연 구 논 문

Temporary-permanent Contracts' Wage Gap across the Wage Distribution in South Korea : Using Unconditional Quantile Regression with Individual Fixed-effects

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This study examines the wage difference between temporary and permanent contracts across the marginal wage distribution in South Korea. For this, I estimate the relationship between the log value of hourly wage and contract types using Korean panel data and unconditional quantile regression with individual fixed-effects. I analyze men and women separately and carry out additional analyses by classifying temporary contracts into three exclusive categories : temporary contracts of one year or more, temporary contracts of less than one year, and casual contracts. The results show that temporary contracts incur a wage penalty relative to permanent contracts and this wage penalty is largely concentrated on low-wage workers, and also that low-wage workers with specific forms of temporary contracts appear to receive a severe wage penalty.

Keywords : Temporary contract, Wage gap, Unconditional quantile regression with fixed-effects, South Korea

I. Introduction

From the late 20th century, many countries have witnessed the large increase in temporary employment. Previous studies suggested that this increase was rooted on various reasons including the transition in industrial structure, the intensification of international competition, and the increase in labor market participation of secondary earners such as female, youth and older adults (Burgess, 1997; Marginson, 1989). Since workers on temporary contracts generally had lower wages and fringe benefits than workers on permanent positions, a series of scholars have shown an interest in whether the difference in contract types between temporary and permanent contracts caused the difference in wage rates between them.

Since the temporary-permanent contracts' wage gap can be affected by the differences in various factors including the degree of importance of tasks and the bargaining powers between temporary and permanent contracts, the investigation of the temporary-permanent contracts' wage gap could be helpful to understand the labor market. Above all, there are worries about the dualization of the labor market in many countries and thus researchers are required to advance knowledge of relevant issues.

In terms of methodology, one major finding of previous empirical studies seems that it is essential to control for individual unobserved heterogeneity in estimating the temporary-permanent wage gap. It is due to that permanent jobs are generally more preferred and thus in competitive labor market permanent workers will have higher productivity which can be determined by unobserved characteristics such as ability, motivation or attitude than temporary workers. Therefore, previous studies have used a linear fixed-effects regression model most widely because a fixed-effects approach does not rely on an assumption

of the distribution of individual unobserved heterogeneity or an assumptions of instrumental variables and because there are generally sufficient variations of contract types in individuals over longitudinal periods.[1] Korean evidence based on a fixed-effects approach show that temporary workers experience a wage penalty to some degree compared to permanent workers(Lee and Kim, 2009; Lee, 2011).

However, existing theories and explanations suggest that the temporary-permanent wage gap can be heterogeneous across the marginal wage distribution. And recent empirical studies show that the temporary-permanent wage gap is heterogeneous across the wage distribution and therefore the estimates from linear fixed-effects regression is insufficient to fully understand the temporary-permanent wage gap structure(Kim, 2009; Comi and Grasseni, 2012; Pfeifer, 2012; Bosio, 2014; Cochrane et al., 2017; Kim and Kim, 2018). Especially, these studies consistently show that low-wage temporary workers experience a higher wage penalty compared to high-wage temporary workers.

The examination of the distributional figures of the temporary-permanent wage gap was enabled through the development of unconditional quantile regression(UQR) by Firpo et al.(2009). However, because previous studies using UQR did not control for individual fixed-effects, their estimates have a high risk to be biased. Therefore, it is required to combine UQR with individual fixed-effects in estimating the temporary-permanent wage gap. For a good example, Lass and Wooden(2019) apply UQR to an Australian panel data with controlling for individual fixed-effects. The way to combine UQR with individual fixed-effects is considerably simple because UQR is a traditional regression model just with transformed dependent variable, so-called the recentered influence function(Firpo et al., 2009). Therefore, traditional fixed- effects regression model can be simply used to combine UQR with a

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1) In sample of this study, the ratio of observations which belong to individuals who experience both temporary and permanent contracts over longitudinal periods among total observations is 33.2 percent in men and 43.4 percent in women.

fixed-effects approach(Borgen, 2016). For brevity, I will name this method 'UQFER(unconditional quantile fixed-effects regression).'

Conclusively, this study estimates the temporary-permanent hourly wage gap across the marginal wage distribution using UQFER to examine the distributional picture of the temporary-permanent wage gap in Korea. Panel data is drawn from the Korean Labor and Income Study. I analyzed men and women aged 20-64 years separately and also consider the internal heterogeneity among temporary contracts by classifying them into three exclusive categories: temporary contracts of one year or more, temporary contracts of less than one year, and casual contracts.

The remainder of this study is constructed as follows. Section Ⅱ reviews the prior literature. Data and variables are explained in section Ⅲ. Section Ⅳ explains unconditional quantile regression and how to combine it with individual fixed-effects. Section Ⅴ presents regression results and section Ⅵ concludes.

Ⅱ. Literature review

Existing theories and explanations suggest that the difference in contract types between temporary and permanent contracts may be a cause of the difference in wage rates between them. Among these, the compensating wage differential theory suggests the wage premium of temporary workers and many other explanations predict the wage penalty of temporary workers. In this section, I briefly discuss these explanations in order.

First, the competitive wage differential theory(Rosen, 1986) argues that in competitive market temporary workers are compensated for their job insecurity by a wage premium. However, because this theory assumes that workers on fixed-term contracts choose their temporary position alternative to permanent

position, this theory may have lower explanatory power for low-skilled workers than for highly skilled workers since many low-skilled temporary workers choose their position alternative to unemployment. It also implies that the temporary-permanent wage gap would be heterogeneous across the wage distribution.

Second, major explanations suggesting the wage penalty of temporary workers include the buffer stock model, the insider-outsider theory and the efficiency wage theory. The buffer stock model(Booth et al., 2002a) says that since firms tend to uses temporary jobs as a buffer stock which can be easily fired when firms confront with financial difficulties, firms set temporary workers a residual task and permanent workers a central task and thus it results in the temporary-permanent wage gap. The insider-outsider theory(Lindbeck and Snower, 1989, 2001) says that the higher firing cost of permanent workers give permanent workers a power to raise their wage above the market clearing level. And based on the efficiency wage theory, Guell(2003) argues that because temporary workers have an incentive to work hard due to a contract renewal, firms have no incentive to give more wage to temporary workers to enhance their efforts. Since these explanations all assumes the low bargaining power of temporary workers which is rooted on their low productivity to a certain extent, these explanations also imply that low-skilled temporary workers could receive more wage penalty compared to high-skilled temporary workers like the wage differential theory.

