

Comparing Determinants of Industrial Performance between Korea and Japan Based on a Wage Analysis

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Abstract:

This research compared determinants of industrial performance measured by wage data, assuming that wage data has rich contexts that records historical change of major economic forces. Analysis yielded major determinants of wage performance for Japan and Korea, and interpretation of the determinants provided invaluable insights to understand political economy and policy evaluation of the two countries.

I . Introduction

Japan and Korea have been widely recognized as industrialization examples in which government initiated and export oriented industrialization(Balassa 1982, Haggard 1988, Wade 1990, Pack & Westpal 1986) worked well with typically large business firms called Keiretsu in Japan and chaebols in Korea. Origin of the industrialization model can be traced back to the late 19th century late development(Gerschenkron 1962) in the sense that the role of government and financial institutions has been substantial. Despite the promise to be an alternative growth model to neoclassical or

market oriented model(Kreuger 1985), the East Asian model had its weakness from inside. The problem being that weak but large financial institutions closely linked to big business has been the Achilles' heel. The very moment the model is challenged, however, brings a good opportunity to review the determinants of industrial performance in the two countries with a sharp analysis. This paper utilizes industrial wage data of the two countries: Japan from 1969 to 1990 for 26 sectors and Korea from 1971 to 1991 for 39 sectors of manufacturing and service industries. With the data, this paper discovers major determinants of industrial performance measured by wage performance. A focus is to compare the common and different aspects between the two countries which has taken similar paths, yet with different degrees of industrial development.

II. Relationship between Financial Sector and Economic Development: Brief Industrial History of Japan and Korea

In both Japan and Korea, economic and industrial development has been closely linked to the development of financial sector. One conspicuous element shared by the two nations has been that the financial sector was managed by technocratic elites who have cooperated with respective governments' macroeconomic management. Despite this shared point, two countries diverge on several accounts regarding the relationship between economic development pattern and its utilization of financial sector.

The first difference comes from the source of investment. In the Korean case, foreign debt has been a major channel through which investment capital was mobilized, although domestic mobilization through savings was increased from the 1980s(Lee 1996). In comparison, Japanese case, during the time frame this research is focused, relied heavily on domestic savings as the source for investment. The second difference between the two countries has been its dependence on export markets. While Korea's dependence has been high, Japanese industries had their advantages

that came from larger domestic markets. This factor became more critical for the machine related durable products, such as automobiles. As a rule of thumb, the famous Japanese auto industry only exports around one-third of its total manufacturing volume to other countries. This factor condition, coupled with technological disadvantages, offered a hardship to the Korean heavy industries and the Government who had to rely heavily on export markets. The third difference comes from corporate structure. In the Korean case, big business firms, chaebols, were the center of industrialization. Financial resources were prioritized to the chaebols, since they entered the Heavy and chemical sectors where policy loans were guaranteed. In Japan, large firms were important, but the Japanese case shows a picture where small and medium size firms have more significance than in the Korean case(Smitka 1991).

With the above characteristics, this section can present brief history of the two nations for the period under study. From the mid 1970s, following the first oil shock timewisely, Japanese economy experienced the decline of private demand vis-à-vis growing supply side capacity. This tendency, from a Keynesian perspective, created a gap between private savings and private investment(Hellwig 1990), in which the former was greater than the latter. Under this circumstance, Japanese economy employed government deficit spending between 1975 and 1980 to overcome the Keynesian gap and sustain growth at a slower pace. A shift occurred, however, in the 1980s, in the way the Japanese economy coped with the situation; the economy had an increasing current account surplus(Rosembluth 1989) up to a point when Yen was significantly appreciated. As an extension, Japan became the world's largest net-creditor from the late 1980s on.

In comparison with Japanese recent industrial history, Korea has waded through a turbulent decades during which the economy has grown up significantly. After successfully accomplishing light industrialization, Korean government undertook the Heavy and Chemical Industrialization(HCI)(Haggard, Cooper, and Collins 1994). The time period when the major investment of the HCI was concentrated coincides with the first oil shock. Due to favorably low international interest rates of the period and

influx of dollars from Middle East construction market, however, real burden of the investment was substantially reduced (Galbraith and Kim 1998). As mentioned above, Korea's dependence on foreign debt in financing major industrial upgrading was significantly high (Lee 1996). The debt-driven structure, however, was changed as the country recorded current account surplus from the mid-1980s, which was used in repaying foreign debt. With the favorable growth conditions, Korean economy was faced with pressures from outside for opening of the economy from the early 1990s.

III. Methodology and Data

1. Theoretical Background

As the above section has reviewed, economic and industrial development had critical inter-relationship with financial sector. A more serious and sensible approach to make is to show what aspects of the financial sector dynamic have influenced the two economies respectively. Furthermore, it would be interesting to find whether the factors that have substantial leverage on both economies differ from each other or coincide with each other. To answer these questions, this research takes wage as a representation of real world economic performance.

