A STUDY ON THE TRADE-OFF BETWEEN SUPERVISION AND WAGES: AN EMPIRICAL TEST OF EFFICIENCY WAGE THEORY

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The undersigned, appointed by the Dean of the Graduate School, have examined the dissertation entitled.

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And hereby certify that in their opinion it is worthy of acceptance.

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ABSTRACT

This dissertation investigates the applicability of the shirking version of efficiency wage models in Korea. Analyses is based on the Survey on Wage Structure in the 1980's and 1990's - using data collected in 1983, 1989, 1993, 1996, and 1999.

Efficiency wage theory predicts a negative relationship between supervision and wages: employers may choose either to pay a wage premium or to increase the level of supervisory intensity to force workers to exert more effort.

The relation between supervisory intensity, as measured by the ratio of supervisors to supervisees in a firm, and wages is explored. Interaction effects between supervisory intensity and employer characteristics on wages are also investigated in more detailed analyses. Finally, we explore whether supervisory intensity is able to explain inter-industry wage differentials.

The evidence suggests that supervisory intensity is positively correlated with wages, implying the efficiency wage model is not applicable in Korea. Industrial interaction analysis shows weak evidence of efficiency wages in the social service sector, but there are no apparent patterns in other industries. In occupational interaction analysis, efficiency wages are paid to drivers and sales workers. Although supervisory intensity does not explain wage variation across industries, there are significant inter-industry wage differentials observed in Korea.

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CHAPTER 1

INTRODUCTION

Efficiency wage models explain that workers productivity is a positive function of wages. Firms, therefore, may not reduce wages in the face of excess supply, because the decrease in wages may result in an increase in labor cost through lowering productivity. These facts offer an explanation that efficiency wage models generate wage differentials across industries and establishments that cause involuntary unemployment. There are several hypotheses to explain the relationship between wages and productivity: 1) nutrition, 2) turnover, 3) selection, and 4) shirking. In this study we focus on the shirking model, in which effort function differs across firms and thus wage differentials arise. The wage differentials reflect firms' efforts to lower cost where the wage is associated with the productivity of workers. The primary purpose of this paper is to test the shirking version of efficiency wage theories with data from Korea's Survey on the Wage Structure (SWS). We investigate whether higher pay for workers serves as a discipline device to elicit workers' effort.

Previous work has focused on developed countries. However, it is worth studying the Korean case given Korea's outstanding performance among developing countries. First, it would be useful to evaluate the consistency of the theory across countries by comparing wage patterns in developed countries with those in developing countries. Edin and Zetterberg (1991) pointed out that although wage differentials caused by variation in supervision intensity seem to be consistent over time and across countries, as they appear to be based on comparison of industries in Sweden and the U.S., magnitudes of the wage differentials may depend on characteristics of the labor markets, such as the density of unionization and unemployment rates.

The Korean labor market is ideal for examining how efficiency wages can be applied at various levels of economic development. Industrial policies have influenced decisions on investment and employment in the private sector, which affects the structure of the labor market dramatically since the 1960's. Korea, as an export-oriented country, has experienced large changes in its main strategic products from wigs and apparel in the 1960's to automobiles and ships in the 1990's. In addition, a large inflow of women and highly-educated workers into the labor market has affected earnings of those groups as well as others.

This paper tests the efficiency wage model by looking at the relationship between supervisory intensity, as measured by the ratio of supervisory to nonsupervisory workers, and wages. To construct supervisory intensity within establishments, we use a hierarchical rank variable that defines worker's supervisory role. The standard occupational code is also used as an alternative measure of supervisory intensity. Since monitoring technology is closely related with firm size, industry, occupation, interaction analyses with supervisory intensity also conducted. We, finally, investigate whether supervisory intensity is able to explain inter-industry wage differentials, comparing the weighted adjusted standard deviations with and without supervisory intensity. This study spans a period of 20 years – examining data collected in 1983, 1989, 1993, 1996, and 1999..

The data set has an advantage in investigating the application of the shirking version of the efficiency wage theory because of the availability of a variable identifying a job's hierarchical rank, a measure not available in other data sets. Because the rank is directly associated with job positions that identify whether a worker has a supervisory role, the hierarchical measure is distinguished from the supervisory intensity measured based on standard occupational code used in previous studies.

This paper is organized as follows. Chapters 2 and 3 contain literature reviews focusing on first theoretical and then empirical investigations of efficiency wages. In chapter 4, we give a detailed description of the data used and explain the procedure used to define supervisory intensity using our hierarchical rank variable and a comparison of the intensity between the hierarchical measure and the occupational measure from the reviewed literature. Chapter 5 describes the analysis methodology. In chapter 6, we present a procedure to find best suitable wage equation with our data. The chosen baseline model is used for firm size / industrial / occupational interaction analyses of monitoring effects on wages. In order to compare our results with those in the previous literature, we adopt supervisory intensity based on an occupational measure, employing the same model used with the hierarchical measure in the first part of the chapter. Finally, in chapter 7, we assess industrial wage dispersion. This analysis confirms the considerable inter-industry wage differentials. However, the wage differentials are not explained by the supervisory intensity.

CHAPTER 2

THEORETICAL LITERATURE

2.1 Efficiency Wage Theory

There are several theories to explain downward wage rigidity, which can cause equilibrium unemployment. Efficiency wage theory provides a theoretical explanation for downward wage rigidity in the sense that firms pay wages above the level at which they can hire qualified workers. Firms may choose not to lower wages, even in the presence of unemployment, if a worker's productivity is positively impacted by his wage.[1] In such cases, lowering wages could increase rather than decrease a firm's labor costs. As a result, wage rigidities and unemployment arise in efficiency wage models.

Efficiency wage theory offers several circumstances in which a firm may want to pay workers a wage that is above the market clearing level. The first model of efficiency wages is that they are paid higher wages in order to enhance worker nutrition. Leibenstein (1957) argued that employers in less developed countries pay higher wages so that the worker can work with greater energy. In the development literature, wages in poor economies determine workers' consumption level. This explanation would appear to have little applicability in the developed countries. Second, Stiglitz (1974) suggested that unemployment and underemployment are caused by turnover cost such as training and hiring cost. Stiglitz takes not only wages but also training cost of a quitting worker as part of a firm's labor costs. If firms bear at least part of the turnover cost and wages have a

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[1] Relative wage theories in which workers' productivity depends on their relative wage are very closely related to the efficiency wage theories. Most efficiency wage theories assume that productivity depends on the relative wages inside and outside the firm. Opportunities outside the firm in turn depend on both the wages paid by other firms, the rate of unemployment, and unemployment benefits [Summers (1988)].

negative impact on turnover rates, then firms have an incentive to raise wages to reduce turnover cost. Turnover costs then cause above-equilibrium wages and result in equilibrium unemployment. Workers in firms of higher wages will not turnover at as high a rate. Third, the selection model provides an additional explanation for a positive relationship between productivity and wages. Assuming that worker performance is a function of the worker's ability, if performance is positively related with a worker's alternative wage, then efficiency wage firms may attract higher quality workers (Weiss, 1980, and Akerlof and Yellen, 1986).

The final model, which is the main focus of this study, posits that higher wages are paid to elicit a desirable level of effort. Efficiency wages are paid to prevent shirking, and may therefore substitute for expenditure on supervision. The shirking model predicts that firms paying higher wages (relative to worker quality) are those with greater monitoring difficulties, high cost from workers' shirking, and greater importance of workers' effort levels. In order to prevent shirking, employers would choose higher wages and thus workers would exert more effort in a firm that pays more than in others because dismissal is more costly. In other words, the employers make the opportunity cost of dismissal artificially high. Efficiency wages, therefore, work as rent (Gordon, 1994).

The shirking model and the selection model are in some ways inconsistent because they make different assumptions about the pool of employees. In the shirking model employers have an incentive to seek workers that have fewer outside employment options, as workers are assumed identical in terms of productive potential. If employees have good alternatives, they would not respond to the threat of dismissal, as they could simply turn to those alternatives. In the selection model, however, employers believe the pool of workers is heterogeneous with regard to productivity and they wish to find employees who have more alternatives, as this is evidence of their qualification for the position.

The model underlying this analysis assumes imperfect information, so that the employer cannot costlessly observe worker productivity or effort. Asymmetric information on the level of effort each employee chooses forces the employer either to increase supervision or pay higher wages. Under full employment, as an extreme case, workers do not have to worry about being fired because they can get another job easily. In contrast, if there is symmetric information on work effort, or if firms can supervise workers perfectly, then firms do not need to offer higher wages. As Shapiro and Stiglitz (1984), and Foster and Wan model (1984) note that if firms can observe and measure the output of each employee, then they are able to punish workers or force them to pay a penalty when output falls below a certain level. There is no reason for employers to pay efficiency wages when the level of effort is reflected directly in observable output. Therefore, if a piece rate wage scheme is applicable, that is, if output can be measured for each worker, the shirking problem in the presence of asymmetric information would be solved (Shearer, 1995).

In essence, the shirking version of the efficiency wage theory says that when there is asymmetric information on workers' effort, firms pay above the wages necessary to hire workers because paying higher wages reduces shirking. Firms can choose, within some range, to pay higher wages or to supervise workers intensely. In other words, both methods can be disciplinary devices that make employees work hard. It should be recognized that monitoring cannot be reduced to zero, since efficiency wages are only effective if there is some chance effort or productivity is observed.

2.2 Alternative Discipline Devices

Employers monitor work effort and threaten to dismiss employees whose work does not reach standard. Hence, both the supervisory intensity and the value of the current job are positively associated with work effort and productivity that in turn leads to higher wages.

It has been suggested that unemployed workers might well be required to pay entrance fees or post performance bonds, essentially paying the firm to be hired at wages above market clearing. If this were the case, it would give firms an incentive to hire more workers. Since entrance fees are costs for prospective workers when they are detected shirking, it works as a discipline mechanism. An entrance fee can be interpreted as a performance bond, which is posted by workers when they are hired and is forfeited if they are caught shirking. The threat of forfeiting the bond can work to increase the cost of being fired, therefore inducing workers to apply effort. In contrast to the implications of the efficiency wage model, under entrance fees or bonds, there is no excess supply of workers, and unemployment does not result (Carmichael, 1985).

Although posting performance bonds is the most direct alternative to assuring optimal worker effort when it is not fully observable, there are obstacles to the use of bonds. Akerlof and Yellen (1984), and Shapiro and Stiglitz (1985) argue that firm incentive effects and moral hazard problems make posting bond as an entrance fee for jobs infeasible. Firms would face moral hazard in evaluating workers' effort, as there will be an incentive for the firm to fire senior workers. This may explain why performance bonds do not occur commonly in the labor market.

Furthermore, there are serious problems in applying these alternatives in the labor market. Among these problems, those frequently discussed are the facts that capital market is imperfect (Shapiro and Stiglitz, 1984) and that posting a bond is technically illegal in some states, at least in Connecticut, as indicated in Bewley's book[2]. Whether capital market imperfections actually preclude bonding is controversial. Carmichael (1985) notes that firms have incentives to require bonds even when such constraints are of importance, and that unemployment will not occur. Bond levels will be set at whatever level is necessary to equalize utility between holding a job and unemployment.

In Ritter and Taylor's model (1994), the authors assume that there is no moral hazard problem in setting up the bonding arrangement and there exists heterogeneity among firms; firms have different possibilities of being bankrupted. Since bonding is costless to firms, all firms may prefer bonding strategies as opposed to costly efficiency wages. However, heterogeneity of firms works to prevent this outcome, that is, safe firms must pay a risk premium on the bond that exceeds the benefits they receive from terminating workers. They argue that the use of both bonding and efficiency wages by some firms characterizes the labor market equilibrium.

[2] In addition, Bewley (2000) argued that "performance bonds are not a practical alternative to antishirking wage premium and share with them the defect of antagonizing workers by implying coercion." (p118)

2.3 Variations of the Efficiency Wage Theories

First of all, the shirking version of efficiency wage theories argues that wage differentials between establishments/ industries are reflected by differences in costs/ technologies of monitoring. Firms, however, may have their wages artificially high in order to get rid of frequent adjustment of wages, in response to external shocks from the labor market, such as recession or inflation. The firm must pay higher wages based on higher adjustment cost or the need for more frequent adjustment. Moreover, the size of a firm seems very likely to be positively correlated with the adjustment cost, since bigger size is sometimes interpreted to be a slow response of external labor market shock, due to its complex organization or decentralized decision process.

Secondly, a firm with several establishments will be better off by paying above-market wages when establishments transfer workers between them with different locations; if a plant is in shortage of skilled workers, transferring workers from plants with many skilled workers to ones with few skilled workers would be a cost-lowering behavior. Wages paid by the firm are rather different from efficiency wages in the sense that higher wages needed to accommodate the adjustment do not induce employee productivity to increase. In the long run, for example, wages of the adjustment contain a worker's cost of inconvenience from moving to a different location to work. Obviously, the increment of the wage contains costs of moving and so on.

The difference between the efficiency wages and the higher wages in this explanation of a firm with multiple establishments is in the productivity aspect. As mentioned above, efficiency wages are positively correlated with the productivity of employees. On the other hand, the explanation of the firm with several establishments does not necessarily require a connection with the productivity, since their decision to pay higher wages is an inter-temporal choice of cost-lowering behavior.

The shirking model could have a different outcome than the selection model of efficiency wage theory. The selection model suggests that firms offering higher wages will have workers who need less supervision. In this case, industrial differences in wages reflected by different monitoring costs or, in other words different technology, would be decreased.

CHAPTER 3

ISSUES IN THE EMPIRICAL LITERATURE:

STUDIES OF EFFICIENCY WAGES AND ALTERNATIVES

3.1 Wage Differences by Industry

Efficiency wage models offer a theoretical explanation for wage dispersion across industries. The existence of inter-industry wage differentials is considered as indirect evidence in support of efficiency wages. Krueger and Summers (1988) present evidence that controlling for unobserved heterogeneity does not eliminate inter-industry wage differentials. Blackburn and Neumark (1992) also find that inter-industry wage differentials may not be attributable to unobserved heterogeneity of labor quality. Murphy and Topel (1986) find that industry differences in the probability and duration of unemployment cannot fully explain inter-industry wage gaps. Moreover, wage differentials were revealed to be consistent over time and even across countries, for instance, in Japan [Kitazawa and Ohta (2002)], Sweden [Arai (1994a, 1994b), Edin and Zetterberg (1991)], Canada [Gera and Grenier (1994)], and the U.K. [Konings and Walsh (1994)].

3.2 Firm Size and Wages

The positive effect of establishment size on wages is a stylized fact in labor economics. Greater union power or firm market power caused by firm size has been frequently introduced to explain the wage differentials between industries. The efficiency wage theory, however, can be a useful instrument to explain the correlation: if there exist difficulties in monitoring employees as firm size grows, it is rational that larger employers pay substantially higher wage relative to small employers (Arai, 1994a; Troske, 1999). Monitoring costs are assumed to be higher in larger firms, given the facts that managers' monitoring time, on average, has higher opportunity costs in larger firms and that larger firms have a higher cost of obtaining information on workers' effort. Moreover, shirking costs are also higher in firms with expensive production equipment. Troske (1999) asserts that wages of nonsupervisory workers are positively correlated with the number of workers in establishment but he finds there is very little change in the effect of firm size when supervisory intensity is controlled.

Krueger and Summers (1988) reported a significant correlation between size of firms and wages. Similar empirical research was conducted by Kruse (1992), who explored the establishment size-wage effect. Kruse tested whether supervision intensity is correlated with both firm size and wages using the 1980 Survey of Job Characteristics (SJC). Although results do not support the view that supervision variables explain the size-wage effect, they do show a negative effect of supervision on wages.[3] Using data from law firms, Rebitzer and Taylor (1995) find that large law firms pay higher wages to associates as well as partners relative to smaller ones. The authors, however, point out the importance of self-selection aspect of efficiency wages: paying higher wage increases the probability of hiring talented associates, implying that unobserved heterogeneity of associates could bias the employer size effect on wage.

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[3] For the supervision intensity, workers are asked the frequency per 40-hour period that supervisor checks on work.

Arai (1994a) finds that in the Swedish case, the size of the industry wage premium is positively and significantly related to the fraction of autonomous jobs, where autonomous jobs are those with particularly low intensity of supervision. Arai (1994b), moreover, suggests that efficiency wage schemes exist in the private sector, but not in the public sector.

Even if larger firms have difficulties in monitoring workers relative to smaller firms, one must take into account unattractive working conditions as employer size grows. Unpleasant working conditions such as more impersonal work atmosphere and less autonomy in action and scheduling force larger firms to pay higher wages. Hence, the relationship between employer size and wages will be positive, consistent with prediction of the efficiency wage theory.

In order to separate those aspects of compensating differentials by undesirable working conditions from wage equation, Brown and Medoff (1989) use detailed industries, occupations, employer sizes, and dummy variables for working on the second or third shift, under difficulties to measure working conditions directly. Moreover, Kruse (1992) concludes that controlling working conditions with more direct measures such as chance of promotion and layoff, and flexible hours reflects not only employer size effect on wages, but also unobserved worker ability.

In this study, we use dummies of industries, occupations, and employer sizes to control possible compensating differentials caused by differences in working conditions.

3.3 Rent Sharing and Efficiency Wages

As an explanation of non-comparative wage setting, that is, above equilibrium wage setting, rent-sharing model could be adopted instead of efficiency wages. Much research has been conducted to identify such rent sharing, for example, Conyon and Freeman (2001), Blanchflower, Oswald, and Sanfey (1996), and Jones and Kato (1995). The theory implies that rent-sharing wage schemes induce a positive association between wages and the firm's profitability. One difference between efficiency wage models and profit sharing models is whether productivity changes or not: efficiency wages increase productivity while rent-sharing need not. This fact needs to be considered carefully to evaluate efficiency wage theory especially when we control firm size effects due to the positive association between firm size and market share. Therefore, controlling profitability or market share of firms as well as firm size in wage equations is useful to separate the effect of rent-sharing from efficiency wages.

However, Conyon and Freeman (2001) suggest possibilities that firms and establishments with shared compensation, particularly those with deferred profit-sharing and employee share ownership, are likely to outperform other firms without shared compensation in productivity and market performance through establishing proper communication and consultation channels with workers. Also, certain types of shared compensation could affect firm performance by 1) resolving principal-agent problems, and 2) reducing free rider problems in team production. For instance, employment stock-ownership plans (ESOP) as a form of profit sharing have somewhat different rationale and consequence as compared to rent-sharing wages. ESOPs are introduced to reduce worker shirking or other negative agency problems by giving workers partial ownership.

ESOPs as a type of shared compensation motivate workers to self-monitor and put pressure on peers. Blanchflower, et al. find that a 1 percent increase in profit-per-employee increases wages by 0.8 percent, with a time lag. Using Japanese panel data, Jones and Kato find that an ESOP boosts productivity by 4 - 5 percent.

In comparing efficiency wages and rent-sharing, causation needs to be considered: the efficiency wage theory predicts that relative wages causally affect productivity, while in the standard version of the rent-sharing model the causation is reversed. In other words, the rent-sharing theory predicts that higher productivity leads to higher profits, which lead to higher wages.

3.4 Compensating Differentials and Efficiency Wages

The comparative labor market model predicts that inter-industry wage differentials are caused by either difference in a worker's ability or in nonpecuniary aspects of work. Adam Smith, in the Wealth of Nations, noted that an unpleasant job needs to compensate workers by offering higher wages to equalize benefits provided to workers.[4] If supervision brings disutility to employees, then the association between supervision and wage would be more complex: compensating differentials result in a positive relation, while efficiency wages imply a negative one.

Kruse (1992) suggests that firms with higher levels of supervision need to compensate workers with higher wages to accept close monitoring. Of course, such monitoring would only be worthwhile if it increased productivity. According Bewley's

[4] Brown (1980) provided empirical evidences of compensating differentials in the labor market.

survey of firm managers (2000), however, a threatening atmosphere with intensive monitoring would not boost productivity, but could even lessen the quality of work.

Overall, it is clear that differences in working condition need to be considered in looking at the relationship between supervisory intensity and wage. In addition, it is well known that unobserved workers' characteristics on productivity can bias estimates of wage equation. However, since our data set does not provide a direct observation of working condition such as hazardous work environment and layoff probabilities, we use dummies of industries, occupations, and employer size that give substantial information on working conditions.

3.5 Shirking and Efficiency Wage

Many studies have attempted to test the shirking version of the efficiency wage theory empirically, focusing on the trade-off between supervisory intensity and wages. Unfortunately, supervisory intensity is hard to measure directly. However, it seems likely that a substantial fraction of the total variation in supervisory intensity is associated with ratio of non-production workers to production workers or the frequency of monitoring workers as a quantitative observation of the intensity of supervision regardless of quality and technology of supervision.

Using an establishment survey data in which supervisory intensity was asked to respondents, Osterman (1994) found that supervisory intensity was negatively correlated with wages but the magnitude of the correlation between supervision and wages varied with firm-size and other firm-specific variables.

Ewing and Payne (1999) support efficiency wage models where firms with lower probabilities of detecting shirking pay higher wages, using work group size, establishment size, and multiple locations of employer as proxies of difficulties in monitoring shirking. However, they conclude that work group size and establishment size are not highly correlated with measures of labor quality such as education, work experience, and score on Armed Forces Qualifications Test (AFQT): They argue that larger firms have greater monitoring difficulties, but they find no evidence that there are higher quality workers in larger firms.

On the other hand, in a study of dual labor market theory using the 1977 Panel Study of Income Dynamics (PSID), Neal (1995) found that workers in primary industries are supervised with equal or greater intensity as those of the secondary sector. In essence, Neal argued there is no evidence that inter-industry differences in monitoring contribute to wage differentials between industries.

Gordon (1990) used the variation in capacity utilization, rents, the possibility of dismissal from the job, the quit rate and union density as determinants of the intensity of supervision to investigate the trade-off between supervision and wages and reported that there does not exist such a trade-off. Gordon, however, suggests further studies with direct micro data on firms' supervisory intensity.

Rebitzer (1995) pointed out that it is hard to measure the trade-off between supervision and wages because of problems caused by omitted variables in constructing the empirical model and the difficulty of measuring supervisory intensity. In order to ameliorate the econometric problems, he considered contract employees in the petrochemical industry. He argued that, for conventional employment relations, variables measuring supervisory intensity are likely to be correlated with omitted variables reflecting other features of the firm’s human resources polices but that this is less likely to be true for contract employees. Rebitzer found that high levels of supervision are indeed associated with lower wages among contract employees.

CHAPTER 4

DATA

4.1 The Survey on Wage Structure

As an annual survey since 1968, the Survey on Wage Structure (SWS) provides information about individual employment characteristics, including an establishment identifier, location, employer size and industry, as well as personal demographic attributes.[5] The main purpose of the survey is to provide information on the structure of wages in the Korean labor market. Conducted by the Korean Ministry of Labor (KML), the SWS is an establishment survey that covers about 4000 establishments selected by a complex stratified random sampling method from non-agricultural firms employing 10 or more employees until 1998, but firms of 5 or more workers after 1999.[6]

In designing the survey, the KML first determines the number of establishments by industry and size classification. The KML selects relatively more establishments within the same industry and size classification if the number of establishments is small, while it selects relatively fewer establishments if there are relatively many establishments within the same industry and size classification. Second, the KML determines the number of workers to be surveyed per establishment. The larger the size of an establishment, the smaller the percentage of the workers surveyed. The sample includes all of the workers in firms with 10 – 99 workers, 80 percent of the workers in firms of size 100 – 299, 70

[5] The Survey on Wage Structure (SWS) was called the Occupational Wage Survey (OWS) until 1991.