Based on these theories and explanations, many empirical studies have been carried out. A series of studies show that the estimate of the temporary-permanent wage gap is highly different between OLS and linear fixed-effects regression(Booth et al., 2002b; Mertens et al., 2007; Lee and Kim, 2009; Lee, 2011). In Korea, Lee and Kim(2009; using KLIPS) find that, compared to temporary workers, permanent workers have 12.6 percent higher hourly wage in OLS and this is reduced to 7.5 percent in linear fixed-effects regression. Lee

(2011; using the Survey on Labor Conditions by Employment Type) also finds that the wage premium of permanent workers is 21.8 percent in OLS and 6.5 percent in linear fixed-effects regression. Therefore, we can say that the control for unobserved heterogeneity is a minimal requirement. Also, the Korean results from linear fixed-effects regression of Lee and Kim(2009) and Lee (2011) are similar to the results in foreign countries. Booth et al.(2002b) showed that in Britain the wage penalty of temporary workers is about 9-11 percentage among men and 7.5-11 percentages among women when using linear fixed-effects regression. And Mertens et al.(2007) found that the hourly wage penalty of temporary workers is 6.9 percentage in West Germany and 4.4 percentage in Spain.

With the development of UQR, recent studies have examined the temporary-permanent wage gap across the wage distribution using UQR without controlling for individual fixed-effects. There are the studies of Bosio(2014) in Italy, Cochrane et al.(2017) in New Zealand and Kim and Kim(2018) in Korea. They consistently find that low-paid temporary workers tend to experience wage penalty and this penalty decreases toward the upper quantiles of the wage distribution. However, some studies(Kim, 2009; Comi and Grasseni, 2012; Pfeifer, 2012) use traditional(conditional) quantile regression(Koenker and Bassett, 1978) which is an inappropriate approach(Killewald and Bearak, 2014). However, the studies using UQR without individual fixed-effects have a higher risk to be biased because individual unobserved heterogeneity can have the considerable confounding effects.

However, I can find only one study which estimates the temporary-permanent wage gap using UQFER. Using Australian panel data and UQFER, Lass and Wooden(2019) find that fixed-term contract workers have similar hourly wage with open-ended workers, low-paid casual workers experience a wage penalty at the lower wage distribution and a wage premium at the higher wage distribution, and temporary agency workers usually receive a wage

premium.

Ⅲ. Data

I use the 4-20th waves(2001~2017) of the Korean Labor and Income Study (KLIPS), an annual panel survey in Korea. KLIPS provides sufficient demographic and labor market variables which is necessary in this study. KLIPS collected 5,000 households at the first wave and additionally added 1,415 household at the 12th wave. The 20th wave succeeded to survey 67.1 percent of original households and 84.4 percent of households who are surveyed at the 12th wave. Using KLIPS, I analyze separately men and women aged 20-64 years who are not in regular education.

Our dependent variable is the log value of hourly wage. Hourly wage is calculated using monthly wage and weekly working hours(summing up both regular and irregular working hours). Wages are adjusted using the consumer price index(2015=100) from the Bank of Korea.

Employment contracts are calculated using two variables. First, in most surveys in Korea including KLIPS, wage earners are basically classified into (a) workers with explicit or implicit contracts of one year or more (including permanent contracts); (b) workers with explicit or implicit contracts of less than one year and 'one month or more'; (c) workers with explicit or implicit contracts of less than one month. Second, KLIPS surveys self-reported status of regular or irregular workers. However, this classification is not exactly same with the classification of temporary and permanent workers. For examples, in Korea, regular workers do not include both part-time earners who are permanent works and permanent workers who are not secured same rights of regular workers in terms of wage or promotion. Despite these problems, the overlapping portion of regular and permanent workers might be very high

because in Korea full-time work is dominant in permanent employment and the non-regular workers with permanent contracts are largely concentrated on public sector which constitutes a small portion among total employment in Korea. Although KLIPS additionally surveys whether fixed-term contract exists or not, this variable shows considerably inconsistent results with above variables(see Choi, 2019). Conclusively, I classify wage earners who are in category (a) and regular workers as permanent workers; those who are in category (a) and irregular workers as temporary workers with contracts of one year or more; those who are in category (b) as temporary workers with contracts of less than one year; and, finally, those who are in category (c) as casual workers.

