A Longitudinal Analysis of Inter-Industry Wage Differentials in the Korean Labor Market

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It is well known that wage differences across industries are observed in the United States and other developed countries, even after controlling human capital and demographic factors. This paper studies the existence of the interindustry wage differentials in the Korean labor market using the panel data set taken from the Korean Labor and Income Panel Study (KLIPS). After controlling the unmeasured worker characteristics, we cannot find any significant wage differentials for any industry. Given the results, industry affiliations themselves do not seem to play an important role in determining the wages of Korean workers. An examination of worker mobility patterns across industries is not consistent with the predictions of the efficiency wage hypothesis.

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1. Introduction

It is well known that wages differ across industries in the US labor market, although there has been a lot of debate over the explanation for this (e.g., Krueger and Summers 1988; Murphy and Topel 1990). Wage differences across industries are observed in different developed countries (Katz and Summers 1989). However, there are very few studies of the Asian labor market on this issue. This paper studies the existence of interindustry wage differentials in the Korean labor market by using the Korean Labor and Income Panel Study (KLIPS). The Korean labor market produces unique outcomes in relation to both the rapid economic growth during the 1970s and 1980s and the recent financial crisis that happened in the late 1990s (e.g., Kim and Topel 1995).

The standard theory of competitive labor market does not expect wage differentials across industries for equally skilled workers. However, cross section analysis of wage differences across industries has a major drawback since it cannot control for the unmeasured (time-invariant) workers' characteristics. It is, therefore, inevitable to use a longitudinal data set for this type of analysis, making the KLIPS appropriate for this study. In addition to the advantage of panel type data, the KLIPS contains useful information relating to wage determination such as union membership and firm size, which are often missing in the panel analysis of the US labor market.

I examine the overall wage differentials across industries in the Korean labor market using the simple OLS estimates. The estimated results indicate that at the one-digit level of industry classification, 4 out of 10 industry dummies show significant wage differentials (3 positives and 1 negative) compared to the wages of average workers in all industries. However, there is a fundamental problem with the OLS method, since the unmeasured worker characteristics tend to be correlated with industry affiliations. Thus, fixed effect estimates are employed in order to solve this possible correlation problem. All of the significant OLS estimates of industry coefficients now become insignificant estimates in the fixed effect estimates. It is, therefore, hard to say that there is a substantial wage variation across industries in the Korean labor market. The results from fixed effect estimates are somewhat different from what the researchers expected, because significant industry wage differentials are found in the US labor market.

Even though the use of panel data can account for the unmeasured individual fixed effect, the well-known problem with the fixed-effects estimate is that job changes are not random movements. Since the most part of job changes is voluntary, this self-selection causes the fixed-effects estimate to be inconsistent (e.g., Solon 1988). However, the examination of worker mobility patterns across industries is not consistent with the predictions of the efficiency wage hypothesis. In order to examine the causes of the different results between the US and Korean labor markets for industry wage differentials, several factors affecting wage determinations are considered. Union membership and firm size do not seem to be important factors affecting the wages of Korean workers. In contrast, occupation and tenure seem to be important factors in determining workers' wages compared to industry affiliations in the Korean labor market.

This paper is organized as follows. Section 2 describes the data sources used in the paper and section 3 presents the empirical methodology. Section 4 describes the main results and section 5 concludes.

2. Data

Empirical analysis of industry wage differentials is conducted using the Korean Labor and Income Panel Study (KLIPS). This survey, conducted by the Korea Labor Institute, was designed to provide researchers and policy makers with an empirical foundation for analyzing the dynamic aspects of the Korean labor market. Begun in 1998, the KLIPS provides longitudinal data concerning representative samples of Korean individuals and the family units in which they reside. The KLIPS sample is an equal probability sample of households from 7 metropolitan areas and urban areas in 8 provinces.[1] The original number of households was 5000, and a total of 13,317 individuals were interviewed in 1998; more than 70 percent of the original samples have been included in the subsequent follow-up surveys. The individuals in the sample represent various industry affiliations from manufacturing to public services. I used the

