FIRM-SPECIFIC HUMAN CAPITAL AND BONUS PAYMENTS : A TEST OF FIRM-SPECIFIC HUMAN CAPITAL HYPOTHESIS

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Abstract

This paper tests a specific human capital model to explain the relative variation of bonus payments in Korea. Typically, bonus payments in Korea is attributed to institutional practices which differ across industry and size of firm. This study argues that it is more fruitful to analyze this phenomenon within the human capital framework in which optimizing decision makers play a primary role. Assuming that bonus payment is the worker's share of the return to firm-specific human capital, the standard model of firm-specific human capital provides testable predictions on the relative variation of individual bonus payments to regular earnings. These predictions are tested by using a micro-data set. The empirical results strongly support the theoretical predictions and show that the relative variation of an inividual bonus pay-ment is primarily determined by the variations which represent firm-specific human capital including duration of job tenure and difference in firm size.

I. Introduction

Among the various characteristic features of the Korean earnings structure, one striking feature is the prevalence of bonus payments in the payment scheme. The Korean bonus payments, which cover almost all workers with regular status including production wage earners and salaried earners, are usually made two or three times a year. The total average ratio of the yearly bonus payments to monthly regular earnings was around

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three in 1984 and has tended to increase in the recent years. (Ministry of Labor, Republic of Korea, Various issues) The bonus-regular wage ratios across workers vary considerably by education, industry, occupation, firm size, sex and so on. One of the interesting regularities in the ratios is that there is a relationspip between the ratios and the human capital characteristics of workers. The purpose of this paper is to investigate the determinants of the individual variation of bonus payments to regular earnings across workers in Korea.

Most of the existing explanations of the Korean bonus system emphasize cultural and historical influences, including the inheritance of Japanese colonialism. Though it is difficult to ignore completely the factors which were inherited from Japanese colonialism and the influence of the famous Japanese bonus system, these explantions do not yield testable predictions about inter-individual and inter-firm differences in the relative variations of bonus payments. In this paper, I raise the following two arguments: 1) the relative magnitudes of the determinants of bonus payments and regular earnings are not the same, and 2) it is more fruitful to examine the popular practice of bonus payments in Korea within a framework in which optimizing decision makers play a primary role.

To investigate the determinants of the relative variation of bonus payments to regular earnings across workers, it is maintained that firms and workers are optimizing decision makers and that a bonus payment is the worker's share of the return to firm-specific human capital. The theoretical framework used to formulate and test the hypothesis about the relative variation of bonus payments is the theory of specific human capital.[1] Specific human capital theory usually concerns itself with two main issues; one is the amount of specific human capital accumulated, and the other is the division of the quasi-rents associated with the investment in specific human capital between worker and employer. The standard model of on-the--job training implies that the optimal amount of firm-specific human capital investment depends on characteristics of the worker and the firm involved in a specific match, as well as on output fluctuations. The sharing ratio itself, however, does not depend on the characteristics of the worker or firm involved. These two implications are used to derive the testable predictions corresponding to the hypothesis that the individual variation of the ratio of bonus payments to regular wage is determined by the amout of the firm-specific human capital of the worker. The theoretical arguments proposed in the model of firm-specific human capital are thus tested by relating the ratios of bon

human capital stocks of individual workers. An explicit empirical test of the firm-specific human capital model, including the argument of rent division, has rarely been attempted in the literature on human capital. Therefore, the present empirical test of the model with individual microdata is an important contribution to the literature.

The empirical investigation is done by estimating various human capital earnings functions which permit the decomposition of returns to specific training and general training. In addition to a single equation approach, the estimation also covers the case in which the bonus ratio and the duration of job tenure are simultaneously determined.

This paper is organized in the following manner. After this introduction, in Section Ⅱ two empirical models are specified, a single equation and simultaneous equations approach. Section Ⅲ describes the source of the micro-data set, sampling method, and summary statistics of the sample. Section Ⅳ and Ⅴ discuss the empirical results from the single equation approach and the simultaneous approach, respectively. The summary and concluding remarks are given in Section Ⅵ.

Ⅱ. Empirical Specification

When formulating an optimal contracts model with on-the-job investment, we use usually two-period model for the sake of simplicity. (see Parsons, 1972 ; Kuratani, 1973 ; Hashimoto, 1979, 1981 ; Kim, 1985) According to Kim(1985), under the assumptions that the parties of the contracts pursue a joint-wealth maximization of the match and post-investment transaction costs do exist, the optimal sharing ratio of the quasi-rent accrued from the firm-specific investment (denoted as α^*) is indepedent of both the amount of initial human capital endowment of the worker (denoted as T) and the firm characteristics (denoted as T). But the optimal amount of on-the-job investment (denoted as t*) depends on worker's characteristics(T) and firm-characteristics(X) such as $\frac{\partial t^*}{\partial T}>0$ and $\frac{\partial t^*}{\partial X}>0$. This simply reflects the fact that T and X affect on the profitablity of the investment.

This theoretical implication of firm-specific human capital model provides testable predictions about the variation of bonus payments. Denoting the post-investment value of a worker who took on the-job investment firm,in the first-period as V^P in this firm and as V^A in an alternative firm, the worker's share of returns to on-the-job investment can be defined as α * (V^P-V^A). As mentioned already, it is assumed that α *(V^P-V^A) represents bonus payment. To control for the effect of general characterostics of human capital, using the ratio of bonus payments to regular earnings, which is denoted as (1), is more superior to using the absolute magnitude of bonus payments for each worker.[2]

$$\text{RBP} = \frac{\alpha\,[V^P - V^A]}{V^A} \tag{1}$$

where RBP represrnts the ratio of bonus payments to regular earnings. Differentiating RBP with respect to the factors representing the profitability of investment in on-the-job training (X), which are related to the characteristics of the demand side of the labor market including firm size and industry, and the amount of initial human capital endowment (T), one obtains, by virtue of the results of the comparative statics of Kim (1985), the predicted signs of the coefficients of the bonus ratio equation :[3]

