Draft, comments welcome

Unemployment Insurance's Time-Varying Impacts on Reemployment Wages

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August 20, 2007

This paper examines the impact of unemployment insurance (UI) on reemployment wages using a recent Canadian panel data set. The preferred empirical specification used here endogenizes workers' wages dynamics as well as their employment and unemployment durations through a random effect setup. In addition, UI's impact on reemployment wages is allowed to be time-varying here. The result shows reemployment wages of UI-covered workers are indeed statistically higher than benefit exhaustees, although the difference isn't economically substantial. The results also shows that most of UI's impact is on the delayed reemployment process rather than lowered reemployment wages.

Key Words: unemployment insurance, reemployment wages, time-varying impacts

*The author is also a research fellow of IZA. The author thanks David A. Green, W. Craig Riddell, Shinichi Sakata, Thomas Lemieux, Nicole Fortin, Chris Riddell, Micheal Baker, Paul Beaudry, as well as seminar participants at the University of British Columbia and the 2005 Canadian Economics Association Meetings for helpful questions and comments. Sincere thanks also go to Lee Grenon, James P. Croal and their collegues with the Research Data Centre at the University of British Columbia for helpful information and prompt processing of test results.

1. INTRODUCTION

Although there are many criticisms for unemployment insurance (UI), there is still an important economic argument for it. That is, UI is theoretically predicted to improve the qualities of workers' job matches. The general idea is that, with UI benefit serving as search subsidies, workers would be able to have better job matches because they could set their reservation wages higher. If it is indeed true, UI could actually be socially desirable in the long run, especially when there is an active technology upgrading. It could then accelerate technology upgrading by encouraging acquisitios of new skills that often come with higher wages but riskier employment. In spite of the importance of this theoretical argument for UI, as a matter of fact, whether or not UI improves job match qualities remains to be an unsettled empirical question.

One major problem with previous research is the lack of control for the endogenous correlation between unemployment durations and reemployment wages, which should be two outcome variables of one single optimality strategy[1]. Theoretically, UI-covered workers should have longer unemployment durations and higher reemployment wages at the same time.

The possibility of UI's time-varying (rather than time-constant) impacts on reemployment wages is another issue ignored by previous studies. Previous studies only differentiate unemployment spells according to initial UI benefit coverage, i.e. whether a worker has UI benefit at the start of his unemployment spell. The timing of reemployment relative to benefit exhaustion weeks has not been considered. Theoretically, unemployed workers' reservation wage is closely related to the number of weeks of remaining benefit. The purpose of this study thus is to re-examine UI's impacts on reemployment wages with considerations of both the endogeneity of employment/unemployment cycles and the possibility of UI's impacts to be time-varying.

[1]It is worthnoting that most theoretical models make predictions about UI in terms of hazard rates and reservation wages, not in terms of reemployment wages. The reservation wage is related to the realized reemployment wages indirectly through the distribution of wage offers—only those offers above the reservation wage could possibly be the realized reemployment wage. Lower reservation wage should cause higher unemployment hazard rates and a lower threshold of reemployment wages. The magnitude of UI's impacts critically depends on the shape of offering wages and position of starting reservation wages. But in any case, the expected coincidence of UI's impacts on hazard rates and reemployment wages should be emphasized in this study's identification of UI's impacts.

The data used here is constructed from a recent Canadian panel data set, the Survey of Labour and Income Dynamics (SLID). Based on individuals' detailed job information, this study is able to have a sample of individuals with possibly multiple employment and unemployment spells. It is also worthnoting, due to institutional differences, there are both advantages and disadvantages in using Canadian data to study the impacts of UI relative to using US data. In the US, variations of individuals' UI benefit durations mainly exist at the state level, which leads to a serious identification problem between state-fixed effects and UI effects. While in Canada, the build-in dependency of UI benefit durations on preceding employment histories creates a rich but very likely endogenous variations in individuals' UI benefit durations. In this sense, the identification of this study is strengthened by the usage of exogenous variation of UI benefit durations due to the Employment Insurance reform, which took place in 1996.

The main empirical analysis here is based on a full information maximum likelihood model which endogenizes individuals' employment/unemployment durations, their wages at the start of each continuous sample periods, and their reemployment wages. The duration parts of the model use a hazard model with heaping effects proposed in Shen (2007), while the wage parts of the model assume wages to have lognormal distribution. Together, the four parts are linked through a vector of heterogeneity terms using a person-specific random effect setup.

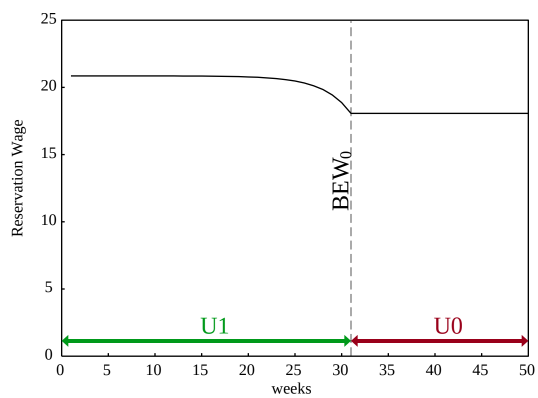
The preferred set of estimation result confirms that workers reemployed with remaining UI benefit coverage do have higher reemployment wage. Specifically, the wages would be 12% to 14% higher if a worker is reemployed with at least 11 weeks of benefit left. Moreover, the coincidence of reemployment wage decreases and unemployment hazard increases as workers approaching benefit exhaustion makes the evidence here even stronger. Besides, comparisons among estimation results of different specifications suggest several important correlations in the micro labour market. In particular, we find longer employment durations and shorter unemployment durations are correlated mainly with persistent higher wages but not temporary wage shocks. I also find workers who are reemployed at precisely their benefit exhaustion weeks are also a group with persistently higher wages.

