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Report

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INSTITUTE FOR MONETARY AND ECONOMIC STUDIES

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"Technological Innovation and Banking Industry/Monetary Policy: Forum on the Development of Electronic Payment Technologies and Its Implications for Monetary Policy "

Report

Executive Summary

1. Preface

The Bank of Japan established the "Forum on the Development of Electronic Payment Technologies and Its Implications for Monetary Policy" in December 1997 to examine the influence of the development of electronic payment technologies including "electronic money" on monetary policy. The Forum released the Interim Report in May 1999. Subsequent to the release of the Interim Report, the Forum expanded the scope of its examinations to the Information Technology (IT) Revolution in general, including electronic payment technologies, and the Forum's name was changed to "Technological Innovation and Banking Industry/Monetary Policy: Forum on the Development of Electronic Payment Technologies and Its Implications for Monetary Policy." The Forum held active discussions regarding the changes to the financial and economic structures prompted by the IT Revolution and its effect on monetary policy, based on papers prepared by experts from academia and by the Forum's Secretariat (refer to Attachment 1 for a list of the Forum's members, and to Attachment 2 for an outline of the reports presented in each meeting). This Report summarizes the main points that were clarified during the Forum's subsequent discussions, based on the Interim Report.

2. Essence of the IT Revolution

The distinctive characteristics of the present IT Revolution, as exemplified by the rapid development of computer technologies and the Internet, may be summarized as follows: ① the integration of information processing and telecommunications technologies; ② the consequent acceleration of the speed of information processing and transmission, reduction of information processing costs, and increase of the geographical distance over which information can be transmitted (globalization); and ③ the astounding speed

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at which information technologies are spreading among the public.

The IT Revolution has increased the efficiency of the information processing used in goods and services production processes. As a result, it has facilitated price reductions for existing goods and services as well as the production of new goods and services that was practically impossible in the past. Moreover, the reduction in information transmission costs utilizing networks has greatly decreased the costs of information collection (search costs), and increased the potential for enterprises to find new trading partners that offer more advantageous terms of trade.

On the other hand, the increase in the volume of information brought about by the reduction in information transmission costs is not expected to eliminate the asymmetry of information (the imbalance of information between the buyers and sellers of goods and services). It is not yet clear whether the increase in the volume of information will make an additional social burden, but if this is the case, frameworks to lessen the burden (such as credible information intermediaries) will become necessary.

The merits of the IT Revolution, such as improved production efficiency and reduced search costs, have the potential to radically change the conventional socioeconomic structure. To begin with, the increase in capacity for information processing and transmission and the reduction of their costs will render existing technologies outdated, and make it easy for enterprises to rapidly enhance their competitiveness with the introduction of the latest technologies. Furthermore, the reduction of search costs utilizing networks is expected to greatly influence the ways businesses are implemented (changes in trading partners and in enterprise management methods).

3. Development of Electronic Commerce, Changes in Trading Patterns and Price Setting Mechanisms, and Influence on Monetary Policy

The integration of computers and telecommunications networks has facilitated electronic commerce over the Internet, and E-commerce is rapidly expanding. First of all, in terms of business transactions, the development of E-commerce has facilitated direct transactions between producers and consumers. Some assert that this phenomenon will result in the elimination of the distribution sector, and of inter-corporate *keiretsu*/subcontractor transactions. In terms of price setting, others have noted that the simplification of distribution sector promotes price reductions, facilitates frequent price revisions, and may lead toward the emergence of a so-called “perfect market” without any “market friction” whatsoever.

Examining these points, E-commerce is indeed changing transaction patterns.

It increases direct transactions between producers and consumers, and for certain intermediate goods, trading is now transcending the conventional business-to-business transaction framework, such as inter-corporate *keiretsu*/subcontractor transactions, and taking place on a global scale. Nevertheless, E-commerce can not resolve the so-called "agency problem" for direct transactions just as under conventional transactions, so the role of the intermediation business will likely remain important. The emergence of a vast number of intermediation sites on the Internet suggests that the intermediation business will continue to play an important role, even with the spread of E-commerce. Among business-to-business transactions, the merits of Internet transactions related to the production of finished goods that require a large number of customized parts and close communication between parts suppliers and assembly manufacturers are relatively small. However, there is a strong likelihood that the trading of general-purpose intermediate goods with a wide range of applications to many finished goods will take place on a global scale and transcend the framework of inter-corporate *keiretsu* transactions.

Turning to price setting, price levels on the E-commerce markets are lower than those on conventional markets, and price revisions are being conducted more frequently, in small steps. However, in the E-commerce markets, the Law of One Price does not hold because of the so-called "lemon problem" (the problem whereby buyers have risks to purchase inferior-quality products ["lemons"] due to the imbalance in product information between buyers and sellers), the switching costs incurred when changing the sites where buyers purchase goods, suppliers' price discrimination in favor of certain customers, etc.

As for the influence of the spread of E-commerce on monetary policy, particularly from the perspective of changes in price setting, first it is generally believed that the central bank should accept the reduction in price levels from the spread of E-commerce as this is interpreted as a downward shift of the aggregate supply curve. Second, because increased price discrimination makes it difficult to compile accurate price indices using conventional methodologies, the issue of how to maintain and improve the quality and reliability of price indices will become increasingly important. Third, the increasing price flexibility resulting from the reduction in menu costs may reduce the effect of monetary policy on the real economy. However, there is another view that this is no great cause for concern because the strengthening of the market mechanism through flexible price adjustments will reduce the necessity of monetary policy itself.

4. Influence of the IT Revolution on the Financial Industry

Even with the IT Revolution, the essential functions of the financial industry – such as the provision of payment and settlement services, the intermediation of risk (or risk taking), information production, and the provision of liquidity – will remain unchanged. However, major changes are expected in the specific contents of financial products and services, and in the financial institutions that provide these products and services.

The IT Revolution has facilitated the provision of derivative products, the development of securitization, and the emergence of electronic payment and settlement means. Thus, technological innovations have raised the quality of financial products and services, and dramatically improved the risk-management capabilities of asset managers. Moreover, the development such as the Internet has also enabled the provision of financial services via new delivery channels.

These changes in financial transactions increase the variety of financial products traded in financial markets, especially through securitization. In addition, the huge reductions in information processing and transmission costs have made arbitrage trading on financial markets much more active, and promoted the development of such trading. Amid this expansion of financial markets, financial intermediaries are substantially changing the contents of their services. One direction is to handle financial products that are difficult to standardize and seldom traded on financial markets. For example, financial intermediaries are moving to improve the efficiency of financial transactions for lending to small and medium enterprises, which entail high agency costs, by adopting the new method of credit scoring. Another trend is to transform advanced, complex financial products into simple ones that are easily understood by consumers and businesses, and then offer these products as new services. For example, the provision of new financial products incorporating derivatives and the expansion of off-balance sheet transactions seem to reflect such development.

Considering these developments, how will financial intermediaries change in the future under the influence of the IT Revolution? The financial industry is now witnessing a wave of mergers and alliances (concentration) based upon the greater economies of scale prompted by the IT Revolution. On the other hand, the IT Revolution is leading to a deterioration of the comparative advantages of banks in information production, the unbundling of existing financial services, and the development of the Internet. These are facilitating the advent of financial institutions specializing in particular services as well as entry into the financial intermediation market by firms in different industries (diversification). The future direction of this concentration and diversification in the financial industry is not yet entirely clear, but

considering the reduced comparative advantages of banks in information production, the future providers of financial intermediation services may not be limited to firms in the present financial industry. There is a high probability that firms in other industries will utilize the fruits of the IT Revolution to provide financial intermediation services. Additionally, considering that the strong economies of scale from the IT Revolution may be limited to certain financial services, the present simultaneous trends toward concentration and diversification may well continue.

Regarding the effect of these financial changes on the monetary policy transmission mechanism, first the development of domestic financial markets is expected to increase the speed at which policy interest rates affect short-term and long-term interest rates via more active arbitrage trading. Meanwhile, in terms of availability channels, the effectiveness of monetary policy will probably decline if the greater variety of fund-raising methods other than bank loans are available and credit rationing decreases from the development of derivatives. Next, as for the influence of the changes in financial intermediaries, the increased competitive pressures from the entry of firms in other industries to the financial intermediation industry may reinforce the response of lending rates to policy interest rates and thus increase the importance of interest rate channels. Conversely, there is a view that if the IT Revolution improves financial institutions' abilities to monitor their borrowers, the transmission effect through changes in corporate collateral value (balance sheet channels) may be reduced.

5. The IT Revolution and Globalization

Since the Internet lessens geographical and spatial restrictions, it will probably make national borders less important and accelerate the globalization of trade and financial transactions. Cross-border E-commerce transactions are not yet very popular for the trade in goods and services, but the reduction in search costs, the dramatic decrease in the transportation costs for digital goods, the changes in transaction patterns, and enhanced product differentiation are expected to increase cross-border E-commerce transactions and accelerate the tempo of trade growth. In terms of international financial transactions, the decrease in information transmission costs has made foreign financial trading much easier than in the past, increasing the substitutability of domestic and foreign financial assets. Therefore, the Internet will probably bring about more international portfolio diversification as well as further convergence of domestic and foreign real long-term interest rates. Additionally, the increase in trade resulting from the development of E-commerce may promote currency substitution through the wider use of the U.S. dollar for the settlement of domestic business-to-business transactions.

As for the influence of further globalization on monetary policy, to begin with, the rising dependence on foreign trade is expected to strengthen the transmission effect via foreign exchange rates. This implies that interest rate channels, which are closely related with foreign exchange rates, will become more important. Moreover, the higher substitutability of domestic and foreign financial assets may increase the influence of interest rates on foreign exchange rates. Nevertheless, it should be noted that it may become more difficult for policy interest rates and short-term interest rates to influence long-term interest rates because of the worldwide convergence of long-term real interest rates when exchange rate expectations are unchanged.

6. The IT Revolution and Monetary Policy

Central banks conduct their monetary policy under an uncertain environment where various changes such as exogenous shocks occur continuously and where it is difficult to grasp the influence of these changes accurately in real time. The IT Revolution is expected to change financial and economic frameworks (structures), resulting in additional uncertainties. For example, with the IT Revolution, it is becoming increasingly difficult to grasp potential growth rates and price trends accurately in real time. Accordingly, central banks must exert every possible effort to grasp the changes accompanying the IT Revolution promptly and accurately, and to minimize the uncertainty faced in making policy decisions. For these purposes, central banks will need to raise the level of their capabilities to analyze monetary and economic conditions and to improve the quality of their economic statistics.

As for the influence of the IT Revolution on the effects of monetary policy and the monetary policy transmission mechanism, there is a strong likelihood that the development of electronic payment technologies and the emergence of new financial products will structurally and unstably decrease the demand for the monetary base. To lessen fluctuations in the real economy in this situation, it is desirable for central banks to adopt interest rate stabilization policies. As almost all nations presently adopt short-term interest rates as their operational targets, the reduced demand for the monetary base is not expected to exert a significant influence on the present frameworks for money market operations. Also, even if the demand for the monetary base does decrease, since central banks are monopolistic suppliers of the monetary base, in principle there seems to be no reason why central banks will lose the controllability of short-term interest rates.

Regarding the influence of the IT Revolution on the monetary policy transmission mechanism, ① the effects of monetary policy via interest rates and foreign

exchange rates will likely become stronger, while ② the effects of monetary policy via funds availability (or balance sheets) will likely diminish.

The IT Revolution will not only change the relative importance of monetary policy transmission channels, but there is also some possibility that it may reduce the necessity and the effectiveness of monetary policy itself due to the reduction in menu costs, the development of electronic money, and the increased domestic use of the U.S. dollar for settlement purposes. Nevertheless, taking information asymmetry into account, for the time being it is not realistic to believe that all transactions will be conducted over the Internet or that pricing will become completely flexible. Moreover, there is a low likelihood that the U.S. dollar will be used for all domestic transactions. Thus, for the foreseeable future, monetary policy will remain both necessary and effective, even though the necessity and effectiveness of monetary policy may decline somewhat.

7. Conclusions

The Forum made every effort to grasp the effects of the IT Revolution on a comprehensive basis, but it was not possible to cover every possible aspect. Issues that require further examination include: ① the best practices for communication between central banks and other market participants when information is exchanged on a real-time basis; ② the effects of the increased speed and globalization of financial transactions on the stability of financial markets; and ③ the influence of the IT Revolution on financial market stability, and the appropriate prudential policies to maintain financial market stability.

Attachment 1

Members of "Technological Innovation and Banking Industry/Monetary Policy: Forum on the Development of Electronic Payment Technologies and Its Implications for Monetary Policy"

{From the 9th Meeting of the Forum}

Chairman	Ryuichiro Tachi	Professor Emeritus, the University of Tokyo
Members	Kazumi Asako	Professor, Hitotsubashi University, Institute of Economic Research
	Kazuhito Ikeo	Professor, Keio University, Faculty of Economics
	Motoshige Itoh	Professor, the University of Tokyo, Faculty of Economics
	Mitsuru Iwamura	Professor, Waseda University, Asia Pacific Research Center
	Hideki Kanda	Professor, the University of Tokyo, Faculty of Law
	Yukinobu Kitamura	Assistant Professor, Hitotsubashi University, Institute of Economic Research
	Kazuharu Kiyono	Professor, Waseda University, School of Political Science and Economics
	Masahiro Kuroda	Professor, Keio University, Faculty of Business and Commerce
	Yutaka Kosai	Chairman, Japan Center for Economic Research
	Wataru Takahashi	Professor, Keio University, Faculty of Economics (former Chief Manager, Research Division II, Institute for Monetary and Economic Studies [IMES])
	Fumio Hayashi	Professor, the University of Tokyo, Faculty of Economics
	Akihiko Matsui	Assistant Professor, the University of Tokyo, Faculty of Economics, and Assistant Professor, the University of Tsukuba, Institute of Policy and Planning Sciences
	Hiroshi Yoshikawa	Professor, the University of Tokyo, Faculty of Economics
Observer	Kazuo Ueda	Member of the Policy Board, the Bank of Japan
Bank of Japan	Yutaka Yamaguchi	Deputy Governor
	Kunio Okina	Director, Institute for Monetary and

		Economic Studies (IMES)
	Michio Ayuse	Chief Manager, Research Division II, IMES
	Kazuhiko Ishida	Senior Economist, International Department, Financial Markets Department and IMES
	Kazuo Monma	Chief Manager, Policy Research Division, Policy Planning Office
	Shuhei Aoki	Chief Manager, Payment System Division, Financial and Payment System Office
	Shigenori Shiratsuka	Senior Economist, IMES
Secretariat	Mahito Uchida	General Manager, Naha Branch (former Chief Manager, Research Division I, IMES)
	Takamasa Hisada	Chief Manager, Research Division I, IMES
	Fumikazu Taniguchi	Assistant Manager, Information System Services Department (formerly assigned to Research Division I and Research Division II, IMES)
	Akira Otani	Research Division I, IMES
	Takuji Kawamoto	Human Resources Management Department (formerly assigned to Research Division I, IMES)
	Tomiyuki Kitamura	Research Division I, IMES

Attachment 2

Reports presented at each meeting of "Technological Innovation and Banking Industry/Monetary Policy: Forum on the Development of Electronic Payment Technologies and Its Implications for Monetary Policy"

9th meeting	Electronic Money and the Monetary aggregates (*Kazuhiko Ishida* and Takuji Kawamoto)
10th meeting	Report of the Findings of the Conceptualization Research Group – Implications for the Forum's Future Deliberations (*Masahiro Kuroda*, *Tetsuya Inoue* [former Senior Economist, Research Division II, IMES] and Fumikazu Taniguchi)
11th meeting	Technological Innovation and the Banking Industry: Summary from the U.S. Experience (*Mahito Uchida*, Akira Otani and Takuji Kawamoto)
12th meeting	Monetary Policy when the Base Money Demand is Absolutely Zero (*Fumio Hayashi*, Akira Otani and Takuji Kawamoto)
13th meeting	E-commerce Present Conditions and Issues: Birth of New Intermediation Businesses and the Formation of Credibility (*Yukinobu Kitamura*, Akira Otani and Takuji Kawamoto)
14th meeting	The IT Revolution and Settlement Currencies (*Akihiko Matsui*, Takashi Shimizu [Tokyo University, Graduate School of Economics], Akira Otani and Takuji Kawamoto)
15th meeting	Information Technologies and Financial Intermediaries (*Kazuhito Ikeo* and Takuji Kawamoto) The Relationship between Technological Innovation and the Economies of scale in Banking Industry (*Mahito Uchida*, Akira Otani, and Akira Andou [Research Division I, IMES])
16th meeting	The Development of the Internet and Globalization (Takamasa Hisada, *Akira Otani* and Takuji Kawamoto)
17th meeting	The Advance of the IT Revolution and Monetary Policy (Takamasa Hisada, Akira Otani and *Takuji Kawamoto*)
18th meeting	Discussion Points not yet addressed in the Forum (Takamasa Hisada and *Akira Otani*)
19th meeting	Draft of Report (*Takamasa Hisada*, Akira Otani and Tomiyuki Kitamura)

*NOTE: The names inside parentheses are the report authors, and the names in italics are the names of the presenters.

Table of Contents

1. Preface

The Bank of Japan established the "Forum on the Development of Electronic Payment Technologies and Its Implications for Monetary Policy" in December 1997 to broadly examine the issues in monetary policy raised by the development of electronic payment technologies including "electronic money" and the potential policy responses to these issues from both theoretical and practical perspectives. This Forum, which was comprised of experts from academia and the Bank of Japan, and observers from government agency, held active discussions during eight meetings held over approximately one and a half years. The Forum then released the Interim Report in May 1999 summarizing the conclusions of the deliberations up until that time.[1]

The main conclusion of the Interim Report was "For the foreseeable future, electronic payment technologies will not raise new issues for monetary policy that are fundamentally different from those raised by previous financial innovations (the advent of MMFs and other new financial products), but in the long run they could substantially change the present financial and economic structures." The Interim Report also identified the following as future issues that require further wide-ranging consideration: how the Information Technology (IT) Revolution in general, including the innovations in payment technologies, will engender structural changes in the organization of the banking industry; how globalization will advance by lessening the importance of national boundaries; and based on these developments, what changes will appear in the overall transmission of monetary policy, including the policy goals.

To examine these issues, subsequent to the release of the Interim Report, the Forum expanded the scope of its examination to the IT Revolution in general, including electronic payment technologies, and the Forum's name was changed to "Technological Innovation and Banking Industry/Monetary Policy: Forum on the Development of Electronic Payment Technologies and Its Implications for Monetary Policy." The Forum met additional 11 times to hold further discussions based on papers prepared by experts from academia and by the Forum's Secretariat. This report summarizes the main points that were clarified during the Forum's subsequent discussions, based on the Interim Report. The opinions contained do not necessarily represent the official positions of the Bank of Japan.

As the IT Revolution is still underway, it is difficult to completely predict all of

[1] "Forum on the Development of Electronic Payment Technologies and Its Implications for Monetary Policy: Interim Report," *Monetary and Economic Studies*, 18(3), Institute for

its ramifications at the present time. Accordingly, the Forum applied economic theory, giving reference to the changes that are presently being (or have already been) observed, in an effort to depict the future image that is presently considered most likely to occur. It need hardly be said that this future image represents just one possibility. The Forum's discussions have indicated that major changes may emerge in financial and economic activities and frameworks (structures), including a substantial transformation of the financial industry due to the entry of firms in other industries into financial intermediation industry, changes in traditional transaction patterns such as inter-corporate *keiretsu*/subcontractor transactions from the expansion of E-commerce, shifts in the goods and services price setting mechanism, and the accelerated globalization of both trade and international financial transactions from the diminishing importance of national boundaries prompted by the development of the Internet. Given these developments, the Forum expects that it will become even more difficult than it was in the past to accurately grasp monetary and economic conditions, as well as changes in the effects of monetary policy and on monetary policy transmission mechanisms. It was noted that central banks will now have to conduct monetary policy amid these uncertainties resulting from the IT Revolution.

The organization of this report is as follows.

Following this Preface, Chapter 2 identifies the distinctive characteristics of the IT Revolution, and then considers the consequent improvements in production efficiencies and the merits from utilizing networks, as well as the impact on the socioeconomic framework.

Chapter 3 examines the potential changes to traditional transaction patterns, such as inter-corporate *keiretsu*/subcontractor transactions, from the ongoing expansion of E-commerce as well as the changes in price setting from the growth of E-commerce, and then investigates the implications of these changes for monetary policy.

Chapter 4 summarizes the potential changes in the financial industry from the IT Revolution and presents the future outlook for the industry. It also examines the influence of these changes on the monetary policy transmission mechanism.

