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Recently, researchers have challenged the validity of the dominant theories of wage growth, claiming that the observed positive relation between wages and tenure is an artefact of omitted job match quality. In sharp contrast to the human capital theory, job match theory implies that women's wages are not directly affected by their discontinuous labour force participation. Using samples of women workers from three data sets, the authors estimate structural models of the wage–tenure relation which control directly for job match quality, and find evidence of a strong positive relation between wages and tenure.

I. INTRODUCTION

Although it is well established that female workers earn less on average than male workers, the source of this wage disparity has been a topic of great controversy for over 20 years. While a number of explanations have been offered, perhaps the most widely accepted explanation is implied by human capital theory. Human-capital theory predicts a positively sloped wage–tenure profile as the returns to firm-specific training are shared between the worker and the firm. Accordingly, women are predicted to earn less than men because of their discontinuous labour force participation, which results in lower average tenure on the job.

Despite the centrality of tenure in explaining wage differences by gender, there has been no examination of the impact on women's wages of potential biases in estimated returns to tenure. Researchers have recently addressed the consequences on estimated returns to tenure of omitted job match quality, but all empirical investigations to date have been limited to male workers (e.g. Abraham and Farber, 1987; Altonji and Shakotko, 1987; and Hersch and Reagan, 1990). However, the impact of job match on women's wage–tenure profiles is of independent interest because job match theory strongly contradicts the widely accepted human-capital explanation of women's relatively lower earnings. If wages are only slightly related to job seniority, as job match proponents claim, discontinuous labour force participation will affect women's earnings only by reducing years of total work experience, but not by reducing within-job wage growth.

A second source of bias in estimated returns to tenure may arise from the joint endogeneity of wages and tenure. While human-capital theory emphasizes the effect of tenure on wage rates, it is clear that wages also affect tenure, through the effect of wages on turnover (e.g. Blau and Kahn, 1981; Viscusi, 1980). This joint endogeneity of wages and tenure also implies that single-equation estimates of the returns to tenure may be biased.

Since we observe wage and tenure only of women who choose to participate in the labour market, selection is potentially a third source of bias that we correct for in this paper.

This paper begins by discussing possible biases in the returns to tenure due to omitted job match quality, the joint endogeneity of wages and tenure, and selection. To correct for these biases, we estimate a structural model, adjusted for selection bias, with direct measures of job match quality. We present estimates of our model using three different data sets.

II. MODEL SPECIFICATION

This section sets out a stochastic model of women's wages and tenure. We can write the wage and tenure of individual i in job j as

$$\ln W_{ij} = g_1 T_{ij} + g_2 EXP_i + g_3 Y_{ij} + e_{ij} \quad (1)$$

$$T_{ij}=b_1 W_{ij}+b_2 AGE_i+b_3 \boldsymbol{Z}_{ij}+u_{ij} \quad (2)$$

where $\ln W$ is the natural logarithm of wage, T is tenure, EXP is total work experience, and AGE is age.[1] The vectors $\boldsymbol{Y}$ and $\boldsymbol{Z}$ represent observable worker and firm characteristics that affect wage and tenure respectively (e.g. education, union status, firm size) with $\boldsymbol{Y}$ and $\boldsymbol{Z}$ having a number of elements in common. The error terms, e and u, include the effects of any unobservables.

Ordinary least squares (OLS) estimates of Equations 1 and 2 may be biased for three reasons. First, omitted individual and job match quality reflected in the error terms are likely to be correlated with the endogenous variables, particularly tenure and experience in the wage equation, and wages in the tenure equation, which may lead to omitted variable bias. Second, wages and tenure are jointly determined, and single-equation estimates may be subject to simultaneity bias, due to the correlation of e with tenure and experience, and of u with wage. Third, the observed wage–tenure distribution reflects only wages and tenure of those women who choose to participate in the labour market. The observed distribution of wage offers is truncated by the reservation wage. Thus, the conditional means of e and u over the employed population are non-zero. In order to obtain unbiased estimates of the coefficients in Equations 1 and 2 it is necessary to correct for this selection bias.

The third problem is solved by the standard Heckman (1979) sample selection correction. The probability that a woman of given individual characteristics is employed is estimated with a probit equation. The inverse Mill's ratio is then calculated and appended to both the wage and tenure equation to adjust for sample selection biases.