The rest of this paper is organized as follows: section 2 reviews theoretical predictions on UI's impacts on reemployment wage; section 3 reviews the literature; section 4 discuss the data as well as some exploratory results; section 5 setups the econometric model and discusses the identification issues; section 6 discusses the main set of estimation results; and finally, section 7 concludes.

2. THEORETICAL MODEL

By construction, UI has no impacts on wages in the standard labour and leisure choice model. There, individuals take wage rates as given and only make their decisions regarding time allocation. Instead, this study is motivated by the job search theories' approach. As an application of this approach, the theoretical work of Shen (2006) examined a model of endogenous employment/unemployment cycles and contingent, temporary UI benefit. Figure 1 reproduces its prediction of the dynamics of unemployed workers' reservation wage over time under a temporary UI benefit coverage.

FIGURE 1. Predicted Impact of Temporary UI Coverage on Unemployed Workers' Reservation Wages



As figure 1 shows the worker's reservation wage decreases at an increasing rate before the benefit exhaustion week BEW_0 (i.e. , during the period **U1**); and, the worker's reservation wage stays constant at a lower level after benefit exhaustion (**U0**). The intuition of the dynamics of reservation wage here is that the worker needs to balance the cost of waiting one more period with the expected benefit of getting another draw of job offers next period. At the benefit exhaustion week, the cost of waiting increases suddenly, as a result, it is better for him to reduce his reservation wage accordingly. For any week prior to benefit exhaustion, the more weeks of benefit a worker has left, the lower is the possibility for him to actually exhaust his benefit, thus the less is his reservation wage brought down due to the consideration of potential benefit exhaustion.

In reality, workers do not get a common number of weeks of UI benefit in Canada, and as a result, the exact timing of reservation wage drops varies across workers. But if we use the benefit exhaustion week as the reference point, the dynamics of reservation wage drops should be very similar across workers. Therefore, the empirical works of this study use a set of time-varying dummy variables constructed with regard to each individual's benefit exhaustion week BEW_0, rather than the spell's starting week.

3. LITERATURE

The empirical literature of UI's impacts on reemployment wages are considerably smaller than those on UI's impacts on unemployment durations. Moreover, most of the studies are done in late 1970s (Burgess and Kingston, 1976; Classen, 1977; Ehrenberg and Oaxaca, 1976; Holen, 1977), except for one recent study (Addison and Blackburn, 2000). These earlier studies all use linear regressions. But they do differ in their measurement of UI coverage and post-unemployment earnings, as well as their sample selection schemes due to data availability issues and variations in their research questions.

Burgess and Kingston (1976) use administrative data of a sample of workers from an experimental UI service program (Service-to-Claimants Project) in the U.S. in late 1970s and find significant positive impacts of UI on earnings in the one-year period post unemployment: a $1 rise of weekly benefit payment is estimated to increase post-unemployment earnings by $25; 1 additional week of potential benefit coverage is estimated to increase post-unemployment earnings by $69. Ehrenberg and Oaxaca (1976) use survey data (National Longitudinal Survey) and find it is mostly among older male job-changers that replacement ratio, i.e. the ratio of weekly UI benefits to pre unemployment weekly wage, increase the post versus pre-unemployment wage ratio: a 0.1 increase of the replacement ratio is estimated to increase the wage ratio by 7%. Classen (1977) use administrative data (Continuous Wage and Benefit History File) and find weekly UI benefit payment does not significantly affect the best-quarterly earnings in the post-unemployment year. Holen (1977) also use the administrative data from Service-to-Claimants Project and find an increase of $90 in the average quarterly earnings for the number of quarters with reported earnings post-unemployment for each $10 weekly UI benefit.

Though the literature in the late 1970s is relatively small, serious questions and doubts are raised. Welch (1977) criticizes these studies on the ground of censoring biases, sample selection biases, simultaneity, etc. But more generally, it questions the validity of the results of these studies considering the tight connections between UI treatment, past earnings and post-employment earnings. Welch (1977) states, as its conclusion, "we have only very tentative evidence of post-wage effects and much remains to be done on this issue."

Much recently, Addison and Blackburn (2000) tries to settle the issue using a newer survey data (the Displaced Worker Surveys). Their measure of reemployment success is the log of the ratio of weekly earning at survey time over that of the lost job. Using linear regressions, they still couldn't find clear evidence to support the classical theoretical claim that UI coverage improves post-unemployment wages.

In summary, the existing literature is not very big; at least some researchers have serious concerns about their data, approach; and, the results of different studies are not strong enough to settle the issue. But, if the existing literature is considered from a different perspective, the sensitivity of the empirical results to sample selection and measurement choices at least suggests that it is very unlikely for UI coverage to have a strong, persistent, and universal impacts on reemployment wages. Thus, it makes one wonder whether it will be more productive to search for temporary impacts of UI, or for substantial impacts of UI among subgroups of workers.