[1] As a result, individuals who reside in rural areas are excluded from this survey.

sample of *regular* salary and wage workers taken from the KLIPS 1998 to 2005 waves, with the exception of the 2000 wave.[2]

The KLIPS contains useful information related to wage determination, such as union membership and firm size, which are often missing in the panel analysis of the US labor market.[3] The sample is restricted to full-time (more than 35 hours of work per week) and non-agricultural sector workers (including both male and female) aged 25-60, who are not in school. The earnings variable is hourly earnings calculated from dividing weekly earnings by hours worked during the week and the earnings are deflated using the Consumer Price Index. Workers who reported earnings of less than $400 per month are not included in the samples, eliminating approximately the bottom 1% of workers. The samples which are missing in the key variables are also dropped from the analysis. If workers have several jobs in any given survey year, the main jobs, defined as jobs having the longest working hours, are only included for the analysis. The final analysis sample contains 9,549 observations and 2,677 individuals, giving an average of 3.6 observations per person.[4]

Table 1 shows sample means for some of the key variables from the final samples of the KLIPS. The samples are substantially male dominated (71% of the samples) and a large number of the respondents (21% of the samples) live in Seoul. In addition, the sample tends to over-represent workers in unionized firms. Table 2 reports ten 1-digit industry distributions among workers in the sample. As shown, workers affiliated with the manufacturing industry comprise most of the samples (40% of the samples); the next largest industry is the social and educational service industry.

3. Empirical Methodology

The neoclassical labor economics predicts the same wages for equally skilled workers. However, empirical studies on the US labor market show that there are

[2] Irregular workers have been prevalent in the Korean labor market since the financial crisis. They are exposed to much lower payment and job stability than regular workers are. The 2000 KLIPS samples are deleted since they do not contain information on the type of employment (regular or irregular).
[3] For example, the Displaced Workers Survey (DWS) used by Krueger and Summers (1988) does not contain information on union members and firm size, and the National Longitudinal Survey of Young Men (NLS) employed by Keane (1993) does not provide information on firm size. The information on union members and firm size are considered to be important factors in determining the workers wage.
[4] Workers who are observed at least twice during the time period are analyzed.

substantial wage variations across industries, even after controlling several human capital accumulations. These wage differentials do not disappear when the unmeasured workers' characteristics are considered by using first difference estimates (see Krueger and Summers 1988). Kruger and Summers argue that the observed industry wage differentials can be explained by the efficiency wages hypothesis, suggesting that workers in high paying industries receive noncompetitive rents.

However, there have been other attempts to explain the industry wage differentials found in the US labor market. For example, using the National Longitudinal Survey of Young Men, Keane (1993) argues that 84 percent of the residual variance of wages across industries can be explained by individual fixed-effects, suggesting that only 14 percent of the residual variance is explained by industry dummy variables. Among studies based on productivity-matching theory, Kim (1995) argues that high skilled workers in low paying industries move to high paying industries and receive high wages.[5] Thus, it is important to consider underlying mobility decisions when one uses the samples of job changers, because the most job changes are not random events.

There are two potential problems with the Displaced Workers Survey (DWS) employed by Krueger and Summers. First, the DWS does not contain information on union members and firm size, which are assumed to be important factors affecting wage determination. It is essential to examine whether industry wage differentials are really due to the industry affiliation itself. Without information on union members and firm size, the observed industry wage differentials, even in the fixed effects estimates, might not correctly reflect industry effects on wages. In this sense, given that it contains information on union members and firm size, the KLIPS has considerable advantages over the CPS.

