Determinants of Inter-Industry Wage Differentials in Korea

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The purpose of this study is to analyze the sources of inter-industry wage differentials in the Korean context. In this study, we examine what causes the inter-industry wage differentials in the manufacturing sector and how they have changed over the last three decades in Korea. The results of our study imply that the industry policy has contributed to inequality of earnings. In addition, such industry characteristics as the average years of schooling and the proportion of female workers in the industry contribute to the persistence of wage differentials across industries in Korea. These results will make a valuable contribution to more accurately assessing the role of the government in the labor market, the issues of income distribution and unemployment. (*JEL* Classification: J31)

I. Introduction

The Korean economy has experienced rapid growth during the last three decades.[1] During this period, the industry structure and the labor market have also undergone a tremendous transformation.[2]

However, the wage structure of the manufacturing industries has been quite stable over time in spite of the rapid changes in the demand and supply of the labor force across industries. There have been large

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[1]The GNP of Korea has increased at the average annual rate of 9.0 percent in real terms between 1962 and 1991. The magnitude increased more than twelvefold since 1962. Its per capita GNP in current dollars has increased from U.S. $87 in 1962 to U.S. $6,518 in 1991. The export has grown from U.S. $55 million in 1962 to $69.8 billion in 1991.

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wage differentials among workers who have similar personal characteristics, but are employed in the different industries.

Although the order in which industries are ranked with regard to the average level of the wage paid to workers has changed slightly, there exist high correlations among wage structures across different points of time both in terms of magnitude and ranking.[3]

With respect to inter-industry wage differentials, the competitive labor market model suggests that inter-industry wage differentials are caused by either systematic differences in worker's ability or by compensating differentials for nonpecuniary aspects of work. This model explains that inter-industry wage differentials reflect discriminatory shifts of labor demand and/or supply due to imperfect short-run labor mobility across industries, and that these differentials disappear in the long run.

On the other hand, the efficiency wage theory and the union threat model suggest that workers' earnings depend not only on their personal attributes but also on industry characteristics in which they are employed. They argue that the optimal wages vary with the conditions necessary for paying efficiency wages across industries. Many empirical studies found that wage differentials across industries have been stable in the U.S. and in many developed countries. However, few studies have been done for developing and underdeveloped countries.

The purpose of this study is to analyze the sources of inter-industry wage differentials in the Korean context. In this study, we examine what causes the inter-industry wage differentials in the manufacturing sector and how they have changed over the last three decades in Korea. The focus of the research is on the manufacturing sector, because this sector has been growing most rapidly and has played a pivotal role in changing the structure of industry and employment.

A series of econometric analysis are conducted with special reference

[2]The manufacturing sector has expanded at the growth rate of 15 percent annually in real terms over the last thirty years. The share of this sector in GDP increased from 16.3 percent in 1962 to 28.6 percent in 1991, and that of the employment increased from 8.7 percent in 1962 to 27 percent in 1991 in the manufacturing sector. There have been significant changes in the structure of employment from the light to the heavy industry and in the composition of employment between large and small-sized firms.

[3]The estimated correlation coefficient of wage differentials between 1972 and 1991 is 0.844 in terms of magnitude from the Occupational Wage Survey of Korea. The coefficient between 1982 and 1991 is 0.896.

to the unique features of the Korean labor market. Special attention is given to the effect of industrial policy supporting targeted industries and the government intervention in the labor market on earnings of workers in the manufacturing industries. Also, the effects of market power of a few large business groups, chaebôls, and a large influx of women and highly educated workers, as well as the effect of exposure to the international competition on the wage differentials across industries are analyzed. No prior study has addressed these topics explicitly.

A two-step approach is adopted to analyze the sources of the inter-industry wage differentials while solving the problems resulting from aggregating the information on individual attributes with the industry characteristics. This is the first time this approach has been used to analyze the inter-industry wage differentials in Korea.

In the first step, we regress earnings on several individual characteristics using micro data and only industry dummy variables. In the second step, the coefficients of industry dummy variables estimated in the first step are regressed on industry characteristics variables to identify the sources of the inter-industry wage differentials.

This study seeks to improve our understanding of the distinguishing features of the Korean labor market, where the wage differentials across the manufacturing industries have been stable over time. The analysis of the sources of the persistent wage differentials across industries will make a valuable contribution to more accurately assessing the role of government intervention in the labor market, the issue of unemployment, and the effect of industrial policies on income distribution.

II. Inter-Industry Wage Differentials in Korea

A. Inter-Industry Wage Differentials Over Time

Many economists argue that the relative wages across industries have been stable in many countries during different periods of time. We examine the wage structure of the manufacturing industries to see whether the inter-industry wage differentials in Korea supports this argument.

We estimate the log of monthly wages for full time workers using the 1972, 1982 and 1991 Occupational Wage Survey (OWS) data. We examine the changes in the magnitude and ranking of wage differentials across 27 manufacturing industries in the three different years.

