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Wage Progression of Less Skilled Workers in Canada: Evidence from the SLID (1993-1998)

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Abstract

The wage progression of less skilled workers is of particular policy interest in light of evidence of skill biased technology changes. There exists two conflicting views regarding the wage progression of less skilled workers. One view believes that work experience is the driving force for wage growth of less skilled workers and hence effective policies should encourage workers to participate in the labour market and accumulate work experience. The other view stresses that less skilled workers are mostly locked into dead-end jobs in which wages are stagnant and policies that facilitate job shopping (changing jobs and employers) would be desirable.

Job tenure is a key factor in testing the hypothesis that less skilled workers are locked into dead-end jobs. If the return to tenure is 0, the hypothesis cannot be rejected. Using data from the Survey of Labour and Income Dynamics (SLID) 1993-1998, I estimate an extended human capital model of wage growth for less skilled workers. In order to compare the wage growth mechanisms for workers with different skill endowments, the model is also estimated for workers with higher skill level. The empirical result implies that the return to job tenure for less skilled workers is significantly different from 0. This is inconsistent with the view that less skilled workers are locked into dead-end jobs. The return to job tenure is also found to be greater than the return to total labour market experience for less skilled workers. This finding supports the notion that firm-specific human capital acquired by less skilled workers substitutes for their low general human capital endowments. And the accumulation of firm-specific human capital by less skilled workers greatly improves their earnings prospect.

Keywords: less skilled workers, wage progression, firm-specific human capital, job tenure, unobserved heterogeneity.

JEL Classification: J31, J41, C23.

I. Introduction

Like other industrialized nations, Canada has experienced rapid technology changes over the past two decades. Economists often postulate that these technological changes lead to a skill biased demand shift in the labour market, which is a key factor in explaining the diverging labour market outcomes of workers of different skill levels.[1] One of the labour market outcomes is the large increase in the "return to skills", which causes concerns with respect to the earnings prospect of less skilled workers[2] and prompts us to study the mechanism of wage progression of less skilled workers.

In a seminal work on wage progression of less skilled workers, Gladden and Taber (2000) link two conflicting views on wage growth of the poor and welfare mothers to wage growth of less skilled workers. One view stresses that low-wage workers are often locked into dead-end jobs in which wages remain stagnant. Another view postulates that the lack of work experience prevents the wage growth of these disadvantaged workers. Their study finds that some, but not all less skilled workers are locked into dead-end jobs, and although work experience does help, it is not a magic bullet. They also find that a substantial amount of wage growth of less skilled workers comes from job changes. They conclude that less skilled workers should be encouraged to work such that work experience are accumulated, they should be encouraged to shop for better jobs (new employers) and they should be protected from being laid off.

Since their wage data is based on annual earnings and annual hours worked, they are not able to estimate the effects of observed job characteristics such as job tenure on wage growth. For the same reason, they are not able to control for unobserved job heterogeneity, and hence their estimates of the effects of work experience and job changes[3] are likely to be biased. This paper attempts to explore the mechanics of wage progression of young Canadian workers with respect to their skill levels using data from the 1993-1998 Survey of Labour and Income Dynamics (SLID). The empirical model is more flexible than that of Gladden and Taber (2000) since SLID allows the inclusion of controls for both worker and job characteristics. The estimation technique is based on Altonji and Shakotko (1987). Their work extends the instrumental variable generalized least square (IVGLS) estimation procedure proposed by Hausman and Talyor (1981). The procedure is capable of achieving estimation efficiency by dealing with the within-worker and the within-job correlation of unobserved worker and job match effects. The returns to general work experience and firm-specific work experience (that is, job tenure) are separately identified. In addition, the model allows a number of key regressors such as work experience, job tenure, years of education, full- and part-time status, union status, and student status to be correlated with the unobserved person/job effects and the idiosyncratic error term.

Studies by Altonji and Shakotko (1987) and Light and McGarry (1998) find that the return to total labour market experience is higher than the return to job tenure. Topel (1991), on the other hand, finds evidence that wages rise with seniority even after controlling for total labour market experience. This study confirms the finding that for high skilled male workers, the return to work

[1] See for example, Juhn, Murphy and Pierce (1993).

[2] U.S evidence suggests the real wages of the less educated U.S. men (10 to 12 years of education) have declined by over 20% since the late seventies (Beaudry and Green (1997)).

[3] As well as other coefficients.

experience is greater than that to job tenure. But for less skilled workers—male and female, the return to job tenure is greater than the return to total labour market experience. The result is somewhat mixed for female high skilled workers, however. The findings imply that firm-specific human capital acquired by less skilled workers may substitute for their (lower) general human capital. And less skilled workers may substantially be better off by staying on their jobs instead of frequently changing their jobs.

The rest of the paper is organized as follows. Section II describes the data and summarizes the observed wage progression in the sample. Section III specifies the wage model and discusses estimation issues. Section IV presents the empirical results, and the final section contains a summary and conclusions.

II. An Overview of Wage Progression of Less Skilled Workers

To make the study comparable to that of Gladden and Taber (2000), the targeted population of this study is young workers aged 16 to 30 in 1993.[4] One particular difficulty in studying the wage progression mechanism for workers at different skill levels is to determine who is less skilled and who is highly skilled. Gladden and Taber (2000) define low- to moderate-skilled workers as those who have completed only twelve or fewer years of schooling (high school dropouts and high school graduates). This study follows their approach by classifying high school graduates and those whose education are below high school as less (or low) skilled workers,[5] and those with above high school education as high-skilled workers, or skilled workers for short. Admittedly, the education level of some workers may change over time. To simplify the matter, this study focuses on workers whose skill levels are fixed such that less skilled workers do not advance into the highly skilled group of workers.[6]

The final sample of this study consists of 6,651 workers and 31,182 wage records. Aside from the above considerations, the following criteria are employed in establishing the final sample. (1) Those who worked in agriculture and fishing industries, 2.5% of the original worker records, are excluded. (2) Those with missing schooling information (about 1% of the worker records) are excluded. (3) Jobs without a starting date are excluded since job tenure cannot be calculated for these jobs. They account for about 13% of the original job records.[7] (4) Jobs ended within their

[4] The primary source of Gladden and Taber (2000) is the U.S. National Longitudinal Study of Youth (NLSY), which begun in 1979 for youth aged 14 to 22. Their secondary data source draws from the March annual demographic supplement to the Current Population Survey (CPS) for people born between 1957 and 1964 (who were between 14 to 22 years old in 1979). SLID collects job information for persons aged 16 to 69. To make the sample reasonably large, I draw the working sample for people aged between 16 to 30 in 1993. A potential benefit by focusing on young workers is that one may obtain more accurate information regarding work experience and job tenure from them than from old workers.

[5] Since the focus is young workers, including high school graduates in the low-skill category makes the sample of low-skilled workers reasonably large.

[6] However, we do allow workers to change their education level within their skill levels. Hence, a worker with less than high school education may obtain a high school diploma during the sampling period; and a worker with education at the university level may obtain a graduate degree latter. Approximately one in four workers aged between 16-30 in 1993 increased their education level from high school or below to above high school by 1998.

[7] Even though this is a fairly large portion, the sample means (standard deviations) of the variables involved are increased (decreased) very little before and after the elimination. For example, the mean (in logarithm) hourly

starting years are also excluded. Since SLID provides only one wage record for each of those jobs that ended within their starting years, the job specific wage means are the same as the wages themselves for these jobs, and hence contribute no useful information once wages are differentiated from their means. They account for 5% of the original job records. A detailed sample count is provided in Table 1.

Table 1. Sample Distribution Across Sexes and Skill Levels

	Number of individuals		Number of wage records
Men			
Low skill	1,527		6,126
High skill	1,846		9,575
Women			
Low skill	1,176		4,356
High skill	2,102		11,125
Total	6,651		31,182

The means of log hourly wage rate during 1993-1998 for the above sample are contained in Table 2.[8] The table (part I) shows that female less skilled workers suffered a nearly 5% wage decrease during these years, while the other three groups of workers experienced considerable wage growth over the same period. Male high-skilled workers faired the best with an 18% increase (change in the means of log hourly real wage rate), they are followed by female high-skilled workers with an 12% increase, and male less skilled workers with a 10% change.

Table 2. Means of Log Hourly Wage Rate by Gender and Skill Level (1993 $)

I. Mean wage rate of all observations					
	Male			Female	
	Less skilled	Highly skilled		Less skilled	Highly skilled
1993	2.30	2.52		2.17	2.38
1994	2.37	2.60		2.18	2.41
1995	2.35	2.60		2.16	2.40
1996	2.38	2.64		2.13	2.44
1997	2.38	2.64		2.11	2.46
1998	2.40	2.70		2.13	2.50
1993-1998	0.10	0.18		-0.04	0.12
# of wage records	6,126	9,575		4,356	11,125
II. Balanced (worker) panel					
1993	2.32	2.54		2.17	2.40
1998	2.55	2.77		2.31	2.57
1993-1998	0.23	0.23		0.14	0.17
# of workers	507	785		358	867

wage for all workers in 1998 (current dollar) is 2.6373 before the elimination, it becomes 2.6388 after the elimination, while the corresponding standard deviations are 0.4687 and 0.4684, respectively.

