한국노동패널연구 2002-03

Quantile Regression Analysis of Wage Determinants in the What Determines the Wage Structure in Korean Labor Market?

2002. 8.

Byung-Joo Lee and Mary J. Lee
(Department of Economics &
Lab for Social Research University of Notre Dame)

Contents

Abstract

This paper investigates wage determinants in the Korean labor market using the recently available Korean Labor and Income Panel Study (KLIPS). This paper uses the quantile regression method for each conditional quantile wage group. Most other labor market analysis uses (mean) regression analysis, which focuses only on average statistics. Different wage groups behave differently with respect to the different socio-economic covariates. Quantile regressions allow us to examine more comprehensive pictures for different quantile wage groups. In the Korean labor market, we found that age is the most significant factor for wage determination while experience is penalized for higher quantile wage groups. Education also plays an important role for wage determination as predicted, and the return on education is quite consistent among all wage groups. However, the return to education in Korea is relatively low when compared to labor markets in the U. S. and other countries. This difference may be explained partly by the fact that the Korean education system does not provide necessary job skills for workers. Female workers are significantly underpaid compared to their male counterparts. Union premiums increase for higher quantile wage groups, but lower quantile wage groups do not appear to enjoy comparable union premiums.

Keywords : Korean labor market, Quantile regression, Korean Labor and Income Panel Study

1. Introduction

There are numerous studies on the U.S. labor markets and those of developed countries, but relatively few studies focus on labor markets of developing countries, where competitive market conditions are less established than those in the developed countries. Korea is one of the fastest growing developing countries in the world under the tightly controlled economic planning of its government. However, her economy has gone through tremendous changes since the 1997 economic crisis. The economic crisis forced the government to loosen its tight controls of the economy and adopt a more flexible and market friendly economic environment. Chaebol groups (Conglomerates) and financial systems have been restructured to make them more competitive in the new world market. Economic policies now focus more on the free market system. In the midst of this economic restructuring, one of the major changes in Korean economy occurred in the labor market, and this paper examines the labor market characteristics of Korea.

The prevailing labor practice in the Korean labor market had typically been characterized as the implicitly guaranteed lifetime employment contract between employers and employees, and Korea had very rigid labor market conditions in this regard. It was almost impossible for companies to lay-off or to fire employees to adjust to market conditions. However, as many companies went through financial turmoil during the recent economic crisis, this kind of implicit contract could no longer be a viable option for the

majority of companies. As a result, there were massive lay-offs during the company restructuring process after the economic crisis. The Korean labor market has become more flexible than before the economic crisis in order to adjust to new economic conditions. However, even after the recent industry-wide restructuring of the economy, the Korean labor market is still relatively rigid, and the wage structure is highly skewed toward a seniority system that is inequitable for the less privileged and the young, typically women and less skilled workers.

Although women consisted of less than 25% of the Korean labor forces until mid-1980, women's labor force participation has continually improved in recent years, and women made up about 37% of total Korean labor forces in the late 1990s. However, even after the steady increase in women's labor force participation, women's average wage still lags considerably behind men's average wage. According to Korean labor statistics, women's average wage for the entire industry was about 44.2% of men's wage in 1982, and it improved continuously to 56.5% in 1993 and reached to 64.8% in 2000. Even though women's wage has improved continuously in recent years, it still lags far behind men's average wage level.

The Korean labor market also favors a seniority system. Wages tend to increase as employees become older. It is natural to observe some rewards for seniority system in any labor market, but in Korea, seniority is one of the most important factors of wage determination. It becomes an even more dominant factor in higher wage groups. However, available statistics show only an absolute comparison of average wages of groups, but do not accurately explain wage differences or discrimination between groups.

This paper analyzes the complex factors of wage determination and issues of inequality in the Korean labor market using the quantile regression method. We use the recently available 1998 Korean Labor and Income Panel Study (KLIPS) for our analysis. There have been numerous studies about the gender and ethnic inequalities in the U.S. labor market. Among those, Dickens and Lang (1985, 1988) investigate the segmented labor market hypothesis for primary and secondary labor markets using "endogenous switching model with unknown regimes," by endogenizing the sector assignment of the individual worker. Heckman and Hotz (1986) examined the segmented market hypothesis using Panamanian data. Juhn, Murphy and Pierce (1993) studied wage inequalities for men, and found that the premium for skills has increased in recent years. Premiums for more highly skilled workers rose faster than those for less skilled workers. Autor, Krueger and Katz (1998), Acemoglu (2002), Bresnahan, Brynjolfsson, and Hitt (2002) investigated the effect of technological changes in the labor market and their implications for wage inequality. Katz and Autor (2000) present a fairly comprehensive survey of major empirical and theoretical developments in labor market analysis. There are also numerous Korean language papers investigating wage and gender inequalities in the Korean labor market. Among others, Kum (2001) uses 2000 KLIPS data to test the dual market hypothesis in the Korean labor market.

The majority of these studies uses the variations of regression analysis of wage determination with various socio-economic covariates. The regression analysis is typically based on conditional mean analysis, but such wage regression analysis explains only the behavior of the average income

group. However, in a typical labor market analysis, we are also interested in various different income groups as well as the average income groups. In fact, policy makers are often more interested in how a certain policy affects different income groups differently, especially lower income groups. Regression analysis of policy effects shows only the impact on the average group, when the impact on lower income groups may be completely different from the average group. In this respect, regression analysis results in only a partial and often misleading expression of policy effects. If we are interested in analyzing the effects of covariates on different income groups, we may use sub-sub-samples of income groups to estimate separate regressions for different income groups. However, if we divide the sample using arbitrary exogenous criteria, we have to deal with problems of sample selection bias for each sub-sample. We may correct the selection bias problem using Heckman's two-stage estimation procedure, but if we divide the sample into more than two sub-samples, a two-stage estimation procedure becomes more complicated.

Quantile regression analysis provides an attractive alternative estimation method to overcome various shortcomings of mean regression analysis. Quantile regression analysis does not impose arbitrary exogenous sample selection criteria to divide the sample, and we can estimate as many quantile regressions as practically possible. Moreover, since quantile regression analysis uses the entire sample to estimate each quantile, there is no sample selection bias problem. Koenker and Basset, Jr. (1978) proposed the quantile regression method to analyze the conditional quantiles of the dependent variable using covariates. Quantile regression analysis estimates the

regression function for different quantiles of the conditional wage distribution. The 50^{th} quantile regression is the familiar conditional median regression. Quantile regression analysis has several advantages over the typical mean regression estimation method. Since the quantile regression is estimated by minimizing the sum of absolute values of residuals instead of the sum of squared residuals, it is robust to heteroscedasticity, or a few extreme observations. Also, it is possible to examine different conditional quantiles of the distribution, not just the conditional mean of the dependent variable. Buchinsky (1994, 1995, 1997, 2000) has used the quantile regression method to analyze various U.S. labor market issues. The quantile regression method estimates the different responses of covariates to a wage equation in different quantiles of a wage distribution.