The second problem is solved by simultaneous estimation of the wage and tenure equations. Simultaneous estimation of this wage–tenure system requires that exclusion restrictions be made in order to identify both the wage and tenure equations. Since many of the individual characteristics expected to affect wages will also affect tenure, estimation of the system using only information on the individuals in the sample may be impossible. One of the data sets used in this paper has information on firms as well as individuals; in the following we show that only this data set, which allows exclusion restrictions using firm-specific information, yields meaningful estimates of the wage–tenure system.

The first problem is mitigated by including observable components of job match quality in the wage–tenure system. Information on the quality of the job match is not available in all data sets; our choice of data sets in this paper is based on the presence of some information on job match quality.

The appropriately modified wage and tenure equations, to be estimated simultaneously, are

$$\ln W_{ij}=g_1 T_{ij}+g_2 EXP_i+g_3 \boldsymbol{Y}_{ij}+g_4 \boldsymbol{M}_{ij}+g_5 \lambda_i+\varepsilon_{ij} \quad (3)$$

$$T_{ij}=b_1 W_{ij}+b_2 AGE_i+b_3 \boldsymbol{Z}_{ij}+b_4 \boldsymbol{M}_{ij}+b_5 \lambda_i+\mu_{ij} \quad (4)$$

where ε and μ are independent and zero mean random variables with normal distributions, λ is the inverse Mill's ratio, and the observable components of job match quality are included in the vector $\boldsymbol{M}$.

Since simultaneous estimation of the wage–tenure system will eliminate simultaneity bias, the remaining source of bias will arise from unobserved individual and match effects. However, as we discuss below, the direction of any bias arising from these effects is ambiguous.

First, consider the bias due to unobserved individual characteristics. High ability individuals are likely to have higher wages, and omitting individual ability may upwardly bias the wage effect in the tenure equation. However, the relation between tenure and ability is uncertain. High ability workers may be less likely to be dismissed from a job, but are more likely to receive a higher outside wage offer, thereby reducing tenure on the current job. Thus the direction of bias deriving from omitted individual ability on the returns to tenure in the wage equation is unclear.

Second, consider the bias due to omitted match variables. On the one hand, once a good match has been established individuals are likely to have high wages and high tenure. This would tend to bias the returns to tenure in the wage equation, and to wage in the tenure equation upward. However, if wages rise with tenure, acceptable outside offers must compensate workers for forgone returns to tenure, and low tenure workers will disproportionately be those with high starting wages. This biases downward the returns to tenure in the wage equation, as well as the returns to wage in the tenure equation.

Since *a priori* we cannot predict the direction of bias attributable to the cumulative effect of omitted individual and match variables, we turn to an empirical investigation of the extent and direction of bias.

III. DATA

Estimation of a structural model which corrects for both selectivity bias and bias due to omitted job match quality imposes additional data demands over standard problems. In particular, the ideal data set would include information on a random sample of women both within and outside the labour force over a broad range of ages, information on the quality of job match for workers, and sufficient information on the work relation to impose exclusion restrictions which permit estimation of a structural model.

Since no single data set meets all of our requirements, we estimate our model using three different data sets, where each data set contains some information that may proxy for job match quality. These data sets are the *National Longitudinal Survey Youth* sample (NLSY), 1977 *Quality of*

[1] Higher-order terms are suppressed for convenience of exposition, but are included in the empirical analysis.

Employment Survey (QES), and the data set collected by Hersch used in Hersch and Reagan (1990).

The *Eugene–Springfield Labor Survey* (hereafter ESLS) was collected in the Eugene–Springfield (Oregon) area in 1986.[2] This data set contains information on a sample of 213 female employees of 18 firms in the manufacturing and wholesale warehouse industries. A unique attribute of this data set is that it contains several firm variables, which were attained by interviews with firm representatives.

A limitation of the ESLS is that information is available only on workers. Thus we also estimated our model using data from the female youth cohort of the *National Longitudinal Survey* (NLSY) for 1982. This data set includes data on 2130 employed women and 919 women not in the labour market. A major drawback of this data set is the limited age span, since all survey participants were between the ages of 17 and 25 in 1982. In addition, minorities were oversampled. However, since the NLSY includes information on both working and non-working women, we use this data set to estimate our probit model for labour force participation, and use the estimated coefficients to calculate the inverse Mill's ratio for each individual in the ESLS as well as the NLSY.

The third data set we use is the *Quality of Employment Survey: 1977 Cross-Section* (QES). The QES is based on a national probability sample of individuals 16 years or older who worked for pay for at least 20 hours per week. The *1977 Cross-Section* has information on 1515 male and female workers. The sample used in this paper consists of 415 female wage and salary workers for whom there was complete reporting on all variables used in the analysis.

