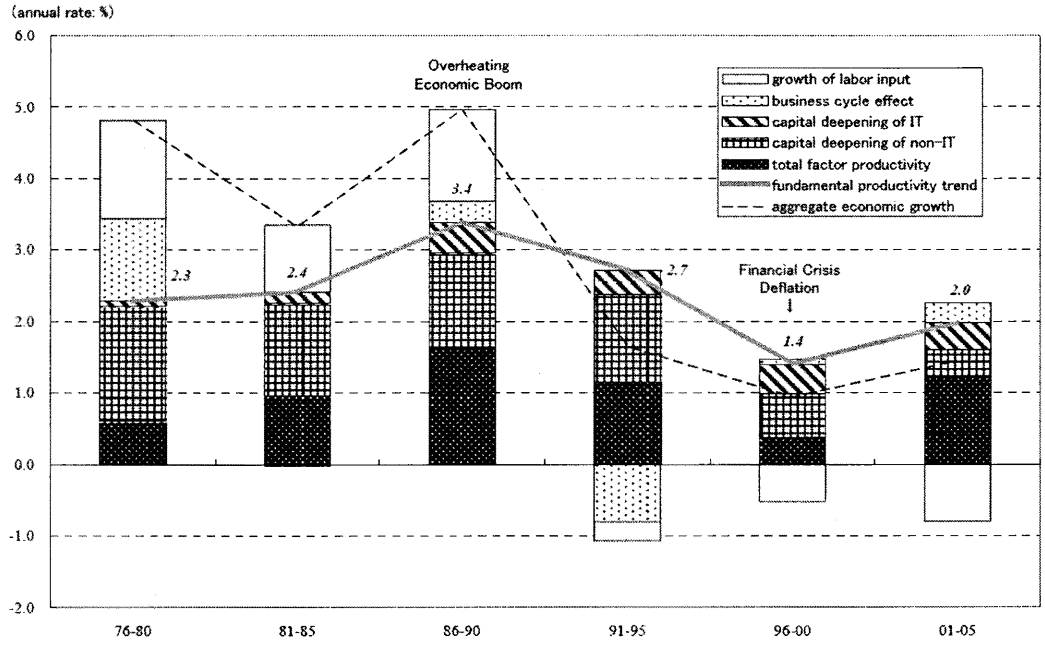
Challenges for Institutional Reform

Although new, emerging information technology paves the way for business opportunities and aggregate economic growth in Japan, these benefits are not automatically realized. The possibilities of technological innovation can only become reality when they are accompanied by institutional change, or regulatory reform. This is especially true in the new fields that innovation opens up, where the existing regulations often become restrictions, and the unintended consequences of such regulations might cause confusion.

For example, some underlying regulations in the broadcasting and telecommunications industries are no longer appropriate. Most such regulations were established several decades ago when the state of technology was completely different from what it is today. In those days, the mainstream businesses were radio broadcasting and telephony communications rather than the digital broadcasting and digital data communications that dominate today. Moreover, broadcasting and telecommunications were considered to have completely different businesses models. There are no longer appropriate formal rules for new businesses in the era of "media convergence." Consequently, the revision of broadcasting laws, telecommunications business laws, copyright laws, and other related regulations is necessary to create an environment in accordance with the current generation of technological changes.

Copyright law presents an illustrative example. It is actually prohibited by law to disseminate the contents of TV programs or movies via internet protocol (IP) based data streaming technology using optical fiber bundles in a telecommunications network, but doing so via a cable television network is allowed. From the consumer's viewpoint, however, it does not matter whether the contents of TV programs or movies are provided by a cable television network, a telecommunications fiber to the home (FTTH) network, or a ground wave broadcasting network. Consumers simply want to enjoy TV programs or movies on sophisticated, sparkling screens, and pay the lowest service charges.

Figure 9: Economic Growth and Sources of Productivity Growth



Source: Table 1 in this paper.

In addition, it is noteworthy that institutions impose not only formal rules but also informal constraints, as Douglass C. North argued.[11] Such informal constraints are closely related to business practices, conventions, and behaviors within the industry. The broadcasting industry is known for exclusive and ambiguous business practices and conventions. In the legacy state of network technology, broadcasting memberships were so limited that they were able to obtain overwhelming advantages in their business and maintain high margins in their income statements: It was a kind of monopoly rent.

As a result, broadcasting firms dominated the market and built business practices and conventions that were to their own advantage. For instance, content producers are obliged to be at an unreasonable disadvantage against broadcasting firms. In some cases, content producers have virtually no rights of secondary use to their own content because broadcasting firms have exclusive bargaining power to run the content in their broadcasting networks.