Control variables include age and its squared term, final educational attainment (high school, college, and university), marital status(with or without spouse), children aged 0-18 in a household, residential area(metropolitan areas, major cities, and other cities), industry(23 categories), occupation(10 categories), firm sizes(11 categories), tenure years and its squared term, labor union in a firm, labor union membership and year dummies. Final observations include 46,053 men and 30,845 women. Table 1 shows summary statistics of hourly wage, age and final educational attainment by contract types. There are considerable differences in hourly wage between temporary and permanent workers. The ratio between the incidence of permanent workers and that of temporary workers appears to be 2.92 : 1 among men and 1.43 : 1 among women. Therefore, men are mostly employed on open-ended contracts. The mean value of hourly wage of temporary workers is 66.3 percent (=9,992/ 15,075) of that of permanent workers among men and 70.5 percent (=7,216/ 10,230) among women. Figure 1 presents the density function of the hourly wage of each contract type. Also, temporary workers are older and have lower educational level than permanent workers, implying the lower productivity of temporary workers than permanent workers. Therefore, the large portion of the
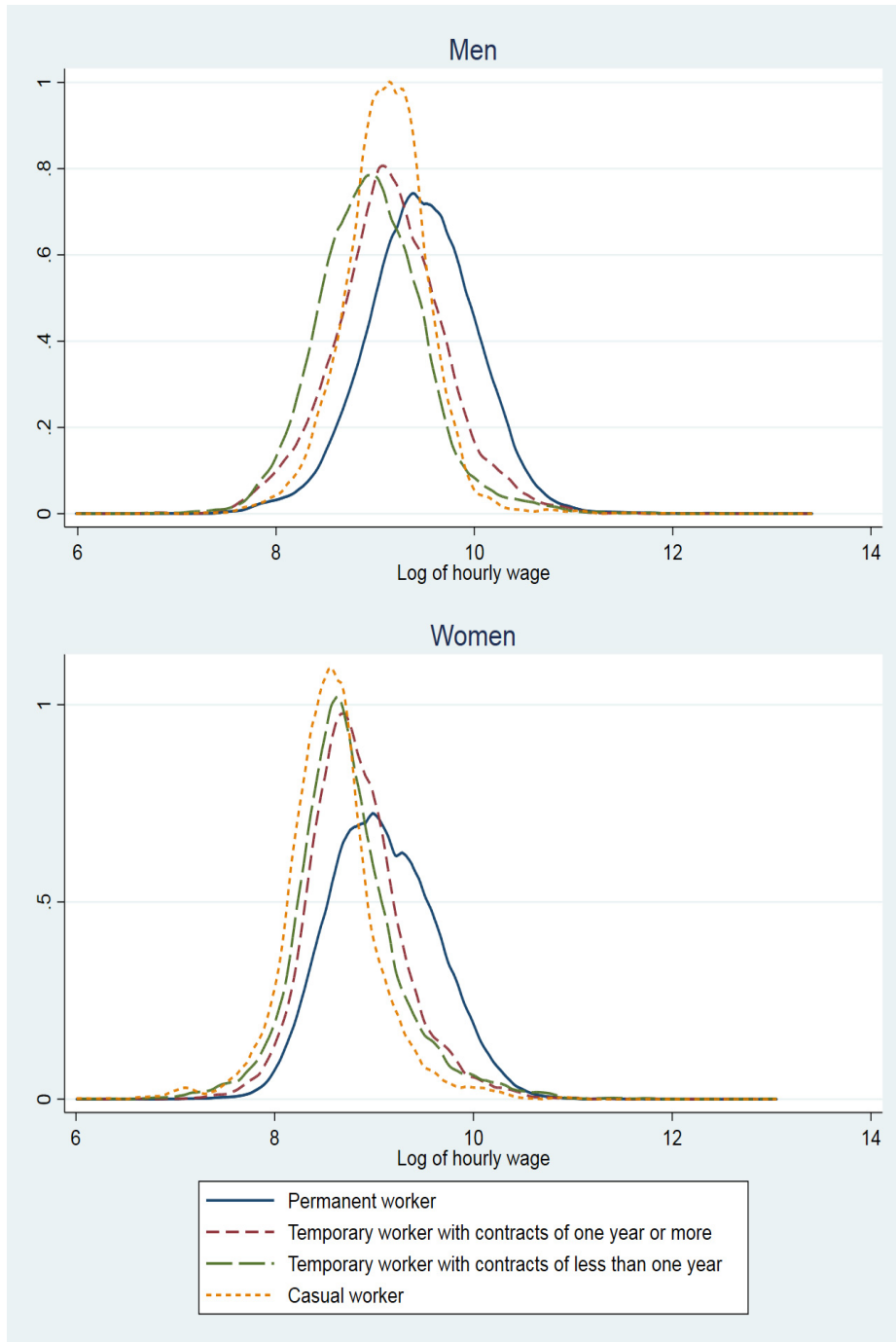
temporary-permanent wage gap may be derived from the temporary-permanent difference in productivity. For brevity, I present full summary statistics for other control variables in appendix.

〈Table 1〉 Summary statistics of hourly wage, age and final educational attainment by contract types

	Permanent worker	Temporary worker	Temporary worker with contacts of one year or more	Temporary worker with contacts of less than one year	Casual worker
(Men)					
Hourly wage (Won)	15,075 (11,070)	9,992 (6,664)	10,975 (7,288)	9,174 (6,984)	9,977 (5,843)
Log of hourly wage	9.46 (0.56)	9.07 (0.51)	9.14 (0.56)	8.96 (0.54)	9.11 (0.43)
Age	40.0 (9.4)	44.3 (11.9)	42.3 (11.8)	41.0 (13.2)	48.3 (9.7)
High School	44%	78%	65%	69%	94%
College	17%	9%	15%	10%	3%
University	39%	13%	20%	20%	3%
Observations	34,298	11,755	3,190	3,735	4,830
(Women)					
Hourly wage (Won)	10,230 (6,376)	7,216 (6,796)	7,665 (5,225)	7,432 (8,406)	5,974 (3,783)
Log of hourly wage	9.08 (0.54)	8.73 (0.51)	8.82 (0.48)	8.73 (0.54)	8.57 (0.47)
Age	37.0 (10.2)	43.7 (11.4)	42.8 (11.0)	42.4 (11.7)	48.4 (9.86)
High School	46%	77%	72%	72%	93%
College	22%	10%	14%	11%	4%
University	32%	13%	14%	17%	3%
Observations	18,131	12,714	4,010	6,181	2,523

Note : Mean(standard deviation) and percentages are presented.

〔Figure 1〕 Distribution of the log of hourly wage by contract types

Men

Women

Log of hourly wage

Log of hourly wage

Permanent worker

Temporary worker with contracts of one year or more

Temporary worker with contracts of less than one year

Casual worker

Ⅳ. Unconditional quantile regression with fixed-effects

As reviewed in section Ⅱ, temporary workers with lower productivity can experience the higher risk of a wage penalty than those with higher productivity. It implies that the temporary-permanent contracts' wage gap would be different across the wage distribution. The heterogeneity of the temporary-permanent contracts' wage gap across the wage distribution can be detected using a quantile regression approach. However, nowadays, it is well recognized that traditional conditional quantile regression(Koenker and Bassett, 1978; so called, CQR) cannot consistently estimate the partial effects of treatment variables on a functional of the marginal distribution of a dependent variable and that unconditional quantile regression(UQR; Firpo et al., 2009) has to be used instead. It is because when using CQR the coefficients means the partial effects of treatment variables on a functional of the distribution of the partialled-out dependent variable by other covariates having effects on worker's wage rates such as age, education, firm sizes, tenure years, unobserved ability and motivation, and so on(for an intuitive explanation, see Killewald and Bearak, 2014).