The advantage of the QES is that it is a random sample over a broad range of ages. However, since it contains information only on workers, we also calculate Mill's ratios by using the estimates from the NLSY probit equation. A major disadvantage of the QES is that the available tenure variable is not continuous, as it is on the ESLS and the NLSY. Instead, respondents were asked to select their tenure from eight categories of unequal length. Since it is not possible to estimate the tenure equation with eight discrete tenure categories, we approximate individual tenure by the midpoint of the tenure category. As we see later, the resulting errors-in-variables problem makes interpretation of the findings ambiguous.

Table 1 summarizes the definitions of the variables and the sample means for each of the data sets. The average wage

Table 1. *Variable definitions and sample means (standard deviations in parentheses)*

Variable	Definition	ESLS	NLSY Employed	QES
Personal background				
AGE	age in years	35.89 (10.46)	21.59 (1.98)	35.36 (12.64)
WHITE	1 if worker is white, 0 otherwise	0.94 (0.23)	0.76 (0.42)	0.87 (0.34)
HANDICAPPED	1 if physical condition limits work, 0 otherwise	0.08 (0.27)	0.05 (0.22)	0.11 (0.31)
MARRIED	1 if worker is married, 0 otherwise	0.56 (0.50)	0.61 (0.49)	0.48 (0.50)
CHILDREN<6	number of children in household age less than 6	0.18 (0.45)	0.27 (0.46)	0.20 (0.63)
*CHILDREN*6–18	number of children in household age greater than 6, less than 18	0.60 (0.92)	0.04 (0.19)	0.64 (1.04)
NO CHILDREN	1 if no children in household, 0 otherwise	0.53 (0.50)	0.71 (0.45)	0.56 (0.50)
Human capital				
EDUCATION	years of school completed	12.93 (1.59)	12.39 (1.83)	12.81 (2.75)
ON-THE-JOB-TRAINING	years of company provided on-the-job training	0.11 (0.36)		
TENURE	years of experience with present employer	5.39 (5.85)	1.34 (1.23)	
	midpoint of tenure category			4.64 (1.76)
EXPERIENCE	years of full-time experience since age 18	12.14 (9.54)		
	years of full-time experience since age 16		0.71 (0.47)	13.10 (10.05)

[2] The data appendix in Hersch (1991) provides information on the procedure used to generate the sample.

Table 1 (*Continued*)

Variable	Definition	ESLS	NLSY Employed	QES
USEFUL	1 if previous experience was useful in doing or obtaining current job, 0 otherwise	0.71 (0.46)		
Job match				
KEEP JOB	1 if worker is not likely to make a genuine effort to change employers in next 12 months, 0 otherwise	0.62 (0.49)		0.64 (0 48)
SATISFACTION	ranking of job satisfaction on scale of 0 to 10 from not at all to very satisfied	6.73 (2.61)		
	ranking of job satisfaction on a scale of 1 to 4 from dislike very much to like very much		3.19 (0.81)	3.30 (0.75)
Job characteristics				
WAGE	hourly wage	7.51 (2.80)	4.67 (2.42)	4.16 (2.44)
UNION	1 if worker is a union member, 0 otherwise	0.35 (0.48)	0.18 (0.38)	0.22 (0.42)
WHITE COLLAR	1 if worker is white collar, 0 otherwise	0.61 (0.49)	0.82 (0.38)	0.63 (0.48)
FULL TIME	1 if worker works 35 hours or more per week, 0 otherwise	0 84 0.37	0.80 (0 40)	0.82 (0.38)
Firm characteristics				
CAPACITY UTILIZATION	percentage productive capacity utilized over current year	88.53 (15.95)		
SIZE	number of employees	171.56 (129.95)		
	midpoint of size category			416.86 (700.06)
PERCENT LAYOFF	percentage of employees laid off in past year	2.15 (4.33)		
PERCENT PART-TIME	percentage of employees that are part time	12.60 (13.65)		
PERCENT SEASONAL	percentage of employees that are seasonal	1.62 (4.42)		
Industry characteristics				
AGRICULTURE, MINING, AND CONSTRUCTION	1 if worker is in agriculture, mining or construction industry, 0 otherwise		0.03 (0 18)	0.01 (0.18)
TRANSPORTATION AND COMMUNICATION	1 if worker is in transport or communications industries, 0 otherwise		0.03 (0.18)	0.03 (0.18)
SERVICES	1 if worker is in retail, financial, insurance, business services or public administration industry, 0 otherwise		0.73 (0.45)	0.75 (0 44)
MANUFACTURING	1 if worker is in manufacturing or wholesaling industry, 0 otherwise	1.0 (0.0)		
EMP500	percentage employed in firms with at least 500 workers		34.55 (27.35)	
Sample size				
ESLS	=213			
NLSY employed	=2130			
NLSY unemployed[a]	=919			
QES	=415			