$$\frac{\partial[\text{RBP}]}{\partial X} = \frac{\partial[\alpha (V^P - V^A)/V^A]}{\partial X} > 0, \tag{2a}$$

as long as $\frac{\partial t^*}{\partial X}>0$ and $v^p>v^A$, and

$$\frac{\partial[\text{RBP}]}{\partial T} = \frac{\partial[\alpha (v^p - v^A)]}{\partial T} \gtrless 0 \tag{2b}$$

according to $E_{tT} = \frac{\partial t^*}{\partial T}\,\frac{T}{t*} \gtrless 1$,

where E_{tT} represents the elasticity of the optimal amount of training with respect to the initial endowment of human capital. Years of education and previous experience of the worker can be regarded as the typical indicators of the initial endowment of human capital. The interpretation of the signs partial derivatives is straightforward. The profitability of on-the--job training (investment) is positively correlated with the ratio of bonus payments to regular earnings, and the effect of initial human capital endowment on the ratio depends on the elasticity, E_{tT}.

(A) *A Single Equation Specification*

Specification of the econometric model is tailored to the data available to the researcher. Assuming that the duration of job match (tenure, internal experience) is determined exogenously in the model, the following specification of a single multiple regression equation would reflect the predictions of the theory :

$$ln\ (RBP)\ i = T_i\,\alpha_T + X_i\,\alpha_X + Error_{RBP} = Z_i\,\alpha + Error_{RBP}$$
$$= a_O + a_1(EDUC)_i + a_2(IE)_i + a_3(EE)_i + a_4(IE)^2_i + a_5(EE)^2_i + a_6(WHOUR)_i + \sum_{J=1}^{2}$$
$$a_{7j}(FIRMD)_{ji} + \sum_{K=1}^{7} a_{8k}(IND)_{ki} + \sum_{m=1}^{5} {}_{9m}(OCCD)_{mi} + a_{10}(LOCD)_i + a_{11}(SEXD)_i +$$
$$a_{12}(MARD)_i + Error_{RBP} \qquad (3)$$

where for each individual worker i, the dependent variable, $ln\ (RBP)_i =$ natural logarithm of the ratio of yearly special payments to monthly regular earnings, and the independent variables include, $(EDUC)_i$ =years of education, $(IE)_i$ = job tenure (internal experience) with the current employer (years), $(EE)_i$ = potential external experience which is defined such that $(EE)_i$ = age - schooling - IE - 6, WHOUR = monthly working hours, (EIRMD) = firm size dummy, (IND) = industry dummy, (OCCD) = occupation dummy, (SEXD) = sex dummy, and (LOCD) = location dummy. The reason that the dependent variable, is taken to be the natural logarithm of RBP is that usually the size distribution of income is log normal ; also, the logarithmic form is convenient in decomposing the relation into the determinants of bonus payments and regular earnings, which will be presented later.

The theory provides the expected signs of the coefficients in (3). The level of education of a worker is regarded as one proxy of the worker's general human capital, T, in the model. The ratio of bonus to regular earnings therefore depends on the elasticity, E_{tT}. It is generally asserted that education increases the profitability of on-the-job training (Mincer, 1974 ; Psacharopoulos and Layard, 1979). In Korea, more educated workers usually have more job market information. So it is easier for them to match with firms with greater opportunities for on-the-job training. Because of this, years of education and the bonus-earnings ratio tend to be positively related. In the earnings function specified in (3), internal experience (job tenure) is distinguished from external experience in order to take into account the tenure effect in earnings determination. Human capital theory views the period of current job tenure as a proxy for the amount of firm-specific human capital (Mincer, 1974 ; Mincer and Jovanovic, 1980). In the job matching process some workers have longer periods of job tenure because the quality of their job match is high, so that their investment in on-the-job training is relatively high. Therefore, the length of job tenure is positively related with the bonus-monthly earnings ratio.

Assuming that a worker was also employed before his current job, the potential period of external experience (EE) can be viewed as another proxy measure of initial endowment of human capital. The relationship between external experience and the bonus earnings ratio then depends on the elasticity of on-the-job training with respect to the initial human capital. It is difficult to delineate definitely the sign of the elasticity because this depends on the relationship between characteristics of previous experience and current job tasks. The current data set does not provide information on the characteristics of previous experience of workers. The squares of job tenure and external experience are included to reflect decreasing marginal profitability of on-the-job investment. Hence, their signs, thus, are expected to both be negative. Monthly working hours is included as an independent variable to correct for possible bias in the measurement of labor supply, since monthly total earnings instead of hourly wage rates are used here (Blinder, 1973). Since the present sample includes only regularly employed workers, the effect is not expected to be very important.

In Korea remarkable earnings differentials by firm size exist, even after controlling for workers; general characteristics. Park (1978) observed that the effects of job experience in Korea are more pronounced in shapig earnings profiles of workers employed by larger firms than those of workers employed by smaller firms. Many people refer to this phenomenon as "market segmentation" implying that some institutional forces are at work. Students of the human capital approach do not agree with the interpretation of segmentation, and they try to explain the scale effect mainly by human capital factors. The model of specific human capital mentioned earlier provides some insight into this issue. If there exist differences in the profitability of on-the-job training by size of firms, inter-scale earnings differentials might result from differences in on-the-job investment. The following two factors might be suggested for rationalizing the human capital approach. First, the difference in the possible choices of job tasks determined by the sizes of firms might be important. It is common that a worker's comparative advantage in job tasks is uncertain in the early period of the employee's labor market career. The greater the choice of job tasks, the less probability of turnover, which could result in inter-scale differences in the accumulation of firm-specific human capital. Second, larger firms particularly in developing economies, use relatively modernized equipment and enjoy preferred capital market accessibility. The profitability of on-the-job training could then differ by firm size. The theory thus predicts a positive relationship between firm size and the bonus-earnings ratio.