Contrary to the difficulty encountered by studies of UI's impacts on reemployment wages, studies of UI's impacts on unemployment and employment durations have been quite successful. This later literature find that the hazard rate of leaving unemployment state increases as workers approach their their benefit exhaustion weeks (Meyer, 1990). Furthermore, related literature also find the hazard rate of leaving employment state decreases as workers accumulate more employment experience for their UI's entrance requirement (Baker and Rea, 1998; Green and Riddell, 1997). Using the recently avaiable Canadian micro panel data, SLID, Shen (2007) shows UI's impacts on unemployment and employment durations are consistent with theoretical predictions of job search theories. This then makes one wonder about the possibility of UI's impacts on reemployment wages to be time-varying as well.

4. DATA AND EXPLORATORY ANALYSIS

The data used here is constructed using the confidential version of SLID. It contains detailed longitudinal information about individuals' job and earning informations. To summarize, the working data here is in the form of sample employment/unemployment spells. The data construction is custom designed for UI studies. In particular, the 'employment spells' used here refer to periods of working on paid jobs; the 'unemployment spells' refer to periods in-between those 'employment spells'. Not in the paid labour market periods are excluded using an event-based 'observation window' approach rather than the usual individual-based approach on the panel data. For details about the data construction, please refer to Shen (2006) or Shen (2007).

In the final sample, it is possible for an individual to have multiple employment and/unemployment spells, either complete or incomplete (right-censored). The spells come from two periods of two panels, with pre-reform ones from panel 1's 1994 July to 1995 December spells and post reform ones from panel 2's 1997 July to 1998 December spells. The set of time-varying UI treatment dummy variables are exactly the same as in Shen (2007), derived using SLID's information on individuals' job dates, weekly working hours as well as UI unemployment rates and the applicable rules of Canadian UI programs. Table 1 explains how each of them are defined.

The key dependent variable here, wage, refers to job-specific hourly wage at the end of relevant year. For employment spells, the hourly wage for the job started the spell is used, same as for the employment wages; for unemployment spells, the hourly wage for the lost job is used; for reemployment wages, the hourly wage for the reemployment job is used.

Table 2 gives linear regression results relating reemployment wages to UI incentives using four different specifications. The sample used here are pooled pre-/post-reform reemployment wages of non-seasonal workers who either quit or are permanently laid-off and who got reemployed within 52 weeks without intermittent out of paid labour market activities.

The estimated coefficients for UI-related variables in column (1) of table 2 show the impact of UI benefit coverage on reemployment wages is very sensitive to the timing of reemployment relative to benefit exhaustion week. Reemployment wages of individuals who got re-employed with at least 11 weeks of benefit left are statistically higher than those of individuals who got re-employed after benefit exhaustion. Specifically, earlier reemployment corresponds to about 20% $(= \exp(0.18))$ higher wages.

Within the group of individuals with initial UI benefit coverage, reemployment wage is in general negatively correlative with remaining benefit weeks, with one salient exception: reemployment wages of those re-employed at the week of benefit exhaustion weeks are much higher than the trend would predict, indeed, they are similar to those reemployed with at least 11 weeks of remaining benefit. One possible explanation of this exception could be tailoring behaviour where the some workers prearrange the reemployment timing to take full advantage of their individual UI coverage. On the other hand, reemployment wages of workers without initial UI coverage at all are very similar to those of workers with UI coverage but re-employed with at least 11 weeks of remaining UI benefit.

Overall, the estimation result confirms the theoretical prediction about the downward sloping of UI's impacts on reemployment wage as workers get closer to benefit exhaustion. To be comparable with previous literature, linear regression results of two additional specifications are presented in table 2 as well. The differences are whether hourly wage at preceding jobs and/or length of unemployment spells are included as control variables.

Whether or not to include preceding wage in the regression really depends on the implicit assumptions about the wage dynamics econometrically. By excluding preceding wage from the control variable set, it is assumed that reemployment wages for an unemployed worker is a totally fresh redraw from the wage distribution once the observable, such as, gender, age, education, have been considered. On the other side, including preceding wage allows the possibility of persistent wage differentials even after controlling for observables.

The choice of whether or not to include log unemployment durations in the regression relates to both identification issues and theoretical assumptions. Generally speaking, the two outcomes of individuals' unemployment experiences, unemployment durations and reemployment wages, are jointly determined. Therefore, unemployment duration is not an exogenous variable in the linear regression. The regression would suffer from the common endogeneity problem if unemployment duration is included in the control variables set and not instrumented.

On the other hand, as workers stay unemployed longer, they will also get closer to benefit exhaustion week, mechanically. That means ignoring unemployment durations could lead to spurious UI benefit exhaustion effect if there is truly just a downward trend of reservation wage. This dilemma will be solved later as both unemployment durations and reemployment wages are endogenized.

The estimated regression coefficients when preceding wages and/or unemployment durations are included are presented in column (2) and (3) of table 2. The results show the nature of the estimated coefficients on UI-related variables remains very similar in this sample, although overall the inclusion of preceding wages seems to lead to a weaker impacts of UI on reemployment wages. The differences here suggest that our earlier linear regression result in column (1) could have exaggerated UI's impacts on reemployment wages because of the endogeneity of unemployment durations and and its correlation with individual-specific wage differentials.

Finally, column (4) of table 2 gives the linear regresion result when we assume quitters were eligible for UI. Although the assumption is false in reality, the exercise here is to explore whether there is indeed a particular time pattern of reemployment wages due to UI coverage[2]. As the results suggest, reemployment wages of quitters, who thus are not eligible for UI, do vaguely decline over time; but quitters who would otherwise have at least 11 weeks of remaining UI benefit do not get higher wages than quitters who would otherwise exhausted their benefits, which is strikingly different from the pattern found from laid-off workers.