[a] Sample statistics for NLSY unemployed available from authors on request.

rates reported are similar for the ESLS and the QES after adjusting for differences in price levels (US$ 6.59 for ESLS and US $ 6.18 for QES, 1982 dollars). The difference in average wage between the ESLS and QES may be due to the inclusion of workers from the south and the large number of workers employed in the lower paying service industries in the QES. As expected from the younger average age and higher minority concentration of respondents, the average

wage for workers from the NLSY is lower than in the other two data sets.

Both the ESLS and the NLSY use the same definition of tenure, while the QES measure corresponds to the midpoint of the tenure category, as described above. Despite the differences in the measurement of tenure, the average tenure based on the ESLS and QES are similar, with both data sets reporting average tenure of about five years. Average tenure for workers in the NLSY is substantially lower, corresponding to the age of the members of this sample. Average years of total work experience reported are similar for both the ESLS and the QES, with the average difference of one year due in part to differences in the way this variable was measured in the two data sets. The ESLS measures years of full-time work experience since age 18, while the QES measures years of total work experience since age 16.

The percentage of the sample of workers that are married is highest in the NLSY, and this group also had the highest average number of children under the age of 6 living at home, as well as the highest percentage of workers with no children. The increase in the percentage of married women workers from the QES value of 48% in 1977 to the ESLS value of 56% in 1986 parallels the national increase in the labour force participation rate of married women over that period. The average years of education across the sample of workers is higher in the ESLS and the QES than in the NLSY, with an average of almost one year of post-high-school education for the ESLS and QES, and almost a half year of post-high-school education for the NLSY.

A larger proportion of the NLSY sample is employed in white-collar jobs than in the other two samples, while the proportion of full-time workers in each sample ranges from 80% to 84%.

The two variables used in this study to measure the quality of the job match are *KEEP JOB* and *SATISFACTION*. *KEEP JOB* is available in the ESLS and the QES, and is a dummy variable equal to one if the worker is not likely to make a genuine effort to change employers in the next year. About two-thirds of the workers in both samples responded that they did not intend to seek a job with another employer. In the ESLS, *SATISFACTION* is measured on an 11 point scale, while the NLSY and QES measure *SATISFACTION* on a 4 point scale. Converting the scales to a common measure suggests that workers in the NLSY and the QES are more satisfied on average than in the ESLS, but this may be due to the more limited range of responses available in the NLSY and the QES.

The human-capital variables available in the ESLS but not in the other data sets are *ON-THE-JOB TRAINING* and *USEFUL*. The training variable measures the quantity of training provided by the firm to the worker. The variable *USEFUL* is a dummy variable which measures whether the worker's previous work experience was useful in obtaining or performing the current job, and thus controls for the training component of previous work that is transferable.

The firm specific variables used in this study that are available on the ESLS are the number of employees (*SIZE*), *CAPACITY UTILIZATION*, *PERCENT LAYOFF*, *PERCENT PART-TIME* and *PERCENT SEASONAL*. The QES also has a measure of the size of the firm, which asks the respondent to select from seven categories of unequal length. As with the tenure variable, we assigned the midpoint of each size category as the measure of firm size. Although a measure of firm size is not available in the NLSY, we use a related measure in our estimates using the NLSY. This variable, *EMP*500, measures the percentage of workers employed in firms with at least 500 workers in the worker's industry, available from the *Current Population Survey* May 1979 data files.

We also assign dummy variables for industry for the QES and NLSY sample. All workers in the ESLS sample are employed in the manufacturing and wholesale warehouse industries.

IV. MODEL SPECIFICATION AND RESULTS

The wage equation follows the human-capital specification typically found in the literature. White workers and those without handicaps have been found to have higher earnings. Married women have been found to earn less than unmarried women workers. Wages are expected to rise with tenure and with experience at decreasing rates, where experience is defined as the sum of previous work experience (an exogenous variable) and current tenure. Estimates based on the ESLS also include the variables *ON-THE-JOB TRAINING* and *USEFUL* in the wage equation, as well as *PERCENT LAYOFF*. Wages are expected to be higher in firms with a high risk of lay-off as a compensating differential. Dummy variables for full-time and white-collar status are included in the wage equations, as well as the relevant measure of firm size available on each data set and industry dummies for the NLSY and QES.