[8] Hourly wage rates are adjusted into 1993 constant dollars.

The above results should be interpreted with caution since workers in each group are not exactly the same individuals at the start and at the end of the comparison periods. After the starting year, some new workers could enter the panel, and some workers who were observed at the starting point might have dropped out of the labour market. If workers are not homogenous within their gender and skill group, the dropouts and additions will lead to biased estimates. For example, if the withdrawals of less skilled workers are due to their poor labour market outcomes, and those who remain in the panel were those who performed better, the observed wage gain of the group during the entire period will be higher than the true wage gain. To examine the problem, the wage growth rates are also calculated for workers who were in the SLID survey and employed in both 1993 and 1998 (the panel is balanced in terms of workers, but unbalanced in terms of wage records). The result provides a largely different picture. Part II of Table 2 shows that, the wage growth of less skilled workers are very similar to that of high-skilled workers, although the wage level of high-skilled workers remains higher than that of less skilled workers.

It is not clear which of the two panels of Table 2 reveals the true wage growth. If workers are homogenous in terms of labour market performance within their own gender and skill group, results from Panel I may be closer to the true wage growth than results from Panel II of Table 2. Otherwise, Panel II provides better estimates for wage growth. Of course, it could be the case that none of the two pictures depicted by the Table 2 is correct. We will have to control for worker and job characteristics as well as other sources of wage variations in order to accurately assess the wage progression for less skilled workers.

III. The Empirical Model and Estimation Strategy

The empirical model assumes the log hourly wage rate w_{ijt}, received by worker *i* on job *j* at time *t*, is determined by the following equation.

$$w_{ijt} = \mathbf{X}_{ijt}\boldsymbol{\beta} + \alpha_i + \delta_{ij} + \varepsilon_{ijt}$$

where β is a kx1 vector of coefficients, ε_{ijt} is the idiosyncratic error term, α_i and δ_{ij} are the unobserved individual and job effects that are invariant over time. The error components ε_{ijt}, α_i, and δ_{ij} are assumed to be independently distributed. They all have a mean of 0 and their variances are σ_ε^2, σ_α^2 and σ_δ^2 respectively. $\boldsymbol{X}_{ijt}$ is a 1xk vector that contains human capital variables such as experience, job tenure and years of schooling. Other controls included are union membership, full-time job, student status, firm size, rural worker, year, region and 15 industry dummies.[9] All explanatory variables are time variant.

The human capital variables, union, student, and full-time worker status can be correlated with one or all of the error components of the model. Altonji and Shakotko (1987) argue that job tenure can be correlated with unobserved worker and job characteristics. Good job matches tend to last longer and hence the unobserved match quality is positively correlated with job tenure. Without controlling the unobserved job match quality, the estimated effect of tenure will be biased upwards. On the other hand, highly motivated workers are more likely to receive high wages and are less likely to be laid off, and workers who receive high wages relative to their alternatives will not quit. Failure of controlling unobserved worker heterogeneity tends to bias

[9] Descriptive statistics are presented in Appendix (Table A1).

upwards the tenure coefficient in the OLS regression. The same arguments also apply to work experience, though indirectly, since work experience is the sum of tenures on past jobs. Level of education is another variable that is often argued to be endogenous in the human capital model. Education is less costly for individuals with higher ability and hence they tend to have higher level of education, and high ability workers also earn more for given years of schooling. In addition, it can be argued that the decisions to join a union or to switch from a part-time job to a full-time job can be endogenous. Assuming workers are aware of the union or full-time wage premium, if non-unionized or part-time workers are not satisfied with their current wage rates, rational decision will lead them to join a union or switch from part-time to full-time jobs. Likewise, a low-educated worker may not be satisfied with the current earnings and decide to upgrade his/her skill through more years of schooling.

The correlation between the above regressors and the error components can be dealt with through instrumental variable estimation procedure. Since those regressors are time-variant, the natural candidates of their IVs are the deviations from their job-specific means. By construction, these IVs are strongly correlated with the endogenous explanatory variables but are uncorrelated with the unobserved components.[10] With these instrument variables, the IV estimates for β are consistent,[11] and consistent estimates for σ_ε^2, σ_α^2 and σ_δ^2 can be calculated based on these IV estimates.[12]

However, the IV estimates are not unbiased. In addition, our observations are based both on person and on the jobs he/she held over time. The observation window is different for different workers, and different workers may hold a different number of jobs. A worker may hold more than one job at the same time, and different jobs held by the same worker may last for a different number of periods. Hence, the covariance matrix of the error terms is person-specific. In general, if worker i is observed holding J_i jobs over T_i time periods, the covariance matrix is

$$\Omega_i = \sigma_\alpha^2 \boldsymbol{l}_i \boldsymbol{l}_i' + \sigma_\delta^2 \boldsymbol{G}_i \boldsymbol{G}_i' + \sigma_\varepsilon^2 \boldsymbol{I}_i$$

where $\boldsymbol{l}_i$ is T_ix1 vector of units, G_i is a T_i x J_i matrix whose tj^{th} element is unit if job j is held at time t and is 0 otherwise, and $\boldsymbol{I}_i$ is an identity matrix of order T_i,.[13] To obtain efficient estimates for β, the generalized least squares (GLS) procedure must be applied. But different from the case where unobserved job effect is assumed to be 0, in which the GLS estimates can be obtained

[10] Parents' education and measures of health status of the worker are also employed as additional instruments. However, the empirical results are essentially the same with or without them.

[11] Hausman and Taylor (1981).

[12] The IV procedure provides a valid estimate for the sum of the variance components. Using the IV estimates for the βs with deviations from job-specific means, σ_ε^2 can be obtained, while using these βs with deviations from person-specific means, σ_δ^2 can be calculated. With these two variance estimates and the sum of the variance components, σ_α^2 is identified. These estimates enable one to construct the covariance matrix needed by the efficient IVGLS procedure.

[13] For more details on the covariance structure, see Altonji and Shakotko (1987). Light and McGarry (1998) also employ this error structure in their study on job mobility and wage.

through the usual θ-transformation,[14] we have to perform the transformation for each worker individually. For example, in the simplest case where a worker's wage rates on two jobs are observed, the covariance matrix is,

$$\begin{bmatrix} \sigma_\alpha^2 + \sigma_\delta^2 + \sigma_\varepsilon^2 & \sigma_\alpha^2 \\ \sigma_\alpha^2 & \sigma_\alpha^2 + \sigma_\delta^2 + \sigma_\varepsilon^2 \end{bmatrix}.$$

But if the two wage observations were from the same job (which necessarily lasts two time periods), the covariance matrix will be instead,

$$\begin{bmatrix} \sigma_\alpha^2 + \sigma_\delta^2 + \sigma_\varepsilon^2 & \sigma_\alpha^2 + \sigma_\delta^2 \\ \sigma_\alpha^2 + \sigma_\delta^2 & \sigma_\alpha^2 + \sigma_\delta^2 + \sigma_\varepsilon^2 \end{bmatrix}.$$

Hence, the transformation matrix depends not only on the number of observations involved for each worker, it also depends on the number of jobs held by each worker, and the duration of each job.

With a consistent estimate for the covariance matrix obtained through the IV procedure and with the original variables being transformed, the IV estimation procedure is again applied to the transformed model. This estimator is referred to as the IVGLS estimator.[15] It is consistent and asymptotically efficient. A number of different specifications of the wage model are estimated. The different specifications hinge on how the potential regressors are correlated with the unobserved error terms.

IV. Empirical Results

1. Descriptive Statistics

The descriptive statistics for variables employed in the regressions are contained in Appendix Table A1. The average log hourly wages for high and less skilled male workers are 2.63 and 2.36, respectively, approximately a 26% difference in average hourly wage rate between them. The corresponding difference between less and high skilled female workers is approximately 29%. The average age of high (less) skilled men is 27.5 (23.1), while the average age of high (less) skilled women is 27.1 (25). The total labour work experience between male less and high skilled workers are quite close (5.9 vs. 5.7 years), while high skilled female workers have a somewhat longer work experience than the less skilled female workers (5.1 vs. 4.7 years). The average year of schooling of high skilled workers is approximately four years longer than that of less skilled workers (15 years vs. 11 years). The average job tenure of high skilled workers is only slightly longer than that of less skilled workers (the difference is about 0.2 year for men and 0.4 year for women). High skilled workers are more likely to be unionized than the less skilled, particularly between female high and less skilled workers (25% vs. 14%). Interestingly, high-

[14] In this case, the covariance matrix is $\sigma_\alpha^2 \, \boldsymbol{l}_i \, l_i' + \sigma_\varepsilon^2 \boldsymbol{I}_i$. Though the dimensions of this matrix are different for different workers in an unbalanced panel, the diagonal elements for all workers are $\sigma_\alpha^2 + \sigma_\varepsilon^2$, and the off diagonal elements are simply σ_α^2.

