UNEMPLOYMENT INSURANCE'S LABOUR MARKET IMPACTS

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Abstract

This thesis examines Unemployment Insurance's (UI) labour market impacts, focusing on the contingent, temporary natures of UI benefit. Using the Survey of Labour and Income Dynamics , the results suggest UI significantly affects both individuals' employment/unemployment transitions and their job match quality.

Chapter 2 presents a historical development of the UI program in Canada; a survey of related literature; and, finally, a theoretical analysis of how contingent, temporary UI benefit coverage could affect labour market dynamics.

Chapter 3 empirically examines UI's impacts on individuals' employment/ unemployment cycles. The two major findings are: 1) UI's minimum employment requirement is found to delay employment separation in the seasonal sector; and, 2) the availability of UI benefits is found to postpone reemployment in both the seasonal and non-seasonal sectors. Overall, simulation results suggest that without those delays, the national unemployment rate could be 16% lower (e.g. lowered from 7.6% to 6.6%) in the late 1990s. Simulation results also imply that, with the exception of the experience rating rules and the divisor rule, the 1996 Employment Insurance (EI) reform did not have a significant impacts on the national unemployment rate.

Chapter 4 empirically examines UI's impacts on individuals' reemployment wages. The random effect model it uses takes account of the endogeneity of both individuals' employment/unemployment durations and their initial wages. Furthermore, the empirical specification allows UI benefits to have time-varying impacts. The results suggest, overall, that UI coverage increases unemployed workers' reemployment wages by about 9.5%.

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Lists of Symbols

$\star$ significantly different from zero at 1% level;

‡ significantly different from zero at 5% level;

† significantly different from zero at 10% level.

Lists of Abbreviations

UI	Unemployment Insurance;
EI	Employment Insurance;
SLID	Survey of Labour and Income Dynamics;
$HMIN$	UI's minimum weeks of employment requirement;
$HMAX$	minimum employment weeks for maximum UI benefit coverage;
$HMAXYR$	minimum employment weeks for accumulating enough UI benefit coverage to the next year's job season;
BEW	UI benefit exhaustion week.

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Chapter 1

Introduction

This thesis is composed of three major chapters. The first main chapter (chapter 2) sets the overall policy, literature and theoretical background, while the two following chapters (chapter 3 and chapter 4) examine empirically how contingent, temporary Unemployment Insurance (UI) coverage affects labour market transitions and wage dynamics.

For decades, UI has been an important policy tool in the labour market for most developed economies; while at the same time, the design of UI varies a lot over time and across countries. At the centre stage of this thesis is the 1996 Employment Insurance (EI) reform of Canadian UI program. This reform made a bundle of changes to the existing program parameters, as well as introduced several new instruments (such as experience-rating) to strengthen work incentives. The exogenous variation of UI treatment due to this policy change provides this thesis a new and novel source of identification.

Chapter 2 serves as the foundation of this thesis. It has three parts. The first section reviews the historical development of the Canadian UI program and details of the main changes of the 1996 EI reform. The review discusses how the UI program has been assigned both an insurance role and an equalization role over time; how the EI reform is part of a bigger trend of social safety net reform in North American countries; as well as the economic implications of each major change of the EI reform. The second section reviews empirical studies of UI's labour market impacts since late

1970s with emphasis on those using Canadian data. The focus here is the growing literature of using hazard model and duration data to study UI's labour market impacts.

The last section of chapter 2 outlines the theoretical foundation of the whole thesis. It theoretically explores how contingent, temporary UI benefit coverage affects individuals employment/unemployment cycles and reservation wages. A combination of analytical and numerical techniques is used here to solve workers' nonstationary dynamic programming problem. The results show how three main parameters of an UI program (benefit duration, employment requirement and weekly benefit) interact with each other and how each affects work incentives differently. Moreover, the results also show how some UI parametric change could function like a double-edged sword on the labour market, providing both work incentives and disincentives at the same time.

The empirical studies in this thesis use a common data source, a recently released Canadian micro panel data, the Survey of Labour and Income Dynamics (SLID). To match the panel nature of the data, an event-based sample selection procedure is used here to construct a set of multi-spell multi-state (employment and unemployment) sample spells.

The main empirical work starts with chapter 3's study on how contingent, temporary UI coverage affects individuals' employment/unemployment cycles. By comparing the estimated impacts using separate and pooled samples of spells from pre- and post-reform periods, this chapter confirms previous findings in a new context: 1) seasonal workers' probability of leaving employment is found to be lower before they satisfy UI's minimum employment requirement for benefit collection; and 2) availability of UI benefit is found to reduce both seasonal and non-seasonal workers' probability of leaving unemployment. Furthermore, the results of this chapter also reveal several new findings. In particular, it is suggested that UI program could have increased the overall unemployment rate of Canada in the late 1990s by about 14%. In other words, if all workers suddenly switch from responding to UI incentives as estimated to ignoring those incentives and *if all other things remain constant*, the unemployment rate could drop from 7.6% to 6.6%.

Chapter 3 also contributes to the literature by formulating a parsimonious econometric model for high-frequency duration data that greatly facilitates estimation of multi-cycle multi-state duration data while accommodating heaping in durations at low-frequency intervals. Specifically, this is a combination of a parametric baseline proportional hazard model with a measurement error type of model that takes account of calendar heaping spikes.

Chapter 4 inherits many of the data and design features of chapter 3 and extends the empirical analysis to examine contingent, temporary UI coverage's impacts on reemployment wages. The focus is on the non-seasonal sector only. The key contribution of this chapter is the introduction of simultaneous endogeneity of wages and employment/unemployment cycles, which is done by estimating a random-effect model with both employment/unemployment transition processes and wage processes. Also, UI's impact on reemployment wages is allowed to be different depending on individuals' remaining benefit durations at the reemployment weeks. The results suggest those who have at least 11 weeks of benefit left when reemployed receive about 12% to 14% higher reemployment wages than benefit exhaustees. Overall, the weighted average impact of UI coverage on the reemployment wages of UI-covered unemployed workers is about 9.5% increase.

In short, this thesis uses a new micro panel Canadian data set, explores a new source of treatment variation: exogenous policy change due to the Canadian EI reform, expands studies on the impacts of contingent, temporary UI coverage on employment/unemployment cycles and wage dynamics. It confirms previous findings about UIs impacts on labour market transitions in the new context while it also provides evidence of drops in reemployment wages as workers approach benefit exhaustion weeks. As of late 1990s in the Canadian labour market, the results suggest UI has not only had significant impacts on workers' employment/unemployment durations, but also has increased workers' reemployment wages significantly.

Chapter 2

Unemployment Insurance and Labour Market: History, Literature and Theory

This chapter builds a foundation for later empirical works. The first section briefly reviews the history of Canadian unemployment insurance (UI) program, in particular, major changes made by the Employment Insurance (EI) reform in 1996. The second section reviews empirical studies of UI's labour market impacts, especially contributions of Canadian researchers. The last section studies contingent, temporary UI coverage's impacts on employment/unemployment cycles and wage dynamics theoretically. Together, these three sections cover a broad range of materials relating to UI and its labour market impacts.

2.1 Historical Development of Canadian UI Program and the EI Reform

2.1.1 Canadian UI Program before the 1990s

The Canadian UI program was officially established in 1940[1]. The economic depression of the 1930s played an important role in this historical event. Such view is expressed in Dingledine (1981) as, "with significant numbers of people unemployed, those out of work could no longer be categorized as lazy and of bad character." Consequently, it became politically necessary for public intervention to counter unemployment.

In Canada, the rationale for establishing a public UI policy was mainly due to concerns about the sustainability of a private UI program. Though publicly managed, the Canadian UI program was carefully designed to mitigate two common problems in insurance market: adverse selection and moral hazard[2]. Only selected groups of the working population were covered by UI. Among others, both workers who would certainly become unemployed (i.e. seasonal workers), and workers who would certainly not become unemployed (i.e. public servants), were excluded from UI coverage in the beginning. The insurance principle was also reflected in other dimensions of the program (such as eligibility requirements and maximum benefit

[1]Most of the historical information presented in this section is based on Dingledine (1981) and Green and Riddell (1993).

[2]Adverse selection refers to the increase of agents' incentive to purchase insurance as their risks, which the insurer might not have full information, increase. Moral hazard refers to the decrease of agents' risk-avoiding incentive once they are insured. Both of these problems are common in the insurance market and could damage the financial sustainability of the relevant market. More detailed discussion on these problems for the case of unemployment insurance could be found in Gunderson and Riddell (2000), Green and Riddell (1993) among others.

durations). Perhaps not too surprising, Canadian UI program had been financially healthy in earlier years.

Since its establishment, the Canadian UI program was closely monitored and frequently adjusted. Over time, it was assigned a second role: equalization. Many regard this addition as a consequence of the specific jurisdiction arrangement between the federal and provincial governments in Canada. Here, provincial governments are responsible for most social programs (e.g. welfare and education). The federal government only has a very small set of income redistribution instruments, among which UI is the most resourceful one. Gradually, changes were made to the UI program and it began to serve as an equalization program for the federal government as well. By the 1990s, with annual expenditures in the range of \$15-\$20 billion (Government of Canada, 1995), UI became the federal government's largest operating program.

The incorporation of the equalization role into UI took off in 1971. Many features of the Canadian UI program today could be dated back to this event. Two changes made by the 1971 reform worth noting for our purpose are,

First, extending UI coverage to nearly all paid workers. From this point on, UI began to cover seasonal workers, teachers and civil servants. Only those marginal workers and people above 70 were excluded. Theoretically, such expansion of UI coverage created a channel for redistribution across industries, favouring industries with more transitory employment patterns.

Second, linking benefit durations with regional labour market tightness through a 5-phase benefit structure. The 5 phases were, initial benefit period, re-established initial benefit period, labour force extended benefit period, national extended benefit period, and *regional extended benefit period.* To implement the 5th phase, 16 UI regions were established so that regional unemployment rates could be used to measure the regional labour market tightness. Through this phase-based benefit structure, the federal government created another channel for equalization, favoring regions with higher unemployment rates.

As a result of the 1971 changes, UI became "an increasingly significant and integral part of the Canadian income protection system (Dingledine, 1981)", and the total UI benefit payment rose dramatically[3]. In the late 1970s, program misuse by both individual workers and governments at various levels became more and more of a concern of the public. There were also serious worries about this program's financial sustainability. As a response, the federal government made a sequence of amendments which somehow restored the UI program's emphasis on its insurance role.

In the late 1980s, additional changes in the program made it even less generous and began to emphasize "active" labour market policies, such as training, rather than the traditional "passive" ones. Then, in 1996 the EI reform, the most important reform of the UI program in Canada, took place.

2.1.2 The Trend of Social Safety Net Reforms in the 1990s

The EI reform is indeed part of a bigger trend of social safety net reforms in the North America in the 1990s. In Canada, the overall budget of social safety net experienced a series of big cuts in the earlier 1990s. It started in the year of 1990, when the federal government set a 5% 'cap' on top of the growth rate of the cost-sharing transfer[4] to the three wealthiest provinces through the Canada Assistance Plan (CAP). The

[3]In nominal terms, the benefit paid in the first 9 years post-1971 was 5 times the amount paid in the 30 years pre-1971. Furthermore, according to Cansim II table 3840031, the national UI benefit payment more than doubled in 1972 from its level in 1971, that is increased from CAN$891 million to CAN$1869 million.

[4]It mainly covered provincial welfare and social services funding.

"cap on CAP lasted till 1994/5. After that, the newly-elected Liberal government froze the overall welfare payment to provincial governments and cut UI expenditure even further. In the budget year of 1996/7, a new "block funding" mechanism replaced both the CAP and old funding arrangement for medicare and post-secondary education. This new mechanism, called Canada Health and Social Transfer (CHST), allowed the federal government to cut its expenditure on the relevant areas (welfare, social services, medicare, and post-secondary education) by another 15% (from $17.4 billion in 1994/5 to $14.9 in 1996/7, Government of Canada (1995, 1997)).

Besides financial considerations, these sequential changes were also meant to encourage local initiatives in active labour market programs. Very similar policy changes also took place in the U.S.. Around the same period, the Aid to Families with Dependent Children was replaced by the Temporary Assistance for Needy Families with the passage of the Personal Responsibility and Work Opportunities Reconciliation Act. These changes of social safety net programs in these two North American countries represent a common shift to the so-called 'pro-work philosophy. In this view, welfare should not be an "entitlement"; rather, welfare should only provide temporary support in order to facilitate employable individuals' stable labour market attachment. This 'pro-work' philosophy certainly promises an appealing result.

2.1.3 The EI Reform

The main framework of the UI program in Canada is such that each workers' benefit durations are set individually[5]. Let the benefit coverage duration be d_b weeks for a

[5]This is different from other developed economies. In the U.S., the UI treatment is usually set at the state level rather than individual level. Furthermore, benefit coverage is set at 26 week for most states. On the other hand, in U. K., UI coverage was set uniformly at 12 months in 1990 and

paid worker who just lost his job. It is a function of two variables: 1) a measure of this worker's recent employment history, d_e (weeks); and, 2) the local unemployment rate at the beginning of his unemployment spell, $ur\%$.

In order to understand the changes made by the EI reform in 1996, it helps to present a reference point[6]. Specifically, according to the UI program for the period from July 1994 to June 1996,

$$d_b(d_e, ur) = \begin{cases} 0 & \text{if } d_e < 26 - ur_1 \\ floor(d_e/2) + 2ur_2 - 8 & \text{if } d_e \in [26 - ur_1, 40] \\ min\{d_e + 2ur_2 - 28, 50\} & \text{if } d_e > 40 \end{cases} \tag{2.1}$$

Where $ur_1 = ceil\{minmax\{trunc(ur), 6, 14\}\}$ and $ur_2 = ceil\{minmax\{trunc(ur), 6, 17\}\}$.

Equation (2.1) shows that a worker could only collect UI benefit if his/her preceding employment weeks, d_e, is above the entrance requirement weeks, i.e. the minimum employment requirement ($HMIN$). The higher the local unemployment rate, the lower $HMIN$ would be. Once passed week $HMIN$, a worker's benefit weeks would increase proportionally with local unemployment rate at the constant rate of 1 to 2, and increase with his/her preceding employment weeks, first at the rate of 2:1, and later at a higher rate of 1:1.

The EI reform made at least 5 major changes on top of the above structure[7]:

cut to 6 months from 1995 and the weekly payment is also uniform across workers.

[6]The focus throughout this thesis is on the duration of UI coverage. The other aspect, weekly UI payment is abstracted here. The UI policy in Canada is such that there is essentially no direct variations across workers in terms of their weekly UI benefit relative to their preceding weekly earnings. The benefit to earnings ratio, replacement ratio, is always common to all workers.

Indirectly, there do exist some variations in the replacement ratio due to the up limit of UI's insurable earnings. In that case, the variation is closely related with workers' earnings, making it endogenous to workers' other labour market experiences, such as employment/unemployment durations.

[7]The information of the EI reform here is mostly based on Human Resources Development

- Adoption of hour-based formula for employment weeks, d_e

To understand this change, let's consider a very general case where individuals could have multiple jobs simultaneously as well as part-time jobs. Let $h_{j,t}$ be a worker's working hours on job j at week t. Then, for this worker, his employment weeks under pre-EI rules, d_e^{pre}, is $\sum_t[(\sum_j I(h_{j,t}) \geq 15) > 0]$ for all weeks within his current UI qualification period[8]. In other words, he needs to have at least one above (or equal)-15-hour job for a week to be counted as employed. Under this rule, two 12-hour jobs would not contribute to his d_e, while a 15-hour job is treated the same as 45-hour job for d_e purpose. The EI reform changed the formula to a hour-based one. Now, $d_e = floor\{\sum_{j,t} h_{j,t}/35\}$, that is a worker's employment weeks equals the sum of total working hours within his qualification period divided by 35, the 'standard' weekly working hours. If the weekly working hours, $h_{j,t}$, is taken exogenous, then this change of d_e formula obviously benefits all workers except those individuals who work on jobs of 15 to 34 weekly hours (Sweetman, 2000)[9].

- Cut of benefit weeks' up-limit

The EI reform cut the maximum benefit weeks by 5 weeks, from 50 to 45. Not all workers are directly affected by this cut. According to (2.1), only those with d_e above 40 and ur above 10 are affected. But this cut of maximum benefit weeks does send a signal of less generous UI support.

Canada (1997-2002) and Rudner (1998). The discussion on the EI reform in this thesis will be focused on the regular benefit part of the Canadian UI program. Changes made on parental leave, sick leave and training parts of the UI program, though are also part of the EI reform, are not incorporated in the later empirical examination, thus are not the focus here.

[8] Qualification period is defined as the shorter of 1) the 52 weeks period preceding the employment separation, and 2) the period from the beginning of last EI claim to he employment separation.

[9] It is of course possible that this change could lead to profound impacts on the workplace arrangement, please refer to (Friesen, 2002) on research in this respect.

- Higher entrance requirement for new-entrants/re-entrants' (NEREs)

Here, NEREs refer to workers whose UI employment and benefit collection durations in the 52 weeks preceding their current UI qualification period are less than 14 weeks pre-reform, or 490 hours post-reform. These are individuals with limited labour market attachment. The entrance requirements for them are set at a constant level independent of their local UI unemployment rates. The EI reform increased this universal entrance requirement from 20 weeks before the reform to 26 weeks after the reform. Obviously, this change created incentives for workers to keep more stable labour market attachment.

- Introduction of worker side experience rating

The worker side experience rating measures introduced by the EI reform affect the net amount of benefit workers' could enjoy. Before the reform, let y^{week} be a worker's average weekly earnings, then his weekly UI benefit amount was set at $0.55\min\{y^{week}, MIE/52\}$. Here MIE refers to maximum insurable earnings[10], which sets an up-limit on both weekly UI benefit payment and UI payroll tax. Often, the 0.55 in the formula is refered as the replacement ratio of the UI program, linking benefit payment with worker's insurable earnings.

The EI reform changed the formula for weekly benefit to $(0.55 - 0.01er_1)min\{y^{week}, MIE/52\}$. Here er_1 is defined such that, starting from week 1, for each additional 20 weeks of UI benefit collection in the preceding 5 years, er_1 increases by 1 up to a maximum of 5. That is, workers replacement ratio are 55% if they collected less than 21 weeks of UI benefit in the preceding 5 years; 54% if they collected 21 to 40 weeks; 53% if they collected 41 to 60 weeks; and so on, till the minimum of 50% if they collected more than 100 weeks in the preceding 5

[10]MIE is $42,380 before the reform and $39,000 afterward.

years. Obviously, er_1 is where the worker-side experience rating came into play. This experience rating rule on replacement ratio is often referred as the 'intensity rule' of the EI reform.

The EI reform also introduced another experience rating rule, often called 'claw-back rule'. This is related to how high annual income workers are required to pay back some or all of their UI benefit collection through the tax system. Before the reform, the UI repayment at taxation time is set at $minmax\{0, 0.3(y^{annual} - 1.5MIE), 0.3y^{UI}\}$. Where y^{annual} represents total taxable income of the year, and y^{UI} is the total UI payment received in the year.

The EI reform changed the formula to
$minmax\{0, 0.3(y^{annual} - (1.25 - 0.25er_2)MIE), (0.3 + er_3)y^{UI}\}$. Here er_2 takes 1 if the individual collected more than 20 weeks of UI benefit within the preceding 5 taxation years[11]; 0, otherwise. If er_2 is zero, then er_3 is also zero. If er_2 is one, then, starting from 0.1 and up to 0.7, er_3 increases by 0.1 for each additional 20 weeks of UI collection within the preceding 5 taxation years.

The two major changes here are: 1) the upper limit for repayment is higher as the second term of $minmax$ function shows. Thus, more people will need to repay their UI benefit, which is consistent with the overall generosity cut of UI program of this reform. 2) the formula incorporated worker-side experience rating through er_2 and er_3. This additional experience rating measure through taxation complements 'intensity rule' in the sense that 'intensity rule' mainly targets low income earners. It only affects individuals with annual earning below $1.1MIE$[12]. The 'clawback rule'

[11] There is a subtle different in the definition of *preceding 5 years* between the 'intensity rule' and 'clawback rule'. For the 'clawback rule', it refers to the preceding 5 taxation years; while for the 'intensity rule', it refers to the 5-year period preceding the start of current UI benefit claim.

[12] For workers who has annual earning above this amount, their effective replacement ratio is always below 0.5, the minimum amount that replacement ratio could get.

mainly targets high income earners and only affects those with annual earnings above MIE[13].

These measures added two things to the unemployed workers' opportunity cost of UI collection: the expected drop in future benefit payment and the increased repayment. In extreme case, it might even be optimal for workers to stop collecting UI benefit while still unemployed[14].

- Discourage short employment by cutting weekly benefit using divisor rule

As mentioned above, in Canada, workers' weekly UI benefit payment is a constant proportion of their average weekly earnings, y^{week}. The divisor rule introduced in the reform got its name from the new formula for y^{week}. Before the reform, y^{week} was $(\sum_{j,t} y_{j,t})/n$. In words, it equals the total earnings from all jobs within the benefit calculation period divided by the total number of working weeks within this period. The reform changed the denominator to $\min\{HMIN + 2, n\}$, thus setting a lower bound which is exactly two weeks above the entrance requirement on this term.

The divisor rule does not affect benefit duration directly, but could affect weekly benefit payment depending on the number of actual weeks worked in the benefit calculation periods. Now that the entrance requirement of UI is based on total working hours, this week-based divisor rule effectively lowers workers weekly benefit if they achieved only minimal employment hours through intensive working weeks instead of having regular working weeks. In this sense, the divisor rule complements the new hourly system.

[13] This is due to the property of *minmax* function.

[14] The experience rating rules introduced here only consider workers' UI usage after the EI reform, that is from 1996 June onwards. Thus these rules would still in their phase-in period until five years later. Surprisingly or not, the experience rating rules were later cancelled in May 2001, when the phase-in period was just about to end.

As described above, some of the changes made by the EI reform are straightforward, while some are very subtle (i.e. institutional details that have hardly been considered in economic modelling). Together, these changes seem to shift the emphasis of the program toward its insurance role, which is to discourage tailoring behaviours, and to encourage stronger labour market attachment.

2.2 Literature Review

The theme of UI's labour market impacts has connections with a wide range of studies. It is far beyond this section to cover them all. The review here should focus more on empirical micro studies based on Canadian data.

Earlier empirical works in this area are often based on aggregate or cross-sectional data. For example, to study changes of the Canadian UI program in the late 1970s, Beach and Kaliski (1983a) use the aggregate transition probability matrix among the three major labour market status. Earlier studies also emphasize more on the classic labour-leisure model and the identification of labour demand versus labour supply. For example, Phipps (1991) and Phipps (1990) explore how the estimation of UI's impacts on labour supply is affected when demand-side constraints are considered.

With micro-level longitudinal data sets become increasingly accessible, recent empirical UI studies tend to emphasize the dynamic nature of labour market turnovers. The research interests are often to examine how UI affects the entire distribution of unemployment spells, and occasionally, even that of employment spells. Clark and Summers (1979), an influential paper in this regard, demonstrates that although most unemployment spells are short, there are always a group of individuals with very long unemployment spells. Their study implies that labour market transitions across different states should not be modelled simply as Markov processes with constant transition rates, and therefore average unemployment duration or even unemployment rate could be misleading statistics for the labour market. At the same time, their study also implies all workers are not the same in terms of labour market turnovers.

Following Clark and Summers (1979), several Canadian studies start to examine issues related to the distribution of unemployment spells. Among them, Beach and Kaliski (1983b) show how cross-sectional data sets tend to oversample long spells; Beach and Kaliski (1987) explore how to estimate the distribution of unemployment spells using cross-sectional data sets.

With the availability of micro panel data in the late 1980s, most recent Canadian studies use duration models. Duration models not only could allow for more flexible distributions of labour market spells, but also could take account of unobserved heterogeneities across workers directly.

Using administrative data on weekly UI collections of male workers from 1975 to 1980, Ham and Rea (1987) examine the impacts of remaining UI benefit length on workers' conditional reemployment probability (i.e. hazard rate). Being almost the first Canadian study to use duration model in this area, their study explores various specifications in order to examine the general pattern of duration dependency of the baseline hazard rates, as well as to examine the sensitivity of their main results. The results show unemployed workers hazard rate increases as the number of remaining UI benefit weeks decreases. The results are shown to be robust whether non-parametric or parametric baseline hazard specifications were used; or, whether spell-wise or individual-wise unobserved heterogeneity is considered. Overall, their results using Canadian data are quite consistent with those found using the U.S. data (Gritz and MaCurdy, 1997; Lee, 2000; Meyer, 1990; Moffitt, 1985).

UI not only could affect workers' unemployment duration, it could also affect workers' employment spells. This point is highlighted by Green and Riddell (1997) and Baker and Rea (1998) based on a natural experiment in Canada. Due to an unrelated dispute between the House of Commons and the Senate, UI entrance requirements of most regions were raised from 10 to 13 weeks to a uniform 14 weeks in the first 11 months of 1990. Both Green and Riddell (1997) and Baker and Rea (1998) use this exogenous policy change as a rare opportunity to examine how UI entrance requirement could affect employment spells.

