Will Japan lag behind Korea? A Theoretical and Empirical Analysis of A Transition to New Economy*

Shumpei Takemori
Department of Economics, Keio University

and

Kenji Wada•
Graduate School of Business Administration, Keio University

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Abstract

In this essay, we will investigate the remarkably different economic performance of Japan and other Asian countries before and after the Asian economic crisis. Japan did not suffer much from the crisis, but it has not recovered from it, while other Asian countries were severely affected by the crisis, but they quickly recovered from it. We will set up a simple matching model and show that we can explain these contrasting performances by technological adoption. We will also undertake some empirical analyses that support the prediction of our theoretical model.

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• The corresponding author: 2-1-1 Hiyoshi-honcho Kohokuku Yokohama Kanagawa 223-8523 JAPAN
Phone +81-45-562-1185, Fax +81-45-562-3502, e-mail kwada@kbs.keio.ac.jp

1. Introduction

Any short list of major economic events in the Asian-Pacific region in the 90's should include (A) the decade-long recession in Japan that was triggered by the crash of its Bubble economy in 1991 and (B) the currency crisis that hit the East Asian emerging markets in 1997. The purpose of our paper is to link these two major events from a theoretical perspective and to support our viewpoint empirically.

There is a large literature on the Japanese long-run recession as well as on the East Asian currency crisis. However, there is a curious lack of systematic studies focused on the link between the two events although the cause of these two crises have been attributed, time to time, to the same structural problems, the problems inherent in "the Asian system", non-transparent commercial practices of corporate groups or bank lending which are not based on sound business judgment, etc.

Corsetti, Pesenti and Roubini (1999) extensively examined the East Asian currency crisis from such structuralist perspective, while discussing the applicability of the Japanese model for East Asia, Itoh (1996) pointed out the country's structural problems as the reason for its slow recovery.

The structuralist perspective, however, leaves many puzzles unsolved:

(a) If the Asian Economic System contained so many structural problems, why did they become apparent only in the 90's? Furthermore, as Furman and Stiglitz (1998) pointed out, many features of the system, which are regarded as major structural

problems, have been appreciated before the crisis as its strong points. Was the public opinion misguided in this respect ?

(b) The past studies on the East Asian currency crisis from the structuralist perspective have been pessimistic about the prospect of a quick recovery in the region because the long-run problems won't go away so soon.[1] Yet, the East Asian countries *did* recover quickly, 1 1/2 years at most, so that the cycle of their activities *did* take a V-shaped pattern. Did these countries truly succeed in overhauling the long-run structural problems in such a short run?

(c) On the other hand, if it were true that East Asian countries did overhaul their structural problems within 1 1/2 years, then, why could Japan not recover from its much milder recession by just doing the same?

Our paper tries to fix these loose ends of the structuralist perspective. In particular, we will compare the economic performances of two countries, Korea and Japan, which share an important structural trait in common, business inside corporate groups. In so doing, we will pay particular attention to a specific period, the second half of the 90's. Perhaps, our idea can be summarized in the following sentence:

[1]Thus, Corsetti, Pesenti and Roubini (1999) state:
"The question is how long and deep this recession is. In this respect, it has been observed that a contraction in economic activity was also experienced by Mexico after the collapse on the peso in 1994: however, in this country the crisis-induced recession was V-shaped: output fell sharply for about 9 months, but the contraction was followed by a rapid recovery after 1995 and a return to a high growth in 1996. There are many reasons to believe that the East Asian cycle will not take place the V-shaped form of Mexico, and that the contraction in economic activity in the region will last for much longer".

" Japanese recession is long because it is mild, whereas Korean economic crisis was short because it was sharp".[2]

In our quest we presume an important contribution of the IT in enhancing the productivities of the developed countries, especially in the second half of the 90's. At this point, it will be instructive to take the U.S. performance of the 90's into the picture as well.

Figure 1 compares the industrial production of three countries, Korea, Japan, and the US in the 90's. The diagram demonstrates—if there is any need to demonstrate!—that the U.S. have performed much better than Japan in the 90's, although in the 80's the former country has also experienced the stagnation of total factor productivity growth, a phenomena which alarmed Paul Krugman into making his book's title: "The Age of Diminished Expectation".

Fig.1 also demonstrates that there is remarkable correspondence between the real sector and financial markets because the movements of market capitalization in these countries seem to mimic the trends in the industrial productions. In fact, the correlations between the industrial productions and the market capitalization are extremely high except for Japan. (Table 1) This observation allows us to focus on the stock markets in the subsequent discussions although our main interest lies in Korean and Japanese economic performance of this period in general.

[2] In a recent book that critically examined the Japanese Economic System from a structuralist perspective, the author Richard Katz used the following metaphor: If a frog is put in lukewarm water and the water temperature is gradually increased, the frog will be eventually boiled to death, whereas if a frog is thrown into hot boiling water, it will quickly jump out.

The impressionable recovery of the US performance in the 90's is commonly seen as accompanying the advent of the IT revolution. Moreover, most studies on the US economic growth concluded that the drive of the IT on the US productivity growth has been accelerated in the second half of the 90's, the period corresponding to the focus of our study. For example, the study by Oliner and Sichel (2000) concludes that through various channels IT factors account for about the two-thirds of speed-up in labor productivity growth since 1995.

Thus, the past empirical results give us hints that the dismal performance of Japanese Economy in the 90's should be at least partially due to the "non-advent" of the IT revolution there. The IT factor might also have played a major role in making the overall performances of Korea excellent, except for the currency crisis period.

Naturally, this does not imply that financial factors can be dismissed in the account of the economic crisis that hit Korea and Japan. It must usually be the case that a crisis or a boom will be amplified by the interaction of the financial and the real factors. A vast economic literature has been devoted precisely to the theme. Kiyotaki and Moore (1999), for example, has shown that a real shock may be magnified by the mechanism of imperfect financial market so that an initial small shock will be magnified into a great boom or recession. The literature on "creative destruction", on the other hand, has taught us that, depending on the circumstance, a short-run financial shock may trigger or delay a large scale restructuring of the real economy.

In any event, we will focus in this paper mainly on real factors simply because the financial side of the matters has already been the subject of numerous studies. A challenge is, therefore, to what extent one can reconstruct the events from the perspective of real side; Our model focused on the IT revolution can trace the evolution of events after 1995 quite well. Thus, it can complement the past studies conducted from uniquely financial perspectives.

In deriving our viewpoint, we have greatly benefited from the insight of Greenwood and Jovanovic (1999) (henceforth G-J): The arrival of the news that the IT revolution awaits in the future has initially depressed the US stock market because the IT revolution was expected to hurt the firms which are based on the old technology (the incumbents). The recovery of the stock markets had to wait the arrival of new players incorporating the IT revolution. Thus, the movement of the total market capitalization has followed a V-shaped pattern, a decline succeeded by a vigorous recovery.

Looking once again at Figure 1 we can actually find this V-shaped pattern in the industrial production of Korea, during the currency crisis episode, while such a pattern is not discernible for Japan. This is the starting point of our theoretical quest. Based on this theoretical insight, we will reinterpret the events after 1994 as follows:

"Prompted by its socio-economic factors Korea has introduced the IT revolution earlier than Japan. This choice was at least partially responsible for a fall in the Korean total market capitalization after 1995,

while contributing to its recovery after 1999. The currency crisis in 1997 has speeded up the Korean IT revolution further. On the other hand, the procrastination of the IT revolution rendered the Japanese recession milder by extending the remaining life of the incumbents, while barring its quick recovery".

The paper is organized as follows: We will present in section 2, a theoretical model based on G-J. We will introduce two new elements into the original: (a) the choice of timing concerning the introduction of the IT revolution, and (b) a search theory framework that will highlight the role of "complementarities" in determining the choice of timing.

Some preliminary confrontation with data will be conducted in section 3, where we analyze, in particular, the trends of the total market capitalization in Korea and Japan after 1994. The study in Section 4, on the other hand, will focus on the stock price movements based on the assumption that the US stock price indexes, Nasdaq conveys the information on the future dividend streams of the IT firms. We will then confront Korean and Japanese stocks index data with this index and calculate their correlations. The analysis will confirm our theoretical prediction: Closer correlation to Nasdaq can be observed for the Korean stocks for most periods. Section 5 concludes.

2. Theoretical Model

In this section, we will build a theoretical model, following the lead from G-J. They recounts the history of US stock prices since 1973: In that year,

a piece of News: "the IT revolution awaits around the corner" arrived, plunging the stock prices of business based on the old technology into a sharp and prolonged depression. The firms that incorporate the fruits of the IT revolution, on the other hand, were yet to arrive the scene. In fact, they would arrive with almost 15 years of a lag. Thus the initial impact of the News was to depress the total U.S. market capitalization. It is only in the mid-80, when high-tech firms arrived the scene with vengeance, that the stock markets have turned into a bull, to the joy of the Wall Street.

Their theoretical model, accounting this sequence of events, is deliberately kept simple: Initially, all agents possess a tree, which will yield a stream of constant dividends. If they so choose, an agent can sell his tree at a perfect asset market, which will correctly price it at the present value of dividend streams.

Then, a piece of surprise news announces that in T periods hence an "old tree" must be exchanged for a "new tree", the latter yielding a higher stream of dividends. A new tree that will come in future, however, cannot be transacted today. The total market capitalization, therefore, will collapse with the arrival of the news because, contradicting the initial expectation, the life of an old tree—the sole item on the asset market—is now known to be numbered.

We will add two new elements to this model in order to account for the contrasting performance of Korea and Japan: The first element concerns the timing of the IT revolution. We assume that a new tree can be exchanged for an old at two different times, in proximate future or in

remote future. By the introduction of this choice element, we intend to illustrate "procrastination" in the economic reform: Japan's inability to recover from the recession may be due to its procrastination, the postponement of the IT revolution.

The second new element concerns the socio-economic factor that lies behind the timing of the IT revolution: the speed with which IT is introduced into an economy will depend on the socio-economic structure. As we will see, a simple search theory model can illustrate the point.

2.1 The Economic System of Corporate Groups

In their textbook of theory of organization, Milgrom and Roberts (1991) underlined the concept of "complementarities" as a key to understand an economic system. Discussing "the Japan Model", Aoki (1996) stressed the complementarities between the lifetime employment system and the main bank system as the essence of Japanese "contingent corporate governance". In order to motivate our model building it is necessary to begin our discussion by spelling out what we regard as the essential characteristics of "the Japan model"; the Korean Economy also shares these characteristics to the extent that corporate groups play a major role there.