Finally, industry dummy variables, occupational dummy variables and remaining other dummies are included to reflect the possibility of differences in the profitability of on-the-job training. If panel data were available, the coefficients of these dummies, in particular industry dummies, could reveal the relationship between returns to on-the-job training and demand fluctuations. Cross sectional data do not allow this distinction of demand factors. This is one limitation of cross-sectional observations for a single year.

One advantage of using *ln*(RBP) as the dependent variable in the specification of regression equation (3) is that some interesting issues can be examined by separately estimating two different standard earnings functions. The dependent variable, $ln(RBP)$, is identically equal to the log. Difference of the numerator and denominator, that is:

$$ln(RBP)_i \equiv In(Y^B)_i - In(Y^R)_i \tag{4}$$

where Y_i^B is the annual bonus payments of worker i and Y_i^R is the monthly regular earnings of worker i.

We can estimate the earnings equations separately as

$$ln\ Y^B = Z\ \beta + \varepsilon_B \tag{5}$$

$$ln\ Y^R = Z\ Y + \varepsilon_R \tag{6}$$

where Z is a vector of the independent variables which are exactly the same as in (3), and β and Y are vectors of the coefficients of the equations. Note that:

$$\begin{aligned} ln(RBP)_i &= ln(Y^B)_i - ln(Y^R)_i \\ &= Z_i(\beta - Y) + \varepsilon_B - \varepsilon_R \end{aligned}$$

Thus, each coefficient of the bonus ratio equation can be decomposed into the difference between the coefficient of the bonus equation (5) and that of regular wage equation (6). The decomposition of the determinants may help to better understand the causes of variations of the bonus-regular earnings ratio.

On the other hand, the monthly total earnings of an individual worker, Y^T, is defined as the sum of the regular earnings and the average monthly bonus payments, Y^{MB} ($\equiv Y^B/12$). In order to examine the role of bonus payments in the determination of total earnings, another earnings function for total earnings is specified and estimated as:

$$ln\ Y^T = W \cdot \delta_i + \varepsilon_T \tag{7}$$

Note the following identity:

$$Y^T \equiv Y^R + Y^{MB} = Y^R(1+\frac{Y^{MB}}{Y^R})$$

$$ln\ Y^T \equiv \ln\ Y^R + ln(1+\frac{Y^{MB}}{Y^R})$$

By comparing the estimates for regular earnings with those for total earnings, we can derive some implications about the role of bonus payments in the determination of total earnings.

These four earnings function, (3), (5), (6) and (7), are estimated by ordinary least square (OLS) method. It is useful to compare the estimates of these four earnings function in order to examine the relative differences of the earnings determinants.

(B) *A Simultaneous Equations Approach*

The previous specification of the single equation (3) assumes that the current duration of job-match (IE) is exogenously determined. This assumption is not completely consistent with the present theoretical argument. The theory implies that the share of the returns to specific investment and the length of job tenure are simultaneously determined by the decisions of workers and employers. As Mincer and Jovanovic (1981) emphasized, whenever specific capital matters, comparable dualities between returns (wages) and turnover may be expected. In this case the question of causality between job tenure and the ratio of bonus to regular earnings should be taken into account in empirical specification. The specification of (3), therefore, suffers from simultaneity and selectivity biases. One needs to extend the single equation specification to correct the biases. In this study I am attempting in part to solve the problem of simultaneity bias by using instrumental variables for the job tenure equation.

The theoretical hypothesis which motivates a simultaneous specification is that individual differences in job-specific complementarities and related skill acquisitions produce different relations between job tenure (or mobility) and wages. In general, tenure and wage effects are distinguished in the labor turnover literature. These two effects are also, however, raised in the presence of job-specific human capital and high mobility costs. If some skills acquired in a particular firm are not transferable to other firms, then individual differences in the amount of specific capital, which are reflected in the differences in (RBP) in the present context, affect the period of job tenure because they lead to differences in job separation probabilities. This is called the "tenure effect" (Mincer and Jovanovic, 1982). On the other hand, the length of tenure affects the stock of specific human capital, which in turn affects the earnings of a worker. This is the "wage effect" to heterogeneity in mobility behavior. In the present theoretical framework, if bonus payments are interpreted as a worker's share of the returns on specific human capital, there is no reason to assume a unilateral causality between those two variables, i.e., (RBP) and (IE).

Consider the following simple story within firm-specific human capital framework. If a job-match is successful, it eventually results in a positive quasi-rent, which is denoted as $V^P - V^A$, where V^P is the value of the current match, and V^A is the value of an alternative match. This rent will be shared so that the worker receives $\alpha(V^P - V^A)$, and the firm receives$(1-\alpha)(V^P - V^A)$. The higher is $\alpha(V^P - V^A)$, the smaller is the incentive for the worker to quit, given V^A and the usual fluctuations in demand. At the same time, employer investments which involve hiring, screening and training costs are recouped by a wage policy which deters both quits and dismissals, that is $V^A \langle$total wage $(\equiv V^A + \alpha(V^P - V^A))\langle V^P$. As long as V^P and V^A are not agreed upon costlessly by the worker and the employer, a selectivity problems exist. More intuitively, consider a job tenure determination process in an assortive matching where employers and workers initially have imperfect information about each other. Workers are screened continuously on the job, and the employer may dismiss those workers whose productivities rise less rapidly with internal experience than some expected minimum. Over time, attributes of the firm are also revealed, and the more able workers may quit to take advantage of higher investment and earnings prospects offered elsewhere. This is a typical situation in a competitive labor market. The leangth of tenure is, thus, determined by a simultaneous decision by employer and worker. Treating the period of job tenure (IE) as an exogeneous variable in the bonus ratio equation, as well as in the wage equations, results in a predictable downward (upward) bias in its coefficients in better (worse) job-matches.