Baker and Rea (1998) separately estimate duration models using samples of each province. The impacts of UI on employment spells are captured using four time-varying dummies for periods corresponding to four segments of the budget line. As Baker and Rea (1998) use two alternative approaches to derive individuals' UI treatment, substantial emphasis of their study is to compare the estimated results from the two approaches and to discuss possible explanations of the differences.

Although using exactly the same episode of exogenous UI policy change, Green and Riddell (1997) choose a very different research strategy. They restrict their sample to regions where the unemployment rate was at least 11.5% throughout 1989 and 1990. In these regions, the entrance requirement was uniformly 10 weeks in 1989 and 14 weeks in 1990. By doing this, they not only achieve precision in the data used in the UI entrance requirement, but also highlight the impacts of UI on the distribution of employment spells in an extreme yet realistic setting.

Although Baker and Rea (1998) and Green and Riddell (1997) approach the question differently, their results are quite consistent with each other. Both indicate the conditional employment separation probability (i.e. hazard rate) drops substantially prior to UI entrance requirement. Furthermore, Green and Riddell (1997) show that much of the behavioural response in employment separation is observed as layoffs rather than quits, indicating certain cooperation between firms and workers.

Besides UI's direct impact on unemployment or employment hazard rates, the empirical Canadian literature is also concerned with a wide variety of issues related to UI's labour market impacts, such as: indirect impacts of UI on employment stability (Belzil, 2001); UI's differential impacts on seasonal versus non-seasonal workers (Green and Sargent, 1998); learning effect of UI collection experience (Corak, 1993; Lemieux and MacLeod, 2000); UI's adverse selection problem among elder workers (Green and Riddell, 1993); sensitivity of the empirical results to consideration of institutional details duration data derivation (Shannon and Kidd, 2000); UI's take-up rates (Storer and Audenrode, 1995).

Regarding the 1996 EI reform, while Nakamura, Wong, and Diewart (2000) present the strategy designed for the reform, a series of studies are done to evaluate various aspects of labour market that this reform might have affected (Fortin, 2000; Friesen, 2002; Green and Riddell, 2000; Human Resources Development Canada, 1997-2002, 2000, 2001a,b,c; Lacroix and Audenrode, 2000; Sweetman, 2000).

More broadly, Gunderson and Riddell (2000), Nakamura and Wong (2000), and Kesselman (2000) reviewed the lessons learned from Canada UI experiences from different angles; Welch (1977), Cousineau (1985), Atkinson and Micklewright (1991), and Holmlund (1998) provide survey of this empirical UI literature. Furthermore, there are a huge set of studies related to the current theme, such as theoretical studies on the issues of UI, unemployment, and labour market turnovers (Burdett, 1978; Hall, 2003; Jovanovic, 1979a,b, 1984; Milbourne, Purvis, and Scoones, 1991; Mortensen, 1978, 1982; Mortensen and Pissarides, 1994), empirical studies on labour market turnover only (Devine and Kiefer, 1991), studies on classifications of labour market states (Flinn and Heckman, 1983; Jones and Riddell, 1995), and so on.

2.3 A Model of Labour Market Turnover with Contingent, Temporary UI

Although many theoretical works have examined UI's labour market impacts, most of them assume unconditional, infinite UI coverage[15]. As an exception, Green and Sargent (1998) show individuals' employment spells theoretically should be affected by UI benefit's minimum employment requirement, which is indeed supported by their empirical results. The model here extends Green and Sargent (1998)'s theoretical work by considering both the contingent and temporary nature of UI coverage. By that, I relate to the fact that most countries' UI programs require some minimum labour market attachment for benefit eligibility and provide benefit for finite length of periods. UI benefit's temporariness critically relies on its contingency. Temporary UI benefit coverage could only be effective with its contingent requirement on employment experiences, as Jovanovic (1984) pointed out,

> "[with temporary UI benefit coverage, if] Without this requirement [minimum employment requirement], as the expiration date of his benefit approached, the unemployed worker could accept any job for an *instant* and then reenter unemployment immediately, thereby assuring himself of another maximum period of coverage."

In a sense, the above remark signifies the relevancy to understand how UI parameters, such as benefit duration and employment requirement, jointly affects the labour market transitions in both directions between employment and unemploy-

[15]Some studies that have considered unconditional, finite UI coverage include Mortensen (1977), Van den Berg (1990), Albrecht and Vroman (2005), Coles and Masters (2004). But none of them considered the contingency of UI coverage.

ment states. Therefore, when examining UIs labour market impacts, we consider these two UI parameters together.

The main contribution of this study is thus exploration of UI's labour market impacts where UI coverage is contingent and temporary by endogenizing both employment and unemployment durations. By connecting workers' decisions while employed and unemployed together in a single framework, the model here is able to allow workers' decision while employed to depend on his expected action while unemployed, which depends on his expected action if he became reemployed, and so on. In this way, workers labour market transitions are modelled to reflect a coherent set of underlying reaction functions to any possible situations in the long run.

Many theoretical efforts have been made to endogenize the labour market transitions in either directions between employment and unemployment states, while there have been only a few studies that endogenize the labour market transitions in both directions[16], which are usually technically intense. Furthermore, the few joint-process types of models almost entirely rely on the stationarity of the problem for analytical solutions. To consider the contingent, temporary UI coverage in these models will turn the problem into a non-stationary one, which is very difficult analytically.

> "It is, of course, desirable that theory should reflect the temporary duration of unemployment benefits, but my attempts to take account of it quickly led to an unexpected complexity in the analysis (Jovanovic (1984) page 115)."

The strategy here is not to solve the non-stationary problem analytically altogether. Rather, I use a combination of numerical and analytical techniques to solve the problem and yet provide intuitive interpretations of the solution.

[16] Most noticeably, Jovanovic (1984).

In particular, the results illustrate how key UI parameters (benefit duration, employment requirement and weekly benefit) interact with each other and how each of them generates both work incentives and disincentives for workers, depending on the stages of their employment/unemployment cycles.

2.3.1 Setup

The model here is about how an agent (the worker) makes labour market decisions. Intertemporal consumption allocation is simplified by assuming this agent to be risk neutral, thus wealth maximizing. The worker has discount rate, β, for next week's income.

The two kinds of decisions he makes are, whether to accept job offers when unemployed and whether to quit when employed.

Each week, the probability for an unemployed worker to get an job offer is λ, where the distribution of such job offer's wage rate w is $F(w)$.

Each week, the probability for an employed worker to get a redrawn for his wage at the current job is η ($\eta < \lambda$). The distribution of the new wage rate is also $F(w)$. Such exogenous on-the-job wage movement creates a simple, transparent mechanism for employment separation.

Figure 2.1 shows the sequence and timing of decisions and events for our model. As the figure shows, each week, an unemployed worker always search for job offers first. He could get at most one job offer each week. If he gets one offer, based on the offered wage rate, he then decides to accept it or not at the end of each week. On the other side, an employed worker always chooses, based on his current week wage rate, whether to quit or not at the beginning of each week. If quit, he will spend the rest of the week unemployed; otherwise, he will be working, and with some possibility, he could get wage redrawn at the end of the week.

This particular timing design, rather than other possible alternatives, is chosen here mainly because it excludes the possibility of direct job to job transitions by making it impossible for a worker to quit and accept another offer within one period/week[17]. It also ensures a worker will stay at least one week on any job he accepted. This could be convenient for solving the worker's problem as it means that when solving the reservation wages through the indifference conditions we could use the value function of week 1 employment.

In the literature on employment separation, there are more complicated approaches, such as considering the wage-tenure relationship to be a reflection of how the exact productivity of each worker-firm match is revealed over time. The simple approach taken here is adopted from Green and Sargent (1998), who use it in their theoretical analysis of the impacts of UI entrance requirement on employment separation[18]. The exogenous wage movement approach here is used not only for its simplicity, but also because it is reasonable to believe employed workers are only partially isolated from overall productivity shock $F(w)$. Commitment to the job match is still weak and not completely immune to outside opportunities at the initial stage of job match.

A simple UI policy is assumed: a worker will be eligible for the benefit if he *quits* after completed at least N_e weeks of employment, that is, from the start of week

[17]In principle, each employment spell could correspond to several job spells, which could even have overlapping. A simple interpretation of the model setup here is that only the simplest situation is considered where each employment spell corresponds to only one job spell. But even in other situations, the exogenous wage dynamics is perhaps an easier approach to describe the corresponding wage processes.

[18]The main difference of my study and theirs is that they focus solely on employment separation process while here I extend their model to include reemployment process as well. As a result, the coherency of the worker's reaction function in these two processes has become a critical issue for the analysis here.

$N_e + 1$ on. All qualified unemployed workers will be able to collect \$B UI benefit per week for N_u weeks.

2.3.2 Characterizations of the Solution

The solution to this worker's optimization problem, assuming existence and well-behaved, is a set of reservation wages for the entire set of value functions for all situations. That's because: the worker has an infinite time horizon and his decisions regarding quitting or accepting job offers are interdependent. For example, an employed worker's decision about quitting depends on the potential payoff he could get from starting a new unemployment spell. This depends on his subsequent decision about accepting job offers while unemployed, which in turn depends on his quitting decisions while he gets reemployed again, and so on.

Let $V(w,t)$ be the value function at the start of employment week t with wage w; $W(t)$ refers to value function at the start of an unemployment week with t weeks of UI benefit remaining. Here is a set of representative value functions:

$$
\begin{aligned}
V(w, N_e+1) &= \max\left\{W(N_u), w + \beta\eta \int V(x, N_e+2)dF(x) + \beta(1-\eta)V(w, N_e+2)\right\} \\
V(w, N_e) &= \max\left\{W(0), w + \beta\eta \int V(x, N_e+1)dF(x) + \beta(1-\eta)V(w, N_e+1)\right\} \\
V(w, N_e-1) &= \max\left\{W(0), w + \beta\eta \int V(x, N_e)dF(x) + \beta(1-\eta)V(w, N_e)\right\} \\
V(w, 1) &= \max\left\{W(0), w + \beta\eta \int V(x, 2)dF(x) + \beta(1-\eta)V(w, 2)\right\} \\
W(N_u) &= B + \beta\lambda \int \max\left\{W(N_u-1), V(x,1)\right\} dF(x) + \beta(1-\lambda)W(N_u-1) \\
W(N_u-1) &= B + \beta\lambda \int \max\left\{W(N_u-2), V(x,1)\right\} dF(x) + \beta(1-\lambda)W(N_u-2) \\
&\dots \\
W(1) &= B + \beta\lambda \int \max\left\{W(0), V(x,1)\right\} dF(x) + \beta(1-\lambda)W(0) \\
W(0) &= \beta\lambda \int \max\left\{W(0), V(x,1)\right\} dF(x) + \beta(1-\lambda)W(0)
\end{aligned}
$$

In words, the first value function $V(w, N_e+1)$ says that a worker who has been employed long enough to qualify for UI benefit, maximizes his/her payoff by choosing whether to quit or not. If quit, his/her payoff will be the same as an unemployed worker with full UI benefit, i.e. $W(N_u)$; if stay, he/she could get the current week's wage and would face potential wage adjustment. The other value functions for employed workers are written similarly, except that the payoff for quitting is now $W(0)$, which is the same as an unemployed worker with no UI benefit.

Next, for an unemployed worker, his/her value functions at each week are composed of two parts: the current week benefit payoff if there is still UI benefit left, and the discounted expected payoff next period, at which point he/she could choose to accept a job or not if a job offer arrives.

The interdependence of the worker's problem while employed and unemployed is also captured in above value function set: value functions while employed, $V(\cdot)$, depend on $\{W(N_u), W(0)\}$; while value function while unemployed, $W(\cdot)$, depend on $V(w,1)$.

To solve this set of value functions, a combination of analytical and numerical techniques are used. Assuming the existence and uniqueness of the solution, here are some important analytical properties of the solutions of the problem. The proofs of these propositions are in appendix A.

Proposition 2.3.1 $\forall t \geq N_e + 1$, *workers value function at employment week* t *is given by*

$$V(w,t) = \begin{cases} W(N_u) + \frac{w - w^{e\star}}{1-\beta(1-\eta)} & \textit{if } w \geq w^{e\star}; \\ W(N_u) & \textit{otherwise.} \end{cases} \tag{2.2}$$

where $w^{e\star}$ *is implicitly given by*

$$(1-\beta)W(N_u) = w^{e\star} + \frac{\beta\eta}{1-\beta(1-\eta)} \int_{w^{e\star}} [x - w^{e\star}]\, dF(x) \tag{2.3}$$

This proposition gives the analytical solution of the value function of a worker who has been employed long enough to qualify for UI benefit. Once qualified for UI benefit, the worker's problem becomes stationary. In other words, for weeks beyond N_e, the value functions and the corresponding reservation wages would remain constant.

The intuition behind proposition 2.3.1 is illustrated by figure 2.2. As shown in the figure, the option provided by UI of quitting created a bottomline of workers' value function. Given $W(N_u)$ at the optimal solution, the worker is indifferent between quitting and staying with wage $w^{e\star}$. He will quit if his wage is below $w^{e\star}$, and his payoff will be $W(N_u)$. He will stay if his wage is above $w^{e\star}$. The lower the probability that he will face a redraw from the wage distribution, the steeper is the slope of his value function in this section, and in the extreme case where $\eta = 0$, the slope will be $\frac{1}{1-\beta}$.

In other words, the value function at weeks beyond $N_e + 1$ is composed of a horizontal segment and a straight up-sloping line. The position of the kink, $w^{e\star}$, is related to the set of parameters of the problem, in particular, the distribution of wage offer, workers' discount rate, and offer arrival rate while employed. The other parameters are implicitly absorbed in the optimal value of $W(N_u)$.

Proposition 2.3.2 *Assume* $W(Nu) > W(0)$, *and* $\forall i \in N$ *s.t.* $1 \leq i \leq N_e$, $V(w^{e\star}, N_e + 1 - i) > W(0)$. *Let* $w_t^{e\star}$ *be workers reservation wage at employment week* t. *Then* $\forall i \in N$ *s.t.* $1 \leq i \leq N_e$,

$$w^{e\star}_{N_e+1-i} = w^{e\star} - \frac{V(w^{e\star}, Ne+1-i) - W(0)}{\sum_{s=0}^{i-1}(\beta(1-\eta))^s} \tag{2.4}$$

$$\frac{\partial V(w, Ne+1-i)}{\partial w} = \begin{cases} (1-\beta(1-\eta))^{-1} & \textit{if } w > w^{e\star} \\ \sum_{s=0}^{i-1}(\beta(1-\eta))^s & \textit{if } w \in [w^{e\star}_{Ne+1-i}, w^{e\star}] \\ 0 & \textit{if } w \leq w^{e\star}_{Ne+1-i} \end{cases} \tag{2.5}$$

$$\int V(x, N_e+2-i)dF(x) > \int V(x, N_e+1-i)dF(x) \tag{2.6}$$

$$V(w, N_e+2-i) \geq V(w, N_e+1-i) \quad \forall w \tag{2.7}$$

This second proposition implicitly defines the solution of the value function of an employed worker who still need to qualify for UI benefit, i.e. when his/her has been employed for no more than N_e weeks.

Equation 2.4 and 2.5 describe the overall shape of each week's value function, which is always composed of three straight line segments: a horizontal one when the wage is below current reservation wage, and two upward sloping ones for wages above current reservation wage. Equation 2.5 shows the later two segments intersect when the wage equals the reservation wage post $N_e + 1$, $w^{e\star}$. The slopes of the first and third segments are independent of employment weeks, while the slope of the middle segment isnt. It is $\sum_{s=0}^{i-1}(\beta(1-\eta))^s$. It decreases from 1 to $1/\sum_{s=0}^{N_e-1}(\beta(1-\eta))^s$ as the worker moves back from only 1 week short of entrance requirement to the start of an employment spell.

Inequalities of 2.6 and 2.7 help to establish the first two equations. Intuitively, inequality 2.6 says, overall, it is always strictly better to be closer to the entrance requriement week, $N_e + 1$; inequality 2.7 says, at any wage level, the payoff could not be lower if the worker is one week closer to $N_e + 1$.

With the slope of each segment found, and with values of $w^{e\star}$, $W(0)$, the knowledge that $V(w, Ne + 1 - i) = W(0)$ if $w < w^{e\star}_{Ne+1-i}$, and finally the fact that $V(w, Ne + 1) = V(w, Ne)$ for $w \geq w^{e\star}$, it becomes possible to backup all the value functions and reservation wages for employment week N_e, and then $N_e - 1$, ..., and finally for the first week employed.

The dynamics of the value functions are illustrated in figure 2.2 and figure 2.3. In particular, figure 2.2 shows, for week N_e, the value function looks like that of week $N_e + 1$ except for the lower part, which has a lower threshold of $W(0)$ and the slope in the middle part is 1. The change could be proved straigntforward by comparing value functions at week $N_e + 1$ and N_e. If we move back one more week, figure 2.3 shows the value function for week $N_e - 1$ is shifted downward and with a steeper middle slope. As a matter of fact, the value functions will continue to be pushed downward and the middle section's slope will become steeper as the worker is farther away from $N_e + 1$.

Proposition 2.3.3 *Assume* $\frac{\partial V(x,1)}{\partial x} > 0$. *Assume* $W(Nu) - W(0) > B > 0$. *Let* $w^{u\star}_t$ *be the reservation wage when there are* t *weeks of UI benefit remaining at the start of an unemployed week. Define* $\Delta_t = V(w^{u\star}_{t+1}, 1) - V(w^{u\star}_t, 1)$, $\forall t \in N,\ s.t.\ t \in [1, Nu-1]$. *Then*

$$\forall t \in N,\ s.t.\ t \in [1, Nu],\ V(w^{u\star}_t, 1) = W(t-1) \tag{2.8}$$

$$\Delta_1 = B \text{ and } w^{u\star}_2 > w^{u\star}_1 \tag{2.9}$$

$$\forall t \in N,\ s.t.\ t \in [2, Nu-1],\ \Delta_t < \beta\lambda F(w^{u\star}_t)\Delta_{t-1} \text{ and } w^{u\star}_{t+1} > w^{u\star}_t \tag{2.10}$$

In this last proposition, the dynamics of reservation wage while unemployed is presented. Since $\beta\lambda F(w_t^{u\star}) < 1$, this proposition shows how the reservation wage increases at an decreasing rate as workers have more weeks of UI benefit remaining.

2.3.3 Numerical Search of the Solution

Above, under some assumptions, proposition 2.3.1 and proposition 2.3.2 present characterizations of workers' value functions while employed taking $\{W(N_u), W(0)\}$ as given, and proposition 2.3.3 presents characterizations of workers' value functions while unemployed taking $V(w, 1)$ as given. The solution of the entire problem not only has to satisfy these propositions, the two parts of the solution (employed and unemployed ones) have to be consistent with each other. That is, the following two conditions have to be true for the solution.

$$V(w, 1) = G^1(W(N_u), W(0), w) \tag{2.11}$$

$$\{W(N_u), W(0)\} = G^2(V(., 1)) \tag{2.12}$$

where $G^1(\cdot)$, $G^2(\cdot)$ are implicitly given in the propositions.

Given the complexity of the solution as indicated in the propositions, it is very unlikely that the analytical solution will be transparent or instructive. Therefore, numerical approach is used for the final solution. Specifically, the final numerical solution is based on a given set of parameters, the analytical propositions as well as the two consistency conditions.

This is done by starting with some educated guess about $\{W(N_u)^1, W(0)^1\}$, and then calculating $V^1(w, 1)$ and $\{W(N_u)^2, W(0)^2\}$, and so on, until
$\{W(N_u)^t, W(0)^t\} = \{W(N_u)^{t+1}, W(0)^{t+1}\}$.

Specifically, the start value of $\{W(N_u)^1, W(0)^1\}$ could be set around $B/(1-\beta)$. Then we could get $V^1(w, 1)$ by calculating $w_t^{e\star}$ and $V(w, t)$ from $t = N_e + 1$ to $t = 1$

using previous analytical results. To get $\{W(N_u)^2, W(0)^2\}$ from $V^1(w,1)$, we can use the value function. These steps could be repeated until the results converge. Once the consistency conditions are satisfied, the full set of reservation wages and hazard rates are backed-out.

2.3.4 Economic Implications

The figures in table 2.1 illustrate the implications of preceding theoretical model for UI's impacts on individuals' reservation wages and hazard rates. These figures show how each UI parameter generates both work incentives and disincentives on the labour market. For a given set of parameters $(\beta, \eta, \lambda, F(\cdot), N_e, N_u, B)$, workers' reservation wages are, relative to the case of no UI, lower in period **E0** (employed but before UI eligible) and period **U0** (unemployed with no UI benefit coverage), and higher in period **E1** (employed and eligible for UI) and period **U1** (unemployed with some UI coverage).

In period **E0**, individuals' reservation wage decreases at an increasing rate as their prospects of getting UI coverage increases; in period **U0**, individuals' reservation wage is constantly lower than the case of no UI, as the possibility of UI coverage after future job losses makes low-wage jobs more attractive. On the other hand, in period **E1**, individuals' reservation wage is constantly higher than the case of no UI as employed workers are able to collect UI if they quit; in period **U1**, individuals' reservation wage decreases at an increasing rate as their prospects of exhausting UI coverage increases as time goes by.

Similar to its impacts on the reservation wages, the implications of temporary contingent UI coverage on hazard rates are such that, relative to the case of no UI, hazard rate is higher in periods **E0** and **U0**, and lower in periods **E1** and **U1**, with only one exception at the first week of satisfying UI employment requirement.

At that moment, the hazard rate of employed workers jumps to its unique peak. This dramatic movement is a result of reservation wage jump at that point, which means all job matches accumulated earlier with wages below the new high level of reservation wage will break suddenly.

Now consider the impacts of adjusting the UI parameters. The figures of table 2.2 show the impacts of reducing weekly benefit payment, where the solid curves correspond to $B = 20$ and the dashed curves correspond to $B = 19$. The figures show the impacts of UI become weaker as B drops. For periods that reservation wage is pushed up, i.e. **E1** and **U1**, this benefit cut will lead to a weaker increase in the reservation wage; for periods where the reservation wage is pushed down, i.e. **E0** and **U0** , this cut will lead to a weaker decrease. The impacts of benefit cut on hazard rate tell very similar story.

Next, for the other two UI parameters, benefit duration and minimum employment requirement, the changes of UI impacts are mainly reflected as shifts of the curves to the new critical weeks. In particular, figures in table 2.3 show as number of minimum employment requirement weeks drops, the reservation wages and hazard rates for the employment spells are affected the most, almost as if the curves have been shifted to the left accordingly. With less weeks of employment required for UI coverage, theoretically, the UI program becomes more generous. Reemployment, therefore, becomes more attractive for unemployed workers, and their reservation wages should drop. But as the figures show, there is only a very slight drop of unemployed workers' reservation wages in this case. Similarly, figures in table 2.4 show as the number of UI benefit weeks drops, the reservation wages and hazard rates for the unemployment spells are affected the most. The expected weakening of UI impacts on the employment spells, though numerically consistent with the theoretical predictions, is hardly noticeable on the figures.

Although the model presented above is simple, the implications for UI's labour market impacts discussed here should be able to capture most of those of a more 'realistic' UI program. After all, the discrete nature of eligibility of UI remains to be the most substantial change in workers payoff calculation.

The results here confirm previous theoretical predictions in an extended context. For example, Green and Sargent (1998) highlight the entrance effect in period **E0**, while Meyer (1990) examined the benefit exhaustion effect in period **U1**. Here, these previous results are shown to be optimal in an unified framework where transitions in both directions of employment and unemployment are endogenized. In addition, these effects are found to coexist with UIs inducement effect of UI in period **U0** and its disincentive effect in period **E1**.

Moreover, using a single theoretical framework, the findings here also highlight several intricacies of UI's labour market impacts. First, all these different aspects of UI's labour market impacts are interdependent on each other; second, while an UI program could be made more generous through different approaches (such as, shortening entrance requirement, lengthening benefit durations, or increasing weekly benefit payment), our theoretical model shows how each of the approach has different implications on the labour market turnovers. Finally, the kind of consistent patterns as illustrated in the figures of table 2.1 show how some UI parameters change could function like a double-edged sword on the labour market, providing both work incentives and disincentives. For example, if benefit duration becomes longer, unemployed workers with benefit coverage at any given week would have less work incentive and higher reservation wages, while short-tenured employed workers would have more work incentive and lower reservation wages.

Given the populations of workers with different employment/unemployment durations have different compositions, both in terms of observables and unobservables, various policy options could have quite different impacts in the labour market. Therefore, it is only sensible to have different UI policy choices corresponding to changing policy priorities.

As discussed in detail earlier, the EI reform increased employment requirement (divisor rule), lowered benefit payment (experience rating) as well as benefit durations, all on some conditional forms. When the overall generosity of the UI program became less generous, it seems that, based on our theoretical model, UI's impacts, both positive and negative, on the labour market would have been weakened. But as noted above, UI's impacts on the labour market could be rather intricate, EI reform's effects on those impacts could be less than uniform across heterogeneous workers.