UQR is suggested through the seminal work of Firpo et al.(2009). They discovered that the partial effects on a functional of the marginal distribution of a dependent variable can be consistently estimated by using the recentered influence function(RIF) of a dependent variable as a new dependent variable. They summarize these findings as Corollary 1(p.958). It may be useful here to quote it.

Corollary 1 −Unconditional Partial Effects : Assuming that $d\chi$, the boundary

of the support χ of X, is such that if $x \in d\chi$, then $f_x(x) = 0$. Then the vector $\alpha(v)$ of partial effects of small location shifts in the distribution of a continuous covariate X on $v(F_Y)$ can be written using the vector of average derivatives

$$\alpha(v) = \frac{dE\left[RIF(Y;v) \mid X=x\right]}{d\chi} dF(x). \tag{1}$$

The RIF is normally definded as follows(Firpo et al., 2009, p.956).

$$
\begin{aligned}
RIF(y;v,F_Y) &= v(F_Y) + IF(y;v,F_Y) \\
&= v(F_Y) + \partial v\left[(1-t)F_Y + t\Delta_y\right]/\partial t\big|_{t=0},
\end{aligned} \tag{2}
$$

where F_y represents the cumulative distribution of y, $v(F_Y)$ indicates the real-valued functional of F_y, and Δ_y is the probability measure that has one at the value y and zero at the others. In the case of quantiles, the RIF is expressed as follows(p.958).

$$RIF(y;q_\tau) = q_\tau + \frac{\tau - 1\{y \le q_\tau\}}{f_Y(q_\tau)}, \tag{3}$$

where y represents a dependent variable, τ represents a specific quantile, and q_τ represents the value of dependent variable at a specific quantile τ. And $1\{\bullet\}$ is an indicator function having a value of zero or one, and $f_Y(\bullet)$ is the density function of a dependent variable which has to be estimated from the sample. Since given a specific quantile τ, q_τ and $f_Y(q_\tau)$ have fixed values and $1\{y \le q_\tau\}$ has a binary value, the RIF will also have a binary value.[2]

Thus, UQR becomes a probability model and finally the equation (4) is to be estimated by using linear probability regression and binary logistic regression.

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[2] Among the Korean articles, Kim and Min(2013) provide more detailed explanations about UQR.

In equation (4), i indicates an individual, t indicates a time, x_{it} represents a row vector of all treatment and control variables and c_i represents individual fixed-effects. Since c_i captures all constant terms, equation (4) can be simply rewritten as equation (5).

$$p\big[RIF(y_{it}; q_\tau)= \tau/f_Y(q_\tau)|X_{it}, c_i\big]/f_Y(q_\tau)+q_\tau+(\tau-1)/f_Y(q_\tau)$$
$$= X_{it}'\beta+c_i. \tag{4}$$

$$p\big[RIF(y_{it}; q_\tau)= \tau/f_Y(q_\tau)|X_{it}, c_i\big]= X_{it}'\big[f_Y(q_\tau)\beta\big]+c_i. \tag{5}$$

However, because Firpo et al.(2009) showed that the regression results are almost similar between linear probability regression and binary logistic regression, subsequent studies also have conventionally used linear probability regression when applying UQR. Therefore, this study also estimates a linear probability model. Also, individual fixed-effects can be easily controlled for by using linear fixed-effects regression. Borgen(2016) explains practical procedures to estimate unconditional quantile regression with individual fixed-effects when using Stata and provides the **xtrifreg** command which can carry out these procedures. So, I estimated the temporary-permanent wage gap using this command. Lastly, men and women are separately analyzed and then the value of each quantile of hourly wage is different between them.

V. Regression results

1. Results from linear regression

Table 2 and table 3 present the linear regression results and the UQR results, respectively. Linear regression estimates the partial effects of covariates on the

conditional mean of a dependent variable and UQR estimates the partial effects of covariates on the specific quantile of the marginal distribution of a dependent variable.

First, I look into the results from linear regression in table 2. In table 2, I present the results from both OLS and linear fixed-effects regression. The OLS estimates show that, compared to permanent workers, temporary workers have 12 percent lower hourly wage among men and 11 percent lower hourly wage among women($p<0.001$). And these estimates are reduced to 8 percentages among men and 6 percent among women($p<0.001$).

This estimated hourly wage gap between temporary and permanent workers from linear fixed-effects regression is almost similar with previous studies in Korea. Lee and Kim(2009; using KLIPS) and Lee(2011; using the Survey on Labor Conditions by Employment Type) estimated that regular workers have 6.5 percent higher($p<0.001$) and 7.5 percent higher($p<0.001$) hourly wages than irregular workers, respectively. These studies did not analyze men and women separately. So, Lee(2011), Lee and Kim(2009) and this study which are all based on a fixed-effects approach result in considerably similar estimates.

In addition, this study finds the evident heterogeneity among temporary workers. The wage penalty of temporary contracts is largest among temporary workers with contracts of less than one year. Linear fixed-effects regression results show that the hourly wages of temporary workers of less than one year are 13 percent lower among men and 9 percent lower among women than those of permanent workers($p<0.001$). On the other hand, temporary workers with contracts of one year or more have 5 percent lower hourly wage among men($p<0.001$) and 3 percent lower hourly wage among women($p<0.01$) than permanent workers. One notable finding is that the wage penalty experienced by casual workers is evidently lower than that experienced by temporary workers with contracts of less than one-year. The coefficients of male casual workers are insignificant at 0.05 level and female casual workers show 4

percent lower hourly wage than female permanent workers. It implies that the compensating wage theory has more explanatory power for the hourly wage of casual workers than workers employed on other temporary contracts.