If panel data are available, the above argument can be investigated by specifying a simultaneous structural system. With a cross-sectional data set, an instrumental two stage least squares (2SLS) procedure can be used to correct for the simultaneity problem.

First, by using some other exogenous variables which are not included in equation (3), estimate the job tenure equation by the ordinary least square method :

$$IE = X_1 b_1 + Z\ b_2 + ERROR_{IE}, \tag{9}$$

where Z denotes the instrumental variables.

Then, calculate $\hat{IE}$ such that

$$\hat{IE} = X_1 \hat{b}_1 + Z\ \hat{b}_2 \tag{9'}$$

where $\hat{b}$ denotes the estimates of the coefficients by OLS. Put in $\hat{IE}$ and $\hat{IE}^2$ instead of IE and IE^2 in equation (3), we obtain

$$\ln(RBP)_i = X\ \alpha + \alpha_I\ \hat{IE}_i + \alpha_2\ \hat{IE}^2 + Error_{RBP}. \tag{10}$$

Since $\hat{IE}$ and the error term of the bonus ratio equation are independent of each other, we can apply the OLS method to equation (10).

The primary purpose of the present 2SLS estimation is to see whether the empirical results obained by the OLS procedure still remain valid when the length of job tenure and the bonus ratio are determined simultaneously.[4)]

Ⅲ. The Data

Since the issues of this paper are concerned essentially with mult--peoried phenomena, longitudinal data for a panel of individual workers are most suitable to examine the issues. Panel data for individual workers are not available in Korea, however. Individual micro cross-sectional data are used in the present empirical test. The data set used in this study is

Table 1. Means and Frequencies of The Sample

		All	Male	Female
Number of Cases		9, 346	5, 632	3, 714
		(100)	(60. 3)	(39. 7)
A. Month Reg.Earnings (Won)		217, 336	280, 679	121, 356
	(S.D.)*	(157, 289)	(169, 487)	(58, 315)
B. Annual Bonus		530, 196	720, 719	241, 282
	(S.D)*	(887, 107)	(1, 077, 563)	(284, 859)
C. Month Total Earnings (A+B/12)		261, 549	340, 749	141, 463
	(S.D)*	(210, 014)	(231, 719)	(75, 010)
D. Ratio Bonus Reg. Earnings (B/A)		2. 14	2. 32	1. 87
	(S.D)*	(1. 97)	(2. 11)	(1. 71)
E. Month Work. Hours		235. 6	234. 1	237. 9
	(S.D)*	(42. 72)	(43. 14)	(41. 97)
F. Job Tenure (Years)		3. 59	4. 44	2. 32
	(S.D)*	(3. 71)	(4. 25)	(2. 12)
		Frequencies (%)		
Education (100%)				
Elementary (6 years)		16. 3	12. 1	23. 8
Middle (9 years)		38. 5	31. 6	48. 7
High (12 years)		32. 6	38. 2	24. 5
Junior College (14 years)		2. 6	3. 4	1. 4
University (16+)		9. 4	14. 6	1. 7
Firm Size (100%)**				
Size I (10—29)		1. 5	1. 7	1. 1
Size II (30—99)		10. 0	11. 6	7. 6
Size III (100—299)		18. 9	18. 8	19. 0
Size IV (300—499)		16. 2	15. 1	18. 0
Size V (500+)		53. 4	52. 8	54. 3
Industry (100%)				
Mining		3. 2	5. 1	0. 5
Manufacturing		74. 2	66. 7	85. 0
Utilities		0. 6	0. 9	0. 1
Construction		2. 9	4. 5	0. 6
Sales and Trade		2. 9	3. 3	2. 4
Transport & Communication		7. 5	9. 7	4. 2
Financing & Insurance		3. 6	4. 2	2. 7
Services		5. 1	5. 6	4. 5

Table 1 (Continued)

Location (100%)			
Metropolitan Area	53.6	51.7	56.4
Small and Medium Cities	46.7	48.3	43.6
Occupation (100%)			
Professional & Technical	7.3	10.1	2.9
Admin. & Managerial	2.9	4.8	0.0
Clerical	19.7	21.1	17.7
Sales	0.7	0.7	0.6
Service	3.7	3.8	3.4
Production Worker	65.7	59.5	75.4
Marital status (100%)			
Single	54.3	30.9	87.6
Married	46.0	69.1	12.4
Age (100%)			
Less than 20 years	13.9	4.0	28.1
20—29	46.9	38.0	59.9
30—39	23.5	35.9	5.5
40—49	12.7	17.8	5.3
50+	3.1	4.3	1.2
Years of External Experience (Years) (100%)			
(=Age—Education—6—Job Tenure)			
0—2 years	19.9	9.4	35.1
3—5 years	21.8	13.9	33.3
6—10 years	25.6	30.3	18.7
11—20 years	20.8	31.7	4.9
20+	11.9	14.7	7.9

* S.D. denotes Standard Deviation
** Firm sixe by Number of Employees

obtained from the raw data file compiled for the *Report on Occupational Wage Survey, 1982* of the Ministry of Labor of the Republic of Korea. The population covered by the survey represents the individual workers who are regularly employed at industrial establishments which employ ten or more workers. The sample was selected by a stratified random sampling method.[5] The purpose of the survey was to analyze the wage structure of the Korean industrial sector. The total original sample size is approximately 560,000 workers. Taking into account the computing cost, a two-percent random sub-sampling from the original data set[6] obtained 11,467 cases. After eliminating the cases which contained missing variables, the actual regression analyses used 9, 346 individual cases. The data encompassed 5, 632 male workers and 3, 714 female workers. The data provide the following information about the firm which employs the worker and about worker's characteristics as of March, 1982 :

For each individual worker

A. Information about the firm (establishment) by which the worker is employed

1) location of the firm
2) industry
3) size[7]

B. Individual characteristics of workers

1) sex (male／female)
2) age
3) marital status
4) schooling
5) occupation
6) job position level
7) job tenure with current employer
8) job experience (length of experience in current occupation)
9) monthly working days
10) monthly working hours (regular working hours／overtime working hours)
11) earnings[8]
    a. monthly base earnigs
    b. monthly overtime earnings
    c. total yearly special payments

The overall means and frequencies of the present sub-sample are given in Table 1. Compared with the frequencies and means for the estimated total workers in the *Report on Occupational Wage Survey, 1982*, there are no big differences.[9] In other words the composition of the current random sub--sampling was relatively similar with that of the report.