The second problem is that there is a possibility that industry changes reported in the DWS might not reflect *real* industry moves. The predisplacement job information including industry affiliation is measured by the respondents' answers to the retrospective questions related to jobs where they were displaced within the past 5 years. Therefore, the DWS might have produced somewhat incorrect measures of workers' true status concerning industry changes and furthermore, as Freeman (1984) pointed out, it can

[5] Kim (1995) used the sample taken from the Displaced Workers Survey.

generate a sizable bias in the fixed effects estimates. Since it is surveyed every year, the KLIPS might have better measures of the status of industry affiliations.[6]

I begin by estimating a simple wage equation of the following form

$$ln\ W_{it} = X_{it}\beta + Z_t\gamma + I_{ijt}\delta + \mu_i + \varepsilon_{it} \quad (1)$$

where $ln\ W_{it}$ is the log real hourly earnings for individual i at time t, X_{it} is a vector of individual characteristics i at time t, Z_t represents year dummies, I_{ijt} is a dummy variable equal to one if individual i belongs to industry j at time t, and ε_{it} is an error term. The μ_i represents unmeasured worker characteristics, possibly correlated with the industry affiliations I_{ijt}. If one simply estimates this wage equation by OLS, we will have biased estimates of δ unless the μ_i is unrelated with the workers' industry choices. If workers with high value of μ_i (high ability) systematically choose a certain industry j, the OLS regression will produce an upward bias for the estimate of δ_j. The direction of bias for estimates of each industry dummy variable in the OLS regression will vary depending on the direction of correlation between unmeasured worker characteristics μ_i and each industry affiliation I_{ijt}.[7]

The fixed effects estimates control for the (time-constant) unmeasured worker characteristics using the following transformation:

$$ln\ \tilde{W}_{it} = \tilde{X}_{it}\beta + Z_t\gamma + \tilde{I}_{ijt}\delta + \tilde{\varepsilon}_{it} \quad (2)$$

where $\tilde{W} = W_{it} - \bar{W}_i$ is the time-demeanded data on wages, and similarly for $\tilde{X}_{it}$, $\tilde{I}_{ijt}$, and $\tilde{\varepsilon}_{it}$. The unobserved individual fixed effect μ_i is now differenced out in the above transformed equation. Therefore, the fixed effects estimates of δ will be consistent as long as the error term ε_{it} is uncorrelated with each explanatory variables across all time periods.[8] In addition, the recent statistical packages allow the researchers to correct both

[6] While this cannot be shown formally, based on personal communication, it is clear that the director of the KLIPS is very confident of the measures of workers' industry affiliations.

[7] It may be possible that on average more able workers join one industry and less able workers locate themselves in another industry.

[8] The fixed-effects estimates of industry dummies might be biased if job changes are due to learning by employees and/or employers in the workplace. For example, workers with high unmeasured ability who are

the heteroskedascticity and the serial correlation for the error terms in the fixed effects estimates.

4. Main Results

I present the empirical results from the cross section regression of the wage equation. The empirical strategy is to control for any factors determining workers' wages as well as possible, and then analyze the effect of industry dummy variables on relative wages. Along with the ten 1-digit level industry dummies, several human capital and demographic variables – education, labor market experience, tenure at current job, union status, firm size, sex, marital status, and location of residence – are used as explanatory variables. Furthermore, 7 one-digit occupation dummies are included as explanatory variables, and 6 year dummies control for any time trends in wage changes over time.[9]

Following the methods employed by Keane and Krueger and Summers, I calculate the estimated industry wage differentials as measured by deviations from the (employment-weighted) mean differential. This method is considered to be appropriate for describing the whole picture of interindustry wage differences, because the traditionally estimated industry coefficients by inserting each industry dummy variable are very sensitive to the choice of one omitted industry. As the first step to calculate industry wage differentials, I choose the trade industry as the omitted industry dummy, since this industry is close to the mean of the coefficients of industry dummy variables estimated from the OLS regression.[10] Since the wage regression indicated by equation (1) includes individual fixed effect terms, the omitted industry (trade industry) is treated as having a zero effect on wages.

