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Hi-Tech Industrial Network and Global Contagion Mechanism of IT Recession

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INTRODUCTION

It is pointed out that the world economic system is becoming more and more vulnerable to shocks on a grand scale. The uncertainty of the U.S. economy, the worsening performance of the world's IT industry and the flagging economic situation in East Asia and South America are the grounds for such worries. The so-called synchronous global IT recession casts its dark shadow all over the world, with a sharp drop in demand in the IT industry affecting the U.S. economy at an accelerating pace, though optimistic forecasts were made for the world economy at the Okinawa Summit in Japan just two years ago. In stock markets of the world, prices show grim bearishness under the influence of a weak economy and a worsening profit outlook.

This paper reviews the mechanism of IT recession, by observing the U.S.-led recession, particularly in the IT industry, and its synchronous effect around the world, together with the characteristics of investment in the IT industry, the disappearance of wealth effects and what people call the era dominated by Internet revolution.

NEW ECONOMY RECONSIDERED

Though it is difficult to say what the "New Economy"[1] is in a word, it can be interpreted as a new economic phenomenon that appeared in the 1990s, accompanied by everlasting changes in economic structure, under the influence of innovation in digital technology and globalization of the financial market. Approaches to the essence of the economy are divided into empirical and positive. Firstly, empirical approaches attempt to look at the New Economy in terms of changes in the present economic situation, to see whether they are temporary or structural. On the other hand, positive approaches try to analyze the structural causes of the New Economy or relationship between macroeconomic variables, focusing on the causes of the prevalent economic phenomenon, rather than on its results. However, when the New Economy is approached from a positive point of view, it is not easy to shed light on new relationships between such macroeconomic variables as growth, prices, unemployment with existing tools of economic analysis. Thus, discussions on the new economic phenomenon are better related to a point of view, such as "Is the new economic relationship between high growth, low prices and low unemployment structural or temporary?" Economists supporting the New Economy say that the sustained rise in productivity will cause new changes in the economic structure.

The positive approaches to the New Economy are divided into the theory of long-term growth, business cycles and that of the source of economic growth.[2] The theory of long-term growth says that the U.S. economy can achieve economic growth with no burdensome rise in commodity prices, through the long-term trend of high productivity. The point is focused on such things as "Will the long-term trend of high labor productivity continue under the New Economy?" and "Will the high-growth trend continue over the long term?"

The theory of business cycles is about the cause of long-term bullishness in the market and its sustainability. Though the case of changes in growth rate or a rise in commodity price appears to be different from those in the past, it is important to consider whether the changes are due to long-term structural changes or are just a temporary phenomenon due to short-term shocks. According to the results of a study concerning the statistical characteristics of business cycles, the period of sustained expansion of an economy is getting longer, while the depth of a business cycle is getting smaller, when compared to economic phenomena of the past. In other words, it is judged that a mild business cycle is already an established fact, and the pattern of recent business cycles is taking a different form to that of the past.[3] In the meantime, the Philips curve shows that, in the short term, there exists a trade-off between inflation and the unemployment rate. However, such a trade-off cannot be found in the New Economy, which features high growth, low prices and low unemployment. This appears to be due to the NAIRU (Non-Accelerating Inflation Rate of Unemployment) showing a permanent drop. It is also insisted that the reason for the absence of pressure for inflation, despite a fall in the unemployment rate to 4% and the NAIRU of the gigantic U.S. economy estimated to reach 5%, is that the NAIRU has gradually dropped more than 1%, due to the appearance of the New Economy.

The theory for the source of economic growth is that the advent of the so-called "digital economy" has caused a new factor for economic growth like the mechanism of increasing returns and the network externality. In the New Economy, feedback mechanisms are formed between the industry and the society, and the economy comes to show non-linear growth when economic transactions reach a critical point beyond a certain magnitude.[4]

In the past where changes were made slowly, the role of technical progress and changes in the system were relatively weak. However, under the present competitive environment, in which changes are made rapidly under the influence of. The New Economy must be a new phenomenon, but it is also a phenomenon that can be explained using existing economic laws. Economists like C. Shapiro and H. R. Varian say,[5] "Technology changes, economic laws do not."

ECONOMICS OF IT RECESSION

Over-investment in IT and Mechanism of IT Recession

IT industry, which had led the world economy as well as the US's in the 1990s, was faced with difficulties due to the rapid drop in demand and over-capacity. The short lifecycle of IT equipments and IT-related capital can be pointed out as a major factor affecting the mechanism of the recession in the IT industry. In the past five years, IT industry saw around 25% annual compound growth rate in real terms. Therefore, the recent drop in investment would have a devastating effect on the economy as a whole, by suppressing an increase in long-term productivity.