Ⅳ. Estimation Results : OLS

The specified regression equations based on the single equation approach are all estimated by the OLS method. The estimation results are reported in Table 2[10]. The estimation results by the 2SLS will be discussed in the next setion.

All of the regression equations fit well. This suggests that the human capital earnings function holds up when applied to Korean data. In particular, the estimated coefficients of job tenure, schooling, and the firm size dummies, most of which are statistically significant in all the cases of the regressions, show consistent positive associations with the ratio of bonus to regular earnings. This is consistent with the predictions of the theoretical model. The adjusted R^2, which denotes the power of explanation of the regression equation, for the bonus equation (5) is lower than that for the regular earnings equation (6). It is 51% for the bonus equation, and 74% for the regular earnings equation, respectively. The difference in the adjusted R^2's implies that the variation of bonus payments is less well explained generally by the human capital earnings function. This also means that unobservable random factors play a more important role in determining the variation of bonus payments than in determining the variation of regular earnings.

Column one of the table presents estimates of equation which is the fundamental testing equation of the present study. The signs and magnitudes of the estimated coefficients for education, current job tenure and firm size dummy variables, with which this study is primarily concerned, are all positively related with the bonus - regular earnings ratio, and the coefficients of these variables are all significant at a 99% confidence interval. For education, an additional year of education increases the ratio by 3.6%. This fact is cross checked by comparing the two coefficents of the education variable in the bonus equation of column two and the regular earnings equation of column three. One year of additional schooling tends to increase annual bonus payments by 9.3% while it increases regular earnings by 5.7%. The return to education in the total monthly earnings equation (column four) therefore is greater than that in the regular earnings equation (6.2% vs 5.7%). This shows that total earnings differentials by education are accentuated by the difference in bonus payments. The empirial model specified in the previous section predicted that the relationship between the ratio of bonus to regular earnings (RBP) and the initial endowment of human capital (T) depends on the elasticity of the job training (t) with respect to the human capital endowment (T) [note the fact that $\frac{\partial(RBP)}{\partial T} \gtrless \leftrightarrow \frac{\partial t}{\partial T}\frac{T}{t} \gtrless 1$ in (2b)]. Assuming that the years of education of the worker represent his initial endowment of human capital, the positive value of the estimated coefficient for education in Eq. (3)

implies that the elasticity of on-the-job training with respect to schooling is larger than one.

The job tenure effect on the ratio of bonus to regular earnings is remarkable. A one year inerease in job tenure raises the ratio by almost 20%. Decomposing this effect into bonus payments and regular earnings, the return to one year of additional job tenure in annual bonus payments is 25.7% while the return in regular earnigs is only 6.0%. This fact confirms the interpretation of bonus payments as a shared return to firm-specific human capital investment in Korea. This is also confirmed indirectly by comparing the estimated coefficients of job tenure in the total monthly earnings equation of column four and in the regular earnings equation of column three (7.7% vs 6.0%).

On the other hand, for the case of external experience, the coefficient of the bonus ratio equation seems to be almost negligible, and is not statistically significant. The main reason might be that the usefulness of external experience in the current job is so different among individual workers that it does not reveal a consistent trend in the bonus ratio equation. External experience is positively associated with bonus payments as well as with regular earnings. The possibility of substitution between internal experience and external experience, however, shows great differences in the determination of bonus and regular earnings. In the case of regular earnings, the substitutability is almost 50% (2.9/6.0), while it is slightly less than 10% (2.9/25.7) in the case of bonus payments. This is another confirmation of the current presumption that job tenure is a good proxy of

Table 2. Estimated Earnings Functions in Korea, 1982

Equation	Log (RBP) (Eq. 3)	$\text{Log}(Y^B)$ (Eq. 5)	$\text{Log}(Y^R)$ (Eq. 6)	$\text{Log}(Y^T)$ (Eq. 7)
Independent Variables				
Constant	.2032 (.0814)	3.6151 (.0875)	3.4119 (.0300)	3.5576 (.0318)
Education (year)	.0358 (.0048)	.0929 (.0051)	.0571 (.0017)	.0625 (.0018)
Job Tenure (year)	.1972 (.0059)	.2574 (.0063)	.0602 (.0021)	.0767 (.0023)
Ext. Experience (year)	−.0008 (.0040)	.0286 (.0043)	.0294 (.0014)	.0297 (.0015)
Job Tenure Squared	−.0086 (.0003)	−.0101 (.0003)	−.0015 (.0001)	−.0022 (.0001)
Ext. Exper. Squared	−.00004 (.0001)	−.0006 (.0001)	−.0005 (.00003)	−.0006 (.00004)
Working Hours	−.0040 (.0002)	−.0023 (.0002)	.0016 (.00008)	.0012 (.00008)
Firm Size				
I (10−99)	−	−	−	−