The next section will briefly introduce the quantile regression estimation, and present the descriptive statistics of the 1998 Korean Labor and Income Panel Study Data. Section three reports empirical estimates of wage equations of the Korean labor market using OLS regression and different quantile regressions. This section also discusses wage determination factors in different quantile wage groups, and investigates causes of wage inequalities conditional on different covariates. The last section offers conclusions and proposes possible extensions for further research.

2. Empirical Model and Data Description

Quantile regression analysis estimates different conditional quantiles of the dependent variable by minimizing the sum of absolute residuals. Koenker and Hallock (2001) is an excellent introduction of quantile regression. Following is a brief summary from Koenker and Hallock (2001).

For any random variable *Y*, the distribution function of *Y* is defined as:

(2.1) $$F(y) = \Pr(Y \le y)$$

For any $0<\tau<1$, the τ^{th} quantile is defined as:

(2.2) $$Q(\tau) = \inf\{y | F(y) \ge \tau\}$$

The quantiles can be formulated as the solution to a simple optimization problem. For any $0<\tau<1$, define the piecewise linear check function, $\rho_\tau(u) = u \cdot (\tau - I(u<0))$, where $I(\lambda)$ is an indicator function, which returns to one if λ is true and zero otherwise. Then, the τ^{th} sample quantile of *Y* can be found by solving

(2.3) $$\xi(\tau) = \arg\min_{\xi \in \Re} \sum_{i=1}^{n} \rho_\tau(y_i - \xi)$$

If $\tau=1/2$, this will become the minimization of the sum of absolute deviations from the quantity ξ, and its minimizer is the sample median. In a typical regression model, the linear conditional quantile function, $Q_Y(\tau | X = x) = x_i'\beta$, can be estimated by solving,

(2.4) $$\hat{\beta}(\tau) = \arg\min_{\beta \in \Re^p} \sum_{i=1}^{n} \rho_\tau(y_i - x_i'\beta)$$

For τ=1/2, this regression estimate will become the median regression.

In this paper, we will follow the human capital theory for wage determination, and adopt the basic Mincerian (1974) wage equation. That is, the natural log of the wage is a function of individual skills, and individual skills are measured as the level of education, age and job experience. Other socio-economic covariates are also included as in the wage equation.

(2.5) $$\ln w_i = x_i'\beta + \varepsilon_i$$

In w_i is the natural log of average monthly wage as a dependent variable, and x_i is a vector of explanatory variables including years of education, age, age squared, years of current job experience, square of job experience, full-time status, occupation types, marital status, gender, union status, metropolitan location and area of birthplace origin.

For U.S. labor market analysis, individual age and experience tend to be highly correlated in regression analysis. Therefore, wage equations typically include only one of them, usually experience (and its square). However, in the Korean labor market, seniority plays a critical role for wage determination, and experience and age do not appear highly correlated. In KLIPS 1998 for a Korean labor market, the age and job experience are correlated with a correlation coefficient of 0.42. Therefore, in this paper, we include age (and its square) in addition to experience for the wage equation, and we examine their roles in Korean labor market. The wage equation also includes the origin of birthplace variable. This is another unique feature of the Korean labor market. In Korean society, there is a widespread perception that people from different regions, especially those from KyungSang-Do area and Cholla-Do area do not get along well in various walks of social life.

Regionalism is also closely tied to school affiliations. Even with conscientious efforts by the government to ameliorate regional hostility, this problem is so deeply rooted throughout a long history and will not go away anytime soon. Currently, various social groups and political parties are formed along regional lines. Such a deeply rooted regional antagonism in Korean society is considered to be similar to racial tension in U.S. society. So it is interesting to investigate whether regional antagonism plays any significant role in the labor market for wage determination.

This paper uses recently available data from the Korean Labor and Income Panel Study (KLIPS). The Korea Labor Institute began to collect detailed starting data for households and individuals starting in 1998. This data collection is modeled after and is similar to the Panel Study of Income Dynamics (PSID) from the University of Michigan. This paper uses data for the 1998 cohort, the first year of its collection. There are 13,738 individual observations in 1998 KLIPS. Among those, we selected those who are currently employed and have positive average monthly income. Therefore, we exclude those who are currently self-employed or unemployed. This reduces our sample size to 4,012 individual observations. We also excluded missing values for any of the explanatory variables used in our analysis. The resulting observations for our analysis total 3,702. The following table summarizes statistics for our data.

The wage variable is an average monthly wage expressed as Korean Won (KRW) in 10,000 Won units (the exchange rate was approximately KRW 1,300/US $1.00 as of March 2002). Average monthly wage income for 1998 is KRW 1.11 Million (approximately US$862). Monthly wage

Table 1: Summary Statistics of Variables

Variables	Observations	Mean	Std. Dev.	Minimum	Maximum
Wage	3966	111.09	64.80	4.00	600.00
Log(wage)	3966	4.55	0.59	1.39	6.40
Education	3739	12.80	4.04	1.00	21.00
Age	4012	37.15	11.13	15.00	76.00
Job Experience	3714	5.74	6.91	0.00	43.00
Total Jobs	4009	2.27	1.42	1.00	10.00
High White	3957	0.24	0.43	0.00	1.00
Low White	3957	0.31	0.46	0.00	1.00
High Blue	3957	0.24	0.42	0.00	1.00
Low Blue	3957	0.22	0.41	0.00	1.00
Origin1	4008	0.31	0.46	0.00	1.00
Origin2	4008	0.29	0.46	0.00	1.00
Origin3	4008	0.21	0.41	0.00	1.00
Origin4	4008	0.19	0.39	0.00	1.00
Region1	4012	0.29	0.45	0.00	1.00
Region2	4012	0.49	0.50	0.00	1.00
Region3	4012	0.22	0.41	0.00	1.00
Female	4012	0.37	0.48	0.00	1.00
Married	4011	0.72	0.45	0.00	1.00
Union	4012	0.15	0.36	0.00	1.00

income ranges from KRW 40,000 to KRW 6,000,000 (from US$31 to US$4,615), which represents the broad range of cross sectional wage groups. Education is measured as the total number of years of schooling. The education variable is available only as a category variable in KLIPS, based on levels of attainment, such as graduation from elementary school, middle school, high school, and college, etc. We calculated years of education by subtracting the year of birth plus seven from the total number of years of educational attainment. This variable is top-coded at 21 years of education.