[15] Altonji and Shakotko (1987).

skilled workers are more likely to enrol in school (full- or part-time) at any point of time (24% vs. 13.5% between male workers, and 25% vs. 18% between female workers) than less skilled workers.

Across industries, male less skilled workers are more likely to work in manufacturing and construction sectors, while their high-skilled counterparts are more likely to work in manufacturing and retail sectors. More than 40% female less skilled workers work in retail and hotel services sectors, while more than 40% high-skilled females work in social services, retail and business services sectors. Finally, slightly below one third high-skilled workers work for the largest firms (1000 or more employees), while more than one third of less skilled males work in firms with less than 20 employees.

2. Estimation Results: Returns to Job Tenure and Work Experience

Three different specifications of the model are estimated separately for male and female less skilled workers. For comparison purposes, the model is also estimated for male and female skilled workers. The estimation results are contained in Tables A2 to A5. The first columns of these tables list the OLS estimates. The second through the fourth columns, under the column titles IVGLS-1, IVGLS-2 and IVGLS-3, present the efficient instrumental variable generalized least squares estimates. The column under IVGLS-1 assumes experience, tenure and their squares, years of schooling, union, student, and full-time status to be endogenous; the column under IVGLS-2 takes union, student, and full-time status away from being endogenous, and the column under IVGLS-3 only assumes job tenure and its squares to be endogenous. This last specification is the most comparable to the IVGLS estimates of Altonji and Shakotko (1987).

For comparison purposes, the OLS estimation results are summarized below. This is followed by detailed discussions of the IVGLS estimation results for each group of workers. The OLS estimates of the model confirm a number of stylized facts such as the low wage rate in retail trade and accommodation industries (manufacture is the reference industry), the higher wage rate for married workers comparing to non-married workers, sizeable union wage premium and evident employer size effect. The OLS estimate of the return to job tenure is greater than the return to work experience for all of the four skill groups. The difference is particularly evident for less skilled workers. The estimated return to job tenure for male less skilled workers is 5.4%, but the estimated return to their work experience is not significantly different from 0. While the estimated return to job tenure for female less skilled workers is 11%, the estimated return to their work experience is negative and likely to be incorrect. These are not surprising since the OLS estimation ignores the potential endogenous problem and unobserved heterogeneity is not controlled, as a result, they are likely to be biased and inconsistent.

Table A2 provides estimates for male less skilled workers. The results are based on 1,527 individuals with 6,126 wage records. The key coefficients estimated are quite similar across the three different specifications. The coefficients on job tenure (0.0515, 0.0517, and 0.0548 under IVGLS-1, IVGLS-2, and IVGLS-3 respectively) are greater than the corresponding coefficients on work experience (0.0298, 0.0351, and 0.0243) for this group of workers. The coefficients on tenure squared of the three specifications (-0.0329, -0.0344, -0.0374) show that wage rises with job tenure at an increasingly slower rate. While the coefficients on experience squared are all negative, they are not significantly different from 0 under IVGLS-1 and IVGLS-3. Only IVGLS-2 produce a coefficient that is significantly different from 0, but its magnitude is fairly small

(-0.0072). This is the case since our sample consists of young workers and the estimates have captured the upward sloping portion of the age-earnings profile.

The results for male skilled workers are contained in Table A3. The table shows that the IVGLS estimates of returns to work experience are greater than the their returns to job tenure. The coefficients on experience are 0.0651, 0.0714 and 00581 under the three specifications. They are far greater than the corresponding estimates for job tenure (0.0135, 0.012 and 0.0235). Different from the case for less skilled male workers, we notice the above estimates vary considerably among the three specifications, likely caused by stronger heterogeneity among skilled male workers. Indeed, the estimated variances of unobserved person and job characteristics (σ^2_α and σ^2_δ) for skilled male workers are all quantitatively larger than those for less skilled male workers in the three specifications (See Tables A2 and A3). On the other hand, the coefficients on experience squared (-0.0134, -0.0166, and -0.013) and the coefficients on tenure squared (-0.0118, -0.0155 and -0.018) indicate diminishing returns to work experience and to job tenure (all the above coefficients are significantly different from 0). However, it can be seen that the coefficients of experience squared and that of the tenure squared are quite close, and again none of them is very large in magnitude.

Table A4 contains the estimates for female less skilled workers. The same comparison between the return to job tenure and the return to work experience is obtained as in the case for male less skilled workers. Under the three specifications, the coefficients of work experience are estimated as 0.0229, 0.0233 and 0.0226, while the corresponding coefficients of job tenure are 0.0325, 0.0451 and 0.0512 (all six of them are significant at the 1% level). Clearly, the three specifications provide very similar estimates for the coefficients on experience. But the estimates for tenure vary considerably. This shall not, however, affect the overall estimates on the return to job tenure as the coefficient on tenure squared (-0.0169, -0.0273 and -0.0303) becomes large in the negative direction when the coefficient on tenure becomes large (0.0325, 0.0451 and 0.0512).

Finally, the results for skilled female workers (Table A5) are somewhat mixed. It is not clear if the return to job tenure is larger than the return to work experience or vice versa. And there are considerable variations in the estimates of the three specifications, even though the coefficients on experience and tenure squared may reduce the variations.

A potential question about the above results is the sensitivity of the estimates. The general conclusion is that the OLS estimators are very robust but the IVGLS estimators are less so. While the OLS estimates of four different specifications confirm that the return to job tenure is larger than that to work experience for all workers, the IVGLS estimates sometimes produce the opposite. However, one particular feature of the IVGLS estimates is that, while the return to job tenure is smaller than that to experience within each skill group, the return to job tenure for less skilled workers is higher than the return to job tenure for skilled workers. In an extreme case in which log wage is assumed to depend only on experience, tenure and their squares, this feature is well illustrated. In Table A6, the coefficients on experience for male skilled and less skilled workers are very close (0.34 vs. 0.33 on experience, -0.12 on experience squared for both groups). Yet the coefficient on tenure is 0.13 for less skilled males, more than twice as large as that for the skilled males (0.06), while the coefficients on tenure squared are -0.1 (for less skilled males) and -0.07 (for skilled males), respectively. For female workers, the table shows clearly that the return to work experience is higher for the skilled than that for the less skilled, and job tenure is more important for the less skilled than for the skilled. So even though the estimated

return to experience can be greater than that to tenure in different specifications, a clear point emerges—less skilled workers receive a higher return to job tenure than skilled workers, while skilled workers receive higher return to work experience than the less skilled workers.

3. Some Simulation Results

To take the non-linear part of the effects of job tenure and work experience on wage rate into consideration, we calculate their partial effects on log wage rate evaluated at the mean and various specific values of tenure and experience. Tables 3, 4 and 5 present the calculated gross effects of job tenure and work experience on log wage rate (based on specifications IVGLS-1, IVGLS-2, and IVGLS-3, respectively). The estimated variances and co-variances of these coefficients are employed to calculate the standard errors of these partial effects.

Table 3. Effects of Tenure and Experience: IVGLS-1 (std. error in parentheses)

	Male less-skilled		Male high-skilled		Female less-skilled		Female high-skilled	
Year	Tenure	Exp.	Tenure	Exp.	Tenure	Exp.	Tenure	Exp.
1	.0449 (.0046)	.0289 (.0052)	.0111 (.0043)	.0625 (.0050)	.0291 (.0052)	.0231 (.0062)	.0363 (.0037)	.0431 (.0046)
2	.0384 (.0043)	.0280 (.0056)	.0088 (.0041)	.0598 (.0048)	.0257 (.0049)	.0234 (.0059)	.0319 (.0035)	.0427 (.0043)
3	.0318 (.0050)	.0271 (.0048)	.0064 (.0048)	.0571 (.0047)	.0224 (.0057)	.0237 (.0057)	.0276 (.0041)	.0422 (.0042)
4	.0252 (.0042)	.0262 (.0047)	.0041 (.0041)	.0544 (.0046)	.0190 (.0047)	.0240 (.0055)	.0233 (.0034)	.0418 (.0041)
5	.0186 (.0058)	.0254 (.0047)	.0017 (.0058)	.0517 (.0047)	.0156 (.0067)	.0243 (.0055)	.0189 (.0049)	.0413 (.0041)
6	.0121 (.0045)	.0245 (.0047)	-.0007 (.0047)	.0490 (.0048)	.0122 (.0052)	.0246 (.0059)	.0146 (.0039)	.0409 (.0043)
Mean[16]	.0301 (.0042)	.0246 (.0047)	.0054 (.0041)	.0499 (.0047)	.0221 (.0047)	.0242 (.0055)	.0255 (.0034)	.0413 (.0041)

Table 3 shows that, for male less skilled workers, the average effect of job tenure on log wage is higher than that of work experience (0.030 vs. 0.025). This means that the return to an additional year of tenure is about half a percentage point higher than the return to an additional year of experience. But the average returns to tenure and experience for female less skilled workers are very close (0.022 vs. 0.024). On the other hand, the average return to experience for skilled workers (male and female) is greater than that to job tenure, particularly for skilled male workers, the difference is very evident the return to job tenure for skilled male workers, 0.0054 has a standard error of 0.0041. However, when the calculation is conducted up to the first 3 years for male less skilled workers and up to the first 2 years for female less skilled workers, we can see that their returns to job tenure are greater than their returns to work experience. Comparing with the returns to experience and tenure for skilled workers, we see that the wage progression mechanism of less skilled workers is quite different. For skilled workers, work experience plays

[16] The averages of job tenure for less skilled male and female, highly skilled male and female are 3.25, 3.09, 3.41 and 3.49 years, respectively. The corresponding averages of work experience are 5.85, 4.70, 5.66 and 5.13 years. See Appendix Table A1.

a far more important role than job tenure in their wage formation process, while for less skilled workers, job tenure may be equally if not more important than total labour market experience.