Ⅱ (100-499)	.0947 (.0297)	.1703 (.0319)	.0756 (.0109)	.0781 (.0116)
Ⅲ (500+)	.3395 (.0288)	.4487 (.0310)	.1092 (.0106)	.1352 (.0128)
Industry				
Mining	-.1022 (.0499)	.1460 (.0536)	.2482 (.0183)	.2303 (.0195)
Manufacturing	-	-	-	-
Utilities	.2229 (.1054)	.3697 (.1132)	.1468 (.0388)	.1651 (.0412)
Construction	-.0113 (.0570)	.2023 (.0612)	.2136 (.0210)	.1990 (.0223)
Sales & Trade	.2159 (.0529)	.3939 (.0568)	.1287 (.0194)	.2062 (.0206)
Tranport & Comm.	-.2764 (.0343)	-.0744 (.0369)	-.1787 (.0126)	.1625 (.0134)
Financ. & Insur.	.4001 (.0480)	.5575 (.0516)	.1764 (.0177)	.2465 (.0188)
Services	.3741 (.0440)	.5434 (.0472)	.1693 (.0162)	.2179 (.0172)
Occupation				
Professional & Tech.	.0910 (.0431)	.4155 (.0463)	.3245 (.0158)	.3373 (.0168)
Admin. & Manager.	-.0631 (.0588)	.5432 (.0631)	.6062 (.0216)	.6076 (.0229)
Clerical	.0867 (.0281)	.2372 (.0302)	.1505 (.0103)	.1596 (.0110)
Sales	-.1907 (.1076)	-.0620 (.1156)	.1287 (.0396)	.0944 (.0420)
Service	-.0665 (.0491)	-.2452 (.0527)	-.1787 (.0180)	-.1865 (.0192)
Production Worker	-	-	-	-
Location				
Metropolitan	-	-	-	-
Small & Med. Cities	.1213 (.0194)	.0906 (.0208)	-.0307 (.0071)	-.0223 (.0075)
Sex				
Male	.0110 (.0241)	.3395 (.0259)	.3286 (.0088)	.3287 (.0094)
Female	-	-	-	-
Marital Status				
Single	-	-	-	-
Married	.0026 (.0301)	.1156 (.0323)	.1130 (.0110)	.1151 (.0117)
R^2(adjusted)	.2862	.5102	.7354	.7384
SEE	.8208	.8816	.3021	.3208
SSE	2518.57	7547.18	3273.86	2709.82
SSR	6281.52	7246.25	851.25	959.72
No. of Cases	9346	9346	9346	9346
F Value	162.506	422.136	1130.268	1144.396

1. Terms in parentheses in the Table are the standard errors of the estimates.
2. RBP=(annual bonus/regular monthly earnings)=Y^B/Y^R
   Y^B=Annual bonus payments
   Y^R=Regular Monthly Earnigs
   $Y^T \equiv Y^R+(Y^B/12)$=Monthly Total Earnings
3. SSE=Sum of squares of Estimates. SSR=sum of squares of Residuals.
   SEE=Standard Error of Estimates.

firm-specific human capital while external experience measures a type of general human capital. The variation of regular earnings thus usually depends upon the characteristics of general human capital, while the variation of bonus payments mainly depends on firm-specific human capital.

The variables of job tenure squared and previous external experience squared are included to check whether the earnigs profiles are concave with respect to experience. Their effects on the bonus-regular earnings ratio equation are shown to be negative. This means there are diminishing returns to job experience. The degree of the concavity of the profile between the ratio and previous potential experience is negligible and statistically not significant. The concavity of the profile with respect to job tenure is, however, important and also statistically significant. It is interesting to calculate the maximum point of the profile between the bonus ratio and job tenure. The maximum of the profile is occurs when job tenure reaches 11.4 years, according to the estimated coefficients for equation (3)[11]. The average length of job tenure for the current sample is around 4 years (see Table 1), which is shorter than the predicted optimum length of tenure of 11.4 years. This implies that many workers change their jobs before the ratio of bonus to regular earnings reaches its maximum point. This slso suggests that the length of job tenure also depends on other factors in addition to bouns payments.

The various types of dummy variables which are included in the regression shift the intercept terms of specific group of workers. The overall control group is female, non-married, simple production workers who are employed in the small-size manufacturing firms located in the large cities.

The estimated coefficients of the firm-size dummies show that a remarked difference in earnings by firm-size is also accentuated by the differences in bouns payments. Looking at the differentials relative to the control group of small firms which employ 10-99 workers, medium-size firms and large firms enjoy 9.4% and 34.0% higher bonus ratios, respectively. Decomposing this effect by bonus payment and regular earnings, it is shown that the scale effect in regular earnings is 7.6% and 10.9%, respectively, while the effect in bonus payments is 17.0% and 44.9%. The scale effect in total earnings, therefore, is higher than in regular earnings. To see the total effect, compare the coefficients of the firm size dummies in equation (6) and in equation (7). An economic interpretation of the empirical results of the inter-scale effect is simple if it is true that there exists a positive correlation between profitability of on-the-job investment and firm size. It is apparent that there should be a more careful examination of this issue.

The estimated coefficients of industry dummy variables also reveal large cross industry variations in the bonus ratio as well as in annual bonus payments and regular earnings. Since the present examination is a one-year cross-sectional analysis, it is difficult to relate these variations to the output demand fluctuations of each industry. This weakness can be partially solved by using panel data. The estimated coefficients, however, show two points related to the specific human capital theory. First, the estimated coefficients of the industry dummies show that inter-industry earnings differentials are accentuated by adding bonus payments to regular earnings. This fact is consistent with the implication of the specific human capital theory that each industry could have different characteristics in the accumulation of firm-specific human capital.[12] Second, even though there exist inter-industry differences in the optimal accumulation of specific human capital, differences in earnings by industry also can be partially caused by the inter-industry differences in the custom of compensation.[13] In particular, comparing the manufacturing sector and finance and insurance and service sectors, the latter two sectors show only approximately 17% higher regular earnings than does the manufacturing sector but approximately 55% higher bonus payments. This fact cannot be explained completely by differences in output fluctuations or by firm-specific human capital.

Occupational dummies are also included as independent variables to check whether there are any inter-occupational differences in optimal specific capital investment. Since workers with different occupations can be employed at the same time in the same industry, the demand effect is not as important in this case. The present cross-sectional study, therefore, can also give some indication of the validity of the specific human capital theory using the inter-occupational earnings differentials. Unfortunately, in many cases the estimated coefficients of the occupation dummies in the bonus ratio equation are statistically insignificant; further examination of separate estimates of occupation-specific earnings functions may be needed.