2.4 Figures

Figure 2.1: Timing of Workers' Decision

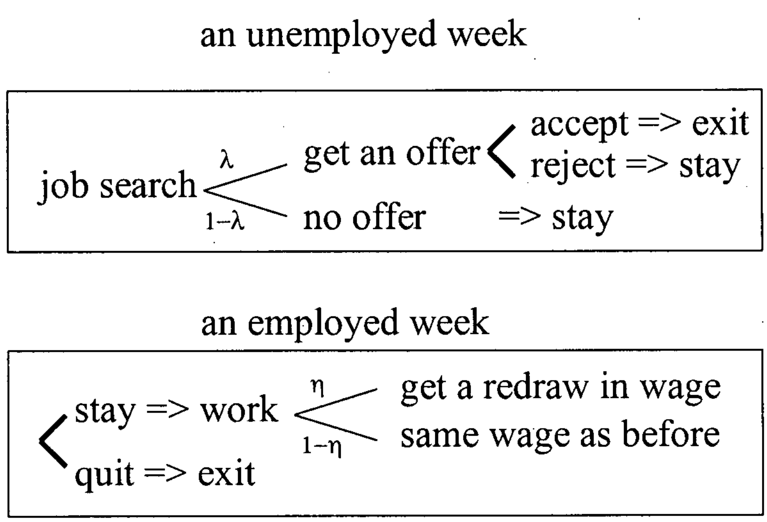


Figure 2.2: Value Function $V(w,t)$ When $t > N_e$ and $t = N_e$

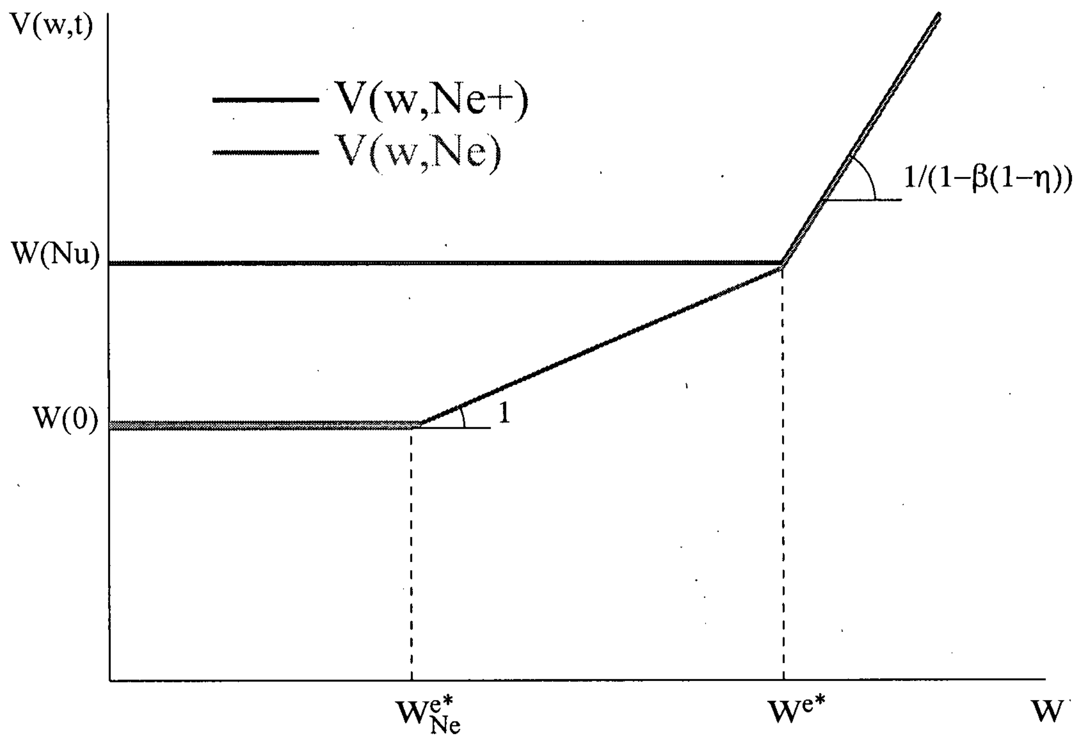


Figure 2.3: Value Function $V(w,t)$ When $t > N_e$, $t = N_e$ and $t = N_e - 1$

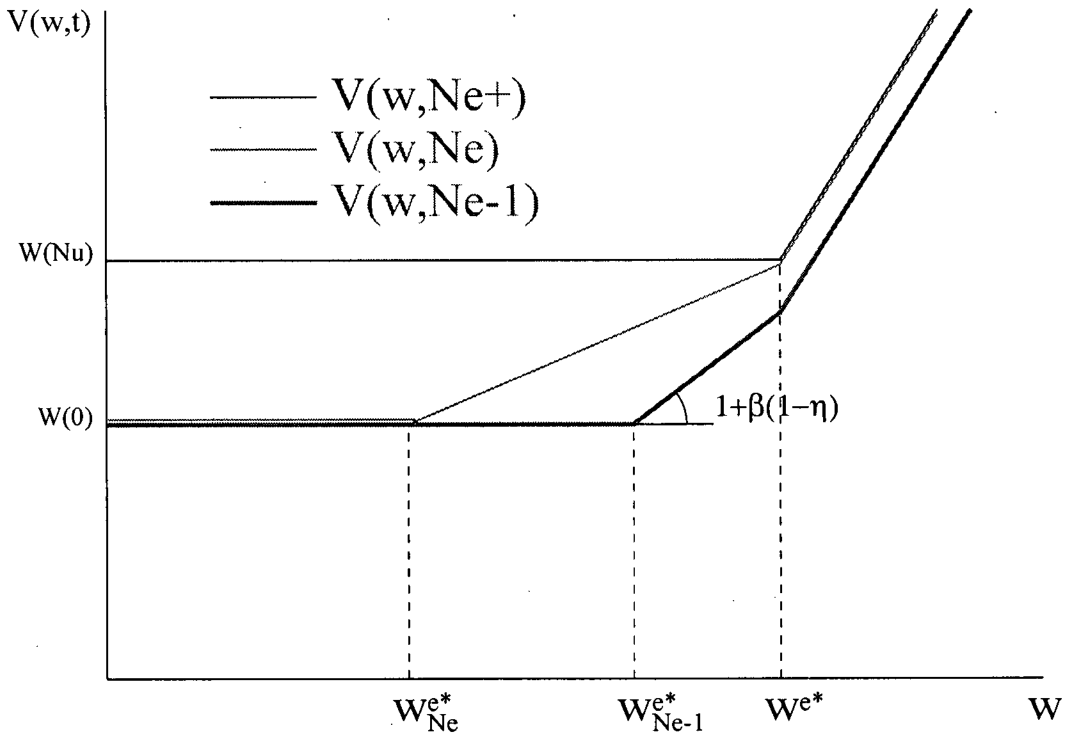
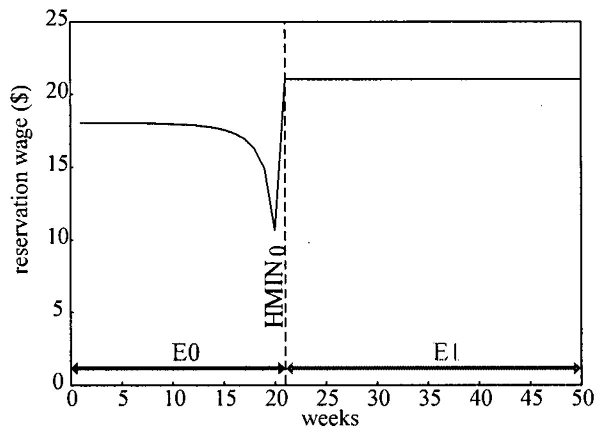
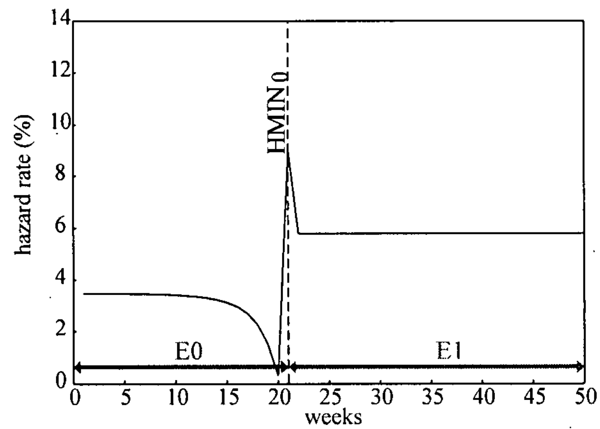
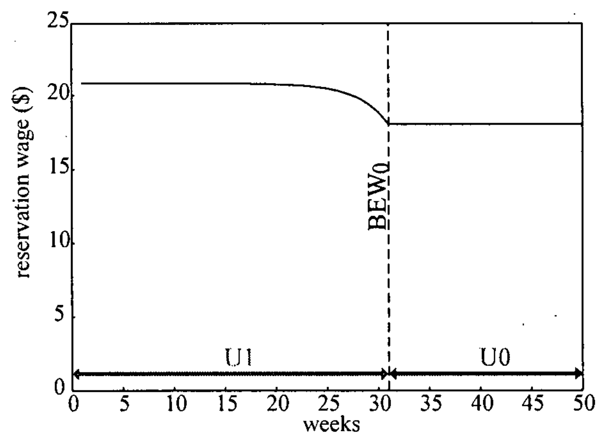
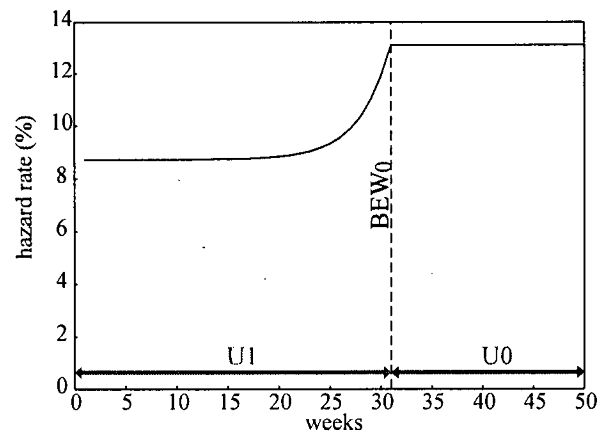


Table 2.1: Predicted Impacts of Contingent, Temporary UI Benefit

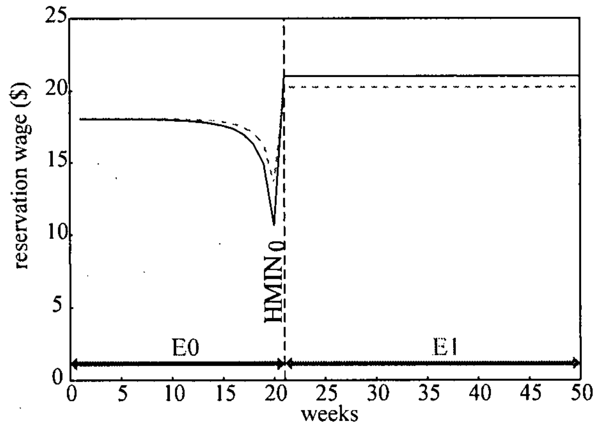
Reservation wage	Hazard rate
Employed	
	
Unemployed	
	

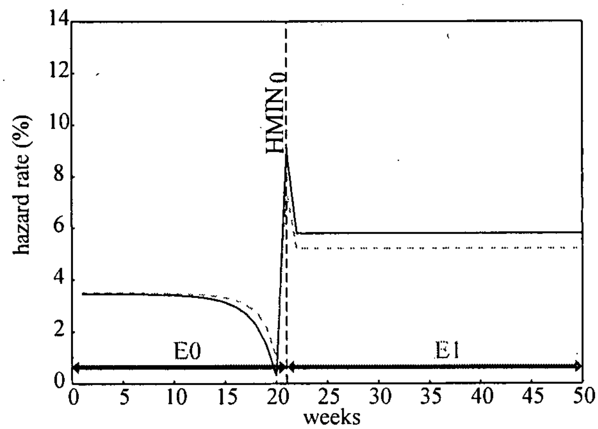
Note: The parameter set used for numerical simulation is: $\beta = 0.8$, $\eta = 0.1$, $\lambda = 0.2$, $N_e = 20$, $N_u = 30$, $B = 20$, $F(w)$ is a truncated normal distribution $N(20, 5)$ with $w \geq 0$. In this case, the minimum employment requirement threshold week $HMIN_0$ equals $N_e + 1 = 21$; and the benefit exhaustion threshold week BEW_0 equals $N_u + 1 = 31$. At the optimal, $\{W(N_u), W(0)\}$ equals to $\{104.9447, 95\}$.

Table 2.2: Predicted Impacts of Weekly UI Benefit Cut

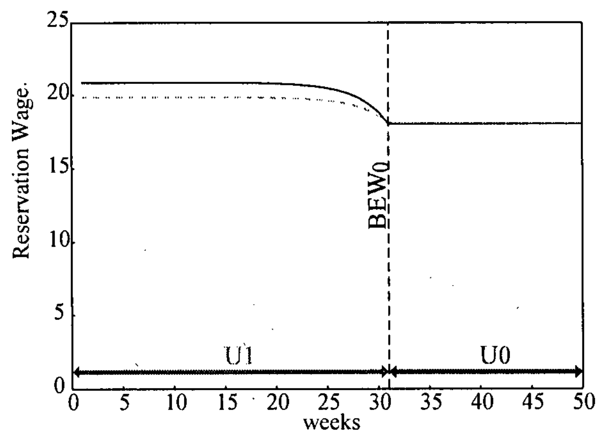
Reservation wage | Hazard rate

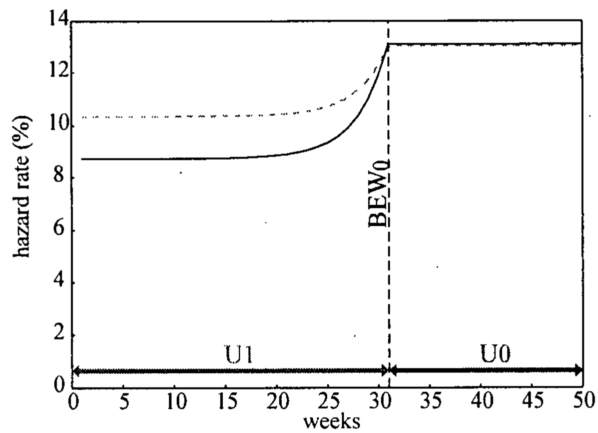
Employed





Unemployed



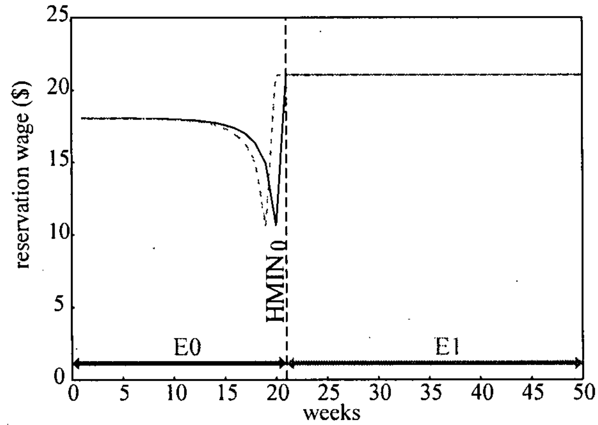


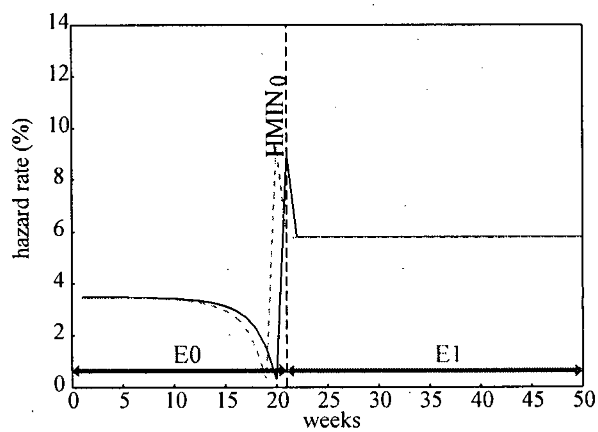
Note: relative to the parameter set in figure 2.1, the weekly benefit payment is cut from \$20 to \$19 per week. At the new optimal, $\{W(N_u), W(0)\}$ equals to $\{101.1466, 95\}$. The solid lines correspond to the original parameter set, the green dashed lines correspond to the new set.

Table 2.3: Predicted Impacts of Employment Requirement Week Cut

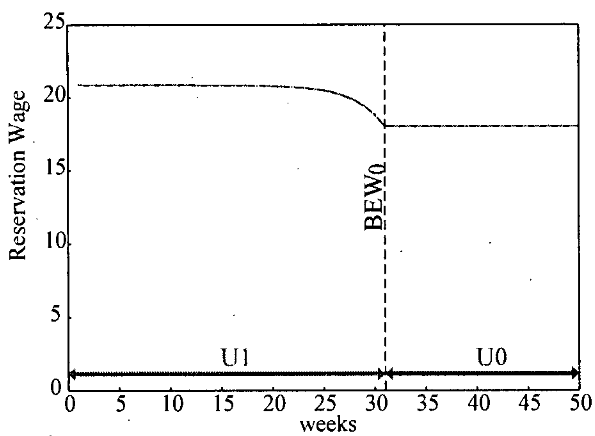
Reservation wage	Hazard rate

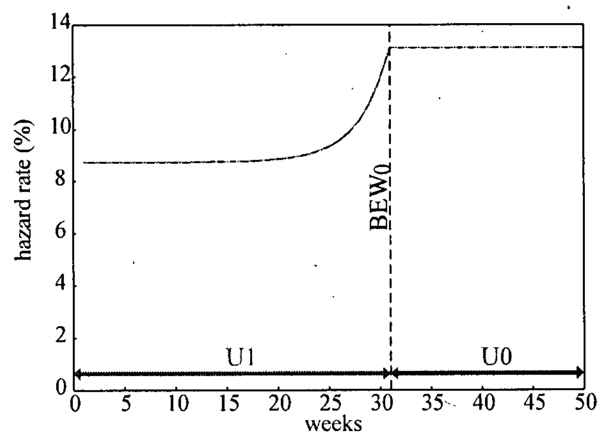
Employed





Unemployed



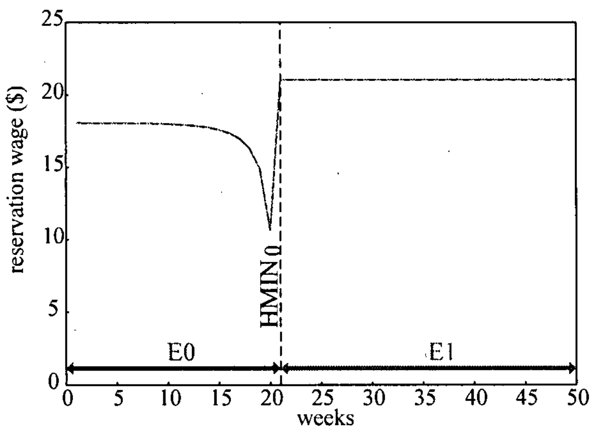


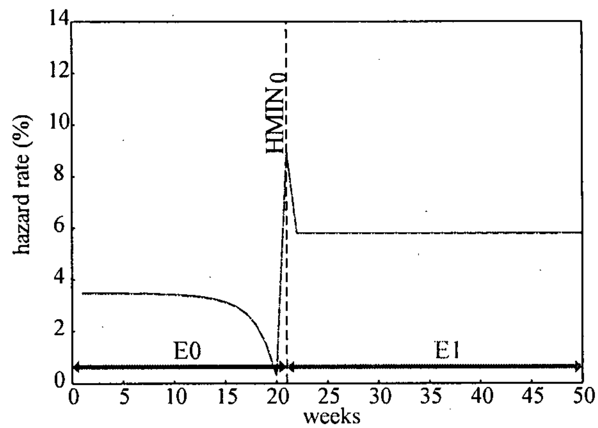
Note: relative to the parameter set in figure 2.1, entrance requirement week N_e is cut from 20 to 19 weeks. At the new optimal, $\{W(N_u), W(0)\}$ equals to $\{104.944, 95\}$. The solid lines correspond to the original parameter set, the green dashed lines correspond to the new set.

Table 2.4: Predicted Impacts of Benefit Week Cut

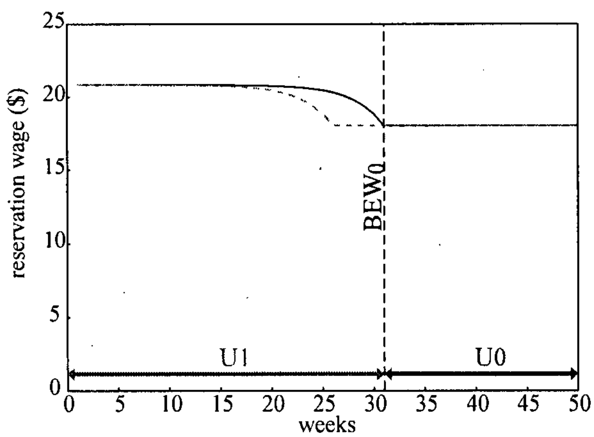
Reservation wage	Hazard rate

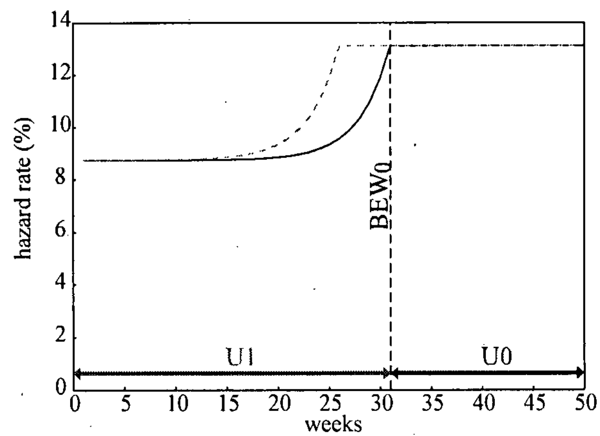
Employed





Unemployed





Note: relative to the parameter set in figure 2.1, benefit week N_u is cut from 30 to 25 weeks. At the new optimal, $\{W(N_u), W(0)\}$ equals to $\{104.942, 95\}$. The solid lines correspond to the original parameter set, the green dashed lines correspond to the new set.

Chapter 3

Contingent, Temporary Unemployment Insurance Coverage and Employment/Unemployment Cycles

3.1 Introduction

There is a trend of updating income support policies among industrial countries since the 1990s. Because of its coverage's employment requirement, Unemployment Insurance (UI) has a closer connection to the labour market relative to other programs. In the empirical literature, previous studies have examined how UI coverage's contingency affects employment spells (Baker and Rea, 1998; Green and Riddell, 1997), and how UI coverage's temporariness affects unemployment spells (Ham and Rea, 1987; Meyer, 1990; Moffitt, 1985). Though jointly these two sets of studies cover UI's impacts on both directions of employment/unemployment transitions, data sources and econometric setups often differ a lot across individual studies, making it difficult to form a synthesized view of the whole picture.

This study re-examines contingent, temporary UI coverage's impacts on both directions of employment/unemployment cycles using a common Canadian data source, the Survey of Labour and Income Dynamics (SLID). Besides the data set used, there are at least two other aspects of this study that reflect its Canadian origin: first, the seasonal sector, the often blamed UI-abuser in Canada, is studied separately from the non-seasonal sector; and second, the 1996 Employment Insurance (EI) reform[1] of Canada is used here as a unique source of exogenous treatment variations.

In theory, timing is critical under contingent temporary UI program: the closer an employed worker is to his employment requirement week, the stronger the incentive is for him to stay employed; the closer an unemployed worker is to his benefit exhaustion week, the stronger the incentive is for him to leave unemployment. In short, UI's impacts on work incentives are time-varying even in the 'steady state'.

Such time-varying impacts of UI on the labour market are supported by several previous studies. In particular, both Moffitt (1985) and Meyer (1990) show the hazard (i.e. conditional probability) of leaving unemployment increases as unemployed workers approach their benefit exhaustion weeks using U.S. data. Ham and Rea (1987) also provide similar results using Canadian data. On the employment side, both Green and Riddell (1997) and Baker and Rea (1998) show the hazard of leaving employment decreases as workers approach their minimum employment requirement weeks.

The identification of all of the above types of time-varying impacts critically relies on having exogenous variations of UI treatment (either employment requirement or benefit durations). For example, if all sample unemployment spells have the same

[1]The EI reform is the most influential change of the Canadian UI program in recent history. Please refer to chapter 2 for a detailed review of this reform and its background.

number of initial UI benefit durations, then the impacts of UI would be indistinguishable from the trend of baseline hazards. This is very close to the U.S. case. There workers' benefit durations are almost the same within each state.

Different from that, workers' UI benefit durations depend positively on their previous employment histories and their local unemployment rates in Canada. While such design does generate valuable treatment variations within Canadian data, the variations it generates could potentially be endogenous. Here the UI treatment is indirectly related to individuals' inherent work attitude through employment histories. While, to examine UI's impacts on labour market transitions, we need the variation of individuals' UI benefit durations to be exogenous to their inherent attitudes toward labour market attachment. To tackle this problem, this study uses the EI reform as a unique exogenous source of treatment variation.