TABLE 1

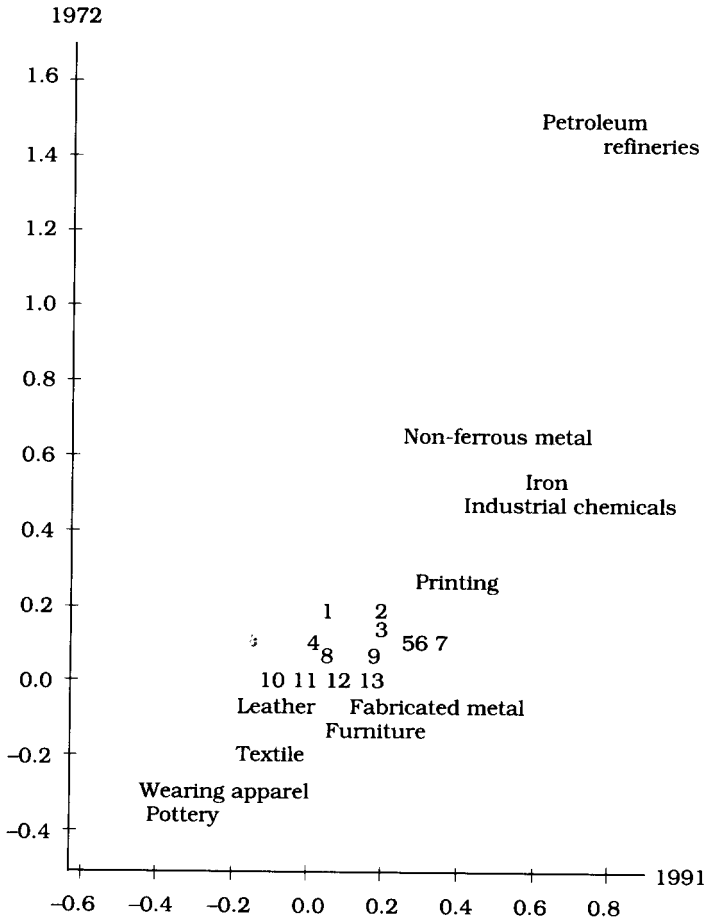
INTER-INDUSTRY WAGE DIFFERENTIALS OVER TIME: LOG MONTHLY EARNINGS OF FULL-TIME WORKERS

(Fractional Differences From the Mean Wage)

Industry	1972	1982	1991
Food	0.03916	0.13563	-0.06648
Beverage	0.14575	0.46201	0.29110
Textile	-0.17887	-0.12826	-0.19457
Wearing Apparel	-0.34712	-0.35651	-0.43373
Leather	0.05864	-0.27924	-0.10018
Footwear	—	-0.20936	-0.40821
Wood	0.16761	0.06220	0.03551
Furniture	-0.11309	0.00339	0.01114
Paper	0.20049	0.20574	0.19281
Printing	0.32035	0.50790	0.29705
Industrial chemicals	0.51976	0.33104	0.41090
Other chemicals	0.10639	0.24561	0.06417
Petroleum refineries	1.44540	0.97877	0.67172
Petroleum products	0.23290	0.41971	0.06346
Rubber	0.00553	-0.09918	-0.20040
Plastic	0.05957	0.15272	0.03401
Pottery, china	-0.37085	-0.23900	-0.41069
Glass	0.16970	0.26191	0.33002
Other nonmetallic	0.25896	0.35798	0.20878
Iron, steel	0.55418	0.39549	0.48107
Non-ferrous metal	0.63843	0.11322	0.14304
Fabricated metal	0.00112	0.00395	0.08328
Machinery	0.10202	0.28465	0.17924
Electronic	0.06723	-0.12381	-0.01751
Transport equipment	0.16870	0.44241	0.28756
Medical measuring goods	0.02770	-0.13366	0.00485
Others	-0.21121	-0.28135	-0.32281
Weighted standard deviation of differentials*	0.249	0.259	0.251

Note: * : Weights are the share of employment in the industry for the respective year.

Table 1 shows the fractional percentage differences from the weighted mean wage of the whole industry. Figure 1 shows the plot of the 1972 wage differentials against the 1991 wage differentials. The result indicates that the high wage industries such as petroleum refineries, iron



1. Petroleum products
2. Other nonmetallic
3. Paper
4. Wood
5. Transport equipment
6. Beverage
7. Glass
8. Other chemicals
9. Machinery
10. Food
11. Electronics
12. Medical measuring goods
13. Plastic

FIGURE 1
A PLOT OF INDUSTRY WAGE OF 1972 AGAINST 1991
(Fractional Differences from the Mean Wage)

and steel in 1972 continued to be high-wage industries in 1991, while the low wage industries such as wearing apparel, pottery and china have continued to be low wage industries since 1972.

The dispersion of industry wage differentials does not have any tendency to increase or decrease over time in other countries. However, it showed a tendency to increase between 1972 and 1982, and decline in korea since the early 1980s.[4]

B. Inter-Industry Wage Differentials With Labor Quality Controls

To examine the effect of controlling measurable labor quality on the inter-industry wage differentials, we estimate the log of the monthly earnings of full-time employees with a variety of worker's characteristics for each year of 1972, 1982 and 1991. We compare the results with those estimated without any controls. If the two wage structures are parallel, the differences in the quality of workers are not expected to alter the wage structure.

The years of education, marital status, sex, occupation, firm and job tenure, monthly working hours, location of the establishment are used as control variables. The regression results show that the industry dummy variables are jointly statistically significant. Table 2 reports the proportionate differences in wages of the individual industry from the weighted average wage of all the industries.[5]

The figures for the oil refinery industry, for instance, imply that the average wage of workers in that industry is 37 percent higher than that of workers in all the manufacturing industries in 1991, after controlling for differences in human capital and demographic characteristics. The wage premiums in that industry were much higher in previous years—89 percent in 1972, and 45 percent in 1982. On the other hand,

[4]H.G. Lewis (1963) showed that the dispersion in relative industry wage differences in the U.S. has no trend over the long run, but that it has a counter-cyclical tendency in the short run: the greatest dispersion occurred in 1932 during the Great Depression; while the lowest standard deviation was during the post-World War II recovery period. Krueger and Summers (1988) found that the structure of industry wages hardly changes between 1900 and 1984, but that the ranking of industry concerning paying wages changed during the same period of time.

[5]We estimate the coefficients of the 27 industry dummy variables in the log of the monthly earnings equation and calculate the weighted industry mean wage by the share of employment of the industry. We normalize the wage differentials by subtracting the industry weighted mean wage from the coefficients of the industry dummy variables.