[6] The SWS excludes agriculture, forestry, fishery, public administration, education, and medical service sectors.

percent of the workers in firms of size 300 – 499, 50 percent of the workers in firms of size 500 – 999, 30 percent of the workers in firms of size 1000 – 4,999, 20 percent of the workers in firms of size 5,000 – 14,999, and 10 percent of the workers in firms of 15,000 or more workers. However, this sampling technique was changed in 1999 when the KML began collecting information on establishments with 5 or more workers. The samples in 1999 and thereafter consist of all of workers in establishments of size 5 – 99, 80 percent of the workers in firms the of size 100 – 299, 70 percent of the workers in firms the size of 300 – 499, 50 percent of the workers in firms the size of 500 – 999, 30 percent of the workers in firms the size of 1000 – 4,999, 20 percent of the workers in the firms with 5,000 – 9,999, and 10 percent of the workers in firms with 10,000 or more workers.

The SWS may have a systematic bias toward larger establishments. As Mueser, Troske, and Yoon (2003, p. 6) indicate, comparison with the Labor Conditions of Establishment Survey in Korea (LCES) shows that the SWS oversamples workers from larger establishments, while samples fewer from smaller establishments.

Because of the sampling bias toward larger establishments, it seems likely that the female work force, which is presumably concentrated in smaller service industry relative to manufacturing industry, may be underrepresented in the SWS.[7] Also female workers normally work discontinuously, while male workers are expected to work continuously

[7] Although inter-plant gender segregation by occupation, education, and industry is decreasing in the Korean labor market, Mueser, Troske, Yoon (2003) shows that the segregation is still substantial. Also the fact that female participation in the labor market decreases over time in the SWS is another proof of the bias toward larger establishments.

Labor market participation by gender is as follow:

Gender	1983	1989	1993	1996	1999
Male	61.0	63.4	72.3	72.3	72.9
Female	39.0	36.6	27.7	27.7	27.1

Source: the Survey of Wage Structure, each year.

after schooling. Differences between male and female employment experiences are substantial in Korea where there exist considerable social obstacles for female workers to enter the labor market.

The SWS contains primarily information of full-time workers in firms with 100 or more workers, while in the case of smaller firms with less than 100 workers, information of part-time workers as well as full-time workers also are collected.

This study uses full sample data for 1983, 1989, 1993, 1996 and 1999. Although the SWS is a sample of employees in the Korean labor market, the data are designed to represent the population of employees with the use of a weight variable. Table 4.1 shows the comparison between the weighted number of workers in the SWS and published figures on the number of workers who are working in establishment of 10 or more employees in 1993. Due to the restricted information in the published figures, we were able to undertake comparison in 1993, 1996, and 1999. We present comparison for 1996 and 1999 in the appendix.

The third column of the table shows the weighted number of workers in the SWS, calculated across industries. The comparison between the total number of workers in the SWS and in the published figure shows a difference of only 0.75 percent. In the category of mining, manufacturing, and transportation industry, the difference is also less than 1 percent. However, it must be noted that our weighted SWS figures for utility, construction, and education, health, and personal service industries are 8 to 9 percent below published figures, and that our figures for trade and hotels and financial industries are above published figures by 9 percent. These differences changed over time, which may reflect changes in industrial compositions or in survey sampling method.

Table 4.1 Comparison between the Weighted Number of Workers in the SWS and Published Figures in 1993

		SWS	PUBLISHED FIGURES	
Yr 1993	% difference*	Weighted number of workers with SWS	Total	Total
All industries	0.75%	4,886,693	4,850,233	4,850,233
Mining (10-14)	0.01%	2,603,090	38,164	2,602,786
Manufacturing (15-37)			2,564,622	
Utility (40-41)	-8.42%	39,194	42,796	42,796
Construction (45)	-8.52%	256,200	280,065	280,065
Wholesale & retail trade (50-52)	9.36%	441,290	331,535	403,526
Hotels & restraunts (55)			71,991	
Transport & telecommunications (60-64)	0.29%	498,531	497,082	497,082
Financial institutions & insurance (65-67)	9.42%	700,774	322,609	640,456
Real estate & Business activities (70-74)			317,847	
Education (80)			136,704	
Health & social work (85)	-9.36%	347,614	127,948	383,524
Other community & personal services (90-93)			118,872	

Source: the Survey of Wage Structure, each year.

Note: Numbers in parenthesis in the column of industry indicate 2-digit industrial classification.

% differences are calculated as following: (weighted number of the SWS / total number of the published figure) - 1

The overall percent difference in all industries varies somewhat over time: the percent difference for the full sample between the SWS and the published figures is 0.75 in 1993, 1.60 in 1996, and –3.64 percent in 1999.

A primary advantage of the SWS is that the data can match employers and employees within a firm. In order to construct employer-employee matched data, this study makes use of plant identification numbers. We use the plant identifier to calculate the proportion of employees who have supervisory or management responsibility in a firm. We take this as a proxy for the supervisory intensity faced by the workers in the firm.

4.2 Supervisory Intensity

Neal and Rosen (1998) point out that the most important focus for studies of the supervision-wage relationship should be on finding adequate data on supervision. Due to the difficulty of getting access to appropriate data, most studies, for instance Gordon (1990 and 1994) and Walsh (1999), used either the ratio of non-production workers to production workers or a self-report of the frequency of supervisor monitoring of workers as proxy variables for the intensity of supervision, utilizing the occupational classification. Constructing the ratio of non-production to production workers, using only the occupational classification, seems to be problematic as a proxy of the intensity of supervision: counts of managerial workers include managerial workers and administrative workers, while those of non-managerial workers contains clerical, service, and production workers. This method of constructing the supervisory ratio possibly leads to measurement error, omitting professionals and sales workers that are significant portion of the labor market.

However, the SWS allows us to lessen the problem since it contains a variable, "hierarchical rank." The variable divides workers into seven categories, based on what kind of rank the workers are in: 1) board member, 2) manager, 3) director, 4) section chief, 5) foreman, 6) production line supervisor, and 7) others.

Table 4.2 Components of Hierarchical Rank

Male	Board Member	Manager	Director	Section Chief	Foreman	Line Supervisor	Others	Total
1983	0.74	1.86	4.18	2.62	0.03	3.24	87.33	100.00
1989	0.62	1.70	4.54	2.45	0.05	3.20	87.44	100.00
1993	0.96	2.47	7.54	2.24	0.03	2.67	84.08	99.99
1996	1.44	2.59	7.27	1.97	0.03	2.56	84.13	99.99
1999	1.72	3.16	8.54	2.44	0.04	2.82	81.28	100.00
1999 (10 or more)	1.62	3.11	8.52	2.44	0.04	2.84	81.44	100.01

Source: the Survey of Wage Structure, each year.

Tabulation of the hierarchical rank, the key variable for the analysis of efficiency wage theory, is presented in Table 4.2. Although the last category, "others," includes a few professionals and some other categories that are not categorized by hierarchical rank, over 90 percent in this category can be viewed as unskilled production workers.

The proxy for supervisory intensity in the previous literature (Gordon, 1990 and 1994, and Walsh, 1999) is constructed from the occupational index code: the number of administrative / managerial workers is the sum of managerial workers, while that of non-managerial workers are counted as the sum of clerical, service, and production workers. Thus counts of both supervisors and supervisees exclude professionals and sales workers, who may be either supervisees or supervisors.

The figures reported in Table 4.3 and Table 4.4 suggest that direct usage of occupational classification is rather inadequate. Yet there may be bias in the definition of supervisees because the hierarchical rank "others" includes not only unskilled production workers but also professionals. Surprisingly, less than 60 percent of managers defined by occupational index are categorized as supervisors in 1983 and 1989. However, other occupations such as teachers, service related workers, and laborers seem to be defined well. It is noticeable that the proportion of supervisors increases over time, from 9 percent in 1983 to 15 percent in 1999.

Table 4.4 provides a cross tabulation of occupations by supervisory status defined by hierarchy in 1983[8]. Note that a quite remarkable number of professionals are categorized as supervisees rather than supervisors and that only a few professionals have supervisory responsibilities. Also 99 percent of sales workers in commerce are supervisees. In mining and manufacturing industries, for example, only 61 percent of managerial workers defined by the occupational index are categorized as supervisors in the hierarchical ranks, while 39 percent of managerial workers are not in supervisory position in hierarchical rank.

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[8] The cross tabulations for other years are presented in the appendix. However, there exists no difference of any importance between years in the comparison.

Table 4.3 Cross Tabulation of Occupation by Hierarchy over Time

	Year 1983		Year 1989		Year 1993		Year 1996		Year 1999	
Occupations	Supervisee	Supervisor	Supervisee	Supervisor	Supervisee	Supervisor	Supervisee	Supervisor	Supervisee	Supervisor
Professionals	13733	3599	22141	5546	23774	6893	27089	7574	22704	8699
	(0.79)	(0.21)	(0.80)	(0.20)	(0.78)	(0.22)	(0.78)	(0.22)	(0.72)	(0.28)
Technicians	10809	679	9860	780	14659	1787	16970	2435	28254	4923
	(0.94)	(0.06)	(0.93)	(0.07)	(0.89)	(0.11)	(0.87)	(0.13)	(0.85)	(0.15)
Medical Professionals	5461	207	11695	587	12351	735	6976	640	16001	1338
	(0.96)	(0.04)	(0.95)	(0.05)	(0.94)	(0.06)	(0.92)	(0.08)	(0.92)	(0.08)
Teachers	8252	45	8524	80	7603	143	13370	141	13300	544
	(0.99)	(0.01)	(0.99)	(0.01)	(0.98)	(0.02)	(0.99)	(0.01)	(0.96)	(0.04)
Other Professionals	2936	95	3618	535	20000	9418	20588	5703	30085	16408
	(0.97)	(0.03)	(0.87)	(0.13)	(0.68)	(0.32)	(0.78)	(0.22)	(0.65)	(0.35)
Managers	6652	8810	8700	8532	2728	9466	1710	9063	2158	11696
	(0.43)	(0.57)	(0.50)	(0.50)	(0.22)	(0.78)	(0.16)	(0.84)	(0.16)	(0.84)
Clerical	95928	20577	113444	23206	87667	12665	82278	14305	81437	11473
	(0.82)	(0.18)	(0.83)	(0.17)	(0.87)	(0.13)	(0.85)	(0.15)	(0.88)	(0.12)
Salesman	5517	116	7606	230	6520	147	7435	188	9935	292
	(0.98)	(0.02)	(0.97)	(0.03)	(0.98)	(0.02)	(0.98)	(0.02)	(0.97)	(0.03)
Personal Service	22107	173	29551	320	11438	361	15057	644	14755	717
	(0.99)	(0.01)	(0.99)	(0.01)	(0.97)	(0.03)	(0.96)	(0.04)	(0.95)	(0.05)
Other production	62116	11693	69020	11420	41677	3835	38333	3513	42984	4090
	(0.84)	(0.16)	(0.86)	(0.14)	(0.92)	(0.08)	(0.92)	(0.08)	(0.91)	(0.09)
Craft	162760	2052	146942	3433	32542	1766	16568	848	16388	1173
	(0.99)	(0.01)	(0.98)	(0.02)	(0.95)	(0.05)	(0.95)	(0.05)	(0.93)	(0.07)
Machine operators	104925	1769	132272	2884	73674	3979	78938	4860	68397	5851
	(0.98)	(0.02)	(0.98)	(0.02)	(0.95)	(0.05)	(0.94)	(0.06)	(0.92)	(0.08)
Driver	33509	49	41874	239	27010	299	20740	415	28092	586
	(1.00)	(0.00)	(0.99)	(0.01)	(0.99)	(0.01)	(0.98)	(0.02)	(0.98)	(0.02)
Laborers and Agr. experts	1307	6	2288	15	23177	1070	27373	1114	30954	1353
	(1.00)	(0.00)	(0.99)	(0.01)	(0.96)	(0.04)	(0.96)	(0.04)	(0.96)	(0.04)
Total	536024	49871	607547	57808	384831	52566	373436	51445	405455	69145
	(0.91)	(0.09)	(0.91)	(0.09)	(0.88)	(0.12)	(0.88)	(0.12)	(0.85)	(0.15)

Source: the Survey of Wage Structure, each year.
Note: Proportion in parenthesis indicates the relative supervisees and supervisors in a given occupational category.

Information on occupation may not be sufficient to determine whether an employee actually supervises workers or how many workers are in charge of monitoring workers. In contrast to Gordon, who used occupational index code to compute degree of supervision, in our primary analysis, we measure the supervision intensity with the hierarchy variable, with our measure of supervisory workers consisting of board members, managers, directors, section chiefs, foremen, and floor chiefs, and supervisees consisting of “others.”

Table 4.5 describes the procedure for constructing each measure of supervision and statistics in detail. The primary hierarchy measure in the first row is calculated using only the hierarchical rank variable. We compare this with measures used in previous research based on occupational index codes.

Comparison of average supervisory ratio between the male and female samples shows that females are found in establishments where supervisory intensity is lower relative to male workers. That is, female workers tend to work where monitoring is less intensive. This phenomenon could be interpreted as a rationale of gender segregation in the labor market. In this case establishments with intense supervision can be thought as those with high competition, since female workers have proficiency of working in less competitive sector. This trend, however, is declining over time, implying female workers are becoming more likely to participate in intensely monitored sectors. In the supervisory intensity measure based on occupation, supervisory intensity in 1999 is higher for females than males.

Table 4.4 Cross Tabulation between Occupational Code and Hierarchical Rank in Year 1983

	Commerce		Construction		Finance		Mining & Manufacturing		Social Service		Transportation		Utility	
Occupations	Supervisee	Supervisor	Supervisee	Supervisor	Supervisee	Supervisor	Supervisee	Supervisor	Supervisee	Supervisor	Supervisee	Supervisor	Supervisee	Supervisor
Professionals	453	87	3476	1237	1052	287	7441	1775	574	72	261	6	476	135
	(83.89)	(16.11)	(73.75)	(26.25)	(78.57)	(21.43)	(80.74)	(19.26)	(88.85)	(11.15)	(97.75)	(2.25)	(77.91)	(22.09)
Technicians	284	7	1188	93	681	35	7176	443	422	12	432	26	626	63
	(97.59)	(2.41)	(92.74)	(7.26)	(95.11)	(4.89)	(94.19)	(5.81)	(97.24)	(2.76)	(94.32)	(5.68)	(90.86)	(9.14)
Medical Professionals	40	1	7	0	57	3	695	16	4641	186	10	1	11	0
	(97.56)	(2.44)	(100.00)	(0.00)	(95.00)	(5.00)	(97.75)	(2.25)	(96.15)	(3.85)	(90.91)	(9.09)	(100.00)	(0.00)
Teachers	0	0	0	0	0	0	1	0	8251	45	0	0	0	0
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(100.00)	(0.00)	(99.46)	(0.54)	(0.00)	(0.00)	(0.00)	(0.00)
Other Professionals	91	2	36	4	117	0	1274	71	705	17	685	0	28	1
	(97.85)	(2.15)	(90.00)	(10.00)	(100.00)	(0.00)	(94.72)	(5.28)	(97.65)	(2.35)	(100.00)	(0.00)	(96.55)	(3.45)
Managers	428	568	617	667	1012	785	3589	5677	403	373	568	719	35	21
	(42.97)	(57.03)	(48.05)	(51.95)	(56.32)	(43.68)	(38.73)	(61.27)	(51.93)	(48.07)	(44.13)	(55.87)	(62.50)	(37.50)
Clerical	7711	1078	4053	1110	16208	1304	46744	13911	5579	990	14621	1936	1012	248
	(87.73)	(12.27)	(78.50)	(21.50)	(92.55)	(7.45)	(77.07)	(22.93)	(84.93)	(15.07)	(88.31)	(11.69)	(80.32)	(19.68)
Salesman	1401	13	0	0	106	0	3917	103	76	0	0	0	17	0
	(99.08)	(0.92)	(0.00)	(0.00)	(100.00)	(0.00)	(97.44)	(2.56)	(100.00)	(0.00)	(0.00)	(0.00)	(100.00)	(0.00)
Personal Service	4682	27	296	1	1630	8	10004	136	3778	1	1543	0	174	0
	(99.43)	(0.57)	(99.66)	(0.34)	(99.51)	(0.49)	(98.66)	(1.34)	(99.97)	(0.03)	(100.00)	(0.00)	(100.00)	(0.00)
Other production	57	6	1065	177	102	32	60606	11441	213	31	54	6	19	0
	(90.48)	(9.52)	(85.75)	(14.25)	(76.12)	(23.88)	(84.12)	(15.88)	(87.30)	(12.70)	(90.00)	(10.00)	(100.00)	(0.00)
Craft	116	0	716	16	312	24	161342	1981	223	29	37	2	14	0
	(100.00)	(0.00)	(97.81)	(2.19)	(92.86)	(7.14)	(98.79)	(1.21)	(88.49)	(11.51)	(94.87)	(5.13)	(100.00)	(0.00)
Machine operators	363	0	2211	25	1051	74	92484	1454	1796	145	6161	71	859	0
	(100.00)	(0.00)	(98.88)	(1.12)	(93.42)	(6.58)	(98.45)	(1.55)	(92.53)	(7.47)	(98.86)	(1.14)	(100.00)	(0.00)
Driver	844	2	575	2	767	0	8878	38	861	2	21487	5	97	0
	(99.76)	(0.24)	(99.65)	(0.35)	(100.00)	(0.00)	(99.57)	(0.43)	(99.77)	(0.23)	(99.98)	(0.02)	(100.00)	(0.00)
Laborers and Agr. experts	70	1	13	0	76	1	169	3	867	1	111	0	1	0
	(98.59)	(1.41)	(100.00)	(0.00)	(98.70)	(1.30)	(98.26)	(1.74)	(99.88)	(0.12)	(100.00)	(0.00)	(100.00)	(0.00)
Total	16540	1792	14253	3332	23171	2553	404320	37049	28389	1904	45970	2772	3369	468
	(90.22)	(9.78)	(81.05)	(18.95)	(90.08)	(9.92)	(0.92)	(0.08)	(0.94)	(0.06)	(94.31)	(5.69)	(87.80)	(12.20)

Source: the Survey of Wage Structure.

Note: Percent is in parenthesis. Each percent is calculated by the proportion of supervisees / supervisors of each occupation in each industry.

Table 4.5 Proxies for Degree of Effort Supervision across Establishment

Proxy	Index Construction		1983 Male	1983 Female	1989 Male	1989 Female	1993 Male	1993 Female	1996 Male	1996 Female	1999 (10 or more) Male	1999 (10 or more) Female
			Summary Statistics									
Primary Hierarchy Measure	Ratios of supervisor / supervisee: Supervisors contain board members, managers, directors, section chiefs, foremans, and floor chiefs. Supervisees contain "others" in the variable of hierarchical rank.	Mean	0.115	0.075	0.112	0.079	0.160	0.114	0.160	0.128	0.195	0.148
		(st. dev)	(0.108)	(0.071)	(0.104)	(0.076)	(0.157)	(0.121)	(0.151)	(0.124)	(0.186)	(0.151)
		Min	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Max	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
		No. of plants	3618	3565	3387	3340	2595	2541	3103	3057	3760	3708
		Mean supervisors	39.013	24.337	40.369	30.480	45.324	27.085	44.462	31.119	39.178	27.216
		(st. dev)	(66.457)	(32.088)	(52.032)	(33.511)	(67.567)	(37.539)	(68.144)	(46.024)	(45.569)	(33.439)
		Mean supervisees	427.035	403.642	447.698	470.837	361.488	305.323	331.510	281.062	244.360	233.221
		(st. dev)	(742.648)	(475.964)	(450.654)	(405.624)	(433.534)	(313.895)	(416.664)	(300.630)	(210.265)	(212.295)
Primary Occupation Measure	Ratios of supervisor / supervisee: Using the occupational code, supervisors consist of managerial /administrative employees. Supervisees contain clerical, service, and production workers.	Mean	0.043	0.022	0.041	0.023	0.058	0.036	0.056	0.040	0.089	0.095
		(st. dev)	(0.081)	(0.046)	(0.074)	(0.048)	(0.106)	(0.073)	(0.105)	(0.083)	(0.169)	(0.184)
		Min	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Max	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
		No. of plants	3621	3566	3396	3347	2593	2539	3115	3069	3550	3496
		Mean supervisors	7.586	4.417	9.773	6.145	47.803	38.974	7.078	4.707	20.940	23.280
		(st. dev)	(11.097)	(6.856)	(14.439)	(10.290)	(78.376)	(73.018)	(11.754)	(7.968)	(43.329)	(60.539)
		Mean supervisees	405.1671	403.0079	427.2593	457.3817	355.9358	289.6203	277.4506	232.5451	251.7638	225.9170
		(st. dev)	(683.186)	(477.004)	(432.728)	(399.985)	(429.059)	(301.719)	(381.972)	(256.098)	(211.200)	(178.590)

Source: the Survey of Wage Structure, each year.
Note: Stats are calculated using male sample out of the original data. Outliers defined that supervisory ratio over 1 are deleted.

The degree of effort supervision, or supervisory ratio, is simply calculated by the number of supervisors divided by the number of supervisees in each establishment. In order to group both supervisors and supervisees, we use a variable called 'hierarchical rank' in the establishment.

There are supervisory ratios of zero and infinity in certain establishments. In this paper, we simply remove the observations of those extreme cases of zero supervisor and zero supervisee in an establishment. Table 4.6 and Table 4.7 present the frequency of supervisory ratio using both hierarchical rank and the occupational classification. We also omit observations with supervisory ratio greater than one for most of analysis. Over our sample period, the proportion of discarded observation is less than 2 percent with the hierarchical rank variable. However, in Table 4.7, using the occupational classification, the portion of removed observation is a little larger, ranging from 0.77 in 1983 to 11.25 percent in 1999. The reason for variations of supervisory intensity most likely stems from changes in the definition of the occupational classification in 1991 and 1998[9]. We also discard firms of five to nine workers in 1999 to make the establishment size coverage consistent over time.

9 Refer to the appendix for the changes in the occupational classification.

Table 4.6 Frequency of Supervisory Ratio Using Hierarchical Rank Variable

Male		1983	1989	1993	1996	1999	1999* (10 or more)
Supervisory ratio (S)							
S = 0.00: zero supervisor	Freq	10373	21044	13644	14024	15293	14449
	Percent	2.90	4.99	4.32	4.57	4.42	4.23
0.00 < S <= 0.10	Freq	189398	219724	131019	124526	116879	116804
	Percent	52.95	52.07	41.46	40.56	33.78	34.18
0.10 < S <= 0.30	Freq	139772	157355	122031	123455	134773	133440
	Percent	39.08	37.29	38.61	40.21	38.95	39.04
0.30 < S <= 1.00	Freq	17478	21509	45952	43848	73372	71867
	Percent	4.89	5.10	14.54	14.28	21.21	21.03
1.00 < S < infinity	Freq	646	2320	3370	1155	5566	5153
	Percent	0.18	0.55	1.07	0.38	1.61	1.51
S = infinity: zero supervisee	Freq	1	2	4	0	92	67
	Percent	0.00	0.00	0.00	0.00	0.03	0.02
N		357668	421954	316020	307008	345975	341780

Source: the Survey of Wage Structure, each year.
Note: Shaded area shows the sample we finally use for the analysis. In 1999, the KML starts to collect establishments with 5 or more workers, but we use sample of ones with 10 or more workers to make establishment size consistent over time.