Chapter 5 investigates the likelihood of the further globalization of trade and international financial transactions from the development of the Internet, as well as the effects of this globalization on monetary policy.

Chapter 6 comprehensively analyzes the influence of the IT Revolution on monetary policy based on the possible changes to the monetary and economic structure

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Monetary and Economic Studies, Bank of Japan, 1999.

and the effects on monetary policy presented in Chapters 3-5, giving special consideration to the uncertainty resulting from the IT Revolution.

Finally, Chapter 7 summarizes the conclusions of this report.

2. Essence of the IT Revolution

The present IT Revolution is exemplified by the rapid development of computer technologies and the Internet. Some think that this may be a third industrial revolution comparable to the first industrial revolution represented by the development of spinning machinery and the steam engine in the late 18th and early 19th centuries and the second industrial revolution represented by the development of electricity, the telegraph and telephone, and railroads in the late 19th century. Although many of the possible impacts of the present IT Revolution remain uncertain at the present time, the Forum came to the conclusion that this revolution is exerting a massive influence on wide-ranging financial and economic fields, or will likely do so in the future, as explained in subsequent chapters.

This chapter begins by examining why the present IT Revolution has the power to prompt significant financial and economic changes.

(1) Characteristics of the IT Revolution

The history of the computer essentially began in 1946 with the development of the world's first programmable computer (ENIAC).[2] The initial trend was toward large supercomputers, but the invention of the microprocessor by Intel Corporation in 1971 and the subsequent drastic improvements in microprocessor performance became a turning point toward the advance of miniaturization and the development of the Personal Computer (PC). While computer prices have continuously declined, information processing capacities have rapidly increased, as symbolically expressed by Moore's Law.[3] As shown in Figure 1, the average price of a PC declined from $3,995 in 1984 to $799 in 1998. Meanwhile, average computer processing capacities as expressed in Million Instructions Per Second (MIPS) jumped from 8.3 to 266 over the same period. Thus, the cost per MIPS dramatically declined from $479 in 1984 to $3 in 1998.

Additionally, the integration of PCs and networks has been advanced by the switch from a centralized network architecture (similar to telephone networks, which have supercomputers at the apex) to a decentralized Local Area Network (LAN) architecture connecting the PCs that serve as network terminals (Figure 2). These

[2] ENIAC is an acronym for Electronic Numerical Integrator and Computer.
[3] Moore's Law states that the number of transistors on a single microprocessor doubles every 18

developments, coupled with the reduction in information transmission costs and the network externality[4], have promoted the rapid expansion of network scales and a further extension of the geographical range of network coverage.

Because of this exponential growth in computer performance and the network externality as typified by the Internet, the present IT Revolution is spreading at an astounding pace compared with former technological innovations. For example, in the United States it took about 50 years from the invention of electricity and the automobile in the 19th century before 25% of Americans came to enjoy these technologies. In contrast, it took only 16 years from the development of the PC to achieve a penetration rate of 25%, and just 7 years from the development of the Internet until a quarter of Americans were on line[5] (Figure 3).

Thus, the distinctive characteristics of the present IT Revolution may be summarized as follows: ① the integration of information processing and telecommunications technologies; ② the consequent acceleration of the speed of information processing and transmission, reduction of information processing costs, and increase of the geographical distance over which information can be transmitted (globalization); and ③ the astounding speed at which information technologies are spreading among the public.

The IT Revolution has increased the efficiency of the information processing used in goods and services production processes, and the reduction in information transmission costs utilizing networks has resulted in dynamic growth in the volume of information. The subsequent sections examine the increased efficiency in production processes and the merits that are generated by the utilization of networks.

(2) The IT Revolution and Improving Production Efficiency

Through the remarkable increases in information processing and data transmission performance and major cost reductions, the IT Revolution is increasing the efficiency of

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months.

[4] For example, in a telephone network, the more subscribers increase the more benefits they receive because the network can then provide connections to and from a wider range of subscribers. However, since the individual subscribers themselves cannot control the overall number of subscribers, the benefits enjoyed by the individual subscribers are under the influence of an externality. This is referred to as network externality (Okuno, Suzumura, and Nanbu [1993]).

[5] Similarly, it took only 13 years from the invention of mobile communications until 25% of Americans had portable phones.

the information processing used in goods and services production processes. Thus, these technological innovations are ① resulting in quality improvements and price reductions for existing goods and services, and ② enabling the production of new goods and services that was practically impossible in the past.

Looking at some specific examples, the transfer of conventional financial services (bank-counter operations and securities brokerage services) to the Internet is facilitating large price reductions. Also, as detailed in Chapter 4, the development of the credit scoring method has systematized credit screening by using computers to execute works formerly conducted by hand, enabling low-cost credit screening. Moreover, the commoditization of new financial technologies such as derivatives is a direct result of the increases in computer processing performance.[6]

In the real economy as well, the accumulation of IT capital stock through active IT investment and the accompanying labor savings and improved production efficiencies[7] are leading to reductions in the prices of goods and services. In addition, the reduction in information transmission costs has enabled a transformation from the former production system, which was based on projected demand, to production based on consumer orders whereby goods are provided in accordance with actual consumer needs.

(3) Merits of Network Usage: From the Perspective of Increased Information Volume

(Merits of Network Usage)

Because the development of the Internet has greatly reduced data transmission costs, the volume and variety of information transmitted and received by individual economic agents has increased beyond comparison with prior levels. What type of impact does this increase in the volume and variety of information transmitted have on financial and economic activities?

The utilization of networks is vastly decreasing information collection costs (search costs), so it is now possible to investigate a greater number of goods and services provided by a wider variety of suppliers. This type of increase in the available choices of trading partners is increasing the potential to find new trading partners that

[6] See Chapter 4 for a detailed discussion of these points.
[7] See Chapter 6 for a discussion of the improvements in Total Factor Productivity (TFP) at the macroeconomic level from the IT Revolution.

offer more advantageous terms of trade.[8] Consequently, many of the Forum members hold the opinion that network usage generates merits for the activities of individual enterprises and consumers by decreasing search costs.[9]

For example, let us consider the case when a consumer purchases a product which will have the same quality from any supplier he chooses (such as a new automobile, CD or book). The consumer can search via the Internet to instantaneously determine which sellers are offering the desired item, and easily compare their prices. This enables the consumer to purchase the item from the source offering the lowest price. This example demonstrates that the reduced search costs from network usage increase social welfare and generate benefits.

(Asymmetry of Information in the Development of Networks)

However, it is also important to consider the issue of asymmetry of information (the imbalance of information between buyers and sellers of goods and services or between the parties to any other sort of transaction). The Forum examined this issue, particularly by deliberating ① whether the increase in the volume of information from the IT Revolution will really eliminate the asymmetry of information, and ② whether the decline in data transmission costs will actually result in a social burden, as the lower transmission costs could make it easy for agents to intentionally distribute biased information and falsehoods that are advantageous to their own interests.

To begin with, many Forum members believed that the increase in the volume of information from the IT Revolution will not eliminate the asymmetry of information itself.

Regarding this point, let us consider the used car market, which is a representative example of the asymmetry of information, and in particular the case of selling used cars via the Internet. Using the Internet, it is now quite simple to obtain a vast quantity of information about the used vehicles being handled by a great many dealers instantaneously, at a negligible cost. For consumers, this has the merit of greatly increasing their selection, which was previously limited to the inventories of dealers located nearby their homes. However, under normal circumstances, the

[8] The extent to which this merit can be enjoyed is dependent upon information users' capabilities to access information. As agents that cannot access information are unable to enjoy this merit (the so-called "digital divide" problem), policy measures will be necessary to resolve this issue.

[9] Other merits of network usage include the substantial reduction in transportation costs for products that can be digitized (such as music). See Chapter 5 for a further discussion regarding this point.

information that is available via the Internet, such as car model, year of manufacture, mileage driven and price, is almost never sufficient to make a purchasing decision. This is because it is impossible to grasp the engine condition and other important factors without actually test-driving the car, and such non-digitized information cannot be obtained via the Internet. This example clearly illustrates that the asymmetry of information will not be completely eradicated even with increased information volume[10].

The Forum reached no unified consensus regarding whether the increase in the volume of information will make an additional social burden. Some members noted that it is becoming easy to link Internet information sources with other Internet information sources, which makes it easy to confirm the veracity of information, and expressed the opinion that even under a network environment the percentage of false information will not necessarily increase. In contrast, other members expressed the opinion that the IT Revolution will not automatically resolve the incentive to spread false information. And they expressed concerns that the increased information volume may lead to a greater volume not only of significant information but also of meaningless and false information because the new technologies make it easy to disseminate such falsehoods. They pointed out that even if the volume of meaningful information ("goods") increases, the volume of noise and falsehoods ("bads") will also inevitably increase, and that it may actually become more difficult than in the past to separate out the "goods" from the "bads." In this case, some sort of framework will be needed to mitigate the burden from the increase in the volume of information.

Let us further examine this point by returning to the prior example of used vehicle sales via the Internet. Even if a dealer intentionally transmits biased information which is advantageous to him, the consumer can easily obtain information from other consumers who have experience in using this dealer, confirm the dealer's reputation beforehand, detect any falsehoods, and thus narrow down the candidate vehicles for purchasing selection.[11]

On the other hand, dealers might still transmit false information that cannot easily be detected by consumers (information that exceeds consumers' judgement

[10] According to a survey conducted by the Ministry of International Trade and Industry and Andersen Consulting, Business-to-Consumer (B-to-C) E-commerce accounted for approximately 25% of the Japanese automobile market in 1999, but this was almost exclusively new vehicle sales. Reportedly, there are virtually no used car sales transactions taking place on line.

[11] In this case, because falsehoods can easily be detected, dealers would presumably refrain from spreading falsehoods that would damage their credibility and reputation.

capabilities). In this case, because consumers believe the information provided by the dealer is accurate, some "lemons" (poor quality used cars) will remain in the candidate vehicles. This implies a growing risk that consumers may actually purchase "lemons," which constitutes a demerit for consumers.

One way to address this issue would be for third-party institutions with a high level of expertise to produce information on dealer credibility on behalf of consumers, and then provide this information. This would make it easier for consumers to narrow down their candidate vehicles and make good selections. The Forum examined the potential for mitigating the harms of the asymmetry of information through such "credible information intermediaries"[12] which would produce and transmit information regarding the veracity of other information.

(4) Changes in the Socioeconomic Structure from the IT Revolution

The prior sections have considered the merits from the IT Revolution in improving production efficiencies and reducing search costs through network usage. These merits have the potential to transform the present socioeconomic framework, and this section considers the types of changes that may occur.

The increase in information processing and transmission capacities provided by the IT Revolution are rendering existing technologies outdated, and the reductions in information processing and transmission costs are also lowering the costs incurred in adopting new technologies. Thus, it is becoming easier for comparatively uncompetitive enterprises and firms in other industries to suddenly enhance their competitiveness through the introduction of the latest technologies.[13] Consequently, those enterprises that cannot introduce the latest technologies, for whatever reason, but continue to use older technologies will find themselves at a comparative disadvantage. In other words, they will suffer from diminishing corporate value (goodwill). This trend is represented by the diminishing relative competitiveness of the banking industry in the field of information production and by the growing entry of firms in other industries into the financial sector, as further described in Chapter 4.

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[12] See Chapter 3 for a detailed discussion of this issue.

[13] This phenomenon is referred to as "leapfrogging," and the extremely rapid spread of mobile telephones in Southeast Asian countries provides a representative example. Initially, mobile telephones were not widely adopted in the industrialized nations because they already had well-developed fixed telephone networks. State-of-the-art mobile technologies rapidly penetrated Southeast Asian nations precisely because their fixed telephone networks were insufficient.

Coupled with "credible information intermediaries" and the other frameworks for reducing the burden from the asymmetry of information, the decrease in search costs utilizing networks described in the previous section expands the choice of trading partners and increases the likelihood of conducting transactions under more advantageous terms. Moreover, the integration of information processing technologies and networks, which is one of the distinctive characteristics of the IT Revolution, is changing the ways in which information is processed and shared, and is likely to greatly influence the ways businesses are implemented. This increases the opportunity costs incurred in maintaining existing business models and transaction patterns, and offers the potential to change existing management methods and trading frameworks. However, some members of the Forum noted that such changes might not occur if the merits from new trading partners and business approaches do not exceed the merits and prerogatives from the present transaction patterns, etc.[14]

Then, to what extent will these changes actually occur? Given the present IT Revolution, how will the traditional transaction patterns such as inter-corporate *keiretsu*/subcontractor transactions change, and what sort of specific transformations will occur in the financial industry? The Forum conducted extensive examinations regarding these questions based on the understanding of the issues outlined above, as explained in detail in the subsequent chapters.

[14] Consequently, if the social structure is highly rigid and vested interests are strong, it will not be possible to take advantage of the merits from the IT Revolution as described above. Thus, one future policy issue will be to identify where the rigidities lie and to determine how to eliminate social structural rigidity.

3. Development of Electronic Commerce, Changes in Trading Patterns and Price Setting Mechanisms, and Influence on Monetary Policy

The integration of computers and telecommunications networks, as presented in Chapter 2, has facilitated E-commerce over the Internet[15], and the scale of E-commerce is rapidly expanding. The emergence of E-commerce has facilitated direct transactions between producers and consumers, and some enterprises are beginning to move beyond the established framework of inter-corporate *keiretsu*/subcontractor transactions toward the global procurement of parts. Accordingly, some assert that the distribution sector will no longer be necessary (the elimination of middlemen), and that the inter-corporate *keiretsu*/subcontractor transactions that have traditionally been one of the salient characteristics of Japanese business transactions may disappear. Moreover, others have noted that as E-commerce may eliminate the distribution sector, it exerts downward pressure on prices, facilitates frequent price revisions, and may lead toward the emergence of a so-called "perfect market" without any "market friction" whatsoever. Will the expansion of E-commerce actually result in these dramatic changes? And if so, what will the effects be on monetary policy?

Based on the understanding of the issues outlined above, this chapter reviews the present conditions of E-commerce, and examines the potential changes to the existing patterns of goods and services transactions among economic agents from the expansion of E-commerce. It also investigates the influence of the expansion of E-commerce on price setting in terms of ① price levels, ② menu costs,[16] and ③ the Law of One Price, and finally considers the implications for monetary policy.

(1) Current Conditions of E-commerce

E-commerce can be broadly divided into two main categories: Business-to-Business (B-to-B) E-commerce and Business-to-Consumer (B-to-C) E-commerce.

The overall scale of E-commerce has been rapidly expanding from the beginning

[15] In this Report, "E-commerce" is defined as "commercial transactions (the delivery of goods or services and the receipt of information or monetary value in relation with the commercial transfer of goods or services among economic agents) via electronic media utilizing networks," following the definition presented by Kitamura, Otani, and Kawamoto (2000).

[16] At restaurants, the purchase prices of ingredients such as meat and fish vary from day to day, but rewriting the menu prices on a daily basis would be costly. These types of costs incurred in revising prices are referred to as "menu costs," and are believed to be one reason for price rigidity.

of the 1990s. According to a survey conducted by the Ministry of International Trade and Industry and Andersen Consulting (Figure 4), in Japan in 1999 the B-to-C market scale was approximately ¥336.0 billion, and the B-to-B market scale was approximately ¥12 trillion. For comparison, in the U.S. the B-to-C market is on the order of $35.6 billion, the B-to-B market is about $250.0 billion, and the Japanese and U.S. markets are both projected to grow at annual rate of more than 40%.

B-to-C E-commerce accounts for only a small percentage of final consumption expenditure (the constituent percentages are projected to reach 1.4% in Japan and 3.2% in the U.S. in 2003).[17] On the other hand, B-to-B E-commerce is projected to have a relatively large impact, accounting for 11.2% of intermediate and final demand in Japan and 19.1% of that in the U.S. in 2003.

(2) Effects from the Expansion of E-commerce

As E-commerce is projected to expand at an annual rate of over 40%, the expansion of this new trading pattern will certainly have some effect on the traditional transaction framework. To what extent will the growth of E-commerce actually result in the breakdown of traditional inter-corporate *keiretsu*/subcontractor transactions and the elimination of the distribution sector?

In actual commercial transactions, the asymmetry of information poses the so-called "agency problem."[18] To resolve the agency problem, commercial transactions are presently conducted within the framework comprised of marketplaces, wholesalers and retailers, and inter-corporate *keiretsu*/subcontractors.

In this section, we examine the potential changes to transaction patterns from the expansion of E-commerce, giving due consideration to the agency problem.

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[17] The purchase prices of durable consumer goods are included in compiling final consumption expenditure under national income statistics. In principle, however, the purchase of durable consumer goods is actually a type of investment, and it may be the cost of the service obtained from such goods that should be counted as consumption expenditure. It should be noted that calculations of final consumption expenditures adopting this approach might result in different figures for the scale of the B-to-C E-commerce market.

[18] The "agency problem" refers to the problem that arises between the principal (the economic entity that entrusts certain works) and the agent (the economic entity that actually implements these works). It means that because the agent's behavior is not necessarily always consistent with the principal's wishes, it becomes necessary to provide some sort of motivation to ensure that the agent acts in the principal's best interest. For further detail, see Kurasawa (1989).

(Traditional Frameworks for Resolving the Agency Problem)

First, we review the traditional frameworks for resolving the agency problem in some detail.

① B-to-C Transactions

The existence of marketplaces where multiple producers gather on a regular basis represents the first framework for resolving the agency problem in B-to-C transactions. This framework reduces consumers' search costs, and the establishment of reputations through repeated transactions at marketplaces also reduces agency costs.[19] At the same time, marketplaces reduce enterprises' search costs as firms are spared the costs that would otherwise be incurred in searching for consumers one at a time.

Similarly, the existence of wholesalers and retailers also reduces search costs for both producers and consumers. These intermediaries accumulate information on producers and products, and by accumulating expertise they remove poor-quality goods from their product offerings and thus reduce agency costs.

② B-to-B Transactions

Inter-corporate *keiretsu*/subcontractor transactions represent the first framework for resolving the agency problem in B-to-B transactions. Under this system[20], parts manufacturers make appropriate investments to meet the product specifications of their parent companies, which share information about changes in parts specifications for new products and quality improvements. This subcontractor system provides various merits from long-term trading relationships (in addition to information sharing, these include coordinated activities, financial accommodations and personnel exchanges). Moreover, because this facilitates appropriate investment by parts manufacturers and because the parent companies are "held hostage" as they will lose their public reputation if they betray subcontractors, there are definite incentives for maintaining long-term trading relationships.

In the realm of international B-to-B transactions, multinational corporations function as another mechanism to resolve the agency problem. The issue of why multinational corporations exist can be broken down into two main questions: ① why

[19] "Agency costs" are the sum of two kinds of cost. The first are the costs incurred to resolve the agency problem through the implementation of policies to motivate agents to act in the best interests of their principals. The second are the disadvantages suffered by principals compared with the case when there is no agency problem, regardless of the implementation of these policies.

[20] The following discussion is based on Itoh and Matsui (1989).

do single corporations conduct production and sales activities in various nations, and ② why are production and sales activities in various nations conducted by single corporations, rather than by different entities. The answer to the first question is simply that locational factors are important, including the supply of low-wage labor, the location of final demand, and the supply of raw materials and other resources. The answer to the second question apparently lies in the merits of internalization, that is, in the merits realized when a single corporate entity conducts the entire production process and then sells final goods. Other merits of internalization include the ease of technology transfer, avoiding conflicts of interest between upstream and downstream processes[21], and mitigating the asymmetry of information in areas such as the quality of intermediate goods and market data.

(Changes in Trading Patterns from the Expansion of E-commerce)

① B-to-C Transactions

The spread of the Internet has greatly reduced consumers' search costs via the use of Internet search engines (producers have also benefited from reduced search costs related to consumer demand surveys, etc.), and thus the volume of direct transactions between producers and consumers has been increasing.

Nevertheless, in goods and services transactions where the asymmetry of information is problematic, direct transactions can not resolve the agency problem, so some kind of framework is needed to settle it. For example, many flourishing electronic market malls essentially fulfill the same functions as traditional marketplaces, and this implies an important role for intermediation businesses in reducing agency costs (see Box 1).[22]

[21] There is a conflict of interest when the upstream and downstream processes are handled by different enterprises because the upstream firms work to maximize their sales price while the downstream firms work to minimize their acquisition price, but this conflict is averted when the upstream and downstream processes are vertically integrated (Krugman and Obstfield [1994]). Of course, this does not necessarily mean that all transactions should be internalized, as internalization also has certain demerits such as conflicts of interest among internal corporate divisions and increasing internal adjustment costs.