Although there is no consensus in the literature on the specification of a standard tenure equation, the specification presented draws on research on the specification of turnover equations.[3] Variables that have been identified as important determinants of turnover include wage, firm-specific human capital, age, race, union status and firm or industry demand for labour. Accordingly, our tenure equation includes the worker's wage rate, on-the-job training (for the ESLS sample), age and its square, race and union status. We also include years of education, marital status, full-time status and firm size. For the estimates using the ESLS sample, we also include the variables *CAPACITY UTILIZATION*,

[3] Empirical research on turnover include Oi (1962), Borjas and Rosen (1980), Mincer and Jovanovic (1981), Borjas (1981), Hall (1982) and Topel (1986).

PERCENT LAYOFF, *PERCENT PART-TIME* and *PERCENT SEASONAL* as proxies for the firm's demand for labour. We expect tenure to be positively related to capacity utilization and inversely related to lay-off. Further, tenure should be higher for workers in firms that employ seasonal and part-time workers, which insulate regular employees from demand fluctuations.

The job match variables, *KEEP JOB* and *SATISFACTION*, are included in both the wage and tenure equations (when available). Workers that are not likely to change jobs and are more satisfied with their current job are likely to be in a successful match. According to job match theory, this indicates that the worker is more productive in this match than in alternative employment. Thus match quality also affects tenure, since workers in good matches are unlikely to receive an alternative wage offer that exceeds the worker's current wage and thus turnover is also lower in good matches.

Since the Mill's ratio used for each sample is calculated using the probit estimates of the participation decision from the NLSY sample, we present these results in Table 2. Women with more children under the age of 6 are less likely to be in the labour force, while white women and those with more education are more likely to be in the labour force.

The results of the estimation of the model using each of the data sets are presented in Tables 3–5. In each table, the OLS results are presented in the first two columns, followed by the estimates of the structural system in columns 3 and 4.

One striking observation is the wide range of estimates on the returns to tenure in the wage equation, and to wage in the tenure equation, even in the OLS results. While tenure is positively related to wages in each sample, the OLS estimates range from 0.006 in the QES sample to 0.092 in the NLSY sample. Although tenure and wage are measured in the same units in each sample, the coefficient on wage in the tenure equation ranges from 0.04 to 5.30.

Table 2. *Probit estimates for the probability of employment*[a]

Independent variables*	
INTERCEPT	−1 7518
	(0.3347)
Personal background	
AGE	−0.0154
	(0.0147)
WHITE	0 3521
	(0.0586)
HANDICAPPED	0.0021
	(0.1160)
MARRIED	−0.0116
	(0.0612)
CHILDREN < 6	−0.3724
	(0.0984)
CHILDREN 6–18	−0.0425
	(0.1278)
NO CHILDREN	0.4265
	(3.6535)
Human capital	
EDUCATION	0.1969
	(0.0164)
Log-likelihood	−1540.13

[a] Standard errors in parentheses.
* Data source: NLSY.

Before discussing the results derived from each data set individually, we should look at some noteworthy patterns in the results. Education is positively and significantly related to wages in each data set, but negatively related to tenure. The effect of union status on wages varies by data set and by method of estimation, while tenure is positively related to union status. Wages are generally higher in larger firms. The job match variables *KEEP JOB* and *SATISFACTION* are generally positively related to wages, but not significantly related to tenure.

Turning to the results in Table 3 based on the ESLS, we find the coefficients on *TENURE* and *TENURE SQUARED* in the wage equation are much larger in magnitude in the 3SLS equation than in the OLS, although the differences are not significant at the 5% level. Years of total work experience is not significant in either the OLS or the 3SLS wage equations. Education is positively related to wages, but negatively related to tenure, in both the single-equation and system estimates. On-the-job training is not significant in either the wage or tenure equation. As expected, workers with higher wages have higher tenure, with the coefficient on wage being over seven times greater in the 3SLS equation than in the OLS equation. The coefficient on the inverse Mill's ratio is not significant in any equation.

As predicted, the coefficients on the match variables *KEEP JOB* and *SATISFACTION* are positive and significantly related to wages at the 5% level, with the exception of the 3SLS result for *KEEP JOB*. However, the match variables are not significantly related to tenure. Thus, in addition to tenure, match quality is an important determinant of wages. Tenure is largely determined by age and wage. The results indicate that tenure falls until a women worker reaches 43 years of age, and rises thereafter. This pattern would correspond to discontinuous labour force participation during the child-bearing years.