Table 4.7 Frequency of Supervisory Ratio Using Occupational Classification Variable

Male		1983	1989	1993	1996	1999 (10 or more)
Supervisory ratio (S)						
S = 0.00: zero supervisor	Freq	6552	13440	67391	70837	97419
	Percent	1.83	3.19	21.32	23.07	28.50
0.00 < S <= 0.10	Freq	162098	170896	141356	121747	131669
	Percent	45.32	40.50	44.73	39.66	38.52
0.10 < S <= 0.30	Freq	140302	168141	49956	50579	48481
	Percent	39.23	39.85	15.81	16.47	14.18
0.30 < S <= 1.00	Freq	45984	60339	27078	29417	25777
	Percent	12.86	14.30	8.57	9.58	7.54
1.00 < S < infinity	Freq	2674	9134	30212	34377	38274
	Percent	0.75	2.16	9.56	11.20	11.20
S = infinity: zero supervisee	Freq	58	4	27	51	160
	Percent	0.02	0.00	0.01	0.02	0.05
N		357668	421954	316020	307008	341780

Source: the Survey of Wage Structure, each year.
Note: Shaded area shows the sample we finally use for the analysis. In 1999, the KML starts to collect establishments with 5 or more workers, but we use sample of ones with 10 or more workers to make establishment size consistent over time.

4.3 Basic Statistics

In order to investigate the consistency of the SWS over time we undertake tabulations using the weight variable that is designed to make the sample comparable to the population, augmenting analyses using the unweighted sample. Table 4.8 presents means of variables using the unweighted sample. Refer to appendix table using the weighted sample. As noted above, male workers appear to be over represented in the SWS, which may be due to the survey's bias towards larger establishments. The data show a decline in labor force participation of female workers, whereas we know the relative size of the female workforce has increased.

Since there were changes in occupational code in 1991, which was quite dramatic in terms of the number of categories and how each category was defined, we use a special set of 14 occupational categories to increase comparability. For more information on the changes in the code and how we construct the 14 categories, refer to the appendix.

In this study, we use the 1-digit and 3-digit industrial code for the baseline model. Using the 1-digit code, we construct 7 industry control variables to obtain compatibility over time: mining and manufacturing, utility, construction, service, transportation, finance, and social service. The number of 3-digit industry codes varies over time: 48 in 1983, 50 in 1989, 129 in 1993, 127 in 1996, and 181 in 1999. Instead of grouping the detailed industry code, we simply employ the code as it is, since the changes in the number of the codes may partly reflect meaningful changes in industry structure. If technological developments cause differentiation within an early industrial classification, the new code may merely identify changes. Workers in newly identified industries may have different experiences from one another, which are captured in the new classification.

Union status, which is an important variable in the context of industry wage differentials, was not asked in 1983. The union dummy is controlled in most analysis for other years.

Table 4.8 Means of Key Variables, Unweighted Sample

	1983		1989		1993		1996		1999 (10 or more)	
Variable	Mean	St.dev.	Mean	St.dev.	Mean	St.dev.	Mean	St.dev.	Mean	St.dev.
log(real monthly wage)	13.114	0.626	13.491	0.494	14.053	0.522	14.237	0.516	14.234	0.523
Male	0.610	0.488	0.634	0.482	0.723	0.448	0.723	0.448	0.730	0.444
Age	29.199	9.390	31.153	9.609	33.977	10.066	34.693	10.443	35.603	10.037
Marriage	0.485	0.500	0.558	0.497	0.650	0.477	0.652	0.476	0.679	0.467
Experience (years)	12.703	9.560	13.723	10.243	15.706	11.065	16.136	11.510	16.772	11.079
Tenure (years)	3.443	3.733	4.445	4.594	5.703	5.783	5.859	6.090	6.448	6.099
Education										
Elementary	0.141	0.348	0.072	0.258	0.066	0.249	0.056	0.231	0.042	0.202
Junior high	0.377	0.485	0.257	0.437	0.150	0.357	0.122	0.327	0.107	0.309
High school	0.350	0.477	0.487	0.500	0.466	0.499	0.460	0.498	0.439	0.496
Junior college	0.030	0.170	0.052	0.223	0.076	0.265	0.093	0.290	0.119	0.324
College or more	0.103	0.304	0.132	0.338	0.242	0.428	0.269	0.443	0.292	0.455
Occupation										
Professionals	0.030	0.169	0.042	0.200	0.070	0.255	0.082	0.274	0.067	0.249
Technicians	0.020	0.139	0.016	0.125	0.038	0.190	0.046	0.209	0.070	0.255
Medical Professionals	0.010	0.098	0.018	0.135	0.030	0.170	0.018	0.133	0.037	0.189
Teachers	0.014	0.118	0.013	0.113	0.018	0.132	0.032	0.175	0.029	0.168
Other Professionals	0.005	0.072	0.006	0.079	0.067	0.250	0.062	0.241	0.098	0.297
Managers	0.026	0.160	0.026	0.159	0.028	0.165	0.025	0.157	0.028	0.165
Clerical	0.199	0.399	0.205	0.404	0.229	0.420	0.227	0.419	0.195	0.396
Salesman	0.010	0.097	0.012	0.108	0.015	0.123	0.018	0.133	0.021	0.144
Personal Service	0.038	0.191	0.045	0.207	0.027	0.162	0.037	0.189	0.032	0.177
Other production	0.126	0.332	0.121	0.326	0.104	0.305	0.098	0.298	0.099	0.299
Craft	0.281	0.450	0.226	0.418	0.078	0.269	0.041	0.198	0.037	0.189
Machine operators	0.182	0.386	0.203	0.402	0.139	0.346	0.148	0.355	0.120	0.325
Driver	0.057	0.232	0.063	0.243	0.062	0.242	0.050	0.218	0.061	0.239
Laborers and Agr. experts	0.002	0.047	0.003	0.059	0.055	0.229	0.067	0.250	0.068	0.252
Establishment size										
10-29	0.020	0.139	0.024	0.153	0.021	0.143	0.034	0.181	0.040	0.197
30-99	0.118	0.323	0.102	0.303	0.086	0.280	0.101	0.301	0.116	0.321
100-299	0.199	0.399	0.155	0.362	0.186	0.389	0.233	0.422	0.253	0.435
300-499	0.168	0.374	0.133	0.339	0.247	0.431	0.197	0.398	0.234	0.423
500 or more	0.494	0.500	0.586	0.493	0.460	0.498	0.435	0.496	0.356	0.479
Industry										
Mining & manufacturing	0.753	0.431	0.725	0.446	0.526	0.499	0.508	0.500	0.473	0.499
Utility	0.007	0.081	0.006	0.078	0.012	0.109	0.021	0.142	0.016	0.124
Construction	0.030	0.171	0.018	0.134	0.048	0.214	0.033	0.178	0.045	0.208
Commerce	0.031	0.174	0.040	0.195	0.071	0.257	0.094	0.292	0.095	0.294
Transportation	0.083	0.276	0.083	0.275	0.088	0.283	0.077	0.266	0.086	0.281
Finance and business services	0.044	0.205	0.061	0.239	0.154	0.360	0.148	0.356	0.159	0.366
Social service	0.052	0.221	0.067	0.250	0.102	0.302	0.119	0.324	0.126	0.332
Central city										
Seoul	0.308	0.462	0.277	0.447	0.327	0.469	0.320	0.467	0.316	0.465
Pusan	0.143	0.350	0.120	0.325	0.076	0.264	0.063	0.242	0.059	0.236
Inchon	0.068	0.252	0.071	0.257	0.024	0.154	0.030	0.172	0.032	0.176
Daegu	0.022	0.145	0.026	0.158	0.028	0.166	0.026	0.160	0.029	0.168
Taejon	0.015	0.123	0.021	0.143	0.030	0.169	0.024	0.153	0.029	0.169
Kwangu	0.053	0.223	0.053	0.224	0.044	0.205	0.045	0.207	0.035	0.183
Outside central city	0.391	0.488	0.433	0.495	0.471	0.499	0.492	0.500	0.500	0.500
Union	.	.	0.715	0.451	0.694	0.461	0.607	0.488	0.595	0.491
N	585885		665354		437384		424870		468272	

Source: the Survey of Wage Structure, each year.

CHAPTER 5

ANALYSIS METHODOLOGY

5.1 Wage Equation

An important empirical question for efficiency wage arguments is whether there is any evidence of a relationship between wage premiums (or efficiency wages) and productivity, and then whether the overall benefits from reduced shirking compensate for the costs of the wage premium. If the benefits are greater than the costs of efficiency wages, then firms are willing to pay the premiums. Of course, the wage premiums would be increased up to the point where the marginal benefit equals the cost. Conversely, monitoring is increased up to the point where the costs of monitoring shirkers equal those of paying the premium.

Efficiency wages can substitute for monitoring. Hence, this suggests that where monitoring is less extensive, firms may substitute higher wages – that is, efficiency wages that are above individuals' alternative – for monitoring. In this paper, we use supervisory intensity as a proxy for monitoring.

There are several possible causes for differences in the levels of supervision across firms at a given point in time. Which applies is critical in determining how to interpret estimates of the supervisory effect on wages. The first case we may think about is where there are mistakes or errors when employers choose degree of effort supervision. If this is the case, deviations from the optimal supervision level will not affect a firm's profit much, as long as the employer also adjusts wages appropriately. The adjustment of wages therefore will reflect efficiency wage choices, and will compensate for monitoring differences: A negative association between wages and monitoring will occur.

Second, firms may face differences in supervisory costs due to relative wages of supervisors or, more plausibly, differences in firm structure may make it easier or more difficult to hire better supervisors. As in the first case, wage could be adjusted by the employer, so that estimates of the impact of supervision on worker wages will not be biased. On the other hand, when firms face differences in the effectiveness of supervision, the attempt to measure supervision by the number of supervisors may be in error. As a result, a firm with a high level of effective supervision may not hire more supervisors and a correlation between supervision and wage may be hidden, causing estimates of the impact of supervision on worker wages to be biased.

The wage function of this study is a modified version of the standard wage equation where wages depend on both employee and employer characteristics. It can be written as follows:

$$\ln(w_i) = \alpha + \beta X_i + \gamma Z_i + \delta S_i$$

where $\ln(w_i)$ is the log of real monthly wage for individual i,[10] X_i is a vector of demographic and human capital control variables, Z_i is a vector of firm and regional control variables, and S_t is supervisory ratio within the worker's firm.

[10] The total monthly earnings are measured the following way: regular monthly salary + overtime monthly salary + yearly special payment/12.

The variables used in the vectors X and Z are listed and described in Table 5.1. Note that since only years of experience in current occupation, not overall experience, were obtained, potential experience is employed.

Competing theories provide different predictions for the relationship between supervisory intensity and wages: 1) the shirking version of efficiency wage theory predicts δ_i to be negative after controlling worker ability. This same prediction also follows from the theory that wages are kept high because of adverse selection, that is, because higher wages attract the kind of people who need less supervision. 2) On the other hand, standard compensating differentials theory predicts a positive correlation because workers dislike supervision.

Throughout the analysis, we control for industrial dummy variables to allow for industry specific effects on wages. In addition, it may be useful to examine how the effects of supervisory intensity differ across industries. To do this, we create interaction terms between industry and corresponding supervisory intensity as following.

$$\ln(w_i) = \alpha + \beta X_i + \gamma Z_i + \delta_j S_{ji}$$

This approach allows each industry to be different in the impact of supervisory intensity on wages. We employ interaction terms of supervisory intensity to establishment size dummies with the industry interaction terms. Since establishments in the SWS were collected based on 3-digit industry and its size, the size analysis is significant as a data checking procedure. We also control for interactions of supervisory intensity and occupation.

Since many variables, including our primary one, are measured at the level of the establishment, not the individual, we apply statistical adjustments for clustering by establishment: errors across individuals in the same firm will likely be correlated, which is taken into account by the clustering adjustments. Unless such clustering adjustments are undertaken, estimated standard errors in the wage equations are artificially small. Therefore, we apply the adjustment for all models in this study.

5.2 Inter-Industry Wage Differentials

Inter-industry wage differentials have been observed in all industrialized countries. Kruger and Summers (1987) report correlations for manufacturing industry wages in 1982 across 14 countries. The correlation between the industry wages in the U.S. and that of Korea is over 0.80. In addition, the inter-industry wage pattern is similar within occupations and over time. For example, wages of janitors vary across industry, and this is consistent over time.

Table 5.1 Means of Log Monthly Wages of Occupations across Industries in 1999

Industry (SIC)	Occupational Classification			
	Secretaries (412)	Janitors (913)	Drivers (832)	All Occupations
Mining & manufacturing	14.20	13.99	14.30	14.34
Utility	14.53	14.39	14.61	14.61
Construction	14.29	13.81	14.41	14.40
Commerce	14.14	13.98	14.16	14.33
Transportation	14.21	13.97	14.17	14.27
Finance and business services	14.51	13.53	14.13	14.38
Social service	14.35	14.16	14.29	14.60

Source: the Survey of Wage Structure.

Table 5.1 shows means of logarithmic real monthly wage of occupations in 1-digit industries in 1999 in Korea. As discussed above, there exist variations in mean wage across industries. Utilities pay higher wages in all the reported occupations. Note that wage differentials between occupations are lower for occupations where average wage is relatively higher.

In order to examine industry differences in the Korean labor market, we adopt the method Krueger and Summers (1988) used: industry wage differentials are constructed as the deviation of the individual industry dummy from the employment-weighted mean of industry dummies. That is,

$$d_i = \hat{\beta}_i - \sum_{j=1}^{k} \frac{n_j}{N} \hat{\beta}_j$$

where $\hat{\beta}_i$ is the estimated coefficient from the industry dummy, N is total employment and n_j employment in industry j[11]. The employment-weighted standard deviation of wage differentials is:

$$SD = \sqrt{\sum_{i=1}^{k} \frac{n_i}{N} d_i^2}$$

Using this standard deviation, we investigate wage variations across industries and

[11] Even if $\hat{\beta}_i$ is an unbiased estimate of the actual wage differentials, β_i, the standard deviation of $\hat{\beta}_i$ overestimates the true standard deviation of β_i. This is because the estimates $\hat{\beta}_i$ to some degree explain variation that is due to sampling error.

compare the estimates of 1-digit industry and 3-digit industry separately.

The supervisory intensity variable is added to the model to determine whether the estimated coefficients for industry-wage differentials would change. If supervisory rating is important to investigate the wage variations across industry, then omission of the variable could cause the estimates to be biased. It is not clear whether the relationship between supervisory ratio and wages is linear. We, therefore, employ squared and cubed supervisory ratio in our baseline model.

Although we observe persistent wage differentials across industries, if unobserved abilities need to be taken into account, our estimated wage differentials may be biased. In order to get unbiased estimates of industry dummy variables, unmeasured abilities must be exogenous. Then one may ask what kind of unmeasured abilities could we think that affect wages, and which vary across different industries. Labor economists frequently consider individual wage determinants such as intellectual abilities in considering this issue. Firms' abilities to pay, which are mainly associated with their own profitability, would be another source of unmeasured differences. These measures, however, are not available in our data set. Rather than analyzing robustness of inter-industry wage differentials, here we investigate whether efficiency wage theory can be applied to explain the observed wage differentials.

In the next chapter, we report the results based on various models, including those with interactions between supervision and various firm characteristics. Although our sample is representative of the Korean full-time labor force when it is weighted, it is not clear whether the unweighted results are comparable to the weighted one. Therefore, comparison the results using both samples would give us a guideline for further analyses.

In the last section of the same chapter, we present the results where supervisory intensity is based on the occupational measure rather than the hierarchical measure. This approach enables us to compare our results to those of previous studies. In chapter 7, we investigate the impact of inter-industry wage differentials, focusing on monitoring effects on wages that presumably play an important role in wage structure in the Korean labor market.

CHAPTER 6

IMPACT OF SUPERVISORY INTENSITY: RESULTS

6.1 Baseline Model

In this chapter, we present the details for the models we will fit as well as our results. We estimate the following log wage equation introduced in the previous chapter:

$$\ln(w_i) = \alpha + \beta X_i + \gamma Z_i + \delta S_i + e_i$$

The dependent variable, $\ln(w_i)$, is log real monthly wages for individual *i,* and supervisory intensity faced by that worker is denoted by S_i. It is measured by the ratio of the number of supervisory workers to the number of production workers. X_i is a vector of human capital variables, and Z_i is a vector of institutional variables generally thought to affect wages. The contents of the vectors are defined in the appendix. The sample is of who are rated as having no supervisory responsibility as indicated in the hierarchical rank.

The efficiency wage model predicts that the coefficient δ should be negative, reflecting a trade-off between wages and the supervisory intensity employees face. If the coefficient is positive, then wage variation is better explained by other theories, such as compensating wage differentials, in which employees must be compensated for the undesirability of constant monitoring.

In this section, we first fit the male sample with regression models for both the weighted and unweighted samples. Second, the female sample is used for the same analysis. Finally, quadratic and cubed supervisory intensity is tested to see whether the relationship between supervisory intensity and wage is nonlinear.

Table 6.1 is designed to find which model best fits the dataset using the male sample. The upper portion of the table shows variables in each model. Human capital and establishment control variables, industrial, occupational, and regional dummies vary across models.

We present seven specifications related to our baseline model, with each model testing a particular coding alternative. For example, model (2) tests whether the 1-digit industry code works as well as the 3-digit code. The results are very consistent across years: all the coefficients in model (2) appear bigger than those in model (1), suggesting a correlation between the detailed industry and supervisory intensity.

Model (3) shows whether omitting those with zero supervisors alters results. There are two possibilities concerned with “zero” supervisory ratings. First, where we find no supervisory workers in an establishment this may indicate errors in the survey. Since the SWS does not collect information of all employees from the selected establishment (except for small establishment), workers with supervisory responsibility might not be surveyed. If this is the case, then the coefficient would be biased toward zero due to measurement error. On the other hand, it is possible that “zero” supervisory intensity ratings may contain information. They might identify establishments with low levels of supervisors. In this case, specification of model (1) may produce the best estimates.

The coefficients of supervisory intensity appear to be lower in 1983, 1989, and 1996, when zero supervisory intensity cases are excluded, which might be an evidence of the measurement error problem, making the coefficients toward zero. However, the results in 1999 show that the coefficient in the model (3) is greater.

Model (4) tests supervisory effects on wages without the occupation control variables. It is notable that all the coefficients are greater than those in model (1) with little changes in the corresponding standard error. It seems that an individual's occupation is highly correlated with the supervisory intensity faced. That is, occupations with high supervisory intensity appear to provide high wages.

Removing of industry control variables appears to have an even stronger effect than removing occupational controls. Model (5), which omits industry control variables, shows even higher coefficients for supervisory ratings as compared to those in model (1) and model (4).

However, it is interesting that omitting both industrial and occupational control variables (model (6)) has an inconsistent effect on the coefficient for the supervisory ratio. The coefficient in 1993 and 1996 are greater than in model (1), while those in the other years decrease.

The last specification we test controls for 3-digit regional code, rather than the 2-digit codes used above. Since the government has had direct impacts on the Korean economy, it is worthwhile to control for the regional effect in detail and to see whether there exist wage variations by supervisory intensity across regions. If the government influences the industry and wage structure in certain regions, then it would be considered as an omitted variable of the model, causing the estimates biased. The results show that supervisory effects decline only in the first three years: it can be inferred that the government might affect some industries in particular regions in the earlier periods, but, more recently, there is little impact as the industry structure became more similar across regions.

As a whole, wage variations in the estimated impact of supervisory intensity are most affected by industry and occupational controls. Comparison between the results of model (1) and those of model (4), no occupational controls, and (5), no industry dummies, reveals evidence of correlation between the supervisory ratio and industry / occupation dummy variables. This suggests that supervisory intensity or supervisory technology differs across industries and occupations.

The shirking version of efficiency wage theory predicts a negative relationship between wages and supervisory intensity. The only negative relation is in model (6) of 1983 data. However, the coefficients among models seldom differ by more than one standard deviation.

Table 6.2 reproduces the models in Table 6.1 using the weighted sample. The sample used is not representative without the weights. However, it is not clear whether the weighted sample should be used in this section, because if a regression model is fully and properly specified, then weighted and unweighted will be the same. If this is the case, it makes sense to do analyses on the unweighted sample, since estimates of standard errors are correct, and estimation efficiency is greater. In the initial discussion, we present results from both weighted and unweighted analysis.

The results show that there are few changes in the coefficient and the corresponding standard errors. However, the differences between the samples are not large and are within one standard deviation for most cases.

Tables 6.3 and 6.4 present estimates of baseline models using the sample of female employees. Although many coefficients of supervisory intensity are not statistically significant, the pattern of coefficients suggests that monitoring effects on wages appears to be changing over time: throughout our sample, females are generally observed at firms where employers choose to pay wage premiums and spend more on monitoring technologies. However, the effects of supervisory intensity on wages appear to change, with a peak in 1989 and decline over the 1990's. The effect on wages of females exceeds those of males. Many coefficients are not statistically significant, but models (2) and (5), with less information on industry, produce statistically significant estimates in most cases.

Table 6.1 Basic Model Using Hierarchical Rank, Unweighted Male Sample

Independent Variable		Male						
		(1)	(2)	(3)	(4)	(5)	(6)	(7)
Industry	1-digit		x					
	3-digit	x		x	x			x
Occupation	14 -categories	x	x	x		x		x
Region	2-digit	x	x	x	x	x	x	
	3-digit							x
Size of firm	dummies	x	x	x	x	x	x	x
Size of establishment	dummies	x	x	x	x	x	x	x
Union	dummy	x	x	x	x	x	x	x
Marital status	dummy	x	x	x	x	x	x	x
Education	dummies	x	x	x	x	x	x	x
Potential experience	years	x	x	x	x	x	x	x
Experience ^{2}		x	x	x	x	x	x	x
Tenure	years	x	x	x	x	x	x	x
Tenure ^{2}		x	x	x	x	x	x	x
Omit zero supervisor				x				
Supervisory intensity	coefficient	0.0430	0.0706	0.0356	0.0634	0.0650	-0.0257	0.0268
1983	(t-statistics)	(0.90)	(1.37)	(0.72)	(1.27)	(1.34)	(-0.51)	(0.58)
	R^2	0.6539	0.6208	0.6528	0.6164	0.6140	0.5606	0.6730
	N	312,152	312,152	301,779	312,152	312,152	312,152	312,152
Supervisory intensity	coefficient	0.1852	0.3594	0.1432	0.1878	0.3447	0.3114	0.1680
1989	(t-statistics)	(2.38)	(4.57)	(1.69)	(2.51)	(4.37)	(4.18)	(2.13)
	R^2	0.5559	0.5247	0.5576	0.5217	0.5227	0.4819	0.5688
	N	368,107	368,107	347,067	368,107	368,107	368,107	368,107
Supervisory intensity	coefficient	0.0572	0.1003	0.0594	0.0660	0.1172	0.1359	0.0342
1993	(t-statistics)	(1.52)	(2.08)	(1.54)	(1.69)	(2.49)	(2.73)	(0.91)
	R^2	0.6497	0.5850	0.6500	0.6279	0.5802	0.5421	0.6582
	N	264,565	264,565	250,921	264,565	264,565	264,565	264,565
Supervisory intensity	coefficient	0.0153	0.0446	0.0079	0.0278	0.0175	0.0295	0.0031
1996	(t-statistics)	(0.45)	(1.03)	(0.23)	(0.79)	(0.39)	(0.63)	(0.09)
	R^2	0.6650	0.6053	0.6618	0.6458	0.5985	0.5655	0.6748
	N	257,875	257,875	243,851	257,875	257,875	257,875	257,875
Supervisory intensity	coefficient	0.0579	0.1053	0.0677	0.0709	0.0862	0.0672	0.0675
1999 (10 or more workers)	(t-statistics)	(1.82)	(3.06)	(2.01)	(2.20)	(2.55)	(1.81)	(2.10)
	R^2	0.6333	0.5656	0.6258	0.6143	0.5611	0.5263	0.6409
	N	276,704	276,704	262,255	276,704	276,704	276,704	276,704

Source: the Survey of Wage Structure, each year.
Note: 1. Dependent Variable is the log of real monthly wages.
2. T-statistics is in parenthesis.
3. Union control is included in all years except 1983.