In selecting wage as the representation of industrial and economic performance of the two countries, justifications can be presented. There are several theoretical grounds to support wage as a performance measure. The first theoretical ground comes from the notion of labor rents (Katz and Summers 1989, Blanchflower, Oswald and Sanfey 1996). The core idea of labor rents is that change in wages must reflect the changing relative performance of economic units, i.e., industries. Therefore, it is possible to infer the changing industrial performance from changing wage variation in time series format (Galbraith and Calmon 1996, 1994). In more easier terms, it is possible to argue that any economic forces are to be recorded in wage performance of respective

economic players. The second theoretical ground is found from a characteristic of wage in comparison with other performance measures. While most performance measures are formed with calculations that might bring in distortions, wage data offers researchers an indirect way of approaching industry performance without any distortion. This allows this research to analyze natural evolution-like change of industry performance. To assist this natural observation, this research employs a cluster analysis to pick up the evolutionary industrial structure from the wage data. This is an effort to replace traditionally used standard industrial classification (SIC) codes which classify industries based on conventionally regarded similarity. Then with the new structure, this research attempts to find underlying economic forces that determined the economic performance represented by wages.

The second group of justification comes from practical grounds. Wage data is available in time series format. This allows an in-depth analysis of an economy as well as a multi-nation comparison, depending on comparability of data sources.

With these justifications, this research utilizes wage as a performance measure, and in utilizing wage data, employs a combination of cluster and discriminant analysis.

1) Grouping Scheme from Cluster Analysis

To investigate the grouping structure from wage data, this research employs cluster analysis as the first step of its methodology. In doing so, annual change rate of average wage for each industry selected in this research, is taken as the basis (Aldenderfer and Blashfield 1984) for clustering different industries. In actual procedures of utilizing cluster analysis, Euclidean distance of wage change rates is selected as the similarity measure. To yield a grouping structure, this study chose Ward's method (Ward 1963) as the structural model, considering its merit of maximizing between group variance and minimizing within group variance. Justification for performing cluster analysis can be discussed as follows. If this research does not employ cluster analysis, an alternative would be using the existing standard industrial classification (SIC) codes, which classify industries based on convention. This

convention comes from people's understanding of industrial sectors. One consequence of using this traditional scheme in time series format is that two neighboring industrial sectors in traditional classification may show divergent industrial performance over the years. Then it becomes difficult to call the traditionally similar industries as truly similar industrial sectors, since their behavior over time was substantially different. To remind one of the objective this research, which is to find out underlying determinants of industrial performance, however, it would be more rational to classify industrial sectors that have changed similarly in empirical wage data rather than in traditional grouping.

Cluster analysis serves this purpose by showing how closely different industrial sectors have changed over the period given in the data set. For example, auto industry and machinery industry may have had similar wage change pattern, because they were influenced by identical forces. With this reasoning, cluster analysis produces a grouping structure, which is utilized as the basis for discriminant analysis.

2) Finding Determinants from Discriminant Analysis

With the grouping structure from cluster analysis, this research attempts to extract underlying forces that have driven the Wage performance of both economies. In doing so, this research utilized discriminant analysis, from which several canonical discriminant functions are extracted. These functions represent the underlying forces of the pooled wage variation across industrial categories (Tatsuoka 1988). In a functional form, a discriminant function can be written as $F = a_1 \times 1 + a_2 \times 2 + \dots + a_p \times p$, and in the context of this research it can be presented as :

$F = a_1 (\Delta w_1) + a_2 (\Delta w_2) + \dots + a_p (\Delta w_p)$, where Δw_i represents the percentage change of average wages for the industry in year i .

Deriving the above discriminant functions can be explained in the following way. Since each discriminant function is to distinguish Group means in such a way as to maximize between-Group variance(B) and minimize within-Group variance(W), when

coefficients from a_1 through a_p form a vector a , the discriminant criterion, λ , can be expressed as follows:

$$\lambda = (a'Ba) / (a'Wa).$$

Using calculus, we can get a condition for λ to be a maximum:

$$\partial \lambda / \partial a = 0$$

$$(W^{-1} B - \lambda I) = 0 \text{ or } W^{-1} Ba = \lambda Ia.$$

From the above mathematical expression, λ , the discriminant criterion, is the eigen value, while a is the eigen vector or eigen root of the matrix $W^{-1} B$. The eigenvectors are the coefficients of the discriminant functions; i.e. they are canonical roots of the discriminant functions. More importantly, the eigen vectors are P-valued time-series variables which can be identified with real world macro economic data.

Identifying these discriminant functions(Galbraith and Calmon 1996, Ferguson and Galbraith 1996) follow as the next step of research. This research matched the functions or the canonical roots with macro economic data series. This matching process starts with macro data series, and then extends into composite indicators of the Korean and Japanese economies respectively. With the matching process, this research found important macro economic time series data: annual investment and the uncovered interest parity for Korea and Current account and real interest for Japan. More detailed explanations on these determinants and characteristics of national difference will be followed in the next section.

3) Data

This research utilizes comparable wage data sources in Korea and Japan. As for the Korean data, the Occupational wage Survey by the Ministry of Labor was used. The Japanese source is the Wage Section of the Annual Statistics by the Bank of Japan.