Let's look at the over-investment in the IT sector in the U.S.[6] in terms of its relation to GDP. The investment-to-GDP ratio has maintained long-term stability, except in the periods of the Great Depression and World War II. In the period from 1950 through the mid-1990s, the ratio was 10 to 15%. However, since 1995, the economy has broken away from such stable trend, with the ratio eventually becoming as high as 20% in 2000. And IT investment has started to show a sharp decrease.

Let's look at the background of such a sharp drop in IT investment. Firstly, if GDP cannot follow an increase in investment at a certain rate, businesses will come to reduce their investment in facilities, as investment cannot create profits. Second, the U.S. economy depends on offshore capital for IT investment, which has resulted in a worsening current account. The consumption-to-GDP ratio has maintained stability at 66 to 68% since the 1980s. The sharp increase in investment disproportionate to demand was offset by a deficit in the foreign sector. Up to 1955, the size of the deficit in U.S. foreign trade

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was maintained at about 1%, whereas in 2000 it rose sharply to 5%. In 2000, IT investment rose sharply to 7% from 2% of GDP in the period up to early 1990.

Now let's look at the relationship between the rate of increase in IT investment and that of IT capital stock as a factor showing excess IT capacity in the 1990s. The rate of increase in equipment investment and that of capital stock shows a similar level in the long term. If a situation continues in which the rate of increase in investment outdoes that of capital stock due to a shock from outside, the rate of increase in capital stock accelerates and both come to strike a balance. The same thing happens at the other end of the picture. After temporary breaks in the balance, one shifts to maintain a similar level to the other. From the viewpoint of this mechanism, the fact that the rate of increase in facility has consistently outdone that of capital stock since 1992 indirectly shows excess in IT investment. Looking at it in more detail, IT investment in the post-1992 period outdid of capital stock by a wide margin. This was then reversed, thus mitigating the problem of excessive investment. However, IT investment particularly in telecommunication sector, sharply rose again in 1999. Since 1994, the rate of increase in investment has outstripped that of capital stock, culminating in 1999, when the difference between the two reached as high as 16.3% point. Thus, there was obviously an excess of IT investment at the end of the 1990s.

Now, let's turn to IT recession from a statistical point of view. First of all, the semi-conductor and telecommunication equipment industry is currently in clear decline, while the computer and office equipment industry is in a relatively calm period of inventory adjustment. The rate of operation in the semi-conductor industry plummeted to 63.8% in June 2001, in contrast to 99.9% (the highest point in history) in the corresponding period the previous year. The rate of operation in telecommunication equipment also dropped to 71.8% in June 2001, from 87.7% at the end of 2000. That of the computer industry posted a slight decline to 76.8%, from 69.6% in the same period. The operating rate in the whole industry, except for the IT sector, showed a period of slight adjustment, posting 77.7%, down from 81% in the last period.

Global Synchronization of IT Recession

Initially, IT recession[7] results in worsening performance on the telecommunication service operators and relevant manufacturers in the U.S. There is a succession of bankruptcies of start-up Internet service providers. The burden of overcapacity and excessive debts is at the center of IT recession and it can be pointed out as a structural stumbling block to an earlier recovery of the U.S. economy. Of course, the entire picture for IT investments and other IT sectors is not as bad as it seems. What economists are worried about is the drastic fall in the two leading sectors and its devastating effect on the others.

Looking at the effects on other sectors in the industry, recently there has been a sharp drop in profits in the sectors of raw materials and consumption, in addition to the drastic 60% drop in profits for hi-tech sectors. As for the operating profits for 500 major firms in the U.S. compared to those in the preceding year, they began falling at the end of 2000 and posted a loss in 2001. The trend is becoming more serious. With the exception of some firms, such as IBM, which are definitely expected to post a profit, there are a number of suffering new-economic firms. Intel, for one, posted a 90% drop in profits, with Sun Micro Systems, one of the largest network computer manufacturers, experiencing its first year of net loss in 12 years. Telecommunication operators, struggling under the burden of surplus facilities and excessive competition, also posted a 30% drop in profits.

Looking at the effect that the IT recession in the U.S. economy has had on the world, East Asian countries are affected in their semi-conductor sector, followed by telecommunication and Internet-based sectors, while European countries see the effects in their Internet-based sector, with the cellular phone sector bearing the brunt of the shock. With the exception of rapidly developing China, the drop in demand for cellular phones shows that the rate of ownership has already hit a ceiling in major markets, such as Europe, the U.S. and Japan, under the influence of a decline in consumption, affected by the recession in the U.S.