Table 6.2 Basic Model Using Hierarchical Rank, Weighted Male Sample

Independent Variable		Male						
		(1)	(2)	(3)	(4)	(5)	(6)	(7)
Industry	1-digit		x					
	3-digit	x		x	x			x
Occupation	14 -categories	x	x	x		x		x
Region	2-digit	x	x	x	x	x	x	
	3-digit							x
Size of firm	dummies	x	x	x	x	x	x	x
Size of establishment	dummies	x	x	x	x	x	x	x
Union	dummy	x	x	X	x	x	x	x
Marital status	dummy	x	x	x	x	x	x	x
Education	dummies	x	x	x	x	x	x	x
Potential experience	years	x	x	x	x	x	x	x
Experience ^{2}		x	x	x	x	x	x	x
Tenure	years	x	x	x	x	x	x	x
Tenure ^{2}		x	x	x	x	x	x	x
Omit zero supervisor				x				
Supervisory intensity	coefficient	0.0703	0.0955	0.0516	0.0886	0.0767	0.0160	0.0662
1983	(t-statistics)	(1.72)	(2.41)	(1.21)	(2.08)	(1.99)	(0.41)	(1.61)
	R^2	0.6445	0.6202	0.6416	0.6079	0.6102	0.5636	0.6623
	N	312,152	312,152	301,779	312,152	312,152	312,152	312,152
Supervisory intensity	coefficient	0.1290	0.2044	0.1090	0.1153	0.2098	0.2141	0.1235
1989	(t-statistics)	(2.70)	(4.14)	(2.15)	(2.47)	(4.21)	(4.43)	(2.59)
	R^2	0.5451	0.5256	0.5502	0.5027	0.5236	0.4778	0.5539
	N	368,107	368,107	347,067	368,107	368,107	368,107	368,107
Supervisory intensity	coefficient	0.0630	0.0712	0.0568	0.0680	0.0957	0.1191	0.0446
1993	(t-statistics)	(1.67)	(1.78)	(1.48)	(1.81)	(2.40)	(2.93)	(1.19)
	R^2	0.6049	0.5583	0.6094	0.5830	0.5506	0.5193	0.6143
	N	264,565	264,565	250,921	264,565	264,565	264,565	264,565
Supervisory intensity	coefficient	0.0391	0.0665	0.0264	0.0520	0.0715	0.1230	0.0141
1996	(t-statistics)	(1.08)	(1.65)	(0.75)	(1.39)	(1.74)	(2.74)	(0.39)
	R^2	0.6193	0.5761	0.6207	0.5992	0.5701	0.5387	0.6298
	N	257,875	257,875	243,851	257,875	257,875	257,875	257,875
Supervisory intensity	coefficient	0.0076	0.0416	0.0165	0.0239	0.0389	0.0451	0.0152
1999 (10 or more workers)	(t-statistics)	(0.29)	(1.48)	(0.61)	(0.92)	(1.41)	(1.60)	(0.59)
	R^2	0.6250	0.5696	0.6196	0.6062	0.5654	0.5396	0.6320
	N	276,704	276,704	262,255	276,704	276,704	276,704	276,704

Source: the Survey of Wage Structure, each year.
Note: 1. Dependent Variable is the log of real monthly wages.
2. T-statistics is in parenthesis.
3. Union control is included in all years except 1983.

As the comparison between the unweighted and weighted sample of male workers, analysis of those samples of females shows no specific trend or differences. The estimate and its standard error appear to fluctuate.

It is notable for both genders that the explanatory power of the models in each year of our sample varies: for example, around 53 percent of wage variation in male sample is captured by the specifications in 1989, while approximately 60 percent can be explained our models in the late 1990's. This can be partially explained by changes in the number of industry and regional codes that each model controls for.[12]

The models reveal: 1) 3-digit industry has more information relative to 1-digit industry for both male and female and weighted and unweighted samples. The usage of 1-digit industry (model 2) yields greater estimates of the effect of monitoring. 2) Occupational dummies are related to supervisory intensities and wages. It is observed that the coefficient changes more when industry controls are dropped than when occupation controls are dropped, implying that the indirect effect of supervisory intensity on wages is greater in the former case. 3) The regional effect is somewhat ambiguous when we use detailed regional dummies. 4) It does not appear that weighted sample produces significantly different result from unweighted sample. Based on the findings above, model (1) will be used for further analysis.

[12] For detailed information on the change in industrial classification, refer to appendix 1.

Table 6.3 Basic Model Using Hierarchical Rank, Unweighted Female Sample

Independent Variable		Female						
		(1)	(2)	(3)	(4)	(5)	(6)	(7)
Industry	1-digit		x					
	3-digit	x		x	x			x
Occupation	14 -categories	x	x	x		x		x
Region	2-digit	x	x	x	x	x	x	
	3-digit							x
Size of firm	dummies	x	x	x	x	x	x	x
Size of establishment	dummies	x	x	x	x	x	x	x
Union	dummy	x	x	x	x	x	x	x
Marital status	dummy	x	x	x	x	x	x	x
Education	dummies	x	x	x	x	x	x	x
Potential experience	years	x	x	x	x	x	x	x
Experience ^{2}		x	x	x	x	x	x	x
Tenure	years	x	x	x	x	x	x	x
Tenure ^{2}		x	x	x	x	x	x	x
Omit zero supervisor				x				
Supervisory intensity	coefficient	-0.0960	-0.0383	-0.0628	-0.0085	-0.1270	-0.0455	-0.0753
1983	(t-statistics)	(-1.50)	(-0.61)	(-0.96)	(-0.13)	(-2.03)	(-0.65)	(-1.37)
	R^2	0.5528	0.5303	0.5527	0.5360	0.5110	0.4402	0.5790
	N	223,584	223,584	215,253	223,584	223,584	223,584	223,584
Supervisory intensity	coefficient	0.0981	0.2066	0.0801	0.1117	0.2052	0.2302	0.0982
1989	(t-statistics)	(1.73)	(3.40)	(1.32)	(1.92)	(3.37)	(3.69)	(1.84)
	R^2	0.4900	0.4455	0.4857	0.4767	0.4398	0.4189	0.5161
	N	238,390	238,390	223,066	238,390	238,390	238,390	238,390
Supervisory intensity	coefficient	0.0551	0.1511	0.0534	0.0656	0.1316	0.1705	0.0478
1993	(t-statistics)	(1.26)	(3.10)	(1.17)	(1.49)	(2.85)	(3.43)	(1.09)
	R^2	0.6267	0.5756	0.6270	0.6150	0.5718	0.5434	0.6417
	N	118,768	118,768	111,653	118,768	118,768	118,768	118,768
Supervisory intensity	coefficient	0.0367	0.0945	0.0297	0.0469	0.0642	0.0885	0.0419
1996	(t-statistics)	(0.82)	(2.03)	(0.64)	(1.03)	(1.40)	(1.78)	(0.97)
	R^2	0.6258	0.5828	0.6189	0.6115	0.5800	0.5493	0.6421
	N	114,965	114,965	109,371	114,965	114,965	114,965	114,965
Supervisory intensity	coefficient	0.1038	0.1632	0.1028	0.1017	0.1251	0.0910	0.1011
1999 (10 or more workers)	(t-statistics)	(2.65)	(3.79)	(2.52)	(2.62)	(2.95)	(2.14)	(2.70)
	R^2	0.6241	0.5794	0.6224	0.6079	0.5763	0.5446	0.6329
	N	121,739	121,739	115,366	121,739	121,739	121,739	121,739

Source: the Survey of Wage Structure, each year.

Note: 1. Dependent Variable is the log of real monthly wages.
2. T-statistics is in parenthesis.
3. Union control is included in all years except 1983.

Table 6.4 Basic Model Using Hierarchical Rank, Weighted Female Sample

Indpendent Variable		Female						
		(1)	(2)	(3)	(4)	(5)	(6)	(7)
Industry	1-digit		x					
	3-digit	x		x	x			x
Occupation	14 -categories	x	x	x		x		x
Region	2-digit	x	x	x	x	x	x	
	3-digit							x
Size of firm	dummies	x	x	x	x	x	x	x
Size of establishment	dummies	x	x	x	x	x	x	x
Union	dummy	x	x	x	x	x	x	x
Marital status	dummy	x	x	x	x	x	x	x
Education	dummies	x	x	x	x	x	x	x
Potential experience	years	x	x	x	x	x	x	x
Experience ^{2}		x	x	x	x	x	x	x
Tenure	years	x	x	x	x	x	x	x
Tenure ^{2}		x	x	x	x	x	x	x
Omit zero supervisor				x				
Supervisory intensity	coefficient	-0.0249	-0.0318	-0.0191	0.0304	-0.1086	-0.0780	-0.0181
1983	(t-statistics)	(-0.41)	(-0.53)	(-0.30)	(0.49)	(-1.79)	(-1.24)	(-0.31)
	R^2	0.5574	0.5374	0.5569	0.5380	0.5171	0.4536	0.5789
	N	223,584	223,584	215,253	223,584	223,584	223,584	223,584
Supervisory intensity	coefficient	0.0919	0.1299	0.0839	0.0846	0.1248	0.1162	0.0769
1989	(t-statistics)	(2.09)	(2.99)	(1.83)	(1.87)	(2.81)	(2.50)	(1.83)
	R^2	0.4691	0.4366	0.4703	0.4454	0.4341	0.4026	0.4910
	N	238,390	238,390	223,066	238,390	238,390	238,390	238,390
Supervisory intensity	coefficient	0.1086	0.1232	0.1052	0.1190	0.0915	0.1103	0.0676
1993	(t-statistics)	(2.40)	(2.72)	(2.19)	(2.65)	(2.00)	(2.42)	(1.54)
	R^2	0.5855	0.5358	0.5776	0.5721	0.5240	0.4941	0.6061
	N	118,768	118,768	111,653	118,768	118,768	118,768	118,768
Supervisory intensity	coefficient	0.0256	0.0563	0.0303	0.0474	0.0326	0.0610	0.0218
1996	(t-statistics)	(0.71)	(1.50)	(0.80)	(1.29)	(0.87)	(1.63)	(0.62)
	R^2	0.6082	0.5662	0.6044	0.5910	0.5621	0.5289	0.6250
	N	114,965	114,965	109,371	114,965	114,965	114,965	114,965
Supervisory intensity	coefficient	0.0669	0.1146	0.0581	0.0850	0.0851	0.0858	0.0642
1999 (10 or more workers)	(t-statistics)	(2.22)	(3.56)	(1.85)	(2.68)	(2.59)	(2.56)	(2.23)
	R^2	0.6098	0.5654	0.6166	0.5900	0.5542	0.5175	0.6151
	N	121,739	121,739	115,366	121,739	121,739	121,739	121,739

Source: the Survey of Wage Structure, each year.
Note: 1. Dependent Variable is the log of real monthly wages.
2. T-statistics is in parenthesis.
3. Union control is included in all years except 1983.

Non-Linear Supervisory Intensity

It is also interesting to specify the model using quadratic and even cubed supervisory intensity, because the relationship between supervisory intensity and wages might not be linear. However, an analysis of non-linear monitoring effect does not show a significant nonlinear relationship between supervisory intensity and wages, as Table 6.5 shows. Each model is based on model (1) in Table 6. 1 in which 3-digit industry, human capital, and firm specific variables are controlled. Except for estimates of the coefficient of the cubed term in 1993, no estimates of squared or cubic terms are statistically significant. This result suggests that specification including squared and cubed supervisory ratio is not necessary for further analyses.

Table 6.5 Basic Model with Squared and Cubed Supervisory Ratio

Independent Variable	Male Workers														
	1983			1989			1993			1996			1999		
Linear supervision	0.0430	0.0012	0.1114	0.1852	0.3019	0.4758	0.0572	-0.0370	-0.3552	0.0153	-0.0149	0.1217	0.0579	-0.0287	-0.1692
	(0.90)	(0.01)	(0.66)	(2.38)	(2.92)	(1.86)	(1.52)	(-0.38)	(-2.05)	(0.45)	(-0.18)	(0.71)	(1.82)	(-0.34)	(-1.02)
Squared supervision		0.0805	-0.4041		-0.2670	-1.0759		0.1645	1.4367		0.0524	-0.4717		0.1298	0.6404
		(0.59)	(-0.74)		(-1.52)	(-0.85)		(1.19)	(2.73)		(0.46)	(-0.91)		(1.24)	(1.33)
Cubed supervision			0.4485			0.7889			-1.1896			0.4554			-0.4303
			(1.05)			(0.69)			(-2.81)			(1.15)			(-1.14)
R^2	0.6539	0.6539	0.6539	0.5559	0.5561	0.5562	0.6497	0.6499	0.6504	0.6650	0.6651	0.6651	0.6333	0.6334	0.6335
N	312,152			368,107			264,565			257,875			276,704		

Source: the Survey of Wage Structure, each year.
Note: 1. Dependent Variable is the log of real monthly wages.
2. T-statistics is in parenthesis.
3. All the other variables from model (1) in Table 6.1 are controlled. Each model includes all human capital and firm specific control variables, and 3-digit industry dummies as in the model (1) in Table 6.1.

6.2 Interaction Analysis between Establishment Size and Supervisory Intensity

It is well recognized that larger employers pay higher wages than smaller employers. It is not difficult to see the effect of the size on wages as indicated by the coefficients of the size variables[13]. However, there is no consensus on the reason such a positive relation. The shirking version of efficiency wage theory has been used to explain the size effect on wages, based on the assumption that monitoring difficulties increases as firm size grows and the difficulties of monitoring workers lead employers to pay a wage premium as an incentive device. Although higher wages in larger establishments can be partly explained by 1) greater union power, 2) a positive correlation between wages and profitability in larger firms, monitoring difficulty could be part of the explanation after controlling for union density[14].

The analysis is designed to verify: 1) whether the establishment size premium can be explained by monitoring difficulties, and 2) whether the unweighted sample produces the same results as the weighted sample. That is, if we have the same coefficients between the samples, then this implies that our specification fits data. Note

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[13] The establishment size effect on wages in the baseline model is shown in the following table. Noting that estimated effects are relative to the largest establishment size of 500 employees or more, the result shows a clear relationship between the size and wages in all years.

	1983		1989		1993		1996		1999	
	Coefficients	St Errors	Coefficients	St Errors	Coefficients	St Errors	Coefficients	St Errors	Coefficients	St Errors
Establishment size										
10 to 29	-0.2861	0.0180	-0.2689	0.0193	-0.2000	0.0193	-0.2012	0.0176	-0.1576	0.0179
30 to 99	-0.2153	0.0132	-0.2197	0.0185	-0.1346	0.0158	-0.1544	0.0163	-0.1048	0.0160
100 to 299	-0.1051	0.0124	-0.1033	0.0190	-0.0784	0.0137	-0.0974	0.0145	-0.0323	0.0140
300 to 499	-0.0496	0.0145	-0.0680	0.0179	-0.0452	0.0140	-0.0586	0.0128	-0.0553	0.0157

Source: the Survey of Wage Structure, each year.
Note: 1. Dependent Variable is the real monthly log wages.
2. T-statistics is in parenthesis.
3. All the other variables from model (1) in Table 6.1 are controlled.

[14] Troske (1999) summarizes theoretical explanations for the size-wage phenomenon:
1. A positive correlation between wages and capital-labor ratio.
2. Rent sharing of a larger establishment that has market power.
3. More skilled workers matched to larger plant.
4. A trade-off by larger firms between higher wages and less supervision and etc.

that the SWS is a representative dataset when the data are weighted and that weight is associated with firm size.

Table 6.6 presents the results of interaction analysis based on establishment size with supervisory intensity, using the male sample. Model (1), which corresponds to the baseline model in tables 6.1, controls for human and firm-specific variables including the 3-digit industry dummy variables and interaction terms between supervisory intensity and establishment size, while model (5) from the Table 6.1 contains all the variables in model (1) and the size interaction terms but no industry dummies. The estimates are reported for both weighted and unweighted samples. Differences between coefficient estimates are generally within one standard deviation of one another. This suggests the estimates are not significantly different, likely due to the fact that firm size is explicitly in the equation now, reducing the impact of weighting by firm size. This leads to a conclusion that when firm-size by supervisory intensity are controlled, weighing is not very important.

Because many coefficients of both model (1) and (5) in the table are not statistically significant, it is hard to determine monitoring effects on wages by establishment size. In 1983, however, the monitoring effect for firms with less than 100 workers on wages appears to be positive, while the effect in establishments of size 300 – 499 is negative. On the other hand, it is hard to conclude with the other sample years whether the data fits the theory well, because there are few coefficients with statistical significance and there is no clear trend over time.

Table 6.7, using the female sample does not produce results substantively different from the outcomes using the male sample. Again, the coefficients using both the unweighted and weighted sample do not show a important differences for most cases.

Table 6.6 Results of Interaction Terms between Supervisory Intensity and Establishment Size, Unweighted and Weighted Male Sample

Model		1983		1989		1993		1996		1999	
		Unweighted	Weighted	Unweighted	Weighted	Unweighted	Weighted	Unweighted	Weighted	Unweighted	Weighted
Model (1)	S*(5-9)									0.0569	0.0535
										(1.28)	(1.24)
	S*(10-29)	0.1181	0.1386	0.0162	0.0316	-0.0202	-0.0239	0.0593	0.0420	-0.0444	-0.0447
		(1.70)	(2.13)	(0.28)	(0.55)	(-0.32)	(-0.39)	(1.14)	(0.73)	(-1.04)	(-0.99)
	S*(30-99)	0.1654	0.1083	0.2808	0.1774	0.0087	0.0530	-0.0301	0.0254	0.0084	0.0346
		(2.64)	(1.79)	(3.11)	(2.31)	(0.14)	(0.86)	(-0.44)	(0.36)	(0.17)	(0.70)
	S*(100-299)	-0.0907	-0.1313	0.0823	0.0897	0.1834	0.2594	0.0299	0.1249	0.0590	0.0364
		(-1.07)	(-1.37)	(0.80)	(0.96)	(2.43)	(2.43)	(0.36)	(1.11)	(1.25)	(0.61)
	S*(300-499)	-0.2615	-0.3045	0.0453	0.1226	0.0388	0.0672	-0.0210	-0.1274	0.1067	0.0797
		(-2.31)	(-2.36)	(0.38)	(1.08)	(0.56)	(0.80)	(-0.31)	(-1.30)	(1.53)	(1.03)
	S*(500 +)	0.1118	0.1067	0.2740	0.3269	0.0378	0.0926	0.0253	0.0265	0.0646	0.0469
		(1.26)	(1.04)	(1.78)	(1.75)	(0.60)	(1.33)	(0.49)	(0.45)	(1.01)	(0.79)
	R^2	0.6545	0.6451	0.5565	0.5457	0.6501	0.6056	0.6651	0.6195	0.6333	0.6189
	N	312,152	312,152	368,107	368,107	264,565	264,565	257,875	257,875	279,474	279,474
Model (5)	S*(5-9)									0.0834	0.0971
										(1.85)	(2.20)
	S*(10-29)	0.1380	0.1358	0.0246	0.0465	-0.0540	-0.0318	0.0835	0.0458	-0.0235	-0.0075
		(2.14)	(2.12)	(0.43)	(0.78)	(-0.87)	(-0.52)	(1.57)	(0.70)	(-0.57)	(-0.16)
	S*(30-99)	0.1391	0.1119	0.3705	0.2659	0.1170	0.0974	0.1182	0.1283	0.0895	0.0867
		(2.16)	(1.75)	(4.16)	(3.30)	(1.82)	(1.40)	(1.81)	(1.80)	(1.74)	(1.67)
	S*(100-299)	-0.1001	-0.1284	0.1877	0.1878	0.1980	0.3129	0.0067	0.2122	0.0587	0.0599
		(-1.13)	(-1.36)	(1.96)	(2.03)	(2.34)	(2.97)	(0.08)	(1.71)	(1.13)	(0.92)
	S*(300-499)	-0.0731	-0.1622	0.1729	0.1923	0.0867	0.1709	0.0213	-0.0410	0.0929	0.0516
		(-0.57)	(-1.18)	(1.49)	(1.73)	(1.08)	(1.96)	(0.26)	(-0.44)	(1.22)	(0.67)
	S*(500 +)	0.1275	0.1281	0.5123	0.4966	0.1178	0.1163	-0.0111	-0.0380	0.1224	0.0693
		(1.52)	(1.46)	(3.44)	(2.69)	(1.46)	(1.23)	(-0.15)	(-0.40)	(1.81)	(1.04)
	R^2	0.6143	0.6107	0.5242	0.5251	0.5804	0.5518	0.5987	0.5708	0.5620	0.5623
	N	312,152	312,152	368,107	368,107	264,565	264,565	257,875	257,875	279,474	279,474

Source: the Survey of Wage Structure, each year.

Note: 1. Dependent Variable is the log of real monthly wages.
2. T-statistics is in parenthesis.
3. Individual and firm specific variables are controlled, using model (1) and (5) from Table 6. 1: Model (1) is specified with 3-digit industry controls, while model (5) with no industry control variables.

