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FURTHER INVESTIGATION INTO THE RELATIONSHIP BETWEEN QUIT RATES AND THE WAGE-TENURE PROFILE IN JAPANESE MANUFACTURING

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Abstract: We examine the relationship between actual quit rates and the slope of wage-tenure profile. The results obtained clarify that there is a negative relationship between these series when we use the definition with monetary units. Conversely, the slope defined in terms of growth is found to be positively correlated with the quit rate. As the theory predicts a negative relationship between these variables, it seems reasonable to conclude from the results that the definition of the slope in monetary units is more appropriate.

JEL classification: J24, J31, J63.

1. INTRODUCTION

The aim of this paper is to analyze the relationship between wage-tenure profile and quit rates from the viewpoint of time-series movements.

It is widely recognized that the existence of long-term employment relationships between firms and workers is one of the most important features of the Japanese labor market. Until recently, this phenomenon has been attributed to cultural uniqueness or historical custom as embodied in the 'lifetime' employment system. Recently, however, Mincer and Higuchi (1988) have found that the low turnover rate in Japan can be explained by the wage structure in Japan, especially the steep wage-tenure profile, and not by Japanese cultural uniqueness. They also verify that the slope of the wage tenure profile and the growth rate of total factor productivity correlate positively. Furthermore, Higuchi (1989) found that the tighter the labor market the flatter the wage-tenure profile becomes. These studies naturally lead us to two hypotheses. One is that the steep wage-tenure profile in

Japan was formed during high growth periods and its slope moves counter-cyclically. The other is that the time-series movement of the slope of wage-tenure profile and that of separation rates show negative correlation.

The former was confirmed by Ohkusa and Ohta (1994). They found that the wage-tenure profile becomes steeper in a high growth period and flatter in a boom when the external labor market is tight. However, the latter part of this theory has not been confirmed yet. This paper attempts to validate the latter hypothesis using time-series data for the Japanese manufacturing industry. The important point to note is that the definition of slope of the wage-tenure profile used in Ohkusa and Ohta (1994) is different from that used in other studies mentioned above. In Ohkusa and Ohta (1994), the slope is measured in monetary units. Whereas, it is measured in terms of growth in other papers. This paper also argues that the definition in monetary units is more appropriate if we interpret the slope of wage-tenure profile as the cost of turnover.

This paper is organized as follows. In section 2, we first describe a simple model of wage determination based on wealth maximizing behavior of workers. It is shown that under the wealth maximization hypothesis, the wage-tenure profile in monetary units becomes steeper when the level of productivity increases and it becomes flatter when the labor market is tight. It is also found that the separation rate of workers becomes a function of the 'single year slope' and the 'lifetime slope' of the wage-tenure profile defined in Ohkusa and Ohta (1994). Next, we examine the result obtained by adopting alternative specification of the utility function. It is shown that the assumption of the logarithmic utility function makes the slope in growth units more appropriate. In section 3, we examine the relationship between actual quit rates and the slope of wage-tenure profile. The results obtained in this section clarify that there is a negative relationship between these series when we use the definition in monetary units. The results support the wealth maximization behavior of workers. Section 4 concludes the paper.

2. AN ILLUSTRATIVE MODEL

This section shows that appropriate definition of the wage slope depends crucially on the underlying assumption about the utility function. Under the assumption of wealth maximization behavior of workers, the slope in monetary units becomes the measure of turnover cost of workers. On the other hand if the utility function is logistic, it is better to examine the slope in terms of growth. We begin with the former.

The framework of the model is a simplified version of Ohashi (1988). One important feature of the model is that wage rates, the level of investment in firm-specific human capital, and separation behavior are jointly determined. Both of which are quite appropriate for our purposes.

For the sake of simplicity, let us assume that workers in this economy live for two periods. During the first period, workers are given firm specific training which

increases their productivity in the second period. In addition, the worker's job dissatisfaction is randomly drawn from a distribution and is only observed by the worker at the end of the first period. At the same time that the worker realizes this, the worker compares the net advantages of the present position with that of the best alternative and then decides whether to quit the firm or to remain. In this section, we assume that both firms and workers are risk neutral agents (wealth maximization hypothesis).

Let w_1 and w_2 be the wage rates firms offer to their employees in the first and second periods, respectively. Suppose that job dissatisfaction is drawn from the distribution $g(u)$. Then, the worker who received u quits the firm at the end of the first period if and only if

$$u \geq w_2 - v\,, \tag{1}$$

where v is the wage rate the worker can get when leaving the firm. Thus, the quite rate, q, is given by

$$q = \int_{w_2 - v}^{\infty} g(u)du\,. \tag{2}$$

The important point to note is that the quit rate is a function of 'lifetime wage slope'. The definition of lifetime wage slope in this paper is the loss of discounted lifetime earnings resulting from the period of a worker's tenure being one year shorter, which is a measure of monetary loss of separation. In this case, the slope is $w_2 - v$.