The sex dummy is also used as an independent variable. The coefficient of the sex dummy in the bonus ratio equation is negligible and statistically insignificant. This fact does not coincide with the conclusion of Landes (1977) who showed that the main earnings differentials by sex in a U.S. data base could be ascribed to sex differences in firm specific human capital. A detailed comparision of sex differences can be given by estimating separate earnings fuctions for each sex[14]. The estimated coefficient of the location dummy shows that firms in small cities have relatively higher bonus payments while they pay lower regular earnings. This indicates that regional earnings differentials, after controlling for general human capital, are not as severe as in the U.S. whose differentials are based on Chiswick's (1974) estimations. This might result from the fact that since Korea is a small country, there is little difference in living costs between metropolitan area and local cities. The marital status dummy does not show and consistent effect on the bonus ratio, while regular and total earnings of married workers are about 11% higher than for non-married workers. This is mainly caused by the age effect.

In conclusion, the regression results with the OLS single equation approach strongly support the hypothesis that the relative variation of Korean bonus payments are primarily determined by variables which represent firm-specific human capital, including job tenure, schooling and firm size. The empirical evidence is thus consistent with the theoretical predictions that the model of firm-specific human capital provides.

Even though this empirical evidence provides important implications for understanding the Korean earnings structure, the methodolgy itself is not thorough in that the simultaneity between the ratio of bonus to regular earnings and the lenght of job tenure is not accounted for. In the next section, we will see whether the basic argument is still valid even after this simultaneity is allowed for.

V. Estimation Results : 2SLS

In a world in which the return to firm-specific human capital and the duration of job tenure are simultaneously determined, the relevance of the previous results estimated by the OLS method is limited. This limitation can be alleviated by using the standard two stage least squares (2SLS) procedure, which has already been specified in equations (9) and (10). Estimation of the bonus ratio equation by 2SLS will make certain whether the theoretical arguments proved by the previous single equation approach are still valid when simultaneity between duration of job tenure and still valid when simultaneity between duration of job tenure and bonus ratio is taken into account. Table 3 reports the estimation results of 2SLS.

In the first stage, the instrumental job tenure equation (9) was estimated by the OLS method. The new exogeneous variables that are used as the instrumental variables include the logarithm of hourly regular wage rate, defined by *In* (HW) = *In* [(monthly regular earnings) / (monthly working hours)], and age. The length of job tenure and schooling are negatively

Table 3. Earnings Functions Estimated by Two-Stage Least-Squares

Equation	Log (RBP) (Eq. 10)	IE (Eq. 9)
Independent Variabies		
Constant	.0102 (.1152)	.3355 (.2622)
Education (year)	.0368 (.0049)	−.1045 (.0159)
ÎE[Esti. by Eq. (4-9)]	.3007 (.0432)	
IESQUAR[Esti. by Eq. (4-9)]	−.0153 (.0028)	
Ext. Experience (year)	.0035 (.0044)	
EESQUAR	−.00014 (.0001)	
Working Hours	−.0039 (.0002)	
Age		.1858 (.0054)
Log (Hourly Wage)		2.2640 (.0901)
Firm Size		
Ⅰ (10−99)	−	−
Ⅱ (100−499)	.0812 (.0308)	.1021 (.1056)
Ⅲ (500+)	.3184 (.0307)	.5437 (.1025)
Industry		
Mining	−.0652 (.0531)	−.4498 (.1776)
Manufacturing	−	−
Utilities	.3103 (.1134)	3.4736 (.3715)
Construction	−.0100 (.0582)	−1.6616 (.2029)
Sales & Trade	.2200 (.0540)	−1.0711 (.1883)
Tranport & Comm.	−.2509 (.0366)	−1.7177 (.1221)
Financ. & Insur.	.4341 (.0509)	−.2149 (.1705)
Services	.4171 (.0482)	−.3665 (.1566)
Occupation		
Profession & Tech.	.0968 (.0440)	.0253 (.1560)
Admin. & Manager.	−.0240 (.0621)	−.0290 (.2166)
Clerical	.0657 (.0299)	.3538 (.1005)
Sales	−.1553 (.1108)	−.4122 (.3824)
Service	−.0770 (.0503)	−.5612 (.1747)
Production Worker	−	−
Location		
Metropolitan	−	−
Small & Med. Cities	.1097 (.0203)	.3024 (.0687)
Sex		

Male	.0110 (.0246)	.9611 (.0881)
Female	–	–
Marital Status		
Single	–	–
Married	–.0852 (.0475)	–.3871 (.1024)
R^2(adjusted)		.3833
SSE		49504.9
SSR		79219.4
No. of Cases	9346	9346
F Value		291.36
SEE		2.915

Notes :
1. Terms in parentheses are the standard errors of the estimates.
2. RBP=(annual bonus/regular monthly earnings)=Y^B/Y^R
3. IE=Job tenure
4. SSE=Sum of Squares of Estimate
5. SSR=Sum of Squares of Residual
6. SEE=Standard Error of Estimate

related. This means that the mobility of highly educated worker is higher than that of less educated workers. This seems to arise mainly for two reasons. One is that highly educated workers have more labor market information than less educated workers in Korea. The other is that the relative demand for highly educated workers has been higher than for less educated workers for the last several years in Korea. As expected in general, the hourly wage rate and the length of job tenure are positively related; indeed, the hourly wage is revealed as one of the most important determinants of the length positively related. The theoretical discussion has also implied this relationship, if it is assumed that large-scale firms invest more in firm-specific training. The various dummy variables including occupation and marital status are also included in the job tenure equation to reflect differences among different categories of workers.