Table 3 reports the differences between the employment-weighted average of all industry dummy coefficients and each industry coefficient. First, we examine the OLS

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in a low paying industry gradually tend to move to a high paying industry as their ability levels are revealed to workers and/or employers over time. This can be also applied to lower ability workers in high paying industries. In order to solve this sorting problem, Krueger and Summers use the sample of displaced workers who were involuntarily displaced from their previous jobs. However, we cannot entirely rule out the self-selection problem, since the new jobs are decided on by workers.

[9] In addition, two types of employment contract dummies – permanent or temporary – are also included in the regression analysis. Note that most workers in the construction industry are under the short-term contract.

[10] Note that the OLS regression is conducted without a constant term in order to include all the industry dummies.

results shown in the first column of Table 3. According to the cross section results, 4 out of 10 industry dummy variables have a sizable impact on relative wages. For instance, workers in the financial and related industries earn wages about 14 percent higher than the average employees in all industries, after controlling worker characteristics variables. While workers in public utilities and social services industries earn higher wages, workers in transportation and communications earn lower wages than average workers. The remaining industry variables do not show significant wage differentials from the wages of average workers.[11] Figure 1 also plots the estimated coefficients of industry dummy variables shown in Table 3. As shown here, 3 industries pay relatively higher wages and only one industry pays significantly lower wages than the average pay. Having compared this result to the previous studies on the industry wage differentials of the US labor market, it seems that wage variations across industries in the Korean labor market are relatively less dispersed.[12] A more detailed explanation will follow in the next subsection. All other coefficients of explanatory variables have the expected effect on the level of wages.

The next column in Table 3 reports the results of fixed effects estimates of wage equation. Surprisingly, none of the industry dummy variables have significant effects on wages. The positive signs of the transportation, communication, and social services industries in the cross section estimates lose significance, and some of the industry coefficients even turn into (insignificant) negative signs. The large wage premium of the financial industry is no longer observed. This implies that we do not need to resort to non-competitive theories such as efficiency wage hypothesis to explain industry wage differentials in the Korean labor market. The wage premiums that workers command in certain industries might be due to the unobserved worker's high ability rather than industry affiliation effects themselves.

At this point, we have to answer a critical question: "Why is it that the industry wage differentials found in the US labor market do not appear in the Korean labor market?" In order to answer this question, I will discuss two issues: the institutional differences between the US and Korean labor markets, and the problem of endogenous

[11] The standard errors, however, are the unadjusted OLS standard errors.
[12] For instance, Krueger and Summers report that most industry dummy coefficients in the wage regressions are statistically significant individually as well as jointly.

mobility of workers related to job changes. First, I consider several factors affecting the worker's wage level. In the Korean labor market, the compensation for workers is traditionally based on a seniority payment scheme. Once the level of starting wage is settled, the wage increase is mainly decided based on years spent in the current workplace, or sometimes labor market experience.[13] In addition to the importance of the job tenure effect in determining the wages of Korean workers, the occupational effect seems to be more important in explaining wage variation than industry affiliations. Table 4 reports the results of the R-squares from the pooled OLS estimates with various specifications. The human capital and demographic variables can explain about 54.9 percent of the variation in log hourly wages. While 7 occupation dummies explain an additional 3.5 percent of wage variation, the 10 industry dummy variables explain only an additional 1.3 percent of wage variation. The results demonstrate the relative importance of occupation effect on wages; this contrasts with the results from the US labor market, which shows that industry has much larger effect on wages than occupation (see Keane, 1993). Furthermore, the significant effect of occupation on wages shown in the cross sectional analysis does not disappear in the fixed effect estimates.[14]

Secondly, we explore the possible problem of the endogenous mobility of workers which may force fixed effects estimators to be inconsistent. As noted, most job changes are voluntary and, as a result, the identification of industry effects on wages in a fixed-effects estimation depends mainly on the wage changes experienced by job changers, which may cause a self-selection problem. In addition, job changers who also change industries are only included for the analysis of fixed effects estimation. As a result, workers who change jobs but keep the same industry affiliations are excluded for the samples of industry changers. Therefore, this may cause the fixed effects estimates of industry wage differentials to have a downward bias if the wages of job changers who stay in the same industry increase compared to the wages of job changers who change industries. Table 5 represents wage changes following job changes for each

[13] There is empirical evidence that the effect of job tenure on wage is stronger in the Korean labor market than in the US labor market (see Cho, 2006).