Although the usage of sample spells in two separate periods with different UI treatments could be good for identification, it also brings about a new problem for this study. That is how to account for across-period macroeconomic differences. This is a problem absent in previous studies. Figure 3.1 plots the Canadian unemployment rate in recent decades. Intervals A and B correspond to the pre- and post-reform sample periods of this study. The EI reform, as shown in the figure, happened in the middle of an economic recovery. Not surprisingly, evaluations of the EI reform constantly find substantial labour market improvement in post-reform years (Human Resources Development Canada, 1997-2002).

Here, we could think of two types of impacts that the economic recovery might have on the employment/unemployment spells' baseline hazards: level-shifts and shape-changes. A post-reform dummy variable is used to account for level-shifts. To examine shape-changes, the analysis here compares the estimation results using pooled sample spells with those using sample spells from each individual period. The comparisons suggest the estimated UI impacts based on pooled samples are hardly affected by this second type of macro impacts. We are not claiming that there are not many shape-changes in the baseline hazards of labour market turnovers across business cycles in general[2]; rather, what our results indicate is that it is possible for the estimated UI impacts to be robust to macroeconomic recovery. It is also worth-noting that we consider such robustness is very likely to come from our usage of time-varying UI dummy variables.

How could the identification of the coefficients for time-varying UI dummies not be affected by possible baseline hazards shape changes in this case? It might be explained using figure 3.2, which gives two examples of such variables. As shown here, this type of variable usually only takes value one at a subset of all the weeks covered by a spell. The set of value-one weeks vary across spells. For unemployment spells, it might depend on unemployment spells' initial UI benefit durations; for employment spells, it might depend on weekly working hours and local unemployment rate. It is unlikely differences in the shapes of baseline hazards due to economic recovery across the two periods would match exactly all spells' sets of value-one weeks of a specifically defined time-varying variable at once. Using figure 3.2 as an example, the estimation of UI's impacts on unemployment hazards for workers with 11 to 20 weeks of benefit left could only possibly be affected by the macroeconomic recovery if such recovery only affects week 20 to 29 for the first spell and week 5 to 14 for the second one. That is indeed very unlikely.

In terms of econometric setup, hazard models naturally allow for incomplete (censored) spells and time-varying variables. Various hazard models have become a common choice in this literature. For our study, since the Canadian UI benefit is

[2]As a matter of fact, we do find some differences in the patterns of baseline hazards across the two periods as will be discussed in detail later.

defined in term of weeks, we need to examine the duration data by weeks as well. But many of our sample spells ended at semi-monthly or monthly frequencies[3]. Tailored to this particular feature of the sample spells, I thus extend the usual hazard model to allow for heaping effect.

The results here confirm most of existing findings of the literature mentioned earlier in a new context, as well as uncover some new ones. In terms of aggregate impacts, the simulations here suggest that at the aggregate level, *ceteris paribus*, the overall unemployment rate of Canada in the late 1990s could drop by around 15% (e.g. from 7.6% to 6.6%) if there are no UI impacts. In terms of the EI reform, the results suggest there is a decline in the seasonality of the employment/unemployment cycles in the seasonal sector. Besides, simulation results also imply the EI reform, except for the experience rating rules and the divisor rule, has no significant impacts on the national unemployment rate.

The rest of this paper is organized as follows: section 2 reviews theoretical implications of contingent temporary UI coverage. Section 3 explains the econometric formulation. Section 4 discusses the data construction. Section 5 presents empirical analysis. Section 6 concludes.

3.2 Theoretical implications

According to the static labour and leisure model, UI's impacts on the labour market mainly work through its impacts on workers' budget lines. For the case of Canadian UI program setup, to be eligible for UI benefit coverage, a worker's employment weeks need to reach some minimum level, $HMIN$. After week $HMIN$, his benefit

[3]In fact, volatile hazard rates are commonly found in high-frequency labour market duration data.

duration increases till week $HMAX$, at which point the worker reaches the upper bound of benefit duration available[4]. Figure 3.3.a and 3.4.a illustrate such a benefit schedule and its corresponding budget line.

In this static model of labour and leisure choice, UIs impacts critically depend on the length of workers' planning horizon (Green and Sargent, 1998). Most seasonal workers in Canada are forced to have one-year planning horizon due to the weather and job season. Once their job season comes, they have to go back to work; otherwise, they will miss their whole employment season. As a result, the effective UI benefit weeks for workers in the seasonal sector is $HYRMAX$. Post the week of $HYRMAX$., one more week of work means one less week of benefit collection for seasonal workers. In terms of hazard rates, the static model thus predicts higher employment hazard rates for weeks between $HMIN$ and $HYRMAX$, and a spike of unemployment hazard rate around the benefit exhaust week (BEW).

The static model might be appropriate for seasonal workers but not for non-seasonal workers. They do not have as nearly a strong foresight on the timing and length of their upcoming employment spells as those in the seasonal sectors. It might be more reasonable to assume an infinite planning horizon with risky employment for non-seasonal workers. Therefore, we might want to consider a model as presented in chapter 2 for non-seasonal sector.

This is a theoretical model for labour market turnover with contingent, temporary UI benefit as well as re-employment and job loss uncertainties. Figure 3.5 shows its implications for the entire pattern of UI's time-varying impacts on employment/unemployment cycles. In summary, the model predicts: 1) *entrance induction effect*: a gradual drop of employment hazard rates before $HMIN$ and an employ-

[4]Here, both $HMIN$ and $HMAX$ vary with local unemployment rates. More detailed information about the schedule is presented in section 2.1.

ment hazard rates spike at $HMIN$; and, 2) *benefit exhaustion effect*: a gradual rise of unemployment hazard rates before BEW. Given the setup of UI in Canada, workers' potential benefit weeks will continue to increase with their employment weeks up to a maximum, $HMAX$. Thus, they still have incentive to stay employed beyond week $HMIN$. For that, we expect a potential *tailoring effect* of UI for workers after week $HMIN$ but before week $HMAX$ for non-seasonal workers (or $HYRMAX$ for seasonal workers).

Besides the above, two sets of new rules introduced by the EI reform are also considered in our specifications. First, *the divisor rule*. It discourages workers from short, unstable labour market attachment by cutting workers' weekly benefit payment if the number of calendar weeks used to claim UI benefit is less than $HMIN+2$. Second, *worker-side experience rating rules*. Simply speaking, workers would receive lower weekly payments and need to repay more of their received benefit through the tax system as their previous 5 years' UI benefit collection weeks increase across each 20-week long interval. If the planning horizon is 53 weeks, considering the 2-week UI waiting period, that means a worker has to work at least 31 weeks in a year to avoid those penalties. Therefore, we expect hazard rates for leaving employment to be lower before week 31, and those for leaving unemployment to be higher before week 19.

3.3 Econometric Setup: Hazard Model with Heaping Effect

The model formulated here uses proportional hazard (PH) model as its starting point. Discrete time PH model has been widely used in the related literature (Green and Sargent, 1998; Meyer, 1990). The main advantage of discrete time PH model is that control variables could vary over the course of a single spell. It has close connection with continuous time PH model in that the probability of a spell to end at a discrete period is modeled as this spell hasn't survived the last period.

Specifically, for spell j, let d_j be its duration; $\theta_{j,t}$ be its instantaneous hazard, that is $\theta_{j,t} = prob\{d_j = t|d_j \geq t\}$; $p_{j,t}$ be its discrete hazard at period t. Then $p_{j,t} = 1 - exp(-\theta_{j,t})$. The way covariates are incorporated in these models is to set

$$\theta_{j,t} = exp(\alpha_t + \beta' x_{j,t}) \tag{3.1}$$

Then the log likelihood function of spell j with duration d_j is

$$\begin{aligned} \ln(f_{j,d_j,c_j}) &= c_j \ln(p_{j,d_j}) + \sum_{s=1}^{d_j-1} \ln(1-p_{j,s}) \\ &= c_j \ln(1 - exp(-exp(\alpha_{d_j} + \beta' x_{j,d_j}))) - \sum_{s=1}^{d_j-1} \exp(\alpha_s + \beta' x_{j,s}) \end{aligned} \tag{3.2}$$

where c_j is a dummy variable which is 1 for complete spells and 0 for censored spells.

This paper extends the above discrete time PH model by adding a heaping effect measurement error component. By heaping effect, I mean the tendency of labour market spells to end at certain low frequencies (e.g. monthly) while the frequency of analysis is high (e.g. weekly). As an illustration, figure 3.6 shows the presence of heaping effect in our pre-reform seasonal employment sample spells. The dashed vertical lines in the figure represent weeks that could possibly contain calendar month ending dates in the sample. As shown in the figure, weekly empirical hazards fluctuate a lot and the hazard spikes match well with the dashed vertical lines. Furthermore, it can be shown most of the spikes between the vertical lines coincide with weeks that have day 15 of calendar months of the period covered. These are our visual evidence of heaping effect.

The irregular and frequent spikes of empirical hazard rates have been a common feature in labour market duration data[5]. Here, to accommodate the vagueness of the observed spell ending, I use an idea similar to that used for relating a discrete time PH model with a continuous time PH model mentioned earlier. First, the calendar property of a spell j could be captured by 3 overlapping week subsets, $\{H_j^0, H_j^1, H_j^2\}$, where H_j^0 contains every week in spell j, H_j^1 only has semi-monthly weeks, and H_j^2 only has monthly weeks[6]. Figure 3.7 gives an example of such subsets of weeks. Define function $h(t, H_j^l)$ so that it gives the latest week in H_j^l prior to week t. In particular,

$$h(t, H_j^l) = \max\{s | s < t, s \in H_j^l\} \tag{3.3}$$

Let probabilities of reporting at each of the three frequencies (weekly, semi-monthly, and monthly) be $\{a_0, a_1, a_2\}$, where $\{a_0, a_1, a_2\} \in [0, 1]$ and $\sum_{l\in\{0,1,2\}} a_l = 1$. Then the likelihood of spell j with heaping considered could be written as a weighted sum of the likelihood of this spell in each of the three frequencies, $\{f^0_{j,d_j,c_j}, f^1_{j,d_j,c_j}, f^2_{j,d_j,c_j}\}$,

$$\tilde{f}_{j,d_j,c_j} = \sum_{l\in\{0,1,2\}} a_l \cdot f^l_{j,d_j,c_j} \tag{3.4}$$

[5]Baker (1992) refereed to such observation as *digit preference*, where he found respondents tend to "report the length of their current unemployment spell as an integer multiple of one month". To deal with digit preference, he used a formula to backup the underlying, smooth distribution of unemployment spells of Current Population Survey. Limited by data, his formula has to be abstract from variations of individual spells' calendar properties. Specifically, his formula assume every spell's week 4, 8, 12, etc, correspond to "integer multiple of one month", while not all calendar months have exactly 4 weeks in reality. Here, my formulation takes care of that calendar variations across spells as well as recognizes that not every spell starts at week 1 of a month. Torelli and Trivellato (1993) has raised similar concerns on the hazard spikes. The application of their method is substantially limited as they only gave formula for complete spells when it is common to have both complete and censored spells in duration data.

[6]Semi-monthly weeks are defined as those contain day 15 or last day of a month, while monthly weeks are defined as those contain last day of a month. Obviously, $\forall j$, $H_j^2 \subset H_j^1 \subset H_j^0$.

Finally, the likelihood with heaping at frequency l, f^l_{j,d_j,c_j}, is related to likelihood without heaping f_{j,d_j,c_j} as follows

$$f^l_{j,d_j,c_j} = \begin{cases} 0 & \text{if } d_j \notin H^l_j \text{ and } c_j = 1 \\ f_{j,h(d_j,H^l_j),0}(1 - \prod_{s=h(d_j,H^l_j)+1}^{d_j}(1-p_{j,s}) & \text{if } d_j \in H^l_j \text{ and } c_j = 1 \\ f_{j,\min\{h(d_j+1,H^l_j),d_j\},0} & \text{if } c_j = 0 \end{cases} \quad (3.5)$$

In other words, equation (3.5) says three things about observing spells at frequency l: first, it is impossible to observe spell-endings outside of the set of expected ending weeks, H^l_j; second, ending at one of the expected ending weeks means the spell survived all observable intervals except the last one; third, observing an incomplete spell means it survived all observable intervals[7].

Although intuitive, the above heaping measurement model requires different likelihood calculation for each individual spell depending on the set $\{H^0_j, H^1_j, H^2_j\}$ and whether the spell is complete or not. There are several ways to simplify this time-consuming procedure. First, we could derive each spell's calendar set $\{H^0_j, H^1_j, H^2_j\}$ before running maximum likelihood estimation. Second, we could calculate the likelihood of surviving till the last but one interval separately as a common component of all frequency specific likelihood. Finally, we could pre-program the mapping from $p_{j,s}$ and $\{H^0_j, H^1_j, H^2_j\}$ to f^l_{j,d_j,c_j}.

There is an alternative nonparametric way to deal with the fluctuating hazard rates in the literature (Green and Sargent, 1998). That is to add time varying

[7]Here, all underlying spells' ending are pushed to their next heaping weeks. A more general setup would also allow the ending to be pushed to their previous heaping weeks. However, there is a practical difficulty in such a general setup with designating values for those time-varying variables at weeks when the observed spells have ended or have been censored. For example, with no knowledge about the working hours in those weeks after the observed employment spells ended, it becomes infeasible to impute the potential EI benefit weeks associated with those weeks.

dummy variable for end-of-month weeks on top of a non-parametric baseline. This alternative approach is both readily accessible and conceptually straightforward. But its ability to separately identify the baseline hazard and the coefficient for end-of-month dummy relies heavily on having rich variation across spells in their calendar properties[8][9]. It is also worth-noting that, with heaping considered, the magnitude of the estimated coefficient for any UI time-varying dummy reflects the number of spell-endings at relevant intervals in all three frequencies (weekly, semi-monthly, and monthly); while without heaping consideration, that magnitude reflects endings only at weekly intervals.

Finally, with heaping effect component taking care of the high frequency part of empirical hazards fluctuations, there is a weaker case for the 'expensive' non-parametric baseline specifications. That means parsimonious parametric baseline specifications become much sensible. Having tried polynomial of various orders as the baseline hazard trend, we choose to present our main results using a 2nd order polynomial and leave the results using 5th order polynomial for robustness check[10].

3.4 Data

The confidential SLID data is a recent Canadian micro panel data set. Currently, it has three panels: panel 1 for the years from 1993 to 1998, panel 2 for the years from 1995 to 2001, and the on-going panel 3 for the years from 1999 to 2002. Table 3.2 gives several basic sample counts of these panels. Like other survey data, SLID

[8]that is, the number of weeks/days in each sequential month.

[9]Applications of this nonparametric approach on our sample spells are not very satisfactory. The calendar spikes such as those shown in figure 3.6 are absorbed mostly by baseline hazards.

[10]Instead of direct polynomial to approximate the baseline, an analytically equivalent approach, the Lagrangian interpolation polynomial method as discussed in Cooper (1972), is used to mitigate the multicollinearity problem in numerical computation.

has a very rich set of demographical variables (e.g. age, gender, education). Besides these, SLID also has detailed information about individuals' job holdings (e.g. dates, wages, weekly working hours), making it possible to derive not only individuals employment/unemployment spells but a whole set of time-varying UI treatment variables according to the applicable UI legislation[11].

For the construction of employment/unemployment spells, SLID does have a weekly labour force states variable readily available. But its' classification of the labour force states is not very useful for UI studies. For example, according to SLID classification, self-employment is counted as employment. But self-employment is not insurable employment according to UI. For another example, though individuals on temporary/seasonal layoff are regarded as employed in SLID, they are eligible for UI benefit if they have enough preceding employment. To solve such discrepancies, the employment/unemployment sample spells used in this study are constructed from scratch based on job information. As a result, it is worth-noting that the definitions for 'employment' and 'unemployment here do differ from textbook definitions considerably[12]: *the 'employment spells' here are periods on paid jobs; 'unemployment spells' are periods in-between 'employment spells'.* By using these definitions, new entrants to the labour market, such as students who just graduate from universities, are excluded from our sample. Thus our study is mainly concerned with active paid

[11]It is of course better to use the exact, realized UI benefit collection durations than to use the derived ones whenever possible. But in general that kind of information is only available from administrative data sets, which usually have very limited information other than UI collections. Specifically, administrative data sets usually do not contain information on education, martial status, or individuals' labour market activities beyond benefit collection spells.

[12]There is no search requirement imposed on the so-called "unemployment spells" as referred in this thesis. As a result, some might even find it more appealing to refer to these spells as *non-employment spells.*

labour market participants.

In addition, with labour market spells custom-made, our estimation results should only be interpreted with our data construction procedure in mind. This is a special 'observation window' kind of procedure (see figure 3.8 for an illustration). It has three broad steps. First, raw employment/unemployment spells are created. Raw employment spells cover all the dates from the start to the end dates of paid jobs, except those on temporary layoffs. Since there is a two-week waiting period for UI benefit collection, two raw employment spells are merged with the intermediate dates added if they are separated by less than 14 days. After the raw employment spells are formed, those periods in-between are our raw unemployment spells. Next, observation windows are created for each individual. These windows are periods of dates that we have no reason to believe a person is out of the labour force. In particular, periods of schooling, disability, non-paid employment, outside the ten Canadian provinces, less than 20 or more than 50 years old are excluded from the entire set of dates of the panel period. In case of a problematic job ending, any dates afterward are also excluded[13]. Whatever dates left form the observation windows. For the two observation windows in figure 3.8, one possibility could be that the individual was attending school in the meanwhile. Finally, raw employment/unemployment spells and observation windows are considered jointly to establish the final sample spells. Only spells started within observation windows are selected. Furthermore, they would be cut at the end dates of their starting observation windows and flagged

[13]Here, 'having a problematic job ending' refers to jobs whose *endtyp9* variable is coded as 2 or 3, which means the job ended because of the job was denied by the respondent or because the survey did not receive information about the job in subsequent collections. For these jobs, the period from the job end to the end of the panel is excluded from the corresponding individuals' observation window(s).

as incomplete if they pass beyond those dates[14].

A key feature of the 'observation window' approach here is that it makes event-based sample spells selection rather than the usual person-based selection. As table 3.2 shows, less than half of the individuals would survive person-based selection; that is, if we only select individuals who had no 'out of labour force' activities throughout their entire panel periods. Specifically, only 12,108 out 30,455 individuals have single panel-long observation windows in panel 1. In a longer panel, person-based selection could reduce the size of sample individuals even further. After all, being in the labour force is just one stage of the life cycle. By making the selection based on events, our 'event-based' approach mitigate panel data sets' sample size problem.

From all the employment/unemployment spells created above, spells in two periods are selected to represent pre- and post-reform sample spells. The pre-reform period is from July 4 1994 to December 31 1995. Here July 4 1994 is the day just after a previous major change in UI program. Although the EI reform's transition period started in mid 1996, December 31 1995 is chosen here to account for anticipation of the coming reform in early 1996. Since only panel 1 of SLID covers the pre-reform period, pre-reform sample spells naturally are those panel 1 spells started in this period. All spells are censored at June 30, 1996, if necessary.

To match exactly the position and length of pre-reform period within the panel period of panel 1, the post-reform period is set from July 4, 1997 to December 31, 1998 and spells are chosen from panel 2 only. There are at least three considerations here. First, although panel 2 starts from January 1 1996, we need at least one year's

[14]The justification to exclude left-censored spells is based on concerns of duration dependence which means left-censored spells are expected to behave differently than fresh spells even after they have entered the observation windows.

labour market information to derive individuals' UI benefit weeks. Thus the earliest usable spells of panel 2 only start from January 1 1997. Second, since our pre-reform period starts in the middle of the year, it is also sensible to start our post-reform period at a similar time of the year to avoid seasonality differences.

Finally, the third concern here is labour market sample spells' attrition over time due to the near absorption nature of employment states[15]: if we start with a sample of random individuals and observe them over time, more and more of them will be absorbed to stable long-term employment if they continue to stay on the labour market. As a result, the sample of individuals at the later part of each panel will not be random. Table 3.3 gives the unweighted sample distribution over the six panel years for each of the panel. The first part of this table shows the distribution of all spells, the second shows that of the seasonal ones, and the last one shows that of individual-wise first spells. A decreasing pattern is obvious across these three parts for all three panels. Moreover, the later a spell starts in the panel the more likely that individual has some earlier spells in the panel, that means, this individual is potentially more likely to be of a high turn over type in the labour market. Therefore, in order to have two sets of sample spells with comparable composition, the position and length of pre- and post-reform periods within their respective panels are chosen to be the same.

The final data issue here is the classification of seasonal and non-seasonal spells. As discussed earlier, we expect UI's impacts on seasonal and non-seasonal sectors to be different and our analysis study these two sectors separately. An option here

[15]Previous empirical studies have examined sample attrition in panel data set from another perspective. Van den Berg and Lindeboom (1998) tested the theoretical hypothesis that individuals heterogeneous attitude toward survey participation could make sample attrition a potentially endogenous problem when studying labour market transitions. But in the end, their results showed whether or not to take account of sample attrition does not affect the results much.

would be to define spells' seasonality according to characteristics of realized spell durations. But this will mean taking spell durations as exogenous and it will make our study of UI's impacts on the spell durations senseless. Therefore, I choose to define spells' seasonality using conditions at the start of each spell. Seasonal spells are defined according to job (or job absence) ending or job absence reasons of each spell's major job (assuming workers know whether their jobs would end for seasonal reason or not). For an employment spell, the major job is the longest job that started this employment spell. For an unemployment spell, the major job is the longest job among all jobs that ended the preceding employment spell. Specifically, a seasonal employment spell is one that started with a job ended (or job absence started) for seasonal reasons[16]; a seasonal unemployment spell is one that the preceding employment spell ended due to a job ended (or job absence started) for seasonal reasons.

3.5 Empirical Analysis

Table 3.5 and 3.6 give the basic characteristics of the sample spells. Table 3.4 gives the empirical hazard rates of the sample spells. Here sample spells are divided into 8 groups according to their labour market states (unemployment/employment), seasonality (non-seasonal/seasonal), and periods (pre-/post-reform). In each case, the post-reform sample sizes are about 100 less than the pre-reform ones. The sample sizes of non-seasonal unemployment spells are about 2.5 times of those of seasonal unemployment spells; while the sample sizes of non-seasonal employment spells are

[16]The approach here could be problematic for spells started late in their panels. Because all spells on-going at the panel end would be counted as non-seasonal. Fortunately, our sample periods are both three years prior to the end of panel and there should be little seasonal employment spells which last more than 3 years continuously.

at least 3 times of those of seasonal employment spells.

Besides differences in sample sizes, non-seasonal and seasonal spells also differ in other dimensions. The seasonal spells have a higher proportion of married workers, male workers, non-immigrant workers and less educated workers. The average ages of workers with various seasonal spells are also slightly higher than those of workers with corresponding non-seasonal spells. Moreover, seasonality also interacts with the employment/unemployment spells' regional distributions. While non-seasonal employment/unemployment spells are more concentrated in Ontario and Quebec, seasonal employment/unemployment spells are more concentrated in Quebec and Atlantic provinces (that is, Newfoundland, Nova Scotia, New Brunswick, and Prince Edward Island).

The last panel of table 3.5 gives the breakdown of reasons of unemployment and UI coverage for unemployment spells. The first category is for those who left their preceding paid jobs voluntarily (such as family responsibility, or relocation). According to the Canadian UI rules, these workers are not eligible for UI benefit coverage. So they have no UI coverage for their 'unemployment' spells. The remaining four categories in this panel are for those who got unemployed involuntarily (such as firm shutdown or layoffs). As the table shows, the distributions across the five categories vary across the two periods and across non-seasonal and seasonal spells. For non-seasonal pre-reform unemployment spells, most (76%) unemployment spells are not qualified for UI coverage from the beginning. Among the 76%, 34%, 37% and 5% are due to quit, permanent layoffs and temporary layoffs respectively. On the contrary, the majority (61%) of seasonal pre-reform unemployment spells are qualified for UI coverage initially, with 41% and 20% due to permanent layoffs and temporary layoffs respectively[17]. For post-reform period, the basic pattern remains similar[18].

In short, not only seasonal unemployment spells are more likely to be eligible for UI coverage initially relative to non-seasonal ones, these spells are also more likely to be due to temporary layoffs. Thus, before returning to their former employers in the near future, unemployed seasonal workers are more likely to wait, or 'enjoy leisure', rather than search for brand-new jobs.

The critical differences between seasonal and non-seasonal labour market turnovers are also evident in the figures of table 3.4. They present the basic patterns of hazard rates of seasonal and non-seasonal spells. Hazards for leaving unemployment and leaving employment in the seasonal sector are higher, more volatile than in the non-seasonal sector. In addition, the empirical hazard figures for the seasonal sector also show vague humps in the later half of the year, which are absent in figures for the non-seasonal sector.

Having gone through the explorative analysis, I shall first explain the set of time-varying UI treatment dummy variables to be used before presenting the estimation results. This set of dummy variables, meant to catch the behavioural impacts of UI, is a quite special set of variables that have often been used in similar empirical studies (Green and Sargent, 1998). Unlike the usual case of time-constant variable, whose value remains the same for different weeks of a spell, the value of each time-varying variable is allowed to be different at different weeks of a spell. Accordingly, each

[17]Since seasonal unemployment spells are defined to be those due to layoffs of seasonal reasons. The proportion of seasonal unemployment spells due to quit is zero by construction.