Based on the estimation results of IVGLS-2, Table 4 shows that, for less skilled workers, the average return to job tenure is only slightly higher than that to work experience, while the differences in the average returns for skilled workers are quite evident. During the first 3 years, on the other hand, it pays for the less skilled workers to stay with their employers as the returns to tenure are higher than the returns to experience in these first few years. Again, Table 4 demonstrates that the wage progression mechanisms for skilled and less skilled workers are very different. Work experience contributes far more to wage growth than job tenure for skilled workers. While for less-skilled workers the contribution of job tenure and experience are equally important in the long run. In the first few years of employment, however, job tenure appears to be more important than experience.

Table 4. Effects of Tenure and Experience: IVGSL-2 (std. error in parentheses)

	Male less-skilled		Male high-skilled		Female less-skilled		Female high-skilled	
Year	Tenure	Exp.	Tenure	Exp.	Tenure	Exp.	Tenure	Exp.
1	.0448 (.0045)	.0337 (.0053)	.0089 (.0044)	.0680 (.0051)	.0396 (.0055)	.0239 (.0068)	.0345 (.0035)	.0470 (.0045)
2	.0380 (.0043)	.0322 (.0050)	.0058 (.0042)	.0647 (.0049)	.0342 (.0052)	.0246 (.0065)	.0303 (.0035)	.0451 (.0043)
3	.0311 (.0050)	.0308 (.0049)	.0027 (.0050)	.0614 (.0047)	.0287 (.0062)	.0252 (.0062)	.0261 (.0039)	.0431 (.0041)
4	.0242 (.0042)	.0294 (.0047)	-.0004 (.0042)	.0580 (.0047)	.0233 (.0051)	.0259 (.0060)	.0219 (.0032)	.0412 (.0040)
5	.0173 (.0059)	.0279 (.0047)	-.0035 (.0060)	.0547 (.0047)	.0178 (.0073)	.0265 (.0060)	.0177 (.0046)	.0393 (.0040)
6	.0105 (.0046)	.0265 (.0048)	-.0065 (.0048)	.0514 (.0049)	.0123 (.0057)	.0271 (.0061)	.0135 (.0035)	.0374 (.0041)
Mean	.0293 (.0031)	.0268 (.0029)	.0014 (.0030)	.0526 (.0034)	.0282 (.0037)	.0263 (.0040)	.0240 (.0039)	.0391 (.0026)

Finally, results based on IVGLS-3 (Table 5) show that job tenure plays an even more important role than it does under the other two specifications. The average effect of job tenure is higher than the average effect of experience for all female workers and male less skilled workers by a larger amount than in the previous specifications. If we look at the comparison over time, this specification indicates that the effect of tenure is still greater than the effect of experience up to the fourth year of tenure and experience. While results based on the other two models show that effect of tenure is greater than the effect of experience up to the second or the third year of employment.

Table 5. Effects of Tenure and Experience: IVGLS-3 (std. error in parentheses)								
	Male less-skilled		Male high-skilled		Female less-skilled		Female high-skilled	
Year	Tenure	Exp.	Tenure	Exp.	Tenure	Exp.	Tenure	Exp.
1	.0473 (.0045)	.0240 (.0036)	.0199 (.0043)	.0555 (.0038)	.0451 (.0059)	.0233 (.0041)	.0485 (.0037)	.0274 (.0031)
2	.0398 (.0039)	.0237 (.0035)	.0163 (.0041)	.0529 (.0039)	.0391 (.0045)	.0239 (.0036)	.0426 (.0035)	.0276 (.0027)
3	.0324 (.0033)	.0234 (.0033)	.0127 (.0040)	.0503 (.0041)	.0330 (.0038)	.0246 (.0031)	.0368 (.0034)	.0279 (.0023)
4	.0249 (.0029)	.0231 (.0032)	.0091 (.0040)	.0477 (.0043)	.0270 (.0032)	.0252 (.0027)	.0309 (.0035)	.0281 (.0020)
5	.0174 (.0026)	.0228 (.0032)	.0055 (.0041)	.0451 (.0045)	.0209 (.0030)	.0259 (.0023)	.0250 (.0037)	.0283 (.0018)
6	.0099 (.0026)	.0225 (.0033)	.0019 (.0044)	.0425 (.0048)	.0148 (.0031)	.0266 (.0021)	.0191 (.0040)	.0285 (.0017)
Mean	.0305 (.0019)	.0226 (.0017)	.0011 (.0030)	.0434 (.0021)	.0325 (.0018)	.0257 (.0024)	.0339 (.0023)	.0283 (.0018)

To summarize, our results show that job tenure has a greater effect on wages for less skilled workers. For male skilled workers, job tenure only plays a minor role while work experience is the main driving force for their wage growth. But for skilled female workers, the result is somewhat mixed.

However, for those workers who stay on their jobs, job tenure and work experience will change together. It would be more realistic if we allow job tenure and work experience to change at the same time. In this way, we can compare the wage growths of those with longer tenure and those with short tenures within each group of workers. In what follows, the predicted wage is calculated at the end of each year for two types of workers: movers and stayers. A mover changes his/her employer at the beginning of each year, while the stayer stays with his/her employer all the time. Both have no employment interruptions. We assume that they start their employment at the same time and have no previous work experience.[17] Their work experience will be identical but their job tenures will be different: the movers always have one year of job tenure while the stayers' tenure and experience will increase by one at the end of each year. All other variables are fixed at their sample means. Table 6 shows wage growths in three, five, ten and fifteen years of employment for these movers and stayers using estimates of the three specifications.

[17] The same conclusion can be drawn when some previous experience is assumed. For example, one can calculate the wage growths for stayers and movers with five years of working experience. Similarly, the wage growths of frequent movers and rare movers can be calculated. The former will necessarily have short tenures and the latter, longer tenures.

Table 6. Wage Growths of Movers and Stayers								
	Male low-skilled		Female low-skilled		Male high-skilled		Female high-skilled	
	Mover	Stayer	Mover	Stayer	Mover	Stayer	Mover	Stayer
IVGLS-1								
Wage at end of year 1	2.17		2.05		2.36		2.23	
Wage growth in…								
3 years	5.6	13.3	5.6	10.8	12.0	13.7	8.5	14.9
5 years	10.9	23.6	10.5	19.4	22.8	25.4	16.9	27.9
10 years	22.5	36.3	22.9	35.6	45.3	45.8	37.0	52.0
15 years	31.9	29.9	36.5	44.5	61.1	54.1	56.1	64.1
IVGLS-2								
Wage at end of year 1	2.20		2.08		2.67		2.27	
Wage growth in…								
3 years	6.5	14.0	4.9	11.8	13.0	14.1	9.0	15.1
5 years	12.3	24.5	10.1	19.4	24.6	25.7	17.3	27.7
10 years	24.5	36.9	24.1	37.7	47.8	43.3	34.5	48.5
15 years	33.4	28.4	40.2	42.2	63.3	45.3	47.3	53.3
IVGLS-3								
Wage at end of year 1	2.27		2.09		2.43		2.29	
Wage growth in…								
3 years	4.7	12.7	4.8	12.6	10.6	13.8	5.5	14.1
5 years	9.4	22.3	9.8	23.4	20.1	25.2	11.2	25.9
10 years	20.4	32.7	23.6	39.7	39.4	42.8	25.6	45.4
15 years	31.2	24.2	38.8	42.8	52.0	45.0	40.5	50.5

The wage rates of movers and stayers are the same at the end of the first year since they both have one year work experience and one year job tenure. But over time, the wage rates of movers and stayers will first diverge and then converge. Under specification IVGLS-1, if a less skilled male worker stays with his employer each year, his wage rate would be increased by 13.3% in three years. But if he changes employer every year, the wage increase would be only 5.6%. The wage gain obtainable by a stayer is thus 7.7% higher than what he would obtain if he changes employer every year. This is referred to as the extra wage gain or growth for a worker who stays on his job (stayer) instead of changing his job every year (mover). The extra wage growth for the stayer would be 7.6% under IVGLS-2 and 8.0% under IVGLS-3 in three years of employment. While in five and ten years, the extra gains for stayers range between 12.4% to 12.9% and 12.3% to 13.8%, respectively. The maximum extra growth obtainable by a less skilled male is between 15% to 16% if he stays with his employer by seven to eight years, after which the extra gain starts to shrink towards 0 (at about the fourteenth year of employment). For less skilled female workers, the results suggest that the extra wage growth obtainable by a stayer ranges between 4.5% to 6.6% in three years, 9.9% to 11.9% in five years, and 8.3% to 10.8% in ten years. A plateau of extra wage gain forms between the 7^{th} year to the 9^{th} year of employment. The maximum extra growth obtainable by a stayer is around 17%, and it shrinks to 0 around the 16^{th} year of employment.