[14] Since the information on union members and firm size are often unavailable in the US data, it may be worthwhile to examine whether we can observe industry wage differentials for the Korean labor market without information on union and firm size. However, we still cannot find any significant industry coefficients without controlling this information, and this implies that union members and firm size are not important sources diluting industry affiliation effects on wages in the Korean labor market.

group of industry holders, and industry changers after job changes. While the hourly wages of industry changers increased by 0.1 log points after job changes, the wages of industry holders increased by 0.12 log points. Given that the current job tenures of industry holders are slightly higher than those of industry changers, wage increases after a job change is not significantly different between industry holders and changers.[15] It is, therefore, hard to believe that the samples of job changers holding the same industry affiliations cause the fixed effects estimator to be inconsistent.

Lastly, it will be very informative to examine the industrial movement for job changers who move industries. Based on the efficiency wage hypothesis, there will be more mobility incentive for workers to move to the (perceived) high paying industries, whereas there will be fewer incentives for workers to move to the low paying industries. Table 6 shows the mobility patterns of workers across industries by one-digit level. Among the 421 samples of job-industry changers, all job movements are shown to be symmetric across industries. Furthermore, the mobility patterns are contrary to the predictions of efficiency wage hypothesis. As shown in Table 6, there is more net flow into the low paying industries, such as the transportation and communication industries, and there is also less net flow into the high paying industries, such as the financial industry. Having considered the possible self-selection problem related to the job changes, it is hard to find evidence that the mobility decisions of workers cause a serious bias in the fixed effects estimation of the industry wage differential in the Korean labor market.

5. Discussion

This is the first paper to examine an overall picture of interindustry wage differentials in the Korean labor market.[16] Using the panel data of the Korean labor market, we are able to control for the unmeasured worker characteristics which is essential for this analysis. Due to the sample size, the analysis is restricted to the aggregated 1-digit industry level. While 4 out of 10 industry dummy variables show significant wage differences compared to the wages of average workers, we cannot find

[15] The higher current job tenures for industry holders might have produced slightly higher wage increases compared to the industry changers having relatively lower job tenures.
[16] There are several papers that examined the industry wage differentials of the Korean labor market but their focus is only on the manufacturing industries.

significant wage differentials for any industry in the fixed effect estimates. Given the results, it is hard to say that there is substantial wage variation across industries in the Korean labor market. Industry affiliations themselves do not seem to play an important role in affecting wages, which is interestingly the opposite result to studies on the US labor market.

We suspect that the reasons we cannot find any significant industry effects on wages in the Korean labor market can be analyzed by two aspects: the differences in terms of labor market institutions, and the famous self-selection problem. Compared to the industry effect on wages, job tenure under the seniority payment scheme and occupation seem to be more important factors in determining the workers' wages in the Korean labor market. As noted by Kim and Topel (1995), there is historical evidence suggesting that aggregate wage growth in the Korean labor market was neutral among industries during the 1970s and 1980s. If this continues to occur, wages in the Korean labor market might become relatively more compressed among industries compared to the US labor market. The examination of the patterns of the worker mobility across industries and related wage changes shows that the possible endogenous problem related to job changes is not an important factor (downward) biasing the fixed effects estimates. In addition, the mobility patterns are not consistent with the predictions of the efficiency wage hypothesis. As a result, the human capital theory seems to fit in explaining inter-industry wage differentials for the Korean labor market.