Table 6.7 Results of Interaction Terms between Supervisory Intensity and Establishment Size, Unweighted and Weighted Female Sample

Model		1983		1989		1993		1996		1999	
		Unweighted	Weighted	Unweighted	Weighted	Unweighted	Weighted	Unweighted	Weighted	Unweighted	Weighted
Model (1)	S*(5-9)									0.1802	0.1325
										(3.42)	(2.93)
	S*(10-29)	-0.0080	0.0716	0.0049	-0.0185	0.0824	0.1292	-0.0107	-0.0263	0.0438	-0.0082
		(-0.09)	(0.70)	(0.08)	(-0.32)	(1.11)	(1.76)	(-0.22)	(-0.53)	(0.88)	(-0.18)
	S*(30-99)	-0.2489	-0.2102	-0.0349	0.0440	0.0235	0.0592	0.0865	0.1137	0.1423	0.1371
		(-2.97)	(-2.38)	(-0.46)	(0.54)	(0.32)	(0.71)	(1.31)	(1.75)	(2.35)	(2.44)
	S*(100-299)	-0.2732	-0.1121	0.0825	0.2927	0.0899	0.1375	0.0293	0.0804	0.0481	0.0343
		(-2.01)	(-0.78)	(0.74)	(2.25)	(1.24)	(1.95)	(0.42)	(1.18)	(0.94)	(0.66)
	S*(300-499)	0.0914	0.0698	0.0933	0.2845	0.0093	0.0135	-0.0429	0.0855	0.0456	0.1159
		(0.76)	(0.57)	(0.75)	(3.26)	(0.14)	(0.16)	(-0.46)	(0.79)	(0.58)	(1.22)
	S*(500 +)	0.0347	0.1160	0.1909	0.1377	0.0731	0.1374	0.0603	-0.0410	0.2038	0.2525
		(0.26)	(0.88)	(1.75)	(1.22)	(0.86)	(1.41)	(0.70)	(-0.37)	(2.23)	(2.47)
	R^2	0.5535	0.5582	0.4904	0.4704	0.6268	0.5856	0.6259	0.6087	0.6225	0.5941
	N	223,584	223,584	238,390	238,390	118,768	118,768	114,965	114,965	123,635	123,635
Model (5)	S*(5-9)									0.2335	0.1540
										(4.56)	(3.17)
	S*(10-29)	-0.0540	-0.0030	-0.0250	-0.0256	0.0977	0.0956	0.0263	-0.0187	0.0647	0.0385
		(-0.69)	(-0.03)	(-0.44)	(-0.45)	(1.37)	(1.27)	(0.54)	(-0.36)	(1.32)	(0.81)
	S*(30-99)	-0.3985	-0.3428	0.0129	0.0750	0.0922	0.0776	0.1093	0.1090	0.1262	0.1162
		(-4.47)	(-3.23)	(0.18)	(0.89)	(1.24)	(0.93)	(1.66)	(1.60)	(2.10)	(1.85)
	S*(100-299)	-0.2764	-0.1843	0.1979	0.3087	0.1514	0.0730	0.0405	0.0595	0.0352	-0.0261
		(-1.91)	(-1.31)	(1.94)	(2.28)	(2.00)	(0.95)	(0.57)	(0.88)	(0.61)	(-0.43)
	S*(300-499)	0.2168	0.1421	0.1929	0.3102	0.1323	0.1135	0.0747	0.1459	0.0987	0.1457
		(0.12)	(1.08)	(1.53)	(3.46)	(1.74)	(1.27)	(0.76)	(1.30)	(1.14)	(1.68)
	S*(500 +)	-0.0118	0.0463	0.3474	0.3039	0.1375	0.1207	0.0675	-0.0063	0.2406	0.2501
		(-0.09)	(0.36)	(2.85)	(2.69)	(1.48)	(1.08)	(0.69)	(-0.05)	(2.28)	(2.10)
	R^2	0.5123	0.5183	0.4409	0.436	0.5718	0.524	0.58	0.5626	0.5754	0.5388
	N	223,584	223,584	238,390	238,390	118,768	118,768	114,965	114,965	123,635	123,635

Source: the Survey of Wage Structure, each year.

Note: 1. Dependent Variable is the log of real monthly wages.
2. T-statistics is in parenthesis.
3. Individual and firm specific variables are controlled, using model (1) and (5) from Table 6. 1: Model (1) is specified with 3-digit industry controls, while model (5) with no industry control variables.

6.3 Industrial Interaction Analysis

Efficiency wage theory has been frequently used to explain wage differentials across industries. Since monitoring technology could vary, it is worthwhile to consider how the technology of production could influence relevant relationships. In this section, we employ interaction terms between industry and supervisory intensity, so that it is able to see how wages in each industry associated with monitoring.

Since we find that the unweighted sample provides estimates similar to those of the weighted sample, analysis of the unweighted sample is used for all further investigations. In order to find any differences in weighting, we also present two models in each year: model (I) does not control for the interaction term of establishment size, while model (II) does.

Table 6.8 presents the results of industry interaction analysis. In each case, the 3-digit industry dummies are controlled even though interactions are only for broad industry groups. Some industries, such as social services and commerce, imply a negative relationship between wages and supervisory intensity, suggesting these industries may pay efficiency wages. However, most of coefficients are not statistically significant.

The analysis shows that there are eight estimates for coefficients that are statistically significant and that only two out of eight coefficients are negative. This suggests that the theory of compensating differentials is more important than efficiency wage theory in the Korean labor market. It should be noted, however, that there is much variation between years and industries, and there is much sampling error in the estimates.

Table 6.8 Industry Interaction Analysis, Unweighted Male Sample

Variable		Male Workers									
		1983		1989		1993		1996		1999*	
		Model I	Model II	Model I	Model II	Model I	Model II	Model I	Model II	Model I	Model II
Interaction terms	*S*industry dummies*										
S*Mining & manufacturing	coefficient	-0.0245	0.0184	0.1048	0.1929	0.0874	0.0781	0.0427	0.0406	0.0219	0.0124
	(t-statistics)	(-0.42)	(0.16)	(0.83)	(1.08)	(1.62)	(1.12)	(0.93)	(0.64)	(0.52)	(0.19)
S*Utility	coefficient	1.4897	1.6806	-0.6039	-0.4357	0.5790	0.5444	0.1187	0.1181	-0.2082	-0.1956
	(t-statistics)	(2.17)	(2.44)	(-1.07)	(-0.76)	(2.05)	(1.78)	(2.53)	(2.47)	(-1.21)	(-1.10)
S*Construction	coefficient	0.1565	0.1536	-0.0096	0.1137	0.1318	0.1109	-0.1120	-0.1089	0.0390	0.0501
	(t-statistics)	(1.88)	(1.80)	(-0.06)	(0.62)	(1.73)	(0.95)	(-1.55)	(-1.20)	(0.43)	(0.47)
S*Commerce	coefficient	-0.1762	-0.1903	-0.0277	0.1281	-0.0022	-0.0045	0.1872	0.1779	0.1539	0.1765
	(t-statistics)	(-0.86)	(-0.83)	(-0.19)	(0.62)	(-0.02)	(-0.04)	(1.23)	(1.14)	(2.39)	(2.00)
S*Transportation	coefficient	-0.1232	-0.0792	0.4500	0.6017	0.0768	0.0659	0.1098	0.1083	0.0752	0.0657
	(t-statistics)	(-0.54)	(-0.32)	(2.54)	(2.59)	(0.50)	(0.39)	(0.88)	(0.83)	(0.45)	(0.39)
S*Finance	coefficient	0.3188	0.3251	0.5157	0.6600	0.0117	-0.0007	-0.0735	-0.0739	0.1409	0.1400
	(t-statistics)	(1.54)	(1.41)	(3.51)	(3.54)	(0.14)	(-0.01)	(-1.21)	(-1.04)	(1.95)	(1.49)
S*Social Service	coefficient	-0.1114	-0.0236	0.2153	0.3736	-0.0910	-0.1037	-0.3455	-0.3614	-0.2815	-0.2676
	(t-statistics)	(-1.51)	(-0.15)	(1.48)	(1.84)	(-0.59)	(-0.64)	(-2.67)	(-2.50)	(-2.15)	(-1.80)
	R^2	0.6545	0.6551	0.5573	0.5581	0.6501	0.6504	0.6659	0.6660	0.6342	0.6344
	N	312,152	312,152	368,107	368,107	264,565	264,565	257,875	257,875	276,704	276,704

Source: the Survey of Wage Structure, each year.
Note: 1. Dependent Variable is the log of real monthly wages.
2. T-statistics is in parenthesis.
3. Model I: Interaction term with establishment size is not controlled. Model II: Interaction term with establishment size is controlled

Table 6.9 Industry Interaction Analysis, Unweighted Female Sample

Variable		Female Workers									
		1983		1989		1993		1996		1999*	
		Model I	Model II	Model I	Model II	Model I	Model II	Model I	Model II	Model I	Model II
Interaction terms	*S*industry dummies*										
S*Mining & manufacturing	coefficient	-0.0900	0.0281	-0.0074	0.0978	0.2022	0.2206	0.1172	0.1487	0.0590	0.1722
	(t-statistics)	(-1.05)	(0.17)	(-0.10)	(0.85)	(2.75)	(2.16)	(1.84)	(1.34)	(1.02)	(1.72)
S*Utility	coefficient	1.4333	1.6257	-0.7224	-0.5673	0.3135	0.3389	0.1087	0.1047	0.1789	0.2623
	(t-statistics)	(1.59)	(1.90)	(-0.69)	(-0.53)	(1.42)	(1.42)	(2.14)	(2.02)	(0.82)	(1.24)
S*Construction	coefficient	0.0664	0.0986	0.1052	0.1983	0.0416	0.0713	-0.1737	-0.1417	0.2002	0.3119
	(t-statistics)	(0.56)	(0.81)	(0.49)	(1.01)	(0.53)	(0.62)	(-1.74)	(-1.03)	(1.58)	(2.02)
S*Commerce	coefficient	0.0174	0.1656	0.1404	0.3097	0.1025	0.1258	0.1027	0.1343	0.2189	0.3383
	(t-statistics)	(0.06)	(0.49)	(0.80)	(1.55)	(0.86)	(0.90)	(0.59)	(0.66)	(2.39)	(2.68)
S*Transportation	coefficient	0.0347	0.1889	0.3606	0.5431	-0.1245	-0.0990	0.0209	0.0285	0.1244	0.2113
	(t-statistics)	(0.17)	(0.77)	(2.71)	(3.40)	(-1.06)	(-0.63)	(0.21)	(0.26)	(0.94)	(1.39)
S*Finance	coefficient	-0.1218	0.0512	0.6116	0.7880	0.0049	0.0250	-0.0153	0.0098	0.2212	0.3160
	(t-statistics)	(-1.17)	(0.32)	(4.34)	(4.73)	(0.06)	(0.24)	(-0.21)	(0.10)	(3.04)	(2.96)
S*Social Service	coefficient	-0.3944	-0.3376	-0.1903	-0.0157	-0.3644	-0.3480	-0.2545	-0.2326	-0.1966	-0.1135
	(t-statistics)	(-1.74)	(-1.48)	(-1.12)	(-0.08)	(-2.60)	(-2.21)	(-1.65)	(-1.22)	(-1.29)	(-0.65)
	R^2	0.5530	0.5538	0.4924	0.4932	0.6284	0.6285	0.6266	0.6268	0.6252	0.6257
	N	223,584	223,584	238,390	238,390	118,768	118,768	114,965	114,965	121,739	121,739

Source: the Survey of Wage Structure, each year.
Note: 1. Dependent Variable is the log of real monthly wages.
2. T-statistics is in parenthesis.
3. Model I: Interaction term with establishment size is not controlled. Model II: Interaction term with establishment size is controlled

The same analysis is conducted for female workers in Table 6.9. As in the case of male workers in social service industry, females in the industry appear to be paid efficiency wages. Although estimates for the coefficients of commerce and transportation interaction terms are not statistically significant for most cases, the sign of the estimates appears to change over time: it is negative in early 1980's but positive thereafter.

According to our results, we see mostly positive coefficients, suggesting efficiency wage theory is not applicable. These results carry over across genders as well as when we consider only significant variables[15].

6.4 Occupational Interaction Analysis

Analysis of interactions between occupations and supervisory intensity shows somewhat interesting and relatively more robust results. This supports the view that the monitoring role of each occupation may be different even within an establishment.

In the Table 6.10, medical professionals and teachers in the private sector seem to be paid efficiency wages. In terms of work quality, workers in these occupations are hard to monitor. Thus employers are likely to pay more, instead of expending resources to monitor their workers.

However, the results for sales workers are somewhat interesting. Efficiency wage theory implies that a wage premium would not be paid if employers can observe workers'

[15] The number of positive and negative coefficients (of a total 70) are reported below:

Number of Coefficients	**Male**		**Female**	
	Positive	Negative	Positive	Negative
Total	54	16	52	18
Significant	14	4	14	2

Source: Table 6.8 and 6.9

productivity or output. In this sense, the estimated negative coefficients of sales workers' monitoring intensity on wages from 1989 and thereafter shows a different result from what the theory expects, since it is relatively easier to observe performance of sales people than other occupations. The result is similar for females in Table 6. 11.

Table 6.10 Occupation Interaction Analysis, Unweighted Male Sample

Variable		Yr 83		Yr 89		Yr 93		Yr 96		Yr 99	
		Model I	Model II	Model I	Model II	Model I	Model II	Model I	Model II	Model I	Model II
*S*Occupational Dummies*											
S*Professionals	coefficient	0.1870	0.2258	0.1045	0.1915	0.0798	0.0580	0.0375	0.0443	0.0983	0.1032
	t-stat	(1.96)	(2.23)	(0.93)	(1.28)	(1.64)	(0.86)	(0.64)	(0.70)	(1.59)	(1.22)
S*Technicians	coefficient	0.0902	0.1392	-0.0231	0.0468	-0.0045	-0.0231	-0.0433	-0.0371	0.0476	0.0538
	t-stat	(0.82)	(1.15)	(-0.20)	(0.32)	(-0.06)	(-0.25)	(-0.78)	(-0.55)	(1.16)	(0.83)
S*Medical Professionals	coefficient	-0.3181	-0.3157	-0.3405	-0.2875	-0.5596	-0.5762	-0.1378	-0.1259	-0.6170	-0.6118
	t-stat	(-0.59)	(-0.58)	(-0.54)	(-0.46)	(-1.46)	(-1.50)	(-0.27)	(-0.24)	(-3.66)	(-3.57)
S*Teachers	coefficient	1.0673	1.0223	2.0792	2.1673	-0.9539	-0.9954	-0.4688	-0.4664	-0.5473	-0.5322
	t-stat	(1.36)	(1.27)	(3.08)	(3.18)	(-2.07)	(-2.12)	(-1.83)	(-1.81)	(-2.28)	(-2.10)
S*Other Professionals	coefficient	-0.3317	-0.2906	-0.2138	-0.0948	0.1279	0.0939	-0.0284	-0.0215	0.0911	0.0973
	t-stat	(-0.78)	(-0.67)	(-1.56)	(-0.55)	(1.13)	(0.74)	(-0.36)	(-0.26)	(1.26)	(1.03)
S*Managers	coefficient	0.2454	0.2527	0.0953	0.2220	0.1675	0.1471	-0.0497	-0.0457	0.1045	0.1303
	t-stat	(2.49)	(1.98)	(1.58)	(1.69)	(1.72)	(1.40)	(-0.70)	(-0.58)	(1.30)	(1.28)
S*Clerical	coefficient	0.1014	0.1491	0.1594	0.2741	0.0519	0.0299	0.0636	0.0712	0.0623	0.0669
	t-stat	(1.48)	(1.45)	(2.23)	(1.96)	(1.39)	(0.49)	(1.67)	(1.30)	(1.46)	(0.96)
S*Salesman	coefficient	0.1859	0.2811	-0.6133	-0.5024	-0.3839	-0.3856	-0.6331	-0.6371	-0.0669	-0.0322
	t-stat	(1.39)	(1.54)	(-2.40)	(-1.81)	(-1.54)	(-1.48)	(-1.77)	(-1.77)	(-0.53)	(-0.23)
S*Personal Service	coefficient	-0.1265	-0.0907	0.5592	0.6548	0.1231	0.1121	-0.0831	-0.0724	-0.2578	-0.2584
	t-stat	(-1.41)	(-0.79)	(2.52)	(2.62)	(0.43)	(0.38)	(-0.72)	(-0.58)	(-1.35)	(-1.29)
S*Other production	coefficient	-0.0803	-0.0390	-0.0775	0.0121	0.1541	0.1397	-0.0130	-0.0055	0.1041	0.1118
	t-stat	(-0.64)	(-0.25)	(-0.59)	(0.07)	(2.46)	(1.85)	(-0.24)	(-0.08)	(1.97)	(1.55)
S*Craft	coefficient	-0.0608	-0.0067	0.5978	0.6762	0.3480	0.3232	-0.0814	-0.0779	-0.0771	-0.0658
	t-stat	(-0.62)	(-0.05)	(2.09)	(2.08)	(2.21)	(1.93)	(-0.61)	(-0.55)	(-0.72)	(-0.54)
S*Machine operators	coefficient	0.1676	0.2169	0.0053	0.0907	-0.0581	-0.0697	-0.0057	0.0036	0.0493	0.0500
	t-stat	(1.95)	(1.91)	(0.05)	(0.62)	(-0.68)	(-0.71)	(-0.09)	(0.04)	(0.89)	(0.71)
S*Driver	coefficient	-0.3129	-0.2676	0.4102	0.5355	0.0239	-0.0035	0.1077	0.1130	-0.0527	-0.0322
	t-stat	(-3.71)	(-2.30)	(2.32)	(2.81)	(0.22)	(-0.03)	(0.87)	(0.83)	(-0.69)	(-0.35)
S*Laborers and Agr. experts	coefficient	-0.0388	-0.0350	1.0862	1.2009	-0.0029	-0.0242	0.0921	0.1007	0.3053	0.3170
	t-stat	(-0.08)	(-0.07)	(2.93)	(3.20)	(-0.02)	(-0.15)	(0.76)	(0.73)	(3.37)	(3.04)
R^2		0.6548	0.6554	0.5589	0.5595	0.6508	0.6511	0.6655	0.6656	0.6346	0.6347
N		312,152	312,152	368,107	368,107	264,565	264,565	257,875	257,875	276,704	276,704

Source: the Survey of Wage Structure, each year.
Note: 1. Dependent Variable is the log of real monthly wages.
2. T-statistics is in parenthesis.
3. Model I: Interaction term with establishment size is not controlled. Model II: Interaction term with establishment size is controlled

Table 6.11 Occupation Interaction Analysis, Unweighted Female Sample

Variable (Female)		Yr 83		Yr 89		Yr 93		Yr 96		Yr 99	
		Model I	Model II	Model I	Model II	Model I	Model II	Model I	Model II	Model I	Model II
*S*Occupational Dummies*											
S*Professionals	coefficient	-0.0883	0.0983	0.5196	0.6129	-0.0196	-0.0160	0.1636	0.1798	0.0464	0.1487
	t-stat	(-0.37)	(0.37)	(1.63)	(1.90)	(-0.21)	(-0.14)	(1.21)	(1.25)	(0.54)	(1.39)
S*Technicians	coefficient	0.3799	0.5759	-0.1543	-0.0687	0.0053	0.0141	-0.0278	-0.0169	0.1351	0.2379
	t-stat	(1.15)	(1.51)	(-0.71)	(-0.29)	(0.06)	(0.12)	(-0.30)	(-0.14)	(1.88)	(2.36)
S*Medical Professionals	coefficient	-0.9755	-0.8508	-0.8405	-0.7441	-0.5803	-0.5758	-0.4295	-0.4130	-0.2484	-0.1599
	t-stat	(-3.46)	(-2.98)	(-3.15)	(-2.74)	(-2.55)	(-2.43)	(-1.84)	(-1.63)	(-0.83)	(-0.51)
S*Teachers	coefficient	0.0866	0.3440	2.2448	2.4521	-0.6626	-0.6599	-0.6800	-0.6532	0.1327	0.2398
	t-stat	(0.05)	(0.21)	(1.99)	(2.18)	(-0.85)	(-0.84)	(-1.26)	(-1.19)	(0.62)	(1.06)
S*Other Professionals	coefficient	0.3517	0.4011	-0.1210	-0.0150	0.1013	0.1019	-0.2558	-0.2370	0.0536	0.1676
	t-stat	(1.42)	(1.52)	(-0.45)	(-0.06)	(0.83)	(0.74)	(-2.01)	(-1.61)	(0.63)	(1.47)
S*Managers	coefficient	0.3991	0.5925	-0.3416	-0.1014	1.0615	1.0928	-0.3267	-0.3406	0.9629	1.0835
	t-stat	(0.59)	(0.86)	(-0.95)	(-3.02)	(2.68)	(2.74)	(-0.70)	(-0.71)	(1.86)	(2.08)
S*Clerical	coefficient	-0.0173	0.1459	0.1527	0.3189	-0.0008	0.0068	0.0382	0.0563	0.0891	0.2100
	t-stat	(-0.34)	(1.26)	(2.91)	(3.22)	(-0.02)	(0.09)	(0.89)	(0.72)	(2.18)	(2.35)
S*Salesman	coefficient	0.5323	0.7395	-0.5718	-0.5002	-0.3027	-0.2876	-0.1500	-0.1110	0.1626	0.2974
	t-stat	(1.57)	(2.07)	(-1.63)	(-1.43)	(-1.36)	(-1.18)	(-0.56)	(-0.39)	(1.19)	(1.89)
S*Personal Service	coefficient	-0.0792	0.0634	0.9158	1.0334	-0.1727	-0.1614	-0.1607	-0.1482	0.0003	0.1043
	t-stat	(-0.63)	(0.38)	(4.75)	(5.02)	(-1.19)	(-0.99)	(-1.22)	(-1.00)	(0.00)	(0.70)
S*Other production	coefficient	-0.3645	-0.1776	-0.1847	-0.0424	0.5744	0.5790	0.2472	0.2736	-0.2413	-0.1477
	t-stat	(-2.17)	(-0.88)	(-1.08)	(-0.22)	(2.55)	(2.51)	(1.81)	(1.74)	(-1.77)	(-0.98)
S*Craft	coefficient	-0.1698	-0.0518	0.2155	0.3161	0.5817	0.5889	0.0052	0.0240	0.3063	0.4358
	t-stat	(-1.03)	(-0.25)	(1.79)	(2.24)	(4.04)	(3.85)	(0.04)	(0.14)	(1.83)	(2.33)
S*Machine operators	coefficient	-0.1071	0.0461	-0.2827	-0.1931	0.1147	0.1207	0.1781	0.1976	0.0079	0.1220
	t-stat	(-0.62)	(0.22)	(-1.62)	(-0.99)	(0.72)	(0.69)	(1.50)	(1.35)	(0.08)	(0.98)
S*Driver	coefficient	-1.1328	-0.8482	-0.9202	-0.8266	-0.5419	-0.5478	0.3168	0.3292	-0.7799	-0.6306
	t-stat	(-1.16)	(-0.86)	(-2.00)	(-1.87)	(-1.54)	(-1.52)	(1.11)	(1.12)	(-2.56)	(-1.95)
S*Laborers and Agr. experts	coefficient	3.1073	3.3281	0.2686	0.4299	0.3711	0.3802	0.3540	0.3678	0.8175	0.9353
	t-stat	(2.50)	(2.62)	(0.54)	(0.84)	(2.09)	(1.98)	(2.26)	(2.08)	(5.33)	(5.30)
R^2		0.5536	0.5543	0.4951	0.4958	0.6302	0.6303	0.6276	0.6277	0.6274	0.6279
N		223,584	223,584	238,390	238,390	118,768	118,768	114,965	114,965	121,739	121,739

Source: the Survey of Wage Structure, each year.
Note: 1. Dependent Variable is the log of real monthly wages. 2. T-statistics is in parenthesis.
3. Model I: Interaction term with establishment size is not controlled. Model II: Interaction term with establishment size is controlled

6.5 An Occupational Measure of Supervision

In this section, we provide results using the occupational measure as a substitute of the hierarchical measure of supervisory intensity. As noted in chapter 4, the primary occupational measure of supervisory intensity is constructed by the occupational classification. We divide occupations into 14 categories that are sorted into 2 groups: 1) workers with a supervisory role and 2) production workers. In the construction of this measure, we omit professionals and related workers to make the measure comparable with those in previous studies such as Gordon (1994). It is also important to note that each regression is fitted using only the sample of production workers.

Table 6.12 shows the Pearson correlation between the hierarchical and the occupational measure across samples. The two proxies of supervisory intensity are somewhat different from each other, suggesting analyses with both measures may be useful.