In the Japan model, the relation-specific knowledge accumulated inside a firm or inside a corporate group plays the vital role because the country's system has a principal objective of producing machines, its main export commodities, with fewer defects and in much varieties as possible: Typically, a machine is a product composed of numerous components.

Thus, achieving quality and variety in production will require vertical coordination among insiders—agents belonging to same firm or same corporate group.

Furthermore, the skill of coordination among insiders can be enhanced if the agents undertook the investment into the relation-specific knowledge. This type of investment, however, is risky because they will lose value outside the groups. Hence the necessity of long-term (life-time) contracts—the system's hallmark—to protect the insiders from the risk.

It necessary follows that in this system the business conducted among insiders—the agents belonging to same firm or same corporate group—can generate superior outcomes than those conducted among outsiders on account of a better coordination achieved by the formers. Thus our theory presumes transactions between insiders as the main source of productivity enhancement before the advent of the IT revolution.

The advent of the IT revolution, however, will make frequent exchange of information doable even among outsiders. On the other hand, the IT revolution will make a different type of complementarities of central importance: Since communications using IT is possible if and only if the both ends of communication adopt IT, instead of the old distinction between insiders and outsiders, the new distinction, "the digital divides"—whether or not an agent is equipped with IT and can handle it—will become of critical importance in a "New Economy". This final observation will also be incorporated into our theoretical modeling.

2.2. The Model

We will assume that there are three types of technology in the Economy: N (New), I (Incumbent), and U (Uncommitted). There are also three types of risk-neutral agents, N, I, and U. We make an assumption common in the Search Theory: In every period, an agent meets randomly with another to conduct a business, the payoffs of which will depend on the matching of types.

However, in time 0, which we call "the current time", type N agents are yet to appear on the stage so that only two types, U and I populate the Economy.[3]. Assume that the population size in this economy is 1. (We will also denote by symbols U and I the population shares of U and I in time 0: U+I=1)

Following the scenario of G-J, we assume that a surprise awaits this Economy at the end of time 0: At this precise moment arrives a piece of "News", telling that each agent, irrespective of whether he is U or I currently, will have an opportunity to exchange his tree for a type N tree to become a N type agent. Moreover—and here is our departure from G-J—this exchange can be made either in the proximate future time, P, or in

[3] "Incumbent" is the term that G-J used. In our interpretation, "Incumbents" represent the insiders of the system, namely the entrepreneurs and the workers who are tied up by long-term contracts to the same firm or to the same corporate group, while "Uninvolved" are the outsiders who are not tied up by such contracts.
Our subsequent discussion will leave out why there are 2 different types of agents, U and I, at the beginning. We can justify this assumption by supposing that there was a Pre-History stage of the game in which only U type agents populate the Economy. Furthermore, U type agents can choose to become I type agents by making investment for acquiring the relation-specific knowledge. The amount of the investment required to become I type, however, are different depending on the agents. For some, given the expectation of the future excess gains from becoming I type, the investment costs are prohibitively high; this is the reason why some will remain type U at the start of our game.

the remote future time, R, where $0 < P < R$. If he so chooses, an agent need not exchange tree at all.

In order to examine their choices—whether or not to switch to the new tree and when—we first have to specify the nature and the outcome of transactions between agents. We assume that at each round of this transaction an agent will bring "a log" obtained from his tree. Two pieces of log brought by two agents will, then, be composed into "machines", the production level of which will depend on the matching of types: Higher production levels can be achieved from the process if it is undertaken either by two type I agents or two type N agents. The following production function incorporates this observation. Let Q be the production level of "machine", then:

$$Q = 2 (1 + i\Gamma + n(t) \Sigma) \quad ,$$

Where:

Γ takes 1 if the production is conducted between two type I agents and 0 otherwise, while Σ takes 1 if the production is conducted between two type N agents and 0 otherwise. Moreover, $n(t) = n$, if $P \leqq t < R$, and $n(t) = n^*$, if $t \geqq R$ $(0 < i < n < n^*)$.

Our production function reflects that fact that a higher productivity can be achieved either through a better coordination among insiders or through a better coordination using IT. We assume that produced machines will be divided between agents by a Nash bargaining process: If the bargaining negotiation is broken up, each agent has the outside option of taking back his log and sells it at the market at price 1. Given this

outside option, agents will divide up evenly any extra-gain from the production process through bargaining.

To summarize, before the advent of type N tree the payoff structure for two types, I and U, are as described in the next table:

Type	*I*	*U*
I	$(1+i,1+i)$	(1,1)
U	(1,1)	(1,1)

If the incumbent type I meet his type, both will obtain (1 + i). For any other encounters, the payoff will always be 1.

On the other hand, after the introduction of type N tree, the payoff structure for the three types will become:

Type	*N*	*I*	*U*
N	*(1+n(t), 1+ n(t))*	*(1, 1)*	*(1, 1)*
I	*(1, 1)*	*(1+i, 1+i)*	*(1, 1)*
U	*(1, 1)*	*(1, 1)*	*(1, 1)*

As we have specified, n(t) = n, if $P \leqq t < R$, and n(t) = n*, if $t \geqq R$.

($0 < i < n < n^*$).

Let us assume that after time R, a new tree delivered at time R and a new tree delivered at time P will become identical. In order to simplify the analysis we will also make a small country assumption: there is an outside market of a safe asset in which the interest rate is fixed at r.

Based on the above payoff tables we can now calculate the asset prices of the trees: First, notice that since type U agent will always get 1 the tree will have the present value of 1/r at the beginning of time 0.

Under our assumption of risk-neutrality and a perfect capital market, the latter will be the beginning of time 0 stock price of a type U tree:

$$S_0(U) = \frac{1}{r}$$

Confronted with the opportunity to exchange his tree for type N tree at time P, however, all type U agents will do so. To see the point, first notice that if a type N tree is introduced in time P, its expected payoff in the interim period between P and R will be:

(1) $E_t(N) = N(1+n) + (1-N) = 1 + Nn, \quad P \le t < R$.

Since the expected payoff above will never be smaller than 1 and strictly greater than 1 if at least a fraction of people shift to a type N tree, we can conclude that all type U agents will switch to a type N tree in time P.

Type I agent, however, will not necessary be better off by switching to a new tree in the proximate future. In fact, he may be better off by postponing the exchange to the remote future. To see the point, taking account of the fact that all type U agents will switch to type N, let us rewrite (1) as:

$$E_t(N) = (1+n)(U+\delta) + (1-U-\delta) = 1 + (U+\delta)n, \quad P \le t < R$$

where "δ" represents the ratio of type I agents who are expected to switch to type N at time P. On the other hand, if he stayed with type I tree, the expected payoff of a type I agent will be:

$$E_t(I) = (1+i)(1-U-\delta)$$

Therefore, the difference between E_t (I) and E_t (N), Δ, will be:

$$\Delta \equiv E_t(I) - E_t(N)$$
$$= 1 + (1 - U - \delta)i - 1 - (U + \delta)n$$
$$= (1 - U - \delta)i - (U + \delta)n$$

Suppose that δ = 0: no type I agent is expected to exchange his tree for a new one. Then, if

(2) $$\frac{1-U}{U} > \frac{n}{i} \quad ,$$

namely, the ratio of incumbent is sufficiently large, the incumbent will indeed be better off by sticking to a type I tree, at least for a while. Thus, there is an equilibrium in which type I will stay with the old technology.[4]

Hence, the Economy may pass the opportunity to shift to "New Economy" in the proximate future. But, what will happen later? Here we are interested in a particular scenario in which the Economy will, indeed, shift to the "New" in the remote future because our objective is to mimic the long-run stagnation of Japan. Suppose that the following inequality condition is satisfied after time R:

(3) $$\frac{1-U}{U} < \frac{n^*}{i} \quad ,$$

Then from the preceding discussions it should be clear that an incumbent will be better off by switching to a type N tree even if his expectation is: "all other incumbents will stay with the old tree". But, in this case such an expectation will not be rational. Hence, "all incumbents will switch to N"

[4] This is only one of the multiple equilibria because if all agents have opted for a new tree at period P, i.e. δ = 1, (3) will become –n so that the switching to a new tree will, in fact, produce a higher payoffs to a type I agent. In other words, there will also be an equilibrium in which everybody shifts for the new technology. We assume that in this situation, "inertia" will settle the matter. No incumbent will risk a decline in his payoff by exchanging his old tree for a new one unless he is perfectly sure that other incumbents will reciprocate his action.

is the only rational expectation equilibrium. In short, (2) and (3) together constitute the necessary conditions for "procrastination".

2.3. Asset Market Equilibrium

We will next characterize the stock price of a new tree under the following two scenarios:

(P): The incumbents have opted for a new tree at time P.

(R): The incumbents have opted for a new tree only at time R.

Let's consider scenario (P), first. In this scenario, a new type will meet another new type with a probability 1 from time P onward. Hence, everybody will obtain payoff of (1+n) in the interim and (1+n*) in the remote future. The total market capitalization of this economy, M_p, will be identical to the stock price of a type N tree from time P onward because it will be the only asset in this Economy:

(4) $M_P(n,r) = S_P(N) = \frac{1+n}{r} + z,$ under scenario (P),

where $z = (n^* - n)/r(1-r)^T$, $T = P - R$

Next, consider scenario (R). In contrast to the previous scenario, there will now be two types of agent, N and I, in time P. In order to calculate the total market capitalization, therefore, we have to calculate the weighted average of the two types of stock, N and I.

Firstly, a former type U agent will hold a type N tree from time P onwards, the stock price of which at time P will be:

(5) $S_P(N) = \frac{1+Un}{r} + \frac{n(1-U)}{r(1+r)^T} + z$, under scenario (R).

On the other hand, a type I tree, which has the remaining life of T at time P. will have the stock price:

(6) $S_P(I) = \frac{\{1+(1-U)i\}\{1-(1+r)^T\}}{r}$, under scenario (R).

The total market capitalization at time P, M_p, under scenario (R) will be the weighted average of (5) and (6):

(7) $M_P(n^*, n, r; i, U, T) = (1-U)S_P(I) + US_P(N)$,

under scenario (R).

(7) shows that, in contrast to scenario (P), in which only 3 parameters, n, n* and r, were enough for the prediction of the market capitalization, 3 more parameters, i, U and T, must be taken into account for the same purpose under scenario (R).

2.4. Dynamics of Stock Prices

Let us now go back to time 0 and see how the stock price will change as the result of the arrival of the News. At this time, the News will make clear that the incumbent technology will die in future. So the current stock price, which has been determined under the assumption of infinite income streams, will collapse in any event.