Age is measured in years. Job tenure is the total number of years of current job experience, and the total number of jobs is measured as the total number of jobs held since entering the labor force including the current one. As we mentioned before, the traditional Korean job market is highly inflexible and the lifetime employment concept is widely held by employees as well as employers. Therefore, total number of jobs held by the majority of workers is less than or equal to two including the current one, and the distribution of this variable is highly skewed to the right. However, surprisingly, the average years of current job experience is only 5.7 years. Given the lifetime employment circumstances in Korean labor markets, it is hard to rationalize this low average total years of job experience. This anomaly may be partly explained by the 1997 Korean economic crisis. Since these data were collected in 1998, this variable may reflect the effect of massive lay-offs by previous employers.

We defined four categories of occupational types: highly skilled white-collar, lower skilled white-collar, highly skilled blue-collar and lower skilled blue-collar jobs. Highly skilled white-collar occupations include government officials, professionals, and scientists. General clerical workers and service sector employees belong to the lower skilled white-collar occupation. Farmers, fishermen and skilled technical workers belong to the highly skilled blue-collar group. Lower skilled blue-collar occupations include simple laborers and less skilled technical workers. Origin variables are dummy variables representing four regions of birthplace origin. There are two measures for birthplace origin variable in KLIPS. The first one is the actual place of birth identified in the questionnaire, and the second is the

respondent's hometown at age 14. These two variables are closely correlated with a correlation coefficient of 0.71. We use the second response, i.e., hometown at age 14, because this variable more closely identifies individuals' origin as well as school ties. Origin1 is for KyungSang-Do region including Busan, Daegu, Ulsan metropolitan areas and KyungBuk and KyungNam provinces. Origin2 includes Seoul, Incheon metropolitan areas, and KyungGi province. Origin3 is for Kwangju metropolitan, ChollaNam-Do, ChollaBuk-Do, and Jeju-Do area. Origin4 includes Daejeon metropolitan area and ChungCheongNam-Do, ChungCheongBuk-Do, KangWon-Do and the rest of Korea including the North Korean region. Regional variables are also dummy variables equivalent to the SMSA specification for the U.S. data. Seoul is the largest city in Korea, and more than 30% of the Korean population lives in the Seoul metropolitan area. Social and economic activity in Seoul seems to be different than in other parts of Korea. Therefore, Region1 is only for Seoul metropolitan area. Region2 is for other large metropolitan areas excluding Seoul. These include Busan, Deagu, Daejeon, Incheon, Kwangju, Ulsan metropolitan areas, and KyungGi province. Region3 includes all other provincial areas. Women comprise 37% of the Korean labor forces. Seventy-two percent of the labor forces are married and 15% of workers are labor union members. The next section reports empirical results and discusses several interesting findings about the Korean labor market.

3. Empirical Results

3.1. Simple Regression Analysis

Before reporting quantile regression results, for purposes of comparison we first report results of OLS regression estimates of the wage equation. We estimated several different models of the Mincerian wage equation of (2.5). Model 1 is the basic wage equation using the years of education as the only skills variable. Model 2 includes education and experience and experience squared. Model 3 is an expanded wage equation with education, experience (and its square), total number of jobs held, full-time status, job types, birthplace origin, region, marital status, gender and union status. Model 4 adds age and age squared to Model 3. All four models are estimated by heteroscedasticity consistent ordinary least squares method. Table 2 reports the estimation results of four models.

For the occupation category variable, highly skilled white-collar workers are the base group for comparison with other occupational categories. For the origin variable, Origin1, KyungSang-Do origin, is excluded as the base group. Seoul metropolitan area is used as the base group for Region1. From the estimation results, we can see that education, age and job experience have a positively significant impact on wage determination. Return on education ranges from 6.5% to 2.4% depending on model specification.[1)]

1) Since the dependent variable is the natural log form, the coefficient for education

Table 2: OLS with Heteroscedasticity Consistent Standard Errors

	Model 1		Model 2		Model 3		Model 4	
	Coeff.	Std. Error	Coeff.	Std. Error	Coeff.	Std. Error	Coeff.	Std. Error
Intercept	3.7643*	0.0281	3.6759*	0.0282	4.0606*	0.0548	3.4426*	0.1137
Education	0.0627*	0.0020	0.0523*	0.0020	0.0267*	0.0023	0.0240*	0.0023
Age			-	-	-	-	0.0400*	0.0057
Age2			-	-	-	-	-0.0005*	0.0001
Experience			0.0558*	0.0030	0.0351*	0.0029	0.0302*	0.0030
Experience2			-0.0010*	0.0001	-0.0006*	0.0001	-0.0003*	0.0001
Total Jobs					0.0142*	0.0057	0.0134*	0.0058
Full time					0.2822*	0.0235	0.2835*	0.0232
Low White					-0.1440*	0.0195	-0.1476*	0.0196
High Blue					-0.2200*	0.0242	-0.2334*	0.0241
Low Blue					-0.3418*	0.0263	-0.3238*	0.0267
Origin2					0.0429*	0.0186	0.0383*	0.0185
Origin3					-0.0173	0.0200	-0.0195	0.0196
Origin4					0.0110	0.0195	0.0066	0.0192
Region2					-0.0525*	0.0170	-0.0563*	0.0168
Region3					-0.0845*	0.0219	-0.0894*	0.0215
Female					-0.3672*	0.0173	-0.3669*	0.0169
Married					0.1235*	0.0167	0.0760*	0.0229
Union					0.0653*	0.0177	0.0568*	0.0178
Observations	3702		3445		3388		3388	
R2	0.1904		0.4515		0.5158		0.5296	
Log-likelihood	-2853.49		-2146.83		-1629.59		-1580.51	
Standard Error	0.5230		0.4512		0.3914		0.3858	

* statistically significant at 5%

** statistically significant at 10%

Age and experience have increasing returns on wage with a decreasing rate. Full time workers earn about 29.6% more than those who work less than full

variable represents the growth rate, i.e., rate of return of education for an additional year of education.

time.[2] Lower skilled white-collar workers, highly skilled blue-collar workers, and lower skilled blue-collar workers make 13.6%, 20.8% and 27.7% less, respectively, than the highly skilled white-collar workers. The estimate for origin 2 for Seoul, Incheon and KyungGi province area is statistically significant and positive at the 5% significance level while origin2 and origin3 estimates are not statistically significant. While those who were born in origin 2 earn 4.4% and 3.9% more than Model 3 and Model 4, respectively, when compared with those in the base group (Origin1), we did not find statistical evidence of wage differentiation between the base group and Origin3. There do not seem to be economic disadvantages for those from Cholla-Do area compared to the KyungSang-Do area. Those who live in the outside of the Seoul metropolitan earn from 5.5% to 8.6% less than those who live in the Seoul metropolitan area, respectively. Women make 30.7% less than men when controlling for all other socio-economic variables such as education, age, etc. This clearly shows that women are paid less than men with similar job qualifications. We investigate this more in greater detail later using the quantile regression method. Married workers make 7.9% more than non-married workers, and union workers in Korea make about 5.9% more than non-union workers.