The most significant outcome of the estimates of the simultaneous system is that women's wages grow more rapidly with tenure than OLS estimates suggest. Our estimated coefficients on *TENURE* and *TENURE SQUARED* in the 3SLS estimates are 0.084 and −0.003 respectively. To see how much of the wage gap between men and women can be accounted for by differences in average tenure, it is helpful to compare these results to the corresponding results for male workers presented in Hersch and Reagan (1990). The coefficients on *TENURE* and *TENURE SQUARED* for male blue-collar workers in the 3SLS estimation are 0.059 and −0.001. Based on these numbers, men would need to have almost seven years of tenure with employer to achieve the wage growth which women experience in five years of tenure.

Table 3. *Parameter estimates for wage and tenure equations* Eugene–Springfield Labor Survey (*ESLS*)[a]

	Ordinary least squares		Three-stage least squares	
Independent variables	log (*WAGE*)	*TENURE*	log (*WAGE*)	*TENURE*
INTERCEPT	0.7069	9.1686	0.4650	22.6842
	(0.3092)	(5.8965)	(0.3358)	(14.6396)
Personal background				
AGE		−0.5481		−1.0998
		(0.2087)		(0.5514)
AGE SQUARED		0.0098		0.0129
		(0.0026)		(0.0068)
WHITE	−0.0306	−0.5090	−0.0085	0.4055
	(0.0917)	(1.5001)	(0.0944)	(3.9395)
MARRIED	0.0282	0.8309	0.0176	1.6484
	(0.0416)	(0.6715)	(0.447)	(2.0989)
HANDICAPPED	−0.0315		−0.0349	
	(0.0686)		(0.0493)	
Human capital				
EDUCATION	0.0429	−0.6608	0.0564	−1.5702
	(0.0173)	(0.2794)	(0.0191)	(0.7968)
ON-THE-JOB-TRAINING	0.0549	0.4789	0.0390	−1.7341
	(0 0536)	(0.8694)	(0.0554)	(2.4155)
TENURE	0.0588		0.0843	
	(0.0003)		(0.0213)	
TENURE SQUARED	−0.0016		−0.0026	
	(0.0003)		(0.0008)	
EXPERIENCE	0.0109		0.0104	
	(0.0073)		(0.0092)	
EXPERIENCE SQUARED	−0.0002		−0.0002	
	(0.0002)		(0.0002)	
USEFUL	0.0265		0.0416	
	(0.0462)		(0.0353)	
Job match				
KEEP JOB	0 0959	1.0409	0.0725	−4.2479
	(0.0499)	(0.8322)	(0.0555)	(2.8335)
SATISFACTION	0 0183	−0.1150	0.0225	−0.5359
	(0.0089)	(0.1460)	(0.0092)	(0.3884)
Job characteristics				
WAGE		0.7329		5.3034
		(0.1286)		(1.8261)
UNION	−0.0122	2.3658	−0.0379	0.6304
	(0.0449)	(0.8390)	(0.0506)	(2.0722)
WHITE COLLAR	0.0735		0.0182	
	(0.0499)		(0.0384)	
FULL-TIME	0.0292	−0.6153	−0.0005	−6.5887
	(0.0653)	(1.0132)	(0.0788)	(3.5254)
Firm characteristics				
CAPACITY UTILIZATION		0.0756		0.0201
		(0.0339)		(0.0617)
SIZE	0.0006	−0.0033	0.0006	−0.0307
	(0.0002)	(0.0053)	(0.0002)	(0.0157)
PERCENT LAYOFF	0.0040	−0 1905	0.0035	−0 2565
	(0.0049)	(0 1336)	(0.0052)	(0.3564)
PERCENT PART-TIME		−0.0681		0.0245
		(0.0629)		(0.1146)
PERCENT SEASONAL		0.2334		−0.0329
		(0.1093)		(0.2685)
Selection				
Mills ratio	0.0660	−0.6318	0.0944	1.5516
	(0.1256)	(2.1113)	(0.1328)	(5.6538)
Adjusted R^2	0.46	0.45		
System R^2			0 45	

[a] Standard errors in parentheses.