In short, the simple OLS results here do provide support to my initial hypothesis. That is, although not uniformly but only for workers when they have quite some weeks of un-exhausted UI benefit, UI does leads to higher reemployment wages.

5. ECONOMETRIC SETUP AND IDENTIFICATION ISSUES

For a more formal examination of the issue, a full information maximum likelihood model is used. Specifically, let individual i have N_i^e employment spells, N_i^u unemployment spells, N_i^{ew} employment wages at the beginning of continuous employment/unemployment periods, and N_i^{uw} reemployment wages chosen using the same set of requirements as in the linear regressions. Then, the four parts of the likelihood of person i are: $\{f_j^e\}_{j=1,\ldots,N_i^e}$ for employment spells; $\{f_k^u\}_{k=1,\ldots,N_i^u}$ for unemployment spells; $\{f_l^{ew}\}_{l=1,\ldots,N_i^{ew}}$ for initial employment wages; and, $\{f_m^{uw}\}_{m=1,\ldots,N_i^{uw}}$ for reemployment wages. The overall likelihood function for this person is set as the product of all of the four parts,

$$\int_{\epsilon_1,\epsilon_2,\epsilon_3} \left\{ \prod_{j=1}^{N_i^e} f_j^e \prod_{k=1}^{N_i^u} f_k^u \prod_{l=1}^{N_i^{ew}} f_l^{ew} \prod_{m=1}^{N_i^{uw}} f_m^{uw} \right\} dF(\epsilon_1,\epsilon_2,\epsilon_3) \tag{1}$$

The first two parts here take account of employment/unemployment spells. The third initial employment wage part, f_l^{ew}, controls for intial condition problem using the correlation between individuals' tendency of frequent labour market turnovers

[2]This specification is due to the suggestion of David A. Green.

and wages. This is because our sample is not random. It only has individuals who started new employment or unemployment spells[3]. Together, individuals' labour market activities are captured by the first three parts of the likelihood function. The fourth part for reemployment wage is then added to study the impacts of UI on reemployment wages.

The four parts of likelihood function are connected through a person-specific random effect setup. Let $\{\mu^e, \mu^u, \mu^{ew}, \mu^{uw}\}$ be the extra term of each of these four parts in the model. Let $\{\epsilon_1, \epsilon_2, \epsilon_3\}$ be a 3-dimension random vector $\sim N(0, I)$. Then,

$$\mu^e = a_{1,1}\epsilon_1 \tag{2}$$

$$\mu^u = a_{1,2}\epsilon_1 + a_{2,2}\epsilon_2 \tag{3}$$

$$\mu^{ew} = a_{1,3}\epsilon_1 + a_{2,3}\epsilon_2 + a_{3,3}\epsilon_3 \tag{4}$$

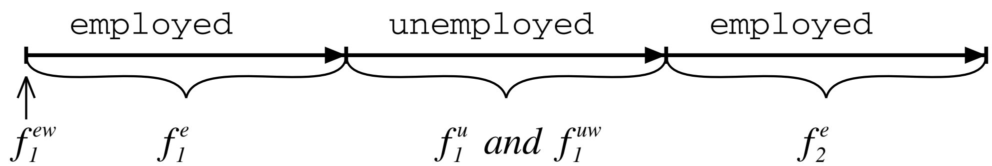
$$\mu^{uw} = a_{1,4}\epsilon_1 + a_{2,4}\epsilon_2 + a_{3,4}\epsilon_3 \tag{5}$$

There is no extra dimension of randomness added for the last part of reemployment here. This is because the role of having $\{\mu^e, \mu^u, \mu^{ew}\}$ in this model is to capture the across-individual differences in employment stability, reemployment speed, as well as persistent wage differentials, in other words, the endogenous correlation between labour market transitions and wage dynamics. This is different from the role of the μ^{uw}, which is present mainly because we need to control for unobserved heterogeneity while examining UI's impacts on reemployment wages. Since reemployment wages of unemployment spells should be employment wages of the following employment spells, there is no particular interests and reason to entertain extra randomness in reemployment wages.

Figure 2 gives an example. This worker only has one period of continuous employment/unemployment cycles. Thus he has only one initial employment wage part in his overall likelihood function (f_1^{ew}). This specific cycle starts with an employment spell, ends with a second employment spell, and has one unemployment spell in-between. Thus he has three duration parts in his overall likelihood func-

[3]Another possible solution to deal with initial condition problem in similar situations is to allow a totally different employment duration component for individuals' first spells. This alternative theoretically should play similar role as including initial employment wages as done in this study, but it will cost a substantial sample size in this study. Another practical advantage of using employment wages is that it will allow estimation of the correlation matrix of the unobserved heterogeneities in employment/unemployment durations and wages, which could be then used to pin down the unobserved part of reemployment wages.

FIGURE 2. Illustration of the Four Duration and Wage Parts of the Likelihood Function



tion (f_1^e, f_1^u, f_2^e). Suppose his unemployment spell isn't due to temporary layoff and it lasted less than 50 weeks, then he would also have a reemployment wage part in his likelihood function (f_1^{uw}). Overall, his likelihood function should be $(f_1^e \cdot f_1^u \cdot f_2^e \cdot f_1^{ew} \cdot f_1^{uw})$.

The exact functional form for the employment and unemployment spells' parts is the discrete-time proportional hazard model with heaping effect as proposed in Shen (2007). Specifically, let d be the duration of a spell; c be 1 if this spell is complete and 0 if not; x be a vector of (potentially time-varying) control variable for this spell; μ be the individual and state-specific heterogeneity term of this spell; H^0 be the set of all weeks covered by this spell; H_j^1 be the set of all semi-monthly weeks covered by this spell; and, H_j^2 be the set of monthly weeks covered by this spell.