The challenges described above are just examples of what we need to address in the age of "media convergence." An important point that must be emphasized is

[11] North, *Institutions*..

Table 5: Japan's Potential Growth Rate and Estimation of Its Acceleration

	Japan's economic growth rate		Estimation of acceleration	
	Average	Potential rate	Case I	Case II
Growth rate	**2.81**	**1.63**	**2.33**	**2.58**
Labor input	**0.31**	**-0.86**	**-0.86**	**-0.86**
Labor Productivity	2.49	2.49	3.19	3.44
Business Cycle	0.15	—	—	—
Trend	**2.35**	**2.49**	**3.19 (+0.70)**	**3.44 (+0.95)**
Capital deepening	1.37	1.51	1.91	1.89
of non-IT	1.13	1.13	1.13	1.13
of IT assets	0.24	0.38	0.78	0.76
Labor quality	0.32	0.32	0.32	0.32
Total Factor Productivity	0.66	0.66	0.96	1.23

Note: Average excludes extraordinary periods of the late 1980s and the late 1990s. The potential rate incorporates demographic trends in the next few decades and recent contribution of IT assets. Case I represents that Japan's TFP and capital deepening of IT assets can catch up with those of the U.S. Case II represents that Japan can accelerate its productivity by 0.95 percentage points, as the U.S. has done since the late 1990s.

that both the regulatory authority and private businesses should make intensive and continuous efforts to avoid slipping up on the chance to grow and reap the benefits of the "new economy" in the following decades.

Simple Estimation of Japan's Potential Growth Rate

Finally, we will conduct some simple estimation of Japan's potential growth rate given that the Japanese economy reaps the gains of IT investment, as the U.S. economy has done since the mid-1990s. Before we formulate such an estimate, it will be useful to review the long-run trace of Japan's fundamental productivity trends in order to put together a baseline for the measurement of the potential growth rate.

As examined in section two, the growth rate of the economy has fluctuated greatly over the last three decades. The changes in the fundamental productivity trend, however, were not so drastic: they were moderate because the trend was free from the fluctuating effects of labor input and the business cycle, as Figure 9 illustrates well.

Furthermore, disregarding the exceptional periods of the late 1980s, a period of overheated economic boom, and the late 1990s, a period of financial crisis and deflation, the fundamental productivity trends are stable: 2.3 percent in the late 1970s,

2.4 percent in the early 1980s, 2.7 percent in the early 1990s, and 2.0 percent in the early 2000s. As the data in Table 5 underscores, the average growth rate of the fundamental productivity trend in these stable periods is around two and half percent. It therefore seems appropriate to conclude that an annual productivity growth rate of two and half percent is the baseline that the Japanese economy preserves as its minimum potential.

For the estimation of economic growth, demographic trends need to be considered as well. The Japanese national population is predicted to decrease for some time into the future. According to the National Institute of Population and Social Security Research, the working-age population will be decreasing at a little less than one percent annually over the next few decades. Under this diminishing demographic trend, the potential economic growth rate would be just less than two percent annually even if the recent level of IT contribution is considered.

What we should not disregard is the fact that the U.S. economy managed to accelerate its productivity by one percentage points from one and half percent annually to more than two and half percent with average annual contributions of 0.8 percent from IT assets and 1.0 percent from the TFP, after the mid-1990s. If we suppose that the Japanese economy catches up with the U.S. or achieves a similar rate of acceleration to that of the U.S., the economy will grow at a healthy clip of around two and half percent annually, rather than merely one and half percent mark that has been generally accepted in Japan so far. Although adaptation of U.S. figures to the Japanese economy might be simple and naïve, several other empirical studies suggest that it is feasible for the Japanese economy to grow at three percent or faster given an appropriate policy mix and corporate reforms.[12] Consequently, we may conclude that the Japanese economy has the potential to realize vigorous economic growth in the years ahead.

Conclusion

In this paper, we examined the impact of the "new economy" on Japanese businesses. We first reviewed the contribution of information technology to Japan's economic growth over the last 30 years. Then we explained the changes and developments within the Japanese information network industries. Finally, we considered the opportunities and challenges for Japan in the upcoming age of the "new economy." These analyses

[12] See Adams, et al., *Accelerating Japan's Economic Growth* and Ministry of Internal Affairs and Communications, *Joho tsushin hakusho.*

revealed that Japan had successfully introduced the "legacy" type of information technology before the mid-1990s but had failed to keep pace when radical changes swept through the global IT scenario in the 1990s. As for whether a "Solow paradox" is prevalent in Japan, we may conclude with confidence that there is neither a "Solow paradox" nor a "new economy" in Japan at present. A major reason why Japan fumbled and could not quite garner the benefits of the "new economy" was found to lie in the country's treatment of its telecommunications industry, which missed important business opportunities related to the technological changes of the 1990s. In spite of that, some promising trends have surfaced recently in such areas as mobile, ubiquitous, and broadband networks. These trends, if supported by appropriate institutional reforms in terms of amendments in formal rules and the elimination of informal constraints, might lead the Japanese economy back from the "lost decade" into the "born-again decade."