TABLE 2

INTER-INDUSTRY WAGE DIFFERENTIALS WITH LABOR QUALITY CONTROLS: LOG MONTHLY EARNINGS OF FULL-TIME WORKERS
(Fractional Differences from the Mean Wages)

Industry	1972	1982	1991
Food	-0.01565	0.03789	-0.05160
Beverage	0.09272	0.20486	0.06272
Textile	0.00372	0.02308	-0.05098
Wearing apparel	-0.10269	-0.06085	-0.15734
Leather	-0.14682	-0.13270	0.01923
Footwear	.	0.01168	-0.07174
Wood	0.01534	-0.00446	-0.02331
Furniture	-0.07247	0.01638	0.06174
Paper	0.04090	-0.01477	0.07217
Printing	-0.16683	0.12742	0.07960
Industrial chemicals	0.25249	0.12397	0.17273
Other chemicals	-0.06957	0.05302	-0.03376
Petroleum refineries	0.89258	0.44820	0.37074
Petroleum products	0.09656	0.16934	-0.11959
Rubber	0.03230	0.03033	-0.03790
Plastic	0.00826	0.03061	-0.01949
Pottery, china	-0.28746	-0.07509	-0.22543
Glass	0.02763	0.10163	0.14147
Other nonmetallic	0.11778	0.10486	0.03856
Iron, steel	0.24276	0.09125	0.20454
Non-ferrous metal	0.29498	-0.08141	-0.01207
Fabricated metal	-0.14333	-0.11472	0.01084
Machinery	-0.10645	0.01315	0.04651
Electronics	-0.03004	-0.07699	-0.00259
Transport equipment	-0.06967	0.11082	0.09471
Medical measuring goods	-0.09654	-0.14044	0.00689
Others	0.08472	-0.10425	-0.17202
Weighted standard deviation of differentials*	0.119	0.08	0.09

Note: * : Weights are the share of the employment in the individual industry for respective year.

the average wage of workers in the wearing apparel industry is 16 percent lower than the average wage of workers in all the manufacturing industries in 1991. The large wage differentials suggest that other factors besides opportunity costs are important in explaining wage differ-

entials.

The correlations of the industry wage differentials between with and without controls in terms of the magnitude are all high in the three years —0.878 in 1992, 0.877 in 1982, and 0.902 in 1991.

Concerning the ranking, the correlations of wage differentials are 0.623 in 1972, 0.848 in 1982 and 0.879 in 1991.[6] The evidence indicates that the addition of personal attributes and human capital characteristics caused no change in the magnitude of wage differentials, but that caused a slight change in the ranking of the industry wage between 1972 and 1991.

While controlling for worker characteristics has little impact on the magnitude of the inter-industry wage differentials and rankings in the wage payments, it reduces the estimated inter-industry dispersion of wages. The standard deviation of the estimated industry wage premiums is reduced from 25 percent when no controls are present to 9 percent when controls are included in 1991.

Among control variables, the years of education and gender are the most important contributors to reduce the standard deviation in 1972, but the tenure with the current occupation plays a crucial role of reducing the standard deviation both in 1982 and in 1991. This indicates that higher wage industries attracted qualified workers with high educational attainments during the early 1970s when the supply of labor was in surplus, but tenure with the firm was more compensated as firms began to develop their firm-specific technologies during 1982-91.

III. Determinants of Inter-Industry Wage Differentials

A. Theoretical Framework

According to the competitive labor market model, the inter-industry wage differentials result from the systematic differences in a worker's ability, or the compensating differentials for non-pecuniary aspects of the work. The models explain that the inter-industry wage differentials reflect the discriminatory shift in labor demand or supply caused by imperfect short-run labor mobility across industries, but that those differentials disappear in the long run.

[6]Krueger and Summers (1988) analyzed the 1984 Current Population Survey (CPS) in the same way and found that the correlation of the industry wage differentials estimated with and without controls is 0.95.

On the other hand, efficiency wage theory and the union threat model suggest that the optimal wages vary across industries with the conditions necessary for paying efficiency wages.[7] They suggest that an individual's earnings are dependent not only on his own attributes but also on industry characteristics. A firm's behavior of paying the higher wages than the ongoing level is rationalized by assuming that firms do not always maximize profit, or that paying higher wage is not very costly for firms because of efficiency wage reasons.

Several strands of theory along with related empirical evidence indicate that industry affiliation is important in explaining inter-industry wage differentials.[8] They suggest that the extent of unionization, the degree of product market that the extent of unionization, the degree of product market concentration, plant and/or firm size and the capital intensity ratio are significant factors affecting workers' earnings. However, whether these factors are also significant in explaining the wage differentials across industries is not clear in the Korean labor market where the government intervenes in the labor market and adopts industrial policies to support targeted industries.

Industrial policies have led to a concentrated market with the rapid expansion of a few large business groups, chaebôls, and promoted export industries by providing many incentives. They have also influenced decisions on investment and employment by the private sector and have affected the wage structure.

The intervention of the Korean government in the labor market has lowered a firm's flexibility in responding to the demand shocks and has affected the elasticity of demand for labor. In addition, the large influx of women and college educated workers into the labor market has influenced earnings for these groups as well as other workers. We incorporate these factors that are specific in the Korean labor market in the analysis of the inter-industry wage differentials. Figure 2 describes the major factors and their interactions in the determination of wages in the Korean labor market.

We start with the proposition that the inter-industry wage differentials result not only from differences in personal attributes and human capital factors, but also from differentials in industry characteristics.

[7]See Salop (1979), Stiglitz (1985), Calvo (1985), Shapiro and Stiglitz (1984), Sparks (1986) as well as Akerlof and Yellen (1988).

[8]See Fleisher and Kniesner (1984), Podgursky (1986), Heywood (1986), Kwoka (1983), Long and Link (1983), Brown and Medoff (1986), Hodson and England (1986), and Lawrence (1985).