In the second stage, the predicted values of the length of job tenure (IE) calculated using the estimated coefficients of equation (9) are used in place of IE in the estimation of the bonus ratio ecuation (10). The estimation results of the bonus ratio equation show basically the same pattern as the results obtained by OLS. The predicted positive relationships between the bonus ratio and the variables representing firm-specific human capital, including job tenure, schooling and firm size, hold up consistently, and the estimated cofficients of these variablcs are statistically significant. There-possible to relate the variation of bonus payments to the characteristics of workers and firms involved in job-worker matches.

Empirical tests have been implemented by estimating various forms of human capital earnings function. First, the OLS method was utilized and then, to incorporate simultaneity between returns to firm-specific human capital and the duration of job tenure, a 2SLS procedure was used. The increased from 19.0% to 30.1%. The dramatic increase might be anticipated by the conceptual model discussed in the previous section. As long as the present procedure is regarded as an appropriate one in the selection of the instrumental variables (the new additional exogeneous variables in the job tenure equation), the estimated coefficients of job tenure in the single-equation regressions are downward biased.

The present 2SLS estimates of the bonus ratio equation, however, leaves some room for improvement. Two major problems may be indicated. First, selection of the instrumental variables needs further study. Strictly speaking, the hourly regular wage rate, one of the new exogenous variables which was used as an instrumental variable, is not statistically independent of log (RBP), since log (RBP) $\equiv$ log (Bonus) — log (Regular Earnings), even though it is independent conceptually. Unfortunately, the present data set does not porovide any other new information which is appropriate for the new exogenous variables in the estimation of the job tenure equation. This question should be re-examined with another data set which supplies additional information. Furthermore, panel data would make it possible to specify a structural equation system which takes into account simultaneous determination of wages and labor turnover.[15]

Another problem is that even though good instrumental variables are used, the problem of severe heteroscedasticity is expected by the current data set, which was obtained with a method of stratified random sampling. This problem can be overcome by applying the method recently suggested by White (1982).[16]

Ⅵ. The Summary and Concluding Remarks

This paper has attempted to explain the variation of the ratio of bonus payments to regular earnings by utilizing a model of firm-specific human capital. The paper started with the presumption that bonus payments in Korea are the workers' shares of the returns to firm-specific human capital. Then, a model of firm-specific human captal provided the testable predictions on the relative variation of bonus payments. The model makes it fore, 2SLS estimation leaves the conclusions based on OLS largely inact. This establishes the robustness of the specific human capital model in explaining the relative variation of the bonus payments in Korea.

A comparison of the 2SLS and the OLS estimates of the bonus ratio equation reveals only one notable difference. The estimated coefficient of job tenure with the 2SLS method is increased dramatically. The value theoretical arguments proposed are supported by both procedures. The empirical evidence in this paper suggests that the prevalence of the bonus system in Korea reflects the importance of firm-specific human capital and that the theory of firm-specific human capital can provide an analytical tool in explainig the Korean earnings structure.

Empirical study is always tailored to the quality of data. Since in general cross-sectional data are not suitable for testing multi-period problems, a test of the specific human capital model by panel data will be highly profitable. An extension of the present results in this direction might provide a better understanding of the behavior of labor market.

Footnotes

1) See kim(1985) for a detailed discussion on the theory of firm-specific human capital including the origin and development of the idea and its empirical relevency.
2) In Korea, the amount of individual total yearly bonus payments is also determined by the characteristics of workers. Thus, in order to examine the relative variation of the bonus payments, it is necessary to control the general characteristics of individual human capital which are the primary determinants of regular earnings.
3) One important result derived from the model which is useful in determining the signs of (2a) and (2b) is that the sharing ratio (α) does not depend on X or T.
4) In this respect, the simultaneity between the bonus ratio and job tenure is presumed here. It might also be possible to simply test for the existence of simultaneity itself between these two variables. One tast of this kind is suggested by Hausman (1978).
5) The frame of the stratification in the sampling includes location, sex and industry. As long as these stratified variables are used exogeneously in the model, the stratification does not cause econometric problems except in special cases. See Maddala, 1983, p. 171.
6) The random subsampling was done by using the SPSS Computer Package, in which the program for a random sub-sampling is designed to make sub-sampling such that the probability of selecting any particular case in the data file is equal to a specified factor. Therefore, this is a kind of uniform random sub-sampling. See N.H. Nie, et al., *SPSS* (second edition : 1975) pp.127-128.
7) Here firm size is determined by the number of employees and refers to the size of the estalishment, i.e., the size of a specific place of business. Since a firm defined as a legal entity may contain more than one establishment, a lorge firm is not always consistent with a large establishment. A large establishment commonly denotes a large firm.

8) The regular monthly and overtime earnings refer to the monthly rate as of March, 1982 ; the special payments, which are dominated by the bonus payments, refer to the yearly rete as of 1981.
9) According to the *Report on Occupational Wage Survey, 1982*, the total estimated number of workers employed in establishments (10 or more employees) is 2, 809, 668. Among them the propottion of male workers is 62. 8% a
10) See Kim(1985) for the estimation results for the various sub-categorzation of the entire sample including male/female workers, manufactruing/non-manufacturing sector and so on.
11) It si calculated as ; $\partial \ln (RBP)/\partial (Tenure)=.1972-2x(.0086)\ x(Tenure)=0$. Thus, $(tenure)^*=11.4$.
12) See Chapman and Tan (1980) for an empirical study of inter-industy wage differentials using the specific human capital framework.
13) A major reason for difference in pay customs could be difference in difficulty of measuring worker's performance across industry.
14) See Kim(1985) for the detailed sex difference.
15) See Mincer and Jovanovic (1981) for a stochastic structural model of labor turnover and wage determination.
16) I am grateful to professor Ian Domowitz who called my attention to this problem. According to his suggestion, I did the significance tests for the current 2SLS estimates based on the White method, which supported the current test results based on t-test. See Chapter Four of Kim(1985).

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