However, since the incumbent technology has a longer remaining life if the incumbents choose to procrastinate, the total market capitalization will decline by less under scenario (R). Specifically, the decline will be less by the following value, X:

$$X = \frac{(1-U)S_P(I)}{(1+r)^P}.$$

In order to see the movements of the total market capitalization, it should be also noted that while the stock price of type I tree will eventually decline to 0 from the current level this decline will be spread over a longer time span under scenario (R).

In other words, if the incumbents opt for an exchange with a type N tree in the proximate future, the Economy will experience a shaper decline in its stock prices but will also enjoy a faster recovery. While if the incumbents procrastinate, the Economy will experience a milder but will also suffer from a prolonged depression. In short, Figure 2 summarizes these trends in the total market capitalization under the two scenarios.

2.5. The Effects of Financial Crisis

Our analysis that focused uniquely on the real factor, the IT revolution, seems to explain the contrasting performance of the two players quite well: the mild, yet long-lasting stagnation of Japan, on the one hand, and a sharp recession followed by a quick recovery in Korea, on the other. Accounting the performances of these economies in the 90's, however, we cannot dismiss the importance of purely financial factors, the birth and bust of Bubble Economy in Japan and the currency crisis in Korea. etc.

There are various channels through which financial and real factors can interact, especially in the genesis of a great boom or recession. For example, a positive impact of the IT revolution may be magnified into a

great boom by triggering credit expansion, while a financial shock, by affecting business strategies, may accelerate or retard the IT revolution.

It is beyond the scope of the present paper to deal with the effects of the real shock on triggering credit expansions. However, the second channel, the effects of a financial shock on the real factor (the IT revolution) cannot be neglected because, as we will see shortly, a glance on the data suggests that this channel has worked strongly in Korea.

In recent years important contributions have been done on the literature of "creative destruction", on the question of whether or not a temporary shock will stimulate the economy's drive to restructure its obsolete technology. The view that a negative shock is favorable for the restructuring, and thus favorable also for the long-run performance, was neatly summarized by Aghion and Saint Paul (1993), which begin by a quotation of the famous words by Joseph Schumpeter: "Recessions are means to reconstruct the economic system on a more efficient plan". Their main argument is that a negative temporary shock tends to accelerate the restructuring by lowering the entry costs for the new firms and by reducing the opportunity costs of resources that are needed for R&D.

On the other hand, in a series of articles, Caballero and Hammour (e.g. 1999) emphasized the reform-retarding effects of negative temporary shocks. The innovation and the starting of new business require new investments, while due to the imperfection of capital market an entrepreneur must finance a part of investments by his own liquid assets rather than relying entirely on the external sources. A recession that will

depreciate the liquid assets of entrepreneurs will, thus, hamper the new investments.

Our theory may also contribute to this debate because a short-run macro/financial shock may also affect the timing of the IT revolution. In the East Asian crisis, traditional players, such as Banks and Corporate Groups because, have been seriously damaged and, as a consequence, they were heavily indebted. Hence, the bulk of the future revenues must be used to pay back the debts rather than to reward the players themselves.

Such an effect can be incorporated in our model as the change of parameter i, the payoffs to type I tree. A severe shock that will reduce the payoffs of incumbents will reduce the option value of I, affecting, in turn, their choice of the timing: Since the option of cringing to the old technology has now lost value, they might be tempted to opt for New Technology sooner. In other words, a short-run financial shock may accelerate the IT revolution.

It may well be the case that while a severe recession, e.g. the one that hit Korea in 1997, can trigger a speed-up in the shift to New Economy, a mild one, e.g. one into which Japanese economy has fallen, is less likely to generate such a reaction. Korea might have recovered from the recession quickly because it was severe!

3. Preliminary Empirical Analysis

In summary, our theoretical analysis of the last section predicted that under the following presumption, 4 propositions (P1-P4) would follow:

(Presumption) Between Korea and Japan, the share of uninvolved players, U, is greater in Korea than in Japan.

(P1) Both in Korea and in Japan, the uninvolved players (U) will shift to the new technology (IT) at the first opportunity.

(P2) The behavior of the incumbents (I) in the two countries will be contrasting: while in Korea, the incumbents will also promptly shift to the new technology (IT), the incumbents will stick to the old technology at least for a while in Japan.

(P3) Reflecting the contrasting behavior of the incumbents, the trends in the total market capitalization of the two countries will also diverge, in the manner predicted by Figure 2: Korea will follow a V-shaped pattern, an abrupt decline followed by a vigorous recovery, while Japan will follow a prolonged gradual fall.

(P4) A severe temporary macro/financial shock, the kind of which Korea has suffered during the currency crisis, may accelerate the shift to a new technology further by depreciating the option value of incumbent sectors.

The presumption and Propositions P1-P4 are, at least to some extent, empirically testable. Our primary works in this respect are shown in this section and the next.

3.1. Structural Differences between Korea and Japan

While the incumbents have a strong presence both in Korea and Japan—and to some extent the past excellent performances of these countries are due to their contributions—there are several important structural differences between two countries. Here we will focus on the two aspects that highlights a more prominent role of "U" in Korea:

(a) The share of younger generations in total population

(b) Freedom of entry for new firms

Regarding (a), we will be able to presume that a greater share of younger generation in a country represents a greater share of U. In fact, those who newly come to labor market do not have past experiences in an organization; they are, therefore, free from the old system. Generally speaking, younger generations have less experience in the incumbent firms so that they have fewer problems in switching jobs. Thus, their stakes in the incumbent system is smaller.

Regarding (b), on the other hand, we should be able to presume that more frequent entry of new firms represents a greater share of U. In fact, a new business that is created from a scratch will have less sunk

investment into the old system. Moreover, a frequent entry will imply that Old System has a less hold on the market at large. G-J also stressed the leading role that new entrants played in IT revolution in the U.S.

Let us confirm (a) and (b) with data:

(a) younger generations' share in the society.

In fact, Korea is a much younger society. Its percentage of the population aged over 60 years old (slightly over 10 %) is about the half of Japan, whereas the percentage in Korea of less than 15 years old is 3 to 4 % higher than the Japanese percentage.

Moreover, also from the standpoint of the age decomposition of actual workforce, Korea is a much younger society. In 1994, slightly over 40 % of Korean workforce was less than 35 years old, while the Japanese percentage was slightly over 30 %. On the other hand, in 1999, the Japanese workforce that has age over 45—the age group for whom finding a Job is extremely difficult in the Japanese Job market—was reaching almost 50%, while this group represented mere 35% in Korea.

Thus, as far as the share of youth is concerned, we can confirm that the share of U is greater in Korea.

(b) The entry of new firms

In Korea, the number of listed companies has risen from the level in 1990, while, in Japan, the number has decreased. The average annual growth rates in the number of listed companies can be calculated as follows: 0.93% in Korea while – 0.64% in Japan. Thus, from the standpoint of the

freedom in the entry of new firms, we can also conclude that U takes a larger value in Korea.

A stock market data also reveals the prominence of U in Korea. It is well known that the presence of new firms is more pronounced in the over the counter markets than in the stock exchanges because the later have stricter criteria for the listing, e.g. a longer record of profits.

Thus, the importance of the over the counter market relative to the stock exchange may serve as the index of the presence of new firms. G-J has also used this idea extensively in their empirical analysis.

Figure 3 summarizes the importance of the over the counter markets relative to the stock exchange in Japan and Korea from the perspective of the market capitalization. This figure tells a remarkable story: First, in the end of 1997 the market capitalization of JASDAQ, which was until the beginning of 2000 the sole over the counter market in Japan, represented about 3.4% of the market capitalization at Tokyo Stock Exchange. While, at the same moment, KOSDAQ, the Korean over the counter market created in 1997, represented about 6.8% of the Korean Stock Exchange.

However, the picture changed dramatically by the end of 1999: By that time, JASDAQ's ratio to the Tokyo Stock Exchange has increased to about 6.2 %, while KOSDAQ's ratio to the Korean Stock Exchange has exploded to 26.7%!

On the whole, the table confirms the greater presence of non-traditional players in Korea.

3.2. The Trends in the Market Capitalization

Next, we will inspect whether the actual data confirm the movement in total market capitalization that our theory has predicted. We do not contend that the movements of the total market capitalization in the whole period of the 90's can be explained by the IT revolution because such a contention will be false.

For example, the 1991 episode, namely, the collapse of the Japanese stock price from its peak should be accounted by the collapse of the Bubble Economy, or to the restrictive monetary policy that has triggered it. It should also be noted that around the time, Korea has still been enjoying rising stock prices.

There is, however, a sub-period in the 90's, in which the movements in the total market capitalization in Japan and Korea fit our theoretical prediction remarkably: the sub-period after 1994. (Figure 4)

In fact, a comparison with our theoretical prediction shows almost literal correspondence in many aspects:

(I) The Korean total market capitalization has started to decline from 1995, while the decline in the Japanese total market capitalization has started at least one year later. Furthermore, the decline in the total market capitalization in Japan has been much milder compared to Korea.

(II) From its bottom in 1997, the Korean total market capitalization has recovered remarkably in 1999. The movement of the total market capitalization of Korea has shown a clear V shaped pattern. On the other hand, the total market capitalization continues to decline until 1999 in Japan.

Thus, the overall picture of the total market capitalization in the two countries after 1994 confirms our prediction, P 3. We will, henceforth, focus on this period and further examine the data to see what has happened behind the scene.[5]

3.3. Trends in the Stock Markets

Figure 5 portrays the market capitalization of 5 stock markets, JASDAQ and TOPIX in Japan, KOSDAQ and KOSPI in Korea and NASDAQ in the U.S.

[5] The diagram of market values in two countries has important implications in interpreting three puzzles surrounding these countries:

a. The Korean total market capitalization has already shown a downward trend from 1994 while the economy was hit by a currency crisis in 1999. Thus, the initial decline cannot be attributed to the currency crisis. Our theory cast a new light upon the reason why the market capitalization went downward, reaching the bottom during the currency crisis episode.

b. The conventional view on the Korean economic crisis in 1997 maintains that its cause was a liquidity problem: the shortage in the foreign reserves. While this view can explain why Korea has quickly recovered its total market capitalization to its pre-crisis level, it cannot explain why the total market capitalization has reached the level far higher than the pre-crisis level in 1999. Our theory can also provide an answer to this puzzle.

c. 1997 was, for Japan, a disappointment. The Economy had started a mild recovery from 1995 onward. From 1997, however, the situation has turned to the worse. Conventional interpretation of this reversal was that the increase in consumption tax that Hashimoto government introduced in 1997 has asphyxiated the economic recovery. Our theoretical prediction casts a new light on this turn of event: It was the delayed introduction of the IT revolution that awaits the country around the corner that has triggered the downward trend of the total market capitalization in 1997.