In hiring new employees on the labor market, it is assumed that the firm must satisfy the following constraint on its wage payment.

$$w_1 + \rho((1-q)(w_2 - u^*) + qv) \geq W \tag{3}$$

where ρ is the discount factor and W is the expected lifetime income assured in the outside market. u^* in equation (3) is the expected dissatisfaction conditional on no quit, i.e. $u^* = \int_{-\infty}^{w_2 - v} ug(u)du / \int_{-\infty}^{w_2 - v} g(u)du$. Now we turn to the problem faced by the firm. Suppose that productivity of workers in the first and second period are denoted by aP_1 and $aP_2(C)$ respectively, where a is the parameter for productivity shock and C is the cost of investment in firm-specific human capital. It is assumed that

$$P_2'(C) > 0 \qquad \text{and} \qquad P_2''(C) < 0\,, \tag{4}$$

which means $P_2(\cdot)$ is an increasing concave function. The firm's optimization problem is to select w_1, w_2 and C to maximize expected present value of the profit subject to the constraint (3). We here define the following Lagrangian function,

$$\begin{aligned}\mathscr{L} = {} & aP_1 - (w_1 + C) + \rho(1-q)(aP_2(C) - w_2) \\ & + \lambda(w_1 + \rho((1-q)(w_2 - u^*) + qv) - W)\,,\end{aligned} \tag{5}$$

where λ is the nonnegative multiplier. Then, the first-order necessary conditions

are given by

$$\frac{\partial \mathscr{L}}{\partial w_1} = -1 + \lambda = 0 , \tag{6}$$

$$\frac{\partial \mathscr{L}}{\partial w_2} = (-1+\lambda)\rho(1-q) - \lambda\rho(1-q)\frac{\partial u^*}{\partial w_2}$$

$$-\frac{\partial q}{\partial w_2}\rho(aP_2(C) - w_2) + \lambda\frac{\partial q}{\partial w_2}\rho(v - w_2 + u^*) = 0 , \tag{7}$$

$$\frac{\partial \mathscr{L}}{\partial C} = -1 + \rho(1-q)aP_2'(C) = 0 , \qquad \text{and} \tag{8}$$

$$\frac{\partial \mathscr{L}}{\partial \lambda} = w_1 + \rho((1-q)(w_2 - u^*) + qv) - W = 0 . \tag{9}$$

The second-order conditions are assumed to be satisfied. By using the fact that $\partial q/\partial w_2 = -g(w_2 - v)$ and $\partial u^*/\partial w_2 = g(w_2 - v)(w_2 - v - u^*)/(1-q)$, we can see that the worker is paid the wage equal to his productivity in the second period. Namely,

$$aP_2(C) = w_2 . \tag{10}$$

Now we can examine the effect of a change in the productivity parameter a and the outside wage rate v on the slope of the wage-tenure profile. The results are

$$\frac{\partial(w_2 - v)}{\partial a} = \frac{P_2(C) - (P_2'(C))^2/P_2''(C)}{1 + \dfrac{a(P_2'(C))^2 g(w_2 - v)}{P_2''(C)(1-q)}} > 0 , \qquad \text{and} \tag{11}$$

$$\frac{\partial(w_2 - v)}{\partial v} = \frac{-1}{1 + \dfrac{a(P_2'(C))^2 g(w_2 - v)}{P_2''(C)(1-q)}} < 0 . \tag{12}$$

Note that denominators are positive by the second-order conditions. Therefore, the model leads to our hypothesis that the slope of the wage-tenure profile defined in monetary units becomes steeper in a high-growth period and flatter in a boom when the external labor market is tight. This hypothesis is empirically confirmed by Ohkusa and Ohta (1994). Moreover, another important result is that the quit rate is negatively related to the slope of the wage-tenure profile.

Next, we analyse the case where utility function of workers is logarithmic. First, let us assume that the capital market is imperfect and thus workers cannot borrow nor lend. In this case, the quit rate is expressed as

$$q = \int_{\log(w_2) - \log(v)}^{\infty} g(u)du . \tag{13}$$

It can be seen from this relationship that the quit rate is a function of logarithm

of relative wage gain. In this case, the slope of wage-tenure profile, which is the cost of separation, is measured in growth units. Then Lagrangian which firms have to solve is expressed as

$$\mathscr{L}=aP_1-(w_1+C)+\rho(1-q)(aP_2(C)-w_2)$$
$$+\lambda(\log(w_1)+\rho((1-q)(\log(w_2)-u^*)+q\log(v))-W)\,, \tag{14}$$

where $u^*=\int_{-\infty}^{\log(w_2)-\log(v)}ug(u)du/\int_{-\infty}^{\log(w_2)-\log(v)}g(u)du$. The first-order conditions are now given by

$$\frac{\partial\mathscr{L}}{\partial w_1}=-1+\lambda/w_1=0\,, \tag{15}$$

$$\frac{\partial\mathscr{L}}{\partial w_2}=(-1+\lambda/w_2)\rho(1-q)-\lambda\rho(1-q)\frac{\partial u^*}{\partial w_2}$$
$$-\frac{\partial q}{\partial w_2}\rho(aP_2(C)-w_2)+\lambda\frac{\partial q}{\partial w_2}\rho(\log(v)-\log(w_2)+u^*)=0\,, \tag{16}$$

$$\frac{\partial\mathscr{L}}{\partial C}=-1+\rho(1-q)aP_2'(C)=0\,,\qquad \text{and} \tag{17}$$

$$\frac{\partial\mathscr{L}}{\partial\lambda}=\log(w_1)+\rho((1-q)(\log(w_2)-u^*)+q\log(v))-W=0\,. \tag{18}$$