Let $a_1 \in [0,1]$ be the probability of spells to heap at semi-monthly frequency; $a_2 \in [0,1]$ be the probability of spells to heap at monthly frequency. Set $a_0 = 1 - a_1 - a_2 \in [0,1]$. Let $\alpha_{1,\dots,50}$ the baseline hazard rates for week 1 to 50, which are transformed from 2-nd order polynomial; β the coefficient vector for control variable vector x, then the likelihood of this spell, is defined as follows,

$$\tilde{f}(d, c, x, H^0, H^1, H^2, \mu | a_1, a_2, a_0, \alpha, \beta) = \sum_{l \in \{0,1,2\}} a_l \cdot f^l(\cdot) \qquad (6)$$

where

$$f^l(\cdot) \;=\; \begin{cases} 0 & \text{if } d \notin H^l \text{ and } c = 1 \\ \prod_{s=1}^{h(d,H^l)}(1-p_s)\left(1-\prod_{s=h(d,H^l)+1}^{d}(1-p_s)\right) & \text{if } d \in H^l \text{ and } c = 1 \\ \prod_{s=1}^{\min\{h(d+1,H^l),d\}}(1-p_s(\cdot)) & \text{if } c = 0 \end{cases} \tag{7}$$

and

$$p_s(\cdot) \;=\; 1-\exp(-\exp(\alpha_s+\beta x_s+\mu)) \tag{8}$$

$$h(t,H^l) \;=\; \max\{t'|t'<t, t' \in H^l\} \tag{9}$$

The exact functional form for the two wage parts, f^{ew} and f^{uw}, is based on log-normal distribution of wages with an individual-specific heterogeneity term for the given type of wage. That is,

$$f_l^{ew} = \phi(\ln(\text{initial employment wage}_l) - \beta^{ew}x_l^{ew} - \mu^{ew}, \delta^{ew}),\ \forall l \in [1, N_i^{ew}] \tag{10}$$

$$f_m^{uw} = \phi(\ln(\text{reemployment wage}_m) - \beta^{uw}x_m^{uw} - \mu^{uw}, \delta^{uw}),\ \forall m \in [1, N_i^{uw}] \tag{11}$$

$$\text{where, } \phi(\upsilon,\delta) = \frac{1}{\delta\sqrt{2\pi}}\exp(-\frac{\upsilon^2}{2\delta^2})$$

Since our model use person-specific random effect, the identification and controlling of the unobserved heterogeneity relies on the composition of our sample. Out of the $3,796$ individuals in our sample, the largest 4 categories of individuals in terms of number of each of the four possible types of events selected in the final sample are listed in table 3. The biggest group, 29%, is composed of those who have one valid employment spell and one valid initial employment wage information only; the second one, 18%, is composed of those with one unemployment spell only. Overall many individuals of our sample do have more than one types of events, which helps us to identify the correlation between heterogeneity terms of different parts.

Furthermore, table 4 shows the total number of incidence in each of the four types of events and the proportion of no repetitions in each types. Table 4 shows the total number of incidence in each of the four types of events and the proportion of no repetitions in each types. It is shown that many of the sample individuals do have multiple observations of any one of the four parts, which helps us to identify the variance of heterogeneity terms of each part of the likelihood.

Besides functional form, the empirical identification of the four individual components of the model, $\{f^{we}, f^e, f^u, f^{wu}\}$, also relies on the differences in the sets of control variables between duration parts and wage parts, i.e., exclusion restrictions. The exclusion restrictions used in this study relate to using unemployment rates at different time in the duration parts and the wage parts: both f^e and f^u use on-going regional unemployment rate to proxy for local macro level labour market condition; while f^{ew} and f^{uw} use initial regional unemployment rate at the start of corresponding spell.

The implicit identification assumptions here are: 1) both employment separation and reemployment processes depends only on on-going unemployment rate once their initial conditions have been taken care of by the wage parts; 2) wages at the start of an employment spell depends only on the unemployment rate at that time; 3) reemployment wages potentially only depends on the unemployment rate as the unemployment spell start once the whole dynamics of unemployment rate have been taken account of within the preceding employment and unemployment spells and initial employment wages components. If any of these assumptions are not valid, then the model proposed here will not be approporiate.

6. ESTIMATION RESULTS

The exploration of estimation results here is based on examination and comparision of a set of results, starting from the most simple setups. We first explore the differences on the estimation of duration parts of the model due to endogenization of the wages. This is done by comparing two sets of estimated coefficients with no consideration of UI for a moment. Based on the template model, table 5 corresponds to a specification with the two duration parts only, and table 6 corresponds to another specification with both the two duration parts and the two wage parts.

Comparison of the tables show, besides coefficients on heterogeneity terms, *the coefficients on log hourly wages are affected the most when the wage parts are added*. In the employment duration part, the coefficient of log hourly wage increases from -0.22 (s.e. 0.08) when wages parts are omitted in table 5 to 0.03 (s.e. 0.13) when wage parts are added in table 6. At the same time, the positive coefficient for ϵ_1 in the employment hazards part drops significantly from 0.83 (s.e. 0.10) to 0.21 (s.e. 0.05) while the coefficient for ϵ_1 in the initial wages part is estimated to be significantly negative (-0.21 with s.e. 0.07). By adding the wage parts, we are effectively controlling for persistent wage differentials across individuals in the hazard parts. As a result, only transitory shocks of wages are used to identify the coefficient of wage in the duration parts. Therefore, the first estimated coefficient (-0.22) corresponds to the joint impacts of persistent wage differentials and transitory wage shocks on the hazard of leaving employment, while the second one (0.03) corresponds to the impact of transitory wage shocks only.