IV. Findings

1. Cluster Structure

With cluster analysis of wage data, this research yielded robust industrial cluster structures of Japan and Korea. An interesting result shared by the two nations is that light industries, heavy industries, and finance-related sectors, in general, were gathered in respective groups and thereby confirmed that their wage performance pattern, i.e., influence received by common macro economic impacts, was similar. In Korean case, a four group structure was yielded. In comparison, Japanese case showed a three group structure: light, heavy, and finance & service industries. Members industries of each group in the two countries can be presented in Table 1 & 2 and Figure 1 & 2(Appendix). This grouping structure yielded by a numerical taxonomy employed in this cluster analysis provides a basis for discriminant analysis to be followed.

2. Determinants of Wage Performance

One of the contribution this research provides is finding determinants of wage performance in time series format. These determinants are roots from discriminant analysis, and they are time-series in nature. Thus, the next step to follow is to match the extracted root with real macro economic series so that the roots can be named and interpreted properly.

With iterated matching, roots from discriminant analysis of wage data of both countries were named. In the Korean case, among three roots that were extracted, two statistically meaningful ones were selected for analysis. The first root, which takes about 72.5% of the total wage variation over the 21 year period from 1971 to 1991 in Korea, is best matched with the annual change rate of investment, as in Figure 3.

The second root, which covers about 17% of the total wage variation in Korea, is

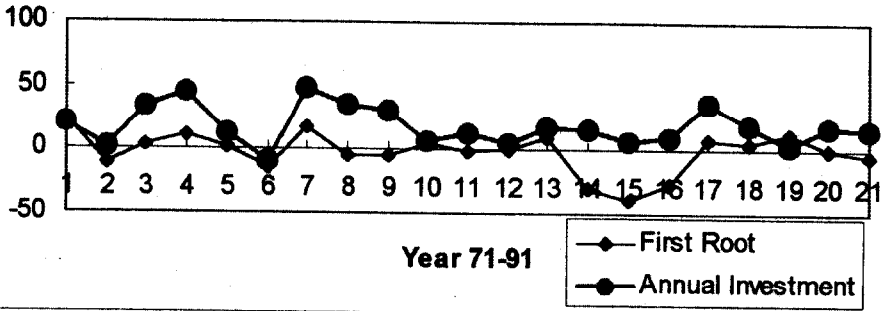


Figure 3. First Root and Investment(Korea).

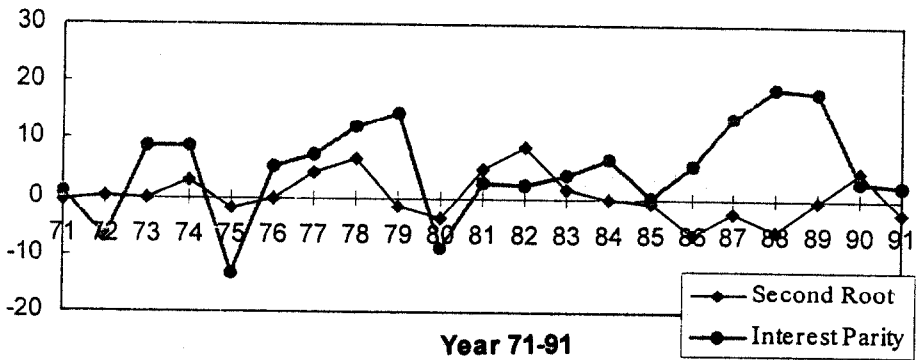


Figure 4. Second Root and Uncovered Interest Rate Parity(Korea).

matched with the annual change rate of uncovered interest parity. The parity is measured by the international interest rate, proxied by the London Inter Bank Offer Rate(LIBOR), minus the Korean Won depreciation rate(Figure 4).

Japanese case found two statistically meaningful roots. The first root takes about 87% of total wage performance variation in Japan between 1969 and 1990. This root is best matched with the annual change of Current Account expressed as its percentage in GNP. The second root, which covers about 13% of wage performance in Japan in identical period is matched with Real Interest Rate of the Japanese economy.

With these roots matched with real macro economic times series data, which can

also be called as macro economic forces, this research turns its attention to interpretation of the determinants of wage performance in the two countries.

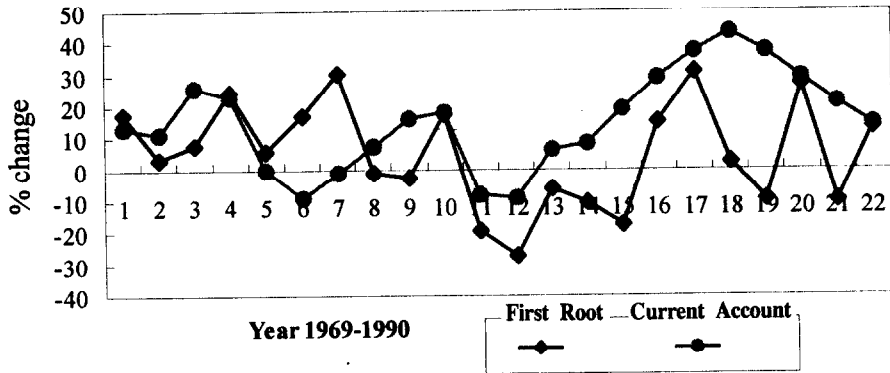


Figure 5. First Root and Current Account(as % of GNP) (Japan).