Second-order conditions are also assumed to be satisfied. By using the fact that $\partial q/\partial w_2=-g(\log(w_2)-\log(v))/w_2$ and $\partial u^*/\partial w_2=g(\log(w_2)-\log(v))(\log(w_2)-\log(v)-u^*)/(1-q)w_2$, it is easily seen from these equations that the equality between productivity and wage rate in the second period obtained in the previous section no longer holds in this case. Namely, w_2 satisfies

$$w_2=\frac{(1-q)w_1+g(\log(w_2)-\log(v))aP_2(C)}{1-q+g(\log(w_2)-\log(v))}\,. \tag{19}$$

The effect of change in the productivity parameter on the wage slope in the second period now turns out to be

$$\frac{\partial(\log(w_2)-\log(v))}{\partial a}=g(\log(w_2)-\log(v))(1-q)^2w_2\{(P_2'(C))^2-P_2(C)P_2''(C)\}/\Omega>0\,. \tag{20}$$

On the other hand, the labor market effect on the wage slope becomes

$$\frac{\partial(\log(w_2)-\log(v))}{\partial v}=g(\log(w_2)-\log(v))\{P_2''(C)\rho w_1(1-q)^2$$
$$-ag(\log(w_2)-\log(v))(P_2'(C))^2w_2\}/\Omega-1/v<0\,, \tag{21}$$

where

$$\Omega = P_2''(C)(1-q)\{w_2^2 g(\log(w_2)-\log(v)) - w_1 w_2(1-q) - w_1\rho(1-q)^2\}$$
$$-w_2 a g^2(\log(w_2)-\log(v))(P_2'(C))^2 > 0\,, \tag{22}$$

by the second-order conditions. It can be seen that the signs obtained here are also in accordance with the hypothesis that the slopes becomes steeper during a high growth period and flatter when the external labor market is tight. Namely, the property of this specification is the same as the one examined in the previous section. Thus, the theoretical consideration alone does not answer the question which specification of the slope is more appropriate.

3. QUIT RATES AND THE WAGE-TENURE PROFILE

It was clarified in the previous section that there is a close relationship between the slope of wage-tenure profile and the separation rate: quit rates increase as the slope becomes flat. In this section, we investigate whether this relationship actually holds true.

First, we estimate the wage function of blue and white collar male workers in manufacturing by using wage data which is classified by age, tenure and education level, so as to identify the wage-tenure profile for each year. The data source is the Wage Census published by the Ministry of Labor. We use a 'Mince type' wage function with a dummy variable for education level following the earlier research on wage structure.

$$\log W^{k,A,T} = \beta_0 + \beta_1 A + \beta_2 A^2 + \beta_3 T + \beta_4 T^2 + \beta_5 A\cdot T + \beta_6 DE \tag{23}$$
$$(k = \text{blue collar workers, white collar workers}).$$

The variable A refers to total experience which is defined as years after graduation from the last school sttended as used in Hashimoto and Raisian (1985). Thus, it denotes total experience in the labor market, and is an index of general human capital. The variable T refers to tenure and DE is the vector of dummy variables of education levels. The dependent variable is the log of the average real wage of employees with the same attributes. We estimate the wage function using White (1980)'s robust estimation for heteroscedasticity. The results are shown in Tables 1 and 2 in Ohkusa and Ohta (1994) and are not reported in this paper. Using these results, we obtain three types of the slopes of wage-tenure profile. The first definition is the most natural one, and it is represented by the expected wage difference between the wage of a worker and that of a worker whose tenure is one year longer, with all other things being constant. As the defined slope is naturally dependent on total experience, tenure and education level of the individual, we focus on the profiles of university graduates and evaluate them at the point where both total experience and tenure equal one, i.e. $E[W^{k,1,1} - W^{k,1,0}]$.

The second definition is the loss of discounted lifetime earnings resulting from the period of a worker's tenure being one year shorter, i.e. $E[\Omega^{k,1,1} - \Omega^{k,1,0}]$ where $\Omega^{k,i,j}$ is the expected discounted value of a worker whose total experience is i and

tenure is j. We call this the 'lifetime slope'. Both of these slopes are fully described in Ohkusa and Ohta (1994). The third definition is the growth rate of wage when the tenure of a worker becomes one year longer. The point of evaluation is the same as that of the 'single year slope', i.e. $E[\log W^{k,1,1} - \log W^{k,1,0}]$.