One interesting finding of this analysis is that the estimated rate of return on education is only about 6.5%-2.4% for an additional year of education depending on different models. In comparison, Buchinsky (1994),

2) Dummy variable coefficient is an approximate measure of difference between the reference group and the comparison group. The accurate measure of difference between groups is calculated as exp(coefficient)-1.

using 25 years of U.S. Current Population Survey (CPS) data for 1963-1987, found that the rate of return on education has increased steadily from 6.65% in 1963 to 9.63% in 1987. Other empirical studies for more recent U.S. labor markets also report between 8-10% return for an additional year of education. Considering that our data are from the 1998 survey, it appears that the education rate of return on education in Korea is quite low compared to typical U.S. results. It is typical to observe a return on education that is inversely related to the degree of economic development. Though Korea is a developing country that is obviously less developed than the U.S., it has a lower return on education. Bils and Klenow (2000) have a table of international comparison of return on education, mostly cited from the work of Psacharopolous (1994). Korea has 10.6% return on education for 1987 data, where U.S. has 9.3% return on education for 1989 data. The U.S. seems to have a stable return on education while the Korean return has decreased from 1987. One possible explanation for this low measured return on education may be the inclusion of an age variable in our wage equation. As mentioned before, seniority plays a critical role for wage determination in the Korean labor market, and the age variable may capture some effects of education on wage determination. To estimate the rate of return on education net of age effects, Model 3 excludes age (and its square) from the wage equation. The estimation results of Model 3 are qualitatively similar to those of Model 4. The suspected age effect on the rate of return on education did not materialize. The rate of return on education increased slightly from 2.4% to 2.7%, but we did not achieve the 8-10% return rate on education observed in the recent U.S. labor market analysis.

The low return on education in the Korean labor market is consistent with other studies using similar KLIPS data. Kum (2001) analyzes 2000 KLIPS, and reported a 4.66% return on education. However, the low return rate on education in the Korean labor market does not seem to be consistent with the high levels of educational aspiration in Korean society. Koreans consider educational achievement as one of their highest priorities, and they think that higher education is the guaranteed ticket to high paying jobs and their upward social mobility. Contrary to common belief, the return on education is relatively low compared to the U.S. labor market, as the estimation results show here, and the Korean labor market seems to value educational achievement less than the U.S. labor market does. There may be two possible explanations for this phenomenon. First, education is typically used as a proxy for skills in a wage equation. But in Korea, more education does not necessarily equate to more job skills. In fact, education has relatively low job productivity compared to the U.S. labor market. There are heated discussions these days in Korea about the adequacy of education in the schools to provide the job skills to meet actual demands in the workplace.

Even for highly educated college graduates, employers often complain that they have to invest extra time and money to retrain new hires to make them productive for their companies. Recently, there have been various policy initiatives by the government to forge a closer industry-academic relationship, so that new hires can be put into productive usage immediately. The second explanation could be the paradoxical reality of highly educated Korean work forces. Since the average education level in Korea is relatively

high (12.8 years, close to the completion of the first year of college education), the marginal increase in productivity from an additional year of education may not contribute to a significant wage improvement. This is the so-called education inflation in Korean labor market. During the 1970s when the returns on education declined in the U.S. labor market, Freeman (1976) concluded that "Americans are over-educated." Koreans may be over-educated for the current state of the Korean economy. It is widely believed in Korea that you cannot obtain decent employment without a college education, and to secure a good respectable job, additional post-graduate education is a necessary requirement. The real answer to the low return on education in the Korean labor market could be the combination of these two and other unexplained phenomena. We shall investigate this issue in greater detail later.

3.2. Quantile Regression Analysis

The above analyses are all based on mean regression analysis, which estimates the average wage equation conditional on the covariates. We shall now consider the more detailed analysis of the wage equation using the quantile regression method. Quantile regression analysis estimates the wage equation in various conditional quantiles of wages. Therefore, we can develop more detailed and accurate information from the wage equation in all different levels of wage groups. We estimate Model 4 using 10 different quantile levels, 5%, 15%, 25%, 35%, 45%, 55%, 65%, 75%, 85%, and 95%. Median regression (50^{th} quantile regression) on the 50% quantile is also

reported. Table 3 reports selected quantile regression results for 5th, 25th, 50th (median), 75th, and 95th quantiles.[3] All quantile estimates are qualitatively similar to the OLS results, and the median regression results are very close to the OLS estimates. Figures 1 to 9 plot coefficients of education, age, job experience, occupation types, regions, and gender for each quantile regressions. For education, the coefficient is the rate of return of additional years of education. For age and job experience, linear coefficients are plotted for each quantile. Figures 10 to 12 present conditional quantiles of wages on education, age and experience.

From Table 3 and Figure 1, we can see that the rate of return on education remains fairly constant (less than 3%) up to the 85% quantile and increases slightly in the 95% quantile (3.3% in the 95th quantile). Thus we conclude that the return on education is relatively stable across all wage quantiles. As mentioned before, the rate of return on education in the Korean labor market is not only low compared to the return in the U.S. labor market, it also does not appear to improve significantly at different quantiles. The return on education remains relatively low throughout all quantile levels. Buchinsky (1994) reports that the educational return at the 90th quantile in 1987 is 11% while the return at the 10th quantile is about 8.7%. In the Korean labor market employers do not readily recognize education as an indicator of productive job skills. Given these circumstances, we used two other proxy variables to measure job skills, age and current job experience.