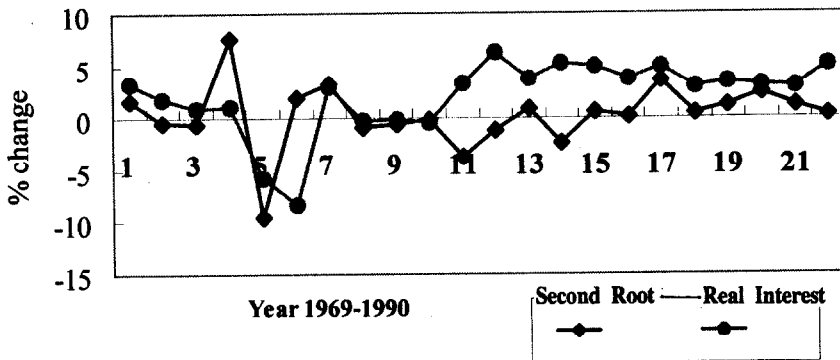


Figure 6. Second Root and Real Interest Rate(Japan).

V. Interpretation of the Results

1. The Korean Case

1) The First Root

The first root in the Korean data is annual change of investment. To present the full implications of the first root, Figure 7 displays a scatterplot of cumulative wage change on vertical axis (as expressed as actual percentage divided by 10) and canonical scores from discriminant analysis of each industry on annual investment on horizontal axis. Figure 7 shows how each group performed on the annual investment ranking; skilled labor industry group marked the highest scores, followed by heavy industry group, light industry group, and service industry group in order.

One conspicuous point found from Figure 7 is the existence of a slope from left to right, linking service sector to skilled labor sector. The importance of the slope is found in that this implies the development of labor rent in Korea with respect to annual investment trend (Kim, Junmo 1997). Since this root covers nearly 72.5% of

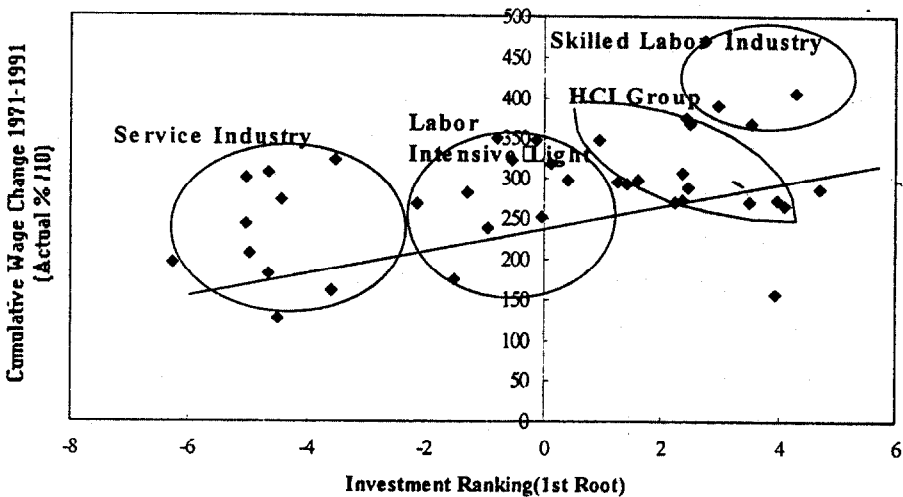


Figure 7. Scatterplot of the First Root(Annual Investment) and Cumulative Wage Change (1971-1991) in Korea.

total wage variation between 1971 and 1990 in Korea, interpretation of this phenomenon becomes crucial. The existence of labor rent means that high rent developing sectors are competitive enough to pay higher wages to their workers vis-à-vis other sectors. Especially important point is that this rent development pattern is very healthy. Similar pattern of industry rent, i.e., skilled labor and heavy industries develop higher rent, is found in most industrialized countries (Galbraith and Lu 1997).

The healthy nature of labor rent in Korea suggests that economic development in Korea was performed in such a robust way that one can reduce one's prior concern that industrial policy may have distorted the economy (Kim, J. H 1990) and thereby produced a deformed structure. To further strengthen this argument discussion on the second root provides more clues why economic development so far has been healthy, especially in dynamic long term perspective.

2) The Second Root

One of the major debate on Korean industrialization centers around whether industrial policy produced distortion and misallocation of resources. The most famous incident in Korean industrial policy that ignites the misallocation debate historically has been the Korean government's Heavy and Chemical Industrialization(HCI) program(Rhee 1987). In implementing the HCI, the target sectors of HCI, including machinery and auto industry, received long term policy loans at a lower interest rate than any other domestic financial program(Leipziger 1987, Haggard, Cooper et al 1994). The emphasis on the HCI meant relative negligence in promoting small & medium size firms and light industries(Kwack 1984).