For skilled male workers, the extra growth obtainable by the stayer is limited. The maximum extra gain is around 5%. It can be achieved around the 5^{th} year of employment and shrinks to 0 immediately thereafter. On the other hand, the extra wage growth for skilled female stayers changes in a similar way as that for less skilled male and female stayers. The extra gain in three years of employment ranges between 6.1% to 8.5%. It ranges between 10.4% to 14.7% in five years, between 14% to 20% in ten years, and between 7% to 10% in fifteen years of employment.

The maximum extra gain obtainable by skilled female stayers is between 14% to 20%, and it can be achieved between the 9th and the 10th years of employment.

The above exercise, conditional on employee and job characteristics, shows that less skilled workers would be able to raise their wages faster if they stay with their employers for a long time period than moving frequently between jobs. For less skilled workers with no previous work experience and skilled female workers, the optimal job tenure is around eight to nine years. The extra wage growth is between 15% to 20% if they stay on their jobs up to the optimal tenure rather than changing jobs every year. However, as more and more general labour market experience is accumulated, the direct effect of job tenure on wage growth will eventually disappear.

Based on the above results, it is reasonable to conclude that the returns to job tenure is higher than the returns to total labour market experience for less skilled workers for the first number of years of employment. The earnings prospect of the young (who generally have few years of work experience) less skilled workers can be improved by about 15%-20% if they could stay on their jobs for eight to nine years rather than changing their jobs every year.

4. The High Returns to Schooling

The estimates of the returns to schooling in this study range between 13% to 18% for male and between 13% to 16% for female workers. These are relatively high comparing to the majority of studies on the returns to schooling.[18] It is worthwhile to notice that the sample for this study captures the upward sloping portion of the age-wage profile. Individual workers in the sample are young and have relatively low, homogeneous total labour market experience (see Appendix Table A1). It is not surprising to observe high contributions made by general human capital such as schooling to wage growth for younger workers. Empirically, the estimates are based on IV estimation. It is well known that the IV estimates for returns to schooling are almost always higher than the corresponding OLS estimates, the high returns to schooling of this study compares fairly well to other IV based studies. For example, Hausman and Taylor's (1981) estimates, based on a random Panel Study on Income Dynamics (PSID) sample of 750 males aged between 25-55 in 1968 and 1972, ranges between 12.5% to 21.7%.

To see the sensitivity of returns to tenure and experience with respect to the returns to schooling, some restricted versions of the wage model, where the returns to schooling are fixed at 8% and 10.5% are also estimated.[19] Under the restriction, the main finding that the return to job tenure is higher than the return to total labour market experience for less skilled male workers still holds, as does the opposite for high-skilled male workers. For example, if we fix the return to schooling at 10.5% for male less skilled workers, their returns to job tenure and to work experience become 8.4% and 7.5% respectively, while if their returns to schooling are fixed at 8%, the returns to tenure and experience become 7.4% and 6.2%, respectively. However, once we lower the returns to schooling for female less skilled workers to 8% or 10.5%, their returns to tenure become smaller then their returns to experience.[20]

[18] Cards (1999) summarizes a huge number of studies on the returns to schooling. The OLS estimates range between 5% to 11%, while the IV estimates vary between 6% to 15%.

[19] The median estimates summarized in Card (1999) is approximately 10.5%.

[20] Results are available upon request.

5. The Effects of Other Variables on Wage Growth

The effects of other explanatory variables in the wage model are quite stable across different specifications. They can be summarized as the follows.

(a) Male workers, regardless of their skill levels, receive approximately a 7% union wage premium, while female workers receive an even higher union premium (11% to 15%).
(b) In general, full-time workers receive a higher hourly wage. Although this is somewhat mixed for female high-skilled workers.
(c) Married workers earn a higher hourly wage, regardless of their gender and skill levels. But the hourly wage rate of married less skilled male workers can be 15% higher than their unmarried counterparts.
(d) Workers in retail, hotel services, and other services industries earn much less than workers in manufacturing sectors.
(e) Workers who work for large firms (those with 500 or more employees and those with more than 1000 employees) earn about 10% wage premium. The firm size premium for high-skilled workers is higher than that for less skilled workers.

V. Summary and Conclusions

Facing skill-biased technology changes, it is important to understand the wage progression mechanism of less skilled workers in order to design public policies to enhance the earnings prospect for these workers. Using data extracted SLID 1993-1998, the study estimates an extended human capital model of wage growth for young workers with different skill levels. The empirical model allows a few key explanatory variables such as work experience, job tenure, and year of education to be correlated with unobserved worker characteristics and job match quality. The model is estimated through the IVGLS procedure implemented by Altonji and Shakotko (1987), which is an extension of the work by Hausman and Taylor (1981). The estimators are consistent and asymptotically efficient.

The study finds that the return to job tenure is significantly different from 0. And contrary to the case of skilled workers, job tenure has a higher effect on wage growth than total labour market experience for all less skilled workers. For skilled female workers, however, job tenure may play a bigger role than work experience. The finding implies that firm-specific human capital acquired by less skilled workers can be used as a substitute for their low general human capital. For example, less skilled workers who have no previous work experience may gain an extra 15% to 20% wage growth if they stay on their jobs for about eight to nine years rather than changing their jobs every year.

The finding may also explain, at least in part, the dramatic difference in wage growth observed from the balanced and unbalanced panel of workers (Table 2). Comparing the two panels, workers in the balanced panel are those with longer job tenures, while workers in the unbalanced panel consist of those with relatively short tenures. In fact, the averages are 4.2 years for less skilled males, 3.8 years for skilled males and less skilled females, and 4.1 years for skilled females in the balanced panel.[21] The corresponding means are 3.3, 3.1, 3.4 and 3.5 years when all workers are included (the unbalanced panel, see Table 1A). The longer job tenures of workers in

[21] Author's calculation for workers in Part II of Table 1.

the balanced panel may play an important role in explaining the higher wage growths observed for these workers.

One limit of the study is that the sample size does not allow some meaningful interactions between job tenure and industries or occupations. Such a practice may shed light on wage progression from the dual labour market perspective.[22]

[22] Dickens and Lang (1985).

Appendix A. Descriptive Statistics and Main Estimation Results

Table A1. Mean and Standard Deviation of Variables Employed

	Less skilled male		Skilled male		Less skilled female		Skilled female	
Variables	Mean	st.dev.	Mean	st.dev.	Mean	st.dev.	mean	st.dev.
log wage	2.364	0.414	2.625	0.472	2.147	0.385	2.436	0.449
Experience	5.85	4.908	5.658	4.22	4.697	4.563	5.132	3.91
Experience^2	5.831	7.344	4.982	6.098	4.288	6.425	4.162	5.213
Tenure	3.254	3.299	3.407	3.06	3.088	3.298	3.491	3.263
tenure^2	2.146	4.079	2.097	3.53	2.041	4.054	2.284	3.933
Schooling	11.208	1.511	15.161	2.661	11.262	1.59	14.989	2.269
Union	0.233	0.423	0.27	0.444	0.144	0.351	0.251	0.433
full-time	0.904	0.295	0.928	0.259	0.728	0.445	0.819	0.385
Student	0.135	0.342	0.244	0.43	0.182	0.386	0.246	0.431
Rural	0.195	0.396	0.132	0.339	0.206	0.405	0.124	0.329
Married	0.405	0.491	0.476	0.499	0.517	0.5	0.533	0.499
Atlantic	0.081	0.273	0.073	0.261	0.093	0.29	0.086	0.281
Ontario	0.367	0.482	0.38	0.485	0.366	0.482	0.354	0.478
Quebec	0.201	0.401	0.238	0.426	0.175	0.38	0.254	0.435
Prairies	0.223	0.419	0.176	0.381	0.205	0.403	0.175	0.38
BC	0.124	0.33	0.132	0.338	0.162	0.369	0.131	0.337
Forest	0.018	0.133	0.009	0.096	0.005	0.072	0.003	0.05
Mining	0.024	0.153	0.016	0.127	0.004	0.064	0.006	0.074
Manufacture	0.229	0.42	0.214	0.41	0.141	0.348	0.085	0.279
Construction	0.149	0.356	0.084	0.278	0.008	0.089	0.009	0.092
Transportation	0.068	0.252	0.043	0.202	0.006	0.077	0.013	0.115
Communication	0.026	0.159	0.034	0.181	0.012	0.107	0.022	0.146
whole sale	0.099	0.299	0.077	0.266	0.037	0.188	0.034	0.182
Retail	0.16	0.367	0.148	0.355	0.212	0.409	0.131	0.337
Finance	0.02	0.139	0.027	0.162	0.056	0.229	0.085	0.28
real estate	0.006	0.078	0.008	0.092	0.007	0.083	0.019	0.138
business services	0.028	0.164	0.074	0.262	0.043	0.203	0.106	0.307
public sector	0.024	0.154	0.069	0.254	0.037	0.189	0.066	0.248
education services	0.003	0.052	0.042	0.201	0.019	0.138	0.077	0.266
social services	0.01	0.097	0.026	0.159	0.066	0.248	0.182	0.386
hotel services	0.085	0.279	0.069	0.253	0.23	0.421	0.093	0.29
other services	0.045	0.207	0.053	0.224	0.11	0.313	0.069	0.253
1993	0.15	0.357	0.127	0.333	0.164	0.37	0.129	0.335
1994	0.161	0.368	0.146	0.353	0.156	0.363	0.151	0.358
1995	0.164	0.371	0.163	0.369	0.159	0.366	0.165	0.371
1996	0.172	0.378	0.171	0.376	0.163	0.369	0.174	0.379
1997	0.178	0.382	0.186	0.389	0.178	0.383	0.185	0.388
1998	0.174	0.38	0.207	0.405	0.181	0.385	0.196	0.397
firm size: < 20	0.358	0.48	0.22	0.414	0.295	0.456	0.269	0.443
firm size: 20 to 99	0.201	0.401	0.198	0.398	0.182	0.386	0.178	0.383
firm size: 100 to 499	0.114	0.318	0.149	0.356	0.111	0.314	0.132	0.338
firm size: 500 to 999	0.066	0.248	0.088	0.283	0.072	0.259	0.08	0.272
firm size: >=1000	0.228	0.42	0.324	0.468	0.304	0.46	0.323	0.468
Sample Size	6,126		9,575		4,356		11,125	