Figure 2 plots the linear coefficient of the return on age. Unlike the return on education, the return on age improves from a relatively low 2%

3) Results from all quantile regressions will be provided upon request.

in lower quantiles to 4.5% in the 85th quantile and 4.2% in the 95th quantile. This shows that age plays a more important role than education for wage determination in Korean labor market. Figure 3 is the return on current job experience, which has a downward trend from the lower quantile to the higher quantiles. This is a peculiar characteristic of the Korean labor market. Unlike the U.S. labor market, experience is less valued in the higher wage groups than in the lower wage groups. Figure 4 combines all three skills variables together in one graph. We can see that the gap between these three variables remain stable for the lower to middle wage groups, but as we move to the higher wage groups, the gap widens significantly, and age becomes the most important factor for wage determination while experience gets less important. It is clear from Figure 4 that among three important skills variables, return on age is higher than those of other variables in almost all quantile levels. In fact, the return on education remains lowest among three skills variables except the 95th quantile where the return on the experience is smaller than that of education. To investigate the impact of skills variables on wage equation, we constructed the conditional quantile regression functions for three skills variables conditioned on other variables. Figure 10, Figure 11 and Figure 12 plot the conditional quantile regressions (linear on education, and quadratic on age and experience) of three skills variables evaluated at the sample means of explanatory variables. For example, Figure 10 plots conditional quantiles of natural log of (monthly) wage as a linear function of education conditioning on the sample means of 37.2 for age, 5.7 for job experience, 2.3 for total number of jobs held, and those who were born in KyungSang-Do area, live in the Seoul metropolitan area, married,

and have non-union, fulltime, high skilled white-collar jobs. Figure 11 and Figure 12 are similarly constructed using the sample mean of 12.8 years for education with the same socio-economic characteristics of Figure 10. Figure 10 and Figure 11 plot the conditional quantiles of natural log of wage as a quadratic function of age and experience, respectively.

From Figure 10, we can observe that the role of education for wage determination is fairly symmetrically distributed. The conditional distribution of wage on education is fairly symmetric up to the 10 to 15 years of education, and as level of education increases close to 20 years, it becomes more clustered around the mean and skewed to the right. This explains the increasing role of education in the higher wage group that we observed from Figure 1. The wage gap between each quantile (25^{th}, 50^{th} and 75^{th}) remains fairly constant across all education levels. Figure 11 shows similar conditional distributions of wage on age. As expected, age has a quadratic relationship on the wage determination. The gap between different quantile is relatively stable except for the very young age group. However, the gap between the 85^{th} and 95^{th} quantiles becomes wider across all age levels, indicating that age is the most important factor for wage determination in the highest wage group. If age is considered as a good proxy for job experience and higher productivity, this phenomenon can be easily understood. However, as we can see from Figure 3, the return on job experience actually decreases in the higher quantiles, and the gap between different quantiles narrows as we move to the longer periods of job experiences in Figure 12. For higher wage groups, experience does not seem to be valued for wage determination, and age dominates all other productivity characteristics of

workers. This is one of the inefficiencies of the typical Korean labor market, where older workers are paid more than young workers regardless of their productivity.

One surprising aspect of the wage and age profile is that the age of peak earnings ranges from 30 to 38 years old across all quantiles except the 95th conditional distribution where the peak earnings age occurs at 42.6 years old. The peak earnings age calculated from OLS regression is also about 38.3 years old. These results are similar to the estimate calculated by Kum (2001) using the 2000 KLIPS. Figure 5 shows the peak earnings age for all quantiles calculated from Figure 11. This is a stark comparison of U.S. labor market where the peak earnings age is around 46 years old according to 2000 March CPS data. This shows one fragile aspect of Korean labor market characteristics. Working lifespan of average Korean workers is very short considering that they have long periods of education and most men have to serve at least 2 years in military obligation before their full-fledged entry into the labor force. They reach their peak earnings age relatively quickly, then they are forced to retire early in their middle 50s. In fact, it is very rare to find anyone employed beyond the age of 60. However, as we have observed from the wage-age profile, older workers are paid more than young workers. These two phenomena seem to contradict each other. To reconcile these seemingly contradictory phenomena, we need to understand the hierarchical nature of the Korean labor market. In Korea, there is fierce competition among young workers to be promoted to the higher positions, and promotions are largely based on seniority as well as on contributions to the company. Therefore, the majority of high level managers are older

workers in their 60s; others who failed to be promoted are gradually weeded out before they reach their 60s. Because of this process, there are only a handful of successful high-level managers, while the majority of older workers is forced into early retirement.

Figure 6 shows the wage differentials among four different occupation types. As expected, white-collar workers are paid better than the blue-collar workers and the highly skilled workers are paid better than the lower skilled workers across all wage groups. We also observe that the wage differentials gaps among different types of occupations widen as we move to the higher wage groups. Lower skilled white-collars, highly skilled blue-collars, and lower skilled blue-collars are paid 8.8%, 18.0%, and 23.9% less than the highly skilled white-collar workers, respectively in the 15^{th} quantile distribution, but they are paid 20.3%, 29.0% and 33.0% less than the highly skilled white-collar workers, respectively in the 95^{th} quantile. This shows the widening wage inequality as we move to the higher wage groups. Figure 7 presents the wage difference in the different areas. Workers living in either region2 or region3 (outside of the Seoul metropolitan area) make anywhere between 1.8% and 11.8% less than those living in region1, and the gap increases as we move to the higher wage groups except the 5^{th} quantile. Figure 8 shows how female workers fare compared to male workers. Female workers are paid 30.7% less than male workers at the 5^{th} quantile. Though the female wage steadily increases in the higher wage groups, women are still paid 24.5% less than male workers at the 95^{th} quantile. The gradual improvement of the female wage is primarily due to the greater labor force participation of highly educated young women in recent years.

Finally, Figure 9 presents the impact of union membership on wage determination. Union workers earn 3.3% more at the 5th quantile and 9.9% more at the 95th quantile. One interesting finding from this result is that the union premium tends to increase as we move to the higher wage groups with the exception of the 75th and 85th quantiles. Union premiums for two lower quantiles, 5th and 15th quantiles, are not statistically significant while all other union premiums are statistically significant at a 5% significance level. This seems to be a very peculiar characteristic of the Korean labor market. Generally, labor unions are popular and typically organized in the lower wage groups, which are dominated by the blue-collar workers in order to protect their job security and wages. Therefore, typical union premiums may be higher in lower wage groups and tend to decrease as we move to higher wage groups. However, we observe the exact opposite for union premiums in the Korean labor market. The union premiums for the lower wage groups are not even statistically significant.

The role of labor unions is one of the serious debates in Korea these days. It is often argued that the militant labor unions are pushing unreasonably hard to demand higher wage increases and other economic incentives even for already well-paid workers. The statistical evidence from our quantile regressions seems to support this argument. The most vocal and militant labor unions in Korea represent relatively well-paid factory workers and white-collar workers who already belong to the middle and higher wage groups. Labor unions are widely spread and well organized in almost every sector of the Korean labor market. Just a few examples of such labor unions include the teachers union, medical workers union, financial workers union,

etc, not to mention the unions representing blue-collar factory workers. They all represent relatively well-paid workers in the Korean labor market. However, the lower wage groups who desperately need union protection for their basic survival do not seem to have well-organized union representation, and their wages do not appear to improve significantly with the union participation. As much as the current status of labor unions could be a significant stumbling block for the future prosperity and well being of the Korean economy, it is also a very serious concern that the lower quantile wage groups are not well protected by their union representation.