[18]One interesting difference is that there is a higher percentage of non-seasonal post-reform unemployment spells due to quitting than in the pre-reform ones. This change perhaps is due to improving macroeconomic situation. A simple story could be, as labour demand increases, workers are more likely to get better jobs, so more job separations are initiated by workers rather than firms.

time-varying variable of each spell takes a vector of values while each time-constant variable of each spell takes only a single value. Earlier on in the introduction section, an example of such time-varying variable is given. Here table 3.1 gives the full list of time-varying UI treatment dummy variables and their definitions.

Here, the time-varying UI treatment dummy variables defined for unemployment spells are all related to the benefit exhaustion week (BEW) except the last one. For week t of an unemployment spell which has initially UI coverage of T weeks, there is $\max\{T-t,0\}$ weeks of benefit left. Based on $\max\{T-t,0\}$, a group of dummy variables (BEW_{21+}, BEW_{11-20}, BEW_{6-10}, BEW_{2-5}, BEW_1, BEW_0) is then created with thresholds of $\{20, 10, 6, 1, 0\}$. As an example, suppose person i's unemployment spell j is covered for 30 weeks of UI benefit, then we have,

$$
\begin{aligned}
(BEW_{21+})_{i,j} &= \{1,1,1,1,1,1,1,1,1,1,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,\ldots,0\} \\
(BEW_{11-20})_{i,j} &= \{0,0,0,0,0,0,0,0,0,1,1,1,1,1,1,1,1,1,1,0,0,0,0,0,0,0,0,0,0,0,0,\ldots,0\} \\
(BEW_{6-10})_{i,j} &= \{0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,1,1,1,1,1,0,0,0,0,0,0,0,\ldots,0\} \\
(BEW_{2-5})_{i,j} &= \{0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,1,1,1,1,0,0,0,\ldots,0\} \\
(BEW_{1})_{i,j} &= \{0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,1,0,0,\ldots,0\} \\
(BEW_{0})_{i,j} &= \{0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,1,0,\ldots,0\}
\end{aligned}
$$

The threshold weeks are set to be closer and closer as they approach the benefit exhaustion week. This is mainly motivated by theoretical predictions that the hazard rate of UI-covered unemployed workers is increasing at an increasing rate prior to benefit exhaustion (figure 3.5). Depending on the number of initial UI benefit coverage weeks, these BEW-related time-varying variables would differ. The last UI variable $WK19$ is set to 1 for the 19th week of post-reform seasonal unemployment spells with initial UI coverage. It is mainly to recognize potential tailoring effect in the seasonal industry due to the experience rating rules[19].

The estimated coefficients of hazard model from unemployment spells are given in table 3.7. To interpret, a coefficient $\hat{\beta}$ here means the hazard rate is proportionally increased by $\exp(\hat{\beta})$. Thus, a negative coefficient means the conditional probability of reemployment is lower. In each estimation, pre- and post-reform sample spells are pooled together. The identification of UI impacts here is thus from both within- and across-period UI treatment differences. Given the setup of Canadian UI program, the within-period UI treatment differences are mainly due to variations of individuals' local unemployment rate movement across region and over time as well as their potentially endogenous employment history[20], while the across-period UI treatment variation should be exogenous.

The estimated coefficients for BEW_{21+} to BEW_0 suggest that the more remaining UI benefit weeks an unemployed worker has, the less likely his unemployment spell will end. In particular, for the non-seasonal spells, the coefficients increase from $-1.51(s.e.\ 0.17)$ when there are at least 21 weeks of benefit to $-0.54(s.e.\ 0.34)$ when the worker just exhausted all his benefit. Seasonal workers are also shown to be responding to the experience rating rules by increasing their reemployment process just prior to the threshold week, week 20. In particular, the estimated coefficient for $WK19$ is shown to be $0.61(s.e.\ 0.29)$.

The top two figures of table 3.9 illustrate the impact of temporary UI benefit

[19]Of course, these time-varying UI treatment variables are set to zeroes throughout for all unemployment spells with no initial UI coverage.

[20]Just a cautionary note, since a dummy for post-reform is included in the model, the identification of the coefficient of unemployment rate is mainly based on within period variations. Since both pre- and post-reform sample periods are only 18 months long. It is probably more sensible to interpret the coefficients of unemployment rate as shot-run impacts of local labour market conditions on employment/unemployment cycles.

coverage on unemployment hazard based on coefficients from table 3.7[21]. Specifically, here I assume the worker has 28 weeks of UI benefit coverage. Based on this, the solid lines give the hazard rates for him to leave unemployment at each of the first 50 weeks of being unemployed. As comparison, the dashed lines give his hazard rates in case of no UI benefit exhaustion effects. The impacts illustrated here are very much consistent with theoretical predictions, especially for the non-seasonal part: with less and less weeks of UI benefit left, the worker's hazard rate becomes closer and closer to the baseline rate.

It is worth noting that there is an obvious difference in baseline hazard trend between non-seasonal and seasonal unemployment spells as shown in the figures. Non-seasonal unemployment spells' hazard is downward sloping, which means the longer a worker is unemployed, the less likely for him to get reemployed (i.e. negatively duration dependency). This finding is very similar to what was found in previous studies in this literature (such as Ham and Rea (1987)). On the other hand, seasonal unemployment spells' hazard is upward sloping, or positive duration dependent. An explanation for this could be based on the notion of 'seasonal', where workers are expected to end their unemployment spells within a year. Again, we find evidence suggesting important difference in the nature of labour market transitions between non-seasonal and seasonal sectors.

The definitions of time-varying UI treatment dummy variables used for employment spells is in the second panel of table 3.1. In particular, the first four of them ($HMIN_{6-10}$, $HMIN_{2-5}$, $HMIN_1$, $HMIN_0$) are defined relative to individuals' minimum employment weeks ($HMIN$), also known as entrance requirement week. As discussed earlier, workers' benefit weeks increase up to a limit even beyond $HMIN$,

[21] Although $WK19$ is included in the estimation for post-reform seasonal unemployment spells, the figure presented does not consider it as the focus here is not on the impacts of the EI reform.

two additional UI variables ($HMIN_0+1$ to $HMAX_0$, $HMIN_0+1$ to $HYRMAX_0$) are used here for non-seasonal and seasonal employment spells respectively to catch any possible tendency for workers to respond to the incentive of additional benefit weeks with extra employment weeks. The last two UI related time-varying variables listed in the table are for post-reform seasonal employment spells only. They are meant to catch the impacts of divisor rule and experience rating rules introduced by the 1996 EI reform[22]. Depending on individuals working hours each week and on-going local unemployment rate, $HMIN$ is recalculated in each week for each employment spells. So are $HMAX$, $HYRMAX$, $HDIV$.

The estimated coefficients of hazard model from employment spells are given in table 3.8. The signs of the UI-related coefficients for both non-seasonal and seasonal spells are all consistent with theoretical predictions except for $HMIN_{2-5}$ for non-seasonal spells. Though theoretically this should be negative, it's coefficient is vaguely estimated to be slightly positive (0.06(*s.e.* 0.11)). In addition, most of the coefficients for seasonal spells are statistically significant while none of the coefficients for non-seasonal spells are statistically significant.

To further appreciate the estimation results, the bottom two figures of table 3.9 illustrate the impact of UI on employment hazard using coefficients from table 3.8. Here $HMIN$, $HMAX$ and $HYRMAX$ are set at 14, 40, 24 weeks respectively. The left figure for non-seasonal spells shows that UI incentives only have minimal impacts on the distribution of non-seasonal employment spells, while the right figure shows UI has significant impacts on that of seasonal employment spells. The closer seasonal workers are to the minimum employment week $HMIN$, the stronger their

[22]There are little impacts of these rules on non-seasonal spells based on alternative estimations. Therefore, the discussion here focuses on tests that only consider divisor rule and experience rating rules on seasonal employment/unemployment spells only.

tendency to postpone job-separation. Even after $HMIN$, these workers still tend to postpone job-separation before they accumulate enough benefit weeks for the rest of the year.

Finally, table 3.10 summarizes the heaping probabilities estimated in our preferred specifications. The numbers suggest heaping is indeed significant in our data. About 20% unemployment spells and 30% employment spells are "reported" in monthly terms, while the numbers drop to 10% and 20% for the semi-monthly cases. Overall, survey respondents get more precise about the dates of their reemployment than about the dates of their job separation. Given the weekly precision that our identification of UI impacts requires, vagueness of our data spells as measured here does indicate the importance to take account of it.

3.5.1 Robustness check

Three sets of maximum likelihood estimation results are discussed here to as robustness checks of the preceding results[23]. First, we check how our results are affected by pooling spells of two periods together. In particular, our question is, if researchers only have pre- or post-reform period sample spells but not both, how would the estimation results differ from those based on pooled sample spells. Actually the two sets of estimation results suggest very similar UI impacts. In particular, the estimation results using the two periods of spells separately are illustrated as figures in table 3.11. These figures suggest both pre- and post-reform, non-seasonal and seasonal unemployment spells show considerable benefit exhaustion effect: the solid lines are much lower than their corresponding dashed lines before BEW in the relevant figures. There are also considerable entrance effects found using both pre- and post-reform seasonal employments: the solid lines are much lower than the corresponding

[23]More specifications are tested but omitted here. They provide very similar information.

dashed lines prior to $HMIN$ in the relevant figures.

On a closer examination, a few things do surface from comparing figures based on separate period estimations and pooled periods estimations. The basic shapes of the baseline hazards for both seasonal employment and unemployment spells are different in pre- and post-reform figures. For seasonal unemployment spells, the baseline hazard is upward sloping in the pre-reform figure while close to flat in post-reform figure. It suggests, before the reform, most unemployed seasonal workers would get reemployed within a year and their chances of reemployment increase dramatically as their unemployment continues. It also suggests, after the reform, the flow of unemployed seasonal workers back to employment is of relatively constant speed and there is no dramatic absorption of unemployed seasonal workers into employment state at the later period of the year-long time horizon. For seasonal employment spells, the inverse U shape of the baseline hazard as shown in the pre-reform figure becomes considerably flatter in the post-reform figure. This means ending of seasonal workers' employment spells is less concentrated in the middle part of a year-long time-horizon in the post-reform period. Together, the differences in the baseline hazards between estimates based on seasonal employment and unemployment spells suggest some critical change in the nature of seasonal labour market. This labour market seems to be making a movement away from cycling between employment and unemployment states annually. In short, seasonal labour market becomes less *seasonal* after the reform.

Next, we check the sensitivity of our results to our model specification. As the top four figures of table 3.12 shows, the estimated UI impacts are not affected much if we assume no heaping effect. The bottom four figures of table 3.12 illustrate the estimated UI impacts when 5th order polynomials are used as our baseline hazard. Comparing this set of figures with our preferred set, it is easy to see with a more flexible setup, the baseline hazards at the end of the year are estimated to be declining instead of increasing as our preferred estimates suggest. Although it seems more intuitive to have a downward sloping hazard at the later half of the year, given the much smaller sample sizes available at the later of the year, the estimation for this period is generally very imprecise.

Finally, we check how our preferred estimation results are affected by considering individuals' unobserved heterogeneity. By that, I mean individuals' inherent tendency of labour market attachment. An important weakness of single spell hazard model often mentioned in the literature is it's lack of power to distinguish individuals' unobserved heterogeneity from 'true' duration dependence of the baseline hazard rate (Heckman, 1991). Among others, Van den Berg (2000) and Lancaster (1990) both recommend multi-spell hazard models to tackle this problem. Intuitively, the advantage of multi-spell hazard models to single spell models is similar to that of panel regressions to cross sectional regressions. By using multi-spell hazard model, researchers hope to know (implicitly) individuals' type (strong or weak labour market attachers) and use that information to adjust the composition of unobserved individual quality at different weeks of each type of spells.

In the context of duration analysis, Lancaster (1990) argues that ignoring unobserved heterogeneity could lead to spurious negative duration dependency of the estimated baseline hazard. This is because it is more likely to have workers who consistently have long spells to have long spells. For example, in the case of unemployment spells, the later the week, the higher the proportion of individuals with *consistently* longer unemployment spells. Without considering the fact that these individuals have longer unemployment spells repeatedly, the estimated baseline hazard rate will be biased down for later weeks. Or in other words, we would come to the wrong conclusion that the later the week in an unemployment spell, the harder for a typical individual to get reemployed (i.e. negative duration dependence). Therefore, the slope of the baseline hazard estimated from multi-spell hazard model is expected to be higher than that of the baseline hazard from single spell model.

If the impacts of these unobserved person-specific factors are important, then single-spell hazard models will produce un-reliable evidence. For our purpose, it is important to know whether our estimated UI impacts based on single spell hazard model are biased as a result of the potential existence of unobserved heterogeneity. To extend the previous single spell hazard model with heaping effect to the case of multi-spell multi-state, let $\{\epsilon_1, \epsilon_2\}$ be a random vector of standard joint normal distribution $N(0, I)$. Without loss of generosity, we can rewrite equation (3.1) as follows to incorporate the unobserved heterogeneity,

for an employment spell

$$\theta^e_{j,t} = \exp(\alpha^e_t + \beta^{e\prime} x_{j,t} + a_{1,1}\epsilon_1) \tag{3.6}$$

for an unemployment spell

$$\theta^u_{j,t} = \exp(\alpha^u_t + \beta^{u\prime} x_{j,t} + a_{1,2}\epsilon_1 + a_{2,2}\epsilon_2) \tag{3.7}$$

Let the corresponding likelihood function of an employment and unemployment spell be $\hat{f}^e$ and $\hat{f}^e$ respectively. Then the likelihood function for individual i is,

$$L_i = \int_{\epsilon_1, \epsilon_2} \left\{ \prod_{j=1}^{N_i^e} \hat{f}_j^e \prod_{k=1}^{N_i^u} \hat{f}_k^u \right\} dF(\epsilon_1, \epsilon_2) \tag{3.8}$$

Since $F()$ is the CDF for standard joint normal distribution, it is straightforward to use the method of Gaussian quadrature for numerical integration. The construction here is quite similar to studies such as Hedeker, Siddiqui, and Hu (2000) and Carneiro, Hansen, and Heckman (2003)[24].

[24] A often used alternative in the literature is to follow Heckman and Singer (1984) and use

Table 3.14 gives the estimated results using pooled pre- and post-reform non-seasonal spells[25]. Only non-seasonal spells are used here. That is both because we have more sample individuals in the non-seasonal sector and because the kind of unobserved heterogeneities that we are concerned about is mainly relevant in the non-seasonal sector. Our earlier evidence shows the length of seasonal workers' employment/unemployment durations are heavily affected by the cycle of four seasons. The inherent seasonality makes the heterogeneity story less applicable. We are not expecting the relative length of these durations to be very informative for individuals' future durations.

Table 3.14 shows that, overall, there are no dramatic differences between the multi-spell multi-state estimation results and the corresponding single spell estimation results as shown in table 3.7 and 3.8. Figures in table 3.13 also looks similar as their single-spell estimation counterparts. The similarity of the two sets of estimation results is comforting in the sense that for most researchers it is more cost-effective to use single spell hazard models than multi-spell multi-state hazard models. But on the other hand, table 3.14 suggests that unobserved heterogeneity is statistically significant for both employment and unemployment spells in our case. The coefficient for ϵ_1 in the employment spell part is 0.75 with s.e. 0.11; while the coefficient for ϵ_2 in the unemployment spell part is 0.65 with s.e. 0.10.

non-parametric specification of the heterogeneity part. But as results of Baker and Melino (2000) indicates, the non-parametric approach could be sensitive in certain cases in their Monte Carlo studies.

[25]As a practical note, to reach a reasonable distribution of the unobserved heterogeneity vector, I utilized an intermediate step rather than set arbitrary starting values of the covariance matrix. Specifically, I first estimated the multi-spell multi-state hazard model without UI variables, the result of which is presented partly in table 4.4. Then, using that set of estimated coefficients as starting values, I estimated the model with UI variables added.

Also quite interesting is the change in the coefficients for UI related variables in the unemployment spell part. Intuitively, we would imagine the estimated coefficient for a dummy variable will increase if the average unobserved heterogeneity of the group of individuals covered by the dummy is negative; decrease if the average unobserved heterogeneity is positive. For unemployment spells, it means if a group of individuals tend to experience longer unemployment spells repeatedly, then the estimated coefficient of the dummy for this group will increase after unobserved heterogeneity is considered. Applying such logic, a comparison between table 3.14 and 3.7 suggest that on average, individuals that on layoffs (both temporary and permanent) with initial UI coverage tend to have long unemployment spells repeatedly.

3.5.2 Policy implications

To examine policy implications, the distributions of average workers' employment/ unemployment spells are simulated under three scenarios: no UI, with pre-reform UI program, and with post-reform UI program. All of these three simulations use post-reform sample spells and coefficients from single spell hazard model estimations using pooled samples (table 3.7 and 3.8). The simulated distributions are based on the average values for both time-constant variables and time-varying variables in each scenario.

For pre-reform scenario, each spells UI treatment variables are calculated based on pre-reform UI rules; for post-reform scenario, post-reform UI rules. For no UI scenario, all UI treatment variables are simply set to zeroes. Considering various economic and social impacts of the UI program, the setup of no UI scenario here could only be regarded as an extremely simplistic one. Its role here is merely to serve as a transparent benchmark to summarize the estimation results. The study here is not designed to evaluate policy changes as dramatic as to abandon UI completely.

Therefore, results of the no UI scenario should only be treated cautiously.

The simulated distributions are presented by figures in table 3.15. In each figure, the long dashed line corresponds to pre-reform UI treatment and short dashed line for post-reform UI treatment. In addition, to illustrate the impacts of experience rating rules and divisor rule, the corresponding coefficients are turned on for seasonal spells in the post-reform scenario.

First, assuming all other things remain stable, the impacts of the EI reform as a result of changes in individuals' UI treatment are captured by the differences across long dashed lines and short dashed lines. As the figures show, in the non-seasonal sector, the pre- and post-reform curves overlap each other very well. Therefore, although it might be that the EI reform leads to various changes in individuals' UI treatment, our results suggest that the impacts of these changes might very well cancel out on average. In the two seasonal figures, the main differences between the dashed lines are due to the new experience-rating and the divisor rules introduced by the EI reform. Comparatively, the new experience-rating rules seem to have substantial impacts on the distribution of employment spells in the seasonal sector, while the divisor rule only have very transitory impacts. If we ignore those two rules, the two pairs of pre- and post- curves would overlap each other just as in the non-seasonal cases.

Overall, the figures suggest the EI reform (except for the two sets of rules mentioned above) did not affect much the UI treatment that workers received on average. But on the other hand, the experience rules and the divisor rule do have substantial impacts. Specifically, our results suggest these new rules are quite effective in encouraging longer employment spells and shorter unemployment spells in the seasonal sector.

Next, using the simulated distributions, we could study how workers' behavioural response to UI incentives affects employment/ unemployment distributions. That is, the impacts of having UI program versus no UI program (or more precisely, the case where all other things remain the same except that workers no longer respond to UI incentives). For the non-seasonal sector, the figures suggest UI has little impact on the distribution of employment spells and relatively linear impact on the distribution of unemployment spells — there are less unemployment spells with shorter durations. For the seasonal sector, the figures suggest the distributions of both unemployment and employment spells are significantly affected by UI: there are less short spells and more spells in the 20 to 35 week range in both employment and unemployment cases.

Finally, it is interesting to understand our results' implications at the aggregate level. Using simulation results discussed above and assuming hazard rates for all weeks beyond 50 are the same as those at week 50, the upper panel of table 3.16 presents the estimated average durations under each of the three scenarios. The lower panel of it then gives the corresponding unemployment rates. Table 3.16 suggests UI program increased the unemployment rate in the non-seasonal and seasonal sector by 15% and 18% respectively pre-reform, and 12% and 10% post-reform. If we assume a third of the labour force is in the seasonal sector, just as what our sample spells roughly show, then the overall impacts of UI program on unemployment rate is 16% pre-reform and 11% post-reform. That means if the on-going unemployment rate with UI is 7.6% and if suddenly workers are no longer responding to UI incentives (as is loosely defined as the no UI case), the unemployment rate would drop to 6.4% pre-reform and 6.8% post-reform.

There are several reasons to consider the above 11% and 16% increases in unemployment rate to be an upper bound of the true values. First of all, this study defines unemployment and employment differently from the LFS does. Only paid employment is considered in this study. Although some out of labour force periods are excluded in the data used here, there is no searching requirement in the definition of unemployment here. Moreover, individuals who have no fresh employment/unemployment spells are excluded from our sample. Many of these individuals could be those with very stable employment.

3.6 Conclusion

This empirical work is related to the bigger question of income support program's labour market consequences. It extends the literature by using a common data source and common econometric setups when investigating UI's impacts on both directions of employment/unemployment cycles. This study also pays attention to the different nature of seasonal and non-seasonal labour market by studying them separately. Most importantly, this study utilizes UI treatment variations due to the EI reform as an unique exogenous source of variation.

The results confirm both findings of previous studies about UI's impacts on employment (Baker and Rea, 1998; Green and Riddell, 1997) and those about UI's impacts on unemployment spells (Ham and Rea, 1987; Meyer, 1990; Moffitt, 1985). In particular, the empirical results presented above show, both non-seasonal and seasonal workers' reemployment probabilities are pushed down when they still have some UI benefit coverage left; and, seasonal workers' probabilities of employment separation are also pushed down before their entrance requirement weeks.

More than just confirming previous findings in a new context where exogenous variation due to the EI reform is used, the results here also reveal new findings about the impacts of the EI reform and the aggregate impacts of UI. In particular, the results show,

(1) there is a decline in the seasonality of seasonal sector's employment/unemployment cycles after the reform due to the introduction of experience rating rules and divisor rule;

(2) the EI reform (except for the experience rating rules and divisor rule) did not affected much the *average* UI treatment that workers received; and

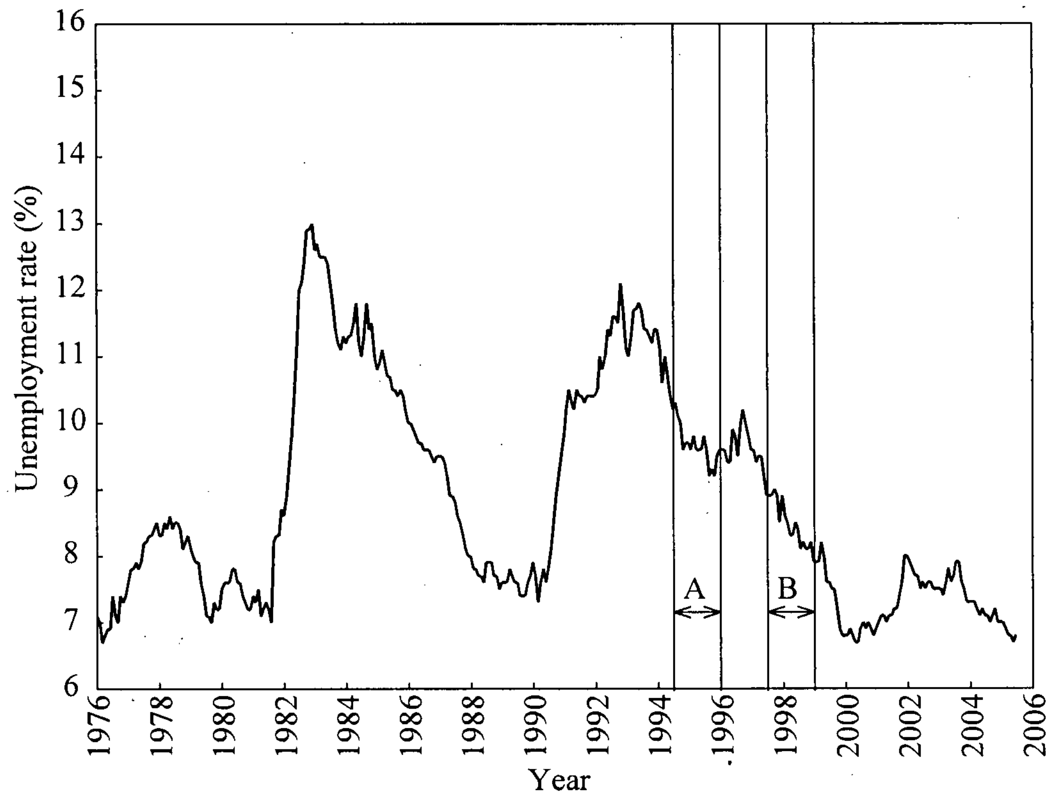
(3) UI program could have increased the overall unemployment rate by 16% pre-reform and 11% post-reform. In other words, if all workers suddenly switch from responding to UI incentives as estimated to ignoring those incentives, and all other things remain constant, the unemployment rate could drop from 7.6% to 6.4% pre-reform and 6.8% post-reform.

Broad interpretations of our estimation results should take into account several choices made here. First, our sample spells are constructed using an event-based selection procedure; second, the definitions for 'employment' and 'unemployment' here are adapted to UI legislation; and last, the usual discrete-time hazard model is extended by a heaping effect component here.