This one diagram supports our contentions, especially the three propositions, P1, P2, and P4, quite well by revealing the following facts:

In 1999, namely slightly over 1 year after the currency crisis, the market capitalization of the Korean over the counter market, KOSDAQ, has literally took a jump. But also the Japanese over the counter market, JASDAQ, followed the trend. What is contrasting between the two countries, however, are the performances of the major stock exchanges: Whereas the Korean stock exchange, KOSPI, followed the trend of the over the counter markets, albeit diminutively, the Japanese stock exchange, TOPIX, has been stagnant and did not follow the trend at all.

Thus, the diagram seems to confirm our main hypothesis: The uninvolved players in the both countries, as well as the incumbents in the country in which the share of the uninvolved is great, Korea, all followed the trend set by the New Economy. Only the incumbents in the country in which the share of the uninvolved is small, Japan, did not follow the trend. Furthermore, the fact that the big jumps in the market capitalization happened in 1999 suggests a positive contribution of the short run severe crisis in accelerating the trend, confirming P4 as well.

4. The Co-Movement of the Stock Markets

In this section, we will provide some evidences on our central hypothesis: Korea has chosen the timing of IT revolution earlier than Japan. As our theoretical analysis has shown, market capitalization will reflect the dividend stream to the new technology if the Economy has accomplished a

transition to “New”, while it will also reflect the dividend stream to the incumbent technology if the transition was not accomplished yet.

Contrary to our simple theoretical model, the dividend stream in the real world will be subject to uncertainty. In fact, when new information arrives, the expectation on the dividend stream also changes. This should be especially important for high-tech stocks because its expected dividend will be particularly sensitive to new information, such as a news of a scientific discovery. Hence, by reading the stock prices we can observe, to some extent, the type of information, good or bad, which is current in the market. Our analysis in this section will be based on this observation.

Specifically, we will extensively use the information that two US Stock Indices, NYSE Industrial index and NASDAQ, convey. We assume that, while both indices convey a wide variety of information, more information concerning the incumbent system can be found in NYSE rather than NASDAQ, and vice versa. Then, we will analyze the correlation between Asian stock indices and the two US indices in order to extract the information on the market capitalization functions.

Although we focus on the risk premium of stock indices over safe assets, our interest in this section does not reside in the mean or the variance of the level of risk premium per se. There is, of course, an important literature on this subject: how risk premium is determined in equilibrium and how the risk premium actually observed in the market

can be reconciled with the prediction based on a standard asset-pricing model, etc.

We will sidestep this issue because the aim of our analysis is to detect from the data on the risk premium structural changes in the markets due to the progression of the IT revolution: If the risk premiums in Asian market jumped simultaneously with NASDAQ, the high-tech market par excellence, and/or if the correlation of the Asian risk premiums to that of NASDAQ significantly increased in certain periods, we may be able to conclude that the Asian markets became more like New Economy because their behavior become quite similar to NASDAQ, the prototype New Economy market.

4.1 Data Set

Let us mention on our data set, first. It will cover three countries, Japan, Korea and the United States, and will contain 3 categories of data:

(I) Market Data for Korea and Japan:

The two types of market are the focus of our study: the stock exchange and the over the counter market. We assume that type I players, the incumbents, will have a stronger presence at the stock exchange, while type U players, the uninvolved, will have a stronger presence at the over the counter market. This imply that we need data on 4 markets (2 countries times 2 types) for the purpose of detecting the information on 2 types of player, N and I.

For Japan, we will use the data of TOPIX index, the stock exchange, and of JASDAQ index, the over the counter market.[6] For Korea, we will use KOSPI index (taken from the homepage of Korean Stock Exchange), the stock exchange, and KOSDAQ index (taken from the homepage of KOSDAQ), the over the counter market.

(II) Market data for the US

In order to see the market evaluation of old and new technologies, we will use data on two US indices: NYSE industry index (taken from the homepage of New York Stock Exchange) is assumed to represent the market evaluation of the incumbents, while the NASDAQ Composite (taken from the homepage of American Stock Exchange) that of New Economy.

(III) The Interest Rates on Safe Assets

In order to control the general macroeconomic factors, we will use data on the interest rates of the safe assets in US, Japan and Korea. The data we will use for Japan and Korea are the overnight call rates of the respective country (taken from the Nippon Tanshi and from the Bank of Korea), while our US data is the Fed Fund Rate (taken from the homepage of the Federal Reserve Bank at Chicago).

[6] The author appreciates the Tokyo Stock Exchange for providing this data.

For three countries, we will use daily data for the sample period between January 6th 1995 and August 22nd 2000. The data series, therefore, cover 1226 workdays (T=1226 work days). One exception is the data series for KOSDAQ, the starting date of which corresponds to the opening of the market: January 1st 1997. This series ends on August 22nd 2000 (T=794 work days).

We will divide the samples into 3 periods because our interest lies in the trends of Korean and Japanese stock markets before and after the currency crisis. Our choice of the sample periods are as follows:

The first period (Pre-Crisis): January 4th 1994 to January 24th 1997.

The second period (Crisis): January 25th to July 16th 1997.[7]

The third period (Post-Crisis): July 17th 1998 to August 22nd 2000.

For three countries in question, Korea, Japan, and the United States, we will first calculate "the excess rate of return", namely, the excess of the rate of return from a stock index in one country over the riskless rate of return in that country. This exercise aims at excluding the macro-economic factors from the stock returns so as to extract the idiosyncratic information on the sectors covered by the indices. Specifically, the dollar denominated excess rates of return on each indices are calculated as:

[7] We have chosen the crisis period based on the following considerations: The collapse of Hanbo steel company, which was regarded as the precursor of the Korean crisis happened in January 1997, while its over the counter market Kosdaq opened in that month. On the other hand, the short run interest rate of Korea, a main indicator of the policy stance in the middle of economic turmoil, returned to the pre-crisis level around July 1998.

$$r_{m,t}{}^{i} = \frac{e^{i}{}_{t}}{e^{i}{}_{t+1}}\{\frac{p^{i}{}_{t+1} - p^{i}{}_{t}}{p^{i}{}_{t}} * -r^{i}{}_{f,t}\}$$

where $r_{m,t}{}^{i}$ is the excess rate of return at time for index i, $e^{i}{}_{t}$ the exchange rate per dollar at time t for country i (=1 for the case of the U.S.), $p^{i}{}_{t}$ the price of the index at t for index i, and $r^{i}{}_{f}$ the riskless rate of return at t for country i. All the excess returns are annualized.

In what follows, we will first test whether the jump in the market capitalization that we have observed in Fig.5 truly represents a structural break. (Section 4.2) Then, we will go on to analyze the characteristics of these indices by creating a "old vs. new" index (Section 4.3).

4.2. Structural Break

As the inspection of Fig.5 in section 3.3 has revealed that all the market capitalization of the Asian markets, except that of TOPIX, experienced a jump in 1999 and, moreover, the jumps in these markets closely correspond to the timing of the NASDAQ jump in 1999. We will test, in this section, whether these changes are statistically significant: whether there was any statistically significant change in the mean excess rate of return for six indices (4 Asian indexes plus NASDAQ and NYSE).

In particular, under consideration will be the structural break between the following pairs of periods:

1) between the 1st (Pre-Crisis) and the 2nd (Crisis),

2) between the 2nd (Crisis) and the 3rd (Post-Crisis),

3) between the 1st (Pre-Crisis) and the 3rd (Post-Crisis).

For this purpose, we first define both the mean and the variance of the excess rates of return as follows:

$$(\mu^{j1}{}_{m,t}, \mu^{j2}{}_{m,t}, \mu^{j3}{}_{m,t}) \text{ and } (\sigma^{j1}{}_{m,t}, \sigma^{j2}{}_{m,t}, \sigma^{j3}{}_{m,t})$$

where $\mu^{j1}{}_{m,t}$ is the population mean excess rate of return in the first period for index j, $\sigma^{j1}{}_{m,t}$ the population variance of the excess rate of return in the first period for index j. The mean and the variance for the other periods are similarly defined.

The null hypothesis for all the indices between the first and the second period is therefore:

$$H_0 : \mu^{j1}{}_{m,t} = \mu^{j2}{}_{m,t}$$
$$H_1 : \mu^{j1}{}_{m,t} \neq \mu^{j2}{}_{m,t}$$

The null hypotheses for other periods are defined in a similar way. Then we consider the following test statistic for the above null hypothesis by employing a central limit theory:

$$t_{12} = \frac{\hat{\mu}^{j1}{}_{mt} - \hat{\mu}^{j2}{}_{mt}}{\sqrt{\frac{\hat{\sigma}^{j1}{}_{mt}}{n_1} + \frac{\hat{\sigma}^{j2}{}_{mt}}{n_2}}}$$

where n_1 is the number of observations for index j, $\hat{\mu}^{j1}{}_{mt}$ the sample mean excess rate of return for index j, and $\hat{\sigma}^{j1}{}_{mt}$ the sample variance for the mean excess rate of return for index j in the first period. The test statistic

for the other pair of periods is similarly defined and the statistic will follow a t distribution in large samples.

The results of the tests are reported in Table 2. It reports the t-value for each test. To summarize:

Between Crisis and Post-Crisis: the change in the mean excess rate of return was significant at 95% level for JASDAQ and KOSDAQ and was significant at the 90% level for KOSPI.

Between Pre-Crisis and Post-Crisis: the change was significant at 95% level for JASDAQ and KOSPI.

The statistical results thus confirmed the intuition we have derived from a casual inspection of Fig.5: Both in Japan and Korea, the over the counter market, representing the uninvolved, experienced a structural break in the post crisis. In Korea, the stock exchange, representing the incumbents, also experienced a structural break in the same period. It is only the Japanese incumbents, supposed to be represented at the stock exchange, which have been immune from the structural break.

4.3 The Old vs. New Indices

Finally, we will create an index that may illustrate, to some extent, the relative positions of Old vs. New in each stock markets. (Let us call this Old vs. New index) The index will help us to compare the characteristics of Korean and Japanese stock markets.

Our analysis focuses on the correlation between the markets: An Asian market that has a closer correlation to NASDAQ rather than to NYSE will be regarded as a market representing New Economy, and vise versa. Our methodology derives its justification from the fact that NASDAQ is universally regarded as the prototype New Economy market. Then a market that behaves almost like NASDAQ should also be regarded as another New Economy market. Hence the correlation between an Asian market and NASDAQ is the key in detecting "the new economy-ness" of the Asian market. The correlation with the other US stock market was also taken into account in order to detract the general trend in the US stock market.