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Table 1:

Descriptive Statistics: Means of Variables in the KLIPS Sample

Variable	Mean
Log of hourly wages	4.16 (0 .54)
Education (years)	12.97 (2.98)
Labor market experience	17.45 (9.94)
Age	37.41 (8.39)
Union members	30.40 (0.46)
Marital status	0.63 (0 .48)
Female	0 .29 (0 .45)
Reside in Seoul	0 .24 (0 .43)
Sample	9,549

Notes: Standard deviations are in parentheses. The sample is restricted to full-time regular and non-agricultural sector salary workers aged 25-65. Experience is age-7- years of education.

Table 2:

Industry Distribution in the KLIPS Sample by One Digit Level

Industry	Number of employment	Percentage of employment
Manufacturing	3,837	0.40 (0.49)
Electricity, Gas, and Water Supply	89	0.01 (0.10)
Construction	607	0.06 (0.24)
Wholesale and Retail Trade	1,137	0.12 (0.32)
Hotels and Restaurants	306	0.03 (0.18)
Transportation and Communication	767	0.08 (0.27)
Financial Institutions and Insurance	560	0.06 (0.23)
Real Estate and Renting and Leasing	91	0.01 (0.10)
Social and Educational Service	1,833	0.19 (0.39)
Personal and Households Service	322	0.04 (0.18)
Sample	9,549	1.00

Table 3:

Estimates of Industry Wage Differentials by one digit level

	OLS	**Fixed Effect**
Education	0.050** (0.002)	
Experience	0.019** (0.002)	
Tenure	0.019** (0.001)	0.015** (0.001)
Union	0.041** (0.011)	0.020 (0.011)
Marriage	0.073** (0.010)	0.024* (0.012)
Female	-0.293** (0.009)	
Industry:		
Manufacturing	-0.025 (0.016)	0.026 (0.037)
Electricity, gas, and water Supply	0.114** (0.042)	-0.037 (0.145)
Construction	0.001 (0.020)	-0.053 (0.050)
Wholesale and retail trade	-0.002	0.020
Hotels and restaurants	-0.021 (0.029)	0.014 (0.065)
Transportation and communication	-0.053** (0.020)	-0.124 (0.067)
Financial institutions and insurance	0.140** (0.023)	0.107 (0.083)
Real estate and renting and leasing	-0.027 (0.042)	-0.103 (0.175)
Social and educational service	0.039* (0.017)	-0.016 (0.043)
Personal and households service	-0.037 (0.025)	-0.058 (0.081)
Occupation:		
Managers and professionals	0.416** (0.022)	0.198** (0.047)

Technicians and associate professionals	0.330** (0.020)	0.255** (0.045)
Clerical workers	0.272* (0.019)	0.201** (0.045)
Service workers	0.126** (0.027)	0.097 (0.052)
Sales workers	0.150** (0.025)	0.173** (0.052)
Craftsmen and related workers	0.146** (0.019)	0.133** (0.043)
Machine and plant operators	0.089** (0.019)	0.127** (0.043)
Adjusted standard deviation of industry wage differentials	0.045	0.051
Adjusted R-squared	0.5907	0.2985
Number of observations	9,549	9,549

Notes: The reported industry coefficients are the difference between each industry coefficient and the employment-weighted average of industry dummy coefficients. Trade industry was omitted and treated as having zero effect on wages. Laborer is the omitted occupation. The standard errors for these industry coefficients are unadjusted OLS standard errors. Six year dummies, two types of employment contract dummies, and fourteen locations of residence dummies are included as explanatory variables.