Table A2. Male Less Skilled Workers (N=6,126)

	OLS		IVGLS --1		IVGLS --2		IVGLS --3	
Variable	est.	std err.	est.	std err.	est.	std err.	est.	std err.
Work experience	0.0027	0.0027	0.0298***	0.0056	0.0351***	0.0057	0.0243***	0.0039
Work experience^2/10	0.0053***	0.0019	-0.0044	0.0033	-0.0072**	0.0033	-0.0015	0.0025
Job tenure	0.0541***	0.0036	0.0515***	0.0049	0.0517***	0.0049	0.0548***	0.0052
Job tenure^2/10	-0.0284***	0.0027	-0.0329***	0.0036	-0.0344***	0.0038	-0.0374***	0.004
Year of schooling	0.0141***	0.0026	0.1781***	0.0044	0.1672***	0.005	0.161***	0.002
Union member	0.1659***	0.01	0.0732***	0.016	0.0706***	0.012	0.0909***	0.0123
Full time worker	0.0232	0.0142	0.0059	0.019	0.0538***	0.0186	0.0939***	0.0131
Enrolled in school	-0.146***	0.0134	0.0442*	0.024	-0.298*	0.0166	-0.0442***	0.0144
Rural resident	0.01	0.0095	0.0234	0.015	0.0321**	0.0144	0.0417***	0.0137
Married	0.153***	0.0088	0.1464***	0.014	0.1449***	0.0138	0.1659***	0.0124
Atlantic region	-0.208***	0.0145	-0.0806***	0.03	-0.0549*	0.0286	-0.0549**	0.0237
Quebec	-0.107***	0.0105	0.0777***	0.024	0.1016***	0.0215	0.0986***	0.0173
Prairies	-0.070***	0.0099	-0.0275	0.024	0.0038	0.0222	0.0021	0.0166
British Colombia	0.1493***	0.0122	0.172***	0.028	0.2138***	0.0264	0.2162***	0.0209
Logging and forest	0.234***	0.0285	0.2508***	0.041	0.2771***	0.038	0.3435***	0.0372
Mining, quarrying & oil	0.2732***	0.0248	0.3439***	0.041	0.3746***	0.0398	0.3740***	0.0388
Construction	0.103***	0.0127	0.0897***	0.025	0.1173***	0.0231	0.1702***	0.0182
Transportation & storage	0.012	0.016	0.0131	0.032	0.0506*	0.0305	0.0906***	0.0254
Communication & utility	-0.116***	0.024	-0.0481	0.047	-0.0514	0.0472	-0.191	0.0418
Wholesale trade	-0.08***	0.014	-0.0389	0.027	-0.0047	0.0263	0.0182	0.022
Retail trade	-0.248***	0.0123	-0.2525***	0.026	-0.2030***	0.0251	-0.1703***	0.0184
Finance & insurance	-0.107***	0.0279	-0.066	0.051	-0.0364	0.0499	-0.0647	0.0468
Real est. & insur. agent	-0.0228	0.0478	0.2038***	0.065	0.2291***	0.0621	0.2505***	0.0596
Business service	-0.0504**	0.0233	-0.1158***	0.036	-0.0948***	0.035	-0.0689**	0.0333
Government service	0.0472*	0.0244	-0.0539	0.039	-0.0026	0.0366	0.0776**	0.0344
Educational service	-0.012	0.0696	0.0572	0.12	0.0795	0.12	0.0634	0.117
Health & social service	-0.113***	0.0379	-0.069	0.052	-0.0044	0.0521	-0.0878*	0.0479
Accommodation & food	-0.277***	0.0155	-0.2716***	0.03	-0.2049***	0.0288	-0.1778***	0.0215
Other services	-0.239***	0.0191	-0.1761***	0.03	-0.1120***	0.0282	-0.1027***	0.0241
1994	0.0815***	0.0129	0.0816***	0.012	0.0841***	0.0126	0.1156***	0.0116
1995	0.0409***	0.0129	0.0258**	0.013	0.0545***	0.0142	0.0691***	0.0119
1996	0.0529***	0.0128	0.029**	0.014	0.0318**	0.0145	0.0556***	0.0126
1997	0.0241*	0.0128	0.0144	0.015	0.151	0.0148	0.0243*	0.0128
1998	0.0483***	0.013	0.0211	0.016	0.307*	0.0164	0.0475***	0.0136
Firm size: 20-99 workers	-0.0055	0.0103	-0.0105	0.013	-0.0048	0.0121	0.0022	0.0116
100 to 499	0.029*	0.0128	-0.0158	0.015	-0.0185	0.0144	0.0038	0.0138
500 to 999	0.0614***	0.0159	0.045***	0.017	0.0467***	0.0173	0.0768***	0.0168
1000 or more workers	0.0593***	0.0109	0.0305**	0.015	0.0515***	0.0141	0.0665***	0.0131
Constant	1.9772***	0.0352	0.0542***	0.018	0.0810***	0.0185	0.0964***	0.0179
σ_α^2	--		0.0247		0.0245		0.0098	
σ_δ^2	--		0.0305		0.0287		0.0287	
σ_ε^2	--		0.0398		0.0424		0.0428	
Adjusted R^2	0.5423		0.928		0.933		0.945	
*. Significant at 10%.								
**. Significant at 5%.								
***. Significant at 1%.								

Table A3. Male Skilled Workers (N=9,575)