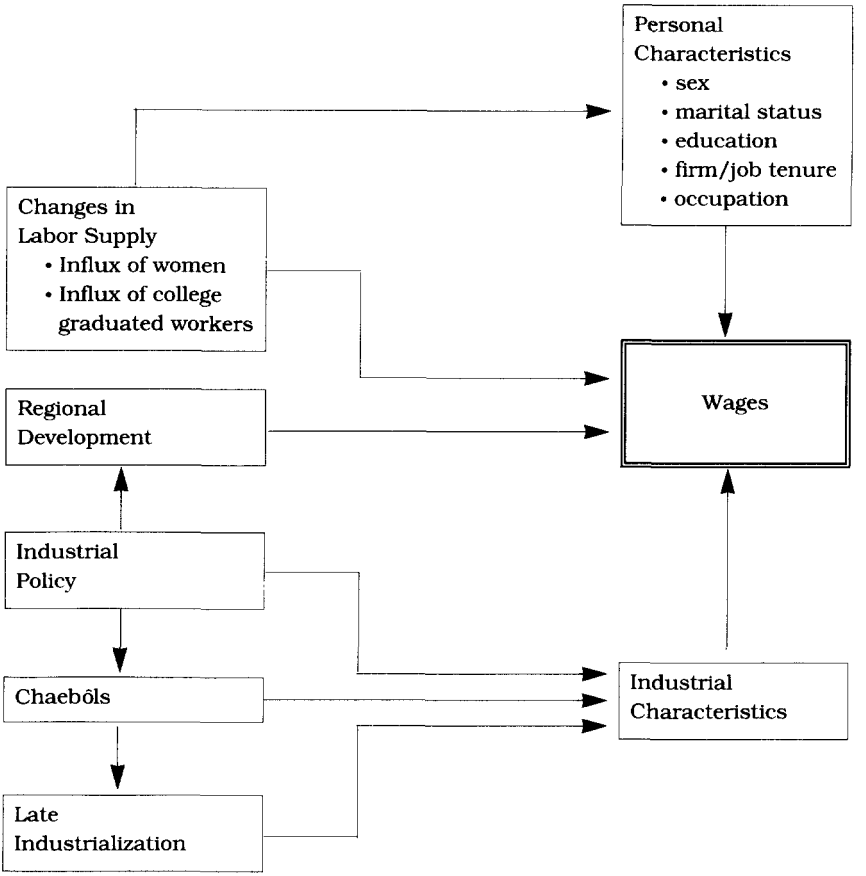


FIGURE 2
MAJOR FACTORS IN THE DETERMINATION OF WAGES IN KOREA

Such personal and human capital characteristics as sex, marital status, education, job and/or firm tenure and occupation have significant impact on earnings at the individual level.

Industrial policies have widened the wage differentials between the supported and non-supported industries since the supported industries demand more labor and the increased demand for labor tends to in turn raise wages. They also tend to induce the migration of workers toward industrial sites and stimulate the unbalanced development of different regions. Furthermore, it leads to increases in the wage differentials between industries that are located in the fast developing

regions and industries that are located in the more slowly developing regions. On the other hand, the industry policy that promotes export-oriented industries narrows the wage differentials since there is downward pressure on the wages of workers in the industries that are exposed to foreign competition.

The emergence of a few large firms, chaebôls, increases the size-wage differentials by segmenting the labor market between large and small firms. Chaebôls expand their activities toward the capital-intensive industries with the help of the industry policy and provide better opportunities for earnings while attracting highly qualified workers. On the other hand, chaebôls also take the superior position in employing workers in the labor market. Whether the effect of market power of chaebôls on wages is positive or negative is revealed by the empirical evidence.

The late-industrialization characterized by the learning and the borrowing of technology from the developed countries makes the wage differentials wider. One reason is that the new industries that rely on turnkey technology transfers pay high wages to motivate workers and to keep workers who have firm-specific skills.

The long overtime working hours caused by the restriction on lay-off are more frequently used in low wage industries in responding to changes in the business cycle and tend to reduce the inter-industry wage differentials since workers are much more compensated in the low wage industries.

The large influx of women in a certain industry also tends to have a negative effect on wages. In addition, the preference of college-educated workers for employment in large firms and capital-intensive industries will increase the wage differentials across industries.

B. The Empirical Model

To examine the sources of the inter-industry wage differentials, we estimate the wage equation in two steps.[9] This approach will solve problems resulting from estimating an earnings equation when industry characteristics are incorporated to the micro data that contains information on human capital factors and personal attributes.[10]

[9]Dickens and Ross (1984) suggest this approach as a possible solution to the aggregation problem. Dickens and Katz (1987) adopt this approach and analyze the inter-industry wage differentials using the 1983 CPS data set.

[10]The first problem occurs when the respondent's employer is assigned to the

In the *first step*, we regress earnings only on a set of individual characteristics and industry dummy variables which represent the 27 manufacturing industries by the three-digit classification,

$$\ln W_{ij} = U_0 + V_{ij} F + W_j G + E \tag{1}$$

where W_{ij} = monthly earnings of individual i in industry j;
V_{ij} = vector of personal attributes, human capital characteristics, occupation dummies and region dummies regarding location of the establishment;
W_j = industry dummy variables;
E = random disturbance term;
U_0 is the intercept, and F and G are the vector of parameters.

The possible correlation between the regressors and deviations of the attributes of the firm's characteristics from industry characteristics can be eliminated in the first step. The coefficients of industry dummy variables represent the wage differentials among industries holding personal attributes and human capital factors constant.

In the *second step*, the estimated coefficients of industry dummy variables from the first step are regressed on variables representing industry characteristics to identify the sources of the inter-industry wage differentials. The estimate function will be as follows:

$$F = L_0 + M_j P + E_j \tag{2}$$

where F = coefficients of industry dummy variables estimated in equation (1);
M_j = vector of j industry characteristics;
E = random disturbance error;

L_0 is the intercept and P is a vector of parameters. The wage equation (1) is estimated for the year of 1972, 1982 and 1991 using Occupational Wage Survey (OWS) data in the first step.

industry level attributes instead of the appropriate firm or plant level attributes. This problem of an incorrect level of aggregation will likely lead to the biased estimates and incorrect standard errors. The second problem is the common group error components or a correlation of the errors within each group. Common group error components arise since two individuals within an industry would be more likely to share an unobserved characteristic than two individuals in separate industries. The group error components lead to the usual OLS coefficient standard errors generally biased downward and the coefficient estimates significant with an exaggeration.