Table 1: Ratio of IT-related products in exports

Degree of Risk	Ratio (%) of IT Equipment to Exports
High	The Philippines (63.0), Singapore (52.4), Malaysia (52.8)
Modest	Taiwan (37.1), Ireland (31.9), South Korea (29.7), Thailand (26.1), Japan (21.8), Finland (20.2)
Low	Israel (18.9), Mexico (18.6), Sweden (16.1), The Netherlands (15.9), China (15.0)
Others	U.S. (18.1), U.K. (16.4)
World Total	14.1

Source: WTO (1999)

The semi-conductor sector of East Asian countries must accept the fact that their business performance has nowhere else to go but downward. Samsung Electronics and Hynix Semiconductor of Korea, which together occupy about 40% of the world semiconductor market, used to place priority on a higher market share, rather than on profitability, but since the middle of 2001 they have started to reduce their production, in response to global IT recession. The ratio of the semi-conductor sector in the entire manufacturing industry of Korea rose from 3.3% 1991 to 7.9% in 1999, with employment also rising from 3.6% in 1991 to 5.8% in 1999, on the back of the worldwide IT boom. Due to changes in their offshore markets, semiconductor's share of entire exports has also changed a great deal, as follows: 7.9% in 1991, 17.7% in 1995 (a boom), 12.8% in 1997, 15.1% in 2000 (another boom), and 10.8% in 2001 (a slump for IT business).

THE CONTAGION MECHANISM OF IT RECESSION

The ripple effect that the IT recession in the U.S. would have on the world is not hard to predict, in consideration of the influence it has over East Asian as well as Europe. This study will look at the mechanism of the global contagion,[8] in terms of the worldwide network of production and the linkage of capital markets.

Global Network of Hi-Tech Production

The global network of production is caused by overseas outsourcing of supply formed by industrialized countries for cost reduction. Usually, NJAs(Non-Japan Asian countries), particularly East Asian countries, are regarded as the most likely regions for forming such a network of production. Export of IT products to the U.S. account for 40% of the region's total GDP. This paper focuses its attention on the formation of the CPN(Cross-National Production Network) for the electronics industry in East Asian countries by U.S. businesses. This enabled them to reduce their dependence on Japan for parts or manufacturing technologies and establish a production base that could compete with Japan. This involved the following two strategies: first, build global outsourcing strongholds with little investment; second, establish sources of supply without giving Japanese the upper hand, unlike household appliances. In East Asia, the U.S.-dominated CPN emerged in the mid-1980s. It can be said that CPN was realized thanks to the existence of the NJA, which was left with stages of development unlike Japan.[9] However, its close connectivity with U.S. economy inevitably makes it the area most susceptible to the IT recession in the U.S. The fact must not be overlooked, either, that the Japanese production network has been involved in the NJA. It is a generally accepted view that Japan's foreign direct investment(FDI) has played the role of an engine in the modernization of East Asian countries. The advance of Japan's electronics industry into other Asian countries, including NIEs then, and China now, was speedily carried out after the Plaza Accord of 1985. In the 1990s, the move of Japan's electronic industry to other Asian countries was made in the form of shifting manufacturing facilities for products requiring cost reduction.

In this way, Japan has gradually formed the production network in Asia for its products.

The Taiwan-China production network is progressing considerably.[10] The economic exchange between the two brethren, seeking inter-dependence and division of labor, is led by the IT industry. Taiwan has sought a higher share of the world market for IT products through localization in China, expansion of the magnitude of production and cost reduction. The linkage between Taiwan and China in the IT industry will surely make an impact on the world market, though there are some uncertainties at the moment, due to the worldwide IT recession.

Today, worldwide trade volume accounts for about a quarter of the total world GDP volume, about four times as large as the 1970s. A change in a major country has an immediate impact on the trade environment of other countries. In particular, the degree of openness of the U.S. economy has the bright side of supporting the growth of the world economy in good times and the dark side of doing serious harm to other economies in times of recession. The present recession in the IT industry is a typical example of the latter. In other words, the IT recession in the U.S. economy brings damage to the world economy. The worldwide recession, in turn, applies additional pressure to the U.S. economy and causes feedback effects on the US's outsourcing regions, thus spreading the effects to wider areas through the international process of contagion.