Table 4. *Parameter estimates for wage and tenure equations* NATIONAL LONGITUDINAL SURVEY YOUTH (*NLSY*)[a]

	Ordinary least squares		Full information maximum likelihood	
Independent variables	log (*WAGE*)	*TENURE*	log (*WAGE*)	*TENURE*
INTERCEPT	0.3733	−4.6885	0.6039	−0.8412
	(0.1239)	(2.9169)	(0.5062)	(0.9286)
Personal background				
AGE		0.5199		−0.1777
		(0.2745)		(0.0772)
AGE SQUARED		−0.0076		−0.0038
		(0.0064)		(0.0018)
WHITE	0.0523	−0.1743	0.1753	−0.1411
	(0.0243)	(0.0690)	(0.0917)	(0.0776)
MARRIED	−0.0138	−0.0094	0.1364	−0.1358
	(0.0203)	(0.0575)	(0.0763)	(0.0605)
HANDICAPPED	0.0231		−0.0562	
	(0.0402)		(0.0407)	
Human capital				
EDUCATION	0.0584	−0.1489	0.0500	−0.0446
	(0.0069)	(0.0220)	(0.0257)	(0.0230)
TENURE	0.0922		1.2125	
	(0.0244)		(0.1902)	
TENURE SQUARED	−0.0105		−0.0086	
	(0.0058)		(0.0070)	
EXPERIENCE	0.1458		−0.0414	
	(0.0577)		(0.0616)	
EXPERIENCE SQUARED	−0.0195		−0.0126	
	(0.0299)		(0 0344)	
Job match				
SATISFACTION	0.0233	−0.0302	−0.0240	−0.0239
	(0.0109)	(0.0308)	(0.0392)	(0.0333)
Job Characteristics				
WAGE		0.0447		0.1129
		(0.0110)		(0.0176)
UNION	0.0893	0 1170	−0.0956	0.1106
	(0.0231)	(0.0657)	(0.0850)	(0.0688)
WHITE COLLAR	0.0449		−0.0166	
	(0.0308)		(0.0371)	
FULL-TIME	0 0828	0.3070	−0.3773	0.3864
	(0.0227)	(0 0642)	(0.1186)	(0.0755)
Industry characteristics				
AGRICULTURE, MINING,	−0 0391	−0.0267	0 3295	−0.3182
AND CONSTRUCTION	(0.0524)	(0.1488)	(0.2153)	(0.1828)
TRANSPORTATION	0.0697	0.0107	−0.0189	0.0218
AND COMMUNICATION	(0.0574)	(0.1580)	(0 2044)	(0.1562)
SERVICES	−0.1130	−0.0783	0.0818	−0.0841
	(0.0290)	(0.0677)	(0.0859)	(0.0683)
EMP500	0.0022	0.0036	−0.0026	0.0031
	(0.0003)	(0 0010)	(0.0014)	(0.0010)
Selection				
Mills ratio	−0.1110	−0.7175	0.1793	−0.2372
	(0.0534)	(0.1527)	(0.2000)	0 1672
Adjusted R^2	0.19	0 13		
Log-likelihood			−3589.82	

[a] Standard errors in parentheses.

Table 5. *Parameter estimates for wage and tenure equations* Quality of Employment Survey (*QES*) *Results*[a]

	Ordinary least squares		Two-stage least squares	
Independent variables	log (*WAGE*)	*TENURE*	log (*WAGE*)	*TENURE*
INTERCEPT	−0.2293	3.3446	−0.1643	−1.4073
	(0.2104)	(3.6932)	(0.2182)	(5.0549)
Personal background				
AGE		0.1597		0.2780
		(0.1588)		(0.1869)
AGE SQUARED		0.0016		0.0003
		(0.0020)		(0.0023)
WHITE	0.0491	−1.2043	0.0336	−0.8724
	(0.0562)	(0.9016)	(0.0591)	(0.9877)
MARRIED	−0.0308	1.4859	−0.0281	1.4077
	(0.0357)	(0.5752)	(0.0367)	(0.6164)
HANDICAPPED	−0.1521		−0.1505	
	(0.0544)		(0.0552)	
Human capital				
EDUCATION	0.0737	−0.4943	0.0667	−0.1666
	(0.0114)	(0.1916)	(0.0126)	(0.2990)
TENURE	0.0057		−0.0017	
	(0.0032)		(0.0045)	
EXPERIENCE	0.0151		0.0246	
	(0.0061)		(0.0107)	
EXPERIENCE SQUARED	−0.0003		−0.0005	
	(0.0002)		(0.0003)	
Job match				
KEEP JOB	0.0560	0 6238	0.0716	1.0220
	(0.0413)	(0.6731)	(0 0427)	(0.7660)
SATISFACTION	0.0020	0.0747	0 0071	0.2119
	(0.0263)	(0.4224)	(0.0268)	(0.4601)
Job Characteristics				
WAGE		0.3820		−0.5497
		(0.1247)		(0 6342)
UNION	0.1843	3 4456	0.2158	4 1307
	(0.0440)	(0 6919)	(0 0466)	(0.8682)
WHITE COLLAR	0.2288		0.2422	
	(0.0424)		(0.0434)	
FULL-TIME	0.1502	0 3792	0 1491	0.9472
	(0.0465)	(0.7416)	(0 0489)	(0.8774)
Firm characteristics				
SIZE	0 0001	0.0007	0.0001	0.0011
	(0.00003)	(0.0004)	(0.00003)	(0.0005)
Industry characteristics				
AGRICULTURE, MINING,	−0 0607	−1.3290	−0.0530	−1.1910
AND CONSTRUCTION	(0.1465)	(2.3338)	(0.1491)	(2.4935)
TRANSPORT	0.1130	3.4140	0.1112	4 4999
AND COMMUNICATION	(0.1027)	(1.6222)	(0 1053)	(1.8770)
SERVICES	−0.1074	−0.2823	−0 1133	−0.2877
	(0.0490)	(0.7638)	(0.0498)	(0.8155)
Selection				
Mills ratio	0.2029	−4.6063	0 1777	−3.9870
	(0 0881)	(1.4868)	(0.0927)	(1.6401)
Adjusted R^2	0.43	0.39	0.41	0.35