4. Conclusion

This paper investigates the Korean labor market using the recently available Korean Labor and Income Panel Study (KLIPS) for 1998. We utilized quantile regression analysis to develop a more detailed picture of various factors in wage determination and explain how individual variables affect different income groups differently. Unlike OLS analysis that describes only average statistics, quantile regression analysis provides a more detailed and accurate explanation of wage determination in different wage groups.

This paper also reports several unique characteristics of the Korean labor market. We discovered that education does not always appear to provide the necessary job skills, so that the return on education is fairly low compared to the U.S. labor market. Age, on the other hand, is one of the most important factors for wage determination especially for the higher wages groups. Moreover, Korean workers reach their peak earnings age very quickly as they are forced to retire at an early age. Experience is not very highly valued and is even depreciated in higher wage groups. As expected, highly skilled white-collar workers are better paid than other occupational types, and those living in the Seoul metropolitan area earn better wages than those living in other areas. Female workers are significantly underpaid compared to their male counterparts. Premiums for union membership increase for higher quantile wage groups, but lower quantile wage groups do

not appear to have a desperately needed union protection.

We have also examined the wage determination factors for the cross section of conditional wage distributions. We found that the various wage-determining factors have differing impacts on different wages groups. However, this analysis does not directly examine the possibility that the different wage groups have different mechanisms for wage determination, as postulated in the so-called labor market segmentation theory. Doeringer and Piore (1971) first introduced the labor market segmentation theory, and Dickens and Lang (1985, 1986), Van der Gaag and Vijverberg (1988), Boston (1990) and others have rigorously tested the dual labor market theory empirically. We would like to investigate the dual labor market theory using Korean labor market data with the enhanced econometric methods.

Table 3: Selected Quantile Regression Results

	5th Quantile	25th Quantile	50th Quantile	75th Quantile	95th Quantile
Intercept	3.0260*	3.3003*	3.6617*	3.6461*	3.8926*
Education	0.0222*	0.0240*	0.0231*	0.0236*	0.0331*
Age	0.0213**	0.0336*	0.0314*	0.0436*	0.0418*
Age2	-0.0003*	-0.0005*	-0.0004*	-0.0006*	-0.0005*
Experience	0.0421*	0.0300*	0.0299*	0.0283*	0.0247*
Experience2	-0.0007*	-0.0003**	-0.0002*	-0.0002**	-0.0003
Total Jobs	0.0069	0.0025**	0.0229*	0.0265*	0.0291*
Full time	0.6471*	0.3197*	0.2299*	0.1798*	0.1334*
Low White	-0.0952**	-0.1189*	-0.1642*	-0.1639*	-0.2270*
High Blue	-0.2137*	-0.2006*	-0.2494*	-0.2366*	-0.2542*
Low Blue	-0.2802*	-0.2870*	-0.3217*	-0.3450*	-0.4001*
Origin2	-0.0688	0.0361*	0.0310**	0.0477*	0.0564
Origin3	-0.0812**	-0.0374	-0.0246	-0.0195	0.0656
Origin4	-0.0173	0.0178	0.0045	-0.0038	0.0279
Region2	-0.0675**	-0.0250*	-0.0539*	-0.0610*	-0.0962*
Region3	-0.1201*	-0.0616*	-0.0771*	-0.0726*	-0.1255*
Female	-0.3810*	-0.3458*	-0.3587*	-0.3399*	-0.2807*
Married	0.0870	0.0781*	0.1118*	0.1144*	0.1102*
Union	0.0325	0.0619*	0.0754*	0.0752*	0.0948*
Observations	3388	3388	3388	3388	3388
Pseudo-R2	0.2964	0.3392	0.3485	0.3490	0.3278

Standard errors are calculated using the bootstrap method, and they are not reported here. Standard errors will be provided upon request.