Figures 1–7 depict each series. Actual series of the quit rate is obtained from the Survey of Employment Trends published by the Ministry of Labor.[1] Figure

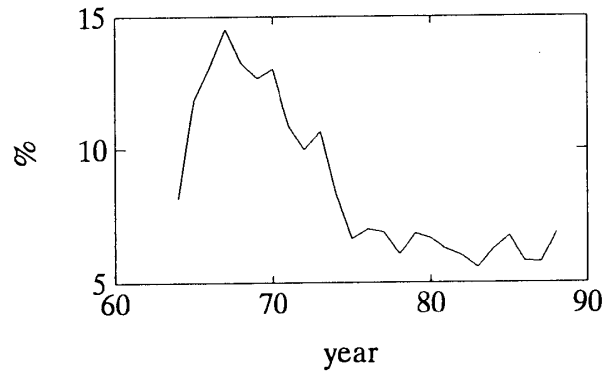

Fig. 1. Quit Rate.

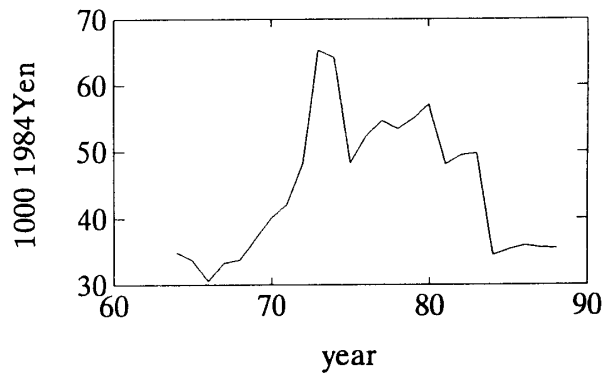

Fig. 2. Wage-tenure profile (SB)

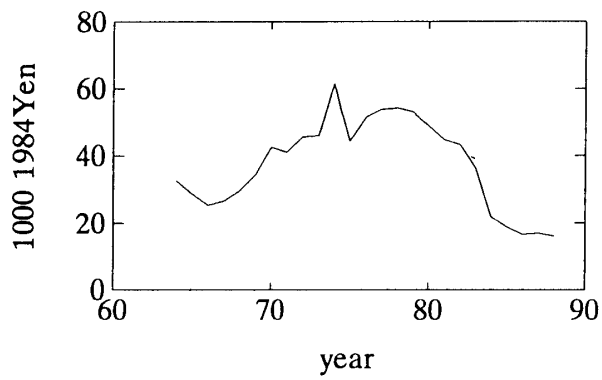

Fig. 3. Wage-tenure profile (SW)

[1] The definition of the quit rate used in this paper is the number of workers who separate from jobs due to "personal reason" divided by the total number of workers.

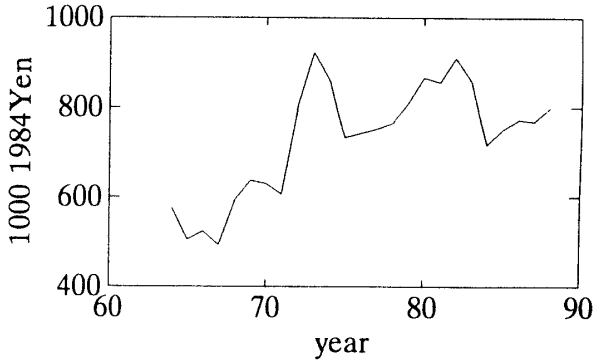

Fig. 4. Wage-tenure profile (LB)

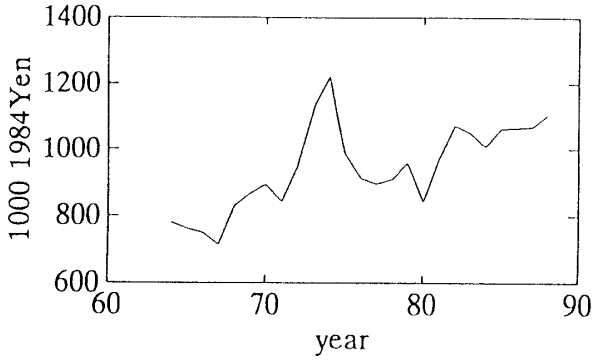

Fig. 5. Wage-tenure profile (LW)

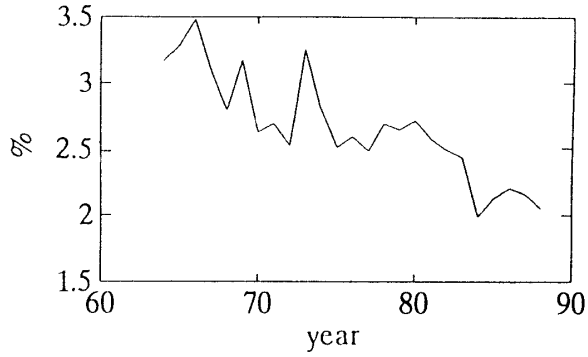

Fig. 6. Wage-tenure profile (GB)