In the second step, the estimated coefficients of industry dummy variables for three years are pooled and regressed on the industry characteristics variables. The relationship between the coefficients of industry dummy variables and the industry average characteristics are simply determined by using OLS unless the normal linear regression model's assumptions are violated. However, it is more realistic to assume that errors are heteroscadastic since values of industry characteristics are different and the variance of omitted minor variables are also different.

If the error variances are not constant and there is a relationship between the error variances and the values of one of the explanatory variables, ordinary squares parameter estimators are unbiased and consistent, but they are not efficient because ordinary squares estimation places more weight on the observations with large error variances than on those with small error variances. This leads to biased estimates of the variances of the estimated parameters. When the biased estimates are used, statistical tests and confidence intervals will be incorrect. If the variance of error terms are heteroscadastic, we have to estimate equation (2) using transformed variables. If the variance of error terms is given by a simple multiplicative function of independent variables,

$$\sigma_i^2 = \exp(w_i' \sigma), \qquad i = 1, \ldots, n$$

where $w_i = [1 \ \ln X_{ji}]'$, $\delta = [\ln \sigma^2 \ \alpha]'$, or equivalently,

$$\ln \sigma_i^2 = \ln \sigma^2 + \alpha \cdot \ln X_{ji}, \qquad i = 1, \ldots, n,$$

then the variance of error terms is proportional to the jth explanatory variable raised to the power α.[11]

We can estimate α_0 and α using the expression,

$$\ln \sigma_i^2 = \alpha_0 + \alpha \cdot \ln X_{ji}$$

and get the estimated variance by taking the exponential of the estimated equation, or

$$\sigma_i^2 = \exp(\alpha_0) \cdot (X_j^{\alpha}).$$

Then we can transform the variables in the equation (2) by dividing by the square root of σ_i^2.

[11]This part relies on *The Econometric Analysis of Time Series* by Harvey, A.C. (1981).

With a transformed equation

$$\frac{F}{\upsilon} = \frac{L_0}{\upsilon} + \frac{M_1}{\upsilon} + \frac{E}{\upsilon} \tag{3}$$

where $\upsilon = \exp(\alpha_0/2) \cdot (\Sigma X_j^{\alpha_j/2})$, the ordinary least squares estimates of the parameters will be appropriate parameter estimates and the variance of errors becomes homoscadastic.

C. Data

The Occupational Wage Survey (OWS), which has been conducted annually by the Ministry of Labor of Korea since 1968, is the basic source of individual worker related information. A six percent random sample is selected from the data of each year of 1972, 1982 and 1991. We focus only on the manufacturing sector that has played a leading role in the rapid growth of the economy. There are 20,137 observations included in the sub-sample of 1972, and 22,574 in 1982, and 19,627 workers in 1991. The earning equation (1) in Section III. *B.* is estimated using this micro-level information.

The major source of the macro industry-related data is the Financial Statement Analysis (FSA), which is conducted annually by the Bank of Korea. The FSA contains statistical data on growth, profitability, financial structure and productivity of Korean corporations classified by industry.

Various years of Input-Output Tables of Korea, generated by the Bank of Korea, are used to calculate the fraction of output exported in the manufacturing industries.

D. Empirical Results

A) The First Step Equation

We estimate wage function (1) in Section III. *B.* for the years of 1972, 1982 and 1991 using the Occupational Wage Survey with OLS. The natural logarithm of monthly earnings ($\ln W_y$) is regressed on the following set of variables:

$$\begin{aligned} \ln (W_y) = {} & \alpha_0 + \alpha_1 \mathrm{SEX}_{1i} + \alpha_2 \mathrm{MAR}_{1i} + \alpha_3 \mathrm{WOR}_i \\ & + \alpha_4 \mathrm{FTEN}_i + \Sigma\beta_k \mathrm{ED}_{ik} + \Sigma\gamma_l \mathrm{JD}_{il} + \Sigma\sigma_m \mathrm{OD}_{im} \\ & + \Sigma h_p \mathrm{RD}_{ip} + \Sigma V_j \mathrm{ID}_j \\ & \qquad\qquad i = 1, \ldots, n, \end{aligned} \tag{4}$$

where SEX_1 = male workers;

MAR_1 = single workers;
WOR = monthly working hours;
FTEN = years of experience with current firm;
ED = educational attainment dummy;
JD = job tenure dummy;
OD = occupation dummy;
RD = region dummy;
ID = industry dummy;

The dependent variable, monthly earnings, includes regular payments and overtime payments, as well as bonuses estimated by dividing the annual total by 12 months.

The equation passes the *F*-test at the 1% significance level and the empirical results of the first step equation support the theory developed in Section III. *A*. Virtually all the estimated coefficients have the same sign predicted by the theory. Also the coefficients of the variables are statistically significant. We summarize the major findings in the below.

(1) Wage earnings of male workers are higher than those of female workers. The coefficients are all statistically significant at the 1% level in each of the three years. The empirical result shows that the earnings of the male worker are higher than those of the female worker, but the effect becomes smaller year by year.

(2) Married workers are paid higher wages than single workers. than single workers. The empirical finding supports the proposition that living cost of a worker is more important than his or her productivity in determining wages in Korea. The effect of marital status on wages is smaller in 1991 than in 1982, but it is still one of the important factors in explaining the wage differentials in Korea.

(3) Educational attainment has positive effect on earnings. The education-wage differentials are decreasing over time, but among human capital factors educational attainment is the most influential factor in the determination of wage level.

(4) The longer monthly working hours result in the higher earnings. This result supports the proposition of compensating wage differentials in Korea.

(5) Firm and/or job tenure have a positive effect on wages. The result supports the proposition that workers who have longer experience with the current firm and firm-specific skills are paid more in Korea.