* statistically significant at 5%

** statistically significant at 10%

Figure 1: Education

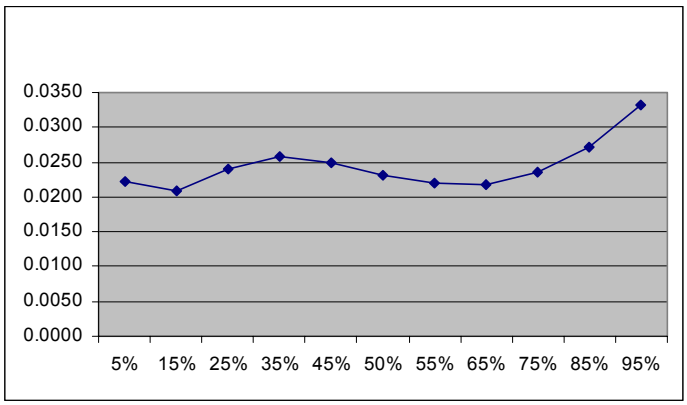


Figure 2: Age

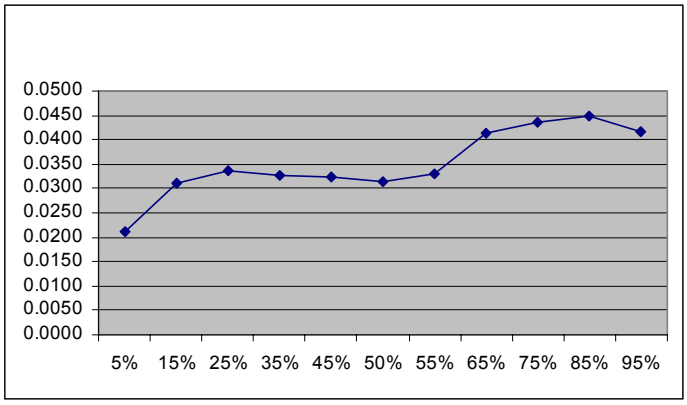


Figure 3: Years of Job Experience

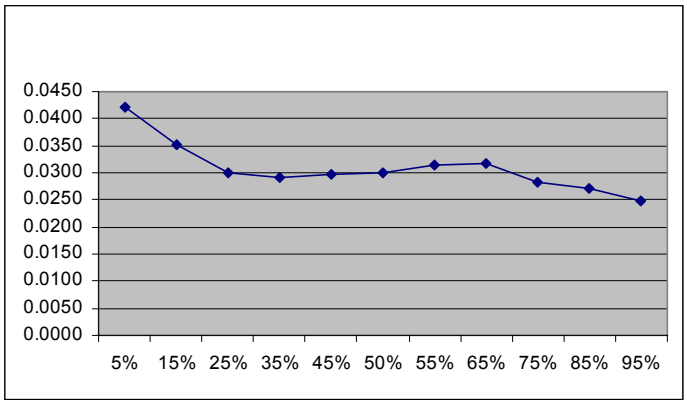


Figure 4: Education, Age & Job Expericnce

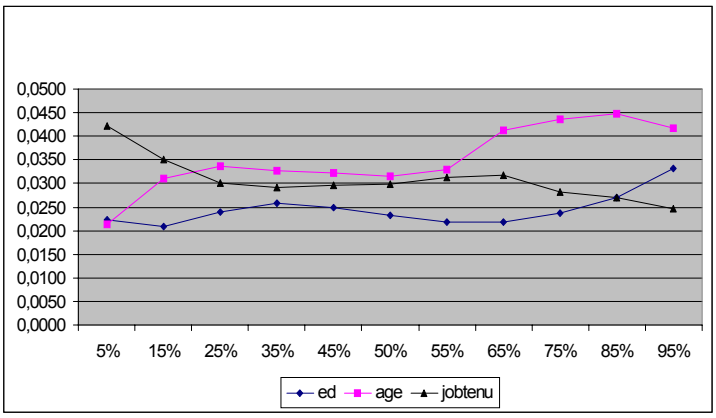


Figure 5: Age of Peak Earnings

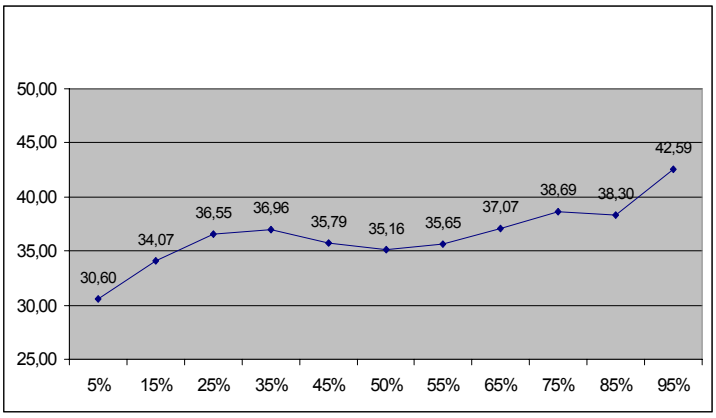


Figure 6: Occupation Types

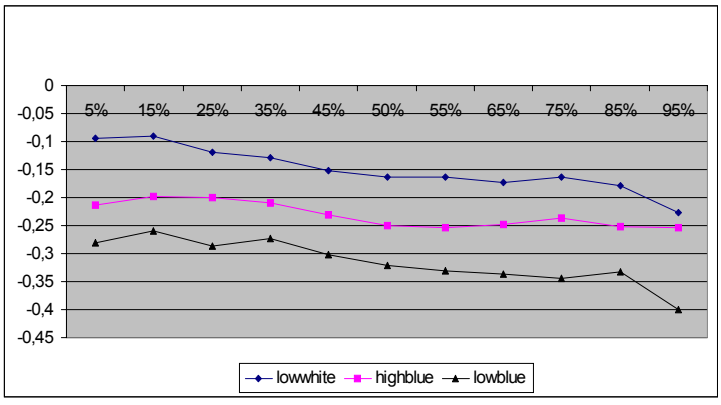


Figure 7: Regional Wage Differences

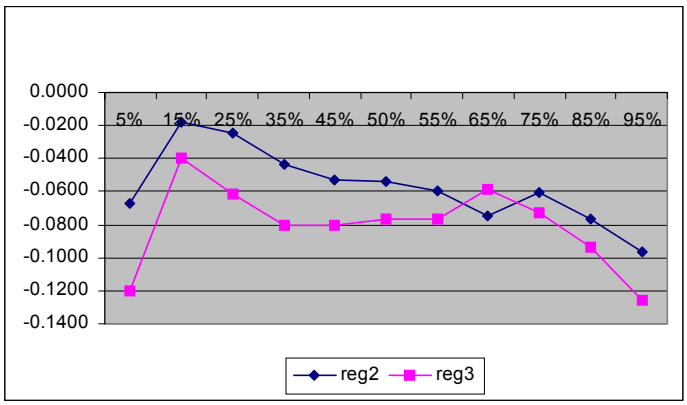


Figure 8: Female Wages

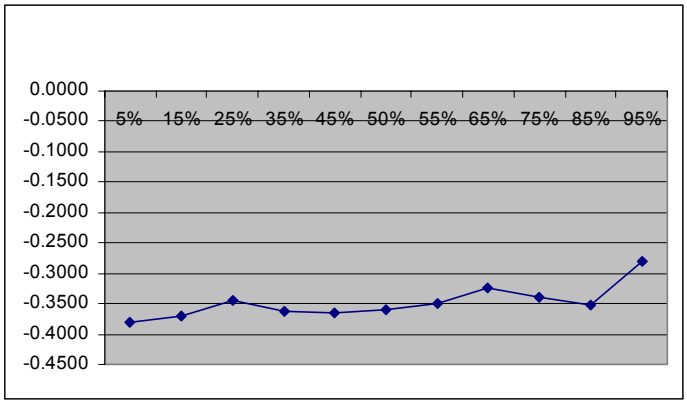
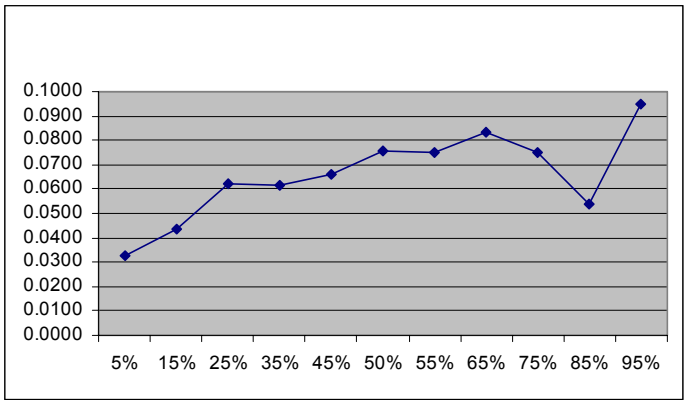
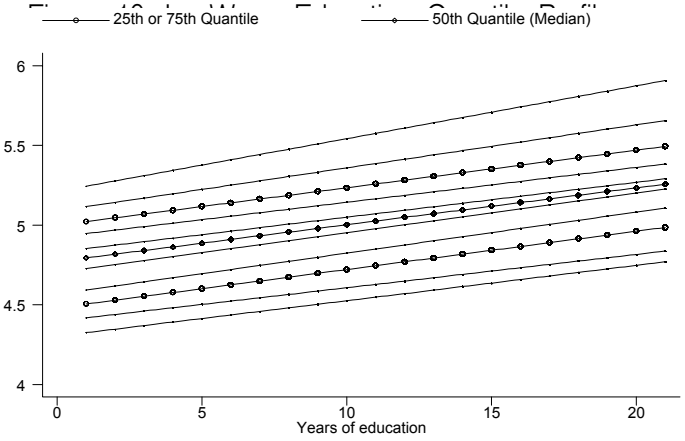
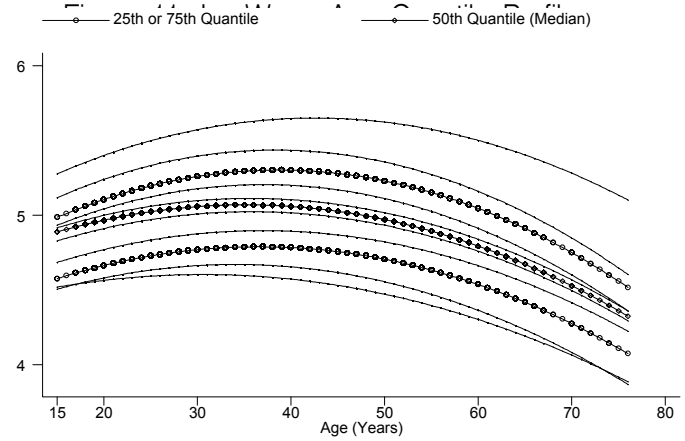
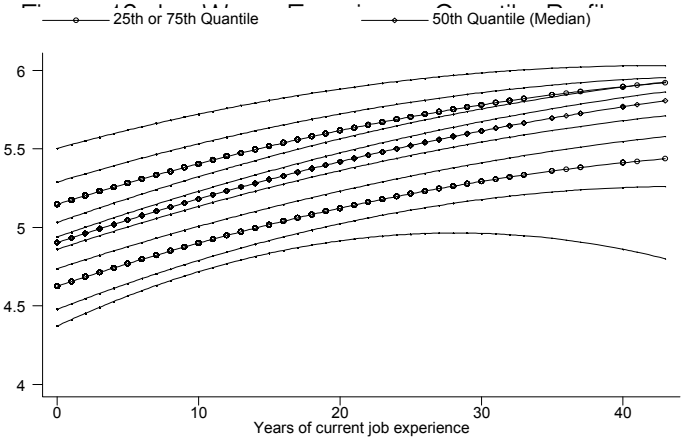


Figure 9: Union




25th or 75th Quantile
50th Quantile (Median)
6
5.5
5
4.5
4
0
5
10
15
20
Years of education


25th or 75th Quantile
50th Quantile (Median)
6
5
4
15
20
30
40
50
60
70
80
Age (Years)


25th or 75th Quantile
50th Quantile (Median)
6
5.5
5
4.5
4
0
10
20
30
40
Years of current job experience

References

Acemoglu, D. (2002), “Technical Change, Inequality and Labor market,” Journal of Economic Literature, XL, 7-72

Autor, D., A. Krueger and L. Katz (1998), “Computing Inequality: Have Computers Changed the Labor Market?” Quarterly Journal of Economics, v.114, 1169-1213

Bils, M., and P. Klenow (2000), “Does Schooling Cause Growth?” American Economic Review, v.90, 1160-1183

Boston, T. (1990), “Segmented Labor Markets: New Evidence from a Study of Four Race-Gender Groups,” Industrial and Labor Relations Review, v.44, 99-115

Bresnahan, T., E. Brynjolfsson, and L. Hitt (2002), “Information Technology, Workplace Organization, and the Demand for Skilled Labor: Firm Level Evidence,” Quarterly Journal of Economics, v.118, 339-379

Buchinsky, M. (1994), “Changes in the U.S. Wage Structure 1963-1987: Application of Quantile Regression,” Econometrica, v.62, 405-458

Buchinsky, M. (1995), “Quantile Regression, the Box-Cox Transformation Model and U.S. Wage Structure 1963-1987,” Journal of Econometrics, v.65, 109-154