Hi-Tech Bubble and Linkage of Global Capital Market

In the 1990s, a dramatic co-movement[11] was observed among capital markets or stock markets all over the world. Of note are the quite different changing trends shown by hi-tech stocks for communication, media and IT sectors, and non-tech ones. As shown by Appendix Figure, the so-called hi-tech bubble observed in the TMT(Telecommunication, Media and Technology) sectors all over the world, with prices showing an approximately six fold increase on the 1990s in Europe and about three fold rise in Asia. Such drastic changes in the capital market give impact to the wealth effect, which is one of the important factors of the New Economy mentioned earlier. Also, the bubble phenomenon in each OECD country is definitely shown in the research of Edison and Sloek(2001). Let's look at the mechanism of global contagion of the recession in the IT industry on the basis of such results.

Typically, stock investors' favorite measure to avoid speculative risks has been a global portfolio, i.e. diversification of investments worldwide. This means reducing the risk of loss in one part of the world by making a profit in another part of the world. However, the capital market itself is recently evolving in such a way as links the whole world very closely. Global factors, such as globalization of economic activities and attempts for control of worldwide stock markets, through wider distribution and innovation of IT, is becoming more important than internal factors for each region of the world. For example, the new trend is that the difficulty in forecasting profitability for a large-sized U.S. hi-tech business leads to a drop in the price of TMT stocks. Such a phenomenon is observed in relevant statistics. The coefficient of correlation between the markets of the U.S. and Europe in the stock prices shows ever-stronger linkage (0.4 in the mid-1990s and 0.8 in 2000).[12]

It is noteworthy that such global linkage supports the view that TMT stocks play a stronger role as a new channel for the global contagion of the recession in the IT industry than "non-TMT stocks." The coefficient of correlation in the price changes of TMT stocks between the U.S. and Europe stood at 0.85 in the period between January 1999 and May 2000, in contrast to 0.54 in non-TMT stocks. The coefficient of correlation in the price changes of IT-related stocks is also higher than that of non-TMT stocks (0.75: 0.35). Also, as shown in Table 2, TMT stocks are characterized by a higher rate of price changes than non-TMT stocks, and thus can be said to act as a factor increasing the anxiety of the world capital markets through global linkage.

Table 2: Rate of price changes in stocks in OECD countries

	GDP	Investment	Capital Market	TMT Stocks	Non-TMT Stocks
Canada	30.6	52.7	146.5	223.8	116.0
France	19.1	15.5	194.5	296.3	177.7
Germany	14.8	15.6	131.7	329.1	110.7
Japan	14.3	-10.7	-34.7	62.5	-56.3
The Netherlands	33.4	36.1	175.7	269.9	165.7
UK	24.5	58.7	125.6	206.7	106.7
USA	38.9	97.0	159.7	233.7	131.2

Source: Edison and Sloek (2001)

Note: For the period from Jan. 1990 (Germany, starting from 1991) through Oct. 2000

CONCLUDING REMARKS

Such a new phenomenon of economic contagion[13] can be attributed to the following three factors. The first is the explosive growth in trade volume that accounts for about 25% of the world economy. Export-oriented countries such as Canada (with 32% dependence on the U.S. for its exports), Mexico(25%) and Asian countries (40%), excluding Japan, place too much dependence on the U.S. Economy.[14] The second is the globalization of finance and capital market. The rapid developments in information and communication technology(IT) has allowed various financial markets in the world to operate as if they are one single market, which means an incident in a market can, in real time, affect the movement of investors and financial institutions throughout the world. Third, the expansion in the scope of activities of multi-nationals has strengthened the connectivity between activities of business enterprises worldwide. In particular, the network of interactivity of hi-tech industries' production has becomes notable.

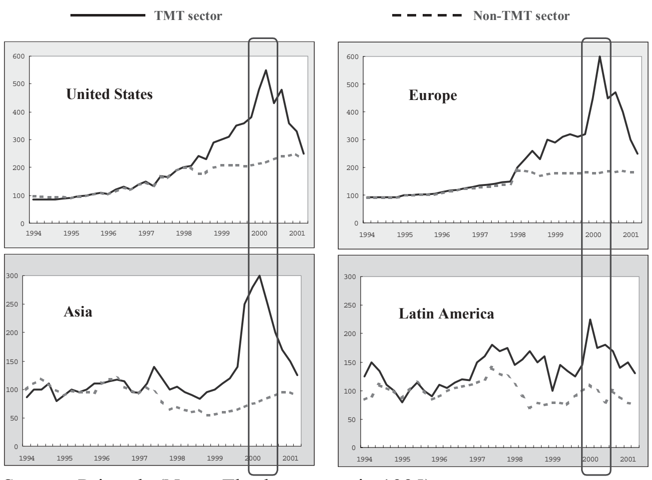
The sharp reduction in demand for hi-tech products, chiefly resulting from the recession in the U.S. economy, is causing a drop in the growth of the world economy, and particularly affects East Asian economies that are highly dependent on the U.S. for their exports. Under the present structure, a drop in imports from the U.S. directly shifts the recession to other countries. Those East Asian economies that used to form the nucleus of the world supply network of IT products during the period of the IT bubble enjoy the benefits "disproportionately." However, they are now in a paradoxical situation, in which they have to pay the "disproportionate" price, after the IT bubble collapsed.