[22] E-commerce information intermediaries that directly link producers with consumers are presently sprouting up like mushrooms after a summer rain. The establishment of solid reputations and brand images will be a decisive factor for these businesses to succeed, so the key will be how they manage to win credibility. Therefore, most likely, many of these businesses will fail and only a small handful will achieve success.

② B-to-B Transactions

Whether enterprises will decide to change their trading partners along with the development of the Internet will depend on whether or not the merits generated by changing trading partners and procuring low-priced intermediate goods will surpass the merits presently realized from inter-corporate *keiretsu*/subcontractor transactions and from internal transactions in multinational corporations.

For many general-purpose intermediate business goods with wide-ranging applications, such as automobile windshield wipers, steel products and computer parts, the merits of low-price procurement surpass those generated by information sharing within *keiretsu* corporate groups. Consequently, the trading of such parts transcending the inter-corporate *keiretsu*/subcontractor and multinational firm framework is now expanding on a global scale.[23]

However, the Forum members noted that the merits of Internet E-commerce will be small for customized product parts that are only used for specific final goods (for example, for drawings-approved automobile parts[24]). This is because there are high costs in initiating transactions with new suppliers for such parts, resulting from the need to provide detailed information and the necessity of additional capital investment for production.

Thus, as long as a "closed and integrated production process"[25] remains the mainstream approach, the conventional transaction framework will likely change only for certain general-purpose intermediate goods with a wide range of applications to many finished goods. Nevertheless, if parts procurement via the Internet results in lower finished product prices, if consumers intensify their price orientation, or if the percentage of goods produced under an "open and modular process"[26] increases,

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[23] For example, in May 2000 the world's leading electric and electronic appliance manufacturers announced that they will be jointly establishing an E-commerce market for electronic parts.

[24] "Drawings-approved parts" refers to parts that are jointly planned by the parent company and its subcontractors right from the design stage, and thus the designs are pre-approved for production.

[25] A "closed and integrated production process" is a process whereby parts are produced in accordance with the final product specifications with close communication among different in-house divisions, or between the parts suppliers and the assembly manufacturers. A typical example of goods manufactured under this process is sedan-style passenger vehicles. For further details, see Ministry of Finance (2000).

[26] An "open and modular production process" is one wherein the production process is open to various suppliers because the functions provided by each part are complete in and of themselves, the connections linking the individual parts are standardized, and modular design is possible. Typical examples of goods manufactured under this process are trucks and PCs. For further details, see Ministry of Finance (2000).

common parts usage would be advanced and thus the global scale of B-to-B E-commerce transactions outside the inter-corporate *keiretsu*/subcontractor framework could expand.

Box 1: Importance of Credibility and Role of Intermediaries in E-commerce

A variety of E-commerce intermediation sites have been appearing on the Internet. Why is the intermediation business required under E-commerce, just as for regular transactions, and what are the specific functions performed by these intermediation businesses? This Box introduces the paper regarding these issues presented in the 13th meeting of the Forum (Kitamura, Otani and Kawamoto [2000]).

(The Asymmetry of Information and the Importance of Credibility)

With E-commerce, consumers must make purchasing decisions without directly viewing or touching the goods they are buying. Moreover, because the market-entry costs are minimal and poor-quality businesses can initiate Internet operations, there is a high probability that the "lemon problem" (the problem whereby buyers have risks to purchase inferior-quality products ["lemons"] due to the imbalance in product information between buyers and sellers) may occur. Thus, when there is asymmetry of information and when the pricing mechanism does not completely function, mechanisms to avert market failures (frameworks to secure trading credibility) are needed. Possible mechanisms to avert E-commerce market failures include: ① sellers providing information to consumers by building up their brand image and via advertising; ② third-party organizations, such as government agencies and consumers' groups, providing quality standards and quality assurance; and ③ the provision of information by private-sector intermediation businesses (platform businesses).

(Role of Intermediation Businesses)

Kitamura, Otani and Kawamoto (2000) note the following five functions of platform businesses, giving reference to Kokuryo (1999).

① Searching for Trading Partners

By collecting information on behalf of a great number of consumers, intermediation businesses can reduce the search costs compared with those that would be incurred when consumers collect information individually. These intermediation businesses generate cost savings in the collection of information concerning suppliers and products

through repeated transactions with various suppliers and by accumulating knowledge about products that provide the same performance (that is, they make good use of economies of scale and of scope). Moreover, they can produce information to meet consumer needs, for example, by providing charts summarizing the prices charged for any given product by various retailers, and thus provide consumers with the lowest prices.

In addition, intermediation businesses generate cost savings for firms as well since it is less expensive for intermediaries to collect important consumer information all at once compared with the costs that would be incurred when firms gather such information individually, and the intermediation businesses can also produce this information to meet specific corporate needs.

② Providing Credibility (Information)

Even when networks are used to identify potential trading partners, commercial transactions cannot be implemented without credibility regarding delivery dates, quality of goods, payment, etc.

The intermediation businesses stand in between buyers and sellers and effectively function as credit intermediaries. For example, credit card companies can conclude transactions because sellers trust them even though sellers are uncertain about the buyer's credibility.

③ Evaluating Economic Value

Intermediation businesses select high-quality companies and products and include them in their information lists based on their long experience and specialized knowledge. By removing firms and products that are subject to consumer complaints, intermediation businesses can limit their offerings to only high-quality products (and thus eliminate "lemons").

④ Standardizing Transaction Procedures

In conducting transactions with various trading partners over networks, it is desirable to standardize (to establish protocols for) basic commercial arrangements such as contract terms, transaction procedures and accounting standards. While the standardization of these systems is often addressed by the government and by organizations for standardization, standardized procedures may also be studied and disseminated by private-sector platform businesses.

⑤ Integration of Distribution and Other Functions

The actual conclusion of goods and services transactions requires not only the exchange of information, but various other functions such as arranging delivery and credit card payment procedures. The integration of these functions represents yet another role of platform businesses.

(3) Expansion of E-commerce, Price Setting Mechanisms, and Monetary Policy

The development of the Internet is reducing search costs, and making it easy for consumers and firms to find suppliers offering goods and services at the lowest prices. Accordingly, some note that the Internet effectively makes the constraints of time and distance less important, and may lead toward the emergence of a so-called "perfect market" without any "market friction" whatsoever.

Let us then consider the actual price setting mechanisms under E-commerce. Specifically, has the expansion of E-commerce ① changed price levels and ② facilitated frequent price revisions (a decrease in menu costs)? And ③ is the Law of One Price maintained in Internet E-commerce? As these issues are related with monetary policy, this section also incorporates some considerations from the monetary policy perspective.

(Changes in the Price Setting Mechanism from the Expansion of E-commerce)

① Reduction in Price Levels

Brynjolfsson and Smith (1999) conducted a survey on the sales prices of books and CDs in 1998 and 1999 on both the conventional market and the E-commerce market. They discovered that on average the prices on the E-commerce market were approximately 16% less than those on the conventional market. After adjusting for transportation costs and local sales taxes, they reported that the average prices on the E-commerce market were 9% less than those on the conventional market for books, and 13% less for CDs.

② Reduction in Menu Costs

Baily (1998) and Brynjolfsson and Smith (1999) investigate the differential in the frequency of price revisions on the conventional market and the E-commerce market. These research papers are based on the idea that prices should be revised at a higher frequency on the market with lower menu costs, given that both markets are subject to

exactly the same shocks. Both papers reach the same conclusion that the frequency of price revisions is overwhelmingly higher on the E-commerce market than on conventional markets. In particular, Brynjolfsson and Smith (1999) report an extremely high frequency of small price changes of less than $1 on the E-commerce market (Figures 5 and 6). These findings suggest the possibility that price revisions are conducted on the E-commerce market even in response to small shocks for which price revisions are not conducted on the conventional market because of the menu costs. Their research also finds that the minimum price revision for books is 5¢ on the E-commerce market compared with 35¢ on the conventional market, and that for CDs is a mere 1¢ on the E-commerce market compared with $1.00 on the conventional market.

③ Failure of Law of One Price in E-commerce

In the real economy, there are differentials in the prices charged for the same products (the difference between the highest price and the lowest price). This is normally attributed to consumers' shortage of information regarding prices due to the existence of geographical distance and search costs. Because E-commerce lessens geographical restrictions and has greatly reduced search costs, it would be natural to assume that the differentials in the prices charged for the same products on the Internet would be smaller than those on the conventional market.

However, Brynjolfsson and Smith (1999) reported that under E-commerce, the maximum price differential for the same books and CDs is 50%, and the average price differential is 33% for books and 25% for CDs. Additionally, Clemons, Hann, and Hitt (1998), who surveyed the prices of airplane tickets sold via on-line travel agencies, found a price differential of 20% after making adjustments for the heterogeneity of products sold, such as the departure and arrival times. Thus, contrary to general expectations, the Law of One Price does not hold on the E-commerce market, even for homogeneous goods that cannot cause a "lemon problem."

The Forum identified the following four background factors as to why the Law of One Price is invalid in E-commerce.

The first factor is the credibility of the suppliers and their products. A large number of consumers apparently feel that they cannot trust sites offering the lowest prices, and only conduct transactions with sites they can trust to avert a potential "lemon problem."

The second factor noted was the non-anonymity in E-commerce transactions. In E-commerce (especially B-to-C), consumers must disclose their names, addresses, credit card numbers and other private information in order to purchase goods and

services. Once consumers have registered such private information on a given site, if they subsequently find another site offering lower-priced products, they must incur the switching costs of registering the same information once again in order to make purchases from that site. When the amount of the price differential is less than these switching costs, consumers may refrain from changing suppliers, and this may account for a certain price differential among sites.

The third factor is the ease of suppliers' price discrimination in E-commerce in favor of certain customers, which is tantamount to a "Law of a Different Price for Each Consumer." For example, an airline ticket sales company site offers two types of options to consumers: the first is a channel whereby the tickets are sold at fixed prices set by the sales company, and the second is a channel whereby the tickets may be purchased at lower prices through on-line negotiations with the sales company. In this case, the Internet sales company makes a discrimination between those consumers who want to purchase fixed-price tickets without conducting negotiations and those who want to purchase their tickets at lower prices, even though this requires negotiations, and offers different pricing to each category of consumers.[27]

The fourth factor is the possibility that the Law of One Price, which is artificially held by suppliers' activity, is losing validity because of a decline in their monopoly power. In the real economy, uniform prices are artificially set for certain goods not as a consequence of arbitrage transactions, but rather by autonomous practices based on monopoly power, such as the private setting of fixed resale prices in Japan. On the Internet, however, monopoly power is declining from the ease of new market entry and other factors, so there is a potential that the Law of One Price based on such autonomous practices may cease to function.

(Influence on Monetary Policy)

First, the reduction in price levels from the spread of E-commerce[28] is interpreted as a downward shift of the aggregate supply curve from the simplification of distribution. Thus, it is generally believed that the central bank should accept, to some extent, the

[27] If prices are considered in a broader manner as the total of the monetary value of goods, the consumer's choice of supplier and the ancillary services related to purchasing (such as delivery and the necessity of price negotiations), prices for the same product differ among individual consumers. Therefore, this ease of price discrimination means that the "Law of a Different Price for Each Consumer" is easily maintained on the Internet.

[28] While, as noted above, the scale of E-commerce itself is still relatively small, through competition the reduction of prices on the E-commerce market may exert downward pressure on the prices charged through conventional sales channels.

reduction in price levels from the spread of E-commerce. In the real economy, however, because various shocks occur continuously it is difficult to distinguish supply shocks from demand shocks. The cost-price relationship (the mark-up ratio) may provide one useful criterion for distinguishing between these two types of shocks. Specifically, when dividing mark-up ratio movements into time trends and cyclical fluctuations, one might be able to interpret the time trends mainly as supply side factors and the cyclical fluctuations mainly as demand side factors. Although it is extremely difficult to conduct such analyses in real time, the ability to accurately grasp the data could provide additional information for making policy decisions.

Second, coupled with the greater ease of price discrimination, the reduction in price levels from the expansion of E-commerce may influence the compilation of price indices. For example, if the revision of price indices becomes belated amid the rapid expansion of E-commerce and items sold over the Internet remain excluded from price surveys, the upward bias of price indices may become an increasingly serious problem. Additionally, when price index measurement error increases it may become extremely difficult to determine whether observed price movements reflect supply shocks, demand shocks, or measurement error.[29] What is more, if the trend toward multiple prices for the same goods advances from further price discrimination and the price movements of items presently used as representative items for individual product categories come to differ from the price movements of the other items in these categories, this would pose a major problem for the usefulness of price indices as indicators. In any event, how to maintain and improve the quality and reliability of price indices will become increasingly important.

Third, the reduction in menu costs on the Internet may have an important influence on the effectiveness of monetary policy. Specifically, in the long run, when real GDP is constant at full employment, the money supply and price levels are proportionally related with each other. Thus, the real money supply may become constant and changes in money supply would no longer have any effect on the real economy (in other words, this would result in a dichotomy between money and the real economy). Regardless of this, in the short run monetary policy still remains effective since central banks can change the real money supply because of the price rigidity caused by menu costs and other factors, and thus influence the real economy.

However, if the expansion of E-commerce is drastically reducing menu costs to one-tenth or even one-one hundredth of prior levels and price flexibility is increasing,

[29] See Chapter 6 for a discussion of this type of statistical uncertainty.

then a dichotomy between money and the real economy may easily appear even in the short run, and the influence of monetary policy on the real economy might diminish.

On the other hand, some Forum members expressed the opinion that this is no great cause for concern because the reduction in menu costs implies a reinforcement of the market mechanism, and leads to a diminishing necessity for monetary policy itself.

Additionally, because price rigidity also derives from the rigidity of nominal wages under employment contracts, it is premature to judge that the necessity or effectiveness of monetary policy will decrease solely due to a reduction in strictly defined menu costs.

4. Influence of the IT Revolution on the Financial Industry

How will financial products and services change from the IT Revolution, and what changes will occur in financial markets, and in the banks and other financial intermediaries that provide these products and services? Even with the IT Revolution, the essential functions of the financial industry – such as ① the provision of payment and settlement services, ② the intermediation of risk (or risk taking), ③ information production (the screening and monitoring of borrowers), and ④ the provision of liquidity – will remain unchanged.[30] However, major changes are expected in the contents of financial products and services, and in the financial institutions that provide these products and services. Moreover, these changes may influence the transmission mechanism and effects of monetary policy.

This chapter examines ① the influence of the IT Revolution on financial transactions, ② the consequent changes in financial markets, ③ the changes in the contents of the services of financial intermediaries, ④ the future outlook for the financial intermediation industry, especially for the banking industry, and ⑤ the consequent changes in the monetary policy transmission mechanism, giving reference to the experience in the United States, which is a front runner in the IT Revolution.

(1) Effects of the IT Revolution on Financial Transactions

As presented in Chapter 2, the present IT Revolution may be characterized by the integration of information processing and telecommunications technologies; the consequent acceleration of the speed of information processing and transmission, reduction of information processing costs, and increase of the geographical distance over which information can be transmitted (globalization); and the astounding speed at which information technologies are spreading among the public. These developments are greatly changing financial transactions. The changes that are presently being observed may be summarized as follows.

(Development of Advanced Financial Products and Services)

First, coupled with the development of financial engineering, the phenomenal improvements in information processing speed and cost performance are facilitating the practical application of various technologies whose theoretical bases had already been

[30] See Cecchetti (1999) regarding this point.

established, but which previously could not be applied to actual financial transactions because the required computation times were too long and the costs too high. These innovations have also enabled the unbundling of existing integrated financial functions and the recombination of their constituent parts into new forms as illustrated, for example, by the combination of variable interest rate loans and interest rate swaps, which provides an equivalent financial function to fixed interest rate loans. As a result, it is now possible to offer new financial products and services that make full use of advanced information technologies, as demonstrated by the dramatic growth in recent years of derivatives (such as options and futures) trading, the development of securitization, and the practical use of electronic money and other electronic payment and settlement technologies analyzed in the Forum's Interim Report. What is more, the compilation of customer databases and the improvement of their quality have made it possible to offer highly detailed and differentiated financial services to each individual customer.

Development of Derivative Products

It is most significant that the increase in information processing capacity from the IT Revolution has provided banks and other finance market participants with the means to actualize the fruits of recent finance theory (even complicated estimations, such as numerical calculations of payoff functions utilizing the Monte Carlo simulation method, can be easily conducted using low-priced hardware and software). Derivatives trading has been rapidly expanding, especially since the 1980s, due to the necessity of responding to fluctuations in interest and foreign exchange rates. According to the Bank for International Settlements (BIS), the worldwide notional amount of OTC derivatives had reached $81.5 trillion at the end of July 1999.[31]

Securitization

Financial products must be standardized for them to be traded on financial markets. Recent IT Revolution has made it possible to present the risks and returns of financial products that previously could not be calculated in practice due to their extreme complexity (that is, to accurately calculate the probability of future cash flows and to present the calculation results to investors). In addition, technologies are also being developed to compose new financial products that have more suitable risk-return characteristics for market trading by pooling together multiple items with different

[31] See BIS (2000) regarding this point.

risk-return characteristics. As a result of these various innovations, the securitization of financial products has clearly been further developed.[32] Cases in point include the rapid growth of Mortgage-Backed Securities (MBS) in the United States, and the securitization of credit card and automobile loans.

Electronic Money and other Electronic Payment and Settlement Means

Along with the development of electronic payment and settlement technologies, many attempts to develop and actualize the practical use of electronic money and other electronic payment and settlement means have been made in nations throughout the world. In Japan as well, debit card payment services are beginning to be offered by many financial institutions.

(Improvement of Risk Management Capabilities)

Second, together with the development of financial engineering, the IT Revolution is dramatically improving the risk-management capabilities of asset managers. Examples include the quantification of portfolio risk such as price volatility risk through Value at Risk (VaR), the identification of the risk factors that influence portfolios, and the calculation of the correlations among these various risk factors. Thus, investment trust, pension fund, hedge fund and other asset managers can now adjust the composition of their portfolios to optimize the risks and returns. This improvement in risk-management capabilities is also supporting the demand for new, advanced financial products and services (as reviewed above).

(Changes to Financial Service Delivery Channels)

Third, new network infrastructure such as the Internet is being constructed, enabling the provision of financial services via these new delivery channels.[33] In the past, because financial services were highly dependent on physical service bases such as bank branches, the provision of such services was greatly restricted by geographical limitations. With the reduction of information transmission costs and the dramatic development of information processing technologies, however, the provision of bank services is no longer dependent upon bank's branch networks, as evidenced by the recent alliances between banks and convenience stores in Japan. Furthermore, the

[32] See Chapter 3 of Crane et al. (1995) regarding this point.
[33] Unique delivery channels are already appearing in Japan, such as terminals for the payment of public utility fees at convenience stores.

increased utilization of networks, such as Internet banking[34] and Internet finance[35] (for example, public offerings of shares via the Internet), is facilitating the provision of financial services via delivery channels that transcends physical and geographical limitations.

Internet Banking

The provision of Internet banking services is becoming more active not only by banks but also by firms in other industries that are entering the financial services industry. This is because utilizing the Internet permits a major reduction in banking operation costs, such as those incurred in checking deposit balances and transferring funds among different accounts. According to a survey conducted by the U.S. consulting firm Booz-Allen & Hamilton Inc., the estimated costs per transaction are about 1¢ for Internet banking compared with $1 or more when conducted by bank branch personnel[36] (Figure 7). Thus, Internet banking is making it possible to provide existing bank services at a lower cost than in the past, and also facilitating the provision of new services. For example, some U.S. banks are not only providing B-to-B E-commerce payment and settlement services, but also providing enterprises with additional information, such as information associated with the procurement and distribution of goods and services among firms.

(2) Changes in Financial Markets

As explained above, the IT Revolution is changing the content of financial goods and services to more advanced and convenient ones. Combined with revisions to the legal, taxation and disclosure systems for financial markets and other market infrastructure improvements, these changes increase the variety of financial products traded in financial markets. Meanwhile, the rise in the speed of information processing and transmission and the reduction of costs are promoting more active arbitrage trading

[34] The physical security of networks is an essential prerequisite to the development of Internet banking. Naturally, measures will have to be implemented to maintain network safety and curtail operational risk from the standpoint of maintaining and fostering the prudent credit order.
[35] Regarding Internet finance, see Box 5 of the Forum on the Development of Electronic Payment Technologies and Its Implications for Monetary Policy: Interim Report (May 1999).
[36] These are average variable costs. Because the initial investment amounts for Internet banking are relatively high, the average costs under Internet banking do not compare favorably with those incurred under conventional means of providing financial services unless the number of accounts reaches a certain level. Some point out that at least one million accounts are required for Internet banking to generate profits.

among financial products.[37]

(Increased Variety of Tradable Financial Products in Financial Markets by the Securitization)

As mentioned in the previous section, securitization increases the variety of the financial products traded in financial markets. Nowadays, financial markets are no longer only the venue where small number of highly rated companies raise funds, but also function as the venue for the trading of various financial products. In the U.S., many small and medium enterprises and low rated firms actively raise funds in capital markets such as NASDAQ and the junk bond markets. On the other hand, these changes are not so conspicuous in Japan since funds raised through financial institutions have accounted for the majority of the flow of funds. However, many derivatives are being developed and their trading volume is increasing dramatically. In addition, the securitization of bank loans is being developed as banks try to regain financial soundness.