Clues to the above debate can be found with respect to the Second Root, the uncovered interest parity. Figure 8 shows a scatterplot of cumulative wage change between 1971 and 1990 in Korea on vertical axis(as expressed in actual percentage divided by 10) and canonical scores(from discriminant analysis) of each industry on horizontal axis.

Figure 8 shows that heavy industry group recorded the highest scores, followed by

light industry; after light industry, skilled labor and service sectors marked relatively low scores. If an industry marks high on this root, this means that the industry performed well when interest parity is high. Then, what does this mean to industrial policy? Recalling the definition of the uncovered interest parity, which is the International interest rate proxied by the London Interbank Offer Rate(LIBOR) minus the depreciation of Korean Won, brings the following argument. The parity is a measure of relative tightness of monetary policy in Korea. Under tight monetary policy and affected financial tightness, firms hard hit were the ones that borrow from open domestic credit markets. In other words, industries and firms that were not given umbrella protection by low interest-bearing policy loans were relatively disadvantaged.

In contrast, HCI sectors were prioritized in receiving policy loans(Rhee 1987). Then, what were the characteristics of these loans? They were offered at low interest rate and in addition given on a long term basis to cover investment burden of the sectors. It functioned as an insulation for the target sectors against domestic and international fluctuations(Kim, Junmo 1997). An interesting argument is that due to relatively low international interest rate of the 1970s when the Korean government

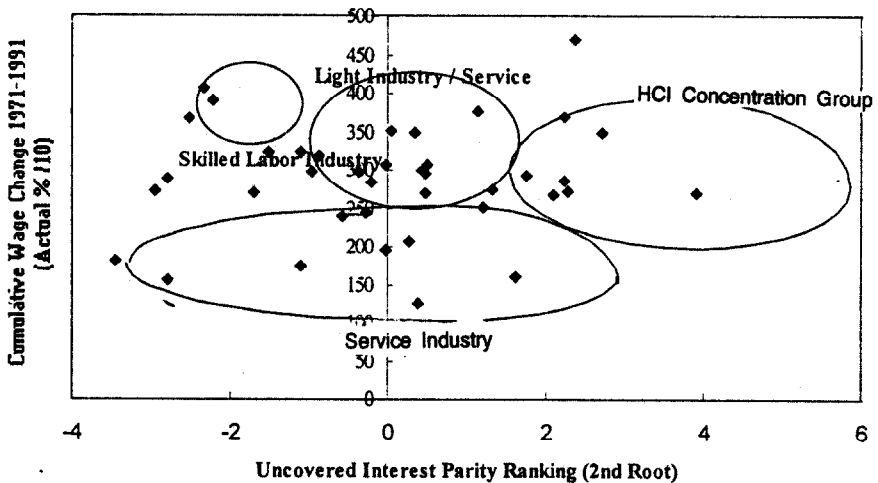


Figure 8. Scatterplot of the Second Root(Uncovered Interest Parity) and Cumulative Wage Change(1971-1991) in Korea.

started the HCI together with an influx of dollars earned by Korean construction firms in the middle east at that time, the burden of Korean government in maintaining its policy loans was relatively lesser than one had expected(Galbraith and Kim 1998).

This is why the HCI sectors marked so high on the interest parity root in Figure 8. Other sectors open to credit market situation are relatively low on the scores. An additional point to mention is that cyclical change of degrees of tightness in Korean financial policy affected by changes in international financial market reduced the impact of interest parity received by firms that were not recipients of policy loans(Galbraith and Kim 1998). This is indicated by the proximity of location of some of the HCI sectors and light and service industries in Figure 8.

2. The Japanese Case

1) The First Root

Previous section discussed the major determinants of wage performance. Then, a following question flows: What can be analyzed with them? This section focuses on that issue. The first root from Japanese data was the annual change of current account as expressed in its percentage in GNP. To present its meaning analytically, this research presents a scatterplot of the first root and cumulative wage change over 22 year period from 1969 to 1990, as in Figure 9. In Figure 9, vertical axis represents cumulative wage change as expressed in actual percentage divided by 10. The horizontal axis shows current account ranking, which shows how well each industry performed along the first root. When an industry scores high on the current account ranking, it means that wage performance of the industry was positively impacted by current account status.