The differences of the estimated coefficient on wages and the major change in the coefficent on ϵ_1 thus suggests hazard of leaving employment is affected little by transitory wage shocks, rather it is correlated negatively with persistent higher wages. In other words, *employment stability correlates mainly with individuals' persistent wage differentials; transitory wage shocks have little impact on it*.

Loosely speaking, the result here argues against the causal linkage from a temporary higher wage to a longer employment spell; instead, it argues for a stable correlation over time between higher wages and stable employment. Similarly, as to unemployment durations, the change of coefficient on log hourly wages for the preceding jobs from 0.15 (s.e. 0.08) in table 5 to 0.01 (s.e. 0.03) in table 6 indicates *shorter unemployment duration correlates mainly with persistently higher wages and transitory wage shocks have little impact on it*.

As to short term impacts due to business cycle, the coefficients of unemployment rate in table 6 shows the most significant impact of unemployment volatility is on individuals' hazard of leaving employment, rather than individuals' hazard of leaving unemployment or their wages. Considering the empirical context here, it seems that a first sign of improvement/recovery of the economy is a slowdown of the entry to unemployment. On the other hand, the coefficients for reform flags suggest the long term impacts of business cycle are obvious in all of the three dimensions of labour market studied here: economic recovery in Canada in the late 1990s leads to significantly longer employment spells, significantly shorter unemployment spells and higher wages.

Next, in table 7, UI-related variables are added to the duration parts of the specification of table 6. Comparing estimates of table 7 with table 6, we find one salient changes in the estimation results due to adding UI variables in the duration parts—the coefficient on log hourly wage for unemployment duration part drops from 0.01 (s.e. 0.03) to -0.19 (s.e. 0.05). Using similar logic as before, this change indicates *workers with positive wage shocks tend to be in the UI-groups where the corre-*

sponding coefficients are higher, such as the two groups of temporary layoffs and the omitted group of UI benefit exhaustees. Only when there is such correlation, would it be possible for us to find that there is little correlation between wages and unemployment durations when UI impacts are ignored, and that higher wages are correlated with longer unemployment spells when UI impacts are accounted for, at the same time.

Finally, table 8 presents our preferred set of estimation result where UI incentives are considered in the two duration parts and the reemployment wage part. If comparing the estimates of this model as presented in table 8 with previous linear regression results, it is easy to see much of the downward trend of reemployment wage towards UI benefit exhaustion week remains similar, except that the coefficient for BEW_0 in the reemployment wages part is no longer statistically significant.

This means reemployment wages of workers with initial UI coverage and get reemployed exactly at benefit exhaustion week is no longer significantly higher than the omitted group, those who get reemployed passed benefit exhaustion weeks. This difference suggests *workers reemployed at precisely the week of benefit exhaustion are also a group of workers with persistently higher wages.*

Furthermore, table 8 shows that the most clear and strong evidence of UI's impacts on the labour market is its impacts on the hazards of leaving unemployment, while at the same time, our results suggest UI coverage does affect workers' reemployment wages, it only leads to statistically significant increases on reemployment wages for workers reemployed with at least 11 weeks of remaining benefit, in which case workers' reemployment wages are about 12% to 14% higher ($\exp(0.11) = 1.12$ and $\exp(0.13) = 1.14$).

Figures of table 9 illustrate UI's impacts on unemployment hazards and reemployment wages as estimated here. As the figure shows, the timing of the drop of reemployment wages matches with the timing of the increase of unemployment hazards. The coincidence of UI's impacts on unemployment hazards and reemployment wages seems to support the notion that the availability of UI benefit does allows workers to set higher reservation wages. At the same time, the difference in magnitude of UI's impacts on these two sides also seems to suggest that the distribution of wage offers is quite narrow on the labour market. It could be an explanation of why it has been difficult to find UI's overall impacts on reemployment wages.

7. CONCLUSION

This study examines an important open, though old, question in the empirical labor literature. That is whether UI does improves workers' job match quality. It extends previous works in the literature by endogenizing individuals' employment/unemployment durations and wages at the same time using a full information maximum likelihood model. Furthermore, UI's impact on reemployment wages is allowed to vary depending on the timing of reemployment relative to benefit exhaustion.

The preferred set of estimation result suggests that reemployment wages of workers with UI coverage indeed would be 12% to 14% higher than those of benefit exhaustees, but only if they got reemployed with at least 11 weeks of benefit left. Moreover, comparisons among estimation results of different specifications suggest several imporant correlations in the micro labour market.

Given only non-seasonal unemployment spells completed within 52 weeks due to permanent seperations are studied here for reemployment wages, the impact of UI on long term unemployed workers remains to be studied.