Interpretations of the results here also need to be clear about some limitations of the research. In particular, both seasonality and wages are taken as exogenous here. It would be interesting to explore how the size and composition of seasonal sector is affected by UI parameters. Knowing these, we could then have better understanding about the overall aggregate impacts of UI. Also since all the employment/unemployment cycles should be coupled with wage or reservation wage dynamics, it would be interesting to know how robust our results would be if wages are endogenized.

3.7 Tables and Figures

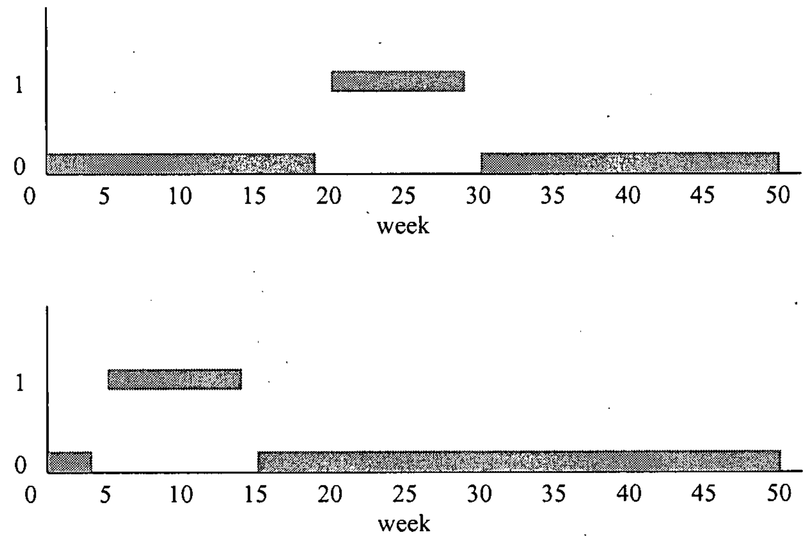
Figure 3.1: Canadian Seasonally Adjusted Monthly Unemployment Rate



Note: A and B refer to pre- and post-reform periods respectively.

Source: Statistics Canada CANSIMII table V2062815

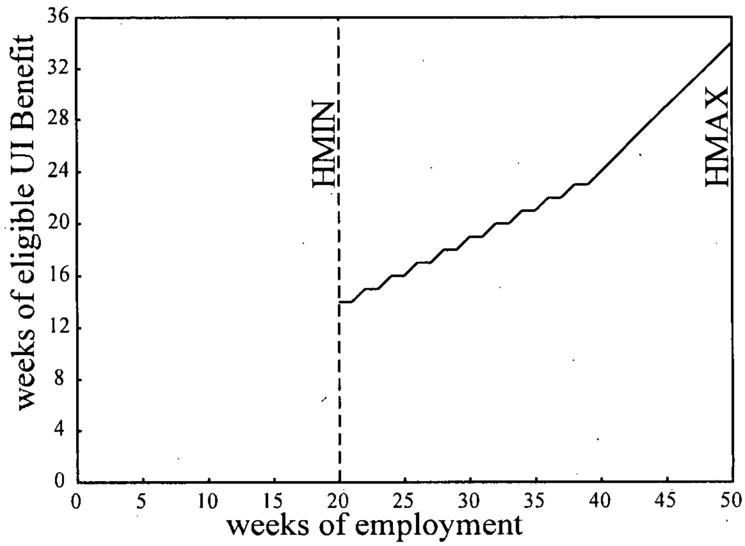
Figure 3.2: Illustration of a Time-varying Variable



Note: Here the first time-varying dummy variable takes value 1 from week 20 to week 29 and value 0 for all other weeks; and the second one takes value 1 from week 5 to 14. In our study, both of these two variables could be capturing periods when the worker only has 11 to 20 weeks of UI benefit left. Only in the first case, there are 40 weeks of initial UI coverage, while in the second case, there are only 25 weeks of initial UI coverage.

Figure 3.3: UI Benefit Schedule

a: actual



b: effective for seasonal Workers

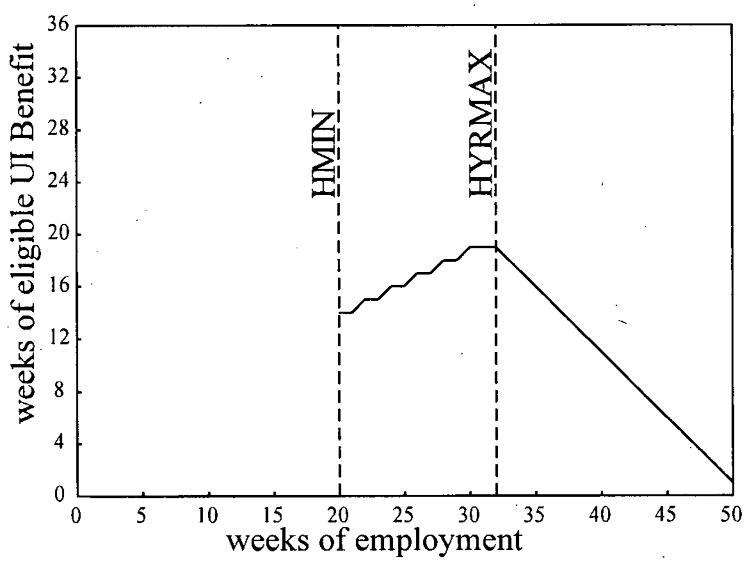
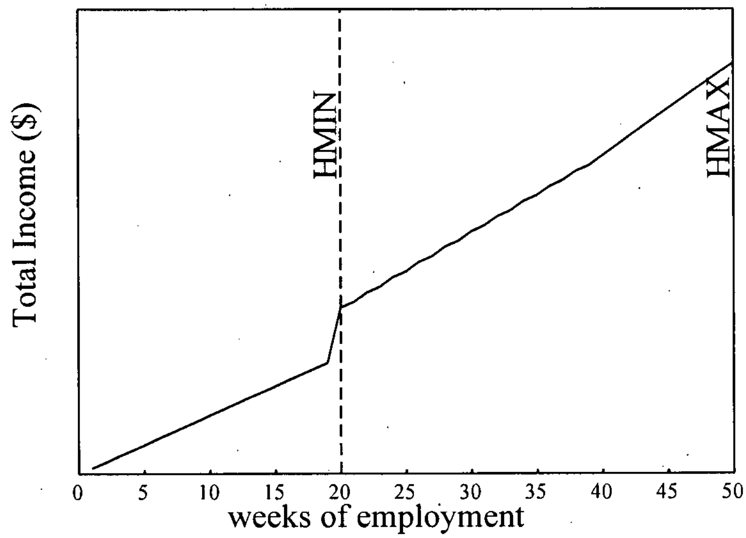
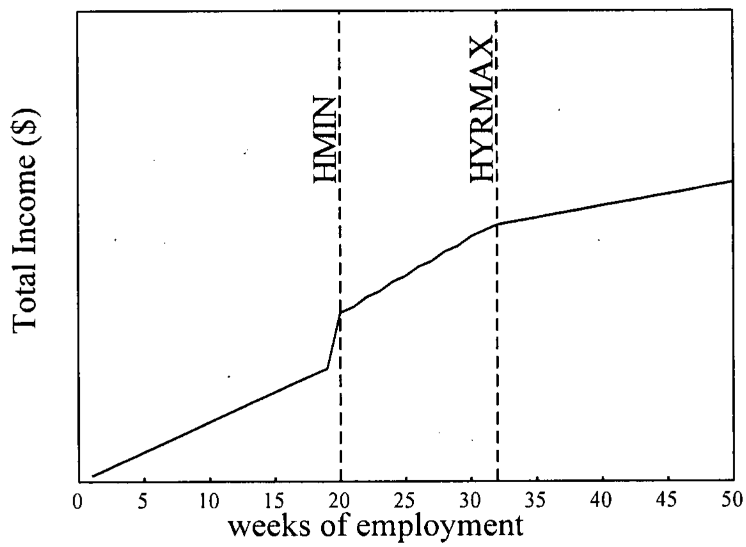


Figure 3.4: Total Income

a: actual



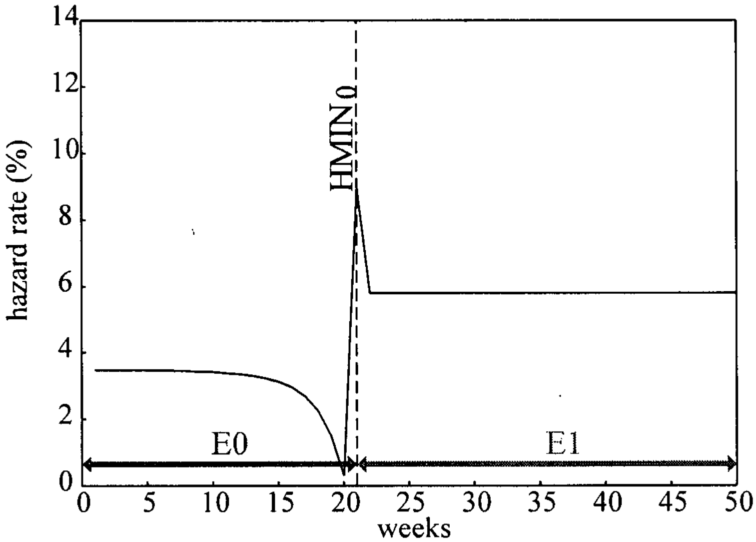
b: effective for seasonal workers



Note: Total income = wage income + UI benefit.

Figure 3.5: Predicted Hazard Rates with Contingent Temporary UI Coverage

a: employment spells



b: unemployment spells

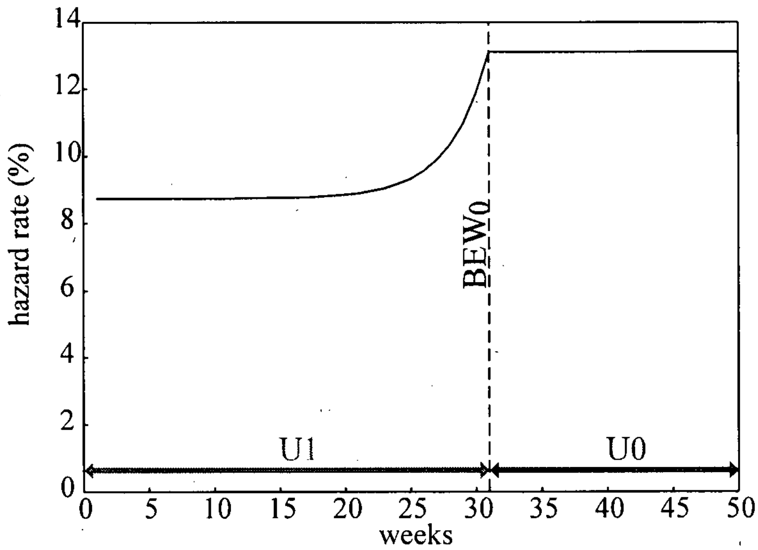
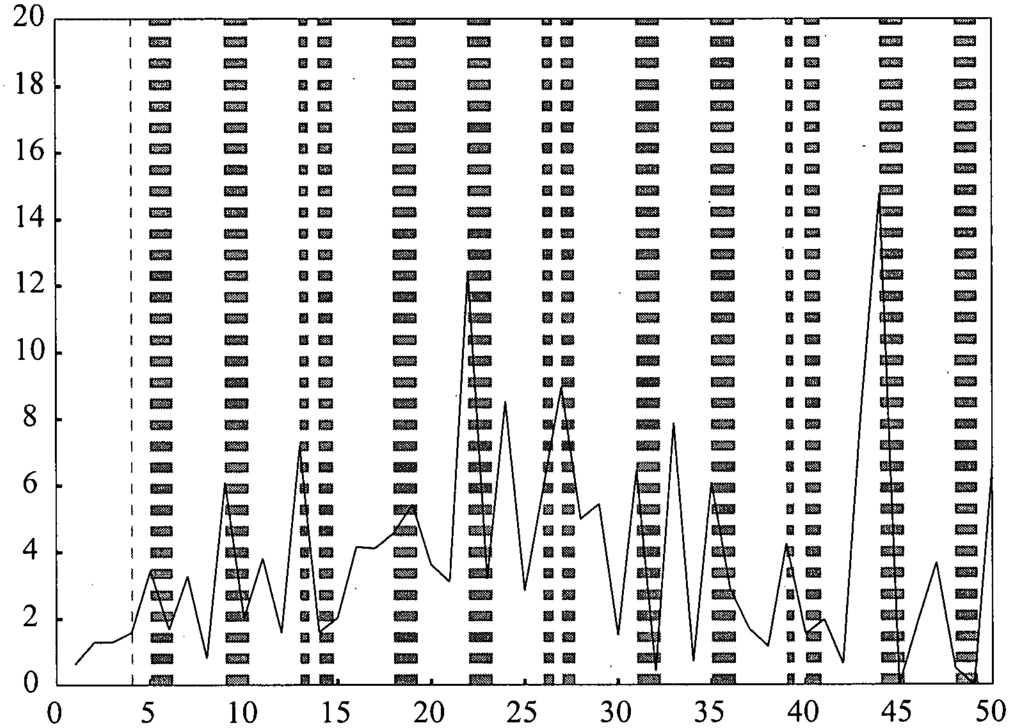


Figure 3.6: Illustration of Empirical Hazard Heaping



Note: There are 18 months in which spells could start in this case, from 1 July 1994 to 1 December 1995. Let there be 18 spells started on the first day of each of these 18 months. The set of dashed vertical lines in this figure covers all weeks that could possibly contain the last day of a month in these 18 spells. The thickness of these dashed lines is set to be proportional to the heaping possibilities.

Figure 3.7: An Example of Week Sets by Calendar Properties

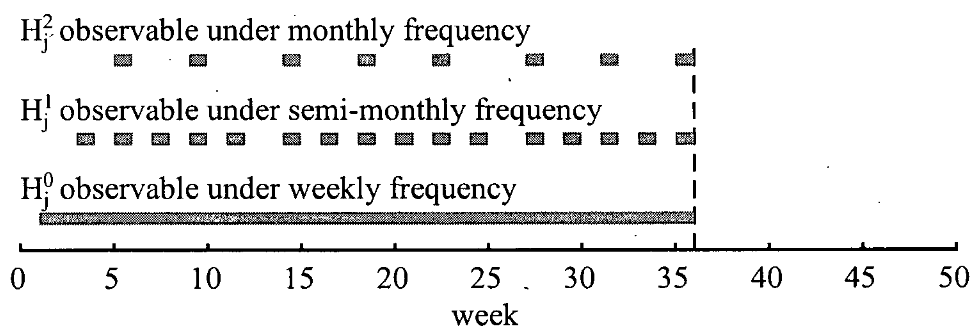


Figure 3.8: Illustration of Sample Spells Construction

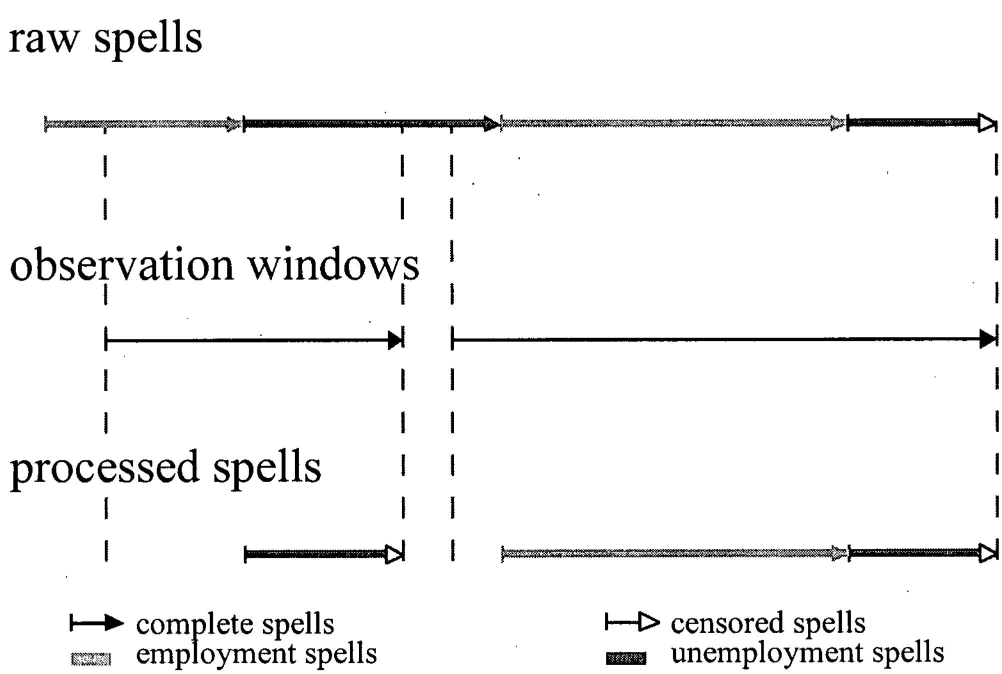


Table 3.1: Definitions of Time-varying UI Treatment Dummy Variables

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 3.2: Sample Description: Part 1. Unweighted Sample Counts

panel	1	2	3
time period covered	1993-1998	1996-2001	1999-2002[a]
Individual-wise			
total	30,455	31,459	32,922
with observation windows	23,840	23,973	24,368
with a single panel-long observation window	12,108	10,534	12,094
Spell-wise			
jobs	44,550	50,599	39,095
paid jobs	39,055	44,013	34,212
paid job employment spells	41,596	46,092	35,287
total employment spells	32,880	34,816	27,358
spells started within observation windows			
employment	8,784	6,835	4,119
inter-employment/unemployment	10,133	7,664	4,840

[a]The 3rd panel of SLID is still on-going.

Table 3.3: Sample Description: Part 2. Within-Observation-Window Spells' Unweighted Distribution across Panel Years

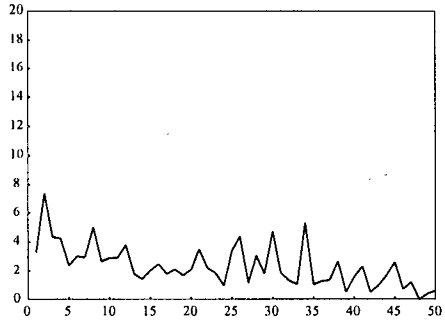
panel	1		2		3	
time period covered	1993-1998		1996-2001		1999-2002	
	e	u	e	u	e	u
total (as 100%)	10,133	8,784	7,664	6,835	4,840	4,119
panel year						
1	19%	20%	21%	22%	30%	31%
2	20%	18%	20%	21%	23%	23%
3	16%	18%	19%	18%	23%	24%
4	15%	16%	16%	14%	24%	23%
5	15%	14%	12%	10%	–	–
6	15%	15%	13%	13%	–	–
total seasonal(as 100%)	2,529	2,634	1,535	1,656	692	803
panel year						
1	24%	22%	22%	22%	33%	34%
2	18%	18%	23%	22%	25%	21%
3	16%	17%	21%	21%	23%	23%
4	14%	15%	16%	16%	20%	21%
5	14%	14%	9%	9%	–	–
6	13%	14%	8%	10%	–	–
total first spells individual-wise (as 100%)	5,166	4,502	4,293	3,923	3,304	2,772
panel year						
1	33%	34%	33%	35%	40%	41%
2	23%	20%	20%	22%	21%	22%
3	12%	15%	16%	15%	19%	20%
4	11%	11%	11%	10%	19%	17%
5	10%	10%	9%	8%	–	–
6	11%	10%	11%	11%	–	–

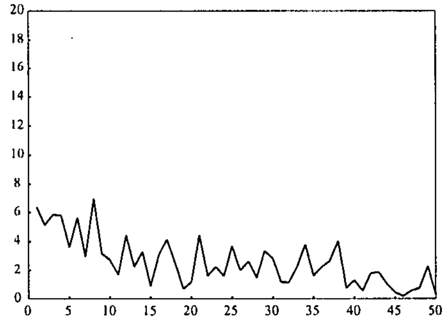
Note: e and u refer to employment and interemployment/unemployment spells respectively.

Table 3.4: Empirical Hazard Rates

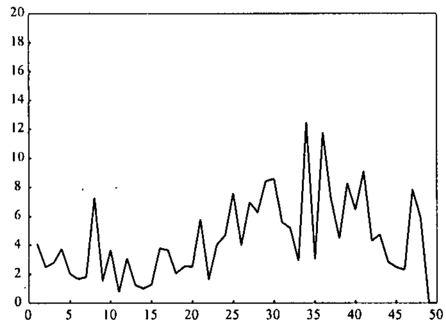
pre-reform	post-reform

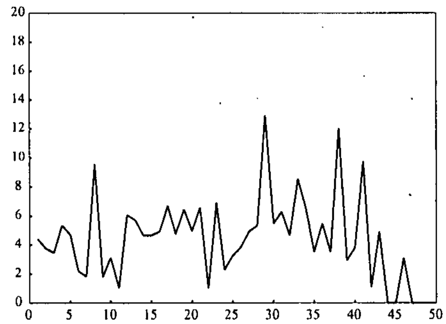
Non-seasonal, unemployment spells



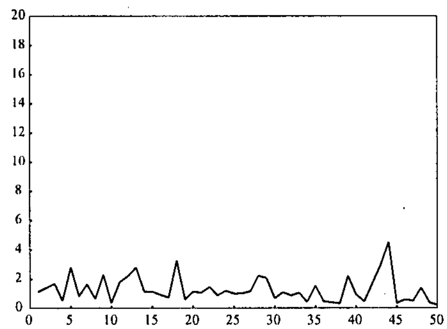


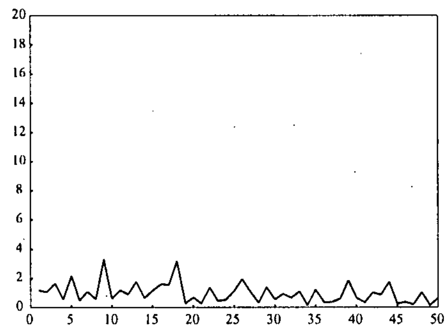
Seasonal, unemployment spells



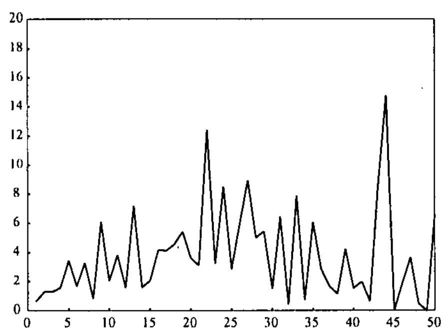


Non-seasonal, employment spells





Seasonal, employment spells



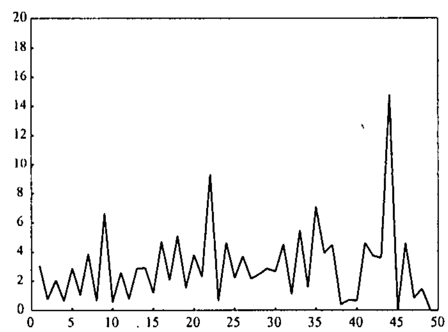


Table 3.5: Summary Statistics of Unemployment Spells

	Non-seasonal		Seasonal	
	pre-EI	post-EI	pre-EI	post-EI
sample size	1,649	1,458	793	613
weighted means				
single (%)	37	37	35	34
female (%)	47	48	33	30
immigrant(%)	14	12	8	9
age	34.8	35.9	36.0	36.4
log hourly wage of lost job	2.4	2.4	2.4	2.4
initial unemployment rate	6.3	5.6	7.1	6.7
highest level of education(%)				
less than high school	23	19	44	32
high school	30	34	23	36
post-secondary	34	35	24	27
university or above	13	11	9	6
Region(%)				
Ontario	26	32	20	22
Atlantic	12	12	26	24
Quebec	34	27	29	32
Parier	17	17	13	10
BC	12	12	12	12
Reason of unemployment and UI coverage(%)				
quit [so, no UI]	34	41	0	0
permanent layoff, no UI	37	31	30	26
permanent layoff, with UI	18	17	41	41
temporary layoff, no UI	5	6	9	14
temporary layoff, with UI	6	5	20	19

Table 3.6: Summary Statistics of Employment Spells

	Non-seasonal		Seasonal	
	pre-EI	post-EI	pre-EI	post-EI
sample size	1,725	1,613	547	435
weighted means				
single (%)	40	41	33	37
female (%)	51	53	40	34
immigrant (%)	13	14	8	10
age	34.1	34.6	36.4	37.2
log hourly wage of initial job	2.3	2.4	2.4	2.5
initial unemployment rate	6.2	5.5	6.4	5.9
highest level of education(%)				
less than high school	21	17	41	30
high school	30	33	25	36
post-secondary	36	36	25	28
university or above	13	14	9	5
Region(%)				
Ontario	31	32	21	23
Atlantic	11	12	25	25
Quebec	30	27	26	29
Parier	16	17	13	11
BC	11	13	16	12