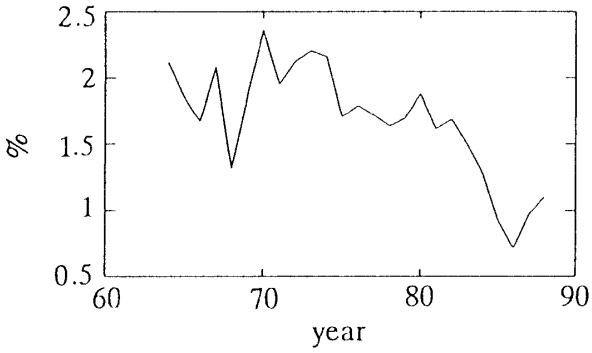

Fig. 7. Wage-tenure profile (GW)

1 shows the movement of the quit rate. The movements of the slopes are shown in Figure 2–7. First, we examine the movement of the slope in monetary units. Figure 1–5 show clear negative relationship between quit rates and the slope of wage-tenure profile. In fact, the correlation coefficients between quit rates and the lifetime slope of blue and white collar workers are −0.855 and −0.690 respectively (see Table 1). Figure 6 and 7 depict the movements of the slope in growth units. It can be seen from these figures that the quit rate is positively related to the slope in growth units. The correlation coefficients for blue and white collar workers are 0.700 and 0.363, respectively. Therefore, we can conclude that the results obtained by utilizing the definition in monetary units are in accordance with the discussion in section 2. On the contrary, the definition in growth units leads us to the opposite conclusion.

Now, let us check the robustness of the result by OLS regression. The dependent variable used is the quit rate in each year. The independent variables are the slope of wage-tenure profile and the quit rate in the previous year. The results are provided in Table 2 and 3. The dummy variable in Table 3 is incorporated so as to capture the effect of change in the definition of wages in the Wage Census data. The definition of wages before 1984 is 'monthly contractual earnings' and that after 1984 is 'scheduled monthly earnings'. It can be seen from these tables that the fit of the equations is sufficiently good and the results support the argument above. Namely, the signs of the coefficients of the slope in monetary units are significantly negative and those in growth units are positive irrespective of the sample period.

Now we confirm the result by examining different definitions of the slope of the wage-tenure profile. The first one, which we call a type 1 measure, represents the wage differential between the worker who has been working for the same firm and the worker who has changed his employer in the previous year, and whose tenure is zero, i.e. $E[W^{k,A,A} - W^{k,A,0}]$ for monetary units and $E[\log W^{k,A,A} - \log W^{k,A,0}]$ for growth units. The second definition, which we call a type 2 measure,

TABLE 1. SUMMARY STATISTICS

	Mean	Standard Deviation	Minimum	Maximum
Quit Rate	0.092	0.030	0.055	0.145
SB	0.244	0.059	0.152	0.341
SW	0.221	0.059	0.126	0.327
LB	3.773	0.814	2.365	4.820
LW	4.764	0.788	3.431	6.487
GB	0.027	0.003	0.024	0.034
GW	0.018	0.002	0.013	0.023

Notes: SB means "the single year slope" for blue collar workers. SW means "the single year slope" for white collar workers. LB means "the lifetime slope" for blue collar workers. LW means "the lifetime slope" for white collar workers. GB means the slope in growth units for blue collar workers. GW means the slope in growth units for white collar workers. Sample period is from 1964 to 1983.

TABLE 2. ESTIMATION RESULT WITHOUT D_{84}

	Constant	WTP	Quit Rate (−1)	R^2	Durbin's h
SB	0.070	−0.181	0.704	0.874	−0.101
	(2.34)	(−2.32)	(5.31)		
SW	0.066	−0.185	0.721	0.888	−0.018
	(2.86)	(−3.37)	(6.10)		
LB	0.100	−0.017	0.603	0.904	−0.158
	(3.56)	(−3.47)	(5.07)		
LW	0.838	−0.013	0.761	0.887	0.061
	(3.04)	(−3.16)	(7.89)		
GB	−0.074	3.467	0.754	0.899	−0.901
	(−3.87)	(3.77)	(8.06)		
GW	−0.729	0.804	0.905	0.804	1.441
	(−0.48)	(0.93)	(11.49)		

Note: See Notes in Table 1. The dependent variable is the quit rate. WTP denotes the slope of wage-tenure profile. Sample period is from 1965 to 1983.

TABLE 3. ESTIMATION RESULT WITH D_{84}

	Constant	WTP	Quit Rate (−1)	D_{84}	R^2	Durbin's h
SB	0.072	−0.185	0.694	−0.017	0.889	−0.161
	(2.43)	(−2.39)	(5.31)	(−1.92)		
SW	0.066	−0.184	0.716	−0.029	0.896	−0.259
	(2.87)	(−3.36)	(6.09)	(−2.4)		
LB	0.100	−0.017	0.599	−0.673	0.913	−0.198
	(3.69)	(−3.57)	(5.19)	(−1.62)		
LW	0.840	−0.013	0.756	0.523	0.896	0.024
	(3.12)	(−3.22)	(8.00)	(1.30)		
GB	−0.070	3.318	0.753	0.018	0.900	−0.729
	(−3.66)	(3.60)	(8.01)	(3.19)		
GW	−0.011	1.091	0.893	0.946	0.831	1.722
	(−0.81)	(1.43)	(11.63)	(1.54)		

Notes: See Notes in Table 1. The dependent variable is the quit rate. WPT denotes the slope of wage-tenure profile. Sample period is from 1965 to 1988.

is the wage differential between the worker who has been working for the firm since his graduation and the one whose tenure is one year shorter, i.e. $E[W^{k,A,A} - W^{k,A,A-1}]$ for monetary units and $E[\log W^{k,A,A} - \log W^{k,A,A-1}]$ for growth units. Both of these measures are evaluated at 5, 10, 20, and 30 years of total experience. The summary statistics for the two types of definition are shown in Table 4. The quit rates are also computed for the different years of the total experience.