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APPENDIX: FIGURES AND TABLES

TABLE 1.
Definitions of Time-Varying UI Treatment Dummy Variables

variable	definition
for unemployment spells	
BEW_{21+}	when there are at least 21 weeks to the benefit exhaustion week (BEW)
BEW_{11-20}	when there are 11 to 20 weeks to BEW
BEW_{6-10}	when there are 6 to 10 weeks to BEW
BEW_{2-5}	when there are 2 to 5 weeks to BEW
BEW_1	when there is only 1 week to BEW
BEW_0	the week of reaching BEW
$WK19$	week 19 (just before experience rating threshold week)
for employment spells	
$HMIN_{6-10}$	6 to 10 weeks before minimum employment weeks($HMIN$, also known as entrance requirement week)
$HMIN_{2-5}$	2 to 5 weeks before $HMIN$
$HMIN_1$	1 week before $HMIN$
$HMIN_0$	week of reaching $HMIN$
$HMIN_0$+1 to $HMAX_0$	after $HMIN$ and till week of achieving maximum benefit coverage ($HMAX$)
$HMIN_0$+1 to $HYRMAX_0$	after $HMIN$ and till week of achieving enough benefit coverage for the next job season ($HYRMAX$)
$HMIN_0$+1 to $HDIV$	after $HMIN$ and till the calendar week of $HMIN + 2$ ($HDIV$)
$HMIN_0$+1 to $HEXP$	after $HMIN$ and till the calendar week of 31 ($HEXP$)

TABLE 2.
Linear Regression Results of Reemployment Wages

	(1)	(2)	(3)	(4)
R^2	0.26	0.47	0.47	0.28
previous wage (ln)	—	0.53 (0.03)⋆	0.54 (0.03)⋆	—
weeks of unemployment (ln)	—	—	−0.01 (0.01)	—
post reform	0.04 (0.03)	0.03 (0.02)	0.03 (0.02)	0.03 (0.03)
unemployment rate	−0.00 (0.01)	0.00 (0.01)	0.00 (0.01)	−0.00 (0.00)
quit [so, no UI]	0.20 (0.08)‡	0.17 (0.06)⋆	0.15 (0.06)‡	0.05 (0.10)
permanent layoff, no UI	0.18 (0.08)‡	0.12 (0.06)‡	0.11 (0.06)†	0.18 (0.08)‡
time-varying UI treatment variables at the reemployment week (for permanent laid-off workers with UI coverage)				
BEW_{21+}	0.18 (0.08)‡	0.14 (0.07)‡	0.11 (0.07)†	0.18 (0.08)‡
BEW_{11-20}	0.19 (0.09)‡	0.14 (0.07)†	0.13 (0.07)†	0.19 (0.09)‡
BEW_{6-10}	0.11 (0.10)	0.14 (0.08)†	0.14 (0.08)†	0.12 (0.10)
BEW_{2-5}	0.11 (0.10)	0.09 (0.09)	0.08 (0.09)	0.10 (0.10)
BEW_1	−0.05 (0.14)	−0.04 (0.15)	−0.04 (0.15)	−0.05 (0.14)
BEW_0	0.18 (0.09)‡	0.17 (0.07)‡	0.17 (0.07)‡	0.17 (0.09)†
if quitters are eligible for UI, their time-varying UI treatment variables at the reemployment week				
BEW_{21+}	—	—	—	0.08 (0.08)
BEW_{11-20}	—	—	—	0.07 (0.09)
BEW_{6-10}	—	—	—	−0.13 (0.10)
BEW_{2-5}	—	—	—	−0.20 (0.24)
BEW_1	—	—	—	0.31 (0.11)⋆
BEW_0	—	—	—	0.08 (0.08)
quit and not enough employment weeks for UI			—	0.19 (0.07)⋆

TABLE 3.
Sample Composition by Individuals

category by counts of f^e	f^{ew}	f^u	f^{uw}	number of individuals	percentage
1	1	0	0	1,107	29%
0	0	1	0	700	18%
1	0	1	1	499	13%
1	1	1	0	301	8%
all other possibilities				1,189	31%
total				3,796	100%

TABLE 4.
Sample Composition by Duration and Wage Data Types

component type f^e	f^{ew}	f^u	f^{uw}
total counts across individuals as 100%			
3,338	1,874	3,107	1,605
counts and proportion of individuals who have one incidence only			
2,190	902	1,815	483
66%	48%	58%	30%

TABLE 5.
Maximum Likelihood Estimation: No UI, No Wage Components

	employment hazard	unemployment hazard
ϵ_1	0.83 (0.10)⋆	−0.36 (0.09)⋆
ϵ_2	—	1.05 (0.09)⋆
post reform	−0.19 (0.06)⋆	0.29 (0.07)⋆
log of hourly wage	−0.22 (0.08)⋆	0.15 (0.08)†
unemployment rate	0.03 (0.02)	0.01 (0.02)

Note: the sample is consisted of 3796 individuals and the mean loglikelihood is -3.935. Other common control variables in the two parts include gender, age, maritial status, immigration status, education dummies and regional dummies.

TABLE 6.
Maximum Likelihood Estimates: No UI

	employment hazards	unemployment hazards	initial wages	reemployment wages
ϵ_1	0.21 (0.05)⋆	−0.71 (0.17)⋆	−0.21 (0.07)⋆	−0.22 (0.05)⋆
ϵ_2	—	0.79 (0.15)⋆	−0.17 (0.02)⋆	−0.10 (0.06)†
ϵ_3	—	—	0.23 (0.10)‡	0.23 (0.09)‡
post reform	−0.19 (0.05)⋆	0.29 (0.07)⋆	0.03 (0.10)	0.04 (0.01)⋆
log of hourly wage	0.03 (0.13)	0.01 (0.03)	—	—
unemployment rate	0.03 (0.02)†	0.01 (0.08)	0.01 (0.13)	0.00 (0.05)

Note: the sample is consisted of 3796 individuals and the mean loglikelihood is -3.491. Other common control variables in the four parts include gender, age, maritial status, immigration status, education dummies and regional dummies. The two wage components also have constant terms.