(Increased Arbitrage Trading)

While the huge reductions in information processing and transmission costs from the IT Revolution have enabled electronic brokering and Internet stock trading, these are also promoting more active arbitrage trading in financial markets. The development of futures and options markets and the improved risk-management capabilities of asset managers are moving in the direction of more active arbitrage trading. Of course, arbitrage trading is nothing new, but the dramatic decrease in information processing and transmission costs in recent years is one factor contributing to significant growth in arbitrage activities. This more active arbitrage trading is promoting greater market liquidity and increasing the quality of market prices as indicators.

[37] With the spectacular improvements in information processing and transmission speeds from the IT Revolution, market prices are coming to instantaneously reflect various exogenous shocks (or information about such shocks). Additionally, the dramatic reduction in information processing and transmission costs and the globalization of networks has enabled 24-hour-a-day trading via overseas markets. See Chapter 5 for a discussion of how this enhanced globalization of financial transactions is affecting the substitutability of domestic and foreign financial assets and the domestic and foreign interest rate differential.

(3) Changes in the Contents of the Services of Financial Intermediaries (Financial Intermediaries and Changes in Financial Transactions/Financial Markets)

As explained in the previous section, the IT Revolution is expanding trading in financial markets, and this trend is greatly changing the contents of the services of financial intermediaries.

To begin with, let us consider the reason why financial intermediaries exist through a comparison with the role of financial markets. While financial markets are appropriate for the trading of standardized financial products, financial intermediaries can provide customized financial products and services that are difficult to standardize. As considered in Chapter 2, if the IT Revolution cannot resolve the problem of the asymmetry of information, financial transactions with the asymmetry of information will still entail costs in examining the creditworthiness of transaction partners before contracts, monitoring the partners and transactions after the contracts are signed, as well as enforcing the partners to fulfill the contracts when the transactions are completed. Thus financial intermediaries will continue to provide great value from their expertise in the screening and monitoring of financial transactions (information production). For example, because the agency costs accompanying the asymmetry of information are particularly high for lending to small and medium enterprises, such financial transactions represent a typical example of financial products that are not suited for trading on markets. Banks and other financial intermediaries are improving their efficiency in conducting such financial transactions through adopting the new method of credit scoring, which has been made possible by the IT Revolution.

Credit Scoring

In the past, many of the credit screening works for loans to small and medium enterprises have been conducted by hand based on the unique know-how of each individual bank. In recent years, however, some banks are adopting the new method of credit scoring (see Box 2 for an outline of the credit scoring model) to calculate borrowers' credit risk based on financial statements and other credit information and then actually providing loans utilizing the results of the credit scoring model. By adopting the credit scoring method, the costs incurred in credit screening for loans are being markedly reduced.

In particular, larger banks are becoming more active in using this new method and providing loans to small and medium enterprises. This trend is particularly conspicuous in the United States. For example, in the San Francisco region, even

after adjusting for the influence from bank mergers, the total amount of loans of under $100,000 provided to small and medium enterprises by larger banks has been sharply increasing (Figure 8).

This trend has been somewhat belated in Japan, as the data required to develop the credit scoring model had not been collected or processed. Recently, however, a corporation was founded to collect financial data on small and medium enterprises[38], and some financial institutions are moving to newly develop their models based on the data obtained.

Moreover, the IT Revolution and the development of financial engineering have enabled the provision of advanced, complex financial products and services, and financial intermediaries are believed to be providing information about these advanced, complex products and services and also transforming them into financial products and services that are easily understood by consumers and businesses (Allen and Santomero [1998]). Theoretically, if diverse risks in financial products are unbundled and reallocated, this should increase the welfare of economic agents. However, the costs incurred by consumers and businesses to understand the nature and properties of such financial products accurately as required for financial products trading (participation costs)[39] will actually increase,[40] so without a framework to reduce these costs, consumers and businesses will not be able to fully enjoy the merits of the advanced financial products and services from the IT Revolution.[41] In response to this issue, banks have been

[38] Japan Risk Data Bank Inc. was founded in April 2000, primarily by system consulting companies. To date, 22 financial institutions, including 19 banks, have announced their intentions to provide capital to Japan Risk Data Bank Inc.

[39] The concept of "participation costs" was introduced by Allen and Santomero (1998), and a comparison with financial transaction costs such as commissions may be useful for understanding this concept. While "participation costs" are the internal costs incurred by individual economic agents in the process of gaining an understanding of the nature of financial products, financial transaction costs are the external costs incurred when individual economic agents conduct financial transactions with other economic agents.

[40] Allen and Santomero (1998) argue that participation costs under the IT Revolution are increasing, and that the essential feature of financial institutions is to decrease these participation costs. As examples demonstrating how participation costs are increasing under the IT Revolution, the authors note that: ① almost all of the participants in derivatives markets, which continue to rapidly expand, are financial institutions, with very few households or firms (final consumers) participating; and ② while there is an ongoing trend toward a reduction in trading costs such as brokerage fees, the number of shares owned directly by individuals is decreasing while the number of shares owned indirectly by individuals through mutual funds and pension funds is rapidly increasing.

[41] It is not inconceivable that the participation costs may fail to decrease if financial intermediaries disseminate inappropriate information, in which case the participation costs may

actively providing new financial products such as those incorporating derivatives, and rapidly expanding their off-balance sheet transactions.

Expansion of Off-balance Sheet Transactions

Banks, especially those in the United States, are actively pursuing highly profitable off-balance sheet operations such as derivatives trading and servicer businesses through the securitization of loan credits (proxy lending and collection businesses) in place of traditional banking businesses (such as making loans to firms, etc. and funding them by issuing demand deposits and other deposits).[42] In Japan, reflecting the fact that the demand for bank deposits remains strongly entrenched, the weight of traditional banking businesses is relatively high compared with that in the U.S., but this situation is gradually changing. These increased off-balance sheet activities are a result of banks' efforts to increase profits while controlling their own risk, and banks are beginning to transform advanced, complex financial products into easily understandable ones and to provide consumers and businesses with these financial products (responding to participation costs).

Box 2: Outline of the Credit Scoring Model

"Credit scoring" is the statistical method used to evaluate the credit risk of loan applicants. This method produces "scores" from the various attributes of individuals and the financial data of businesses applying for loans, and then generates a total score expressing the creditworthiness of loan applicants. The total score is then used as a criteria for making credit decisions (in actual practice, banks set a "cut-off score" as the lending criteria, and provide credit to applicants whose scores exceed this minimum standard). The credit scoring model has long been used for credit card loans and other consumer financing. But the dramatic improvements in information processing capabilities from the IT Revolution and the increase in computer memory capacity have facilitated the construction of the databases required for further model development, and

exceed the merits provided by higher-level financial transactions. This would pose the same issues examined in Chapter 2 regarding the necessity of credible information intermediaries to lessen the social burden from the increase in the volume of information.

[42] As detailed below, banks are said to achieve certain synergy effects from simultaneously conducting deposit and lending businesses. For an explanation of this point see, for example, Chapter 2 of Freixas and Rochet (1997).

the credit scoring model has recently become widely used for lending to small and medium enterprises.

Specifically, the process of constructing a credit scoring model comprises the three steps of ① selecting effective attribute data for the credit screening, ② setting "classes" for each attribute, and ③ assigning scores for each class. These steps are conducted by the optimization method. (The following tables show an example of the model).

Attribute: Liquidity Ratio	
Class	Score
100% or more	30
50-100%	20
25-50%	10
Less than 25%	5

Attribute: Cash and Deposits / Total Assets	
Class	Score
10.0% or more	50
5.0-10%	35
2.5-5.0%	20
Less than 2.5%	10

Attribute data commonly adopted in the credit scoring models includes: ① corporate financial indices (divergence from the industry average ratio of pre-tax profits to total assets, liquidity ratio, etc.); ② personal data regarding corporate representative directors (age, net holding assets, etc.); ③ corporate credit data provided by credit monitoring firms (key negative information, number of days elapsed on overdue payments, etc.); and ④ personal credit data provided by credit monitoring firms (number of credit inquiries over the past six months, etc.).

(4) Future Outlook for the Banking and Financial Intermediation Industries

The previous section pointed out that the contents of the services of banks and other financial intermediaries are changing under the IT Revolution, and financial intermediaries will continue to play significant roles given the existence of the asymmetry of information and participation costs. What, then, is the potential influence of the IT Revolution on the organizational forms (institutional aspects) of

financial intermediaries? The Forum members noted several possibilities, as outlined below.

(Concentration of Financial Intermediaries)

To begin with, because the IT Revolution offers the potential to achieve greater economies of scale in certain financial transactions, mergers and alliances among financial institutions may become more active, resulting in a greater concentration of financial intermediaries. In fact, the number of bank mergers and alliances has been increasing worldwide since the late 1980s, and in Japan mega-banks have also been appearing recently through mergers among large banks. It is said that the greater economies of scale prompted by the IT Revolution represent one factor behind this movement toward the establishment of mega-banks.

However, even if the economies of scale are increasing from the IT Revolution, this may not significantly influence all of the services conducted by financial intermediaries. Rather, strong effects may be limited to certain financial services such as payment and settlement services (see Box 3 regarding this point). Additionally, the wave of bank mergers in recent years is apparently being prompted by a wide variety of factors including: ① responding to the geographical expansion of markets from the removals of restrictions on interstate banking in the United States and the integration of the European Union; ② trying to maintain a presence in various markets under globalization; ③ efficient risk diversification via mergers; and ④ responding to the worsening profitability of existing banking services caused by the intensified competition from the entry into the financial intermediation market by firms in different industries.[43,44]

(Diversification of Financial Intermediaries)

The second point is that the IT Revolution may be reducing the barriers to market entry into the financial intermediation business. The IT revolution may be ① deteriorating the comparative advantages of banks in information production (see Box 4 regarding

[43] Some also note the incentive to pursue scale under "too-big-to-fail" policies and the private interests of bank managers as additional factors that may be contributing to the merger trend.

[44] The Forum members generally agreed that because the economy of scale from the IT Revolution differ for each banking service field, there is no need for traditional banks which provide all possible banking services, like Japanese banks, to expand their scale while providing the same services. Some members also expressed the opinion that the costs of post-merger internal adjustments may be higher at Japanese banks than at banks in the U.S. and Europe due to slow restructuring.

this point), ② facilitating the provision of new financial products and services and the unbundling of existing financial functions so that certain financial institutions may be able to specialize in the provision of particular services, and ③ promoting the construction of network infrastructure such as the Internet (and thus greatly diminishing the significance of bank branches in providing banking services). All of these factors are facilitating the advent of financial institutions specializing in particular services as well as new entry into the financial intermediation market by firms in different industries (diversification).[45] In the U.S. one information industry firm founded a subsidiary on the Internet which conducts credit screenings for loans using the credit scoring model on behalf of financial institutions. This case may be considered as a representative example of this trend. In Japan, firms in distribution industry and IT-related firms are also moving to enter the financial intermediation business via the Internet. Given these developments, the Japanese government is trying to improve the environment for non-financial firms to enter the financial intermediation business. For example, the Financial Services Agency and the Financial Reconstruction Commission issued "Measures for Licensing for and Supervision of New Types of Banks (Operational Guidelines)." on August 3rd, 2000.

(Future Outlook for Financial Intermediaries)

The future direction of this concentration (trends to mega-banks) and diversification (specialization in certain financial services; market entry of firms from other industries) of the financial intermediation business is not yet entirely clear. Nevertheless, many of the Forum members expressed the opinion that as the comparative advantages of banks in information production may decline under the IT Revolution, the future providers of financial intermediation services may not be limited to firms in the present financial industry, and that there is a high probability that firms in other industries will utilize the fruits of the IT Revolution to provide financial intermediation services. Additionally, considering that the strong economies of scale from the IT Revolution may be limited to certain financial services such as payment and settlement services, the Forum members suggested that while concentration may continue in such fields, diversification may

[45] Of course, when economies of scope can be realized by providing multiple financial services, the provision of multiple services by individual financial institutions results in cost savings merits. To date, however, no clear consensus has been obtained regarding such economies of scope in the provision of multiple financial services (such as combining lending with CP underwriting or off-balance sheet transactions), as some empirical research has confirmed such economies of scope and other empirical research has disproved them.

concurrently advance in other fields (specialization in certain services and outsourcing of others). In other words, the Forum members indicated that the two simultaneous trends toward concentration and diversification may well continue. Considering this likelihood, sufficient consideration must be given to the potential for major changes in the financial intermediation business (see Box 5 regarding this point).

Box 3: The IT Revolution and the Economies of Scale in the Banking Industry

The IT Revolution is apparently resulting in remarkable cost reductions by using computers to systematize operations that have traditionally been conducted by hand. For this reason, banks have been making huge IT-related investments in recent years, but does the actual data verify that this IT-related investment is generating cost-reduction merits for banks through greater economies of scale?

This Box introduces the latest empirical analyses regarding the economies of scale in banking operations overall, beginning with a discussion of the economies of scale in payment and settlement services, for which a great deal of research has already been accumulated, based on the paper presented in the 15th meeting of the Forum (Uchida, Otani and Kawamoto [2000]).

(Economies of Scale in Payment and Settlement Services)

The provision of payment and settlement services requires back-office works for data processing. Personnel expenses, data processing costs, and the telecommunications costs for data transmissions among various offices and sites comprise a large portion of the back-office works costs. Therefore, if data transmission costs among sites decrease and the increase in computer data processing capabilities results in remarkable economies of scale, then merits would be generated through the integration of multiple sites or of multiple banks' payment and settlement services.

The Federal Reserve Board (FRB) has conducted empirical analyses on the economies of scale for payment and settlement services, including check processing (interbank settlement of check transactions), automated clearinghouse (ACH) services (interbank value-dated electronic funds transfers) and Fedwire service (real-time gross settlement for federal funds transactions and for U.S. Treasury bond and government-related debt transactions).

Bauer and Ferrier (1996) found that among these three payment and settlement services, there is no scale economy merit for check processing, which is mostly

conducted through paper-based processing and is thus the most difficult to be influenced by the IT Revolution. In contrast, significant economies of scale may be achieved for ACH and Fedwire services, which are conducted electronically. For ACH services, Bauer and Ferrier (1996) found that the elasticity of the total costs to the number of transactions handled is 0.5 (that is that an increase of 1.0% in the number of transactions handled results in a cost increase of approximately 0.5%). Similarly, Hancock, Humphrey and Wilcox (1999) found that the elasticity of the total costs to the number of transactions handled for Fedwire service is also 0.5.

Accordingly, considering that there are high economies of scale for those payment processes (ACH and Fedwire services) that most easily benefit from the merits of the IT Revolution, there is a strong probability that the recent IT Revolution is generating growing economies of scale in payment and settlement processes overall.

(Economies of Scale in Banking Operations Overall)

While banks conduct certain operations, such as the screening and monitoring of large-lot loans and debt collection, for which it is difficult to realize benefits from the IT Revolution, banking operations also include fields (such as payment and settlement services) which can definitely benefit from the scale economy merits provided by the IT Revolution. Given this situation, how is the optimum scale changing for banking operations overall?

Under the initial research conducted from the late 1980s through the early 1990s (utilizing data from the 1980s), a consensus was achieved that the average variable cost function to total bank assets is a relatively gradual U-shaped curve, that the scale for minimizing average variable costs is a small to medium scale with total assets of $100 million to $10.0 billion, and that greater scales result in an increase in average variable costs (in diseconomies of scale).

Subsequently, utilizing data from 1990 through 1995, Berger and Mester (1997) estimated that banks' average variable costs are minimized when the scale of total assets is $10.0 to $25.0 billion. Their conclusion implies that the optimum scale of banks increased in the 1990s, reflecting the greater economies of scale.

Box 4: Changes to the Specialty of Banks

Banks are said to be special in that they efficiently produce information and provide

liquidity by simultaneously providing payment and financial intermediation services.

How is the specialty of banks changing under the IT Revolution? This Box introduces the paper regarding this issue presented in the 11th meeting of the Forum (Uchida, Otani and Kawamoto [2000]).

(What is the Specialty of Banks?)

① Information Production

More frequent monitoring must be conducted in cases where the problem of the asymmetry of information is serious and financial statements and other financial data are not so credible, such as in lending to small and medium enterprises. In this regard, banks can grasp corporate behavior more accurately than other funds providers by monitoring changes in cash flow because they provide enterprises with payment and settlement services. Accordingly, it has generally been accepted that banks enjoy comparative advantages in financial intermediation to borrowers with high agency costs such as small and medium enterprises.

② Liquidity Provision

The standard theory is that even if depositors' liquidity demand is uncertain, banks can afford to maintain just a portion of their deposits as payment reserves because the percentage of depositors actually requesting repayment becomes more stable as the total number of depositors increases. Accordingly, it is said that banks can provide liquidity (bank deposits) and also acquire fixed assets (lending).

(Changes to the Specialty of Banks From the IT Revolution)

① Deterioration of Banks' Comparative Advantages in Information Production

As a result of the IT Revolution, even firms other than banks can now conduct credit screening without payment account information by using the credit scoring model. Especially in the United States, which is a front runner in this field, Internet firms are being founded which utilize the credit scoring model to conduct credit screenings and make lending decisions on behalf of banks. Moreover, there may be ways other than corporate cash flow analyses that provide an accurate grasp of corporate behavior. (For example, Higano [1999] claims that information regarding goods distribution, such as raw materials and equipment purchasing data and product sales data, has an equivalent value to cash flow data. And he also states that firms which have access to such purchasing and distribution data can engage in information production.)

Thus, banks' comparative advantages in information production (for credit

screening and monitoring) may decline.

② **The Effect of the IT Revolution on the Provision of Liquidity**

Sufficiently persuasive conclusions have yet to be reached regarding the influence of the IT Revolution on the provision of liquidity by banks. On the one hand, under the increase in direct financing resulting from the IT Revolution (especially the increase in CP and other highly-liquid short-term financial assets), some assert that not only bank deposits but also MMFs are somehow meeting the economic demand for assets with good ratings and high liquidity, and institutions providing MMFs may come to play the central role in the provision of liquidity (Gorton and Pennacchi [1990]). In response, others argue that, for example, if the ratings of bank deposits are high because of deposit insurance systems, individuals and enterprises may prefer bank deposits for their liquid assets, and therefore it is difficult to predict that MMFs will come to play the central role in the provision of liquidity (Kashyap and Stein [1994]).

Regardless of the liquidity issue, at the very least, the IT Revolution does have the potential to diminish banks' comparative advantages in information production.

Box 5: Changes in the Management of Financial Intermediaries under the IT Revolution

What is the potential influence of the IT Revolution on the organizational forms of financial intermediaries? This box introduces the paper regarding this issue (Ikeo [2000]) presented in the 15th meeting of the Forum, which regards the increase in the volume of information (discussed in Chapter 2) as the provision of more detailed information on a more frequent basis and examines the possible effects on financial institutions.

(Influence from More Highly Detailed Information)

The trend toward more highly detailed information has enabled financial institutions to recognize distinctions among different customer segments that could not be distinguished in the past, and thus provide a more precise response to each customer segment. Conversely, if the customers themselves also become aware of these distinctions, they may no longer accept banks' conventional offerings of uniform products and services. If financial institutions take a differentiated response based on

customer segment characteristics, internal conflicts of interest may arise among the different departments responsible for individual customer segments, so it might be the case that all operations should be conducted under a single organization. However, this response entails the risk that the organization as a whole may lose the ability to make optimal decisions. Thus it would be most beneficial for the organizational structure, which responds to each customer segment, to be divided as much as possible by individual function, and to thus increase the independence of each organizational unit.

On the other hand, when organizations are divided into small, independent units, the economies of scale may be lost. Nevertheless, economies of scale are actually realized for back-office operations in particular and it is difficult to believe that strong economies of scale can be realized for customer-interface operations. Thus, greater efficiencies may be achieved by small organizational units for some operations, and by large organizational units for others. This may be the reason for the simultaneous trends toward both concentration and diversification in the organizational structure of financial institutions.

(Influence of More Frequent Information)

With the provision of information on a more frequent basis, because activities and decisions must be changed at distinctively shorter intervals, there is a pressing need to expedite decision making and to facilitate the reallocation of management resources (so that decisions can be implemented promptly).