〈Table 2〉 Temporary-permanent wage gap : OLS and Linear FE regression

	Men			
	Without fixed-effects		With fixed-effects	
Temporary contract	-0.12*** (0.01)		-0.08*** (0.01)	
Temporary contract of one year or more		-0.10*** (0.01)		-0.05*** (0.01)
Temporary contract of less than one year		-0.17*** (0.01)		-0.13*** (0.01)
Casual contract		-0.09*** (0.01)		-0.03 (0.02)
R-squared or within R-squared	0.52	0.52	0.29	0.29
Observations	46,053	46,053	46,053	46,053
	Women			
	Without fixed-effects		With fixed-effects	
Temporary contract	-0.11*** (0.01)		-0.06*** (0.01)	
Temporary contract of one year or more		-0.09*** (0.01)		-0.03** (0.01)
Temporary contract of less than one year		-0.13*** (0.01)		-0.09*** (0.01)
Casual contract		-0.10*** (0.01)		-0.04* (0.02)
R-squared or within R-squared	0.52	0.52	0.22	0.22
Observations	30,845	30,845	30,845	30,845

Note : Estimates from OLS and linear fixed-effects regression. Coefficients(standard error) are presented. The reference category is the permanent worker. Control variables include age and its squared term, final educational attainment(high school, college, and university), marital status(with spouse, and without spouse), children aged 0-18 in a household, residential area(metropolitan areas, major cities, and other cities), industry(21 categories), occupation(10 categories), firm sizes(11 categories), tenure years and its squared term, labor union in a firm, labor union membership and year dummies.
+$p<0.1$, *$p<0.05$, **$p<0.01$, ***$p<0.001$.

2. Results from unconditional quantile regression

Next, I turn to the results from UQR and UQFER. I present estimated coefficients in table 3 and these are summarized in figure 2 and 3. First, when not classifying temporary contracts into detailed categories, the temporary-permanent hourly wage gap is wider at the lower wage distribution than at the higher wage distribution. Among men, the wage penalty of temporary workers from UQFER is 12-14 percentages at the 10-30th quantiles, 6-9 percentages at the 40-60th quantiles and 2-4 percentages at the 70-90th quantiles. In women, those are 9-11 percentages, 5-9 percentages and 1-3 percentages, respectively. So, the theoretical expectation that the wage penalty of temporary workers is more severe at the lower wage distribution than at the higher wage distribution appears to have explanatory power for the temporary-permanent wage gap in Korea.

On the other hand, when classifying temporary workers into three categories, there are evident differences in the temporary-permanent wage gap across the wage distribution among three forms of temporary contracts. Through the results from UQFER in figure 3, we can see that the wider wage penalty of temporary workers at the lower wage distribution than at the higher wage distribution can be found only in temporary contracts of less than one year among men and in temporary contracts of less than one year and casual contracts among women. Especially, the wage penalty experienced by low-wage temporary workers with contracts of less than one-year is severe at the lower wage distribution. Male temporary workers with contracts of less than one-year have about 22-31 percent lower hourly wage at the 10-30th quantiles than comparable male permanent workers. Also in women, these gaps are 15-18 percentages.

Also, there are several differences between men and women. First, at the lower wage distribution, the wage penalty of a casual contract exists only for

women and not for men. It seems because there are higher demands of a high degree manual labor through casual contracts. Construction is a representative industry belonging to this case. Second, at the high wage distribution, women with a temporary contract of less than one year and a casual contract appear to experience a wage premium which is not observed in men. Although there could be many potential reasons for this gender difference, I think that it can be due to the difficulties of women to achieve both work and life goals in a country where the male breadwinner model is dominant.

Now, I compare the above results with previous studies in Korea other than Lee(2011) and Lee and Kim(2009). Using the Establishment Survey and cross-sectional analysis, Kim and Park(2006) found that the temporary-permanent wage gap is 6.8 percent among men and 7.7 percent among women when not controlling for firm size dummies and these gaps increase to 20.7 percent among men and 20.9 percent among women after controlling for firm size dummies. Based on this study as well as Lee and Kim(2009) and Lee(2011), the estimates of Kim and Park(2006) seem to be considerably overestimated because they do not control for an individual unobserved heterogeneity. Therefore, their former estimates(6.8-7.7 percentages) which are similar with the estimates of this study seem to be resulted from two sources of bias having contrasting effects. One is from not controlling for unobserved heterogeneity and the other is from not controlling for firm size dummies.[3]

Also, Kim and Kim(2018) estimated the temporary-permanent wage gap using only the 19th wave of KLIPS using UQR. They show similar figures of the temporary-permanent wage gap across the wage distribution with this study. However, since this study uses the KLIPS over much more longer period, this study can be understood to supplement the results of their study and I do not refer to the study of them in detail. Lastly, Nam(2007) concluded that the

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3) Their following study(Park and Kim, 2007) reports somewhat lower estimates (11.1-12.6 percentages among men and 15.7-17.9 percentages among women).

〈Table 3〉 Temporary-permanent wage gap across the wage distribution : UQR and UQFER