Buchinsky, M. (1997), “Women’s Return to Education in the U.S.: Exploration by Quantile Regression,” Journal of Applied Econometrics,

v.13, 1-30

Buchinsky, M. (2000), “Quantile Regression with Sample Selection: Estimating Women’s Return to Education in the U.S.,” Empirical Economics, forthcoming

Dickens, W., and K. Lang (1985), “A Test of Dual Labor Market Theory,” American Economic Review, v.75, 792-805

Dickens, W., and K. Lang (1988), “Labor Market Segmentation and the Union Wage Premium,” The Review of Economics and Statistics, v.70, 527-530

Doeringer, P., and M. Piore (1971), *Internal Labor Markets and Manpower Analysis,* Lexington, MA, Lexington Books

Freeman, R. (1976), *The Over-educated American*, New York, Academic Press

Heckman J., and J. Hotz (1986), “An Investigation of the Labor Market Earnings of Panamanian Males Evaluating the Source of Inequality,” Journal of Human Resources, v.21, 507-542

Juhn, C., K. Murphy, and B. Pierce (1993), “Wage Inequality and Rise in Returns to Skill,” Journal of Political Economy, v.101, 410-442

Katz, L., and D. Autor (2000), “Changes in the Wage Structure and Earnings Inequality,” *Handbook of Labor Economics,* vol.3, Ashenfelter, O. and D. Card eds., Elsevier, Amsterdam, Netherlands

Kum, J.H. (2001), “Dual Labor Market and Sex Discrimination,” Korea Labor Institute Working Paper (written in Korean and the title translated)

Mincer, J. (1974), *Schooling, Experience and Earnings*, New York,

National Bureau of Economic Research

Koenker, R., and G. Bassett (1978), “Regression Quantiles,” Econometrica, v.46, 33-50

Koenker, R., and K. Hallock (2001), “Quantile Regression,” Journal of Economic Perspectives, v.15, 143-156

Psacharopoulos, G. (1994), “Returns to Investment in Education: A Global Update.” World Development, v.22, 1325-1343

Van der Gaag, J., and W. Vijverberg (1988), “A Switching Regression Model for Wage Determination in the Public and Private Sectors of Developing Country,” The Review of Economics and Statistics, v.70, 244-252