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Addendum: Analysis on IT-Using Industries

This Addendum section is intended to reexamine the features of the Japanese industrial organization, or corporate system, in order to understand why the implications of information technology were lost on the Japanese IT-using industries.

As we have already discussed, information technology, the Internet in particular, began to deeply affect economic performance world wide in the 1990s. At the same time, a clear contrast emerged on both sides of the Pacific Ocean: the longest and most vigorous economic expansion in the U.S. and a dawdling slump in Japan. It seems that this contrast was partly but significantly caused by a difference in corporate attitudes of IT-using industries toward the issue of investment in new technology.

Thus, we will first review the strengths of the Japanese corporate system, and then analyze how those strengths became weaknesses when it came to leading the economy into the open network information age. Through this argument, we can analyze possible impediments preventing the Japanese economy from achieving the benefits of the information technology revolution.

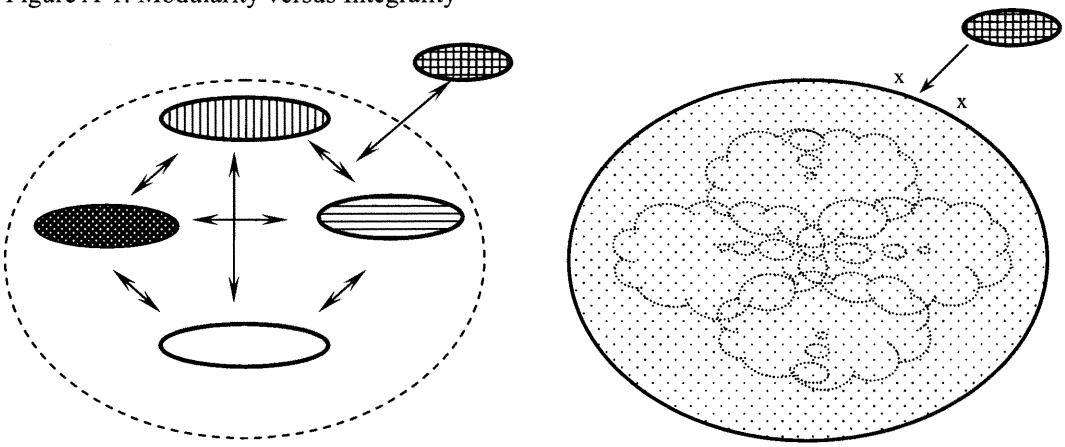
1) Integral System vs. Modular system

According to the Economic Planning Agency, which analyzed the strengths of the 1980s Japanese economy, Corporate Japan's organizational structure had several principal features.[13] These characteristics facilitated success in technological improvement and in transforming the economy, through the 1970s and 80s, from energy-consuming heavy industries to well-advanced R&D manufacturing. The features were: (1) intensive face to face communications based on an intimate human network; (2) shared business information through informal communication; (3) some overlap in jobs under a flexible organizational structure and unrestricted job descriptions within a firm; and (4) the extension of these characteristics to the transactions between the firms and the creation of long-term relationships in an industrial organization.

Herein, we refer to the above-mentioned set of characteristics as an "integrated organization" or "integrated system."[14] In an integrated organization information circulates by means of informal traffic and is shared in a tacit manner. Accordingly, an integrated system is quite appropriate for technological improvement through "learning by doing"[15] because invisible and tacit skills can be shared and transferred

[13] Economic Planning Agency, *Keizai hakusho*.
[14] Policy Research Institute, *Nippon keizai*, refers to a Japanese system as an integrated system.
[15] Kenneth J. Arrow argues the implication of learning by doing. See Arrow, "The Economic Implications."

Figure A-1. Modularity versus Integrality



Modular Organization
(Corporate USA Type)

Integrated Organization
(Corporate Japan Type)

Source: Adams, et al., *Accelerating Japan's Economic Growth*, 64, Figure 8.1.

easily among employees or an exclusive group of companies and are assimilated within a membership day by day.