As seen in Figure 9, light industry group is scoring highest among the three groups. Heavy industry group marked the lowest, while service sector including finance industries was located in the middle. One more eye-catching observation is that in contrast to the Korean case where an upward slope was found in the first root

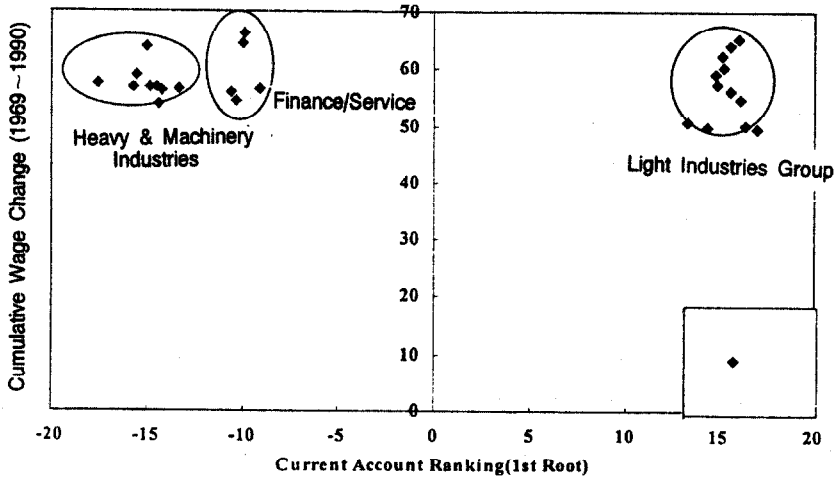


Figure 9. Scatterplot of the First Root(Current Account) and Cumulative Wage Change (1969-1990) in Japan.

scatterplot, this picture does not suggest any evidence of a slope. This means that in terms of overall cumulative wage increase pattern, the three groups showed a similar behavior.

Then, how can one interpret why light industries could perform well on the first root, which is the current account? Japanese economy is a big economy. This means that the proportion and absolute size of domestic market in Japan is much more important than that in small economies. When industries record high current account ranking, it means that those industries performed well when current account's size relative to GNP was high. In Japanese case, this means a current account surplus in general. It is very natural to follow that when current account's portion in GNP is high or when current account marks a positively steep increase, Japanese currency Yen is likely to be appreciated(Rosebluth 1989). When Yen is appreciated, it is logical to present the following sequences. First, industries that are domestically oriented perform well. Second, due to reduced price competitiveness, industries that rely heavily on foreign markets would not perform well. Third, Yen appreciation may be followed by lower domestic interest rate, and leads to a low performance of the

finance sector.

Linking the above statement to the findings of Figure 9, this research reports that light industries, which are domestically oriented, performed very well on the current account root. In comparison, heavy industries were relatively disadvantaged by the current account situation, mainly from Yen appreciation. This implies that Japanese machine-related sectors, including auto industry, have been relying on non-price competitiveness to a greater degree (Odagiri and Goto 1996) than price competitiveness over the period this research utilizes. This does not mean that these industries are immune to price competitiveness. It is possible, however, to suggest that reliance on price factor has been less important in those industries in Japan vis-à-vis similar heavy industries in other countries including Korea. Finance and other service sectors performed in the middle between light and heavy industries.

Also, it is possible to present additional implications from Figure 9. First, Japanese economy, shown in Figure 9, is a typical large economy in which domestic consumption is very important. Second, the location of light industries suggest its characteristic. In terms of cumulative wage increase, it is never lower than heavy industries. In most industrialized countries, light industries are split by skilled labor and traditional light industries (Piore and Sabel 1984). A typical trend is that skilled labor sectors are paid higher than heavy sectors, while heavy sectors are paid higher than traditional light industries. Japanese light industries in Figure 9 feature a tendency toward either skilled labor or other value-adding orientation.

2) The Second Root

The second root from Japanese data, which covers about 13% of total wage variation between 1969 and 1990, was best matched with annual change of Real Interest Rate in Japan. To show the full meaning and implications, Figure 10 presents a scatterplot of cumulative wage change (as expressed as actual percentage divided by 10 on vertical axis) and real interest scores of each industry from discriminant analysis. When an industry marked high on real interest ranking (scores), it means that

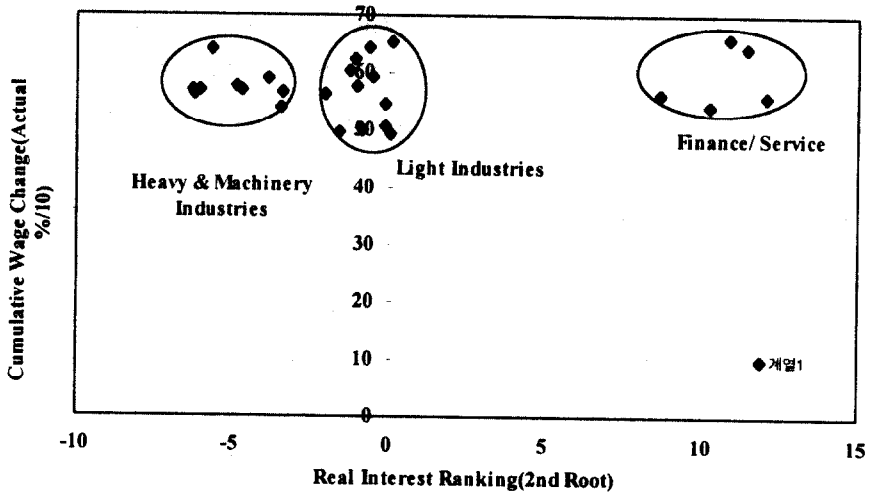


Figure 10. Scatterplot of the Second Root(Real Interest) and Cumulative Wage Change (1969~1990) in Japan.

the wage performance of the industry was benefited when real interest was high. As seen in Figure 10, Finance, real estate, and utility sectors performed well under the real interest conditions, followed by light industries and heavy industries in order.