Table 6.12 Pearson Correlation between Hierarchical and Occupational Measure

Gender	Sample	1983	1989	1993	1996	1999
Male	Unweighted	0.3821	0.4289	0.4478	0.4364	0.4086
	Weighted	0.4177	0.4559	0.4417	0.4458	0.4327
Female	Unweighted	0.4680	0.4797	0.4642	0.4155	0.4653
	Weighted	0.4883	0.4920	0.4514	0.4025	0.4240

Source: the Survey of Wage Structure, each year

First, we use the primary occupational measure of the supervisory intensity in the baseline model developed in the previous chapter, shown in Table 6.13[16]. Detailed information on control variables is provided in the upper part of the table. The results present no evidence of efficiency wages for either gender. However, the magnitudes of the estimated positive monitoring effect on wages are decreasing over time for female workers; the impact in 1996 is 3 percentage points lower than that in 1989 but 2 percentage points higher than in 1999.

Consistent with results in Tables 6.6 and 6.7 show, Table 6.14 does not demonstrate a consistent pattern as to how establishment size interacts with the supervision to affect wages. As the efficiency wage model predicts, monitoring is more difficult as firm size grows. However, if the effectiveness of supervision is not constant across firms, there can be biased estimates of the impact of supervision on wages. In other words, if effective monitoring is lower for a given number of supervisors in large firms, then we would expect the negative effect of supervisory intensity on wages will be closer to zero for larger firms. However, the similarity of coefficients suggests no differences regardless of weighting, implying that monitoring effectiveness does not vary across establishments.

When replicating industry interaction analyses with the occupational measure, there seems to be a negative association between the industry interaction term and wages in both the utility and construction industries. Tables 6.15 and 6.16 show that 7 out of 10 coefficients of interaction terms between supervision and industry are negative in the utilities industry for men and construction for women, implying these industries are more likely to pay wage premiums rather than investing in more monitoring technology. In contrast to these results, the same model with the hierarchical measure suggested that

[16] This corresponds to Model (1) in Table 6.1.

social service sectors appear to have a negative relationship with wages.

In tables 6.17 and 6.18, we present occupational interaction analyses with male and female workers. As in the previous analyses, professional and related workers are omitted from the model in order to construct the primary occupational measure of the supervisory intensity. Also, occupations categorized as managerial workers are also eliminated since we look at the impact of monitoring on employees' wages. With the occupational measure, it is observed that there is a trade-off between wages and supervisory intensity for male drivers and salesmen as well as female drivers and machine operators. Female workers classified in "other production," such as minors and construction workers, appear to receive efficiency wages in the 1980s, but not in the 1990s.

These results seem close to those generated with the hierarchical measure. It is notable that analyses with both measures of supervisory intensity indicate salesman and drivers in Korea receive efficiency wages over last two decades, regardless of the ease of observing workers' productivity.

It seems to be relatively easier to observe outputs of workers in those occupations but this does not mean that employers know how much effort those workers exert. For example, it is possible that employers monitor the mileage drivers cover, but it is hard to monitor how safely they drive and how carefully they handle firm resources, such as their truck. These factors may cause Korean firms to pay wage premiums despite the apparent ease of observing outputs.

Table 6.13 The Baseline Model Using Primary Occupational Measure, Unweighted Male and Female Sample

		Model (1) in Table 6.1	
Independent Variable		Male Workers	Female Workers
Industry	1-digit		
	3-digit	x	x
Occupation	14 -categories	x	x
Region	2-digit	x	x
	3-digit		
Size of firm	dummies	x	x
Size of establishment	dummies	x	x
Union	dummy	x	x
Marital status	dummy	x	x
Education	dummies	x	x
Potential experience	years	x	x
Experience ^{2}		x	x
Tenure	years	x	x
Tenure ^{2}		x	x
Omit zero supervisor			
Supervisory intensity	coefficient	0.0467	-0.0695
1983	(t-statistics)	(1.34)	(-1.26)
	R^2	0.6148	0.4666
	N	303,152	221,358
Supervisory intensity	coefficient	0.1753	0.1066
1989	(t-statistics)	(2.75)	(2.38)
	R^2	0.5146	0.4060
	N	355,388	229,319
Supervisory intensity	coefficient	0.0126	0.0178
1993	(t-statistics)	(6.83)	(0.82)
	R^2	0.6236	0.5926
	N	222,363	105,025
Supervisory intensity	coefficient	0.0352	0.0753
1996	(t-statistics)	(1.28)	(2.37)
	R^2	0.6367	0.5894
	N	212,310	100,175
Supervisory intensity	coefficient	0.0270	0.0567
1999 (10 or more workers)	(t-statistics)	(1.78)	(3.04)
	R^2	0.6178	0.5732
	N	211,037	93,078

Source: the Survey of Wage Structure, each year.
Note: 1. Dependent Variable is the log of real monthly wages.
2. T-statistics is in parenthesis.
3. Union variable is not controlled in 1983 data.

Table 6.14 Establishment Size Interaction Analysis Using Primary Occupational Measure, Unweighted and Weighted Male and Female Sample

Model		1983		1989		1993		1996		1999	
		Unweighted	Weighted	Unweighted	Weighted	Unweighted	Weighted	Unweighted	Weighted	Unweighted	Weighted
Model (1), Male	S*(5-9)									-0.0651	-0.0436
										(-1.15)	(-0.86)
	S*(10-29)	0.1022	0.1102	-0.1049	-0.0530	0.0608	0.0511	0.1815	0.2216	0.0166	0.0318
		(1.47)	(1.88)	(-1.31)	(-0.73)	(1.79)	(1.75)	(2.42)	(2.64)	(0.73)	(1.37)
	S*(30-99)	0.2239	0.1871	0.1667	0.1799	-0.1083	-0.0982	-0.0325	0.0381	0.0040	0.0124
		(3.03)	(2.47)	(1.55)	(1.84)	(-1.63)	(-1.15)	(-0.29)	(0.34)	(0.40)	(1.19)
	S*(100-299)	0.4061	0.3540	0.1608	0.2800	0.0611	0.1127	0.1654	0.1653	0.0132	0.0130
		(3.74)	(3.48)	(0.91)	(1.59)	(1.09)	(1.39)	(1.52)	(1.12)	(1.44)	(1.37)
	S*(300-499)	0.5218	0.3098	0.1194	0.2358	-0.1423	-0.0762	0.1338	-0.0152	0.0436	0.0292
		(2.80)	(1.60)	(0.40)	(0.82)	(-1.73)	(-0.88)	(1.35)	(-0.11)	(3.03)	(2.00)
	S*(500 +)	0.5773	0.3014	0.7987	0.7739	0.0056	0.0518	0.0962	0.0820	0.0414	0.0362
		(4.58)	(1.58)	(2.83)	(2.46)	(0.09)	(0.58)	(1.02)	(0.85)	(1.88)	(1.76)
	R^2	0.6159	0.5878	0.5144	0.4875	0.6238	0.5688	0.6371	0.5846	0.6151	0.5775
	N	302,762	302,762	354,728	354,728	221,478	221,478	211,750	211,750	217,902	217,902
Model (1), Female	S*(5-9)									0.0112	0.0162
										(0.41)	(0.73)
	S*(10-29)	-0.0933	-0.0393	0.0960	0.0860	0.0636	0.0613	0.1508	0.1116	0.0248	0.0204
		(-1.37)	(-0.71)	(1.27)	(1.29)	(1.02)	(1.03)	(2.45)	(2.13)	(1.85)	(1.52)
	S*(30-99)	-0.0877	-0.0506	-0.0080	0.0978	0.0018	-0.0461	0.2142	0.2092	0.0214	0.0166
		(-0.94)	(-0.54)	(-0.08)	(1.03)	(0.03)	(-0.58)	(2.04)	(2.08)	(2.62)	(2.23)
	S*(100-299)	-0.0699	0.2927	0.2019	0.3946	0.0440	0.0359	0.0075	0.0026	0.0213	0.0151
		(-0.42)	(2.97)	(0.98)	(2.00)	(2.23)	(2.17)	(0.24)	(0.08)	(0.01)	(1.03)
	S*(300-499)	0.0361	0.2708	0.4562	0.5589	0.0512	0.0414	0.0275	0.0905	0.0391	0.0301
		(0.15)	(1.13)	(2.12)	(5.36)	(0.85)	(0.64)	(0.29)	(0.83)	(2.90)	(2.25)
	S*(500 +)	0.0758	-0.0253	0.7582	0.3990	0.0179	-0.0114	-0.0127	-0.0846	0.0576	0.0452
		(0.33)	(-0.10)	(3.05)	(1.45)	(0.39)	(-0.22)	(-0.17)	(-0.90)	(2.97)	(2.28)
	R^2	0.4663	0.4596	0.4073	0.3741	0.594	0.5465	0.5871	0.5544	0.5769	0.5336
	N	221,317	221,317	229,126	229,126	104,950	104,950	100,002	100,002	98,155	98,155

Source: the Survey of Wage Structure, each year.
Note: 1. Dependent Variable is the log of real monthly wages.
2. T-statistics is in parenthesis.
3. Model (1) is the baseline model found in chapter 6.

Table 6.15 Industry Interaction Analysis Using Primary Occupational Measure, Unweighted Male Sample

Variable		Male Workers									
		1983		1989		1993		1996		1999*	
		Model I	Model II	Model I	Model II	Model I	Model II	Model I	Model II	Model I	Model II
Interaction terms	*R*industry dummies*										
R*Mining & manufacturing	coefficient	0.6164	0.7299	0.4073	0.8669	0.2059	0.3470	0.0781	0.0437	0.2194	0.2857
	(t-statistics)	(7.93)	(5.91)	(3.03)	(3.06)	(1.58)	(1.85)	(0.68)	(0.29)	(3.19)	(3.46)
R*Utility	coefficient	-3.8755	-3.7963	-3.1360	-2.5802	-0.2750	-0.1450	0.6718	0.6906	-0.1363	0.0114
	(t-statistics)	(-1.35)	(-1.31)	(-3.64)	(-2.81)	(-0.78)	(-0.45)	(4.09)	(4.02)	(-1.18)	(0.10)
R*Construction	coefficient	0.1047	0.2169	-0.0209	0.4595	-0.1151	0.0549	-0.0179	-0.0466	-0.1789	-0.0720
	(t-statistics)	(0.78)	(1.13)	(-0.11)	(1.24)	(-1.41)	(0.33)	(-0.28)	(-0.44)	(-2.41)	(-0.79)
R*Commerce	coefficient	-0.3081	-0.0888	-0.2427	0.3991	0.1447	0.3093	0.2848	0.2615	0.1561	0.2862
	(t-statistics)	(-1.79)	(-0.39)	(-1.10)	(1.02)	(1.20)	(1.73)	(1.76)	(1.41)	(1.04)	(1.71)
R*Transportation	coefficient	0.0066	0.1124	-0.2685	0.2593	0.0976	0.3108	0.7565	0.7273	0.2373	0.3700
	(t-statistics)	(0.03)	(0.43)	(-0.60)	(0.40)	(0.42)	(1.16)	(2.33)	(2.17)	(1.95)	(2.58)
R*Finance	coefficient	0.4943	0.6126	0.6835	1.1399	-0.0059	0.1322	0.0849	0.0340	0.7251	0.8511
	(t-statistics)	(2.52)	(2.53)	(2.88)	(3.36)	(-0.04)	(0.67)	(0.72)	(0.23)	(4.18)	(4.58)
R*Social Service	coefficient	0.2725	0.3800	0.4817	0.7898	-0.2862	-0.2376	0.1351	0.0766	0.1047	0.1787
	(t-statistics)	(2.44)	(2.55)	(2.16)	(2.74)	(-2.66)	(-2.68)	(0.62)	(0.31)	(1.23)	(1.80)
	R^2	0.6170	0.6172	0.5153	0.5165	0.6233	0.6237	0.6375	0.6376	0.6206	0.6208
	N	303,153	303,153	355,389	355,389	222,366	222,366	212,310	212,310	211,060	211,060

Source: the Survey of Wage Structure, each year.
Note: 1. Dependent Variable is the log of real monthly wages.
2. T-statistics is in parenthesis.
3. Model I: Interaction term with establishment size is not controlled. Model II: Interaction term with establishment size is controlled

Table 6.16 Industry Interaction Analysis Using Primary Occupational Measure, Unweighted Female Sample

Variable		Female Workers									
		1983		1989		1993		1996		1999*	
		Model I	Model II	Model I	Model II	Model I	Model II	Model I	Model II	Model I	Model II
Interaction terms	*R*industry dummies*										
R*Mining & manufacturing	coefficient	0.0831	0.1485	-0.0146	0.5490	0.1409	0.1667	-0.0167	-0.1696	0.2997	0.4444
	(t-statistics)	(0.64)	(0.59)	(-0.10)	(2.13)	(0.90)	(0.79)	(-0.15)	(-1.14)	(3.24)	(4.03)
R*Utility	coefficient	-2.7428	-2.7012	-2.1215	-1.4604	-0.0147	0.0215	0.8198	0.7532	-0.0462	0.1366
	(t-statistics)	(-1.00)	(-0.98)	(-1.44)	(-0.97)	(-0.05)	(0.07)	(3.39)	(3.46)	(-0.38)	(0.99)
R*Construction	coefficient	-0.3666	-0.2854	-0.0390	0.6770	-0.0489	0.0352	-0.1257	-0.2609	-0.0569	0.1059
	(t-statistics)	(-2.36)	(-1.01)	(-0.25)	(2.35)	(-0.72)	(0.24)	(-1.34)	(-2.29)	(-0.73)	(1.14)
R*Commerce	coefficient	-0.2630	-0.1734	-0.0734	0.6541	0.3445	0.3961	0.5230	0.3467	0.2043	0.4820
	(t-statistics)	(-1.05)	(-0.46)	(-0.26)	(1.78)	(2.24)	(2.03)	(3.10)	(1.77)	(1.10)	(2.36)
R*Transportation	coefficient	0.2436	0.3191	0.2899	1.0014	-0.2440	-0.1848	0.3430	0.2531	0.0794	0.3019
	(t-statistics)	(0.85)	(0.89)	(1.35)	(3.24)	(-0.97)	(-0.61)	(1.18)	(0.88)	(0.41)	(1.40)
R*Finance	coefficient	-0.2240	-0.1487	0.7263	1.3100	0.0635	0.1095	0.1124	0.0212	0.3921	0.6101
	(t-statistics)	(-1.18)	(-0.54)	(5.07)	(4.79)	(0.80)	(0.98)	(1.35)	(0.20)	(2.65)	(3.62)
R*Social Service	coefficient	0.0561	0.1261	-0.0543	0.3539	-0.0826	-0.0463	0.0008	-0.1460	0.0026	0.1335
	(t-statistics)	(0.35)	(0.51)	(-0.26)	(1.29)	(-0.44)	(-0.24)	(0.00)	(-0.76)	(0.04)	(1.50)
	R^2	0.4668	0.4668	0.4080	0.4099	0.5930	0.5933	0.5900	0.5904	0.5749	0.5763
	N	221,358	221,358	229,319	229,319	105,025	105,025	100,175	100,175	93,084	93,084

Source: the Survey of Wage Structure, each year.
Note: 1. Dependent Variable is the log of real monthly wages.
2. T-statistics is in parenthesis.
3. Model I: Interaction term with establishment size is not controlled. Model II: Interaction term with establishment size is controlled

Table 6.17 Occupational Interaction Analysis Using Primary Occupational Measure, Unweighted Male Sample

Variable		Male workers									
		Yr 83		Yr 89		Yr 93		Yr 96		Yr 99	
		Model I	Model II	Model I	Model II	Model I	Model II	Model I	Model II	Model I	Model II
*S*Occupational Dummies*											
S*Clerical	coefficient	0.3739	0.4926	0.3925	0.9026	0.0072	0.0498	0.2127	0.2104	0.1641	0.2520
	t-stat	(5.66)	(3.83)	(2.95)	(3.15)	(0.13)	(0.47)	(3.32)	(1.91)	(3.75)	(3.80)
S*Salesman	coefficient	-0.1276	0.0101	-0.8780	-0.1781	-0.1227	-0.0770	-1.1875	-1.1981	-0.6061	-0.5504
	t-stat	(-0.32)	(0.02)	(-2.80)	(-0.43)	(-0.45)	(-0.26)	(-1.29)	(-1.29)	(-1.25)	(-1.08)
S*Personal Service	coefficient	0.1705	0.2832	0.1746	0.5650	-0.1554	-0.1372	0.3037	0.2525	0.0872	0.1986
	t-stat	(1.51)	(1.81)	(0.63)	(1.62)	(-0.31)	(-0.27)	(1.02)	(0.82)	(0.94)	(2.09)
S*Other production	coefficient	0.6541	0.7795	0.1841	0.7601	0.1147	0.1384	0.0684	0.0474	0.1490	0.2186
	t-stat	(3.62)	(3.51)	(1.23)	(2.72)	(0.82)	(0.76)	(0.66)	(0.30)	(2.43)	(2.77)
S*Craft	coefficient	0.5384	0.6573	0.6240	1.1388	0.3326	0.3582	0.4078	0.4053	0.1972	0.2831
	t-stat	(2.07)	(2.10)	(2.47)	(3.44)	(0.97)	(1.02)	(1.28)	(1.24)	(1.23)	(1.73)
S*Machine operators	coefficient	0.9395	1.0215	0.1413	0.6499	-0.0800	-0.0693	0.0663	0.0658	0.2356	0.3012
	t-stat	(9.69)	(7.90)	(1.06)	(2.35)	(-0.44)	(-0.34)	(0.40)	(0.34)	(2.84)	(3.08)
S*Driver	coefficient	-0.2096	-0.0721	-0.0481	0.5369	-0.2447	-0.2066	-0.0048	-0.0043	-0.1055	-0.0050
	t-stat	(-2.65)	(-0.53)	(-0.34)	(2.21)	(-2.02)	(-1.34)	(-0.04)	(-0.03)	(-1.46)	(-0.05)
S*Laborers and Agr. experts	coefficient	-0.0293	0.0529	1.3953	1.9508	-0.0668	-0.0571	-0.0194	-0.0220	0.2733	0.3630
	t-stat	(-0.05)	(0.09)	(2.07)	(2.85)	(-0.43)	(-0.33)	(-0.10)	(-0.10)	(3.54)	(3.85)
R^2		0.6175	0.6176	0.5142	0.5157	0.6230	0.6234	0.6373	0.6375	0.6193	0.6196
N		303,153	303,153	355,389	355,389	222,366	222,366	212,310	212,310	211,060	211,060

Source: the Survey of Wage Structure, each year.

Note: 1. Dependent Variable is the log of real monthly wages.

2. T-statistics is in parenthesis.

3. Model I: Interaction term with establishment size is not controlled. Model II: Interaction term with establishment size is controlled

Table 6.18 Occupational Interaction Analysis Using Primary Occupational Measure, Unweighted Female Sample

Variable (Female)		Yr 83		Yr 89		Yr 93		Yr 96		Yr 99	
		Model I	Model II	Model I	Model II	Model I	Model II	Model I	Model II	Model I	Model II
*S*Occupational Dummies*											
S*Clerical	coefficient	0.0703	0.2119	0.3149	0.9268	0.0279	0.0691	0.1252	0.0036	0.0632	0.2090
	t-stat	(0.96)	(0.98)	(3.64)	(3.95)	(0.55)	(0.64)	(2.06)	(0.04)	(1.42)	(2.75)
S*Salesman	coefficient	-0.5261	-0.3734	-0.0044	0.6278	0.7296	0.7627	-0.4811	-0.6027	-0.4650	-0.3117
	t-stat	(-1.09)	(-0.71)	(-0.01)	(1.46)	(1.98)	(1.96)	(-1.06)	(-1.31)	(-1.67)	(-1.12)
S*Personal Service	coefficient	-0.6130	-0.4811	-0.2654	0.2557	-0.2169	-0.1840	0.0900	-0.0532	0.0788	0.1903
	t-stat	(-3.58)	(-1.83)	(-1.20)	(0.84)	(-0.78)	(-0.61)	(0.38)	(-0.22)	(1.09)	(2.12)
S*Other production	coefficient	-1.4462	-1.3106	-0.8783	-0.3600	0.9649	1.0158	0.7747	0.6483	0.5195	0.5733
	t-stat	(-4.30)	(-3.32)	(-2.85)	(-0.97)	(1.96)	(2.05)	(1.66)	(1.34)	(4.02)	(4.40)
S*Craft	coefficient	0.2761	0.3944	0.6679	1.1411	0.7032	0.7430	-0.0111	-0.1501	0.7139	0.8767
	t-stat	(0.80)	(0.97)	(1.83)	(2.83)	(1.48)	(1.51)	(-0.03)	(-0.37)	(2.91)	(3.48)
S*Machine operators	coefficient	-0.6130	-0.5051	-0.7158	-0.2374	-0.2660	-0.2479	-0.1201	-0.2754	0.3056	0.4460
	t-stat	(-1.39)	(-0.96)	(-1.49)	(-0.44)	(-0.74)	(-0.66)	(-0.44)	(-0.92)	(2.74)	(3.51)
S*Driver	coefficient	-0.5292	-0.4595	-4.9395	-4.3363	-1.2775	-1.2951	-0.0655	-0.1658	-0.4180	-0.2768
	t-stat	(-0.40)	(-0.35)	(-5.49)	(-4.67)	(-1.88)	(-1.89)	(-0.13)	(-0.33)	(-2.58)	(-1.45)
S*Laborers and Agr. experts	coefficient	2.8424	2.9594	-0.6538	0.0539	0.1630	0.2211	0.2886	0.1458	0.5065	0.6367
	t-stat	(1.02)	(1.06)	(-1.52)	(0.11)	(0.58)	(0.73)	(1.05)	(0.50)	(3.04)	(3.37)
R^2		0.4679	0.4680	0.4084	0.4105	0.5934	0.5938	0.5893	0.5897	0.5757	0.5767
N		221,358	221,358	229,319	229,319	105,025	105,025	100,175	100,175	93,084	93,084

Source: the Survey of Wage Structure, each year.

Note: 1. Dependent Variable is the log of real monthly wages.

2. T-statistics is in parenthesis.

3. Model I: Interaction term with establishment size is not controlled. Model II: Interaction term with establishment size is control.

Chapter 7
Supervisory Intensity and Inter-Industry Wage Differences: Results

In the face of substantial wage differentials between industries, many economists have attempted to estimate industry impacts after controlling for observable characteristics of employees and employers. When estimated impacts can be made to disappear, the differences may be said to be explained. As a potential explanation, efficiency wage theory offers a rationale for why some industries pay higher wages to workers with similar occupations, since monitoring technology may well differ by industry. In this chapter, we investigate the differences in inter-industry wage differentials with and without supervisory intensity and find how much this measure is able to explain in the wage differentials across industries.

Since the variance of the industry wage effects will be influenced by weighting, all models in this chapter are fitted with the weighted sample. Once again, the SWS is a representative data of the Korean labor market only when the weighting is applied, and our goal is to identify the importance of monitoring in the population.

Tables 7.1 and 7.2 present the coefficients of industry dummy variables at the 1-digit level of both male and female workers, respectively. We compare the weighted adjusted standard deviations with and without controls for supervisory ratings, with mining and manufacturing sector as the omitted category. First, we turn to a discussion of the industry wage effects and their changes over time.

In Table 7.1, we observe from model (1) and model (2) that in 1983 male workers in mining and manufacturing receive lower pay than those in other industries.

Workers in finance are paid the highest wage: they earn approximately 20 percent more than workers in mining and manufacturing sector do, other things being equal. However, the average wage gap between mining and manufacturing and finance narrows in 1990's: 5-6 percent in 1993 and in 1996, and 7 percent in 1999.