A centralized decision-making system (with a hierarchical pyramid structure) may be expected to accurately transmit all the necessary information and to realize high performance in the mutual coordination among departments, provided that the information processing capabilities at the top of the structure are of a high level. However, large-scale organizations may not accurately transmit information because of the conflicts of interest among departments, and there are also physical limitations to the information processing capabilities at the top of the structure. Meanwhile, a decentralized decision-making system (with delegation of authority) may be superior in terms of information transmission and information processing at the individual unit level, but may have low performance in the mutual coordination among departments.

Thus, a “capsulized” organizational structure which combines the merits from the centralized and decentralized systems may be required to expedite decision making and to facilitate the reallocation of management resources. Under this system, the organizational structure is arranged so that the mutual dependencies among the

individual units (capsules) are not that high, and each unit (capsule) retains a high level of autonomy. While the decision-making authority concerning the roles and functions of the individual units is delegated to these units, the decision-making authority concerning the mutual coordination among the capsules is retained by a holding company or some other centralized organization. This structure may provide a means of responding to the provision of information on a more frequent basis.

(5) Financial Changes and Monetary Policy

This section examines the effect of the financial changes described above (changes in financial transactions, in financial markets, and in the financial intermediation business) on monetary policy from the perspective of its transmission mechanism.

(Influence of Changes in Financial Markets)

① Interest Rate Channels

The dramatic reductions in information processing and transmission costs and the improvement in risk-management capabilities from the development of derivatives and other new markets (that is, the simplification of the transfer of risk from economic agents that wish to avert risk to economic agents that are willing to take risk) are resulting in more active arbitrage trading among financial assets with various term structures on domestic financial markets. As a result, the transmission speed at which changes in policy interest rates affect short-term and long-term interest rates is believed to be increasing. Thus, the IT Revolution is apparently raising the effectiveness of interest rate channels.[46,47]

[46] For example, Fernald, Keane and Mosser (1994) examine the influence of securitization on the monetary policy transmission mechanism using mortgage-backed securities as an example. Arbitrage transactions are normally conducted between mortgage-backed securities and government bonds, which have approximately the same terms. When monetary tightening decreases the pace at which mortgages are repaid and increases the interest rates charged on mortgage-backed securities, long-term government bond interest rates also rise via arbitrage trading. Fernald, Keane and Mosser demonstrate that the growth in the trading of mortgage-backed securities and in arbitrage trading is increasing the response of long-term interest rates to short-term interest rates.

[47] The improvement in risk-management capabilities from the development of derivatives and other markets is not reducing the extent of exogenous shocks themselves. However, the more appropriate risk diversification within the economy may be lessening the influence of interest rate changes on the spending of economic agents (see BIS [1994]), so further analyses of this issue will be needed.

② Availability Channels

In addition to interest rate channels, the monetary policy transmission mechanism includes availability channels, which are the route whereby firms and other agents can borrow funds from banks. These channels depend on the idea that because the bonds traded on financial markets are not complete substitutes for bank loans, decreases in borrowings from banks cannot always be covered by fund raising from financial markets.[48]

If the development of securitization and the growth of financial market transactions under the IT Revolution increase fund raising methods other than bank loans (the substitutability of bank loans and bonds increases), the effectiveness of availability channels will probably decline.[49]

Another important point is the influence of derivatives on credit rationing.[50] The conventional understanding is that credit rationing appears on bank lending markets because of the existence of the asymmetry of information (the fact that lenders can not grasp borrowers' creditworthiness perfectly), and that the supply and demand are not balanced by interest rates.[51] Nevertheless, when firms raise funds from markets, the attachment of derivatives to the securities increases the amount of information available about these firms. Additionally, when lenders identify specific types of risk and use derivatives to hedge such risk, it becomes possible for them to reduce the risk

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[48] By assuming this incomplete substitutability, it becomes possible to explain that shifts in the supply-demand function of bank loans can influence real GDP and interest rates independent of change in money supply.

[49] Assume the substitutability between bonds such as CPs and bank loans is strengthening in recent years because of the IT Revolution. Then, the demand curve for bank loans should become more elastic to interest rates, that is the curve should become more flat, and the shift of the supply curve should result in larger changes in the loan volume. From this perspective, Becketti and Morris (1992) conduct empirical analyses to confirm whether a flattening of the loan demand curve in the United States actually occurred during the post-war era. They show that the amount of decrease in the volume of loans resulting from a permanent increase in the Federal Funds Rate of 1% (an upward shift of the loan supply curve) doubled from the mid-1970s to the early 1980s. And they claim that the curve flattened further from the early 1980s, when financial technological innovation rapidly advanced. These empirical findings are consistent with the conjecture that the substitutability between bank loans and bonds is strengthening and that the importance of availability channels is diminishing with financial technological innovation.

[50] When credit rationing exists on lending markets, the importance of availability channels definitely strengthens, but it is important to note that credit rationing is not a necessary condition for the existence of availability channels.

[51] For example, when the interest rates on risk-free assets rise due to monetary tightening, because of adverse selection (corporations about to borrow at higher interest rates pose higher credit risks), banks shift their assets from loans to lower-risk bonds and some firms are unable to borrow from banks. See Stiglitz and Weiss (1981) regarding this issue.

accompanying an increase in lending, and this should reduce the likelihood of credit rationing on bank lending markets (BIS [1994]). This sort of possible reduction in credit rationing caused by derivatives may also decrease the effectiveness of monetary policy availability channels.

(Influence of Changes in Financial Intermediaries)

As for the influence of changes in financial intermediaries on monetary policy, the first issue is how the concentration and diversification of financial intermediaries will change the monetary policy transmission mechanism. The second main issue is how the improvements in financial intermediaries' monitoring technologies resulting from the IT Revolution may influence the monetary policy transmission mechanism.

① Influence of the Concentration and Diversification of Financial Intermediaries

To begin with, let us consider the influence of the concentration and diversification of financial intermediaries, specifically the trend toward mega-banks and the entry into the financial intermediation market by firms in different industries. Will the increase in mega-banks make the market more oligopolistic and have an adverse effect on the setting of loan interest rates? Alternatively, will the increased market entry by firms in different industries heighten competitive pressures, and thus have the opposite effect?[52] According to the most orthodox microeconomics, when the market becomes more oligopolistic, interest rate competition pressures decrease and profit margins expand. This may lead to concerns of a slower response and a decreased extent in how lending rates reflect changes in policy interest rates.[53,54] Conversely, when competitive pressures intensify from new market entries, the response of lending rates to policy interest rates may actually strengthen.

Then which scenario is more likely to occur: further oligopolization or stronger competitive pressures? Reviewing the conditions in foreign countries where bank mergers have occurred, the research does not demonstrate that bank mergers have

[52] While the changes in financial intermediaries may also influence the demand side, this discussion assumes that the demand side remains constant.

[53] Additionally, if the market share of a specific bank increases in a given financial asset market, this could obstruct arbitrage trading and prevent the effective functioning of interest rate arbitrage.

[54] For example, export industries in an oligopolistic market may refrain from changing their export prices as denominated in local currencies, regardless of exchange rate changes, to preserve market share. Thus, in some cases the above argument may not apply even when a market changes from a monopoly to an oligopoly.

resulted in higher profit margins.[55] Some empirical research has also found a higher transmission effect of changes in short-term interest rates on lending rates amid the increase in bank mergers. Thus, to date a reduction in the effectiveness of interest rate channels from oligopolization has not been observed.[56] In Japan, IT related firms have only just expressed their intentions to enter the banking business. Considering that these plans will move on to the implementation stage and that an increasing number of firms in different industries will also enter the financial intermediation market, the competitive pressures are projected to increase. If this is the case, we should think that the effectiveness of interest rate channels would strengthen. Nevertheless, it is possible that during the process whereby the competitive pressures increase, the relationships between short-term interest rates and lending and deposit rates may become unstable, and the extent of the effect of monetary policy on final demand may change substantially. Therefore, it should be noted that the implementation of monetary policy may become more difficult.

② Influence of the Improvement of Monitoring Technologies

Corporate lending by financial institutions is dependent upon corporations' net assets. Simply stated, when corporations have large net assets, their collateral value is also high, making it easy for financial institutions to provide large loans (smaller credits are offered to corporations with lesser net assets).[57] Monetary policy influences bank lending indirectly through its effect on corporations' net assets, and these transmission effects are referred to as balance sheet channels (which are one type of availability channels). The extent of the effect via balance sheet channels is dependent upon financial institutions' monitoring capabilities. When the monitoring capabilities are low, because the financial institutions have a limited understanding of corporations' conditions, the scale of the corporations' collateral value may greatly influence the loan decision-making process. But when financial institutions can improve their

[55] See Braun et al. (1999) regarding this point.

[56] While no consensus has yet emerged as to why bank mergers have failed to result in higher profit margins, one Forum member expressed the opinion that this may be due to influences from the expansion of international markets and the intensification of competition from the relaxation of U.S. interstate banking regulations, the integration of the European Union, and globalization.

[57] Behind this mechanism lies the moral hazard issue from the asymmetry of information. Assuming limited liability, when a corporation's net assets are small, the owners' losses are relatively small even when projects fail. In this case, the incentive to invest in high-risk projects increases, and the moral hazard worsens. Consequently, financial institutions restrict their lending to such corporations. Regarding this point, see Bernanke and Gertler (1995).

monitoring ability using the fruits of the IT Revolution, this reduces corporations' agency costs as well as the influence of the amount of the collateral value on bank lending. Consequently, some Forum members expressed the opinion that the influence of monetary policy via balance sheet channels may decrease under the IT Revolution.

5. The IT Revolution and Globalization

Since the Internet lessens geographical and spatial restrictions, it has the potential to make national borders less important and to increase cross-border E-commerce transactions. Thus, the IT Revolution may further accelerate the tempo of trade growth. In terms of financial transactions, the IT Revolution may increase the substitutability of domestic and foreign financial assets and promote currency substitution (or dollarization). This chapter examines the globalization[58] from the development of the Internet in terms of both trade and financial transactions, as well as the influence of these developments on monetary policy.

(1) Expansion of Cross-border E-commerce

Reviewing the trends in cross-border E-commerce, for B-to-C transactions, it is difficult to grasp the overall conditions because of insufficient statistics. But, according to OECD (1998), approximately 6% of U.S. software exports are presently sold via the Internet, and approximately one-third of the export sales of firms that are most actively engaged in E-commerce are generated via the Internet (Figure 9). As some firms that conduct E-commerce do not make international transactions, the overall scale of cross-border B-to-C E-commerce is believed to be relatively small at present.

Turning to B-to-B E-commerce, although some firms are moving to procure parts from overseas via the Internet, the vast majority of parts procured via the Internet are those of domestic inter-corporate *keiretsu*/subcontractors. Additionally, most transactions in the electronic B-to-B markets are also among domestic firms. Thus, it appears that overall the majority of B-to-B E-commerce is composed of domestic transactions.

Possible reasons why cross-border E-commerce transactions are not yet very popular include the lemon problem and other concerns regarding the safety of E-commerce transactions, as well as the home bias toward domestic goods (the national borders effect[59]), which is similar to that in conventional trade.

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[58] While there is presently no definitive definition of "globalization," this report follows Okina, Shirakawa and Shiratsuka (1999) in defining globalization as the condition whereby the hurdles presented by national borders decrease and whereby individual national markets, such as those for goods and financial transactions, are unified into a single market. (On the other hand, a "borderless economy" refers to the condition whereby globalization has further advanced and the existence of national borders has become meaningless).

[59] MacCallum (1995) estimates the goods transactions within and between the United States and

The reasons for this home bias, which divides markets, apparently include: ① foreign exchange rate fluctuations; ② educational, cultural, political, social, and emotional linkages based on families, transportation and telecommunications networks, etc.; ③ tax systems and other economic systems such as the existence (or non-existence) of inter-corporate *keiretsu*/subcontractor transactions; ④ the greater uncertainty and the higher likelihood of agency problems in cross-border transactions than in domestic transactions; and ⑤ the higher search costs in foreign countries.

Among these factors, while the foreign exchange rate fluctuations and the established bonds based on locality and kinship will not change from the IT Revolution, the development of the Internet is greatly reducing the search costs for foreign products. Additionally, as noted in Chapter 3, the advent of Internet electronic markets may have an influence on domestic inter-corporate *keiretsu*/subcontractor transactions and other trading patterns.

Moreover, the Internet is dramatically reducing the transportation costs for digital goods (Figure 10), facilitating the low-cost delivery of digital goods at distant locations.

Consequently, while the development of the Internet cannot completely eliminate the home bias toward domestic goods (result in a completely borderless economy), it is likely to reduce the extent of the home bias.[60] Considering these points,

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Canada for cities in both countries, utilizing the gravity equation. His findings indicate that when the sizes (GDP) and distances are the same, the volume of domestic trade is 22 times bigger than that of cross-border trade. These findings demonstrate that national borders remain important even for the trade between the United States and Canada, two nations which share a similar culture, language and systems and which are said to have one of the smallest national borders effects on earth. Thus the findings imply that national borders are even more important for cross-border trade between other countries. Similarly, Engel and Rogers (1996) estimate tradable good prices in U.S. and Canadian cities based on the understanding that the Law of One Price does not hold due to the distance among cities (a proxy for the transport cost) and because of national borders (using a dummy variable whose value is 1 when both cities are in the same country, and 0 when the cities are in different countries). Specifically, they estimate the differential from the Law of One Price utilizing these factors. Their findings show that the differential from Purchasing Power Parity (PPP) in the United States and Canada is not only due to the distances among cities, but that the existence of national borders also has a large influence, equivalent to a distance of 2,500 to 23,000 miles.

[60] The United States and international organizations such as OECD are proposing various measures to increase cross-border E-commerce from the perspective of ensuring the security of E-commerce, and harmonizing tax and other economic and legal systems internationally. For example, in July 1997 the U.S. government issued a report entitled "Framework for Global Electronic Commerce" which presented proposals for the role of government in the development of E-commerce, and in 1997 the OECD issued a report entitled "Electronic Commerce Opportunities and Challenges for Government" which advocated government measures for the development of E-commerce. Such efforts are also likely to work toward

there is a high probability that the volume of cross-border E-commerce transactions will increase in the future.[61]

The following section examines whether the increase of cross-border E-commerce may result in an autonomous and endogenous increase in the degree of dependence upon foreign trade.

(2) Trade Growth from the Expansion of E-commerce

If existing foreign trade is simply conducted on the Internet, its impact on the macro-economy will not be all that great, but if E-commerce induces new cross-border transactions, this may significantly raise the tempo of trade growth and have a great influence on domestic economies. Accordingly, this section examines the macroeconomic effects from the expansion of E-commerce, particularly focusing on the question of whether E-commerce will induce new cross-border transactions.

(B-to-C Transactions)

The development of the Internet is not only reducing search costs, but also greatly decreasing the transportation costs for goods which can be digitized (software, music, etc.; see Figure 10). Consequently, the Internet is projected to increase the trade volume of such goods and to transform services that were formerly nontradable goods into tradable goods, and thus induce new trade.

Furthermore, since the development of the Internet is facilitating surveys of consumer needs by producers, it will advance product differentiation to better match consumer demand and increase intra-industry trade.

For products that cannot be digitized, the development of the Internet is reducing the search costs, consequently increasing product imports from foreign firms whose very existence the purchasers were formerly unaware of, and is thus expected to result in a demand shift from domestic products to foreign products. Nevertheless, as the development of the Internet will not affect the transportation costs of products that cannot be digitized, its major effects in inducing an expansion of cross-border B-to-C transactions are expected to primarily arise from growth in the trade in digital goods and services and from greater product differentiation.

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increasing the volume of cross-border E-commerce and mitigating the home bias.

[61] One Forum member expressed the opinion that the volume of B-to-B Internet transactions may not increase until an open and modular production process becomes more popular than a closed and integrated production process.

(B-to-B Transactions)

As for B-to-B transactions, the reduction in transportation costs from the development of the Internet is expected to induce an expansion in the trade of intermediate goods and services which can be digitized (IT services such as the data and application services required for production activities).[62]

Turning to the trading of existing intermediate goods, as noted above, businesses are highly likely to continue purchasing customized parts via domestic inter-corporate *keiretsu*/subcontractor transactions. There is, however, a possibility that businesses may move toward shifting their procurement of common-use parts with wide-ranging applications from domestic inter-corporate *keiretsu*/subcontractor parts manufacturers to foreign parts manufacturers, and this may increase the trade in intermediate goods.

(Will the Expansion of E-Commerce Increase the Overall Volume of Trade?)

As explained above, B-to-C E-commerce is expected to directly increase the volume of trade by increasing the trade of digital goods and services and through greater product differentiation. On the other hand, theoretically the increase in the trade of intermediate goods and services under B-to-B E-commerce could either increase or decrease the trade of finished goods because the increase in the imports of intermediate goods may increase the domestic production of finished goods and thus decrease the trade in finished goods.

However, empirical research indicates that the increase in the trade of intermediate goods is actually promoting an increase in the trade of finished goods and thus increasing the overall volume of trade.[63] Additionally, considering the trend toward a greater division of labor in the international supply of intermediate goods and services, the increase in the trade of intermediate goods and services from the expansion of cross-border B-to-B E-commerce is highly likely to result in an increase in the overall volume of world trade (an increase in the degree of dependence upon foreign trade in each nation).[64]

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[62] In the United States, Application Service Providers (ASPs), which are businesses that provide customers with IT services such as application services from remote locations, are becoming very active, and the scale of the ASP market is projected to reach $2.0 billion by 2003.

[63] For example, see Hummels, Rapoport and Yi (1998).

[64] According to economic geography theory, the location of production sites is determined by a trade-off between the transportation costs from production locations to final consumers and other producers, and the economies of scale or the positive externalities from the agglomeration of production factors and from information sharing. Thus, when the transportation costs are

Thus, the expansion of E-commerce is expected to accelerate the tempo of trade growth overall.

(3) Expansion of International Financial Transactions

(Advance of Asset Substitution)

In the real world, international portfolio diversification is not progressing to the level projected in economic theory, and a strong preference for domestic financial assets is observed. This phenomenon is referred to as the home bias (in portfolio investment).[65] The reasons for this home bias are said to include: ① the existence of nontradable goods (while domestic investors hold equities of both foreign and domestic tradable goods firms in order to diversify risk internationally, they don't need to hold equities of foreign nontradable goods firms, and thus they have an incentive to hold more domestic equities than foreign equities); ② the limited merits from international portfolio diversification[66]; and ③ the existence of factors obstructing investors' optimizing behavior (foreign-exchange risk, systemic and social factors, the asymmetry of information, etc.).

As the expansion of E-commerce is expected to turn services and other formerly nontradable goods into tradable goods, for risk diversification, foreign investors may then have an incentive to hold equities of domestic firms producing what were formerly nontradable goods. Consequently, the influence of factor ① above will decline. Moreover, if the reduction in data transmission costs and the emergence of intermediaries accompanying the development of the Internet make foreign financial transactions easier than in the past, the factors obstructing investors' cross-border

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high, production sites are concentrated nearby final consumers and intermediate goods providers. Therefore, when transportation costs are sharply reduced, actual production sites tend to be dispersed. Because the advent of the Internet is greatly reducing the shipping costs for data and other digital goods, firms' locational strategies are changing, and this is apparently permitting the development of corporate production and sales systems on a global scale. As for the effects of the increase in direct investment accompanying the dispersion of corporate production locations on trade, trade theory offers two mutually contradictory conclusions. The first is that the volume of trade increases (that is, factor mobility is a complement of trade). The second is that the volume of trade decreases (that is, factor mobility is a substitute of trade). The empirical research has not reached definitive conclusions on these issues, but recent research (such as Collins, O'Rourke and Williamson [1997] and Goldberg and Klein [1997]) confirms a complementary relationship. For a detailed consideration, see Otani, Kawamoto and Hisada (2001b).

[65] The following discussion is based on Shiratsuka and Nakamura (1998).

[66] Some studies show that the potential merits from international portfolio diversification are on

optimizing behavior may weaken. As a result, the development of the Internet has the potential to mitigate home bias.

(Convergence of Long-term Real Interest Rates)

Along with the increased capital flows and financial services transactions in recent years, international interest-rate arbitrage trading is becoming more active. But real interest rates are not completely converging internationally, even long-term interest rates which are most likely to be arbitraged, because of expectations of foreign-exchange rate fluctuations, risk premiums, the asymmetry of information (the relative ease of obtaining information related to domestic securities as opposed to foreign securities, etc.), and certain factors obstructing investors from optimizing their investments, such as taxation systems. Among these factors, the problem of the asymmetry of information in particular may be diminished by the reduction in data transmission costs and the emergence of information intermediaries (such as those providing financial services). Consequently, we must consider the possibility of a still closer convergence of long-term real interest rates.