Variable	OLS		IVGLS --1		IVGLS --2		IVGLS --3	
	est.	std err	est.	std err.	est.	std err.	est.	std err.
Work experience	0.0156***	0.0029	0.0651***	0.0052	0.0714***	0.0054	0.0581***	0.0038
Work experience^2/10	0.0005	0.002	-0.0134***	0.0031	-0.0166***	0.0033	-0.0130***	0.0025
Job tenure	0.0554***	0.0036	0.0135***	0.0047	0.012**	0.0048	0.0235***	0.0046
Job tenure^2/10	-0.03***	0.0031	-0.0118***	0.0039	-0.0155***	0.0042	-0.0180***	0.0036
Year of schooling	0.039***	0.0015	0.1399***	0.0025	0.1367***	0.0029	0.1282***	0.0014
Union member	0.0555***	0.09	0.0709***	0.0123	0.0786***	0.0099	0.0728***	0.0098
Full time worker	0.1041***	0.0146	0.0382***	0.0152	0.36**	0.0154	0.0675***	0.0112
Enrolled in school	-0.144***	0.0088	-0.059***	0.0096	-0.0496***	0.0083	-0.045***	0.0076
Rural resident	0.0053	0.0108	0.0635***	0.0138	0.0756***	0.0136	0.076***	0.0135
Married	0.1208***	0.0077	0.0505***	0.0107	0.0543***	0.0108	0.0668***	0.0097
Atlantic region	-0.245***	0.0146	-0.0604***	0.0291	-0.0589**	0.0279	-0.0451*	0.0273
Quebec	-0.097***	0.0093	-0.0079	0.0205	0.0068	0.0201	0.0228	0.0172
Prairies	-0.08***	0.0104	0.0522**	0.0221	0.0652***	0.0214	0.0788***	0.0209
British Colombia	0.0622***	0.0104	0.1474***	0.0229	0.1584***	0.0224	0.183***	0.0476
Logging and forest	0.1149***	0.0374	0.1101**	0.055	0.1067**	0.0486	0.1519***	0.0476
Mining, quarrying & oil	0.1409***	0.0287	0.2563***	0.0456	0.2596***	0.0447	0.2739***	0.0435
Construction	0.0476***	0.0148	0.1655***	0.0235	0.1485***	0.0228	0.2058***	0.0208
Transportation & storage	-0.109***	0.0188	0.0761***	0.0289	0.0803***	0.0285	0.1183***	0.0268
Communication & utility	-0.0226	0.0207	0.0396	0.0306	0.044	0.0309	0.0761***	0.0283
Wholesale trade	-0.114***	0.0149	-0.0093	0.0193	-0.0103	0.0201	0.0123	0.018
Retail trade	-0.259***	0.0121	-0.1272***	0.0211	-0.123***	0.022	-0.0788***	0.0176
Finance & insurance	0.1166***	0.0229	0.0813**	0.0383	0.0887**	0.0379	0.1457***	0.0347
Real est. & insur. agent	-0.137***	0.039	-0.0684	0.0442	-0.095**	0.043	-0.0093	0.041
Business service	-0.0226	0.0153	0.0275	0.0245	0.0236	0.0258	0.0761***	0.0211
Government service	-0.0096	0.0157	0.0038	0.0271	0.0068	0.0269	0.0482**	0.0239
Educational service	-0.0204	0.0194	-0.0492	0.0328	-0.038	0.0328	0.0074	0.0293
Health & social service	-0.115***	0.0231	0.0261	0.044	0.0217	0.0433	0.0698*	0.0409
Accommodation & food	-0.487***	0.0158	-0.1623***	0.025	-0.1683***	0.0256	-0.12***	0.0223
Other services	-0.19***	0.0174	-0.0661***	0.025	-0.0682***	0.0254	-0.0329	0.0221
1994	0.043***	0.0134	0.0207**	0.0101	0.0276***	0.0098	0.0612***	0.0091
1995	0.042***	0.0131	-0.0042	0.0109	0.0055	0.0109	0.039***	0.0095
1996	0.064***	0.013	0.0001	0.0123	0.0174	0.0123	0.0378***	0.0103
1997	0.0555***	0.0128	-0.0264*	0.014	-0.0091	0.0139	0.0115	0.0111
1998	0.0928***	0.0126	-0.018	0.016	0.0101	0.0156	.0523***	0.0121
Firm size: 20-99 workers	0.1045***	0.0109	0.0593***	0.0114	0.0769***	0.0114	0.0898***	0.0105
100 to 499	0.1428***	0.0121	0.0907***	0.013	0.0993***	0.013	0.1062***	0.0118
500 to 999	0.1408***	0.0144	0.1079***	0.0142	0.1152***	0.0142	0.1401***	0.0131
1000 or more workers	0.1327***	0.0105	0.1094***	0.0124	0.1139***	0.0124	0.1312***	0.0111
Constant	0.1327***	0.0299	0.0108	0.0138	0.0295**	0.0134	0.1063***	0.0133
σ_α^2	--		0.0537		0.0493		0.0460	
σ_δ^2	--		0.0460		0.0406		0.0391	
σ_ε^2	--		0.0409		0.0430		0.0409	
Adjusted R^2	0.4765		0.898		0.905		0.907	
*. Significant at 10%.								
**. Significant at 5%.								
***. Significant at 1%.								

Table A4. Female Less Skilled Workers (N=4,356)

	OLS		IVGLS --1		IVGLS --2		IVGLS --3	
Variable	est.	std. err.	est.	std err.	est.	std err.	est.	std err.
Work experience	-0.011***	0.0033	0.0229***	0.0066	0.0233***	0.0073	0.0226***	0.0047
Work experience^2/10	0.02***	0.0022	0.0015	0.0039	0.0032	0.0043	0.0033	0.0031
Job tenure	0.1057***	0.004	0.0325***	0.0056	0.0451***	0.006	0.0512***	0.0063
Job tenure^2/10	-0.029***	0.0031	-0.0169***	0.0043	-0.0273***	0.005	-0.0303***	0.0053
Year of schooling	0.0044***	0.0026	0.1644***	0.0059	0.1478***	0.0062	0.1372***	0.0022
Union member	0.1153***	0.013	0.1158***	0.022	0.1441***	0.0167	0.1413***	0.0168
Full time worker	0.0332***	0.0097	0.0471***	0.0146	0.0707***	0.0128	0.0948***	0.0105
Enrolled in school	-0.101***	0.0129	0.0142	0.0235	0.0249	0.0182	0.0424***	0.0147
Rural resident	-0.0014	0.0102	-0.0216	0.0161	-0.0084	0.0162	-0.0094	0.0104
Married	0.0543***	0.0092	0.0714***	0.0151	0.084***	0.0148	0.1***	0.0123
Atlantic region	-0.239***	0.0147	-0.1918***	0.0285	-0.1711***	0.0285	-0.1583***	0.0249
Quebec	-0.071***	0.0119	0.0979***	0.0222	0.1011***	0.0225	0.1045***	0.0198
Prairies	-0.066***	0.011	-0.0202	0.0217	0.0022	0.0222	0.01	0.018
British Colombia	0.0996***	0.0119	0.1275***	0.0241	0.1545***	0.0248	0.1638***	0.0197
Logging and forest	0.3754***	0.0555	0.3762***	0.1128	0.4595***	0.111	0.564***	0.1
Mining, quarrying & oil	0.2653***	0.062	0.4598***	0.1055	0.4485***	0.1052	0.557***	0.101
Construction	-0.0427	0.045	0.0985	0.0722	0.1753**	0.0699	0.2041***	0.0644
Transportation & storage	-0.0497	0.0513	0.0385	0.0831	0.1151	0.0793	0.162**	0.0752
Communication & utility	0.1899***	0.0378	0.1987***	0.0737	0.2404***	0.0665	0.4051***	0.0708
Wholesale trade	0.103***	0.0231	0.0295	0.0496	0.0935**	0.0462	0.1555***	0.0367
Retail trade	-0.113***	0.0142	-0.1086***	0.0422	-0.0103	0.0396	0.0368*	0.0215
Finance & insurance	0.0688***	0.0208	-0.0207	0.0499	0.0555	0.049	0.0895**	0.0386
Real est. & insur. Agent	0.0163	0.0481	0.0967	0.1004	0.1835*	0.0997	0.2618***	0.0932
Business service	0.2432***	0.022	0.0241	0.0507	0.1272***	0.047	0.1867***	0.0321
Government service	0.3303***	0.0238	0.1347***	0.0494	0.2004***	0.0474	0.2569***	0.0375
Educational service	0.1604***	0.0304	0.2713***	0.0572	0.3467***	0.0552	0.4349***	0.045
Health & social service	0.1354***	0.0187	0.1237***	0.0453	0.2007***	0.0436	0.2523***	0.0293
Accommodation & food	-0.158***	0.0142	-0.1349***	0.0411	-0.0441	0.0377	0.0036	0.0215
Other services	-0.118***	0.0163	-0.1583***	0.044	-0.0694*	0.0402	-0.012	0.0243
1994	0.0116	0.0137	0.0372***	0.0138	0.0604***	0.0137	0.0834***	0.0124
1995	-0.003	0.0137	0.0144	0.0145	0.0193	0.0139	0.0345***	0.0129
1996	-0.03**	0.0136	0.0122	0.0156	0.0123	0.0147	0.0389***	0.0133
1997	-0.027**	0.0134	-0.0065	0.0158	0.0196	0.0155	0.0232*	0.0138
1998	-0.0212	0.0134	-0.0069	0.0167	0.0078	0.0167	0.0268*	0.0147
Firm size: 20-99 workers	0.0746***	0.0117	0.0537***	0.0159	0.0685***	0.0149	0.0880***	0.0131
100 to 499	0.0874***	0.0141	0.0712***	0.019	.0869***	0.0183	0.1134***	0.0156
500 to 999	0.019	0.0165	-0.0088	0.02	0.0042	0.0191	0.0216	0.0178
1000 or more workers	0.0843***	0.0111	0.0828***	0.0168	0.0900***	0.0159	0.112***	0.0139
Constant	1.9191***	0.035	0.0417*	0.0234	0.1025***	0.0222	0.1239***	0.0224
σ_α^2	--		0.0113		0.0150		0.0050	
σ_δ^2	--		0.0286		0.0310		0.0376	
σ_ε^2	--		0.0317		0.0326		0.0321	
Adjusted R^2	0.5667		0.936		0.934		0.945	
*. Significant at 10%.								
**. Significant at 5%.								
***. Significant at 1%.								