|		Men(Observations: 46,053)								
		10th	20th	30th	40th	50th	60th	70th	80th	90th
UQR	Temporary contract	-0.16***	-0.16***	-0.17***	-0.15***	-0.13***	-0.13***	-0.12***	-0.08***	-0.06***
	R-squared	0.21	0.28	0.33	0.36	0.39	0.39	0.38	0.34	0.24
	Temporary contract of one year or more	-0.11***	-0.11***	-0.12***	-0.13***	-0.10***	-0.10***	-0.10***	-0.08***	-0.07***
	Temporary contract of less than one year	-0.32***	-0.27***	-0.25***	-0.20***	-0.15***	-0.15***	-0.12***	-0.07***	-0.04**
	Casual contract	-0.01	-0.07***	-0.12***	-0.13***	-0.15***	-0.16***	-0.14***	-0.10***	-0.08***
	R-squared	0.21	0.28	0.33	0.36	0.39	0.39	0.38	0.34	0.24
UQFER	Temporary contract	-0.14***	-0.11***	-0.12***	-0.09***	-0.06***	-0.06***	-0.04***	-0.02+	-0.03+
	R-squared	0.09	0.13	0.15	0.16	0.16	0.16	0.15	0.12	0.08
	Temporary contract of one year or more	-0.08*	-0.06*	-0.07***	-0.07***	-0.04**	-0.05**	-0.04*	-0.04*	-0.03+
	Temporary contract of less than one year	-0.31***	-0.23***	-0.22***	-0.14***	-0.09***	-0.07***	-0.03+	-0.01	-0.01
	Casual contract	0.01	0.00	-0.08**	-0.03	-0.05*	-0.06**	-0.04+	-0.02	-0.03+
	R-squared	0.09	0.13	0.15	0.16	0.16	0.16	0.15	0.12	0.08
		Women(Observations: 30,845)								
		10th	20th	30th	40th	50th	60th	70th	80th	90th
UQR	Temporary contract	-0.12***	-0.12***	-0.13***	-0.13***	-0.14***	-0.12***	-0.14***	-0.10***	-0.04**
	R-squared	0.16	0.25	0.33	0.37	0.40	0.42	0.42	0.39	0.30
	Temporary contract of one year or more	-0.04***	-0.06***	-0.07***	-0.08***	-0.10***	-0.11***	-0.15***	-0.14***	-0.10***
	Temporary contract of less than one year	-0.15***	-0.16***	-0.16***	-0.16***	-0.17***	-0.14***	-0.14***	-0.08***	-0.01
	Casual contract	-0.18***	-0.16***	-0.15***	-0.15***	-0.13***	-0.08***	-0.06***	-0.02	0.03+
	R-squared	0.16	0.25	0.33	0.37	0.40	0.42	0.42	0.39	0.30
UQFER	Temporary contract	-0.11***	-0.10***	-0.09***	-0.09***	-0.07***	-0.05***	-0.03+	0.01	0.03+
	R-squared	0.07	0.11	0.15	0.14	0.13	0.13	0.11	0.09	0.09
	Temporary contract of one year or more	-0.03	-0.02	-0.04*	-0.04**	-0.03*	-0.03+	-0.03+	-0.02	-0.01
	Temporary contract of less than one year	-0.18***	-0.17***	-0.15***	-0.13***	-0.11***	-0.07***	-0.03+	0.02	0.06**
	Casual contract	-0.15***	-0.13***	-0.09**	-0.09***	-0.04	-0.02	0.01	0.06**	0.08**
	R-squared	0.07	0.11	0.15	0.14	0.13	0.13	0.11	0.10	0.09

Note : Estimates from unconditional quantile regression and unconditional quantile fixed-effects regression. Coefficients are presented. The reference category is the permanent worker. Control variables include age and its squared term, final educational attainment (high school, college, and university), marital status(with spouse, and without spouse), children aged 0-18 in a household, residential area(metropolitan areas, major cities, and other cities), industry(21 categories), occupation(10 categories), firm sizes(11 categories), tenure years and its squared term, labor union in a firm, labor union membership and year dummies.
+$p<0.1$, *$p<0.05$, **$p<0.01$, ***$p<0.001$.

〔Figure 2〕 Temporary-permanent wage gap across the wage distribution
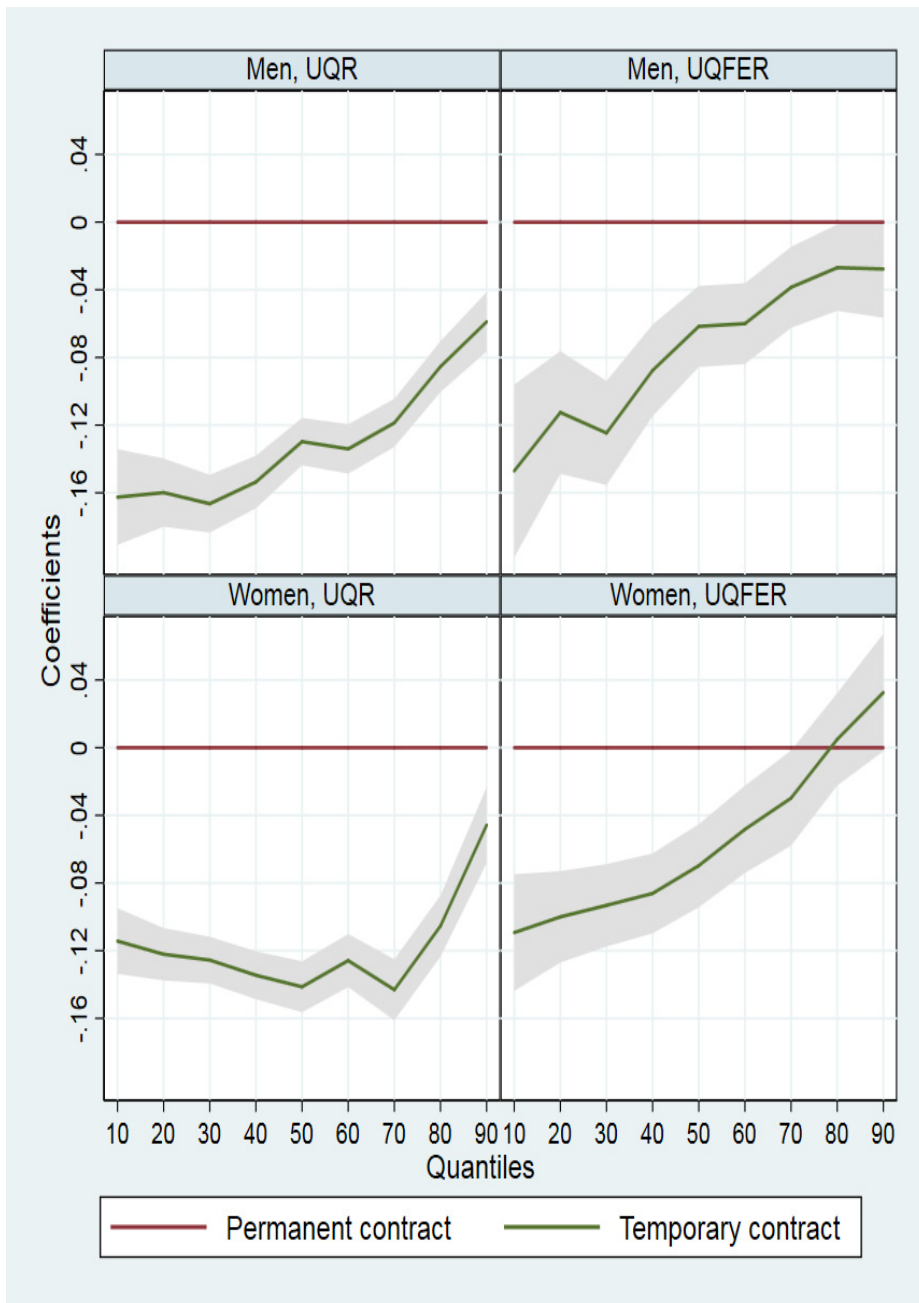
Note : Coefficients and 95% confidence intervals are figured.