(Potential for Currency Substitution)

The conventional understanding is that currency substitution normally progresses when there is a great decline in the credibility of a national currency, such as during periods of hyperinflation. Nevertheless, the growth of trade from the expansion of E-commerce may also directly advance currency substitution.

Following the revisions made to Japan's Foreign Exchange Act in April 1998, settlements using on-hand U.S. dollars are beginning to increase among trading companies, manufacturers, and other firms engaged in foreign trade. If most foreign trade continues to be settled in U.S. dollars in the future, with the growth of trade resulting from the expansion of cross-border E-commerce, the amount of firms' on-hand dollar funds and of the dollar funds required for settlement may both increase. If the weight of such dollar settlements surpasses a certain level, the use of the dollar for the settlement of B-to-B transactions (dollarization) may then accelerate.

For B-to-C commerce as well, since the Internet has facilitated instantaneous and low-cost deposits in overseas banks, the dollar holdings of consumers may rise and the use of the dollar for payments may increase as well. However, considering that the scale of B-to-B transactions is much larger than that of B-to-C transactions, a more

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the order of merely 0.5% of permanent income. For example, see Lewis (1996).

likely scenario is that dollarization will advance mainly for B-to-B transactions.[67]

(Competition among Financial Markets)

The competition among financial markets is nothing new. There have been many examples where financial transactions that were formerly conducted on domestic financial markets were relocated to foreign markets with fewer regulations and lower tax rates, such as the development of Euro markets under regulation Q[68] in the United States in the 1970s and the increase of bond issues by domestic firms on foreign markets.

The development of the Internet is dramatically reducing data transmission costs and greatly curtailing the expenses incurred in conducting financial transactions. Thus, the possibility that financial transactions in domestic markets may be relocated to foreign markets from slight differences in regulations and tax systems is rising to an unprecedented level.[69] To avert this, efforts toward the international harmonization of regulations and tax systems are becoming even more important than in the past.

(4) Globalization and Monetary Policy

This section examines the developments described above, specifically the increase in the degree of dependence upon foreign trade, asset substitution, convergence of real interest rates and currency substitution, from the perspective of the monetary policy transmission mechanism.

(Influence of the Increase in the Degree of Dependence upon Foreign Trade)

Because the degree of dependence upon foreign trade is increasing from globalization and the influence of the balance of trade (foreign demand) on the business cycle is growing, foreign exchange rates are believed to be becoming more important in the monetary policy transmission mechanism.[70] Assuming uncovered interest-rate parity, the expectations of foreign exchange rate changes are equal to the sum of the differential between domestic and foreign interest rates and the risk premium, so this

[67] See Appendix 1 for a discussion of how an equilibrium may be established under the co-existence of two different currencies in one country.
[68] Regulation Q set upper limits on savings and time deposit interest rates.
[69] Recently, in conjunction with the growing demand for pan-European stock trading from the introduction of the common currency the euro, the competition among European securities markets has been intensifying, resulting in a wave of mergers and alliances.
[70] Mishkin (1995) also emphasizes this point.

implies that interest rate channels will become even more important.

(Influence of Asset Substitution and the Convergence of Long-term Real Interest Rates)

If, as discussed above, the IT Revolution is mitigating the home bias and increasing the substitutability of domestic and foreign financial assets, the differential between domestic and foreign real interest rates may come to have a great influence on real exchange rates via more active capital transfers (in other words, the importance of interest rate channels will increase). On the other hand, the substitutability of domestic and foreign financial assets may advance further, resulting in greater pressure for the worldwide convergence of long-term real interest rates when expected changes of exchange rates are unchanged. Thus, it is important to note that under these conditions it may become more difficult for policy interest rates and short-term interest rates to influence long-term interest rates.

(Influence of Currency Substitution)

Turning to the influence of currency substitution[71], to begin with, under a partial advance of dollarization, central banks will not lose the controllability of short-term interest rates denominated in domestic currencies. However, in this situation, since a portion of domestic transactions will be conducted in dollars, the influence of domestic monetary policy will decline proportionately. Additionally, the advance of dollarization will likely make the compilation of monetary aggregates statistics even more difficult. Even if monetary aggregate statistics can be accurately compiled, the relationship of monetary aggregates with the real economy or prices may become unstable. In the case of a complete dollarization, domestic monetary policy would be both unnecessary and ineffective.[72]

[71] It is also noteworthy that the advance of dollarization will also decrease the central bank's seigniorage revenue. But the discussion here is limited to the effectiveness of monetary policy.
[72] This point is made clear by the fact that the monetary policy decision-making authority was transferred from each nation's central bank to the European Central Bank by the introduction of the common currency, the euro.

6. The IT Revolution and Monetary Policy

Central banks conduct their monetary policy under an uncertain environment where various changes such as exogenous shocks (e.g. oil shock), economic structural changes and systemic changes occur continuously, and in which it is difficult to grasp the influence of these events accurately in real time. As described in the previous chapters, the ongoing IT Revolution is expected to change financial and economic frameworks (structures), and this may well advance at a pace exceeding all expectations. Consequently, the IT Revolution will bring new uncertainties to the world within which central banks implement monetary policy.

Various research is being conducted regarding the best approach to monetary policy implementation under such uncertainty.[73] One influential argument is that a conservative and gradual implementation of monetary policy is desirable. For example, suppose that although the effect of monetary policy on the real economy is actually strengthening, the central bank judges that it is weakening or unchanged, and implements a major policy change. This change could cause major damage to the economy. On the other hand, some warn that a conservative and gradual implementation of monetary policy could easily result in policy changes that are "too little and too late." They believe that when there is a high level of uncertainty, monetary policy should be changed as flexibly as possible, and then promptly changed back if the desired results are not achieved. Thus, at the present time, no firm consensus has yet been reached regarding the appropriate approach to monetary policy implementation under uncertainty.[74]

Accordingly, this chapter examines the difficulties posed by the IT Revolution for the implementation of monetary policy, notes the increasing difficulty central banks will face in grasping economic conditions, and considers appropriate countermeasures. This chapter also reviews and summarizes the influence of the IT Revolution on the effects of monetary policy and the monetary policy transmission mechanism, as examined in the previous chapters.

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[73] See Appendix 2 for a detailed explanation of this point.

[74] The Forum also discussed whether the implementation of monetary policy under uncertainty should be based on rules or on discretion. Some Forum members expressed the opinion that a rule-based monetary policy framework is necessary to set a nominal anchor precisely because of the uncertainty. Nevertheless, no consensus was reached regarding whether the framework should be based on rules or on discretionary policy, or whether a discretionary policy is actually inevitable under such circumstances.

(1) Influence on the Ability of Central Banks to Grasp Financial and Economic Conditions

Because the IT Revolution is increasing the volume of information as explained in Chapter 2, it is also increasing the volume of information that central banks can utilize in conducting monetary policy.

Nevertheless, the IT Revolution inevitably makes it increasingly difficult for central banks to accurately grasp the real economic and price conditions that are the basis for policy decisions. This section considers these issues in some detail, and notes the necessity of decreasing this uncertainty.

(Accurately Grasping Potential Growth Rates)

The IT Revolution is expected to raise Total Factor Productivity (TFP) via labor savings, more efficient inventory control[75], and the synergy effect[76] in industries that use the goods produced by new technologies as inputs. However, actual estimations failed to show a rise in TFP in the U.S. economy for a long time (the so-called "productivity paradox"). While various hypotheses have been proposed to explain this paradox (see Box 6), recently some empirical analyses have appeared confirming that the IT Revolution has in fact raised TFP, and opinions for a rise in TFP are becoming dominant. For example, the annual report of the U.S. Council of Economic Advisors (CEA) released in February 2000 very positively evaluates the rise in TFP from the IT Revolution. It shows that the annual increase in labor productivity since 1995 is 1.47% higher than the long-term trend[77] (Figure 11). Moreover it clearly demonstrates that, during the current economic expansion, the growth rate of productivity has actually been accelerating as the expansion continues even though the normal pattern is to level off during the latter half of economic expansion phases (Figure 12).

Although IT-related investment in the U.S. increased from the early 1990s, the rise in TFP has only recently been confirmed. It is extremely important for central banks to accurately grasp macroeconomic productivity and potential growth rates in real time for the implementation of monetary policy, but as demonstrated by the U.S. experience, this is also extremely difficult. In fact, one study claims that the failures of

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[75] For example, firms can now easily trade their excess inventories via Internet electronic marketplaces (such as MetalSite), and this should reduce the appropriate inventory-sales ratios.

[76] This synergy effect is dependent upon the extent to which the market mechanism functions in each market, such as the level of labor market mobility.

[77] This can be broken down into 0.47% from the increase in capital stock under active IT investment, 0.23% from the rise of TFP in the computer sector, and 0.77% from TFP increases in other sectors.

U.S. monetary policy in the 1970s resulted from excessive monetary easing, which was implemented without recognizing the decrease in the potential growth rate from the oil shock and other factors at that time.[78]

(Accurately Grasping Price Conditions)

The IT Revolution is also making it more difficult for central banks to accurately grasp price conditions, which are an important basis for making policy decisions.

To begin with, when prices decline under the advance of the IT Revolution, it is necessary to distinguish between the effect of a demand shock and that of a supply shock from the IT Revolution. In addition, to quantitatively measure price declines from a supply shock, it is necessary to grasp the extent of the downward shift of the aggregate supply curve from the IT Revolution. In actual practice, this estimation is likely to be exceedingly difficult as it requires an accurate grasp of the productivity increases from the IT Revolution and other factors such as the changes in the level of monopoly concentration in each market. Moreover, there are concerns that the price indices may have an upward bias if the new products developed under the IT Revolution and E-commerce transactions cannot be promptly incorporated. What is more, if the trend toward multiple prices for the same goods advances and the price movements of items presently used as representative items for individual product categories come to differ from the price movements of the other items in these categories, this would pose a major problem for the usefulness of price indices as indicators.

While it is always difficult to accurately grasp price conditions, the IT Revolution is highly likely to make this task even more difficult.

(Necessity of Responding to Uncertainty)

As noted above, it may become increasingly difficult to accurately grasp potential growth rates and price conditions under the development of IT Revolution. Considering that an accurate understanding of monetary and economic conditions is a major premise for the implementation of monetary policy, central banks must exert every possible effort to grasp the changes accompanying the IT Revolution promptly and accurately, and to minimize the uncertainty faced in making policy decisions as with other exogenous shocks. In other words, to make more accurate judgments regarding macroeconomic conditions under the advance of the IT Revolution, central banks will need to raise the level of their analyses on monetary and economic

[78] See Orphanides (1999) regarding this point.

conditions and to improve their research abilities. Additionally, from the perspective of accurately grasping monetary and economic conditions, central banks will also need to improve the quality of their economic statistics. For example, there is a high probability that the reliability of certain monetary aggregate indices will decline with the development of financial and payment technologies. Therefore it will become necessary to review the definition and the financial assets covered by existing monetary aggregate statistics with appropriate timing (see Box 7 for the history of the redefinition of the monetary aggregates in the U.S. based on the advent of new financial products, and the stance that should be taken toward the compilation of monetary aggregate statistics in the future). The various approaches toward compiling new statistics of E-commerce, which has recently been notably expanding, and toward maintaining and improving the reliability of price statistics (mitigating the upward bias, etc.) may also be important issues.

Box 6: Several Hypotheses Explaining the Productivity Paradox

The debate regarding the productivity paradox may be broadly classified into three main approaches: the historical lag hypothesis, the measurement error hypothesis, and dynamic TFP estimation. This Box introduces the paper regarding this issue presented in the 17th meeting of the Forum (Otani, Kawamoto and Hisada [2001a]).

① Historical Lag Hypothesis

According to David (1990), while the electric power motor was invented around 1880, it was not until 1913-1929 that this invention contributed to boosting the productivity of the U.S. manufacturing industry. This implies that there was a 30-40 year time lag between the invention and the increase in TFP. Applying this time lag to the development of the computer, the 1980s and 1990s represent a gestation period and the rises in TFP should become manifest from now on.

Similarly, Kitamura (1997) reviews Japanese economic history and notes that the electric power, telephone, broadcasting and railroad technologies that gradually spread from the end of the 19th century only resulted in full-scale productivity increases with the revolution in application technologies after the Second World War. Kitamura generally takes an affirmative stance toward the lag hypothesis.

② Measurement Error Hypothesis

Nordhaus [1997] argues that although the advent of new high-performance goods reduces the cost to enjoy the same service or utility as in the past, price indices in general do not fully reflect the effects of these goods. He states that the U.S. Consumer Price Index (CPI) has an average annual upward bias of 1.2% because it fails to fully reflect quality improvements. And he also says that such quality adjustments would raise the 10 % increase of U.S. real wages from 1959 to 1995 (on a cumulative base) to a 70% increase, and would also boost the U.S. TFP increase rate during this same period from 0.6% to 1.8%. Thus, Nordhaus argues that TFP increases may be underestimated because price indices do not properly reflect quality improvements.

③ Dynamic TFP Estimation

According to Kuroda and Nomura (1997), traditionally the majority of capital stock has comprised buildings and civil engineering related capital goods, but in recent years the constituent percentage of such goods has been declining while that of electrical and general machinery has been rising. The IT Revolution represents a technological advance in capital goods, especially in electronic equipment, and this should be making the capital goods in each industrial sector more efficient through changes in quality and composition. On the other hand, capital stock as a factor of production is the accumulation of past investments, and reflects the technological levels when these investments were made. Thus, in order to measure current productivity, it becomes necessary to retroactively evaluate the efficiency of the old capital stock. Additionally, the IT Revolution is changing the mutual dependence relationships among industries, and this factor must also be taken into consideration in measuring productivity. Based on this understanding, the concept of "dynamic TFP" is a means of measuring a nation's production efficiency from a dynamic perspective. Applying this concept, Kuroda and Nomura (1997) calculate that Japan's annual productivity increase rate averaged 3.32% from 1985 through 1990, and this greatly surpasses the figure calculated under the normal approach (1.65%). They conclude that the productivity paradox is no longer observed when dynamic TFP estimation is adopted.

Box 7: Changes of the Definition of Monetary Aggregates from the Advent of New Financial Products

How is the advent of new financial products influencing monetary aggregate statistics, and what should central banks do to maintain the usefulness of monetary aggregate statistics? This Box introduces the paper regarding these issues presented in the 9th meeting of the Forum (Ishida and Kawamoto [2000]), which reviews the influence of the advent of new financial products on existing monetary aggregate statistics in the U.S. as well as the implications for the compilation of monetary aggregate statistics.

① NOW Accounts

In the U.S., savings banks (savings and loan associations, mutual savings banks and credit unions) were legally prohibited from issuing demand deposits that can be withdrawn by check (checking accounts), but they successfully circumvented this legislation through the development of Negotiable Order of Withdrawal (NOW) accounts. NOW accounts provide similar functions to checks, but are not considered to be checks under the law. As a result, there was a huge shift of funds from demand deposits, which legally cannot bear interest, to NOW accounts. In response to this development, NOW accounts were added to M1 from November 1978, and to M1B (current M1) from February 1980.

② ATS Accounts

Commercial banks were prohibited from issuing interest-bearing demand deposits by law, but they developed Automatic Transfer from Savings (ATS) accounts to counter the shift of funds to NOW accounts. Under ATS, whenever funds are required for payment, the required amount is automatically transferred from interest-bearing savings accounts to demand deposits. This development rendered the distinction between ATS accounts and demand deposits meaningless in terms of monetary aggregate statistics, so ATS accounts were added to M1 from February 1980.

③ MMMFs

Money Market Mutual Funds (MMMFs), which are investment trusts that primarily invest in short-term public and corporate bonds, first appeared in 1971. From the late 1970s, under Regulation Q, with the high-interest policies implemented by Federal Reserve Board Chairman Paul Volcker and the improved settlement functions for these instruments, the outstanding balance of funds in MMMFs rapidly increased as funds

were transferred from savings accounts and small time deposits. In response, MMMFs for individual investors were added to M2 from February 1980.

④ MMDAs

Banks developed Money Market Deposit Accounts (MMDAs), which are investment trusts managed directly by banks, to respond to the shift of funds from their deposits to MMMFs. MMDAs are covered by the Federal Deposit Insurance and permit both withdrawals at bank branch counters and the use of checks, so a large volume of funds were transferred from MMMFs and other instruments to MMDAs. Consequently, the MMDA category was added to M2 from January 1983.

⑤ The Rapid Increase in Bond and Stock Mutual Funds and "Missing M2"

From the early 1990s, with the improved settlement functions for mutual funds (the funds transfer services linking mutual funds with demand deposit accounts at affiliated banks), there was a shift of funds from time deposits, which are a component of M2, to bond and stock mutual funds. As a result, the rate of increase in M2 remained at a low level, despite repeated monetary easing.

In response to this situation, many FRB economists began to compile broadly defined monetary aggregate statistics, and numerous empirical analyses were conducted to examine the stability of the relationship between these monetary aggregates and real economic indices. But they did not show clear empirical results which would lead to specific statistical revisions.

These five examples demonstrate how the FRB has sequentially expanded the coverage of monetary aggregate statistics whenever new financial products with high settlement functions are developed, to seek monetary aggregates definitions that provide the greatest empirical usefulness for the relationship with the target variables, such as nominal GDP and prices.

Accordingly, if the future advance of the IT Revolution results in the development of new financial products, it may well be necessary to pursue the type of trial-and-error approach adopted by the FRB for the compilation of monetary aggregate statistics.

(2) Influence on Monetary Policy and the Monetary Policy Transmission Mechanism

Next, this section reviews the influence of the IT Revolution on the effects of monetary policy and the monetary policy transmission mechanism.

(Control of Short-term Interest Rates by Central Banks)

There is a strong likelihood that the development of electronic payment technologies including "electronic money" and the advent of new financial products from the IT Revolution will structurally and unstably decrease the demand for the monetary base, similar to the effects from the spread of MMFs and credit cards in the past. To lessen real GDP fluctuations when the demand for money becomes unstable, it is considered desirable for central banks to adopt interest rate stabilization policies (Poole [1970]). In actuality, as almost all nations including Japan presently adopt short-term interest rates as their operational targets, the reduced demand for money is not expected to exert a significant influence on the present frameworks for money market operations.

Also, even if the demand for the monetary base does decrease, since central banks are monopolistic suppliers of the monetary base, in principle there is no reason why central banks will lose the controllability of short-term interest rates.[79]

Of course, if the further development of electronic payment and settlement technologies results in a long-term decline in the demand for the monetary base, the influence of the short-term interest rates controlled by central banks on financial markets and the overall economy may well decline. Nevertheless, at present the daily settlement volume is more than 100 trillion yen with a monetary base of several trillion yen, and even if settlement efficiencies improve further from the IT Revolution and the monetary base decreases to several hundred billion yen, it is difficult to believe that the influence of short-term interest rates will weaken. On the contrary, considering that a decline in the demand for the monetary base implies the further development of financial markets, the effects of the transmission mechanism via short-term interest rates may actually increase.[80]

(Influence on Monetary Policy and the Monetary Policy Transmission Mechanism)

Chapter 3 and the subsequent chapters examine how the monetary policy transmission

[79] Are central banks still able to control short-term interest rates when financial and payment technologies advance further and the outstanding balance of the monetary base falls to zero? See Appendix 3 for a conceptual experiment concerning this point.

[80] See Chapter 4 regarding this point.

mechanism may change from the changes in financial transactions and financial intermediaries, and from globalization. Here, we present a brief summary of these considerations (Figure 13).

① The reductions in information processing and transmission costs and the improvement in risk-management capabilities are resulting in more active arbitrage trading, and thus the transmission speed of interest rate changes in the financial markets is believed to be increased. On the other hand, the effectiveness of availability channels may decline from the greater variety of fund raising methods other than bank loans due to the growth of financial markets, and from the decrease in credit rationing resulting from the development of derivatives.

② The entry into the financial intermediation industry by firms in different industries may increase the effectiveness of interest rate channels as the increased competitive pressures reinforce the response of lending rates to policy interest rates. On the other hand, some believe that the influence of monetary policy via balance sheet channels (the effect on bank lending through changes in firms' collateral value) may decrease under the IT Revolution if financial institutions' monitoring capabilities improve.

③ The rising degree of dependence on foreign trade due to globalization is expected to increase the effect of monetary policy via foreign exchange rate channels. This also implies that the effectiveness of interest rate channels may increase via the influence on foreign exchange rates. If the substitutability of domestic and foreign assets strengthens from the IT Revolution, the influence of interest rates on foreign exchange rates may increase. But it is important to note that it may become more difficult for policy interest rates and short-term interest rates to influence long-term interest rates with the greater pressure for the worldwide convergence of long-term real interest rates when the expected change of exchange rates is assumed to be unchanged.