TABLE 7.
Maximum Likelihood Estimates: UI Variables in Duration Parts

	employment hazards	unemployment hazards	initial wages	reemployment wages
ϵ_1	0.38 (0.19)‡	0.24 (0.13)†	−0.19 (0.21)	−0.14 (0.06)‡
ϵ_2	—	0.54 (0.11)⋆	0.21 (0.19)	0.21 (0.06)⋆
ϵ_3	—	—	0.22 (0.13)†	0.22 (0.11)†
post reform	−0.19 (0.05)⋆	0.23 (0.03)⋆	0.03 (0.09)	0.04 (0.01)⋆
log of hourly wage	0.09 (0.14)	−0.19 (0.05)⋆	—	—
unemployment rate	0.03 (0.02)‡	0.01 (0.08)	0.01 (0.11)	0.00 (0.05)
time-varying UI treatment variables for employment spells				
$HMIN_{6-10}$	−0.14 (0.09)	—	—	—
$HMIN_{2-5}$	0.06 (0.12)	—	—	—
$HMIN_1$	−0.08 (0.26)	—	—	—
$HMIN_0$	−0.13 (0.25)	—	—	—
$HMIN_0 + 1$ to $HMAX_0$	−0.08 (0.11)	—	—	—
quit [so, no UI]	—	−2.02 (0.00)⋆	—	—
permanent layoff, no UI	—	−2.19 (0.02)⋆	—	—
temporary layoff, no UI	—	−0.37 (0.03)⋆	—	—
temporary layoff, with UI	—	1.04 (0.03)⋆	—	—
time-varying UI treatment variables for unemployment spells				
BEW_{21+}	—	−1.73 (0.06)⋆	—	—
BEW_{11-20}	—	−1.74 (0.01)⋆	—	—
BEW_{6-10}	—	−1.30 (0.02)⋆	—	—
BEW_{2-5}	—	−0.98 (0.04)⋆	—	—
BEW_1	—	−1.29 (0.03)⋆	—	—
BEW_0	—	−0.59 (0.03)⋆	—	—

Note: the sample is consisted of 3796 individuals and the mean loglikelihood is -3.425. Other common control variables in the four parts include gender, age, maritial status, immigration status, education dummies and regional dummies. The two wage components also have constant terms.

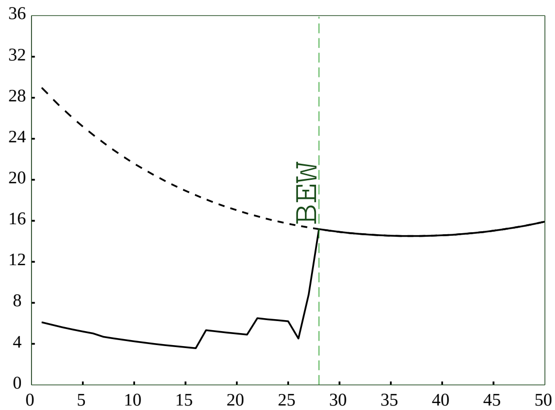
TABLE 8.
Maximum Likelihood Estimates: UI Variables in Duration Parts and Wage Parts

	employment hazards	unemployment hazards	initial wages	reemployment wages
ϵ_1	0.32 (0.19)†	0.33 (0.14)‡	−0.18 (0.21)	−0.14 (0.08)†
ϵ_2	—	0.45 (0.14)⋆	0.21 (0.19)	0.20 (0.08)⋆
ϵ_3	—	—	0.22 (0.13)†	0.22 (0.11)‡
post reform	−0.19 (0.05)⋆	0.22 (0.03)⋆	0.03 (0.08)	0.03 (0.01)⋆
log of hourly wage	0.04 (0.14)	−0.11 (0.06)‡	—	—
unemployment rate	0.03 (0.02)‡	0.01 (0.10)	0.01 (0.11)	0.00 (0.04)
time-varying UI treatment variables for employment spells				
$HMIN_{6-10}$	−0.14 (0.10)	—	—	—
$HMIN_{2-5}$	0.06 (0.12)	—	—	—
$HMIN_1$	−0.08 (0.26)	—	—	—
$HMIN_0$	−0.13 (0.25)	—	—	—
$HMIN_0 + 1$ to $HMAX_0$	−0.08 (0.11)	—	—	—
quit [so, no UI]	—	−1.98 (0.00)⋆	—	0.14 (0.21)
permanent layoff, no UI	—	−2.16 (0.02)⋆	—	0.11 (0.04)‡
temporary layoff, no UI	—	−0.35 (0.03)⋆	—	—
temporary layoff, with UI	—	1.03 (0.03)⋆	—	—
time-varying UI treatment variables for unemployment spells				
BEW_{21+}	—	−1.69 (0.07)⋆	—	0.11 (0.06)†
BEW_{11-20}	—	−1.73 (0.01)⋆	—	0.13 (0.05)⋆
BEW_{6-10}	—	−1.29 (0.02)⋆	—	0.08 (0.05)
BEW_{2-5}	—	−0.98 (0.04)⋆	—	0.07 (0.06)
BEW_1	—	−1.30 (0.03)⋆	—	0.00 (0.09)
BEW_0	—	−0.59 (0.03)⋆	—	0.10 (0.12)

Note: the sample is consisted of 3796 individuals and the mean loglikelihood is -3.423. Other common control variables in the four parts include gender, age, maritial status, immigration status, education dummies and regional dummies. The two wage components also have constant terms.

TABLE 9.
Illustration of UI's Impacts on Reemployment Process

unemployment hazards



reemployment wages