As a first step, we calculated the non-overlapping correlations between indices. To illustrate our procedure, let's take the 30-day correlation between NYSE and TOPIX as an example:

$$Cor_t(R_{m,t}^{TOPIX}, R_{m,t}^{NYSE}) = \frac{1}{N}\sum_{i=t}^{N}\{(R_{m,i}^{TOPIX} - \overline{R_{m,t}^{TOPIX}})(R_{m,i}^{NYSE} - \overline{R_{m,t}^{NYSE}})\}$$

where $\overline{R_{m,t}^{TOPIX}}$ is the sample mean rate of return on TOPX index, $\overline{R_{m,t}^{NYSE}}$ the sample mean rate of return on NYSE index and N equals 30 in this example.

Our next step is to derive the non-overlapping series of correlations. In other words, in calculating correlations based on the above formula, we took the value of t as t = 1, 31,61,…, T-30 (T represents the number of observations, equal to 1226 for all the data except for KOSDAQ). These series do not contain any overlap of dates because we use observations for

the first correlation has the starting date t = 1, while the ones used for the second correlation has the starting date t = 31, and so forth.

For our purpose of investigating whether or not stock indices of Japan and Korea represent the same tendency of NASDAQ (New Economy) rather than that of NYSE (Old Economy), we next calculated differences of the correlation series. To illustrate the process, let's take TOPIX as an example:

$$DifCor^{TOPIX}{}_t \equiv Cor_t(R_{m,t}{}^{TOPIX}, R_{m,t}{}^{NASDAQ}) - Cor_t(R_{m,t}{}^{TOPIX}, R_{m,t}{}^{NYSE})$$

In other words, the above index represents the difference between the correlation to NASDAQ excess return and that to NYSE excess return of TOPIX excess return. The indices for JASDAQ, KOSPI and KOSDAQ are similarly defined.

As this is the difference between correlations, it can take the value between –2 and 2. If the value defined above is larger than zero, TOPIX is more correlated with NASDAQ than with NYSE, and vise versa.

As the final step to derive our "Old vs. New index", we summed the above index over time:

$$AcmDifCor^{TOPIX}{}_t \equiv \sum_{i=1}^{t} DifCor^{TOPIX,NSADQ-TOPIX,NYSE}{}_i$$

In other words, we have summed over the entire time span up to a specific point in time, t, of the differences of correlation. Thus, the index might be thought as the average score up to a specific point in time.

The reason why we constructed our “Old vs. New index” this way is the following: Since the correlation itself is a highly volatile indicator, summing up is necessary to see how on average Korean and Japanese stock indices behaved up to a specific date. Our “Old vs. New indices”, which in fact represents the accumulated correlation differences, were thus calculated for TOPIX, JASDAQ, KOSPI and KOSDAQ.

We will next illustrate our results with the help of diagrams.

Figure 6 and Fig.7 plot the difference of correlations themselves, not the accumulated ones. Fig.6 represents the results for two Asian over the counter markets starting from 1994 (from 1997 for KOSDAQ). The horizontal axis represents the time interval while the vertical axis the difference in the correlation: Difcor. A higher value on the vertical axis implies a stronger correlation with NASDAQ while a lower value a stronger correlation with NYSE. It seems that the KOSDAQ index moves more closely with NASDAQ than JASDAQ does.

Figure 7 considers the correlations for Japan and Korea stock exchanges starting from 1994. From a simple visual inspection, it is hard to obtain any clear-cut conclusion. Thus we resort to our “Old vs. New index”, namely the accumulated differences of the correlation.

Fig. 8 plots this index for two over the counter markets: JASDAQ and KOSDAQ, while Fig. 9 plots the same for two stock markets: KOSPI and TOPIX. It is now clear that, compared to KOSPI, TOPIX has represented a stronger tendency toward “New” at early periods, yet it

became more representative of “Old” later, especially after the currency crisis. On the other hand, the comparison of the two over the counter markets reveal that, while KOSDAQ represents a higher tendency for “New”, the two indices represent quite similar tendencies.

Thus, the analysis based on our “Old vs. New indices” once again confirmed our predictions: While the uninvolved players (the over the counter markets) quickly adopted the strategy to become new players in both countries, those that the incumbents adopted have been contrasting in two countries: a quick conversion toward the New in Korea and stay with the Old in Japan.

5. Concluding Remark

In this paper we claimed that the choice of timing concerning the transition to New Economy is a factor that can, at least partially, account the contrasting performances of two countries: Japan, which is suffering a mild yet long-run recession, and Korea, which has suffered a severe crisis yet recovered in a short period.

Our theory points out a key factor that determines the timing of transition: It is the weight in the economy of those who have been not involved in the incumbent system, e.g. the young generation and new firms, which decides the timing of the transition.

Our empirical analysis has also shown that Korean stocks have started to show a higher correlation to NASDAQ index—an index in which the weight of New Economy is high—rather than NYSE index—in which

Old Economy is more prominent—at an earlier date compared to Japanese stocks

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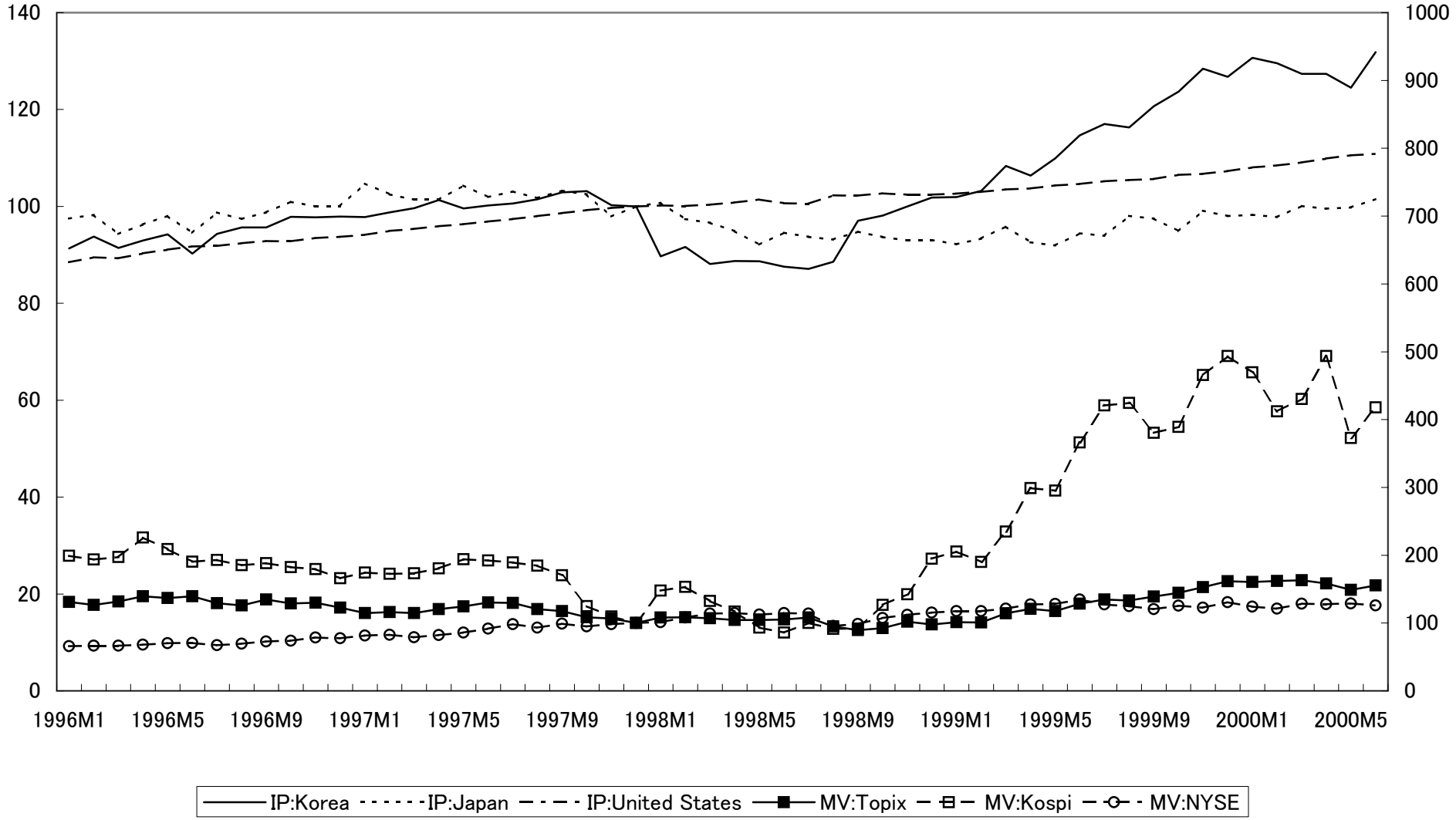
Figure 1:
Industrial Production(IP, Left Axis) and Market Capitalization (MV, Right Axis)