Judging from the results of the considerations summarized above, the conclusions regarding the influence of the IT Revolution on the monetary policy transmission mechanism are as follows: ① the effects of monetary policy via interest rates and foreign exchange rates will likely become stronger, while ② the effects of monetary policy via funds availability (or balance sheets) will likely diminish.

In addition, the IT Revolution will not only change the relative importance among the channels through which monetary policy exerts its influence on the economy, but there is also some possibility that the IT Revolution may reduce the necessity and

the effectiveness of monetary policy. Specifically, as noted in Chapter 3, the reduction in menu costs from E-commerce implies the possible emergence of economic conditions wherein monetary policy itself will become unnecessary. Moreover, the development of electronic money as a generally accepted settlement currency and the advance of dollarization (as discussed in Chapter 5) will reduce the necessity and effectiveness of domestic monetary policy. Nevertheless, taking the asymmetry of information into account, it is not realistic to believe that all transactions will be conducted over the Internet or that pricing will become completely flexible. Additionally, a complete dollarization remains highly unlikely provided that the credibility of domestic currencies is not completely lost from hyperinflation. Thus, for the foreseeable future, monetary policy will remain both necessary and effective, even though the necessity and effectiveness of monetary policy may decline somewhat.

7. Conclusions

The Forum held comprehensive and active discussions regarding how the IT Revolution may change financial and economic activities and frameworks (structures), how the implementation of monetary policy may be influenced by these changes, and how central banks should respond. As noted at the beginning of this report, because the IT Revolution is still underway, it is impossible to completely predict exactly how its influence will come out or the extent of its impact at the present time. It is important to recognize the risk of overestimating the impact of the IT Revolution as well as that of failing to predict its ramifications. Nevertheless, in order to prepare for the future, we must grasp the potential of the IT Revolution and its likely effects from the broadest possible perspective as a type of conceptual experiment.

The Forum's conclusions may be summarized as follows.

① The IT Revolution may lead to major changes in financial and economic activities and frameworks (structures), which are the object of monetary policy, including changes in financial transactions and the financial industry, changes in the framework of goods and services transactions, and further globalization. Moreover, the changes brought about by the IT Revolution may well advance at a pace exceeding all expectations.

② Considering that an accurate understanding of monetary and economic conditions is a major premise for the appropriate implementation of monetary policy, central banks must exert every possible effort to grasp the changes accompanying the IT Revolution promptly and accurately, and to minimize the uncertainty faced in making policy judgments as with other exogenous shocks. From this perspective, central banks will need to raise the level of their analytical capabilities and to further improve the quality of their economic statistics.

③ As for the influence of the IT Revolution on the effects of monetary policy and its transmission mechanism, the IT Revolution may change the relative importance among the routes whereby monetary policy affects the economy, for example it may make interest rate channels more effective. Nevertheless, for the foreseeable future, monetary policy will remain both necessary and effective.

As explained at the beginning of Chapter 6, it is important to note here that the various problems posed by uncertainty are not unique to the IT Revolution. Nevertheless, as the IT Revolution may have a major influence on every aspect of financial and economic activities, including their fundamental frameworks, the resulting uncertainty

will likely be wide-ranging and multifaceted.

The Forum endeavored to grasp the effects of the IT Revolution on a comprehensive basis, but it was not possible to cover every possible aspect.

For example, the IT revolution has made it possible to acquire a great volume of information in real time, for this information to be promptly reflected in market prices, and for central banks to also disseminate information in real time. Thus, finding the best practices for central banks to communicate with other market participants when information is exchanged on a real-time basis may be considered as one important issue that requires further examination.

It might also prove valuable to conduct more in-depth examinations regarding the effects of the increased speed and globalization of financial transactions on the stability of financial markets. This report has focused on increased financial transactions from the perspective of their impact on the financial industry. But it would also be desirable to conduct further studies on how speedy financial transactions[81] may influence the volatility of interest rates, foreign exchange rates and stock prices, and on how the herding behavior of investors and the exogenous shocks from foreign countries may influence domestic markets.[82]

Another important issue is the potential influences of the IT Revolution on financial system stability, and the appropriate prudential policies to respond to such influences. As introduced in this report, while the IT Revolution is prompting the further development of financial markets, it is also resulting in the simultaneous advance of greater diversification and concentration in the financial intermediation industry, with diversification from the market entry by firms in different industries and concentration through bank mergers (the creation of mega-banks). These changes in markets and the financial intermediation industry will also have a great influence on the stability of the financial system and on the policies to achieve this stability (such as

[81] While the IT Revolution facilities financial transactions in increments of a few hours or minutes, the spread of E-commerce may also be increasing the demand for such speedy transactions. The shortening of transaction periods may increase the number of financial transaction errors. Thus, in an effort to achieve the ideal combination of the benefits and risks of speedy financial transactions, it may become necessary to reconsider the optimal basis period for the calculation of interest, which has traditionally been conducted on a daily basis. The preparation of markets in which such short-term financial transactions are conducted may also be important for the conduct of open market operations.

[82] Regarding this point, one Forum member noted that as the influence of foreign exchange rates on domestic economies will strengthen from the increase of trade, it may become easier for foreign shocks, such as policy mistakes in foreign countries which can cause financial crises, to exert a harmful influence on domestic economies. The member stated that therefore policies to avert such circumstances may come to represent an important issue.

safety nets, supervision of financial institutions, and regulations).

While these areas lie outside of the scope of this report, they are considered to be important issues that require further examination in the future.

(Appendix 1) Regarding the Domestic Co-existence of Multiple Currencies

While dollarization may progress along with globalization, is it really possible for multiple currencies to be circulated within a single nation as settlement currencies? The paper regarding this issue presented in the 14th meeting of the Forum (Matsui and Shimizu [2000]) utilizes a model with a microeconomic foundation and demonstrates that there is an equilibrium where multiple currencies are simultaneously circulated as settlement currencies. This Appendix introduces a summary of this paper.

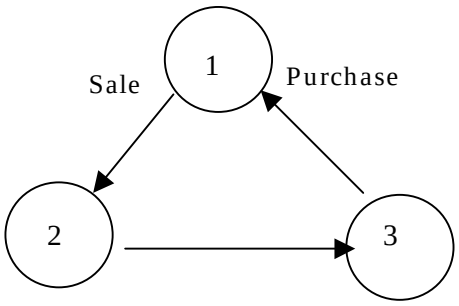
The paper first constructs a model with a microeconomic foundation for the case of a single currency, and then expands this model to multiple currencies.

(Case of a Single Currency)

① Basic Framework of the Model

The basic framework of the model is as follows. Assume that there are *K* types of goods, and that these goods are perishable and indivisible. In contrast, unlike the goods, the currency (fiat money) is non-perishable and divisible (the total nominal stock of fiat money is expressed as *M*). This economy is populated by a continuum of infinitely lived agents with unit mass, and there are *K* types of agents. While an agent of type *k* produces a good *k+1*, which an agent of type *k+1* wants to consume, an agent of type *k-1* produces a good *k*, which an agent of type *k* wants to consume. When an agent of type *k* consumes one unit of good *k*, he obtains utility *u*. (These transactions cannot be achieved through barter and are always conducted with fiat money. In addition an agent cannot simultaneously buy and sell goods.)

(Purchase and Sale Relationships in the Case of Three Types of Agents)

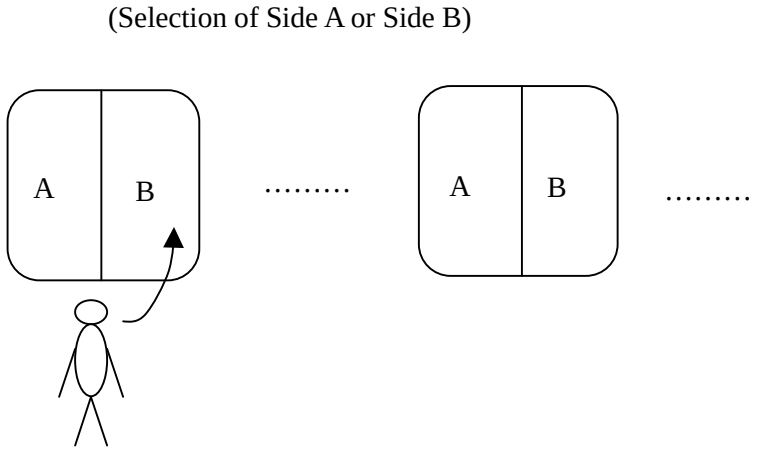


The purchases and sales by each agent must be conducted in marketplaces. There are

countably many marketplaces, and each marketplace has two sides, Side A and Side B (transactions can only take place between agents located on opposite sides).

② Transaction Steps

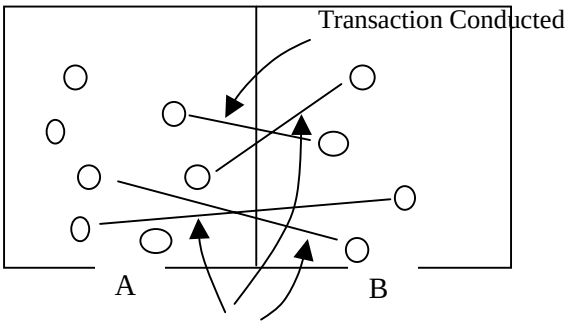
The transactions among agents are implemented through the following steps. First, the agents decide which marketplace to visit, and then decide which side of it (Side A or Side B) to enter (Stage 1).



Then, when the agents visit each marketplace, random matchings are made between agents on Side A and agents on Side B (Stage 2). When these random matchings pair an agent of type *k* with an agent of type *k+1*[83], because the agent of type *k* produces a good *k+1*, which the agent of type *k+1* wants to consume, the agent of type *k* acts as a seller and the agent of type *k+1* acts as a buyer. If the number of buyers exceeds the number of sellers, the number of buyers that exceeds the number of sellers are unable to conduct transactions. Thus, it is assumed that rationing occurs when there is an imbalance in the number of agents on both sides (Stage 3). When the buyers and sellers meet, if the seller's offer price P_s is below the buyer's bid price P_b then the transaction is consummated at price P_s (Stage 4).

[83] Of course, transactions are not conducted when the matching pairs an agent of type *k* with an agent of types other than *k+1*.

(Matching Process)



Transaction not Conducted

③ Definition of Equilibrium

Each type of agent acts after determining his strategy for selecting marketplaces, and for setting the offer prices for the goods the agent produces when the agent acts as a seller and the bid prices when the agent acts as a buyer, under the constraint of the fiat money stock the agent holds. Here, the condition whereby the strategies of each type of agent, under the fiat money stock the agent holds, remain unchanged is referred to as a stationary equilibrium. Any strategies other than those selected by each agent under this stationary equilibrium will not generate greater utility than that derived under the stationary equilibrium.

④ Existence of Equilibria

While countless stationary equilibria are possible under this model, here we consider a stationary equilibrium in which every good is traded at price *p*.

The total real stock of fiat money, *M*/*p*, is expressed as *m*. Let us consider the case where the number of agents holding *p* units of fiat money is exactly *m* and the percentage of agents holding zero fiat money is *1-m*. For example, assume that the type *k* agents that hold *p* units of fiat money adopt a strategy to stand on Side B of marketplace *k*, to act as buyers, and to present a bid price of *p*. Meanwhile, assume that the type *k* agents that hold no fiat money adopt a strategy to stand on Side A of marketplace *k+1*, to act as sellers, and to present an offer price of *p*[84]. In this case, if m

[84] Here we assume symmetrical strategies whereby type *k* agents that hold *p* units of fiat money adopt a strategy to stand on Side B of marketplace *k*, to act as buyers, and to present a bid price of *p* , and type *k* agents that hold no fiat money adopt a strategy to stand on Side A of

is 1 or less (if $p \geq M$), although rationing may take place based on the size of m[85], there is no merit to be gained by any of the agents from changing their strategies. Consequently, this case is a stationary equilibrium, and thus a stationary equilibrium exists under this model setting.

(Case of Multiple Currencies)

The above single currency model is now expanded to cover multiple currencies. Assume that there are two types of currencies, Currency *0* and Currency *0**, and that the marketplaces where transactions may be conducted using each type of currency are different.

Let us consider the case when every good is traded at the same prices p and p^*. Here, the total nominal stock of fiat money is M and M^*, and the total real stock of fiat money is expressed as $m=M/p$ and as $m^*=M^*/p^*$. Additionally, n percentage of agents use Currency *0* and $n^*=1-n^*$ percentage of agents use Currency *0**. In this case, if the likelihood of concluding a transaction is exactly the same using Currency *0* or Currency *0**, there is no incentive for the agents using Currency *0* to start using Currency *0** (similarly, there is no incentive for the agents using Currency *0** to start using Currency *0*). Thus, in this case, a situation in which two currencies co-exists becomes an equilibrium.

This equilibrium requires that the ratio of agents that are holding currency *0* to agents that utilize Currency *0* must be equal to the ratio of agents that are holding currency *0** to agents that utilize Currency *0** (that is, $\frac{m}{n} = \frac{m^*}{n^*}$). The reason why this is a condition for equilibrium can be explained as follows. For example, if $\frac{1}{2} > \frac{m}{n} > \frac{m^*}{n^*}$, then using either currency there will be fewer buyers than sellers, so a rationing of sellers will occur. However, because for sellers the likelihood of rationing will decrease when using Currency *0**, n^* will decrease and n will increase. This movement will continue until $\frac{m}{n} = \frac{m^*}{n^*}$ holds and the equilibrium will then be established under this condition.

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marketplace $k+1$, to act as sellers, and to present an offer price of p .

[85] For example, when $m=1/2$, because the number of sellers and buyers is the same on all marketplaces, rationing will not occur. However, when $m<1/2$, because the number of buyers is less than the number of sellers, a rationing of sellers will occur.

(Appendix 2) Monetary Policy under Uncertainty

How should monetary policy be conducted under "uncertainty"? Otani, Kawamoto and Hisada (2001a) identify three types of uncertainty – parameter uncertainty (when policymakers cannot accurately grasp the influence of changes of a given variable on others), economic data uncertainty (when policymakers cannot accurately grasp real economic conditions), and model uncertainty (when policymakers cannot accurately judge macroeconomic structures) – and discuss the conduct of monetary policy under each type of uncertainty. This Appendix first introduces the case where there is only additive uncertainty (when there is no parameter, economic data or model uncertainty, but when random shocks, that policymakers cannot grasp, directly influence economic variables in an additive manner) as a benchmark, and then introduces a discussion regarding the conduct of monetary policy under these three types of uncertainty.

① Additive Uncertainty and Certainty Equivalence

The analysis begins with the case where there is only additive uncertainty. The model is comprised of the following two equations;

$$\pi_{t+1} = a\pi_t + y_{t+1} \qquad (0 < a < 1) \qquad (1)$$

$$y_{t+1} = -bi_t + \varepsilon_{t+1} \qquad (b > 1) \qquad (2)$$

where π is the inflation rate, y the GDP gap, and i the nominal short-term interest rate. Equation (1) is the Phillips curve and Equation (2) is the IS curve.[86] The term ε expresses the so-called additive shock and it is a random variable with an expected value of 0 and a variance of σ_ε^2.

The reduced form for inflation rate is obtained by substituting Equation (2) into Equation (1), as shown in Equation (3).

$$\pi_{t+1} = a\pi_t - bi_t + \varepsilon_{t+1} \qquad (3)$$

Let's assume that the central bank moves nominal interest rates to achieve inflation rate targets. In other words, the central bank implements its monetary policy to minimize the expected value of the square of the deviation of the inflation rate from the target under the constraints of Equation (3). For simplification, we assume that the

[86] Equation (2) assumes that the nominal short-term interest rate influences the GDP gap, but it is the real short-term interest rate that should actually be viewed as influencing the GDP gap, so the equation should properly be $y_{t+1} = -b(i_t - \pi_t) + \varepsilon_{t+1}$. Nevertheless, the following discussion follows Batini, Martin and Salmon (1999) in adopting Equation (2) from the perspective of model simplification. For a discussion of this formulation of the IS curve, see Svensson (1997).

inflation rate target is zero.

The following "optimal" policy reaction function is obtained by solving this minimization problem.

$$i_t = \frac{a}{b}\pi_t \qquad (4)$$

This function is exactly the same as the solution to the model in which Equation (2) has no uncertainty (that is, the term ε_{t+1} does not exist).

This is the 'Certainty Equivalence Principle' previously demonstrated by Theil, and it shows that the optimal policy reaction function when there is only additive uncertainty takes exactly the same form as the optimal policy reaction function when there is no uncertainty. In other words, there is no need to take uncertainty into consideration for the optimal monetary policy under only additive uncertainty.

② Parameter Uncertainty

A representative example of parameter uncertainty is when the central bank cannot accurately know the value of b in Equation (3) and there is uncertainty regarding the extent to which changes in the interest rate change the GDP gap and the inflation rate. How should the central bank implement monetary policy under such conditions?

Let's assume that even though the central bank does not know the exact values of parameters a and b in Equation (3), it does know that they are random variables which have independent normal distributions with means of $\bar{a}$ and $\bar{b}$ and variances of σ_a^2 and σ_b^2.[87] In this case, the desirable policy reaction function may be expressed as shown in Equation (5) from the first order conditions for the minimization problem.

$$i_t = \frac{\bar{a}\bar{b}}{\bar{b}^2 + \sigma_b^2}\pi_t \qquad (5)$$

While this expression is somewhat more complicated than Equation (4), it basically demonstrates that when the uncertainty of the inflation rate reaction to monetary policy increases (that is, when σ_b^2 expands), the optimal change of interest rates in response to inflation becomes smaller. This is the Brainard Conservatism Principle as expressed in Blinder (1998), which states that when there is uncertainty regarding the multiplier effect in policy, policymakers should adopt a conservative stance toward policy implementation.

[87] The Brainard Conservatism Principle does not necessarily hold true when there are correlated relationships among the parameters.

When the central bank conducts its monetary policy in accordance with Equation (5), the inflation rate (in the next period)[88] does not converge with the target (which is 0) during the period, so during the next period as well the monetary policy must respond to the remaining influence from the initial shock. This provides the grounds for adopting gradualism as the ideal policy approach when there is parameter uncertainty.

③ Economic Data Uncertainty

The next issue is how the central bank should implement monetary policy when it cannot accurately grasp the true economic conditions due to measurement error, the time lag and revisions of economic statistics, and the existence of economic variables, such as potential GDP, that cannot be measured directly.

Chow (1977) argues that when this type of uncertainty is treated as "additive error," it does not influence the optimal policy reaction function. Let us consider this based on the above model. Assume that the central bank makes policy decisions not in accordance with Equation (2), but rather in accordance with the following Equation (2')

$$\hat{y}_{t+1} = -bi_t + \varepsilon_{t+1} + \eta^y_{t+1} \qquad (b > 1) \qquad (2')$$

where $\hat{y}$ is the estimated value of the GDP gap and η^y expresses the measurement error between the real GDP gap and the estimated value. In this case, the central bank cannot distinguish between the additive error ε_{t+1} examined in ① and the measurement error η^y_{t+1}. Nevertheless, under Equations (1) and (2'), the optimal policy reaction function remains Equation (4), just as in the case considered in ①. Thus, under this example, the existence of GDP gap measurement error does not have any influence on the optimal policy reaction function. This is the case which Chow's claim applies to.

Nevertheless, this conclusion will not always hold true. Especially, it is known that when there are multiple additive uncertainties that require different policy responses, measurement error requires a more conservative policy reaction (Aoki [1999]). For example, when the measured value of the inflation rate increases, it is not clear whether this reflects a supply shock, a demand shock, or simply measurement error. Here, we assume that the central bank's objectives are not only to maintain the target interest rate but also to maintain the stability of real GDP. In this case, the central bank may make a major policy mistake by substantially increasing interest rates

[88] Under the model settings, changes in the nominal short-term interest rate in this period influence the inflation rate in the next period.

if the central bank believes that the increase in the inflation rate is completely due to a demand shock although it is actually because of measurement error. Accordingly, the monetary policy reaction function should be more conservative than that under the case when there is no measurement error.

④ Model Uncertainty

The above cases all assume that the central bank has an accurate grasp of the macroeconomic structure, yet it goes without saying that the real economy is exceedingly complex, and it may be more realistic to assume that the central bank does not accurately understand the economic structure. Moreover, if the IT Revolution is actually changing the economic structure itself, the model uncertainty will increase.

Then what type of monetary policy implementation is desirable under model uncertainty? One approach is to adopt monetary policy that achieves the best performance from among numerous practical models (which is robust monetary policy).