The world economy depends greatly on exports for its growth. World trade now accounts for about a quarter (i.e. about twice the level of the 1970s) of the total GDP of the world. The U.S. economy has contributed to about 40% of the growth in GDP of the world for the past five years, under such a growth pattern of the world economy. There clearly exists a paradoxical phenomenon that can be called "a global paradox", in which the U.S. economy could be the cause of the present worldwide recession and the world should see its economy recover following the pattern of the US's V-shaped or L-shaped recovery.

In a way, the present global recession in the IT industry can be said to be a period of correction of over-investment and excessive capacity, shifting to the "information infrastructure" and "platforms." Thus, once "contents and software" sector of IT industrial structure are given momentum, they will start creating new employment and lead the economic recovery. In reality, there are moves for stock adjustment and expansion of employment slowly appearing on the horizon in the industry, which are expected to bring about a new phase of the New Economy.

APPENDIX

Changing Trends in Stock Indexes



Source: Primark (Note: The base year is 1995)

ENDNOTES / RFERENCES

[1] Please refer to the following, for their examples. Sirkka Haemaelaeinen, “Is the New Economy really new?,” *Jaakko Honko Lecture*, Helsinki School of Economics, January 29, 2001.

[2] This classification is based on the following. K. J. Stiroh, “Is There a New Economy?,” *Challenge*, Vol. 42, No.4(July/August 1999), pp.82<□101.

[3] M. Fleming, “The New Business Cycle: The Impact of the Application and Production of Information Technology on U.S. Macroeconomic Stabilization,” *Business Economics* Vol.32 No.4(October 1997), pp.36<□42.

[4] K. Kelly, *New Rules for the New Economy,* Viking, New York, 1998.

[5] C. Shapiro and H. R. Varian*, Information Rules: A Strategic Guide to the Network Economy*, Harvard Business School Press, 1998.

[6] Looking at the growth trend of the IT industry of the U.S. in terms of the industrial production index, it posted an average of 13.2% in the 1987 to 1994 period and an average of 41.9% in the 1995 to 2000 period. This marks a clear contrast with 2.3% in the corresponding period of the “old economy”(i.e. the entire industry excluding the IT sector). Putting the industrial production index of the old economy in 1992 at 100, the figure for 2000 stood at 1,194.6 / 122.6, i.e. about 10 times as large as that of 8 years ago.

[7] For example, the operating rate of the IT industry posted 67.5% in June 2001, showing drops for ten consecutive months from 90.9% in September 2000, in comparison with 65%, the lowest figure ever in history, in the first oil shock. It is especially noteworthy that it dropped more than 20 basis points in a year.

[8] S. Roach, “The New Global Contagion,” *Global Economic Forum*, 18 June 2001.

[9] M. Borrus, “Left for Dead: Asian Production Networks and the Revival of US Electronics,” *BRIE Working Paper* 100, UC Berkeley, April 1997.

[10] Please refer to the following concerning the global production network under the influence of Japanese businesses’ localization, particularly in the China Circle. D. Ernst, “Partners for the China Cirlcle ?: The Asian Production Networks of Japanese Electronics Firms,” *Danish Research Unit for Industrial Dynamics Working Paper* No.97<□3, March 1997.

[11] R. Brooks and L. Catao, “The New Economy and Global Stock Returns,” *IMF Working Paper WP/00/216,* December 2000

[12] H. Edison and T. Sloek, “New Economy Stock Valuations and Investment in the 1990s,” *IMF Working Paper WP/01/78,* June 2001.

[13] This is also called “global contagion” or “high-tech contagion,” *The Economist*, “Dancing in step,” the March 24, 2001 issue.

[14] The U.S. import accounts for about 20% of the total international trade. The void made by the reduction in the U.S. imports is filled with the orders given to the electronics manufacturing service commissioned by the U.S. businesses, in which the hi-tech recession or IT recession is also being exported to East Asia and South America. For more details, please refer to the following. *The Economist*, “Exporting Recession,” the July 20, 2001 issue.

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