(6) There are large wage differentials among occupations. As shown in Table 3, there exist large wage differentials among occupations. The result suggests that earnings differentials between administrative and

TABLE 3
ESTIMATES OF FIRST STEP EQUATION

	1972	1982	1991
Gender (omitted = female)			
SEX1	0.380 (50.2)***	0.362 (67.1)***	0.302 (64.7)***
Marital status (omitted = married)			
MAR1	-	-0.142 (-26.0)***	-0.073 (-15.9)***
Education (omitted = college graduate)			
ED1	-0.724 (-44.2)***	-0.642 (-53.1)***	-0.430 (-41.7)***
ED2	-0.597 (-37.5)***	-0.559 (-49.2)***	-0.362 (-43.3)***
ED3	-0.364 (-24.5)***	-0.431 (-42.1)***	-0.258 (-37.4)***
ED4	-	-0.319 (-19.5)***	-0.196 (-21.4)***
WOR	0.002 (20.9)***	0.002 (37.2)***	0.002 (37.1)***
FTEN	0.053 (29.37)***	0.031 (33.6)***	0.028 (44.5)***
Job-tenure	0.044 (32.4)***	-	-
Job-tenure (omitted = JD 7)			
JD1	-	-0.420 (-36.2)***	-0.349 (-34.2)***
JD2	-	-0.263 (-24.9)***	-0.193 (-19.5)***
JD3	-	-0.163 (-24.9)***	-0.123 (-13.2)***
JD4	-	-0.061 (-16.8)***	-0.082 (-9.2)***
JD5	-	-	-0.071 (-8.3)***
JD6	-	-	-0.029 (-4.2)***
Occupation (omitted = production related jobs)			
OD1	0.246 (12.9)***	0.208 (16.5)***	0.165 (19.9)***
OD2	0.399 (12.0)***	0.484 (30.6)***	0.501 (39.4)***
OD3	0.144 (12.3)***	0.165 (22.8)***	0.091 (16.8)***
OD4	0.009 (0.6)	-0.036 (-3.0)***	0.011 (1.1)
Region (omitted = Gyeonsang-Do)			
RD1	0.118 (12.5)***	0.007 (1.1)	0.028 (4.8)***
RD2	-0.001 (-0.1)	-0.075 (-10.8)***	-0.089 (-12.8)***
RD3	0.072 (6.4)***	-0.035 (-5.8)***	0.005 (1.0)
RD4	-0.058 (-4.3)***	-0.063 (-8.3)***	-0.021 (-3.1)***
Industry (omitted = manufacturer of others)			
ID1	-0.109 (-6.5)***	0.144 (10.7)***	0.104 (8.3)***
ID2	0.006 (0.2)	0.305 (15.1)***	0.213 (8.3)***
ID3	-0.088 (-6.6)***	0.104 (9.1)***	0.097 (8.6)***
ID4	-0.213 (-12.8)***	0.015 (1.3)	0.014 (1.2)
ID5	-0.153 (-4.5)***	-0.043 (-2.1)**	0.182 (9.3)***
ID6	-	0.106 (5.6)***	0.100 (7.3)***
ID7	-0.083 (-4.2)***	0.042 (2.3)**	0.136 (6.0)***

TABLE 3
CONTINUED

	1972	1982	1991
ID8	-0.172 (-3.6)***	0.104 (4.1)***	0.215 (10.2)***
ID9	-0.056 (-2.6)***	0.070 (3.8)***	0.210 (13.3)***
ID10	-0.248 (-11.8)***	0.193 (10.8)***	0.261 (17.4)***
ID11	0.159 (6.0)***	0.240 (14.1)***	0.355 (22.5)***
ID12	-0.141 (-7.1)***	0.186 (12.9)***	0.175 (13.2)***
ID13	0.807 (21.7)***	0.608 (16.8)***	0.546 (28.7)***
ID14	0.018 (0.6)	0.234 (9.0)***	0.071 (1.9)*
ID15	-0.039 (-1.9)*	0.109 (7.2)***	0.110 (7.3)***
ID16	-0.147 (-5.2)***	0.129 (6.3)***	0.138 (8.6)***
ID17	-0.382 (-11.3)***	0.004 (0.2)	-0.080 (-2.9)***
ID18	-0.058 (-1.9)*	0.201 (8.4)***	0.298 (15.9)***
ID19	0.024 (1.1)	0.163 (10.1)***	0.184 (12.1)***
ID20	0.129 (5.7)***	0.166 (10.5)***	0.364 (25.9)***
ID21	0.248 (4.9)***	0.016 (0.5)	0.151 (5.8)***
ID22	-0.221 (-12.3)***	-0.010 (-0.7)	0.178 (14.0)***
ID23	-0.176 (-7.7)***	0.121 (8.3)***	0.221 (17.5)***
ID24	-0.108 (-6.5)***	0.057 (4.9)**	0.174 (16.1)***
ID25	-0.151 (-6.3)***	0.223 (15.8)***	0.286 (23.8)***
ID26	-0.181 (-5.1)***	-0.013 (-0.7)	0.200 (11.1)***
R-square	0.611	0.754	0.774
F-value	789.7	1,498.8	1,394.8
Mean of log Wages	9.7	12.1	13.4
Number of observations	20,098	22,498	19,627

Note: The *t*-values are in the parentheses.
* : significant at 10% level
**: significant at 5% level
***: significant at 1% level

managerial workers and production workers are increasing, but earning differentials between technical workers and production workers are declining. The occupation dummy variables along with educational attainment explain the large portion of wage differentials in Korea.

(7) The effect of regional development on earnings is positive. The result shows that the workers in Seoul are paid highest and workers in

the less developed regions such as Gangweon, Chungcheong and Jeonla-Do are less paid than workers in Gyeongsang-Do holding demographic and human capital factors constant.