Table 3.7: Maximum Likelihood Estimates Using Pooled Pre-/Post-Reform Unemployment Spells

	non-seasonal	seasonal
sample size	3107	1406
post reform	0.19 (0.05)⋆	0.29 (0.07)⋆
ln of hourly wage	−0.00 (0.06)	0.20 (0.09)‡
unemployment rate	0.02 (0.01)	−0.06 (0.02)⋆
quit [so, no UI]	−1.86 (0.17)⋆	—
permanent layoff, no UI	−1.98 (0.17)⋆	−2.13 (0.14)⋆
permanent layoff, with UI (omitted group)	—	—
temporary layoff, no UI	−0.37 (0.19)‡	−0.47 (0.16)⋆
temporary layoff, with UI	0.88 (0.11)⋆	0.74 (0.09)⋆
time-varying UI treatment variables		
BEW_{21+}	−1.51 (0.17)⋆	−1.12 (0.16)⋆
BEW_{11-20}	−1.61 (0.18)⋆	−1.20 (0.15)⋆
BEW_{6-10}	−1.21 (0.22)⋆	−0.86 (0.17)⋆
BEW_{2-5}	−0.91 (0.24)⋆	−0.66 (0.18)⋆
BEW_1	−1.24 (0.45)⋆	−0.33 (0.33)
BEW_0	−0.54 (0.34)	0.08 (0.30)
$WK19$	—	0.61 (0.29)‡

Note: other control variables include gender, age, maritial status, immigration status, education dummies and regional dummies

Table 3.8: Maximum Likelihood Estimates Using Pooled Pre-/Post-Reform Employment Spells

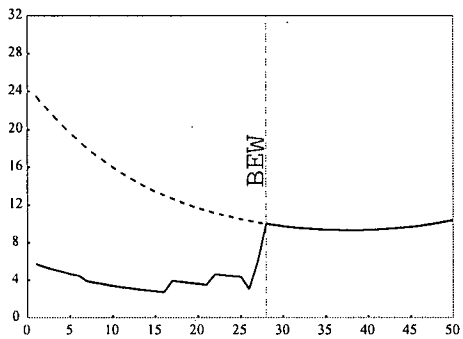
	non-seasonal	seasonal
sample size	3338	982
post reform	−0.18 (0.05)⋆	−0.19 (0.10)†
ln of hourly wage	−0.19 (0.07)⋆	−0.86 (0.10)⋆
unemployment rate	0.03 (0.02)‡	−0.05 (0.02)‡
time-varying UI treatment variables		
$HMIN_{6-10}$	−0.14 (0.09)	−0.25 (0.14)†
$HMIN_{2-5}$	0.06 (0.11)	−0.53 (0.15)⋆
$HMIN_1$	−0.08 (0.25)	−0.45 (0.27)†
$HMIN_0$	−0.12 (0.24)	−0.92 (0.37)‡
$HMIN_0 + 1$ to $HMAX_0$	−0.07 (0.11)	—
$HMIN_0 + 1$ to $HYRMAX_0$	—	−0.23 (0.12)‡
$HMIN_0 + 1$ to $HDIV$	—	−0.17 (0.21)
$HMIN_0 + 1$ to $HEXP$	—	−0.22 (0.15)

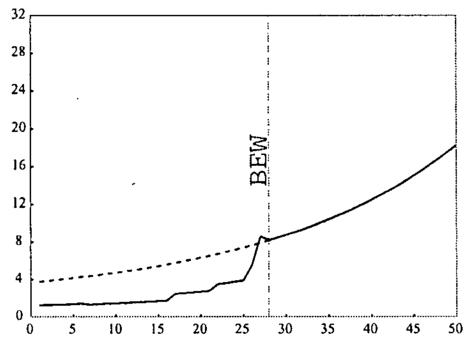
Note: other control variables include gender, age, maritial status, immigration status, education dummies and regional dummies

Table 3.9: Illustration of UI's Impacts on Hazard Rates: Based on Estimations Using Pooled Pre-/Post-Reform Spells

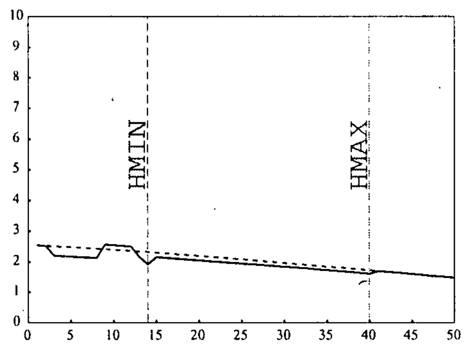
non-seasonal	seasonal

unemployment spells





employment spells



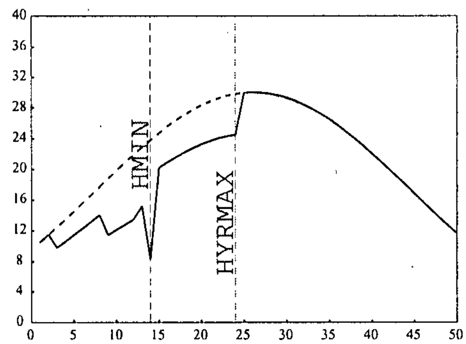


Table 3.10: Estimated Heaping probabilities

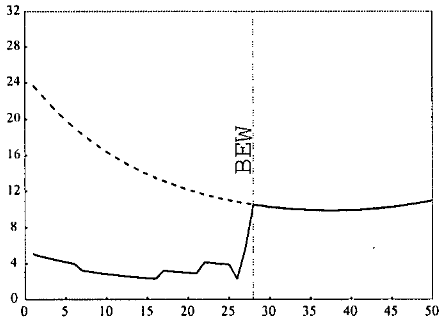
probability of report in .. frequency	unemployment non-seasonal	unemployment seasonal	employed non-seasonal	employed seasonal
semi-monthly	0.10 (0.02)⋆	0.10 (0.03)⋆	0.16 (0.03)⋆	0.20 (0.03)⋆
monthly	0.19 (0.02)⋆	0.18 (0.02)⋆	0.28 (0.02)⋆	0.30 (0.03)⋆

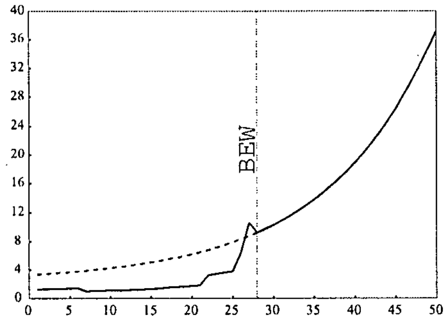
Note: these estimates correspond to the maximum likelihood estimations of table 3.7 and 3.8.

Table 3.11: Illustration of UI's Impacts on Hazard Rates: Based on Estimations Using Pre- and Post-reform Spells Separately

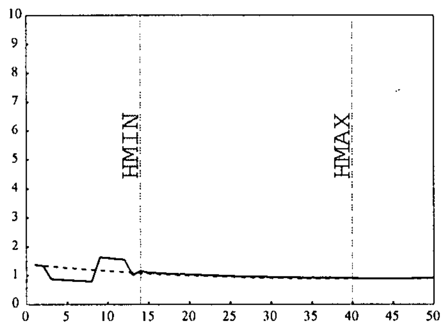
non-seasonal | seasonal

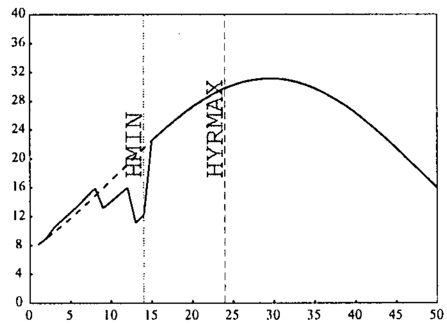
pre-reform unemployment spells



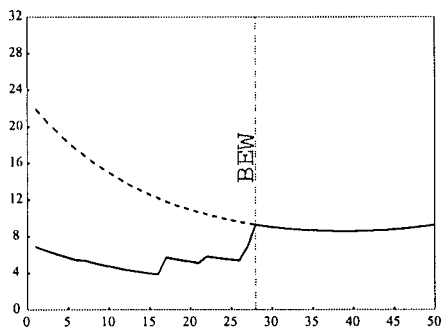


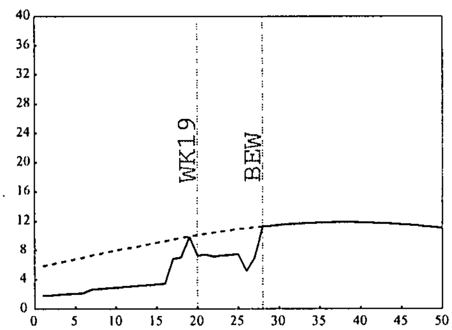
pre-reform employment spells



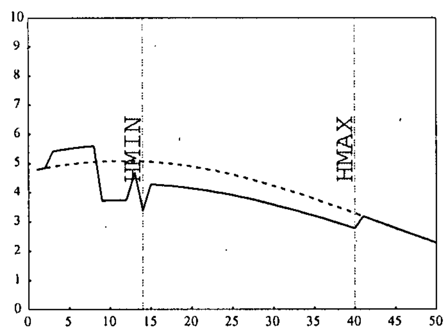


post-reform unemployment spells





post-reform employment spells



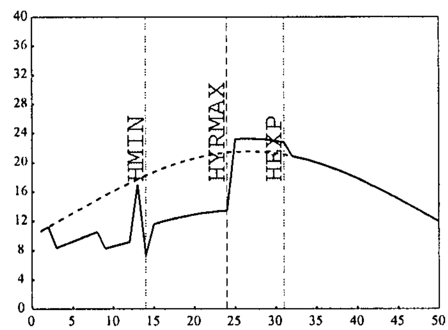
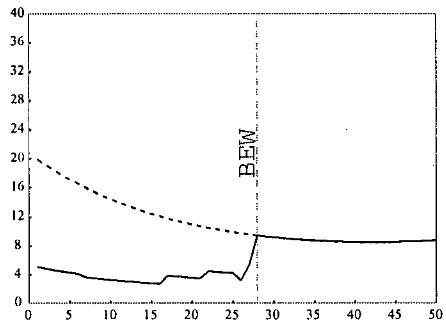
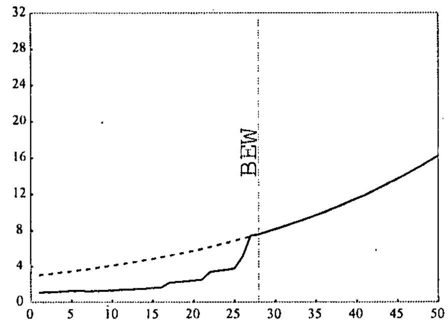


Table 3.12: Illustration of UI's Impacts on Hazard Rates: Based on Alternative Estimations Using Pooled Pre-/Post-Reform Spells

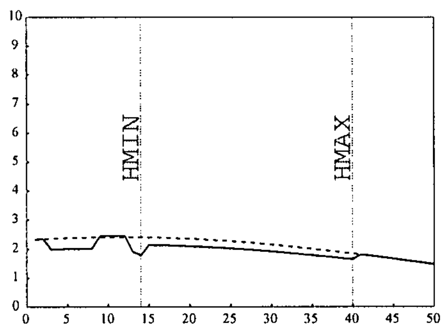
non-seasonal	seasonal

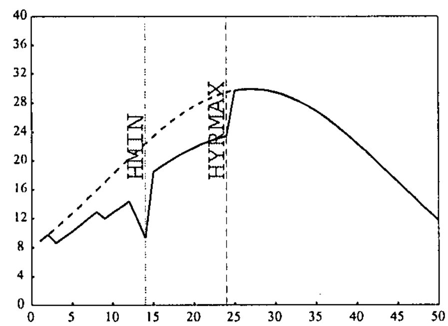
unemployment spells, no heaping



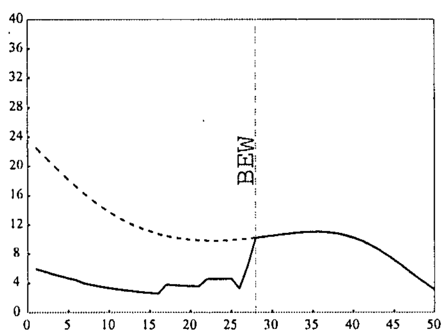


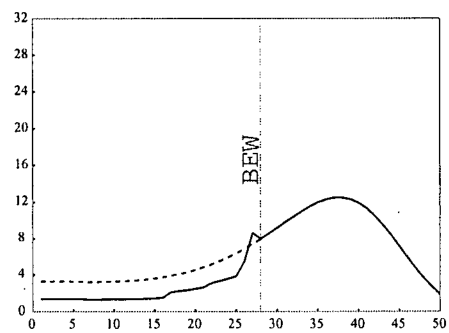
employment spells, no heaping



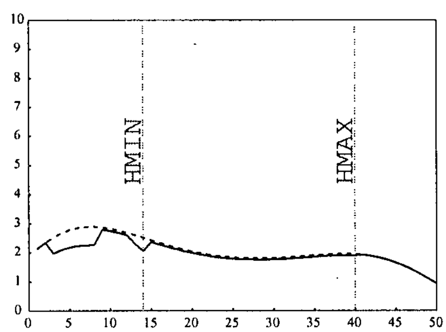


unemployment spells, with 5th order polynomials as baseline specification





employment spells, with 5th order polynomials as baseline specification



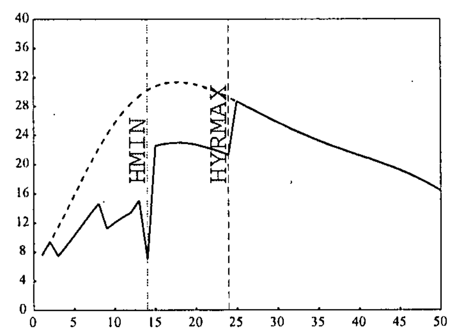
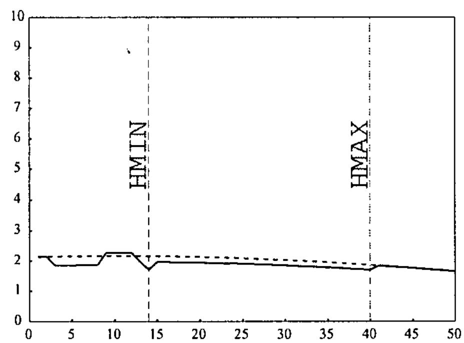


Table 3.13: Illustration of UI's Impacts on Hazard Rates: Based on Estimation Using Pooled Pre/Post-Reform Non-Seasonal Spells with Unobserved Heterogeneity Considered

employment	unemployment



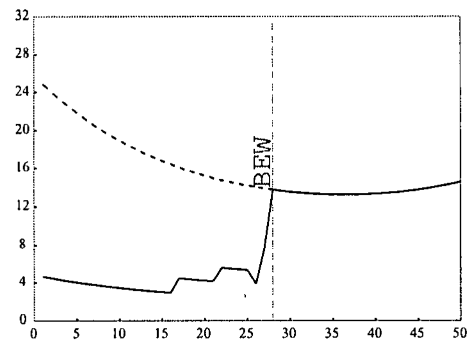


Table 3.14: Maximum Likelihood Estimates Using Pooled Pre-/Post-Reform Non-Seasonal Spells with Unobserved Heterogeneity Considered

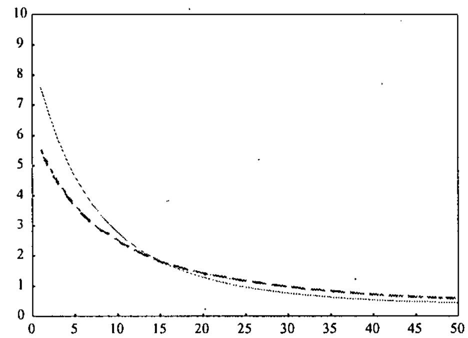
	employment hazards	unemployment hazards
ϵ_1	0.75 (0.11)⋆	0.02 (0.10)
ϵ_2	—	0.65 (0.10)⋆
post reform	−0.18 (0.06)⋆	0.23 (0.06)⋆
log of hourly wage	−0.23 (0.08)⋆	−0.02 (0.07)
unemployment rate	0.03 (0.02)‡	0.01 (0.02)
time-varying UI treatment variables for employment spells		
$HMIN_{6-10}$	−0.15 (0.10)	—
$HMIN_{2-5}$	0.05 (0.12)	—
$HMIN_1$	−0.10 (0.26)	—
$HMIN_0$	−0.15 (0.10)	—
$HMIN_0 + 1$ to $HMAX_0$	−0.09 (0.11)	—
quit [so no UI]	—	−2.06 (0.20)⋆
permanent layoff, no UI	—	−2.24 (0.20)⋆
temporary layoff, no UI	—	−0.41 (0.22)†
temporary layoff, with UI	—	1.05 (0.14)⋆
time-varying UI treatment variables for unemployment spells		
BEW_{21+}	—	−1.79 (0.20)⋆
BEW_{11-20}	—	−1.79 (0.20)⋆
BEW_{6-10}	—	−1.34 (0.23)⋆
BEW_{2-5}	—	−1.02 (0.25)⋆
BEW_1	—	−1.33 (0.45)⋆
BEW_0	—	−0.63 (0.37)†

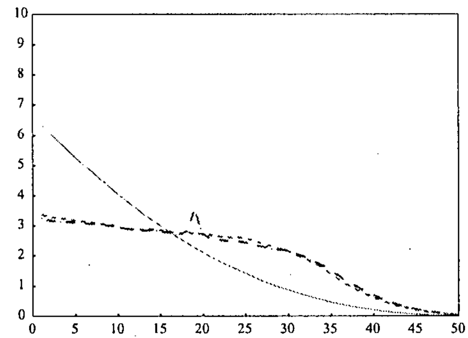
Note: the sample consists of 3796 individuals and the mean loglikelihood is -3.870. Other control variables included are gender, age, maritial status, immigration status, education dummies and regional dummies.

Table 3.15: Simulated Density Functions

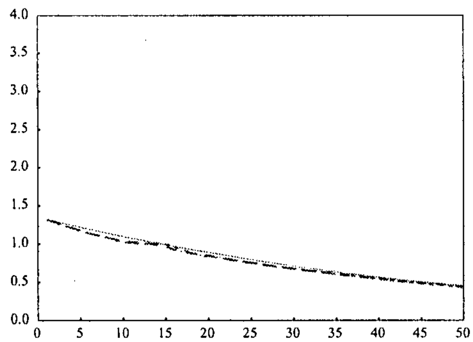
non-seasonal	seasonal

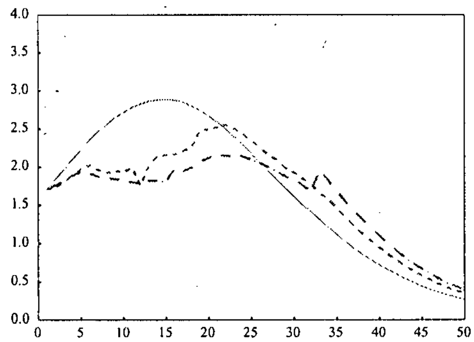
unemployment spells





employment spells





Note: All of the simulations are based on average characteristics of post-reform spells and estimated coefficients using single spell hazard model. Solid line refers to case of no UI treatment effect (setting the coefficients of UI-related variables to zeros); long dashed line refers to UI treatment according to post-reform rules; short dashed line refers to UI treatment according to pre-reform rules.

Table 3.16: Summary Statistics from Simulations

	no UI	pre-reform UI rules	post-reform UI rules
average duration (weeks)			
non-seasonal unemployment spells	23.2	28.5	28.3
non-seasonal employment spells	116.8	124.2	121.2
seasonal unemployment spells	12.3	18.2	17.8
seasonal employment spells	30.0	34.9	37.9
unemployment rate(%)			
non-seasonal sector	16.5	19.1	18.5
seasonal sector	29.1	34.3	31.9
overall(assuming 1/3 of the population in the seasonal sector)	20.7	24.1	23.0

Note: All of the simulations are based on average characteristics of post-reform spells and estimated coefficients using single spell hazard model.

Chapter 4

Temporary UI Coverage's Time-varying Impacts on Reemployment Wages

4.1 Introduction

A key rationale for UI is its potential to improve job match qualities. It is a claim seen in most job search theories. There, the common logic is that workers would be able to have higher reservation wages thus better job matches with UI subsidized searches. If it is indeed true, UI could be beneficial in the long run, especially when there is active technology upgrading. It could then encourage individuals' to acquire new skills that are demanded by emerging, better paid but often unstable jobs. But as a matter of fact, in spite of the theoretical importance of the claim, whether or not UI coverage actually improves unemployed workers' job match qualities is still an unsettled question empirically. Although some studies find UI's impact on reemployment wages to be positive, others find none (Addison and Blackburn, 2000; Burgess and Kingston, 1976; Classen, 1977; Ehrenberg and Oaxaca, 1976; Holen, 1977).

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. Besides, there is another important issue ignored previously: the possibility of UI to have time-varying impacts on reemployment wages. Previous studies only differentiate unemployment spells according to initial UI benefit coverage. 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 is thus 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.

The empirical study here uses the same data and historic event as the preceding chapter. Specifically, this work uses a recent Canadian panel data set, the Survey of Labour and Income Dynamics (SLID) to examine sample employment/unemployment spells in periods both before and after the Employment Insurance (EI) reform in 1996[2]. There are both advantages and disadvantages in using Canadian data to study UI effects relative to using U.S. data. In the U.S., variations of individuals' UI benefit durations mainly exist at the state level, which lead to serious identification problem between state-fixed effects and UI effects. While in

[1]It is worth noting 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 indirectly related to the realized reemployment wage 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 studys identification of UI's impacts.

[2]Please refer to chapter 2 for details about this reform.

Canada, the built-in dependency of UI benefit durations on preceding employment histories creates 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 EI reform.

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 period, and their reemployment wages. The two duration parts of the model inherit the hazard model with heaping effects used in the previous chapter. The wage parts of the model assume the wage distribution to be lognormal. 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 reemployed with at least 11 weeks of benefit left. On average, UI coverage increases UI-covered workers' reemployment wages by about 9.5%. Furthermore, the evidence here shows there is a coincidence of reemployment wage decreases and unemployment hazard increases as workers approaching benefit exhaustion, which makes the evidence here even stronger in terms of supporting the job search subsidy role of UI.

Besides, comparisons among estimation results of different specifications also 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. We also find workers who get reemployed at precisely their benefit exhaustion weeks are also a group with persistently higher wages.

The rest of this chapter 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.

4.2 Theoretical Model

By construction, UI has no impacts on wages in the standard textbook model of labour and leisure choice. There, individuals take wage rates as given and only make choices regarding time allocation. Instead, this study is motivated by the model of endogenous employment/unemployment cycles and contingent, temporary UI benefit explored in chapter 2. Figure 4.1 shows how the predicted pattern of unemployed workers' reservation wage looks like given the temporary UI benefit coverage.

As the figure shows, during the period before exhausting all benefits, **U1**, the worker's reservation wage drops at an increasing rate. In the period after benefit exhaustion, **U0**, the workers reservation wage stays at a low level. The intuition of the dynamics of reservation wage here is that workers get to balance the cost of waiting one more period with the benefit of getting another draw of job offers at each period. At the benefit exhaustion period, the cost of waiting suddenly becomes higher, thus it is better for him to set reservation wage lower. For any period before exhaustion, the further away from the exhaustion period, the possibility of him having to actually wait till that period of exhaustion and the impact of benefit exhaustion on his reservation wage will be lower.

4.3 Literature

Despite its importancy, there is only a small and quite old literature examining UI's impacts on reemployment wages. Most of the studies were 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). All earlier studies use linear regressions. Due to data availability and variations in research questions, they differ in their measurement of UI coverage and post-unemployment earnings, as well as their sample selection schemes.

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. The conclusion of Welch (1977) is that, "we have only very tentative evidence of post-wage effects and much remains to be done on this issue."

The single recent study, Addison and Blackburn (2000), tries to settle the issue using a recent 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 couldn't find much support for UI to improve post-unemployment wages either.

In summary, the previous literature is relatively small; there are serious concerns about their data, approach; the results of different studies seem inconclusive. But, the sensitivity of the empirical results to sample selection and measurement choices at least eliminate the possibility of a strong, persistent and universal impact of UI coverage to reemployment wages. While at the same time, 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 among studies of UI's impacts on reemployment wages, studies of UI's impacts on unemployment durations have been quite successful in finding the predicted impacts of UI. This later literature find hazard for leaving unemployment increases as workers approach their benefit exhaustion weeks (Meyer, 1990). Furthermore, related literature also find hazard for leaving employment decreases as workers approach their minimum employment requirement weeks (Baker and Rea, 1998; Green and Riddell, 1997). In a new setting, which is very similar as the current study, the study of the previous chapter confirms both of the these two findings, which then makes one wonder about the possibility of UI's impacts on reemployment wages to be time-varying as well.

4.4 Data and Exploratory Analysis

This study inherits much of the data used in the study of the preceding chapter. To summarize, the data is in the form of sample employment/unemployment spells. These spells are constructed from a Canadian micro panel data set, the confidential version of SLID. The data construction is custom designed for our 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.

The final sample allows both multiple spells for each individual as well as incomplete (right-censored) spells. The spells come from two periods of two panels: the pre-reform ones from panel 1's 1994 July to 1995 December spells and the post reform ones from panel 2s 1997 July to 1998 December spells. The set of time-varying UI treatment dummy variables are exactly the same as in previous study, 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 (please check table 3.1 for their definitions).