[a] Standard errors in parentheses

Many data sets report two years difference in average tenure between male and female workers (including the ESLS). Thus discontinuous labour force participation is not likely to be an important determinant of the wage gap between men and women, once the bias due to the joint endogeneity of wages and tenure is taken into account.

The results using the NLSY and the QES data sets are presented in Tables 4 and 5. The specification is similar to that employed in the estimation of the model using the ESLS, except that no firm-specific variables are available (except for an approximation of firm size in the QES). While identification of the system using the ESLS was achieved by considering the different impact proxies for demand for the firm's output have on wages and tenure, identification of the system using the NLSY and QES is based on the fact that education plus experience do not generally sum to age minus six for a sample of female workers. In addition, since only eight categories for tenure are available in the QES data set, the correlation between tenure and its square is 0.93. Equations which included both tenure and tenure squared failed to be estimable as a simultaneous system. The QES estimates therefore exclude tenure squared.

The OLS wage equation estimates for both the NLSY and the QES appear to be largely consistent with the ESLS and with other estimates that have appeared in the literature. More educated workers and those with more years of tenure with employer and work experience have higher hourly wages, as do union members, full-time workers, and those in larger firms (QES) or in industries that tend to have more employees per firm (NLSY). The job match variables are positively related to wages, although they are not significant for the QES results. Marital status has no effect on wages.

The OLS tenure equation results indicate that workers with higher wages have longer tenure with the firm, and that education has a negative impact on tenure. As noted in the ESLS, the job match characteristics have no impact on tenure.

The estimates of the system using the NLSY and the QES yield a number of results that are difficult to interpret. Although the coefficient on tenure increases in the system estimation based on the NLSY, as we found in the ESLS, the value it takes on indicates a rate of wage increase with tenure of more than 100% per year. This is a very improbable growth rate of wages, even for the young workers in the NLSY sample. The coefficient on wage in the tenure equation almost tripled in the system estimates, as we found in the ESLS, but the effect of wage on tenure using the QES became insignificant. The effect on wages of full-time employment in the NLSY went from significantly positive in the OLS estimates to significantly negative in the system estimates.

In sum, the NLSY and the QES results may be less reliable than those using the ESLS. First, for young women workers, years of education plus experience will sum fairly closely to age minus six, making our exclusion restrictions tenuous. Second, imputing the mean value of tenure from eight categories of unequal length leads to the classic errors-in-variables problem, which produces biased coefficient estimates. Our reduced success using these other data sets relative to the ESLS underscores the value of firm-specific information in estimating simultaneous wage–tenure systems.

V. CONCLUSION

The issue of whether the returns to tenure in wage equations are biased is of great importance to observers of women's role in the labour market. If, in fact, years of tenure has no effect on wages, as job match proponents claim, then women's discontinuous labour force participation will not account for much of the earnings gap. If, on the other hand, the returns to tenure estimated from single-equation procedures are biased downward, then wages rise with tenure more rapidly than is commonly believed, and again the bulk of the wage gap cannot be explained by differences in tenure. The results based on estimates of a structural wage–tenure system using the ESLS data set suggest that the returns to tenure for women are biased downward. Further, consistent with the greater heterogeneity of women workers than male, the magnitude of the bias appears to be more severe for women than for men.

Finally, the findings in this paper lend further support to both the human-capital and agency models that predict positively sloped wage–tenure profiles. However, job match quality is also an important determinant of wages.

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