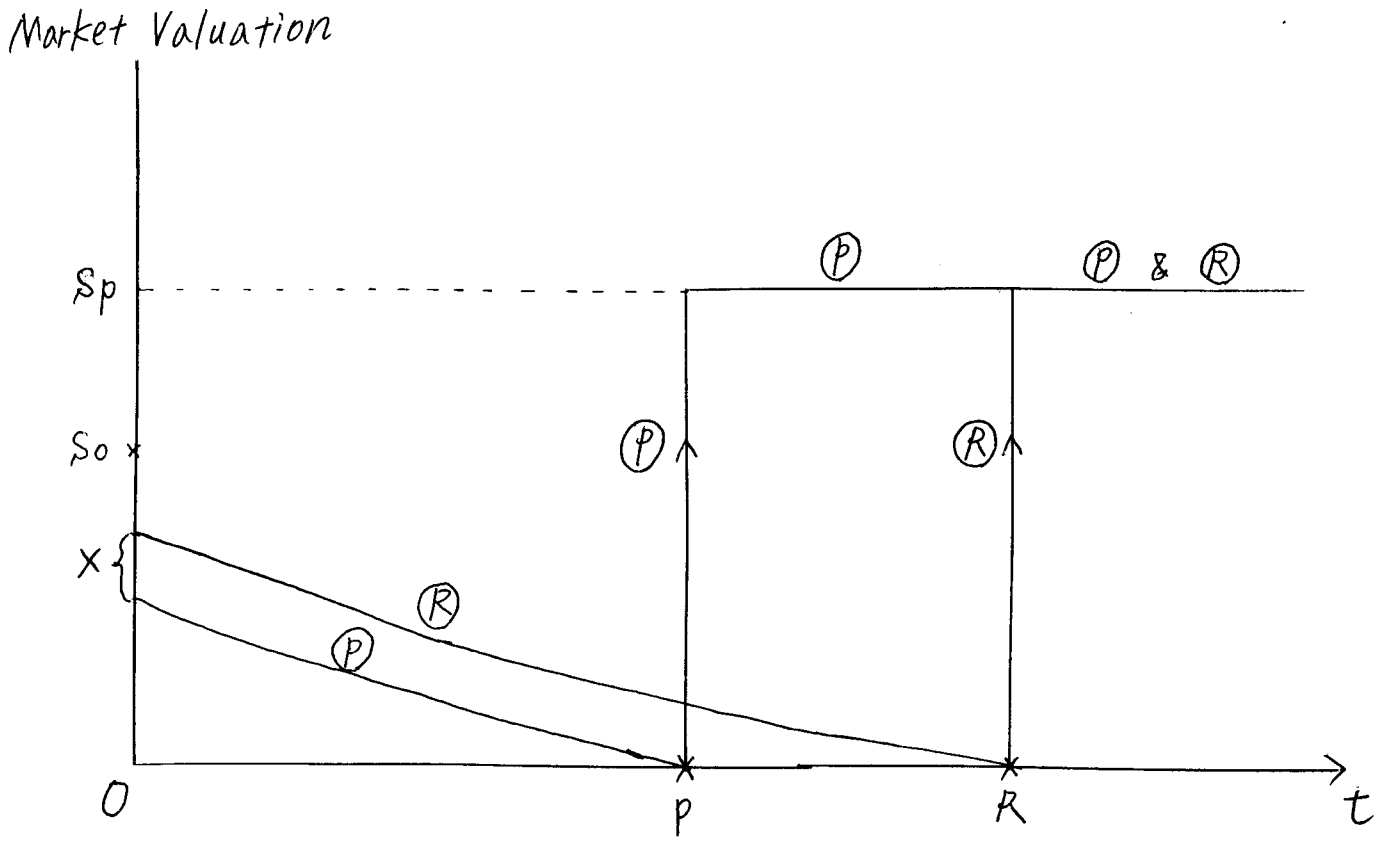

Market Valuation
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Figure 3: The Ratio of Market Capitalization in Local Currencies

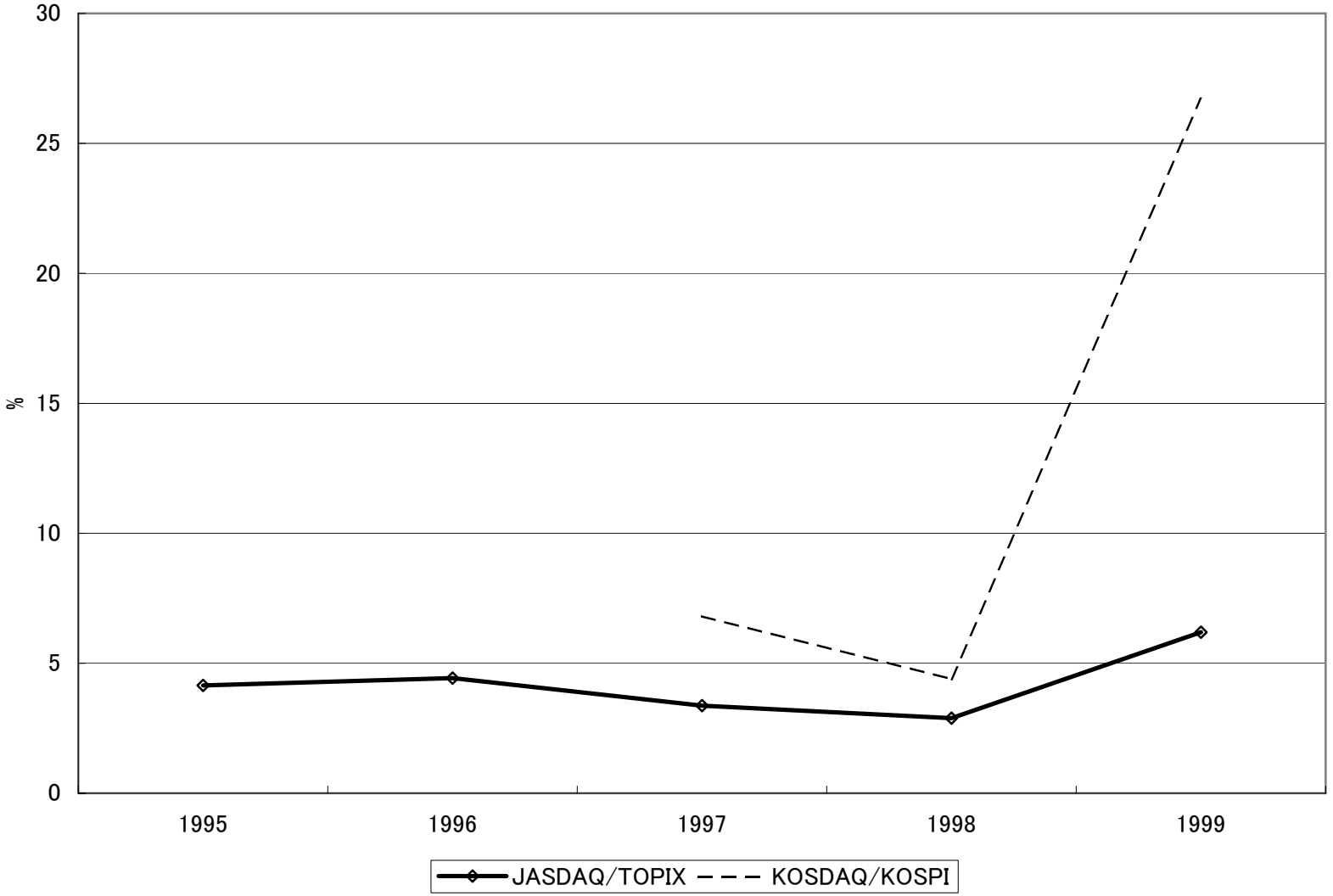

Figure 4: Change in the Total Market Value

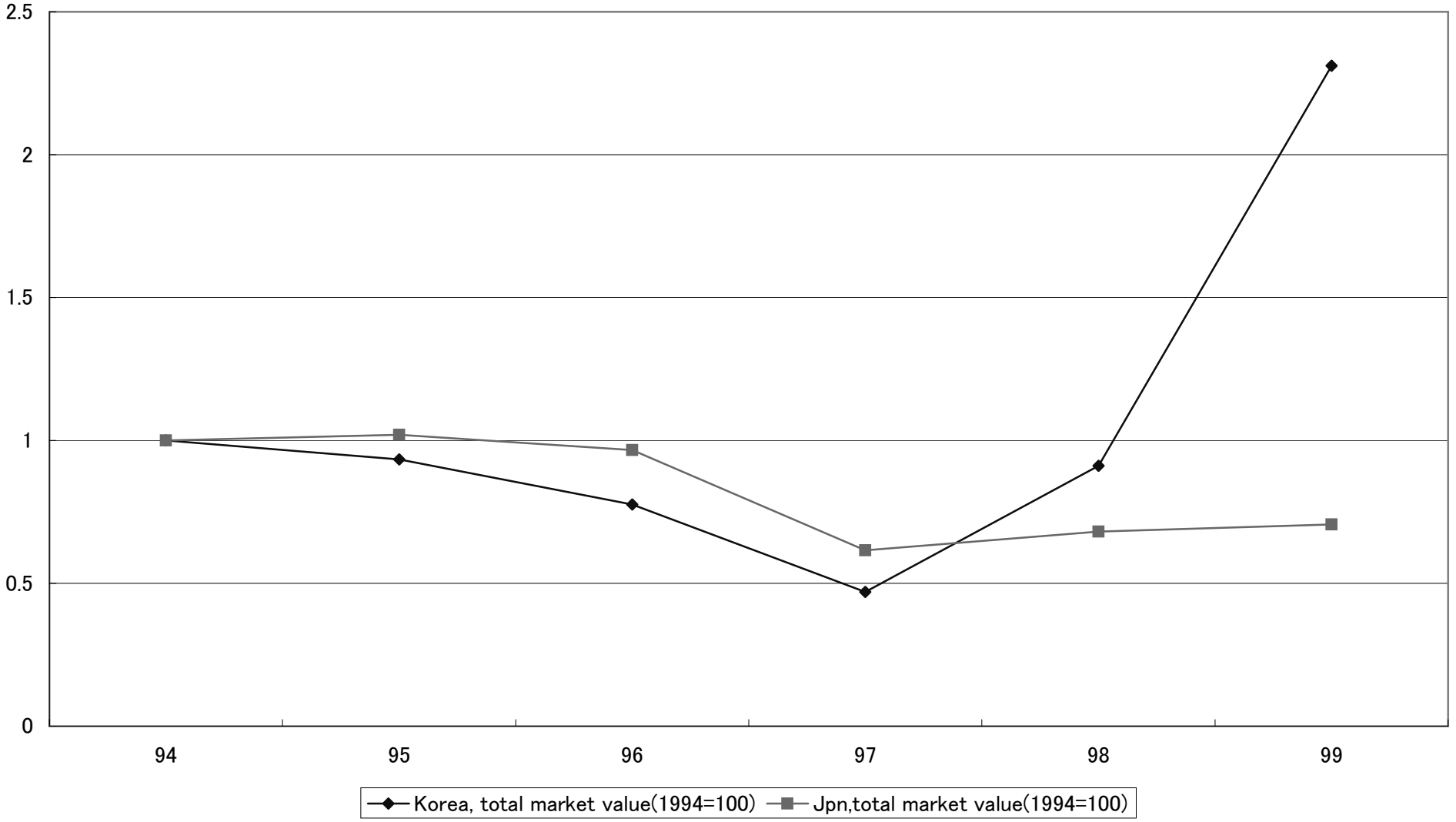

Figure 5:
Market Capitalization (monthly data)