What implications can be gleaned from Figure 10? First, it is understandable that finance sector performed well under high real interest conditions. Under high real interest rate, financial institutions tend to gain more profits. In comparison, real estate business experienced high wage performance in Japan historically. Two possibilities can be suggested which are interlinked. One comes from a fact that financial assets of real estate industry brings a huge increase of interests accrued to its assets under high real interest condition. The other reason comes from history. Even when real interest was high, Japanese economy has reacted in such a manner to over-evaluate the value of real estate. A consequence was that people believed that returns from owning real estate would be high enough to surpass the high real interest. Thus, in Japan, real estate business was prospering even under high real interest situation.

One interesting finding was the location of light and heavy industries. In contrast to

the location of Korean heavy industries that were located in the middle of scatterplot(Figure 8) as a result of government's credit allocation policy, which was designed to insulate them vis-à-vis external shocks, Japanese heavy industries scored low on real interest ranking. Even more, heavy industries marked lower than light industries in Japan. This shows relative performance of light industries in Japan with respect to real interest. In other words, the highly renowned Japanese heavy industries have been performing well even at disadvantages coming from macro economic conditions, typified as current account and real interest condition. This reflects that competitiveness of the Japanese heavy industries has been more technology-based superiority. In contrast, Korean counterparts were relying on macro economic conditions, namely annual investment and uncovered interest parity. This implies that competitiveness of the Korean heavy industries comes less from technological basis.

VI. A Concluding Remark: Origins of Difference

With identical method applied to comparable wage data of Japan and Korea, this research attempted to illuminate determinants of wage performance from 1969 to 1990 in Japan and 1971 to 1991 in Korea. Determinants found were closely related to financial dynamic of each country. In the Japanese case, two determinants were current account as expressed as its percentage in GNP and real interest rate. In comparison, the Korean case yielded annual investment and uncovered interest parity.

This concluding section discusses what can be inferred from the determinants of two countries in understanding the differences, if they exist, between them. A serious inspection brings intuition for inference. Despite seemingly identical political economy of both countries in that government, financial institutions, and large business closely work together, the two countries differ in their status in the world economy together with different domestic economic structure. This difference brings the following contrast. First, since Japanese economy is a mature and large economy, its domestic

market is substantially large enough to sustain its industries. In comparison, Korea economy is relatively small, and lacks capability to stabilize against international economic fluctuations. Especially when a developing country is engaged in a massive investment, viability of the investment becomes very susceptible. A solution in the Korean case was to provide an artificial stabilization through government policy. It was typified in the promotion of the HCI sectors by giving them low interest bearing loans on a long term basis. This policy loans functioned as an insulation against fluctuations.

Second, determinants found in the Korean case offer more clues to track policy effects than the Japanese case. Annual investment in Korea has been directly connected to government's industrialization strategy, while uncovered interest parity provides clues to evaluate credit ration policy. In contrast, the major Japanese determinant, current account in GNP that covers 87% of variation, is a window to see how Japanese economy reacted in international contexts. Thus, Japanese determinant possessed more global economic content than the Korean determinants.

Third, in discussing competitiveness of industries, Japanese industries seemed to have competitiveness from technology side. In other words, competitiveness existed at the disadvantages coming from the wage determinants. The argument on the origin of Japanese industrial competitiveness can be indirectly evidenced by the fact that Japanese heavy industry, although they marked low on both wage determinants, still perform well in international market. Their low performance on wage determinants was relative to other domestic sectors, and their competitiveness vis-à-vis other heavy industries in other countries can only be understandable by non-price factors, namely technology. This reasoning holds water, since the Japanese heavy industries marked low on both determinants(current account condition and real interest) that can be translated to their "price competitiveness". In contrast, performance of the Korean heavy industries was clearly benefited in the contexts of price competitiveness by the two determinants, yet their international competitiveness has been weak in technological standing(Enos and Park 1987).

As this section has reviewed, this paper yielded another layer of understanding the political economy of the two countries. Wage data clearly opens possibilities for policy analysis and evaluation in different realm and depth. It would be interesting to follow how the current reform would affect wage performance of the two countries and thereby impact industry performance. Also an interesting question would be how reform policy would be evaluated in the wage analysis. These tasks are open for the future until enough data gathering is permitted.