* significant at 5% level; ** significant at 1% level

Figure 1: Industry Wage Differentials

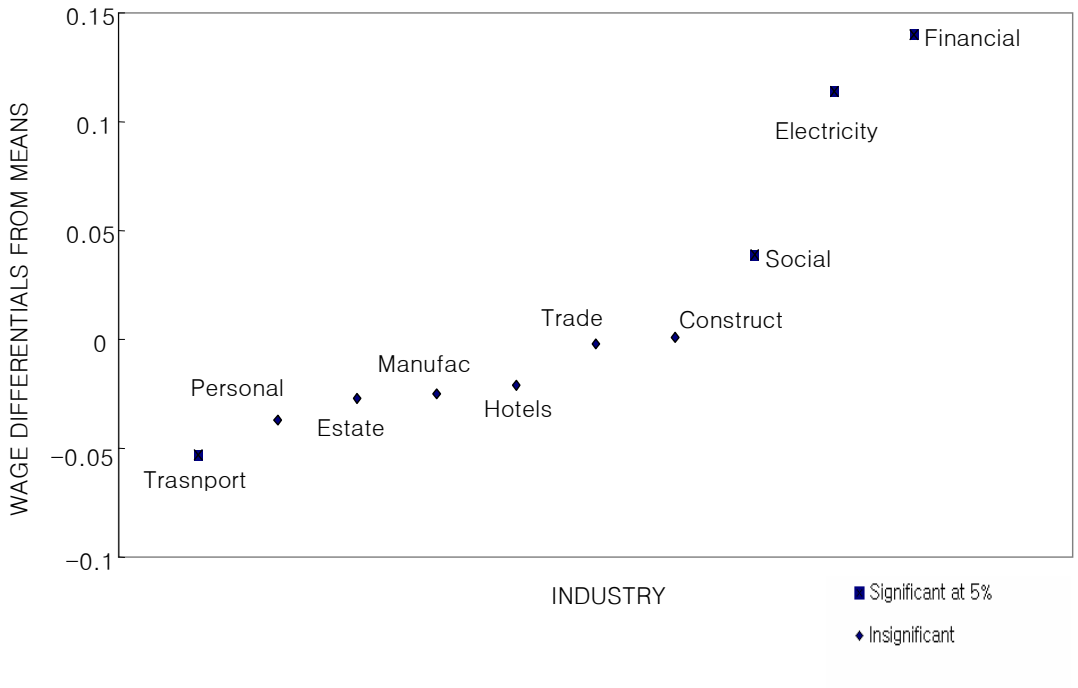

Table 4:

The Effect of Occupation and Industry on Wage Variations

Occupation dummies	Industry dummies	Adjusted R-Squared
No	No	0.5494
Yes	No	0.5850
No	Yes	0.5627
Yes	Yes	0.5907

Notes: The R-squares are calculated from the pooled OLS wage regressions. Trade industry and laborer are omitted industry and occupation.

Table 5:

Mobility of Workers and Wage Changes

	Industry holders	Industry changers
Wages before job changes	3.92 (0.47)	3.98 (0.47)
Wages after Job changes	4.04 (0.51)	4.08 (0.52)
Wage changes due to Job changes	0.12 (0.36)	0.10 (0.47)
Job tenure	1.33 (2.66)	1.22 (2.23)
Sample size	681	421

Table 6:

Mobility of Workers across Industries

	MANUFAC	UTILITY	CONSTRUCT	TRADE	HOTELS	TRANS	FINANCIAL	ESTATE	SOCIAL	PERSONAL	Total
MANUFAC	0	2	13	39	7	15	1	0	32	5	114
UTILITY	1	0	0	0	0	0	0	0	0	0	1
CONSTRUCT	18	0	0	4	1	4	1	1	8	2	39
TRADE	33	0	8	0	4	9	8	3	22	3	90
HOTELS	8	0	0	5	0	2	1	1	3	2	22
TRANS	10	1	5	1	1	0	0	2	11	2	33
FINANCIAL	5	0	1	9	1	0	0	1	3	0	20
ESTATE	1	0	2	1	0	1	0	0	2	0	7
SOCIAL	25	0	14	19	4	6	6	1	0	3	78
PERSONAL	6	1	3	1	1	0	1	1	3	0	17
Total	107	4	46	79	19	37	18	10	84	17	421

Notes: Industries shown in the rows are those from the current jobs and industries in the columns are taken from the previous jobs.
Each number represents the amount of workers who move from one industry to another industry.