Table A5. Female Skilled Workers (N=11,125)

Variable	OLS		IVGLS --1		IVGLS --2		IVGLS --3	
	est.	std. err.	est.	std err.	est.	std err.	est.	std err.
Work experience	0.0148***	0.0027	0.0436***	0.0049	0.0489***	0.0048	0.0272***	0.0036
Work experience^2/10	0.0015	0.002	-0.0023	0.0032	-0.0096***	0.003	0.0011	0.0025
Job tenure	0.0434***	0.0031	0.0406***	0.004	0.0387***	0.0038	0.0544***	0.0041
Job tenure^2/10	-0.020***	0.0025	-0.0217***	0.0034	-0.021***	0.003	-0.0294***	0.0035
Year of schooling	0.0498***	0.0014	0.139***	0.0029	0.1408***	0.0029	0.129***	0.0013
Union member	0.1122***	0.0085	0.132***	0.0122	0.1166***	0.0098	0.1061***	0.0097
Full time worker	0.0488***	0.008	0.0189**	0.0095	-0.0005	0.0086	0.0307***	0.0073
Enrolled in school	-0.0825***	0.0076	-0.0174*	0.009	-0.0107	0.0077	-0.0005	0.0069
Rural resident	-0.0066	0.0091	0.0412***	0.0116	0.0497***	0.0115	0.0489***	0.0113
Married	0.0544***	0.0066	0.0332***	0.0091	0.0343***	0.0092	0.0638***	0.0083
Atlantic region	-0.2144***	0.0112	-0.1675***	0.0216	-0.1676***	0.0206	-0.1424***	0.0199
Quebec	-0.1098***	0.0077	-0.1026***	0.0158	-0.1075***	0.0149	-0.074***	0.0133
Prairies	-0.1105***	0.0088	-0.0362**	0.0168	-0.04**	0.0158	-0.0048	0.0149
British Colombia	0.0676***	0.0097	0.0983***	0.0185	0.0881***	0.0174	0.1259***	0.0167
Logging and forest	0.218***	0.0588	0.165**	0.0743	0.1455**	0.0733	0.2695***	0.073
Mining, quarrying & oil	0.2902***	0.0409	0.3221***	0.0625	0.3272***	0.061	0.3929***	0.0587
Construction	-0.0501	0.033	0.0773*	0.0434	0.0593	0.0431	0.149***	0.0386
Transportation & storage	-0.0637***	0.027	0.0749*	0.0424	0.0987**	0.0422	0.1727**	0.0368
Communication & utility	0.0031	0.0224	0.0777**	0.0382	0.0598	0.037	0.1666***	0.0312
Wholesale trade	-0.0873***	0.0187	-0.0152	0.0354	-0.0468	0.0344	0.0663**	0.0271
Retail trade	-0.2836***	0.0129	-0.1427***	0.0275	-0.1752***	0.0266	-0.0774***	0.0177
Finance & insurance	-0.0236*	0.0142	0.0868***	0.0296	0.0662**	0.0286	0.1648***	0.022
Real est. & insur. agent	0.0926***	0.0231	0.0683	0.0418	0.033	0.0406	0.1423***	0.0352
Business service	0.0848***	0.0134	0.1199***	0.0289	0.1068***	0.0281	0.2203***	0.019
Government service	0.0382**	0.0158	0.0568*	0.031	0.0468	0.0294	0.1489***	0.022
Educational service	0.044***	0.0151	0.0625*	0.0331	0.0435	0.0322	0.1654***	0.022
Health & social service	0.0875***	0.0125	0.1238***	0.03	0.1032***	0.0287	0.2218***	0.0185
Accommodation & food	-0.3707***	0.014	-0.143***	0.0283	-0.1749***	0.027	-0.0736***	0.0191
Other services	-0.2587***	0.015	-0.0729***	0.0295	-0.0923***	0.0285	0.0102	0.02
1994	0.0317***	0.011	-0.0216**	0.0093	-0.0136	0.0091	0.0126	0.0083
1995	-0.0007	0.0108	-0.0609***	0.0099	-0.0471***	0.0103	-0.0198**	0.0088
1996	0.0232***	0.0107	-0.0605***	0.0108	-0.0495***	0.0113	-0.0172*	0.0093
1997	0.0389***	0.0107	-0.0796***	0.0116	-0.0656***	0.0119	-0.0377***	0.0098
1998	0.0669***	0.0106	-0.0827***	0.0128	-0.0573***	0.013	-0.0258**	0.0105
Firm size: 20-99 workers	0.0414***	0.009	0.0253**	0.0101	0.0256***	0.01	0.0418***	0.0093
100 to 499	0.0622***	0.0101	0.0501***	0.0116	0.0445***	0.0115	0.0711***	0.0105
500 to 999	0.1284***	0.012	0.0975***	0.0127	0.0774***	0.0128	0.1145***	0.0117
1000 or more workers	0.1473***	0.0085	0.0839***	0.0111	0.0877***	0.011	0.1055***	0.0096
Constant	1.4421***	0.0265	0.019	0.0127	0.0539***	0.0124	0.0529***	0.0125
σ_α^2	--		0.0266		0.0223		0.0221	
σ_δ^2	--		0.0388		0.0353		0.0352	
σ_ε^2	--		0.0402		0.0416		0.0414	
Adjusted R^2	0.5391		0.9243		0.9310		0.9310	
*. Significant at 10%.								
**. Significant at 5%.								
***. Significant at 1%.								

Table A6: IVGLS Estimates with Experience and Tenure [*]

	Male	LSKLD.	Female	LSKLD.	Male	SKLD.	Female	SKLD.
Variable	est.	std err.	est.	std err.	est.	std err.	est.	std err.
Experience	0.3264	0.0083	0.2713	0.0117	0.3353	0.0077	0.3523	0.0074
Experience^2/10	-0.1225	0.0053	-0.0929	0.0078	-0.1199	0.0049	-0.1507	0.0054
Tenure	0.1302	0.0096	0.1412	0.0118	0.0560	0.0082	0.0927	0.0073
Tenure^2/10	-0.1002	0.0072	-0.0957	0.0092	-0.0674	0.0065	-0.0823	0.0060
Constant	0.6255	0.0290	0.8052	0.0371	0.7277	0.0218	0.6300	0.0204
R^2	0.5541		0.4785		0.4928		0.5162	

[*] All estimates are significant at 1%.

Appendix B. Estimation Details

As illustrated by Altonji and Shakotko (1987), the co-variance matrix for the model

$$W_{ijt} = \beta X_{ijt} + \alpha_i + \delta_{ij} + u_{ijt},$$

is

$$\Sigma_i = \mathrm{Var}[\alpha_i + \delta_{ij} + u_{ijt}] = \sigma^2_{\alpha} l_i l_i' + \sigma^2_{\delta} G_i G_i' + \sigma^2_{\varepsilon} I_i,$$

and the GLS estimate of β is given by,

$$\beta_{GLS} = \left(\sum_{i=1}^{n} X_{i.}' \Sigma_i^{-\frac{1}{2}} X_{i.}\right)^{-1} \left(\sum_{i=1}^{n} X_{i.}' \Sigma_i^{-\frac{1}{2}} W_{i.}\right)$$

where $W_{i.}$ and $X_{i.}$ are stacked observations of W_{ijt} and X_{ijt} for worker *i*. When all or some of the X variables are instrumented, the above GLS estimator is referred to as the IVGLS estimator. In order to obtain the IVGLS estimates, one has to calculate the σ^2_{α}, σ^2_{δ}, and σ^2_{ε}, the unknown elements of Σ_i. The following lines provide more details for the construction of Σ_i.

(1) Calculate the IV estimates of β using deviations from job-specific means of the endogenous explanatory variables as the instruments, and using $\boldsymbol{b}_{IV}$, the consistent estimates of β to calculate $\mathrm{var}(\alpha_i + \delta_{ij} + u_{ijt}) = \mathrm{var}(W_{ijt} - b_{IV} X_{ijt})$ for latter use.

(2) Derive σ^2_u from $\mathrm{var}(u_{ijt} - u_{ij\bullet}) = \sigma^2_u + \sigma^2_u / t_i$, where,
$\mathrm{var}(u_{ijt} - u_{ij\bullet}) = \mathrm{var}[(W_{ijt} - W_{ij\bullet}) - \beta_{IV}(X_{ijt} - X_{ij\bullet})]$.
$W_{ij\bullet}$ and $X_{ij\bullet}$ are job specific means of W_{ijt} and X_{ijt}. This works since the model can be expressed in the deviation from job-specific mean form,
$W_{ijt} - W_{ij\bullet} = \beta (X_{ijt} - X_{ij\bullet}) + (u_{ijt} - u_{ij\bullet})$.

(3) Drive σ^2_{δ} using σ^2_u (from step (2)) and $\mathrm{var}[(\delta_{ij} - \delta_{i\bullet}) + (u_{ijt} - u_{i\bullet\bullet})]$. The latter is obtained using β_{IV} in the deviation from worker-specific mean form of the model,
$W_{ijt} - W_{i\bullet\bullet} = (\delta_{ij} - \delta_{i\bullet}) + \beta (X_{ijt} - X_{i\bullet\bullet}) + (u_{ijt} - u_{i\bullet\bullet})$.

(4) Calculate σ^2_{α} using $\mathrm{var}(\alpha_i + \delta_{ij} + u_{ijt})$ from step (1) and σ^2_{δ} and σ^2_u obtained above.

(5) Construct Σ for each worker. The IVGLS estimates are obtained by running IV estimation of $W^*_{ijt} = (\Sigma_i)^{-.5} (W_{ijt})$ on $X^*_{ijt} = (\Sigma_i)^{-.5} (X_{ijt})$, with $X^*_{ijt} - X^*_{ij\bullet}$ as the instruments for potential endogenous X*s*.

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