Tables 5–8 show the estimated quit rate equation. We can see that both measures in monetary units affect the quit rate negatively for almost every point of

TABLE 4. SUMMARY STATISTICS

	Mean	Standard Deviation	Minimum	Maximum
Type 1				
SB5	0.092	0.016	0.064	0.121
SB10	0.210	0.034	0.151	0.271
SB20	0.456	0.067	0.338	0.558
SB30	0.571	0.094	0.395	0.677
SW5	0.119	0.024	0.073	0.158
SW10	0.299	0.053	0.199	0.388
SW20	0.793	0.110	0.592	1.007
SW30	1.270	0.140	1.042	1.600
GB5	0.130	0.014	0.115	0.161
GB10	0.239	0.024	0.213	0.290
GB20	0.395	0.031	0.363	0.459
GB30	0.467	0.027	0.424	0.534
GW5	0.090	0.012	0.068	0.114
GW10	0.176	0.022	0.143	0.218
GW20	0.338	0.037	0.278	0.397
GW30	0.484	0.052	0.401	0.561
Type 2				
SB5	0.018	0.003	0.012	0.024
SB10	0.020	0.003	0.013	0.026
SB20	0.018	0.004	0.009	0.023
SB30	0.008	0.004	−0.001	0.016
SW5	0.022	0.004	0.013	0.030
SW10	0.026	0.005	0.016	0.036
SW20	0.028	0.005	0.018	0.040
SW30	0.019	0.005	0.012	0.032
GB5	0.002	0.024	0.021	0.030
GB10	0.020	0.001	0.018	0.024
GB20	0.012	0.001	0.010	0.014
GB30	0.005	0.002	−0.001	0.009
GW5	0.002	0.023	0.012	0.021
GW10	0.014	0.001	0.011	0.017
GW20	0.010	0.001	0.008	0.013
GW30	0.005	0.001	0.003	0.008

Notes: Type 1 measure represents the wage differential between the worker who has been working for the same firm and the worker who has changed his employer in the previous year, and whose tenure is zero. Type 2 measure is the wage differential between the worker who has been working for the firm since his graduation and the one whose tenure is one year shorter. SBA means "the single year slope" in monetary units for blue collar workers evaluated at the point where total experience is A. SWA means "the single year slope" in monetary units for white collar workers evaluated at the point where total experience is A. GBA means the slope in growth units for blue collar workers evaluated at the point where total experience is A. GWA means the slope in growth units for white collar workers evaluated at the point where total experience is A. Sample period is from 1964 to 1983.

evaluation. This supports the hypothesis of wealth maximization behavior of workers. On the other hand, the sign of the effect of the slope in growth units is significantly positive for some cases, and some negative coefficients are found for

TABLE 5. ESTIMATION RESULT OF TYPE 1 WITHOUT D_{84}

	Constant	WTP	Quit Rate (−1)	R^2	Durbin's h
SB5	0.087	−0.661	0.702	0.876	−0.641
	(1.90)	(−1.81)	(4.59)		
SB10	0.093	−0.317	0.700	0.876	−0.734
	(1.91)	(−1.82)	(4.57)		
SB20	0.112	−0.178	0.656	0.885	−1.132
	(2.30)	(−2.22)	(4.36)		
SB30	0.125	−0.152	0.577	0.899	−1.193
	(3.97)	(−3.98)	(4.67)		
SW5	0.045	−0.285	0.863	0.846	−0.656
	(1.89)	(−1.88)	(8.62)		
SW10	0.046	−0.123	0.881	0.844	−0.604
	(1.87)	(−1.85)	(9.06)		
SW20	0.052	−0.058	0.912	0.843	−0.471
	(2.00)	(−2.03)	(9.89)		
SW30	0.066	−0.049	0.942	0.850	−0.049
	(2.50)	(−2.72)	(11.12)		
GB5	−0.082	0.803	0.750	0.905	−0.943
	(−4.09)	(4.00)	(8.31)		
GB10	−0.095	0.491	0.743	0.914	−0.878
	(−4.49)	(4.42)	(8.73)		
GB20	−0.139	0.413	0.731	0.941	−0.246
	(−7.08)	(7.02)	(11.34)		
GB30	−0.201	0.471	0.783	0.955	0.469
	(−9.09)	(9.37)	(16.00)		
GW5	−0.010	0.206	0.896	0.806	1.079
	(−0.63)	(1.00)	(11.05)		
GW10	−0.015	0.144	0.879	0.808	1.212
	(−0.80)	(1.07)	(10.02)		
GW20	−0.033	0.149	0.807	0.818	1.553
	(−1.02)	(1.13)	(6.214)		
GW30	−0.058	0.180	0.676	0.836	1.469
	(−1.21)	(1.28)	(3.355)		

Note: See Notes in Table 4. The dependent variable is the quit rate. WTP denotes the slope of wage-tenure profile. Sample period is from 1965 to 1983.

each measure.