It is also interesting in Table 7.1 and 7.2 that overall income dispersion within gender are much lower in 1989, perhaps due to increased labor demands resulting from the 1988 Seoul Olympic games. Wage dispersion across industries, however, was not significantly altered as a result of the financial crisis in late 1997. Finally, it could be seen that wage dispersion within gender appears to converge in late 1990's.

Tables 7.3 and 7.4 report estimates of the weighted adjusted standard deviation of industry wage effects at both the 1-digit and the 3-digit industry level with male and female sample, respectively. We also consider how the standard deviation varies when the supervisory intensity is controlled along with its square and its cube. For example, the first row is constructed with the baseline model where 1-digit industries are included but supervisory intensity is not controlled.

The standard deviation of the estimated coefficients change over time in the baseline model at the 3-digit level: for male workers, a decline in the magnitude of industry wage dispersion is observed in between 1983 and 1989, but we see a gradual increase thereafter, while females' wage dispersion appears not to be changed in the 1980's but to change between 1996 and 1999 when the financial crisis occurred. In essence, male wage dispersion has increased since the democratization in 1987, while the dispersion for female increased during the 1997 financial crisis.

These patterns can be explained in several ways: Entrance of female workers into

Table 7.1 Comparison of Industry Coefficients and Weighted Adjusted Standard Deviation, Male Workers

Variable	1983		1989		1993		1996		1999	
	1	2	1	2	1	2	1	2	1	2
Supervisory intensity controlled	*No*	*Yes*	*No*	*Yes*	*No*	*Yes*	*No*	*Yes*	*No*	*Yes*
Mining & Manufacturing (Omitted Category)										
Utility	0.1514	0.1514	0.1211	0.1162	0.0106	0.0065	-0.0274	-0.0336	0.1320	0.1307
	(0.067)	(0.066)	(0.039)	(0.040)	(0.036)	(0.036)	(0.023)	(0.024)	(0.023)	(0.023)
Construction	0.0738	0.0677	-0.0120	-0.0270	0.0899	0.0852	0.0614	0.0572	0.0431	0.0397
	(0.026)	(0.027)	(0.025)	(0.026)	(0.021)	(0.021)	(0.021)	(0.021)	(0.022)	(0.022)
Commerce	0.0757	0.0793	0.0442	0.0479	-0.0194	-0.0189	0.0040	0.0045	0.0398	0.0407
	(0.022)	(0.022)	(0.019)	(0.019)	(0.019)	(0.019)	(0.020)	(0.020)	(0.018)	(0.018)
Transportation	-0.0239	-0.0168	-0.0412	-0.0313	-0.0942	-0.0900	-0.0822	-0.0779	-0.0100	-0.0065
	(0.022)	(0.022)	(0.026)	(0.026)	(0.019)	(0.019)	(0.027)	(0.027)	(0.025)	(0.026)
Finance	0.2044	0.2083	-0.0120	-0.0031	0.0583	0.0611	0.0564	0.0594	0.0732	0.0737
	(0.030)	(0.030)	(0.020)	(0.020)	(0.017)	(0.017)	(0.017)	(0.017)	(0.017)	(0.017)
Social Service	0.1122	0.1149	0.0083	0.0111	0.0298	0.0343	0.0706	0.0753	0.0987	0.1024
	(0.017)	(0.018)	(0.021)	(0.021)	(0.025)	(0.025)	(0.022)	(0.023)	(0.019)	(0.019)
Weighted adjusted standard deviation of differentials	0.0798	0.0795	0.0523	0.0503	0.0580	0.0563	0.0541	0.0544	0.0498	0.0494
R^2	0.6199	0.6202	0.5233	0.5256	0.5579	0.5583	0.5757	0.5761	0.5694	0.5696
N	312,152	312,152	368,107	368,107	264,565	264,565	257,875	257,875	276,704	276,704

Source: the Survey of Wage Structure, each year.
Note: 1. Dependent Variable is the log of real monthly wages.
2. T-statistics is in parenthesis.
3. Estimated figures of the weighted adjusted standard deviation are calculated from the industry coefficients.

Table 7.2 Comparison of Industry Coefficients and Weighted Adjusted Standard Deviation, Female Workers

Variable	1983		1989		1993		1996		1999	
	1	2	1	2	1	2	1	2	1	2
Supervisory intensity controlled	*No*	*Yes*	*No*	*Yes*	*No*	*Yes*	*No*	*Yes*	*No*	*Yes*
Mining & Manufacturing (Omitted Category)										
Utility	0.0160	0.0158	-0.0550	-0.0587	-0.1072	-0.1169	-0.1096	-0.1160	0.0096	0.0068
	(0.038)	(0.038)	(0.054)	(0.054)	(0.038)	(0.038)	(0.029)	(0.030)	(0.031)	(0.031)
Construction	0.0158	0.0199	-0.0390	-0.0547	0.0067	-0.0066	0.0114	0.0051	-0.0372	-0.0526
	(0.027)	(0.029)	(0.027)	(0.028)	(0.020)	(0.020)	(0.026)	(0.027)	(0.025)	(0.026)
Commerce	0.0934	0.0925	0.0622	0.0623	0.0217	0.0217	0.0220	0.0233	0.0421	0.0485
	(0.024)	(0.024)	(0.021)	(0.021)	(0.018)	(0.018)	(0.018)	(0.018)	(0.019)	(0.019)
Transportation	0.0603	0.0583	-0.0379	-0.0357	-0.0660	-0.0652	0.0281	0.0304	0.0317	0.0398
	(0.023)	(0.023)	(0.026)	(0.026)	(0.032)	(0.032)	(0.030)	(0.030)	(0.025)	(0.025)
Finance	0.2979	0.2964	0.0057	0.0087	0.1236	0.1280	0.0847	0.0870	0.1526	0.1567
	(0.024)	(0.024)	(0.022)	(0.022)	(0.018)	(0.018)	(0.019)	(0.019)	(0.019)	(0.019)
Social Service	0.1661	0.1644	-0.0002	0.0034	0.0168	0.0251	0.0324	0.0369	0.0666	0.0777
	(0.023)	(0.023)	(0.016)	(0.016)	(0.022)	(0.022)	(0.018)	(0.018)	(0.016)	(0.016)
Weighted adjusted standard deviation of differentials	0.1071	0.1061	0.0391	0.0423	0.0720	0.0759	0.0578	0.0610	0.0588	0.0648
R^2	0.5373	0.5374	0.4353	0.4366	0.5342	0.5358	0.5658	0.5662	0.5639	0.5654
N	223,584	223,584	238,390	238,390	118,768	118,768	114,965	114,965	121,739	121,739

Source: the Survey of Wage Structure, each year.
Note: 1. Dependent Variable is the log of real monthly wages.
2. T-statistics is in parenthesis.
3. Estimated figures of the weighted adjusted standard deviation are calculated from the industry coefficients.

the labor market from the 1970's to early the 1980's appears to have increased the female wage gap across industries, while the gap is lowered through labor market liberalization around late 1980's. Strengthened union power also seems to contribute to narrowing the wage differentials across industries at the time, as explained in chapter 3.

Main findings in this chapter are 1) that variations in wage differentials across industries appear to fluctuate more with male workers than females and 2) that the wage variation with and without the proxy of supervisory intensity is not significantly different, suggesting shirking version of efficiency wage theory does not explain industry wage differentials in the Korean labor market. Differences in the weighted adjusted standard deviation between when supervisory intensity is controlled for and when it is not are lower then 1 percent for all the cases. This is the same when non-linear supervision is controlled for in the models.

Our conclusion is that the monitoring effect appears not of importance in accounting for wage variation between industries, as identified in the SWS. Analyses with the squared and cubed monitoring effect also underscore that there is no nonlinear relationship hidden in the data.

Table 7.3 Estimated Inter-Industry Wage Differentials over Time, Male Workers

Supervisory Ratio	1983	1989	1993	1996	1999
1-digit industy					
None	0.0798	0.0523	0.0580	0.0541	0.0498
included linear	0.0795	0.0503	0.0563	0.0544	0.0494
3-digit industry					
None	0.1181	0.0837	0.0996	0.1236	0.1353
included linear	0.1182	0.0811	0.0995	0.1240	0.1351
included squared	0.1182	0.0795	0.0996	0.1240	0.1351
included cubed	0.1183	0.0785	0.0995	0.1237	0.1347

Source: the Survey of Wage Structure, each year.
Note: 1. Dependent Variable is the log of real monthly wages.
2. T-statistics is in parenthesis.
3. Estimated figures are the weighted adjusted standard deviation of the industry coefficients.

Table 7.4 Estimated Inter-industry wage differentials over time, Female Workers

Supervisory Ratio	1983	1989	1993	1996	1999
1-digit industy					
None	0.1071	0.0391	0.0720	0.0578	0.0588
Included linear	0.1061	0.0423	0.0759	0.0610	0.0648
3-digit industry					
None	0.1156	0.1032	0.1006	0.0967	0.1358
included linear	0.1154	0.1019	0.1018	0.0966	0.1355
included squared	0.1171	0.1015	0.1022	0.0961	0.1357
included cubed	0.1163	0.1013	0.1022	0.0959	0.1357

Source: the Survey of Wage Structure, each year.
Note: 1. Dependent Variable is the log of real monthly wages.
2. T-statistics is in parenthesis.
3. Estimated figures are the weighted adjusted standard deviation of the industry coefficients.

Chapter 8
Conclusion and Further Study

Efficiency wage models provide a promising explanation for unemployment and inter-industry wage differentials. Those models can generate equilibria in which involuntary unemployment arises, providing a circumstance where employers find it profitable to pay wages above workers' alternative wages. Wages above the market clearing wage level, efficiency wages, function to boost productivity by lowering workers' absenteeism, turnover rate, and the probability of shirking and by attracting higher quality workers. Among these models, this study focuses on the shirking version.

When a firm cannot observe the productivity of its workers, a moral hazard of shirking might arise. Some solutions have been suggested in which the firm shifts the output risk to the workers by monitoring and penalizing the shirkers. Suppose when there is an excess supply of labor and when the productivity or output of workers can be observable, it is reasonable that employers simply replace a shirker. However, it is almost impossible to perfectly monitor worker productivity in the real labor market. In this case, wages must be sufficiently above market-clearing to ensure that workers prefer employment to unemployment and do not shirk, and the extent of that increment should be inversely related to the level of monitoring.

The purpose of this paper is to find 1) whether the shirking efficiency wages can explain the wage variation across homogeneous workers, looking at the impact of supervisory intensity on their wages, and 2) how much supervisory intensity is able to explain in the wage differentials across industries.

When using hierarchical measures, we calculate a proxy of supervisory intensity in each establishment using a rank variable that differentiates supervisors from supervisees. As an alternative, occupational measure, we proxy monitoring technology using standard occupational codes frequently used in the literature.

First, we find the best fitting wage equation among many alternative codings and do analyses of the interaction between supervisory intensity and wages by firm size, industry, and occupation.

Since we could not find any strong evidence that wages are linearly associated with supervisory intensity, we also investigate the possibility of a non-linear relationship. Finally, we explore whether there are wage differentials across industries, using weighted adjusted standard deviations of wage differentials in 1-digit and 3-digit industry levels.

Conclusion

This study, based on the SWS, contributes in several ways to improve the understanding of efficiency wage theory in the Korean labor market:

1. The evidence suggests that efficiency wage theory may not to be applicable in the Korean labor market as a whole. The supervisory intensity measure of firms' monitoring of their workers appears to be positively associated with employee's wages. This suggests rent-sharing or a compensating differential wage scheme is

more relevant to the Korean labor market. The result is the same using both the primary hierarchical and the occupational measures.

2. Investigation shows no evidence of a nonlinear relationship between wages and supervisory intensity.
3. The impact of supervisory intensity on wage variation appears to vary by industrial and occupational identifiers, which suggests monitoring technology is highly correlated with the type of industry and occupation.
4. a. Contrary to the predictions of theory, the interaction of firm size and supervisory intensity does not reveal any relationship with wages.

   b. There is weak evidence of efficiency wages in the social service industry and the results are consistent across genders. In other industries, there are no apparent patterns.

   c. When analyzing specific occupations, we see evidence of efficiency wages among salesmen, medical professionals, and more recently among teachers. The result for salesmen is unexpected because they are typically not expected to receive efficiency wages as their output is easily measured.
5. Although evidence of efficiency wages could not be found in the Korean labor market as a whole, wage dispersion across industries does exist. Supervisory intensity does not explain wage variation across industries.

Overall, the estimated results do not provide evidence of efficiency wages, since supervisory intensity appears positively related to wages. This suggests that compensating differentials or a profit sharing wage scheme may be more directly applicable theories than efficiency wages.

Further Study

In future studies, more individual-level information would be beneficial in evaluating the application of efficiency wage theory. Variables indicating work environment, whether firms collect economic rent, and whether those firms share these rents with their employees are important factors to find the applicable efficiency theory in the labor market.

Furthermore, the assumption that all individuals are homogenous after controlling for the factors in the wage equation (even after controlling for monitoring) may be tenuous; there are many characteristics that affect wages and may induce bias in these results. In addition to those characteristics, panel data may be useful to control for individual or employer fixed effects in the wage equation. Since individual characteristics such as schooling and experience do not capture all the wage variations, the wage equation still does not entirely control for individuals' ability to earn.

Finally, productivity changes are difficult to capture with wage equations and the direction of causation between wages and productivity is hard to determine with cross-sectional analyses. A production function approach would be useful in the sense that it could help identify the possible impact of productivity on wages.

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APPENDIX

1. The Korean Industrial Classification (Industry Code)[17]

The Korea National Statistical Office (KNSO) first introduced industry codes in mining and manufacturing sectors in 1963 and for the other industries in 1964. The office revised the code in 1965, 1968, 1970, 1975, 1984, 1991, 1998, and 2000. For the time periods of our analysis, the most significant changes in industry code occurred in 1991. The new industrial code is composed of five hierarchical structures. In actual application, the office constructed 17 categories at the one-digit level, 60 at the two-digit level, 160 at the three-digit level, 333 at the four-digit level, and 1,192 at the five-digit level.

The KNSO adopted criteria that were advised by United Nations (UN) for international comparison: 1) characteristics of produced goods or services, 2) uses of produced goods and services, and 3) similarity of inputs, production procedure, and technology. These criteria are strictly applied up to four-digit industry code. In case of five-digit codes, however, the KNSO developed their own standard to reflect the Korean industrial structure. As the economy grew and become more sophisticated, a more detailed categorization was applied in 1998 and again in 2000.

In this study, we use 1-digit and 3-digit industrial codes in our base model. Table A1.1 shows how the industry codes match for the changes in 1992.

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[17] We summarize the history of the Korean industrial classification based on the website of the Korean Ministry of Labor, http://laborstat.molab.go.kr.

Table A1. 1 Matching 1-digit industry code between before and after 1992

1983 & 1989			Industry	1993, 1996, & 1999		
3-digit code				3-digit code		
200	-	399	Mining & Manufacture	100	-	399
400	-	499	Utility	400	-	449
500	-	599	Construction	450	-	499
600	-	699	Commerce	500	-	599
700	-	799	Transportation	600	-	649
800	-	899	Finance	650	-	749
900	-	999	Social service	750	-	999

Source: the KML statistics web site: http://laborstat.molab.go.kr/

The numbers of 3-digit industry codes increased over time. Instead of grouping the detailed industry code, we simply employ the code as it is since the changes in the number of the code may partly reflect meaningful changes in industry structure. If technological developments cause differentiation within an early industrial classification, the new code may merely identify changes. Workers in newly identified industries may have different experience from one another, which are captured in the new classification. Following table is the number of 3-digit industries in SWS data sets.

Table A1.2 Number of 3-digit industry code in the SWS

Year	1983	1989	1993	1996	1999
No of 3-digit industry	48	50	129	127	181

Source: the SWS, each year.

2. The Korean Occupational Classification (Occupational Code)[18]

In 1963 Korea adopted an occupational code based on International Standard Classification of Occupations (ISCO) - 58 developed by the International Labor Organization. The code was modified in order to accord with changes in ISCO in 1968 and 1988, and to reflect changes in Korea's occupational structure and production technology in 1970, 1974, and 1991.

For our purposes, the most important change occurred in 1991, in response to developments in information, communication, and service industries, which created a number of new occupations. In the revised system, 1) occupations were defined by a group of jobs performed by a worker, 2) skills for jobs were categorized into four groups by educational attainment, and 3) the code is, finally, specified by products or services produced and tools or materials used.

The 1991 changes make it impossible to compare the simple one or two digit codes for the surveys before and after 1992. We constructed 14 categories in an attempt to construct the best match over time. The number of two digit occupations (the most detailed available to us) changed over time, from 72 in 1983 and 1989 to 24 in 1993, 25 in 1996, and 27 in 1999.

The changes in occupational code in 1991 were quite dramatic in terms of the number of categories and how each category was defined, so our matches are not very good in some cases. Table A2.1 shows how we match occupations in 1989 and 1993. We

[18] We summarize the history of the Korean occupational classification from website of the Korean Ministry of Labor, http://laborstat.molab.go.kr.

use 14 categories in the first column, which are our base occupation control variables and then show how those categories are divided into for more detailed occupation controls.

Matching occupations such as professionals, clerical workers, and other white-collar occupations seems to be done well. Also, managers (OCC6), a key variable in constructing supervisory intensity using occupational code, is stable over time increasing from 2.54 to 2.92 percent. However, the other occupation of importance, laborers, is not defined well with the 2-digit occupational codes, because laborers or workers with simple tasks are scattered through occupations and thus, are hard to match before and after the 1991 change of the classification. This is because the changes in the occupational classification simplify blue-collar workers relative to the codes used before 1991. 12 categories of crafts in 1989, for example, are merged to 2 categories in the 1993 code. To make matters worse there were changes in sampling methods in the SWS in 1992 that may bias proportions of each occupation. This change mainly causes changes in proportions across industries and establishment sizes.

Table A2.1 Matching occupational code between in 1989 and in 1993, Weighted Sample

OCC	OCC	Description	Year 83		Year 89		OCC	Description	Year 93		Year 96		Year 99	
			Freq	Percent	Freq	Percent			Freq	Percent	Freq	Percent	Freq	Percent
Professionals (OCC1)	1	Physical Scientists and related technicians	28	0.00	152	0.00	21	Scientist and engineers	227677	4.66	285194	5.38	253631	4.67
	2	Architects and engineers	68961	2.31	131006	2.91								
	8	Statisticians, mathematicians, systems sanlysts and related technicians	6167	0.21	21452	0.48								
	9	Economists	791	0.03	906	0.02								
	11	Accountants	73	0.00	903	0.02								
		Total 1,2,8,9,11	76020	2.55	154419	3.43		Total 21	227677	4.66	285194	5.38	253631	4.67
Technicians (OCC2)	3	Related technicians (architecture and engineering)	56529	1.89	63639	1.41	31	Science related associate professionals	162146	3.32	221717	4.18	327798	6.03
	5	Life scientists and related technicians	761	0.03	3545	0.08								
		Total 3, 5	57290	1.92	67184	1.49		Total 31	162146	3.32	221717	4.18	327798	6.03
Medical Professionals (OCC3)	6	Medical, dental, vererinary and related workers	10144	0.34	18183	0.40	22	Health and medical professionals	56732	1.16	72161	1.36	56690	1.04
	7	Medical, dental, vererinary and related workers	18403	0.62	45625	1.01	32	Health and medical associate professionals	20366	0.42	10582	0.2	47828	0.88
		Total 6, 7	28547	0.96	63808	1.41		Total 22, 32	77098	1.58	82743	1.56	104518	1.92
Teachers (OCC4)	13	Teachers	75749	2.54	99429	2.21	23	Teaching professionals	90982	1.86	112092	2.11	161680	2.98
							33	Teaching associated professional	1952	0.04	16831	0.32	45737	0.84
		Total 13	75749	2.54	99429	2.21		Total 23, 33	92934	1.9	128923	2.43	207417	3.82
Other Professionals (OCC5)	4	Aircraft and ships' officers	2870	0.10	2051	0.05	24	Other professionals	40026	0.82	48985	0.92	56288	1.04
							34	Other associate professionals	186952	3.83	243370	4.59	488884	9
	14	Workers in religion	609	0.02	127	0.00								
	15	Authors, journalists and related writers	4726	0.16	8749	0.19								
	16	Sculptors, painters, photographers and related creative artists	3070	0.10	7975	0.18								
	17	Composers	1195	0.04	1737	0.04								
	18	Athletes, sportsmen and related workers	1005	0.03	1176	0.03								
	19	Professional, technical and related workers not elsewhere classified	2341	0.08	2342	0.05								
		Total 4, 14, 15, 16, 17, 18, 19, 12	15816	0.53	24157	0.54		Total 24, 34	226978	4.65	292355	5.51	545172	10.04

Managers (OCC6)	20		55	0.00			12	Administrative and corporate manager	160128	3.28	161860	3.05	222767	4.1
	21	Managers	121902	4.08	192524	4.28	13	General manager	36478	0.75	49170	0.93	74511	1.37
		Total 21	121957	4.08	192524	4.28		Total 12, 13	196606	4.03	211030	3.98	297278	5.47
Clericals (OCC7)	30	Clerical supervisors	144224	4.83	295841	6.57								
	32	Stenographers, typists and card-punching machine operators	23859	0.80	28472	0.63	41	Office related clerks	890972	18.23	1052999	19.86	933259	17.17
	33	Bookkeepers, cashiers and related workers	157203	5.26	196103	4.36	42	Customer related clerks	315200	6.45	261983	4.94	290551	5.35
	34	Computing machine operators	2013	0.07	3267	0.07								
	35	Transport and communications supervisors	269	0.01	6226	0.14								
	36	Transport conductors	34254	1.15	6255	0.14								
	37	Mail distribution clerks			1790	0.04								
	38	Telephone and telegraph operators	11013	0.37	18861	0.42								
	39	Clerical and related workers not elsewhere classified	278375	9.32	524147	11.64								
		Total 30, 32, 33, 34, 35, 36, 37, 38, 39	651210	21.81	1080962	24.01		Total 41, 42, 49	1206172	24.68	1314982	24.8	1223810	22.52
Salesmen (OCC8)	42		370	0.01	67	0.00	52	Salesmen, models and demonstrators	85221	1.74	92670	1.75	127178	2.34
	43	Technical salesman, commercial travellers and manufacturers' agents	16120	0.54	13533	0.30								
	44	Insurance, real estate, securities and business services salesmen and auctioneers	61	0.00	1235	0.03								
	45	Salesmen, shop assistants	15393	0.52	45826	1.02								
		Total 43, 44, 45	31944	1.07	60661	1.35		Total 52	85221	1.74	92670	1.75	127178	2.34
Personal Service (OCC9)	52	Housekeeping and related service supervisors	1296	0.04	1552	0.03	51	Personal services related workers	108952	2.23	144952	2.73	168475	3.1
	53	Cooks, waiters, bartenders and related workers	30002	1.00	55726	1.24								
	54	Maids and related housekeeping service workers not elsewhere classified	2445	0.08	6390	0.14								
	55	Building caretakers, charworkers, cleaners and related workers	16374	0.55	36935	0.82								
	56	Launderers, dry-cleraners and pressers	1893	0.06	2231	0.05								
	57	Hairdressers, barbers, beauticians and related workers	1218	0.04	202	0.00								