(8) Large inter-industry wage differentials exist across industries throughout the three years. The estimated coefficients represent the percentage effect of the industry dummy variables.[12] Although there are slight changes in the ranking with regard to the relative wage level over time, the empirical finding supports the hypothesis which argues that a worker's earnings are dependent not only on his personal attributes and human capital factors but also on industry characteristics.

B) The Second Step Equation

We estimate wage equation (2) in Section III. *B.* to examine the sources of the wage differentials, while regressing the coefficients of industry dummy variables estimated from wage equation (3) on the industry characteristics variables. The model specification is as follows:

$$F = \beta_0 + \beta_1 \text{ SCH} + \beta_2 \text{ FEM} + \beta_3 \text{ FD72} + \beta_4 \text{ FD82} + \beta_5 \text{ LOAN} + \beta_6 \text{ OW} + \beta_7 \text{ MAR} + \beta_8 \text{ EXP} + e, \quad (5)$$

where F = vector of the estimated coefficient of industry dummy variables;

SCH = average years of schooling in the industry;

FEM = proportion of female workers in the industry;

FD72 = dummy variable of FEM for 1972;

FD82 = dummy variable of FEM for 1982;

LOAN = amount of long-term debt to bank and foreign debt per worker in the industry;

OW = average overworking hours in the industry;

MAR = ratio of workers employed in firms that employ more than 500 workers;

EXP = fraction of output exported in the industry.

We have already controlled for such human capital variables as education attainment, working experience and firm tenure at the individual level. However, it is possible that average levels of human capital in a given industry level may still be correlated with wages. Workers in

[12]The method that Kennedy (1981) suggested to measure the relative effect of dummy variables on earnings in the semilogarithmic equation is as follows: $[\exp\{c - 0.5 \cdot V(c)\} - 1] \times 100\%$, where c is the estimated coefficient of the dummy variables and $V(c)$ is the variance of c.

industries where other workers are highly educated, more experienced and/or have longer firm tenure may be treated exceptionally. Among the human capital variables, we use only the average years of schooling in the industry to proxy the difference in the quality of workers since other variables such as working experience, and the current firm and job tenure are likely to be correlated with the educational attainment.

The large influx of women in the labor market results in a remarkable change in the employment structure during the last 30 years in Korea. The percentage of an industry's work force which is female tends to be related to the average wage in the industry. The percentage of each industry's workers that are female is used to proxy the effect of a large influx of women on earnings.

The Korean government adopted industrial policies and provided various incentives to the private sector to support the targeted industries. Among many incentives, subsidized loans are the most important factor, which affects the employment and wage structure in Korea. The subsidized loans, of which interest rates are about 5 percentage points lower than commercial loans and grace periods on repayment are longer than commercial loans, are rationed based on the magnitude of the capital of the firm. The amount of loans per worker in the industry is used to estimate the effect of industry policy on earnings differentials between supported and non-supported industries since the amount of value-added per worker and/or the capital intensity ratio is closely related to the ability of a firm to access the subsidized bank loans.

The number of hours of overtime worked is a source of compensating wage differentials. However, the long overtime working hours in Korea is caused by the legal constraint on layoffs. The law aims to protect workers from being laid-off, but most firms use the overtime working hours of existing workers to respond to the business cycles. With overtime working, the employers are able to avoid high quasi-fixed employment costs related to the fringe benefits, training and hiring while at the same time workers make more earnings. The monthly average of overtime working hours in the industry is used as a proxy for the compensating wage differentials.

The industrialization of Korea is propelled by a few large firms, chaebôls, that expand the labor-intensive assembly lines under the subcontracting system. Chaebôls make the prime contracts and small firms supply parts and components. Since most of small firms are either independent suppliers within the chaebôls or controlled by chaebôls financially and technically, the profits of small firms are squeezed and

chaebôls concentrate the market. Industries where chaebôls participate tend to be highly concentrated and the highly concentrated industries are expected to yield higher profits to share with the labor force. On the other hand, chaebôls that have the market power are in the superior position in employing workers and determining wages (Hodson 1983). The effect of chaebôls on earnings will depend on technology adopted in the industry and the labor market situation. We use the ratio of workers employed in firms that employ more than 500 workers in a given industry to proxy the market power of chaebôls.

Since the early 1960s, the Korean government has adopted export promotion policies to overcome the small scale of the domestic market. Fraction of output exported is used to approximate the effect of the foreign competition on wage earnings. The ratio is calculated based on the information from the Input-Output table.

The equation (5) passes the F-test at the 1% significance level, but does not pass the test of homoscadasticity.[13] We specify the variance of error terms as a multiplicative function of independent variables. We tried all the variables and found that the average overtime working hours (which is included in the model) and the average years of firm tenure in a given industry (which is not included in the model since it has multicollinearity problem with years of schooling and the proportion of female workers in the industry) are significantly related to the estimated variance of error terms. We extended the simple multiplicative specification discussed in Section III. *B.* to the two variable model and regressed the variance of error terms on the variables. The result of regression is as follows:

$$\ln \sigma_i^2 = 0.751 - 1.382 \ln (\text{OW}) - 1.926 \ln (\text{FTEN})$$
$$(0.457) \quad (-3.029)^{***} \quad (-3.044)^{***}$$
$$R^2 = 0.232$$

where σ_i^2 = variance of error terms;
OW = overtime working hours;
FTEN = years of working experience with current firm.

By taking the exponential, we estimated the variance of error terms as follows:

[13]The test of first and second moment specification shows that $\chi^2(41) = 230361$, which rejects the null hypothesis: errors are constant.

$$V_2 = \sigma_i^2 = \exp(0.751)^*(\mathrm{OW}^{-1.382})^*(\mathrm{FTEN}^{-1.926}).$$

We transformed the model (5) by dividing all the variables by the square root of the estimated variances of error terms. The transformed equation is as follows:

$$\begin{aligned} F/\upsilon = {} & \beta_0/\upsilon + \beta_1\ \mathrm{SCH}/\upsilon + \beta_2\ \mathrm{FEM}/\upsilon + \beta_3\ \mathrm{FD72}/\upsilon \\ & + \beta_4\ \mathrm{FD82}/\upsilon + \beta_5\ \mathrm{LOAN}/\upsilon + \beta_6\ \mathrm{OW}/\upsilon \\ & + \beta_7\ \mathrm{MAR}/\upsilon + \beta_8\ \mathrm{EXP}/\upsilon + e/\upsilon, \end{aligned} \tag{6}$$

where $\upsilon = \exp\ (0.751/2)^*(\mathrm{OW}^{-1\ 382/2})^*(\mathrm{FTEN}^{-1\ 926/2})$.