〔Figure 3〕 Temporary-permanent wage gap across the wage distribution by classifying temporary contracts into three categories
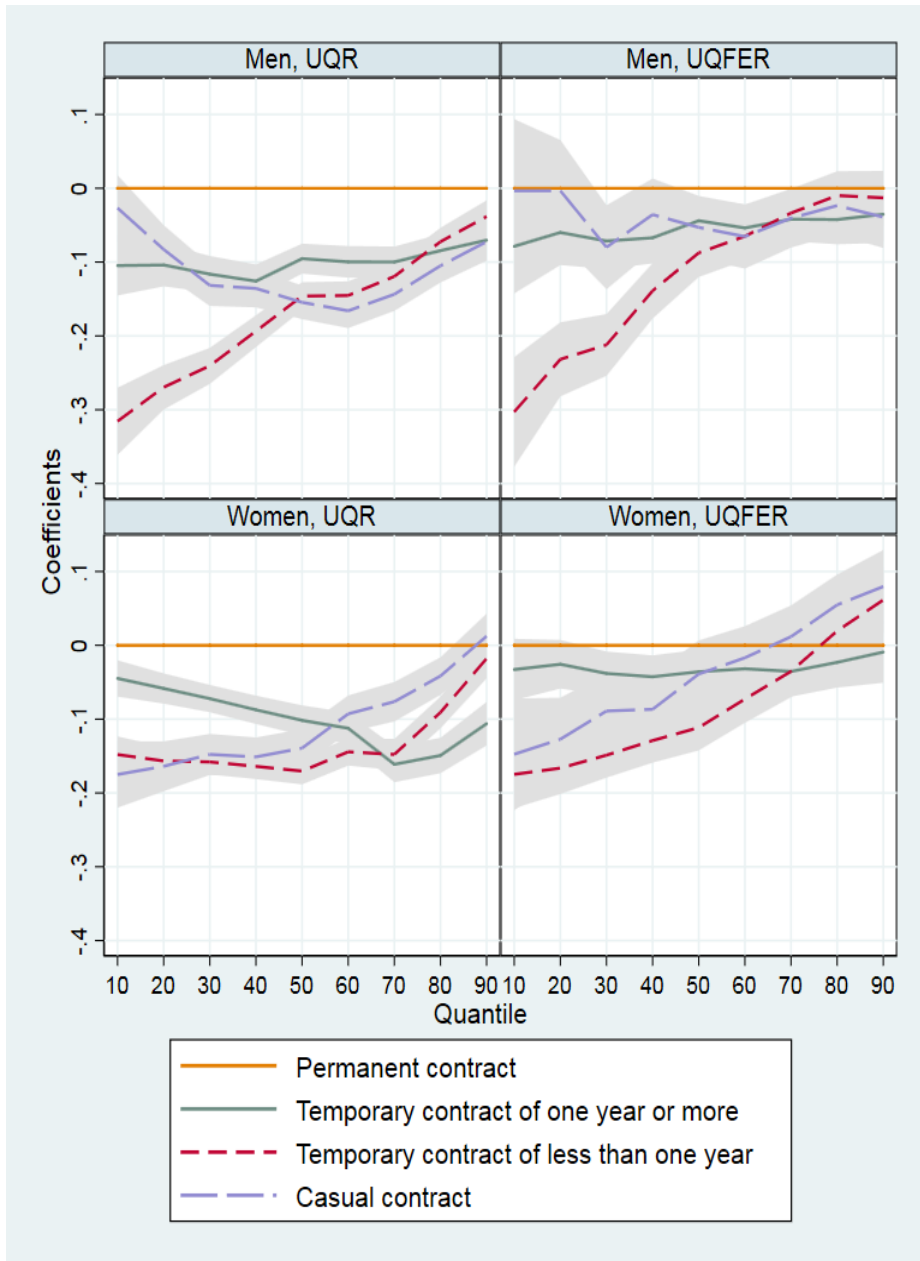
Note : Coefficients and 95% confidence intervals are figured.

temporary-permanent wage gap actually does not exist in Korea using Economically Active Population Survey. The highly different results of Nam (2007) with other studies including this study seem to be caused by the definition of employment contracts which Nam used. As explained in section III, in Korea, there is a basic classification of wage earners. However, Nam did not use this classification and he relied on only whether there is an explicit contract duration. Therefore, the permanent workers of the results of Nam included the workers with implicit temporary contracts, resulting in the underestimation of the temporary-permanent wage gap.

VI. Conclusion

Relying on sufficiently longer and larger panel data in South Korea, this study estimates the temporary-permanent contracts' hourly wage gap across the wage distribution using unconditional quantile regression with individual fixed-effects. This study conclusively finds that temporary workers experience some wage penalty than permanent workers and that this penalty is largely concentrated on low-wage workers. Also, low-wage workers with specific forms of temporary contracts appear to receive severe wage penalty.

Compared to prior empirical evidence in Korea, this study evidently provides more robust pictures in the temporary-permanent wage gap structure. Also, this study comprehensively considers both gender difference in labor market regimes and internal heterogeneity among temporary workers.

There remain two methodological issues which are not sufficiently discussed even in foreign studies. One is the bias which can be generated from interpolation or extrapolation(King and Zeng, 2006). It is occurred by the high imbalance of covariates between treatment and control groups. However, since in general individuals compete for more secure jobs, the distribution of

covariates which affects hourly wage can be highly different between temporary and permanent contracts. For an example, the results of Kim and Park(2006) imply that the distribution of firm sizes is highly different between temporary and permanent workers. The distribution of ages, education, tenure years, industry, occupation or union membership all tend to be highly different between fixed-term and open-ended contracts. Therefore, future studies are needed to examine whether the results will differ when applying the covariate balancing approach.