	58	Protective service workers	49776	1.67	79130	1.76								
	59	Service workers not elsewhere classified	26662	0.89	34757	0.77								
		Total 52, 53, 54, 55, 56, 57, 58, 59	129666	4.33	216923	4.81		Total 51	108952	2.23	144952	2.73	168475	3.1
Other Production (OCC10)	70	Production supervisors and general supervisor	74498	2.49	110488	2.45	71	Extraction and building trades workers	65879	1.35	53238	1	64786	1.19
	71	Miner, quarrymen, well drillers and related workers	45269	1.52	39597	0.88	72	Metal, machinery and related trades workers	477708	9.78	513077	9.68	471223	8.67
	72	Metal processers	42340	1.42	66216	1.47								
	74	Chemical processers and related workers	36194	1.21	50697	1.13								
	83	Blacksmiths, toolmakers and machine tool operators	129660	4.34	227029	5.04								
	95	Bricklayers, carpenters and other construction workers	12185	0.41	17277	0.38								
		Total, 70, 71, 74, 83	340146	11.39	511304	11.35		Total 71, 72	543587	11.13	566315	10.68	536009	9.86
Crafts (OCC11)	73	Wood preparation workers and paper makers	31638	1.06	35183	0.78	73	Precision, handicraft and related workers	66699	1.36	36416	0.69	41848	0.77
	75	Spinners, weavers, knitters, drers and related workers	242516	8.12	254322	5.65	74	Other craft and related trades workers	350334	7.17	197373	3.72	169971	3.13
	76	Tanners, fellmongers, and pelt dressers	6439	0.22	13313	0.30								
	77	Food and beverage processers	59661	2.00	77103	1.71								
	78		3	0.00	4280	0.10								
	79	Tailors, dressmakers, sewers, upholsterers and related workers	192040	6.43	205131	4.56								
	80	Shoemakers and leather goods makers	103802	3.47	134090	2.98								
	81	Cabinetmakers and related workers	16056	0.54	22161	0.49								
	82	Stone cutters and carvers	168	0.01	1595	0.04								
	87	Plumbers, welders, sheet-metal and structural metal preparers	67180	2.25	64643	1.44								
	88	Jewllery and precious metal workers	889	0.03	2462	0.05								
	89	Class formers, potters and related workers	26477	0.89	34681	0.77								
		Total 73, 75, 76, 78, 79 80, 81, 82, 77, 87, 88, 89	746869	25.02	848964	18.87		Total 73, 74	417033	8.53	233789	4.41	211819	3.9
Machine operators (OCC12)	84	Machinery fitters, machine assemblers and precision-instrument makers	118445	3.97	179210	3.98	81	Stationary plant and system operators	163880	3.35	178745	3.37	147942	2.72
	85	Electrical fitters and related workers	157561	5.27	307935	6.84	82	Machine operators and asemblers	678232	13.88	771080	14.54	570900	10.51
	86	Broadcasting station and sound-equipment operators	739	0.02	1384	0.03								
	90	Rubber and plastics product makers	61947	2.07	67425	1.50								

	91	Paper and papterboard products makers	42	0.00	9395	0.21								
	92	Printers and related workers	23111	0.77	36476	0.81								
	93	Painters	13556	0.45	23280	0.52								
	94	Production and related workers not elsewhere classified	53370	1.79	63152	1.40								
	96	Stationary engine and related equipment operators	21077	0.71	29904	0.66								
	97	Material handlinn and related equipment operators	46719	1.56	85349	1.90								
		Total 84, 85, 86, 90, 91, 92, 93, 94, 95, 96, 97	496567	16.61	803510	17.85		Total 81, 82	842112	17.23	949825	17.91	718842	13.23
Drivers (OCC13)	98	Transport equipment operators	209662	7.02	361032	8.02	83	Drivers, mobile plant operators	428639	8.77	418619	7.9	358406	6.6
							86						6	0
		Total 98	209662	7.02	361032	8.02		Total 83, 86	428639	8.77	418619	7.9	358412	6.6
Laborers and agricultural experts (OCC14)							61	Skilled agricultural workers	5288	0.11	2835	0.05	6567	0.12
	62	Agricultural and animal husbandry workers	1252	0.04	2952	0.07	91	Services related elementary occupations	216762	4.44	257001	4.85	242906	4.47
	63	Forestry workers	120	0.00			92				83	0	1116	0.02
	64				74	0.00	93	Laborers in manufacturing	49488	1.01	98517	1.86	103266	1.9
	99	Laborers not elsewhere classified	4318	0.14	13867	0.31								
		Total 60, 62, 63, 64, 99	5690	0.18	16893	0.38		Total 61, 91,92, 93	271538	5.56	358436	6.76	353855	6.51
		Overall Total	2,987,133	100.01	4,501,770	100.00		Overall Total	4,886,693	100.01	5,301,550	99.98	5,434,214	100.01

Source: the Survey of Wage Structure, each year.

3. Comparison between the Number of Workers in the SWS and Published Figures: The SWS as a Representative Data

The SWS is based on a stratified sampling frame and is designed to be representative with use of the weight variable. As explained in text, the Korean Ministry of Labor determines 1) how many establishments will be surveyed by industry and establishment size, and then 2) how many workers will be chosen to be surveyed within each firm. To make the SWS representative, the KML assigns weights to each observation, so we are able to compare the number of observations in the SWS and the number of workers in a published statistics.

The following tables show differences of number of workers in the SWS, as compared to published figures by industry classification. Because of lack of information on the number of workers by industry who are employed in establishments with 10 or more workers in 1980's, we make comparison in 1993 and 1996. In 1999, the SWS has information on workers employed in establishments with 5 or more worker. Therefore, published figures for the comparison also use the number of workers employed in corresponding establishments.

Overall percentage differences of the SWS from published ones are similar in the selected years. The mining and manufacturing sectors that make up around 50 percent of total workers. However, variations in other industries such as construction and financial institutes are considerably larger.

Table A3. 1 The Number of Workers by Industry Who Are Employed in Establishments with 10 or More Workers

		SWS	PUBLISHED FIGURES	
Yr 1996	% difference	Weighted number of workers with SWS	Total	Total
All industries	1.60%	5,301,550	5,217,993	5,217,993
Mining (10-14)	-3.65%	2,573,094	26,723	2,670,524
Manufacturing (15-37)			2,643,801	
Utility (40-41)	6.14%	44,243	41,685	41,685
Construction (45)	2.71%	291,503	283,801	283,801
Wholesale & retail trade (50-52)	7.65%	522,998	407,675	485,831
Hotels & restaurants (55)			78,156	
Transport & telecommunications (60-64)	3.37%	530,775	513,493	513,493
Financial institutions & insurance (65-67)	10.40%	863,750	351,207	782,368
Real estate & Business activities (70-74)			431,161	
Education (80)	7.93%	475,187	160,885	440,291
Health & social work (85)			167,776	
Other community & personal services (90-93)			111,630	

Source: the SWS, each year. Published figures are obtained from the KML statistics web site: http://laborstat.molab.go.kr/
Note: % difference is calculated by
(weighted number of workers in SWS / total number of workers in published figures – 1) * 100

Table A3. 2 The Number of Workers by Industry Who Are Employed in Establishments with 5 or More Workers

		SWS	PUBLISHED FIGURES	
Yr 1999	% difference	Weighted number of workers with SWS	Total	Total
All industries	-3.65%	5,434,216	5,640,065	5,640,065
Mining (10-14)	-2.05%	2,276,392	2,323,960	21,954
Manufacturing (15-37)				2,302,006
Utility (40-41)	-1.98%	44,833	45,738	45,738
Construction (45)	-12.48%	281,253	321,360	321,360
Wholesale & retail trade (50-52)	-4.83%	720,979	757,587	631,728
Hotels & restaurants (55)				125,859
Transport & telecommunications (60-64)	-2.97%	488,186	503,115	503,115
Financial institutions & insurance (65-67)	-8.26%	977,158	1,065,172	503,667
Real estate & Business activities (70-74)				561,505
Education (80)	3.58%	645,415	623,133	243,989
Health & social work (85)				215,006
Other community & personal services (90-93)				164,138

Source: the SWS, each year. Published figures are obtained from the KML statistics web site: http://laborstat.molab.go.kr/
Note: % difference is calculated by
(weighted number of workers in SWS / total number of workers in published figures – 1) * 100

Table A4. 1 Variables in the SWS

		1983	1989	1993	1996	1999
Year		X	X	X	X	X
Region Code	3-digit	X	X	X	X	X
Plant Identification Number		X	X	X	X	X
Industry Code	3-digit	X	X	X	X	X
Establishment Size		X	X	X	X	X
Weight		X	X	X	X	X
Union			X	X	X	X
Sex		X	X	X	X	X
Marital Status		X	X	X	X	X
Production Worker*		X	X	X	X	X
Full-time Worker**		X	X	X	X	X
Education		X	X	X	X	X
Level of Skill Certification		X	X	X	X	X
Age		X	X	X	X	X
Tenure (Year) in Firm		X	X	X	X	X
Experience in Occupation		X	X	X	X	X
Occupational Code	2-digit	X	X	X	X	X
Hierarchical Rank		X	X	X	X	X
Monthly Working Days		X	X	X	X	X
Working Hours per Month		X	X	X	X	X
Pay Basis***				X	X	X
Monthly Regular Wage		X	X	X	X	X
Overtime Wage		X	X	X	X	X
Yearly Special Bonus		X	X	X	X	X
Minimum Wage						
Obs		585,885	665,354	437,384	424,870	479,655

Source: the SWS, each year.

Note: * Production workers: 1. production worker, 2. other

** Full-time workers: 1. Full-time worker 2. Part-time worker

*** Pay basis: 1. per hour 2. per day 3. per week 4. per month 5. per year 6. piece rate

Table A4. 2 Variables for Analysis

Variables		Definition
log(Wage)		Log of hourly wage
Gender	Male	0-1 dummy variable, =1 if male
Marital Status	Married	0-1 dummy variable, =1 if married
Total Experience	Age - schooling - 6	Years of labor market experience
Experience Squared		Years of labor market experience squared
Tenure with Current Employer		Years of experience in current firm
Tenure Squared		Years of experience in current firm squared
Education		Educational attainment: Graduation from indicated level
	Elementary school or less	0-1 dummy variable
	Middle school	0-1 dummy variable
	High school	0-1 dummy variable
	Junior college	0-1 dummy variable
	College or more	0-1 dummy variable
Occupation		
	Professional workers	0-1 dummy variable
	Managerial workers	0-1 dummy variable
	Clerks	0-1 dummy variable
	Sales	0-1 dummy variable
	Service	0-1 dummy variable
	Production workers	0-1 dummy variable
Establishment Size		Number of employees
	10-29	0-1 dummy variable
	30-99	0-1 dummy variable
	100-299	0-1 dummy variable
	300-499	0-1 dummy variable
	500 or more	0-1 dummy variable
Industry (1-digit)		
	Mining & manufacturing	0-1 dummy variable
	Utility	0-1 dummy variable
	Construction	0-1 dummy variable
	Commerce	0-1 dummy variable
	Transportation	0-1 dummy variable
	Finance	0-1 dummy variable
	Social service	0-1 dummy variable
Central City	Seoul	0-1 dummy variable
	Pusan	0-1 dummy variable
	Inchon	0-1 dummy variable
	Daegu	0-1 dummy variable
	Taejon	0-1 dummy variable
	Kwangu	0-1 dummy variable
	Non-metro	0-1 dummy variable
Supervisory Intensity		ratios of production workers to managerial workers

Source: the SWS, each year.

Table A4.3 Means of Key Variables, Weighted Sample

	1983		1989		1993		1996		1999 (10 or more)	
Variable	Mean	St.dev.	Mean	St.dev.	Mean	St.dev.	Mean	St.dev.	Mean	St.dev.
log(real monthly wage)	13.107	0.630	13.449	0.496	13.934	0.514	14.131	0.513	14.128	0.529
Male	0.632	0.482	0.667	0.471	0.707	0.455	0.720	0.449	0.709	0.454
Age	29.904	9.842	32.096	9.989	34.332	10.611	35.230	10.956	35.991	10.555
Marriage	0.507	0.500	0.595	0.491	0.657	0.475	0.660	0.474	0.684	0.465
Experience (years)	13.344	10.011	14.680	10.664	16.489	11.700	16.989	12.051	17.370	11.593
Tenure (years)	3.366	3.825	4.014	4.459	4.617	5.289	4.919	5.665	5.508	5.835
Education										
Elementary	0.147	0.354	0.078	0.268	0.080	0.272	0.062	0.241	0.045	0.207
Junior high	0.354	0.478	0.257	0.437	0.176	0.381	0.139	0.346	0.118	0.323
High school	0.355	0.479	0.473	0.499	0.494	0.500	0.495	0.500	0.466	0.499
Junior college	0.033	0.180	0.058	0.233	0.071	0.257	0.094	0.292	0.120	0.324
College or more	0.110	0.313	0.135	0.341	0.178	0.383	0.210	0.407	0.251	0.434
Occupation										
Professionals	0.025	0.157	0.034	0.182	0.047	0.211	0.054	0.226	0.050	0.218
Technicians	0.019	0.137	0.015	0.121	0.033	0.179	0.042	0.200	0.062	0.241
Medical Professionals	0.010	0.097	0.014	0.118	0.016	0.125	0.016	0.124	0.021	0.143
Teachers	0.025	0.157	0.022	0.147	0.019	0.137	0.024	0.154	0.037	0.189
Other Professionals	0.005	0.073	0.005	0.074	0.046	0.210	0.055	0.228	0.097	0.296
Managers	0.041	0.198	0.043	0.202	0.040	0.197	0.040	0.196	0.046	0.210
Clerical	0.218	0.413	0.240	0.427	0.247	0.431	0.248	0.432	0.216	0.411
Salesman	0.011	0.102	0.013	0.115	0.017	0.131	0.017	0.131	0.021	0.145
Personal Service	0.043	0.204	0.048	0.214	0.022	0.148	0.027	0.163	0.025	0.156
Other production	0.114	0.318	0.114	0.317	0.111	0.314	0.107	0.309	0.102	0.302
Craft	0.250	0.433	0.189	0.391	0.085	0.279	0.044	0.205	0.041	0.197
Machine operators	0.166	0.372	0.178	0.383	0.139	0.346	0.145	0.353	0.114	0.318
Driver	0.070	0.255	0.080	0.272	0.088	0.283	0.079	0.270	0.070	0.255
Laborers and Agr. experts	0.002	0.043	0.004	0.061	0.056	0.229	0.068	0.251	0.067	0.251
Establishment size										
10-29	0.129	0.335	0.154	0.361	0.199	0.399	0.230	0.421	0.266	0.442
30-99	0.238	0.426	0.262	0.440	0.276	0.447	0.265	0.442	0.266	0.442
100-299	0.213	0.410	0.215	0.411	0.206	0.404	0.200	0.400	0.206	0.404
300-499	0.084	0.278	0.080	0.272	0.071	0.256	0.069	0.254	0.056	0.231
500 or more	0.336	0.472	0.289	0.453	0.249	0.432	0.235	0.424	0.206	0.404
Industry										
Mining & manufacturing	0.674	0.469	0.635	0.481	0.533	0.499	0.485	0.500	0.445	0.497
Utility	0.007	0.086	0.008	0.090	0.008	0.089	0.008	0.091	0.009	0.095
Construction	0.032	0.176	0.028	0.166	0.052	0.223	0.055	0.228	0.047	0.211
Commerce	0.046	0.209	0.063	0.243	0.090	0.287	0.099	0.298	0.109	0.312
Transportation	0.090	0.286	0.099	0.298	0.102	0.303	0.100	0.300	0.097	0.295
Finance and business services	0.074	0.262	0.082	0.275	0.143	0.350	0.163	0.369	0.179	0.384
Social service	0.077	0.267	0.085	0.279	0.071	0.257	0.090	0.286	0.114	0.318
Central city										
Seoul	0.323	0.468	0.316	0.465	0.226	0.418	0.264	0.441	0.255	0.436
Pusan	0.146	0.353	0.116	0.320	0.077	0.267	0.071	0.257	0.058	0.234
Inchon	0.061	0.239	0.060	0.238	0.026	0.160	0.034	0.180	0.035	0.184
Daegu	0.024	0.153	0.025	0.157	0.024	0.154	0.023	0.151	0.034	0.180
Taejon	0.020	0.139	0.021	0.144	0.027	0.163	0.022	0.146	0.032	0.175
Kwangu	0.060	0.238	0.066	0.247	0.050	0.218	0.056	0.230	0.057	0.232
Outside central city	0.366	0.482	0.397	0.489	0.569	0.495	0.530	0.499	0.530	0.499
Union			0.509	0.500	0.498	0.500	0.425	0.494	0.414	0.493
N	2,987,140		4,502,149		4,886,693		5,301,550		4,734,152	

Source: the SWS, each year.

Table A4.3 is constructed not only to investigate the consistency of the SWS but also to analyze characteristics of the population, using the weight variable, which is designed to make the data set comparable to the population. Earlier in appendix, we showed how the industrial structure of the SWS compared with the published figures. Insofar the SWS is representative of the Korean labor market, Table A4.3 identifies characteristics of the labor market.

Comparison of the weighted and unweighted statistics reveal the nonrandom structure of the SWS sampling. Means for the unweighted sample show around 50 percent of the total observations drawn from establishments of 500 or more workers, while Table A4.3 indicates only 20 to 33 percent of employees work in the firms with the corresponding establishment size. Weighting also causes a decline in the mean of trade union status.

The proportion of female in the work force is expected to be larger in the weighted sample, but the table shows little difference. This suggests that female workers may tend to work in smaller establishments that are not surveyed in the data sets.

A gradual increase in experience and tenure seems a common phenomenon in the Korean labor market from the 1980's to 1990's, but those figures are increasing at a decreasing rate. The trend is somewhat changed in 1999, when there were economy wide layoffs and few new hires as a result of the Asian financial crisis.

It is notable that industrial structure is changed dramatically, that is, we observe decreases in manufacturing and mining and increases in other industries, especially finance and business services. We decompose the finance and business services in Table A4.4, using the weighted sample. The table indicates that establishments related to the finance industry are smaller relative to the market, while insurance and real estates are bigger after the crisis. Automation and transformation of labor-intensive industries to capital-intensive ones could be an explanation of the changes in industry composition of the Korean economy.

Table A4.4 3-digit Industry Composition of Finance and Business Related Service Using the weighted SWS

Industry		Year 1983	1989	1993	1996	1999
Finance	freq	133,370	166,836	238,397	256,741	243,758
	percent	60.09	45.00	34.02	29.72	24.95
Insurance	freq	21,148	34,008	93,378	107,988	196,477
	percent	9.53	9.17	13.32	12.50	20.11
Real estates	freq	15,120	41,455	123,091	135,935	165,920
	percent	6.81	11.18	17.57	15.74	16.98
Business services	freq	52,319	128,449	245,908	363,086	371,003
	percent	23.57	34.65	35.09	42.04	37.97
N*		221,957	370,748	700,774	863,750	977,158

Note: * Total observation number is the number of workers in finance and business related service.
Source: the SWS, each year.

Table A5. 1 General results of the baseline model, Unweighted Male Sample, Dependent variable = log (real monthly wage)

	1983		1989		1993		1996		1999	
	Coefficients	Robust St Errors	Coefficients	Robust St Errors	Coefficients	Robust St Errors	Coefficients	Robust St Errors	Coefficients	Robust St Errors
Married	0.0994	0.0050	0.0384	0.0118	0.0603	0.0078	0.0745	0.0041	0.0493	0.0107
Elementary School	-0.1675	0.0086	-0.1056	0.0106	-0.1037	0.0126	-0.0446	0.0133	-0.0213	0.0121
Middle School	-0.1060	0.0056	-0.0811	0.0082	-0.0751	0.0080	-0.0686	0.0092	-0.0521	0.0087
Junior College	0.1250	0.0070	0.0781	0.0085	0.0664	0.0060	0.0615	0.0049	0.0607	0.0053
College or more	0.3844	0.0096	0.2810	0.0094	0.2275	0.0089	0.2112	0.0073	0.2244	0.0087
Experience	0.0369	0.0009	0.0296	0.0016	0.0313	0.0013	0.0317	0.0011	0.0341	0.0013
Experience squared	-0.0007	0.0000	-0.0006	0.0000	-0.0006	0.0000	-0.0006	0.0000	-0.0006	0.0000
Tenure	0.0538	0.0018	0.0374	0.0018	0.0476	0.0016	0.0503	0.0015	0.0424	0.0015
Tenure squared	-0.0014	0.0001	-0.0007	0.0001	-0.0010	0.0001	-0.0011	0.0001	-0.0009	0.0001
Union	.	.	0.0050	0.0148	-0.0283	0.0125	-0.0225	0.0114	0.0441	0.0147
Establishment size										
10 to 29	-0.2861	0.0180	-0.2689	0.0193	-0.2000	0.0193	-0.2012	0.0176	-0.1576	0.0179
30 to 99	-0.2153	0.0132	-0.2197	0.0185	-0.1346	0.0158	-0.1544	0.0163	-0.1048	0.0160
100 to 299	-0.1051	0.0124	-0.1033	0.0190	-0.0784	0.0137	-0.0974	0.0145	-0.0323	0.0140
300 to 499	-0.0496	0.0145	-0.0680	0.0179	-0.0452	0.0140	-0.0586	0.0128	.	.
500 or more	.	.	.	.	.	.	.	.	0.0553	0.0157
Central cities										
Pusan	-0.0689	0.0149	-0.0729	0.0232	-0.0030	0.0272	-0.0068	0.0234	-0.0506	0.0234
Inchon	-0.0758	0.0224	-0.0692	0.0263	0.0347	0.0243	-0.0057	0.0298	-0.0025	0.0288
Taejon	-0.1613	0.0331	-0.1301	0.0311	-0.0553	0.0338	-0.0632	0.0247	-0.0213	0.0318
Kwangju	-0.1689	0.0394	-0.0456	0.0350	-0.0754	0.0279	-0.0035	0.0283	-0.0472	0.0311
Daegu	-0.0678	0.0222	-0.0499	0.0251	0.0139	0.0290	0.0002	0.0206	-0.0751	0.0325
Outside central city	-0.0536	0.0135	-0.0260	0.0192	0.0082	0.0154	0.0179	0.0152	-0.0306	0.0159
R^2	0.6539		0.5559		0.6497		0.6650		0.6333	
N	312,152		368,107		264,565		257,875		276,704	

Source: the SWS, each year.
Note: As control variables, 3-digit industry, 14 occupations, and 3-digit regional dummies are included. The model above also contains supervisory ratio for the main analysis, which is presented in the main context.

The baseline model is corrected for clustering by establishment to adjust for group-wise heteroscedasticity. Other control variables used in the model are 3-digit industry, 14 occupations, and 3-digit regional dummy variables, and supervisory intensity.

The OLS above results shows: 1) return to education is much lower in 1989 than in 1983 but increased to the level of the returns in 1983 through the 1990's, 2) the marriage premium shows a similar pattern, and 3) the size effect on wages seems identical over time. The coefficients identifying the impact of region on wages indicates that mean wages of metropolitan cities such as Pusan, Inchon, and Daegu, as well as areas outside central cities, seem to catch up with those of Seoul over time.

The estimated union effect on wages is inconsistent over time and differs from that in other studies, but oversampling of larger establishment might result in lowering the effects. As described in the main text, the SWS was designed so it oversampled large firms, which leads percentage of union membership artificially high.

VITA

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