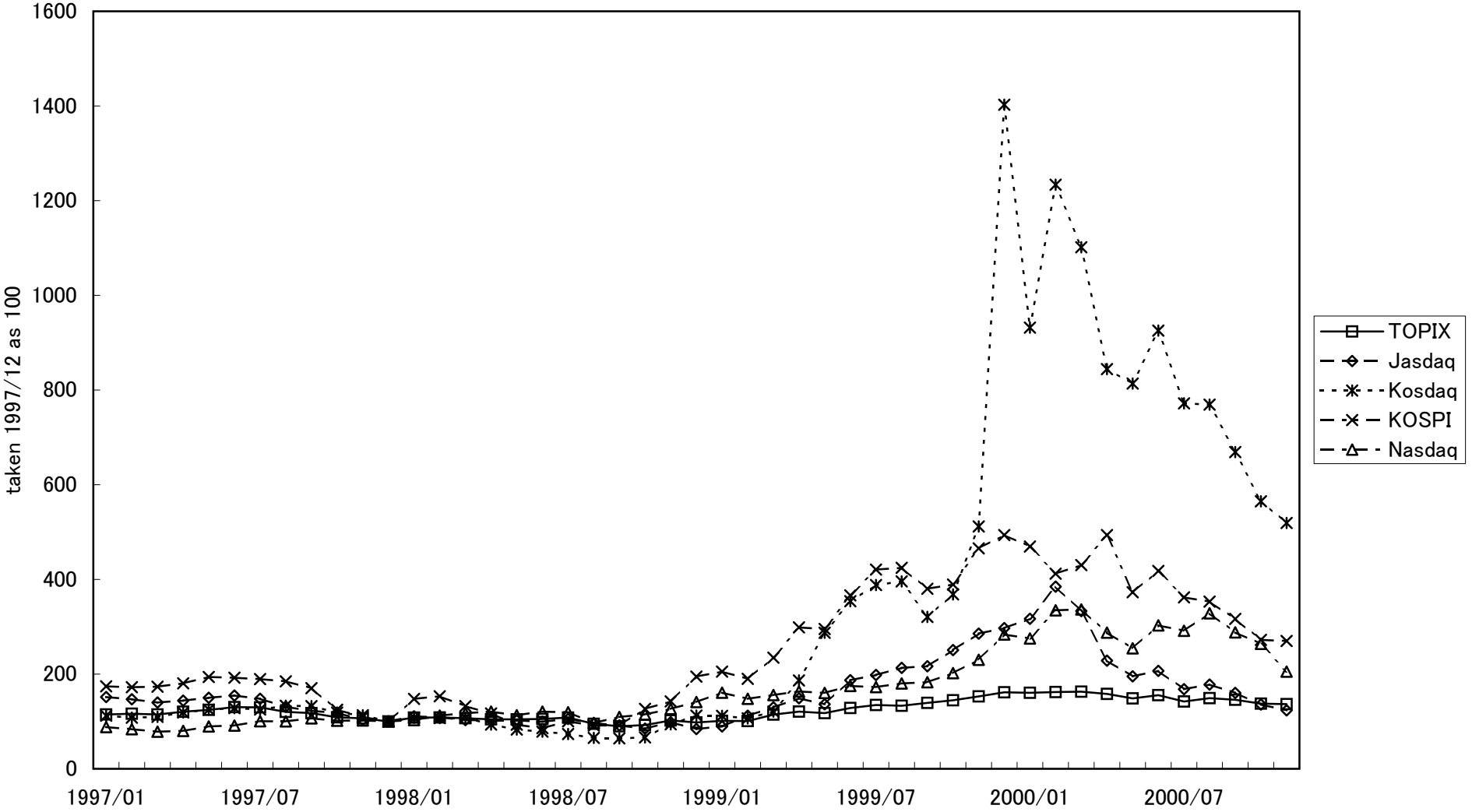

Figure 6: Plots for the Difference of Correlation inJapan and Korea (30 days)

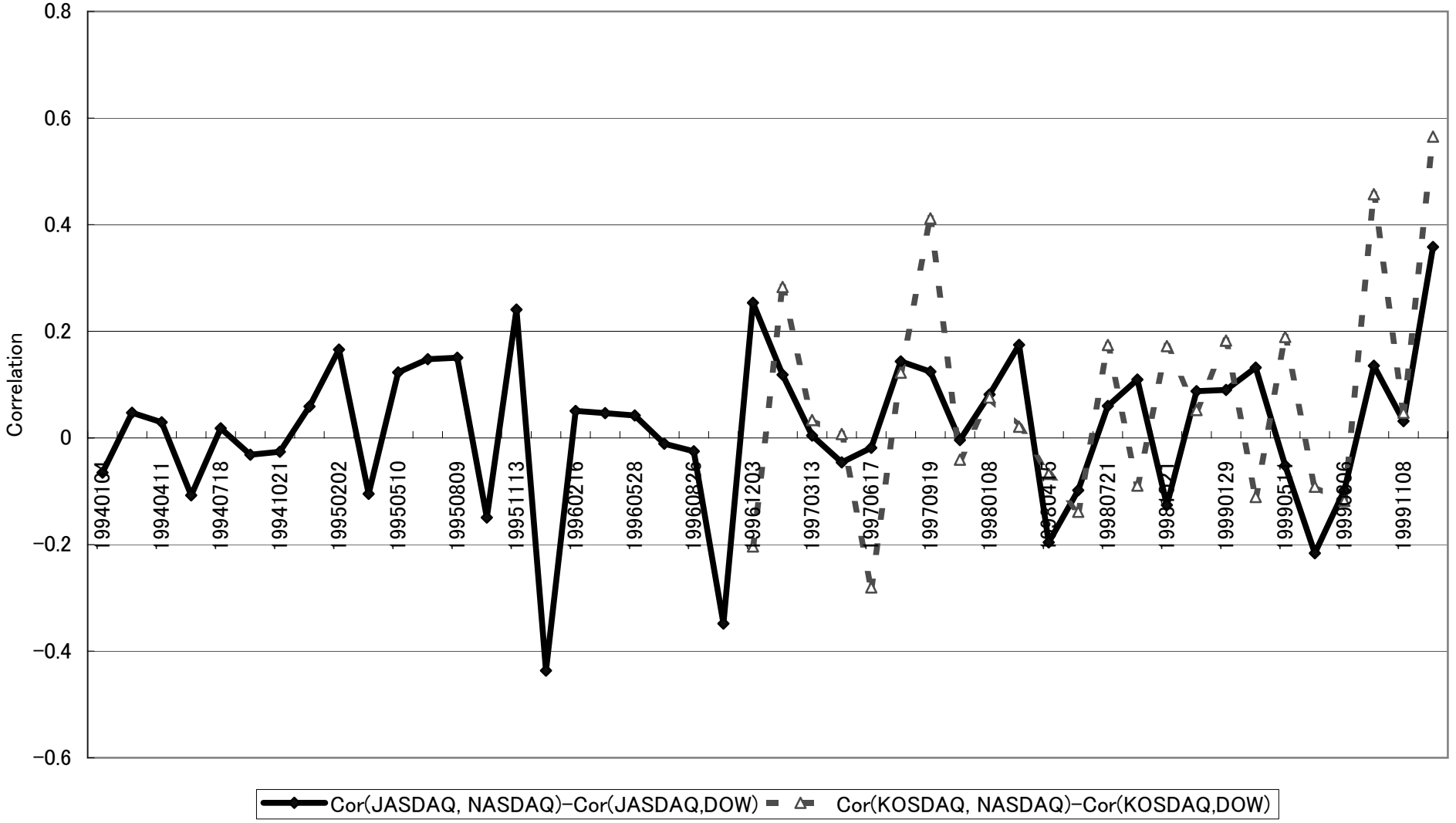

Figure 7: Plots for the Difference of Correlation inJapan and Korea (30 days)

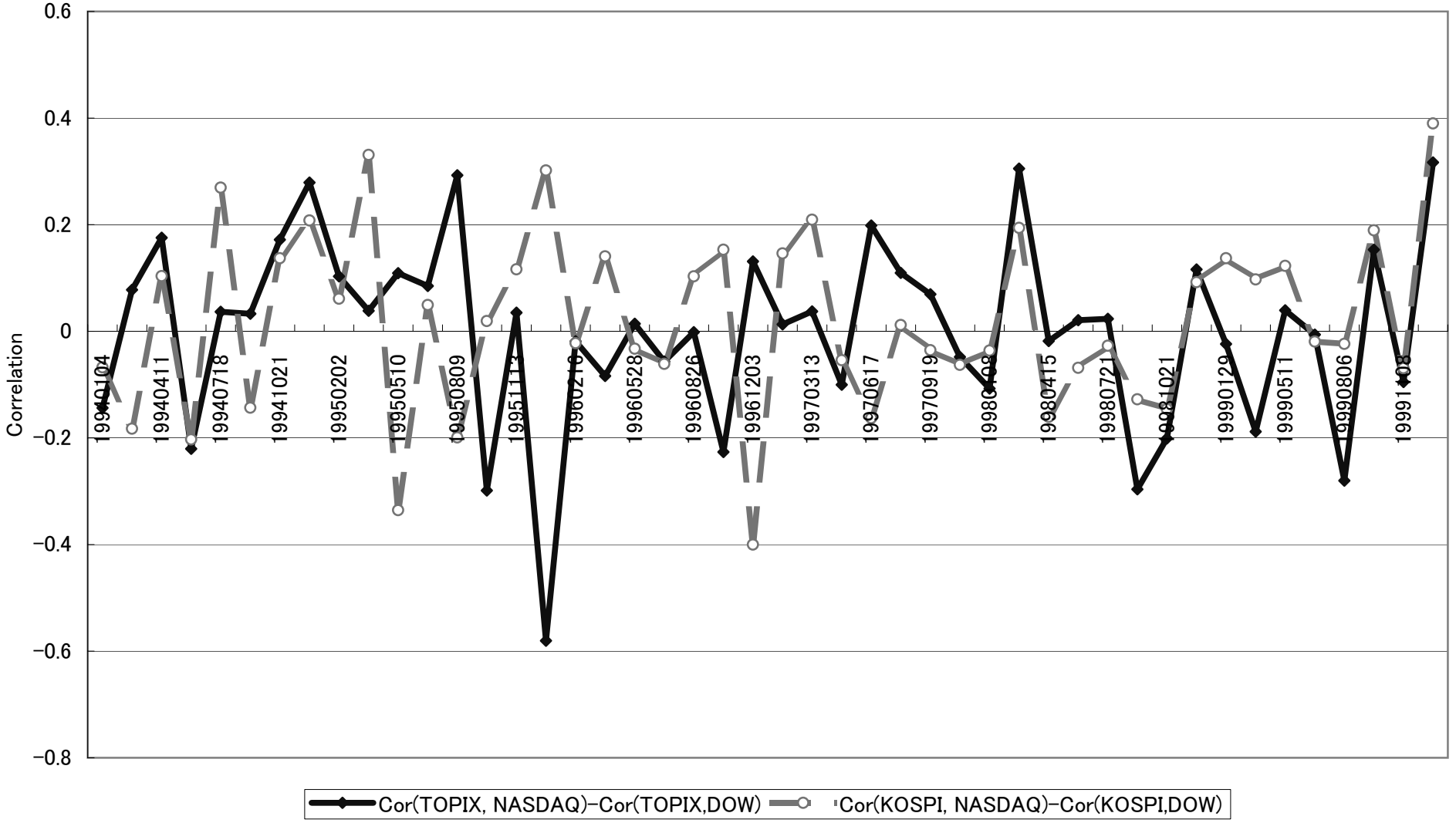

Figure 8: Plots for the Accumulated Difference of Correlation inJapan and Korea (30 days)