We first consider the paper by Sargent (1999) as one example of research on such robust policy. Sargent compares various policy reactions in terms of the best possible results under the worst possible cases (the "min-max principle") by conducting simulations. He reaches the conclusion that an aggressive policy stance is the most robust.[89] Hansen and Sargent (2000) utilize various types of dynamic macroeconomic models, and conclude that an aggressive policy response is desirable. On the other hand, Taylor (1998) compares policy performance under both aggressive and conservative monetary policy and arrives at different conclusions, which indicate that there is no specific policy style that is superior in all cases. Thus, the research on this issue has only just begun, and no clear academic consensus has yet been reached.

In summary, the stance toward the conduct of monetary policy differs greatly depending upon how uncertainty is understood, and no clear consensus has emerged regarding the conduct of monetary policy under model uncertainty.

[89] Macklem (2000) interprets the conclusions of Sargent (1999) intuitively as implying that aggressive policy changes are necessary as a type of insurance to prepare for the worst possible situation.

(Appendix 3) Interest Rate Control when the Outstanding Balance of the Monetary Base is Zero

In the real economy, the demand for the monetary base is undergoing a long-term decline, reflecting reductions in required reserve ratios (for example, the required reserve ratio in Canada has been reduced to zero), improvements in the security and efficiency of payment and settlement systems, greater depth and liquidity in short-term government securities markets, and the development of electronic payment technologies such as debit card and credit card transactions.

This Appendix introduces the paper presented by Forum member Hayashi in the 12th meeting of the Forum (Hayashi, Otani and Kawamoto [1999]). The paper examines, as a type of conceptual experiment, whether central banks can actually control short-term interest rates under the circumstances where there is no reserve requirement and the outstanding balance of the monetary base has declined to zero due to the advance of the IT Revolution.[90,91] One important point here is that when the monetary base declines to zero this means that the aggregate interbank monetary base declines to zero, and does not imply that the monetary base demand of each individual bank for settlement and other purposes declines to zero.

The analysis assumes that private banks all have accounts at the central bank, and that the final settlements for interbank transactions are all conducted via these accounts.[92] When the central bank does not supply or absorb any funds in the interbank market (and if there are no banknotes or Treasury Funds), for every bank with a credit balance on the central bank account, there must be another bank with a debit balance. Thus the settlements will all be completed as long as the debtor banks can borrow from creditor banks the reserves they need to close their positions at the end of the day. However, when the central bank absorbs funds on the interbank market, the aggregate debit balance will exceed the aggregate credit balance[93], so the banks that are unable to borrow the necessary funds will be unable to complete their settlements, and

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[90] Of course, each bank's demand for monetary base on a stock basis will be positive, and will not decline to zero, if the interest rates charged by the central bank for funds supply at the end of the day are too high or if the market participants do not believe that at the end of the day the amount of funds supplied by the central bank will equal the amount of funds absorbed.

[91] The discussion presented here is based upon Hayashi, Otani and Kawamoto (1999), the discussions in the 12th meeting of the Forum, and Henckel, Ize and Kovanen (1999).

[92] This appendix assumes that the outstanding balance for each bank must not be negative.

[93] Only the central bank can artificially create an imbalance between the aggregate funds shortage and the aggregate excess funds supply.

thus they will have to receive credit from the central bank.

In this situation, private brokers would offer interest rates that differ from those offered by the central bank, match debits with credits, and the central bank might lose the controllability of interest rates. In actual practice, however, this situation will never occur. This is because as long as the central bank retains its status as the monopoly supplier of the monetary base, the central bank will be able to conduct unlimited intervention in the interbank market, and thus the short-term interest rates among private banks will not be able to deviate from the rates announced by the central bank.[94]

[94] Naturally, the private-sector brokers would offer different interest rates to each bank considering the credit risk of each bank borrowing funds. Even in this case, however, the market interest rates would still be based on the interest rates announced by the central bank, but adjusted for each individual bank's credit risk.

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(Figure 1)

Changes in PC Prices and Processing Capacities

	1984	1997	1998
Price	$3,995	$999	$799
MIPS	8.3	166	266
Cost/MIPS	$479	$6	$3

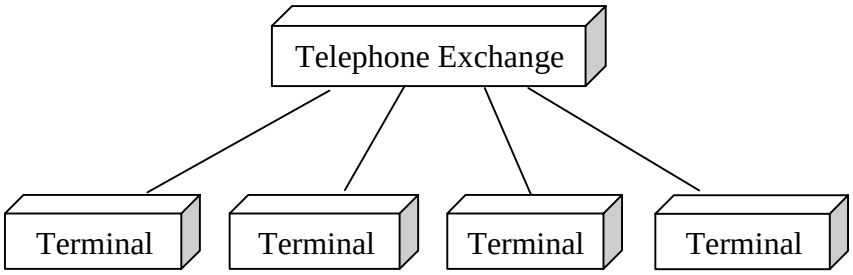
Source: Kumasaka (1999); Federal Reserve Bank of Dallas (1997).

Note: MIPS = Million Instructions Per Second.

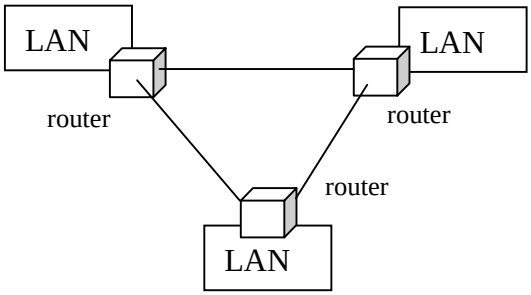
(Figure 2)

Network Architecture

a) Intelligent Network (Telephone)



b) Stupid Network (Internet)



Source: Ikeda (1999).

(Figure 3)

Number of Years until Inventions are Used by 25% of the Population

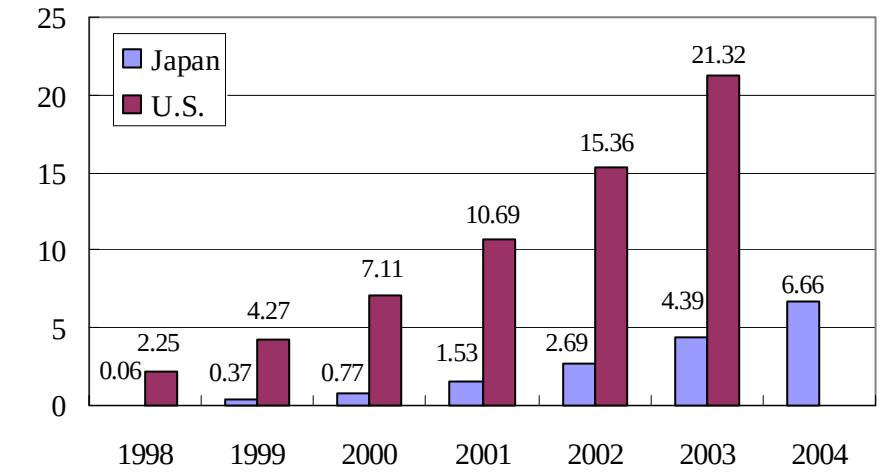
Invention	Date of Invention	Number of Years to Achieve 25% Penetration
Electricity	1873	45
Telephone	1876	35
Automobile	1886	55
PC	1975	16
Internet	1991	7

Source: Kumasaka (1999); Federal Reserve Bank of Dallas (1996).

(Figure 4)

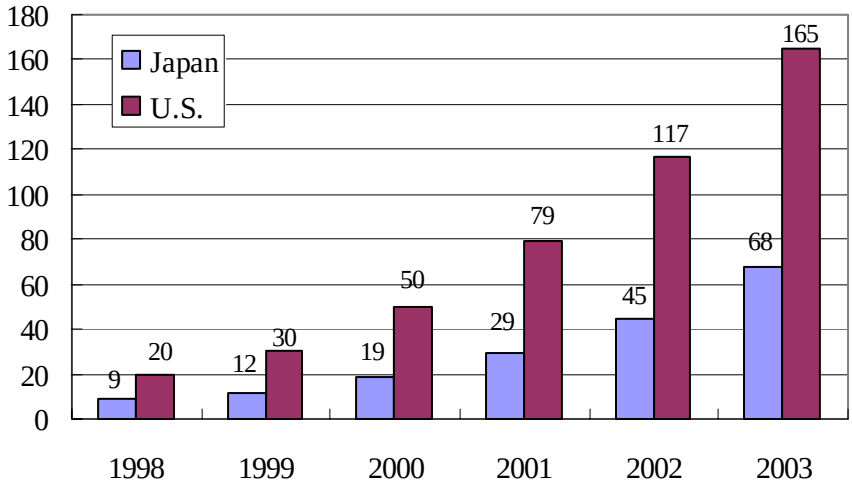
a) B-to-C E-commerce Market Scale

(Unit: ¥ trillion)



b) B-to-B E-commerce Market Scale

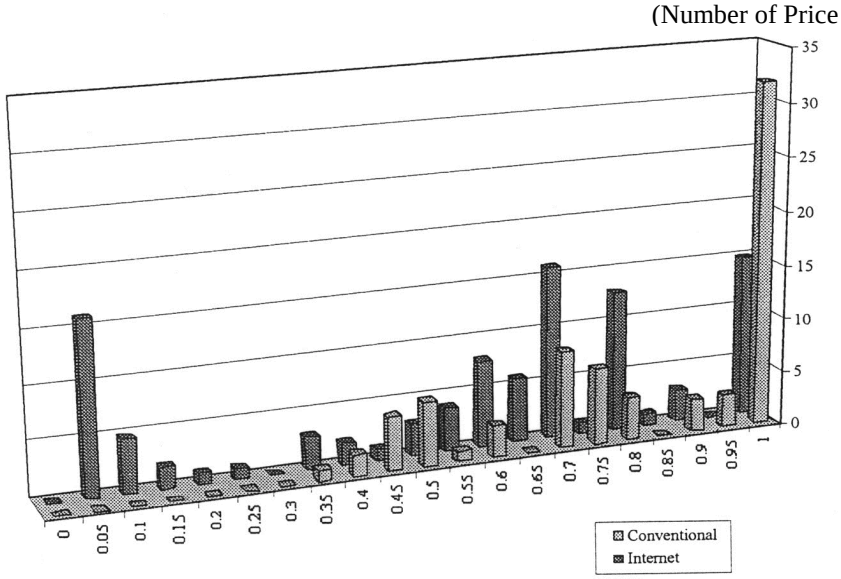
(Unit: ¥ trillion)



Source: Ministry of International Trade and Industry; Andersen Consulting.

(Figure 5)

Histogram of Book Price Changes



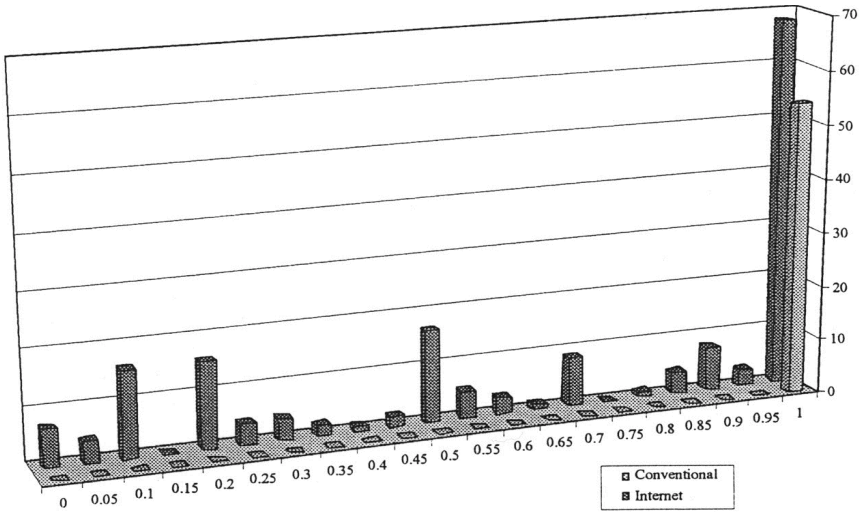
(Price Change Amounts - $US)

Source: Brynjolfsson and Smith (1999).

(Figure 6)

Histogram of CD Price Changes

(Number of Price Changes)



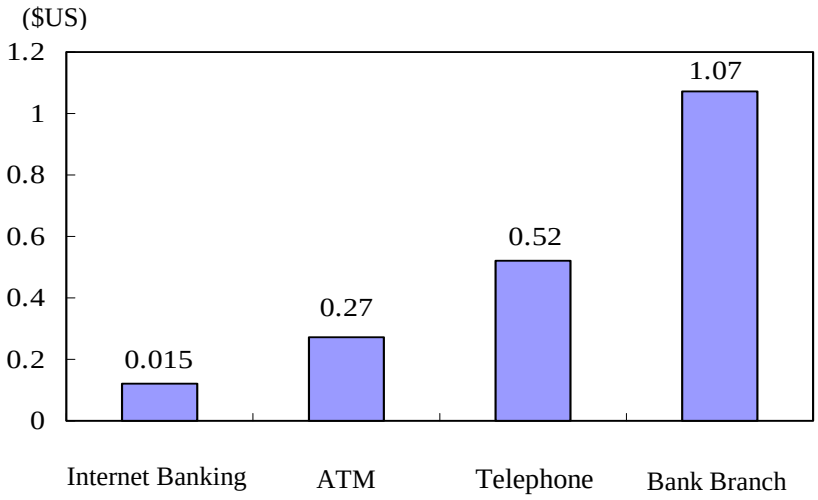
(Price Change Amounts - $US)

Source: Brynjolfsson and Smith (1999).

(Figure 7)

Cost Per Banking Transaction

(Researched by Booz-Allen & Hamilton Inc.)

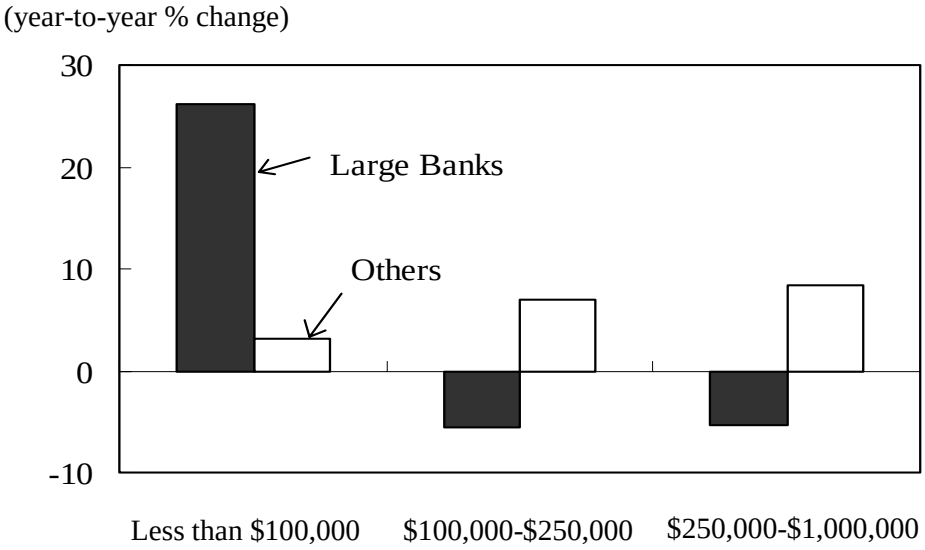


Source: U.S. Department of Commerce (1999); Booz-Allen and Hamilton, Inc.

(Figure 8)

Growth in Petty Loans Provided in the California Region

(June 1995 ~ June 1996)



Source: Levonian (1997).

(Figure 9)

International Trade of Selected E-Commerce Firms, 1997

Company	Segment	Online Revenues as % of Total	International Revenues as % of Total
CDnow	Music	100	35
Music Boulevard	Music	100	33
Amazon	Books	100	26
Barns & Nobel	Books	0.50	30
FastParts	Electronic Components	100	30
Virtual Dreams	Pornography	100	25
Dell	Computers	Almost 50	20
1-800-Flowers	Flowers	10	15-20
Sabre	Travel	67.30	17.50
E*Trade	Consumer Brokerage	63	2.80

Source: OECD (1999).

(Figure 10)

E-Commerce Impact on Various Distribution Costs

(US$ per Transaction)

	Airline Tickets	Banking	Bill Payment	Term Life Insurance Policies	Software Distribution
Traditional System	8.0	1.08	2.22-3.32	400-700	15.00
Telephone-based		0.54			5.00
Internet-based	1.00	0.13	0.65-1.10	200-350	0.20-0.50
Savings (%)	87	89	71-67	50	97-99

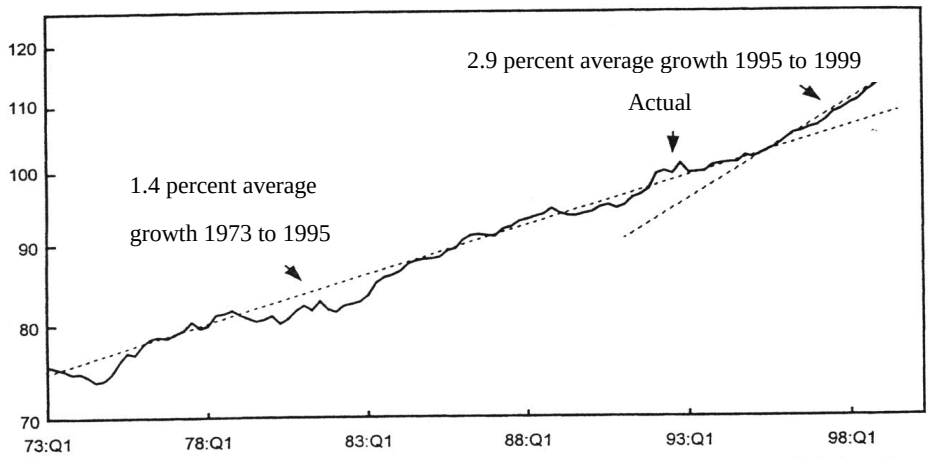
Source: OECD (1999).

(Figure 11)

Labor Productivity in U.S. (Nonfarm Business Sector)

Labor productivity tended upward at an average annual rate of 1.4 percent from 1973 to 1995. It then accelerated to a 2.9 percent clip over the past 4 years.

Index: 1992=100 (ratio scale)



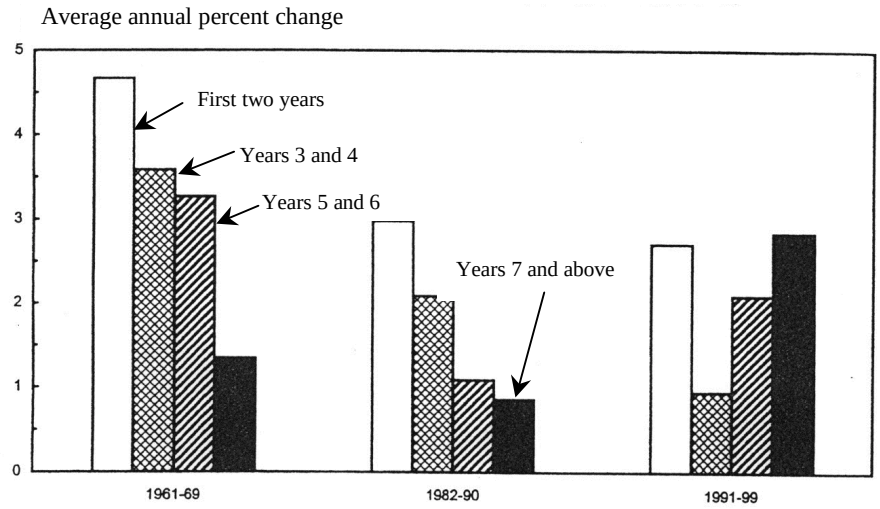
Note: Productivity is the average of income- and product-side measures. Productivity for 1999 is inferred from the first three quarters.

Source: Council of Economic Advisors (2000).

(Figure 12)

Growth in Nonfarm Business Sector Output per Hour During Expansions in the U.S.

Productivity growth has fallen over time during previous long expansions but has risen during the current one.



Note: The final column shows growth from 1997 through the third quarter of 1999.

Source: Council of Economic Advisors (2000).

(Figure 13)

Changes in the Monetary Policy Transmission Mechanism Under the IT Revolution.

	Interest Rate Channel	Availability Channel
Development of financial and capital markets	○	X
Changes in financial intermediaries	○	X
Expansion in the volume of trade	○	_
Asset substitution Reduction of the differential between domestic and foreign real interest rates	? (Influence on foreign exchange: ○ Convergence of domestic and foreign interest rates: X)	_

Note: ○ represents an increase in effectiveness and X represents a decrease in effectiveness.