Also, although most previous studies have used a linear probability model instead of a binary probability model(logit or probit) when applying UQR following the simulation results of Firpo et al.(2009). However, when combining the UQR with fixed-effects, the considerable difference raises between a linear probability model and a binary probability model. This is that the logistic fixed-effects regression(Andersen, 1970; Chamberlain, 1980) which is typically used as a binary probability model does not include observations which have no variation in a dependent variable over individual observed longitudinal periods. However, the linear fixed-effects regression which is used as a linear probability model does not exclude them. Therefore, when applying fixed-effects approach, the number of analyzed observations is highly different between logistic fixed-effects regression and linear fixed-effects regression. Evidently, it can result in considerable difference in estimates between linear probability regression and binary probability regression.

Conclusively, this study highlights on the active labor market policy which can help those who involuntarily takes residual tasks in forms of temporary contracts to translate into better jobs which have responsibilities for more central tasks of firms.

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Appendix

〈Table A1〉 Full summary statistics

	Men		Women	
	Permanent	Temporary	Permanent	Temporary
With Spouse	75.3%	63.5%	59.5%	67.3%
Children(0-18)	55.4%	34.9%	44.0%	40.1%
Residential area				
Metropolitan areas	44.3%	45.7%	45.2%	45.4%
Major cities	30.1%	27.1%	30.2%	28.4%
Other cities	25.6%	27.2%	24.6%	26.2%
Industry				
Agriculture, forestry and fishing	0.4%	1.6%	0.1%	1.6%
Mining and quarrying	0.3%	0.2%	0.1%	0.0%
Manufacturing	32.8%	12.9%	20.3%	14.0%
Electricity, gas, steam and water supply	1.1%	0.3%	0.1%	0.2%
Sewerage, waste management, materials recovery and remediation activities	1.5%	0.7%	0.6%	0.2%
Construction	7.9%	35.6%	1.7%	2.1%
Wholesale and retail trade	10.2%	9.0%	11.5%	15.5%
Transportation	7.1%	5.8%	2.2%	1.4%
Accommodation and food service activities	2.1%	3.7%	5.1%	18.0%
Information and communications	5.6%	2.8%	4.0%	2.6%
Financial and insurance activities	3.6%	2.1%	4.7%	3.1%
Real estate activities and renting and leasing	2.8%	4.3%	2.6%	2.8%
Professional, scientific and technical activities	4.3%	1.6%	4.1%	1.7%
Business facilities management and business support services	1.4%	5.6%	1.6%	3.4%
Public administration and defense; compulsory social security	7.0%	2.5%	4.3%	2.8%
Education	5.2%	4.5%	14.8%	11.3%
Human health and social work activities	2.2%	1.4%	17.3%	8.3%
Arts, sports and recreation related services	0.6%	2.0%	0.9%	1.6%
Membership organizations, repair and other personal services	3.7%	3.4%	3.9%	5.7%
Activities of households as employers; undifferentiated goods and services producing activities of household for own use	0.0%	0.0%	0.1%	3.5%
Activities of extraterritorial organizations and bodies	0.1%	0.1%	0.1%	0.0%

	Men		Women	
	Permanent	Temporary	Permanent	Temporary
Occupation				
Manager	2.8%	0.6%	0.5%	0.1%
Professionals and related workers	27.0%	14.7%	34.8%	14.9%
Clerks	20.1%	5.0%	28.9%	9.3%
Service workers	3.7%	3.5%	6.1%	17.0%
Sales workers	6.8%	6.0%	8.4%	13.2%
Skilled agricultural, forestry and fishery workers	0.2%	1.3%	0.0%	0.4%
Craft and related trades workers	11.7%	32.6%	3.6%	6.4%
Equipment, machine operating and assembling workers	21.0%	13.7%	8.6%	5.9%
Elementary workers	6.0%	22.6%	9.1%	32.8%
Armed forces	0.8%	0.0%	0.0%	-
Firm sizes				
1~4	7.9%	18.3%	13.6%	25.0%
5~9	9.6%	16.1%	13.9%	14.2%
10~29	15.2%	15.4%	16.0%	13.3%
30~49	7.2%	5.0%	6.4%	4.6%
50~69	5.6%	3.2%	4.5%	3.1%
70~99	3.9%	2.1%	3.3%	1.9%
100~299	11.3%	5.3%	8.5%	5.5%
300~499	4.1%	1.5%	3.1%	1.8%
500-999	4.0%	1.6%	3.3%	1.9%
1,000+	19.1%	6.8%	12.3%	9.2%
Missing	12.0%	24.6%	15.1%	19.6%
Tenure years	7.9(7.8)	5.3(7.2)	5.5(6.2)	3.0(3.9)
Labor union in a firm	27.6%	7.0%	19.5%	6.4%
Labor union membership	17.2%	2.6%	10.5%	1.5%
Observations	34,298	11,755	18,131	12,714

Note : Missing values of firm sizes are not excluded and coded as an additional category.

초 록

유기계약과 무기계약 간의 임금분포에 따른 임금격차 : 무조건부 분위 고정효과 회귀분석을 사용하여

최 요 한

본 연구는 우리나라를 대상으로 유기계약(temporary contract)과 무기계약(permanent contract) 간의 한계임금분포에 따른 임금격차를 추정하였다. 이를 위하여, 시간당 임금의 로그값과 계약유형 간의 관계를 패널자료와 개인의 고정효과를 통제한 무조건부 분위 회귀분석을 사용하여 추정하였다. 남성과 여성을 구분하여 분석하였으며, 유기계약을 1년 이상 유기계약, 1년 미만 유기계약, 그리고 일용계약의 세 배타적 범주들로 나누어 추가적인 분석을 수행하였다. 본 연구는 유기계약이 무기계약에 비해서 임금페널티를 발생시키고 또한 이 임금페널티는 주로 저임금 근로자들에게 집중되어 있다는 것을 발견하였으며, 또한 특정한 유기계약 형태를 가진 저임금 근로자들은 매우 높은 임금페널티를 받는 것으로 나타났다.

핵심용어 : 유기계약, 임금격차, 무조건부 분위 고정효과 회귀분석