The regression results cannot reject the null hypothesis that errors are homoscadastic ($\chi^2(42) = 44.5$) and the F statistic is statistically significant. The results of our analysis can be summarized as follows.

(1) The result of analysis reveals that although the human capital factors are controlled at the individual level, the average levels of schooling in the industry have a positive effect on earnings.[14] As shown in Table 4, the coefficient is statistically significant at the 1% level. This indicates that a worker's wage is dependent not only on the level of schooling of himself or herself, but on the average level of schooling in the industry. The evidence suggests that some industries prefer highly educated workers, while paying higher wages, but others do not. In addition, educational attainment is an important factor in entering firms and in the later promotion, as well as in the determination of wages in the internal market.

(2) Negative relationship between proportion of female workers and earnings. The empirical result shows that the coefficients are statistically significant at the 5% level. The relationship between the proportion of female workers and earnings are negative in 1972 and 1991, but positive in 1982. It can be assumed that the positive relationship in 1982 represents the tight labor market situation that changed from the surplus of supply to the shortage beginning in the latter half of the 1970s. The crowding of female workers in unskilled and low wage jobs has, however, had a negative effect on wages of these group and other workers, as the industry structure becomes more capital-intensive. The evidence supports the proposition that female workers are likely to have a shorter life-time employment span and enter the low-skilled labor-intensive industries.

(3) Industrial policy has a positive effect on earnings. The result

[14]Earnings refer to wage differentials across industries hereafter.

TABLE 4
RESULTS OF SECOND STEP EQUATION

	Parameter Estimates	*T*-value
Intercept	–0.496	–3.377***
SCH(years of schooling)	0.056	4.554***
FEM	–0.146(D-2)	–2.546**
FD72	–0.290(D-2)	–2.247**
FD82	0.156(D-2)	2.161**
LOAN (bank loan per worker, thousand won)	0.341(D-5)	4.762***
EXP (fraction of output exported, %)	–0.329(D-3)	–0.565
MAR (ratio of workers employed in large firms, %)	0.770(D-3)	1.499
OW(overtime working hours)	0.160(D-3)	0.180

Note: Mean of dependent variable = 0.090
Total number of observations = 77
F-value = 87.4
Correlation between estimated parameters and fitted values = 0.994
$\chi^2(42) = 44.5$ ($\chi^2_{0.05}(42) = 58.11$)
*: significant at 10% level
**: significant at 5% level
***: significant at 1% level

shows that the coefficient is statistically significant at the 1% level. It indicates that the amount of long-term bank loans per worker which has been a means of implementing industrial policy is an important factor in explaining inter-industry wage differentials in Korea. The finding of a positive relationship between the amount of bank loans per worker and earnings is mainly due to the fact that firms in the supported industries invest more in the capital-intensive technology with subsidized funds and demand in turn highly qualified workers.

The covariance analysis shows that differences in the amount of bank loans per worker in the industry account for the 72% of the total wage differentials. The evidence supports a proposition that the industrial policy has widened the wage gap between workers in the supported industries and workers in the non-supported industries.

(4) Our finding of the insignificant relationship between the ratio of

export to output and earnings does not support the proposition that the international competition lowers wages of workers.

(5) The proportion of workers with large firms in the industry is not significant in explaining inter-industry wage differentials in Korea. It does not support the hypothesis of the positive effect of concentration on wages; nor does it support the hypothesis of the negative effect of the monopsonic restraints in the employment practice.

(6) The result of analysis shows that the differences in overtime working hours is not significant in explaining wage differentials across industries in Korea. The positive relationship between overtime working hours and earnings in high wage industries is due to the fact that employers use existing workers and make them work overtime in response to an increased demand rather than employing additional workers and thereby incurring the quasi-fixed costs related to recruiting and training. On the other hand, the negative relationship between overtime working hours and earnings in low wage industries are mainly due to the fact that workers tend to work overtime to make extra income to compensate for their low wage rate.

IV. Conclusion

The rapid economic growth in Korea during the last three decades has substantially changed the industry structure and the labor market. In particular, the labor market has undergone significant changes since the beginning of the 1970s. The following features are prominent in the Korean labor market and wage structure.

(1) Working hours per worker in Korea are much longer than in other countries.

(2) Increases in wage rates are much more marked than in other countries.

(3) Wage differentials among workers are fairly large compared to other countries.

(4) Inter-industry wage differentials in terms of magnitude and ranking are stable over the last three decades.

(5) Inter-industry wage differentials are the result of differences both in human capital factors and industry characteristics.

The results of our study imply that the industrial policy has contributed to inequality of earnings. In addition, such industry characteristics as the average years of schooling and the proportion of female workers in the industry contribute to the persistence of wage differen-

tials across industries in Korea. These results will make a valuable contribution to more accurately assessing the role of the government in the labor market, the issues of income distribution and unemployment.

We have studied the industry characteristics that are responsible for the persistent inter-industry wage differentials in Korea. Unfortunately, our study has the following weaknesses:

1) This study does not analyze the effect of union on wages, although collective bargaining has become a major factor in determining wages since 1987 in Korea.

2) This study does not consider the intra-industry wage dispersions. Both weaknesses are due mainly to the lack of data, the impossibility of identifying firm codes in the data sets used, and the impossibility of matching relevant firms to the industry characteristics. Better data sets will eliminate these deficiencies.

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