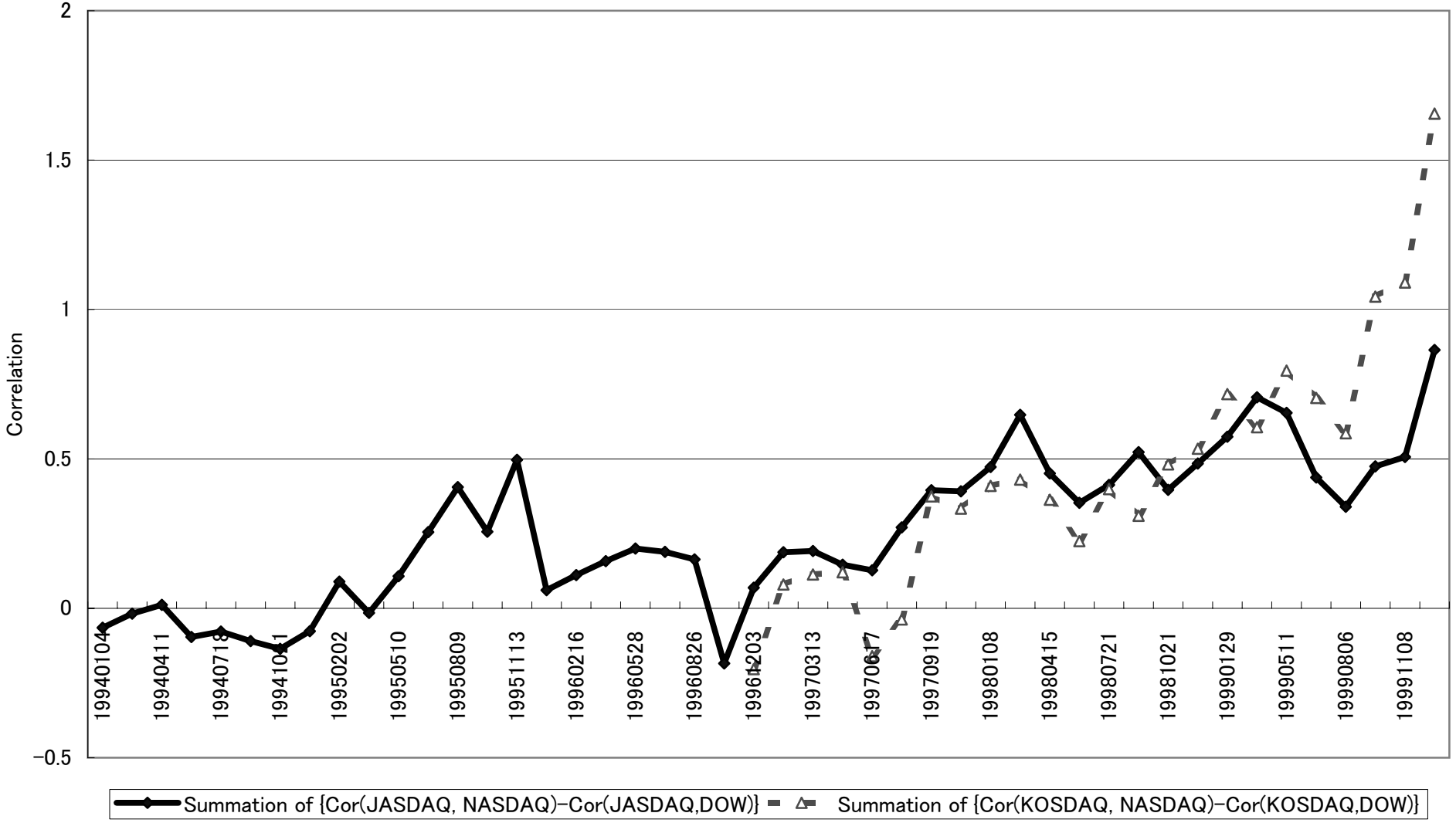

Figure 9: Plots for the Accumulated Difference of Correlation inJapan and Korea (30 days)

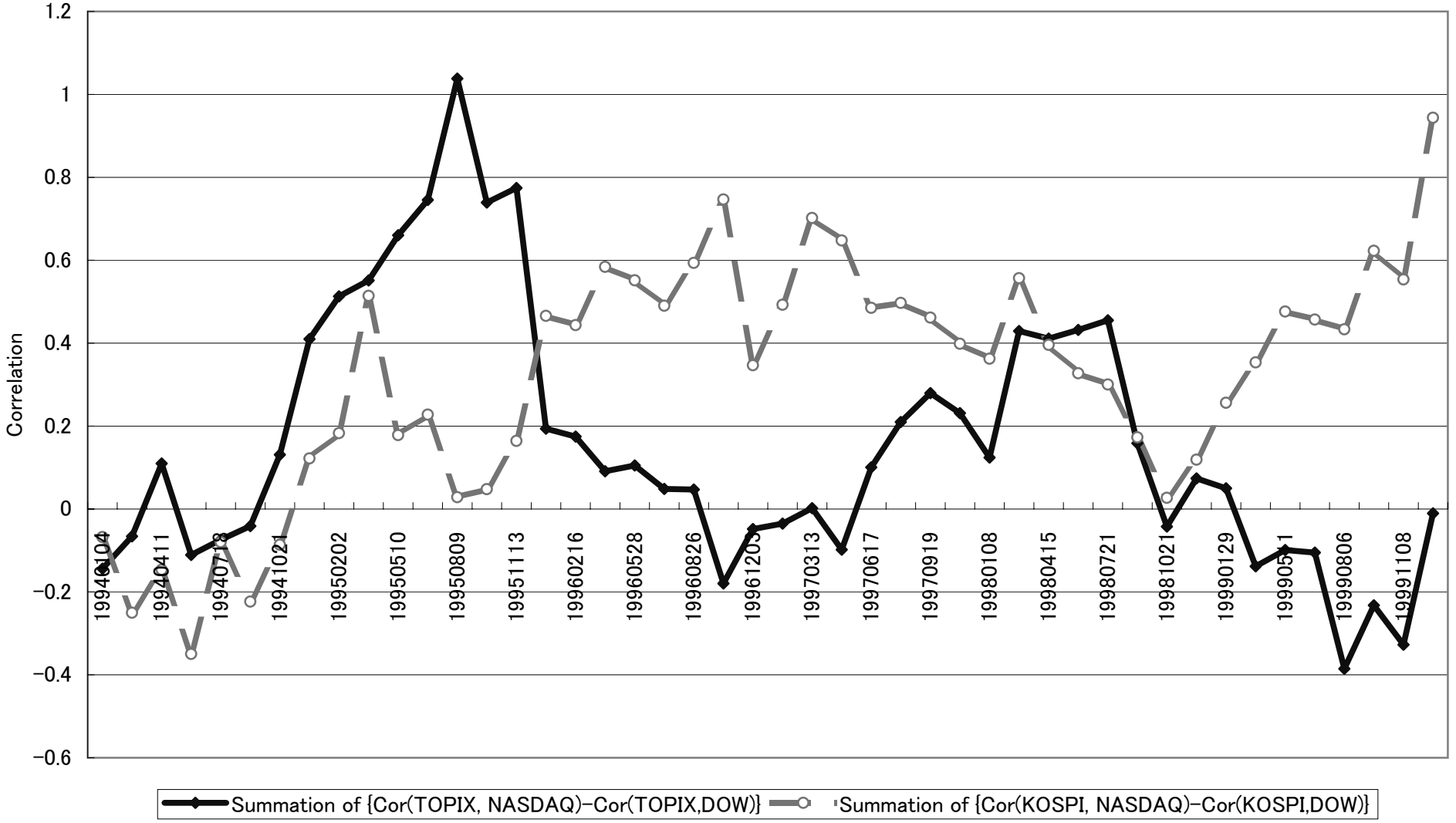

Table 1:
Monthly Correlation between Industrial Production and Rate of Return on Index

	1997/12-2000/06
Japanese Industrial Production and TOPIX	0.3396
Japanese Industrial Production and JASDAQ	0.2248
Korean Industrial Production and KOSPI	0.945
Korean Industrial Production and KOSDAQ	0.8471
U.S. Industrial Production and NYSE Industry	0.8861
U.S. Industrial Production and NASDAQ	0.9017

Currenccy: Local Currency
Base Year: 1997/12

Table 2

A Test for the Strucutual Break in the Mean Excess Rate of Return for Indices between Each Period

Mean Excess Rate of Return in Each Period	NYSE	NASDAQ	TOPIX	JASDAQ	KOSPI	KOSDAQ
The First Period	0.32196	0.25446	−0.2408	−0.04306	−0.10648	NA
The Second Period	0.35282	0.388228	−0.5192	−0.00189	−0.37311	−0.63069
The Third Period	0.0375	0.853243	0.995494	0.327113	1.451529	1.367585

	NYSE	NASDAQ	TOPIX	JASDAQ	KOSPI	KOSDAQ
Between the First and the Second Period	up	up	down	up	down	NA
Between the Second and the Third Period	down	up	up	UP	up	UP
Between the First and the Third Period	down	up	up	UP	UP	NA

t Value for the Change in the Mean Excess Rate of Return	NYSE	NASDAQ	TOPIX	JASDAQ	KOSPI	KOSDAQ
Between the First and the Second Period	−0.12	−0.48	−0.13	1.14	0.43	NA
Between the Second and the Third Period	0.8	−0.75	−0.84	−3.64	−1.72	−2.82
Between the First and the Third Period	0.78	−1.2	−1.23	−3.23	−2.07	NA

The First Period: January 4th 1994 to January 25th, 1997 (690 samples)
The Second Period: January 25th, 1997 to July 16th 1998 (330 samples)
The Third Period: July 17th 1998 to (390 samples)