For this reason, Corporate Japan had performed well through continuous improvements such as *kaizen* or total quality management in its production lines. As Arrow mentioned, "knowledge is growing time";[16] learning by doing is an important engine of R&D activities in an integral organization, which is characterized by its continuous improvement, tacit skills, long-term relations, integrality, common culture, gradual (flying geese style) progress, etc. That is one reason why Japanese business maintains better performances in such industries as automobiles and liquid crystal display manufacturing, even in the Information Age.

In contrast, Corporate America has different features in its organizational structure (Figure A-1), which we refer to here as a "modular organization," or "modular system."[17] In a modular organization, formal job descriptions define the mission of each job position. Moreover, borders that separate job units or divisions are much clearer than in an integrated organization. However, a modular system sometimes makes it difficult to understand the internal activities of other job units and to share information that involves the entire organization. To resolve this difficulty, a standard format for an open interface is created, which promotes smooth formal communication among units. This common interface and simple protocol eases

[16] Ibid., 155.
[17] Richard N. Langlois and Paul L. Robertson argue the nature of modularity. See Langlois and Robertson, "Networks and Innovation."

Table A-1. Economies in the Information Age and the Industrial Age

Types of Merit	Emerging Information Age	Matured Industrial Age
Scale Merit	Network Effects (Externalities) - consumers' scale merit	Economies of Scale - producers' scale merit
Resource Merit	Economies of Outsourcing - outside resources - multiple organizations - synergy effect - innovations (new combinations)	Economies of Scope - in-house resources - single integrated organization - cost saving - learning by doing
Desirable Industrial Organization	Multiple small players Competitive market Compatibility Modularity	Larger organization Oligopoly, or monopoly Continuity Integrality

Source: Adams, et al., *Accelerating Japan's Economic Growth*, 65, Table 8.1.

communication, even with newcomers or participants outside the organization, in a modular organization. This is in sharp contrast to communication carried out in an integrated organization.

As mentioned above, one type of activity that improves the R&D payoff is what Arrow calls "learning by doing"; it's a philosophy that works better in an integrated system. Another type of activity that improves the R&D payoff is what Joseph Schumpeter refers to as "innovations." Innovations are characterized as disruptive changes, new combinations, open source relations, modularity, novelty and variety, random (or leap frog style) progress, etc. These characteristics are more suitable for the modular system of the U.S. rather than the integrated system of Japan.

2) Transformation of the Economies

Progress and diffusion of information technology seems to cause dynamic changes in the economic environment. In fact, it seems reasonable to assume that economies are going to change from those favoring an integrated system to those favoring a modular system. The reason for this presumption is that, with the prevalence of open network and digital technology, significant "network effects" emerge, as do "economies of outsourcing."

Table A-1 clarifies the notion of "economies of outsourcing" and incorporates it into other concepts of economies; "economies of scale," "economies of scope," and "network externalities." Economies of outsourcing are the obverse of economies

of scope just as network effects are the obverse of economies of scale.[18] Under economies of outsourcing, economic benefits arise from resources outside the organization, rather than from in-house resources under economies of scope, inducing a synergy effect of dynamic "new combinations," which is the key concept in what Joseph Schumpeter refers to as the driving force of innovation.

With open networks and digital technology prevailing, modularity has come to gain an advantage over integrality, where some of the strengths of an integrated system turn into weaknesses. This is what is thought to have happened in the 1990s, the period of transformation from the Industrial Age to the Information Age.

3) Challenges to the Japanese system

Information and communications technology has progressed and changed its nature from simple high-performance automatic transaction machinery to an effective business communications tool. This will enable modular organizations to easily adapt the technology to a standard format of formal communication and reap the benefits of technological change in the form of productivity resurgence.

In contrast, integrated organizations tend to be unsuccessful at adapting technology. Their intimate human networks have traditionally performed so efficiently and dependably that their management is not attuned to the importance of using new technology and thereby pays less attention to formulating responses to technological change.[19] It therefore takes a while for integrated organizations to fully implement new technology as a communication tool, which results in them losing their advantage over time. Furthermore, even if integrated organizations recognize the importance of using a given technology, they would need drastic business process reengineering and business unit restructuring in order to gain the benefits of the technology.

Let us take intensive face-to-face communication as an example. Such a preference engenders a locational constraint when the organization expands its business globally. Too much dependence on face-to-face and informal communication within the human network implies less, perhaps even inadequate, attention to

[18] Network effects represent the scale merits of the demand-side (consumption), whereas economies of scale represent those of the supply-side (production). Michael L. Katz and Carl Shapiro argue the nature of network externalities. See Katz and Shapiro, "Network Externalities." For detailed arguments, see Shinozaki, *Joho gijutsu kakushin*, Chapter 9.