The instability of the sign of the coefficient of the slope in terms of growth can be explained as follows. Suppose that the actual quite rate is determined by (2). If we regress it on the slope in terms of growth ($\log(w_2/v)$) by mistake, the result becomes

$$\frac{\partial q}{\partial(\log(w_2)-\log(v))} = -w_2 g(w_2-v)\left\{\frac{w_2-v}{v\dfrac{\partial w_2}{\partial v}-\dfrac{w_2}{v}}+1\right\}. \tag{24}$$

TABLE 6. ESTIMATION RESULT OF TYPE 1 WITH D_{84}

	Constant	WTP	Quit Rate (−1)	D_{84}	R^2	Durbin's h
SB5	0.090	−0.678	0.692	−0.018	0.892	−0.717
	(2.02)	(−1.91)	(4.68)	(−1.77)		
SB10	0.096	−0.325	0.691	−0.019	0.892	−0.812
	(2.03)	(−1.92)	(4.67)	(−1.79)		
SB20	0.114	−0.181	0.647	−0.018	0.899	−1.223
	(2.45)	(−2.34)	(4.48)	(−2.15)		
SB30	0.126	−0.153	0.570	−0.008	0.910	−1.382
	(4.21)	(−4.20)	(4.77)	(−2.01)		
SW5	0.041	−0.249	0.862	−0.011	0.854	−0.555
	(1.71)	(−1.66)	(8.68)	(−1.16)		
SW10	0.043	−0.109	0.876	−0.010	0.853	−0.536
	(1.72)	(−1.67)	(9.12)	(−1.13)		
SW20	0.051	−0.055	0.904	−0.008	0.856	−0.501
	(1.94)	(−1.95)	(9.93)	(−1.08)		
SW30	0.068	−0.050	0.937	−0.001	0.868	−0.113
	(2.65)	(−2.89)	(11.10)	(−0.34)		
GB5	−0.078	0.769	0.749	0.018	0.904	−0.763
	(−3.87)	(3.81)	(8.25)	(3.25)		
GB10	−0.090	0.471	0.742	0.017	0.911	−0.691
	(−4.24)	(4.20)	(8.65)	(3.33)		
GB20	−0.133	0.398	0.729	0.015	0.933	−0.094
	(−6.49)	(6.48)	(11.17)	(3.37)		
GB30	−0.195	0.460	0.779	0.002	0.946	0.451
	(−8.72)	(9.00)	(16.04)	(0.66)		
GW5	−0.014	0.266	0.883	0.010	0.833	1.407
	(−0.95)	(1.45)	(11.25)	(1.660)		
GW10	−0.019	0.175	0.864	0.010	0.835	1.527
	(−1.10)	(1.44)	(10.31)	(1.77)		
GW20	−0.037	0.164	0.791	0.012	0.844	1.850
	(−1.20)	(1.34)	(6.51)	(1.80)		
GW30	−0.057	0.179	0.671	0.007	0.854	1.780
	(−1.22)	(1.32)	(3.43)	(1.71)		

Note: See Notes in Table 4. The dependent variable is the quit rate. WTP denotes the slope of wage-tenure profile. Sample period is from 1965 to 1988.

The sign of this expression is ambigous. Therefore, it is not surprising that we observe unstable effects of the slope in growth units on the auit rate.

The argument can be summarized as follows. The slope of wage-tenure profile is nothing but the cost of turnover. Thus the theoretical consideration requires that a steeper slope is associated with a low turnover rate since the cost of turnover is large when the wage-tenure profile has a steep slope. The results obtained in this section show that this relationship holds only when the slope is defined in monetary units. Our conclusion is straightforward. The slope of wage-tenure profile measured in monetary units is 'economically' more appropriate than that defined in terms of growth.