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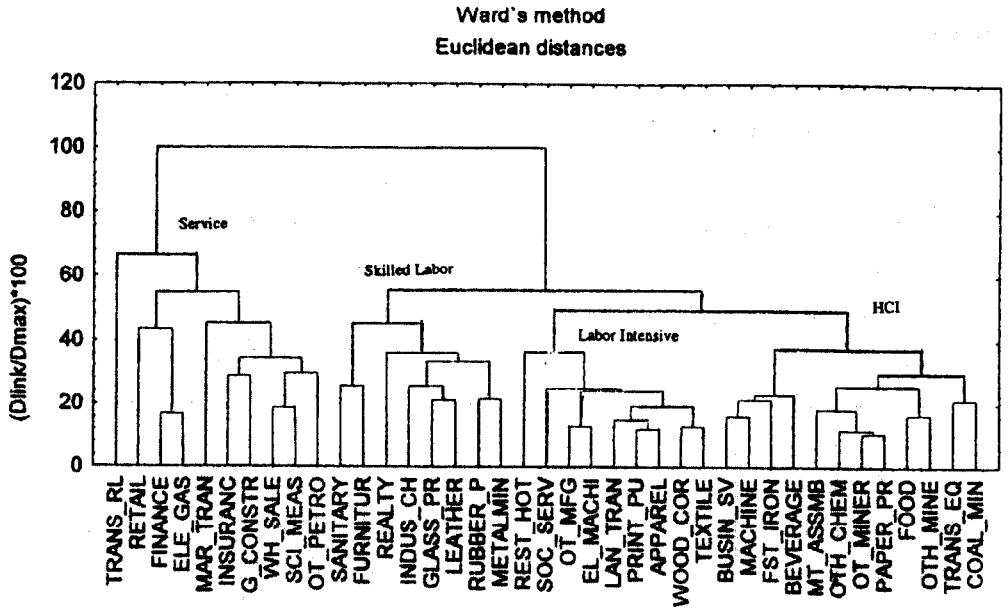


Figure 1. Cluster Tree of 39 Industries(Korea).

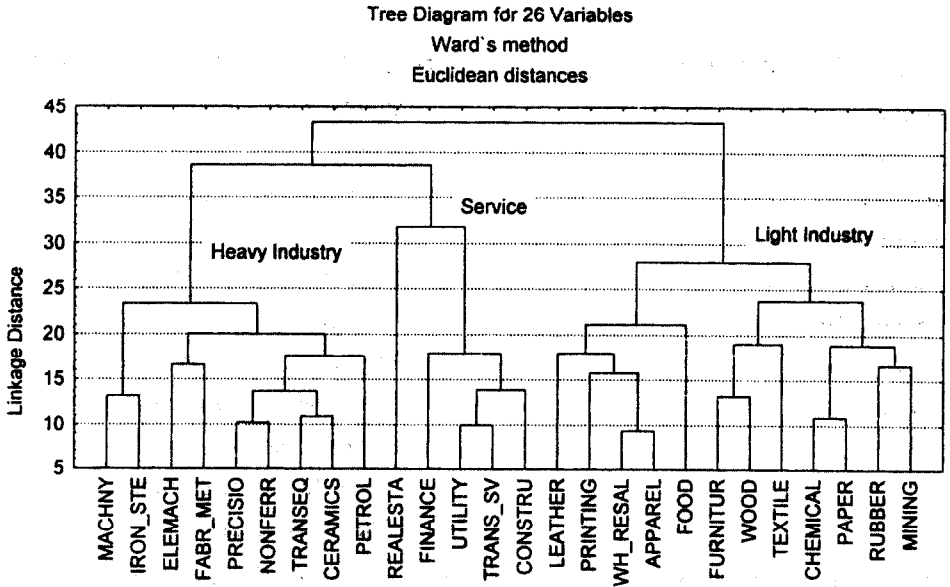


Figure 2. Cluster Tree of 29 Industries(Japan).

Appendix.

Table 1. Member Industries of Cluster Group (39 Industries in Korea).

Group 1: HCI Concentration

- Machinery
- Transportation Equipment
- Primary Iron and Steel
- Metal Assembly
- Other Chemical
- Coal Mining
- Other Mineral
- Other Mining
- Business Service
- Beverage / Paper

Group 2: Labor Intensive/ Service

- Textile
- Apparel
- Other Manufacturing
 - Wood / Cork
- Print
- Electrical Machinery
- Social Service
- Restaurant / Hotel
 - Land Transportation

Group 3: Skilled Labor

- Glass
- Leather
- Rubber
- Furniture
- Industrial Chemical
- Metal Mining
- Realty
- Sanitary

Group 4: Service Industry Concentration

- Wholesale
- Retail
- Electricity/ Gas Utilities
- Finance
- Insurance
- Construction
- Marine Transportation
- Transportation Related
- Personal Service
- Scientific Measurement
- Other Petroleum

Table 2. Member Industries of Cluster Group (26 Industries in Japan).

Group 1: Heavy Industry Concentration

Machinery	Iron and Steel	Electrical Machinery	Fabricated Metal Product
Precision Equip	Nonferrous Metal	Transportation Equipment	Ceramics Petroleum

Group 2: Service

Real Estate	Finance	Utility	Transportation Service	Construction
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Group 3: Light Industry Concentration

Leather	Printing	Apparel	Wholesale	Food
Furniture	Wood	Textile	Chemical	Paper
Rubber	Mining			