[19] According to an international comparison survey conducted by Andersen Consulting in 1997–98, Japanese senior managements ranked last in web literacy among those in developed countries. Less than 80 percent of Japanese executives were using the web, while almost a hundred percent of U.S. executives were using the web. To make matters worse, only 15 percent of Japanese executives felt "comfortable" or "familiar" with web access, and only 13 percent had experience shopping on the web. In contrast, almost two thirds of U.S. executives felt "comfortable" and "familiar" with web access and enjoyed on-line shopping (Andersen Consulting, *Press Release Handout*).

creating a formal means of information traffic flow and a consequent reluctance toward building and using an information technology network as the main tool of communication between business processes. If lacking in appropriate technology, a global organization will fail to make prompt decisions.

Another problem arises from the overlapping missions and unclear job unit borders that gave Japanese firms such an advantage in the 1980s. Such complexity and obscurity makes it impossible to reap the benefits of outsourcing or the more recent trend of offshoring because it is so hard to identify the job units that should be outsourced. It is therefore vital that the complexity or obscurity in integrated organizations be confronted during any restructuring of the organization resulting from mergers and acquisitions.

The arguments in this subsection are not in any way intended to reject all the features of the Japanese system. The integrated system works quite well with some businesses such as high-quality consumer products industries that depend heavily on technological improvement through "learning by doing." Nevertheless, it can be concluded at least that the integrated system of the Japanese economy, which performed excellently in the 1980s, is unsuitable in general for the emerging Information Age. In some cases information technology performs far more effectively than intimate human networks. Unfortunately, Corporate Japan was hesitant to introduce such technology that might erode its human network advantage and, thereby, missed the chance to accelerate their productivity through intensive investment in technology.

4) Private Sectors Reforms

Having said all that, there is no need to be overly pessimistic. There have been encouraging signs in that investment in technology seems to be on the rise in recent times. In addition, private business sectors have finally realized the importance of business process reengineering and business unit restructuring for the Information Age, even though they are still at the halfway mark. To facilitate this momentum, we must clarify the kinds of efforts that will be needed.

Based on a nation-wide survey of 9500 firms (effective response from 3141 firms), multiple comparison analysis revealed that reforms in organizational structures and human resource management significantly affect the effective outcome of investment in information technology (Table A-2, A-3). Yet, it was also found that small-sized firms have difficulties with human resource management in their use of technology and that some industries such as medical and educational services are less enthusiastic about the use of information technology (Shinozaki, 2007b).

Table A-2: Business Process Reengineering and Investment in IT

(investment outcome score)

		Business Process Reengineering	
		Intensive effort firms	Less effort firms
Investment in IT	Massively investing firms	3.564	2.605
	Less investing firms	2.981	1.974

Source: Shinozaki, "Keiei kaikaku," 12, Table 7.

Note: A higher score represents a better outcome of investment in IT. Score differences between the categories are statistically significant.

Table A-3: Human Resource Management and Investment in IT

(investment outcome score)

		Human resource management	
		Intensive effort firms	Less effort firms
Investment in IT	Massively investing firms	3.405	2.604
	Less investing firms	2.852	1.981

Source: Shinozaki, "Keiei kaikaku," 13, Table 8.

Note: A higher score represents a better outcome of investment in IT. The difference of scores between the firms with less invested and intensive human management efforts (score 2.852) and those with massively invested and less human resource management effort (score 2.604) is not statistically significant. Other differences of scores are statistically significant.

Likewise, our logit model analysis revealed that reforms such as paperless transactions make the business process efficient both internally and between firms whereas drastic and fundamental organizational reforms, such as changes in the top management's decision-making process, business unit restructuring through mergers and acquisitions, and the revision of long-term relationships with suppliers and customers, have not been observed to fully pay off yet (Shinozaki, 2006a). The analysis also found that human resource management is more effective and important than organizational reforms in reaping the benefits of information technology; so far, however, the major role of human resource management appears to have been in training merely existing employees in firms, rather than hiring new experts from outside.

These empirical analyses suggest that Japanese companies as a whole tend to plan sustainable corporate reforms rather than drastic reforms. This tendency implies that the inertia of Japan's integrated system persists in the midst of an age of information technology innovation. In this sense, it may still be necessary for Japanese private

sector businesses to continue their intensive efforts for drastic business reforms for some time yet, until it leads to their transformation and sure-footed evolution into the technology age.

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