TABLE 7. ESTIMATION RESULT OF TYPE 2 WITHOUT D_{84}

	Constant	WTP	Quit Rate (−1)	R^2	Durbin's h
SB5	0.083	−3.140	0.712	0.875	−0.579
	(1.89)	(−1.79)	(4.80)		
SB10	0.082	−2.840	0.721	0.875	−0.583
	(2.01)	(−1.90)	(5.24)		
SB20	0.069	−2.484	0.726	0.883	−0.575
	(3.14)	(−3.11)	(6.95)		
SB30	0.036	−1.951	0.771	0.875	−0.362
	(2.64)	(−3.11)	(7.48)		
SW5	0.043	−1.397	0.866	0.845	−0.632
	(1.85)	(−1.83)	(8.63)		
SW10	0.041	−1.203	0.884	0.842	−0.564
	(1.79)	(−1.79)	(9.03)		
SW20	0.041	−1.202	0.908	0.846	−0.246
	(1.92)	(−2.01)	(9.84)		
SW30	0.027	−1.132	0.929	0.844	0.974
	(1.97)	(−2.03)	(10.61)		
GB5	−0.082	4.194	0.765	0.890	−0.570
	(−3.62)	(3.55)	(8.37)		
GB10	−0.084	4.862	0.806	0.860	0.345
	(−3.21)	(3.24)	(9.84)		
GB20	0.042	−2.795	0.921	0.815	0.628
	(0.984)	(−0.91)	(10.08)		
GB30	0.030	−3.180	0.835	0.874	−0.556
	(2.553)	(−1.05)	(8.96)		
GW5	−0.008	0.786	0.908	0.803	1.618
	(−0.34)	(0.71)	(11.23)		
GW10	−0.002	0.606	0.915	0.801	1.458
	(−0.10)	(0.38)	(10.63)		
GW20	0.158	−1.268	0.953	0.802	0.842
	(0.616)	(−0.43)	(8.953)		
GW30	0.018	−2.863	0.966	0.816	1.156
	(1.344)	(−1.08)	(9.348)		

Note: See Notes in Table 4. The dependent variable is the quit rate. WTP denotes the slope of wage-tenure profile. Sample period is from 1965 to 1983.

4. CONCLUSION

Let us summarize the main discussion in the paper.

Firstly, the simple model analyzed in this paper predicts that the slope of the wage-tenure profile and quit rates correlate negatively. This relationship is robust with regard to the specification of the utility function of workers. However, under the assumption of wealth maximization behavior for the workers, the definition of the slope in monetary units becomes an appropriate measure. Contrastingly, we can construct a model in which the slope in growth units plays a crucial role by adopting logarithmic utility function for the workers.

TABLE 8. ESTIMATION RESULT OF TYPE 2 WITH D_{84}

	Constant	WTP	Quit Rate (−1)	D_{84}	R^2	Durbin's h
SB5	0.085	−3.218	0.703	−0.017	0.891	−0.663
	(2.01)	(−1.89)	(4.91)	(−1.74)		
SB10	0.084	−2.903	0.713	−0.015	0.891	−0.680
	(2.13)	(−2.00)	(5.37)	(−1.80)		
SB20	0.070	−2.516	0.719	−0.004	0.896	−0.715
	(3.33)	(−3.27)	(7.07)	(−1.16)		
SB30	0.037	−1.959	0.765	0.009	0.887	−0.463
	(2.74)	(−3.19)	(7.52)	(2.16)		
SW5	0.039	−1.210	0.865	−0.011	0.853	−0.519
	(1.66)	(−1.61)	(8.70)	(−1.12)		
SW10	0.380	−1.058	0.880	−0.009	0.852	−0.474
	(1.63)	(−1.59)	(9.12)	(−1.04)		
SW20	0.039	−1.131	0.902	−0.005	0.858	−0.264
	(1.85)	(−1.88)	(9.90)	(−0.76)		
SW30	0.027	−1.104	0.925	0.007	0.861	0.959
	(2.06)	(−2.11)	(10.63)	(1.69)		
GB5	−0.077	3.963	0.765	0.016	0.891	−0.419
	(−3.42)	(3.38)	(8.32)	(3.01)		
GB10	−0.075	4.442	0.808	0.012	0.867	0.439
	(−2.99)	(3.04)	(9.80)	(2.36)		
GB20	0.044	−2.921	0.915	0.002	0.838	0.624
	(1.08)	(−1.00)	(10.05)	(0.66)		
GB30	0.030	−3.177	0.829	0.012	0.885	−0.633
	(2.62)	(−1.05)	(8.97)	(2.50)		
GW5	−0.010	1.154	0.893	0.008	0.830	1.974
	(−0.68)	(1.18)	(11.52)	(1.29)		
GW10	−0.007	1.122	0.897	0.006	0.827	1.836
	(−0.42)	(0.79)	(11.13)	(0.91)		
GW20	0.010	−0.559	0.993	0.0005	0.824	1.078
	(0.41)	(−0.19)	(9.29)	(0.07)		
GW30	0.018	−2.714	0.959	0.005	0.837	1.180
	(1.41)	(−1.10)	(9.42)	(0.99)		

Note: See Notes in Table 4. The dependent variable is the quit rate. WTP denotes the slope of wage-tenure profile. Sample period is from 1965 to 1988.

Secondly, the relationship between the slope in monetary units and actual quit rates shows a negative correlation which supports the model provided in section 2. Contrarily, it is found that the slope defined in growth units and the quit rate exhibit unstable relationship which contradicts the model obtained in section 3.

It would seem reasonable to conclude from the results that the definition of the slope in monetary units is more appropriate as a measure of turover cost. Thus, we should be careful in choosing the definition of the slope when analyzing the wage-tenure profile. We also believe that researchers examining the slope in growth units should provide any and all meaningful 'economic' rationale of doing so.

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