The key dependent variable here, the wage, refers to the 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 4.1 gives linear regression results relating reemployment wages to UI incentives using three different specifications. The samples 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 4.1 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; they are indeed similar to those re-employed with at least 11 weeks of remaining benefit. One possible explanation of this exception could be the tailoring behaviour of some workers who 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 to previous literature, linear regression results of two additional specifications are presented in table 4.1 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 observables, such as, gender, age, education, have been considered. On the other hand, 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 4.1. 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 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 its correlation with individual-specific wage differentials.

Finally, column (4) of table 4.1 gives the linear regression 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. As the results suggest, reemployment wages of quitters, who thus are not eligible for UI, do vaguely decline over time. The quitters who would otherwise have at least 11 weeks of remaining UI benefit do not get higher wages than quitters who would have otherwise exhausted their benefits, which is strikingly different from the pattern found from laid-off workers.

4.5 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 are chosen using the same set of requirements as in the linear regressions. Then, the four parts of the likelihood of person i are: $\{f_j^e\}_{j=1,\dots,N_i^e}$ for employment spells; $\{f_k^u\}_{k=1,\dots,N_i^u}$ for unemployment spells; $\{f_l^{ew}\}_{l=1,\dots,N_i^{ew}}$ for initial employment wages; and, $\{f_m^{uw}\}_{m=1,\dots,N_i^{uw}}$ for reemployment wages. The overall likelihood function for this person is set as the product of all of the four parts,

$$\int_{\epsilon_1,\epsilon_2,\epsilon_3} \left\{ \prod_{j=1}^{N_i^e} f_j^e \prod_{k=1}^{N_i^u} f_k^u \prod_{l=1}^{N_i^{ew}} f_l^{ew} \prod_{m=1}^{N_i^{uw}} f_m^{uw} \right\} dF(\epsilon_1, \epsilon_2, \epsilon_3) \tag{4.1}$$

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

[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.

$$\mu^e = a_{1,1}\epsilon_1 \tag{4.2}$$

$$\mu^u = a_{1,2}\epsilon_1 + a_{2,2}\epsilon_2 \tag{4.3}$$

$$\mu^{ew} = a_{1,3}\epsilon_1 + a_{2,3}\epsilon_2 + a_{3,3}\epsilon_3 \tag{4.4}$$

$$\mu^{uw} = a_{1,4}\epsilon_1 + a_{2,4}\epsilon_2 + a_{3,4}\epsilon_3 \tag{4.5}$$

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 are no particular interests and reason to entertain extra randomness in reemployment wages.

Figure 4.2 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 function (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 in the previous chapter. 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 $\alpha_1, \ldots, \alpha_{50}$ be 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,

$$\tilde{f}(d, c, x, H^0, H^1, H^2, \mu | a_1, a_2, a_0, \alpha, \beta) = \sum_{l \in \{0,1,2\}} a_l \cdot f^l(\cdot) \tag{4.6}$$

where

$$f^l(\cdot) = \begin{cases} 0 & \text{if } d \notin H^l \text{ and } c = 1 \\ \prod_{s=1}^{h(d,H^l)} (1 - p_s) \left(1 - \prod_{s=h(d,H^l)+1}^{d} (1 - p_s)\right) & \text{if } d \in H^l \text{ and } c = 1 \\ \prod_{s=1}^{\min\{h(d+1,H^l),d\}} (1 - p_s(\cdot)) & \text{if } c = 0 \end{cases} \tag{4.7}$$

and

$$p_s(\cdot) = 1 - \exp(-\exp(\alpha_s + \beta x_s + \mu)) \tag{4.8}$$

$$h(t, H^l) = \max\{t' | t' < t, t' \in H^l\} \tag{4.9}$$

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

$$f_l^{ew} = \phi(\ln(\text{initial employment wage}_l) - \beta^{ew} x_l^{ew} - \mu^{ew}, \delta^{ew}),\ \forall l \in [1, N_i^{ew}] \tag{4.10}$$

$$f_m^{uw} = \phi(\ln(\text{reemployment wage}_m) - \beta^{uw} x_m^{uw} - \mu^{uw}, \delta^{uw}),\ \forall m \in [1, N_i^{uw}] \tag{4.11}$$

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

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 4.2. 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 type of events, which helps us to identify the correlation between heterogeneity terms of different parts. Furthermore, table 4.3 shows the total number of incidence in each of the four types of events and the proportion of no repetitions in each type. Table 4.3 shows the total number of incidence in each of the four types of events and the proportion of no repetitions in each type. 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 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 depend 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 into 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 appropriate.

Obviously, the above assumptions deviate from a standard spot market model of the labour market. Nonetheless, the idea here does share some of the features of the costless mobility contract model as argued by Beaudry and DiNardo (1991). Beaudry and DiNardo (1991) empirically shows that there is strong correlation between the wage we observe at a point of time and the best labour market condition since the job matches. Furthermore, they show such correlation is much stronger than the wage's correlation with the labour market condition at the job start or the on-going period. Although, they use annual national measures of the labour market, while this study uses weekly regional unemployment rate, there is still reason to favor on-going rather than initial unemployment rate for the duration parts of our model given their strong results. In the future, it would be interesting to know whether other measures of unemployment rate or the change of unemployment rates is more powerful in explaining workers' employment/unemployment transitions.

4.6 Estimation Results

The exploration of estimation results here is based on examination and comparison of a set of results, starting from the simplest setups. We first explore the differences on the estimation of duration parts of the model due to endogenization of 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 4.4 corresponds to a specification with the two duration parts only, and table 4.5 corresponds to another specification with both the two duration parts and the two wage parts.

Comparison of the tables shows, 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 4.4 to 0.03 (s.e. 0.13) when wage parts are added in table 4.5. 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 coefficient 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 4.4 to 0.01 (s.e. 0.03) in table 4.5 indicates *shorter unemployment duration correlates mainly with persistently higher wages and transitory wage shocks have little impact on it.*

As for short term impacts due to business cycle, the coefficients of unemployment rate in table 4.5 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 4.6, UI-related variables are added to the duration parts of the specification of table 4.5. Comparing estimates of table 4.6 with table 4.5, we find one salient change 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 corresponding 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.

We could also compare estimates of table 4.6 with table 3.14 to check how endogenization of wages affects the estimation of the duration parts when UI impacts are considered. Similar to the comparison between table 4.4 with table 4.5, the comparison here shows the coefficient on log hourly wage for unemployment hazard part increases and the coefficient on log hourly wage for employment hazard part drops. Furthermore, comparison of table 4.6 and 3.14 also shows, though endogenization of wages does not affect the magnitude of UI impacts much, but it does improve the precision of the estimated impacts substantially.

Finally, table 4.7 presents our preferred set of estimation result where UI incentives are considered in the two duration parts and the reemployment wage part. By comparing the estimates of this model as presented in table 4.7 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 who have initial UI coverage and get reemployed exactly at benefit exhaustion week are no longer significantly higher than the omitted group, those who get reemployed past 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 4.7 shows that the clearest and strongest evidence of UI's impacts on the labour market is its impacts on the hazards of leaving unemployment. 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 $\exp(0.13) = 1.14$). Overall, the weighted average impact of UI coverage on the reemployment wages for UI-covered unemployed workers is about 9.5%.

Figures of table 4.8 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 allow workers to set higher reservation wages.

4.7 Conclusion

The study of this chapter examines an old, but open question in the empirical literature. It inherits the data and econometric model of the previous chapter's work, then extends previous chapter's work by endogenizing individuals' wages and examines the impacts of UI on reemployment wages using a full information maximum likelihood model. Specifically, the two features of this study are that both employment/unemployment cycles and wage dynamics are endogenized in the estimation; and that UI's impacts on reemployment wages are 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. Overall, the weighted average impact of UI coverage on the reemployment wages for UI-covered unemployed workers is about 9.5%.

Our evidence shows while UI leads to longer unemployment spells, it does indeed help to improve workers' job match qualities. These two most prominent impacts of UI are both statistically and economically significant.

Moreover, comparisons among estimation results of different specifications suggest several important correlations in the micro labour market. Given only non-seasonal unemployment spells completed within 52 weeks due to permanent separations are studied here for reemployment wages, the impact of UI on long term unemployed workers remains to be studied.

4.8 Tables and Figures

Figure 4.1: Predicted Impact of Temporary UI Coverage on Unemployed Workers' Reservation Wages

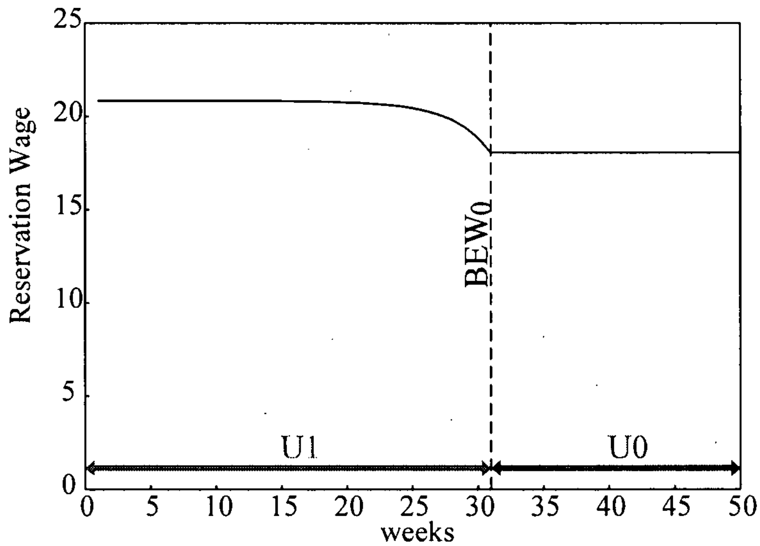


Figure 4.2: Illustration of the Four Duration and Wage Parts of the Likelihood Function

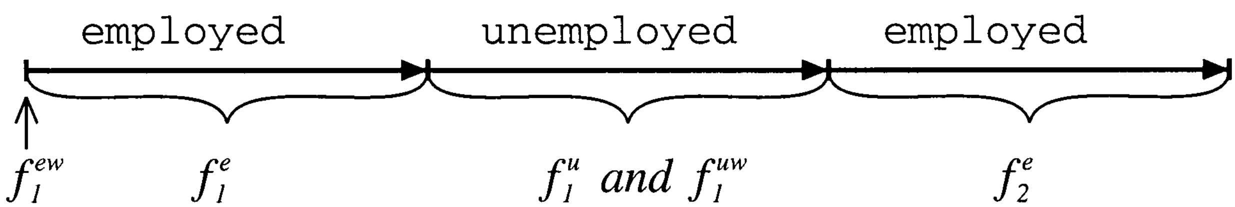


Table 4.1: Linear Regression Results of Reemployment Wages

	(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 lay-off, 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)⋆

Note: The sample size is 1605. The independent variable is ln of the reemployment wage. Other control variables include constant, gender, age, maritial status, immigration status, education dummies and regional dummies.

Table 4.2: 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 4.3: 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 4.4: 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 consists 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 4.5: 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 consists 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 4.6: 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 consists 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.

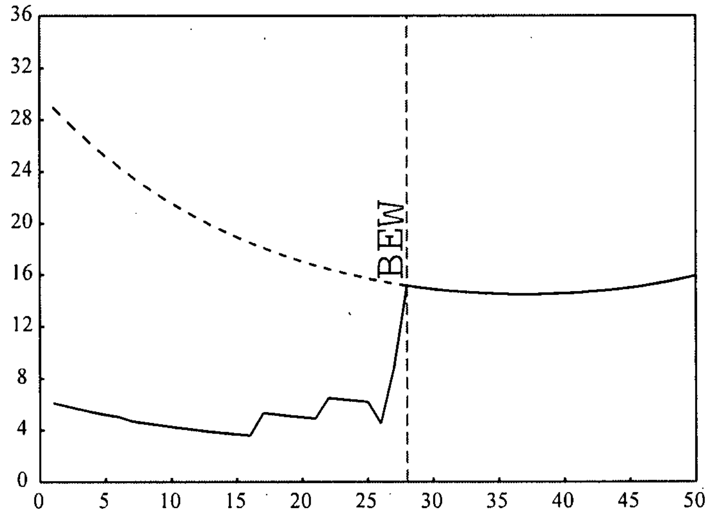
Table 4.7: Maximum Likelihood Estimates: UI Variables in Duration Parts and Wage Parts

	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)

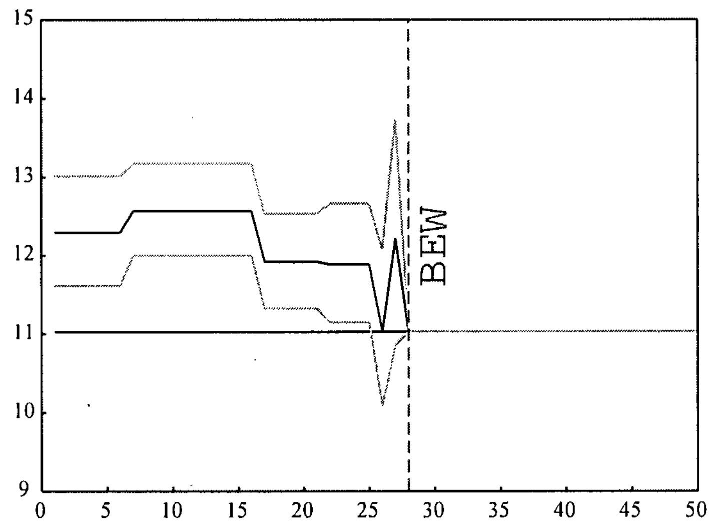
Note: the sample consists of 3796 individuals and the mean loglikelihood is -3.423. Other common control variables in the four parts include gender, age, maritial status, immigration status, education dummies and regional dummies. The two wage components also have constant terms.

Table 4.8: Illustration of UI's Impacts on Reemployment Process

a: unemployment hazards



b: reemployment wages



Chapter 5

Conclusions and Discussions

This thesis's study on UI's labour market impacts belongs to a classical research area. Here, the focus is the contingent, temporary nature of UI coverage; two aspects of the labour market, employment/unemployment cycles and wage dynamics are examined. Some highlights of the thesis include: solving a non-stationary model of endogenous employment/unemployment cycles; formulating an event-based duration data construction procedure; creating a parsimonious hazard model with heaping effect to account for volatile empirical hazards; utilizing the novel variations of UI treatment due to the EI reform; estimating a 'super' model where both employment/unemployment cycles and wage dynamics are endogenized; and allowing for UI to have time-varying impacts on reemployment wages. Overall the approaches adopted here pay a lot of attention to details.

As a result, the research here not only confirms previous findings in a new context but also suggests several new insights on the labour market and UI. In chapter 2's theoretical modelling section, it is suggested that the three key parameters of a UI program (benefit duration, employment requirement and weekly benefit) interact with each other and each generates both positive and negative impacts on individuals' work incentives, depending on the timing. In chapter 3, the analysis shows how the seasonal sector lost some of its seasonality after the EI reform; it is also able to show that the UI program could have increased the overall unemployment rate of Canada in the late 1990s by about 15% (e.g. from 7.6% to 6.6%). In chapter 4, the analysis shows how important the persistent correlations among employment spells, unemployment spells and wages are in the labour market; it also shows that, while availability of UI significantly slows the reemployment process (from 23 weeks to 28 weeks of average non-seasonal unemployment durations, a 22% increase), it is also able to increase reemployment wages by 9.5% on average and 12%-14% for the group of very early unemployment-leavers, who have at least 11 weeks of benefit left at their reemployment weeks.

The research here does suffer from several serious caveats: the definitions of employment and unemployment used here are different from the conventional ones in order to make them sensible for UI studies; for computational reasons, all sample spells are censored at week 50 if they continue beyond that point. Furthermore, spells' seasonality is taken as exogenous and our set of control variables excludes all job-related information such as occupation, industry, and firm sizes. Given the huge differences of seasonal and non-seasonal labour market, it would be very useful for policy makers to know the factors that determine workers' seasonality choice. Although it is possible to get some aggregate measures of UI's impacts on the labour market, it would also be interesting to know how these impacts are realized at the workplace, whether it is realized through mobility across firms of different sizes and/or firms of different industries.

Generally, UI is regarded as a sensible public policy in many developed countries because of both economic and political reasons. The focus of this thesis is entirely on the economic side, i.e., the insurance role of UI. From an economic point of view, most unemployed workers could not borrow against their human capital, thus facing liquidity constraints. Without UI coverage, many unemployed workers can't afford to search long enough for proper jobs. Subsidized by UI benefit, more patient search then becomes viable. But given the high cost to monitor workers job search activities, it is also possible for workers to take the UI benefit as subsidy for leisure. Without strong evidence on UI's impact on reemployment success, it is hard to distinguish the job search subsidy story from the leisure subsidy one.

Although job search theory has long been one of the major explanations for unemployment in the literature, people are still skeptical about the productive role of UI through improved job matches. Instead, researchers have been very concerned about higher unemployment rate due to generous UI program. But here, as shown in this thesis, although UI coverage leads to longer unemployment spells, it also leads to better job matches at the same time — as implied by higher reemployment wages. These two most prominent impacts of UI are both statistically and economically significant.

Overall, the results here strongly suggest that UI coverage does allow unemployed workers to continue working on high-quality jobs rather than having to accept low-wage jobs in a hurry. These results are rather encouraging as they suggest that the UI program not only allows workers to smooth their consumption and maintain steady income streams, in addition, it also contributes to the overall human capital utilization of an economy. Together, the two empirical studies of this thesis suggest that longer unemployment spells or higher unemployment rates could be just the cost that we have to pay for better job matches. Therefore, it is only reasonable to evaluate the UI program by considering its negative impact of higher unemployment rate and positive impact of better job matches together.

Besides providing strong support to the general economic rational of UI program, the results here also suggest ways to make the program more efficient. As shown repeatedly in this thesis, individuals' labour market turnovers are indeed sensitive to UI's contingent and temporary rules. Currently, the UI program in Canada only takes into account individuals' employment histories within 2 years or so (1 year for benefit duration calculation, and 1 year for new entrants classification), except for the experience rating rules, which have a memory of 5 years and are shown to be very effective in promoting work incentives. As a result, workers who have been employed for 8 years are treated the same as those with 2 years of employment, while workers who repeatedly leave unemployment with many unused UI benefit weeks in the past are in general not rewarded with extra benefit weeks in their future unemployment spells. Our results suggest workers labour market attachment could be strengthened if additional experience-rating rules are implemented to reward workers with good UI usage histories.

Given our results, it seems that the program could be more effective in promoting work incentives if UI benefit coverage calculation could take account of individuals' labour market and UI collection experiences for a longer period. In other words, if contingency works to promote work incentive, why not extend the basis of contingency. Doing it properly, a revised UI program might even be able to mitigate some of the current negative impacts of postponed reemployment. Although it is useful to compare the generosity of two UI programs, UI programs usually have multiple parameters. Modifying an existing UI program so that there is less incentive to abuse the system might be regarded as cutting down the generosity of the program as a whole, but it could actually mean more resources for the desired purposes, thus better welfare for most people.

Finally, it is important to understand that the results here only suggest UI coverage improves job match qualities in a particular developed country: Canada. Here, the whole system of UI, as well as other institutions has been almost constantly evaluated and modified for decades. Over time, many problems have been found, some fixed and others consciously compromised. Would such a custom-made UI program produce similar results in another developed economy? Maybe. Would it work similarly in a developing country such as China? I doubt. Not only because taxation system in China is not as powerful, but also because there is just not as much research been done regarding the labour markets in developing countries. Even for a developed economy as Canada, there is still not much understanding about the other side of labour market, about how firms and workers interact with each other. Often, the job offers are just assumed to be given. In many ways, more research on UI's labour market impacts is needed.

Bibliography

Addison, J. T., Blackburn, M. L., 2000. The effects of unemployment insurance on post unemployment earnings. Labour Economics 7 (1), 21–53.

Albrecht, J., Vroman, S., 2005. Equilibrium search with time-varying unemployment benefits. Economic Journal 115 (505), 631–648.

Atkinson, A. B., Micklewright, J., 1991. Unemployment compensation and labor market transitions: A critical review. Journal of Economic Literature 29 (4), 1679–1727.

Baker, M., 1992. Digit preference in CPS unemployment data. Economics Letters 39 (1), 117–121.

Baker, M., Melino, A., 2000. Duration dependence and nonparametric heterogeneity: A Monte Carlo study. Journal of Econometrics 96 (2), 357–393.

Baker, M., Rea, S. A., 1998. Employment spells and unemployment insurance eligibility requirements. Review of Economics and Statistics 80 (1), 80–94.

Beach, C. M., Kaliski, S. F., 1983a. The impact of the 1979 Unemployment Insurance Amendments. Canadian Public Policy 9 (2), 164–173.

Beach, C. M., Kaliski, S. F., 1983b. Measuring the duration of unemployment from gross flow data. Canadian Journal of Economics 16 (2), 258–263.

Beach, C. M., Kaliski, S. F., 1987. The distribution of unemployment spells: Canada, 1978-82. Industrial and Labor Relations Review 40 (2), 254–267.

Beaudry, P., DiNardo, J., 1991. The effect of implicit contracts on the movement of wages over the business cycle: Evidence from micro data. Journal of Political Economy 99 (4), 665–688.

Belzil, C., 2001. Unemployment insurance and subsequent job duration: Job matching versus unobserved heterogeneity. Journal of Applied Econometrics 16 (5), 619–636.

Burdett, K., 1978. Theory of employee job search and quit rates. American Economic Review 68 (1), 212–220.

Burgess, P. L., Kingston, J. L., 1976. The impact of unemployment insurance benefits on reemployment success. Industrial and Labor Relations Review 30 (1), 25–31.

Carneiro, P., Hansen, K. T., Heckman, J. J., 2003. Estimating distributions of treatment effects with an application to the returns to schooling and measurement of the effects of uncertainty on college choice. International Economic Review 44 (2), 361–422.

Clark, K. B., Summers, L. H., 1979. Labor market dynamics and unemployment: A reconsideration. Brookings Papers on Economic Activity 1 (79), 13–60.

Classen, K. P., 1977. The effect of unemployment insurance on the duration of unemployment and subsequent earnings. Industrial and Labor Relations Review 30 (4), 438–444.

Coles, M., Masters, A., 2004. Duration-dependent unemployment insurance payments and equilibrium unemployment. Economica 71 (281), 83.

Cooper, J. P., 1972. Two approaches to polynomial distributed lags estimation: An expository note and comment. American Statistician 26 (3), 32–35.

Corak, M., 1993. Is unemployment insurance addictive - evidence from the benefit durations of repeat users. Industrial and Labor Relations Review 47 (1), 62–72.

Cousineau, J.-M., 1985. Unemployment insurance and labour market adjustments. In: Vaillancourt, F. (Ed.), Income distribution and economic security in Canada. Vol. 1. University of Toronto Press, Toronto.

Devine, T. J., Kiefer, N. M., 1991. Empirical Labor Economics. Oxford University Press.

Dingledine, G. A., 1981. A Chronology of Response: The Evolution of Unemployment Insurance from 1940 to 1980. Ottawa: Minister of Supply and Services.

Ehrenberg, R. G., Oaxaca, R. L., 1976. Unemployment insurance, duration of unemployment, and subsequent wage gain. American Economic Review 66 (5), 754–766.

Flinn, C. J., Heckman, J. J., 1983. Are unemployment and out of the labor-force behaviorally distinct labor-force states. Journal of Labor Economics 1 (1), 28–42.

Fortin, P., 2000. The impact of worker's experience rating on unemployed workers. Tech. rep., Human Resources Development Canada.

Friesen, J., 2002. The effect of unemployment insurance on weekly hours of work in Canada. Canadian Journal of Economics 35 (2), 363.

Government of Canada, 1995. Public Accounts of Canada 1995, volume 1.

Government of Canada, 1997. Public Accounts of Canada 1997, volume 1.

Green, D. A., Riddell, W. C., 1993. The economic effects of unemployment insurance in Canada: An empirical analysis of UI disentitlement. Journal of Labor Economics 11 (1), S96–S147.

Green, D. A., Riddell, W. C., 1997. Qualifying for unemployment insurance: An empirical analysis. Economic Journal 107 (440), 67–84.

Green, D. A., Riddell, W. C., Nov 2000. The effects of the shift to an hours-based entrance requirement. Tech. rep., Human Resources Development Canada.

Green, D. A., Sargent, T. C., 1998. Unemployment insurance and job durations: Seasonal and non-seasonal jobs. Canadian Journal of Economics 31 (2), 247–278.

Gritz, R. M., MaCurdy, T., 1997. Measuring the influence of unemployment insurance on unemployment experiences. Journal of Business and Economic Statistics 15 (2), 130–152.

Gunderson, M., Riddell, W. C., 2000. Unemployment insurance: Lessons from Canada. In: Berry, A. (Ed.), Labor Market Policies in Canada and Latin America: Challenges of the New Millennium. Kluwer Academic Publisher.

Hall, R. E., 2003. Modern theory of unemployment fluctuations: Empirics and policy applications. American Economic Review 93 (2), 145.

Ham, J. C., Rea, Jr., S. A., 1987. Unemployment insurance and male unemployment duration in Canada. Journal of Labor Economics 5 (3), 325–353.

Heckman, J. J., 1991. Identifying the hand of past - distinguishing state dependence from heterogeneity. American Economic Review 81 (2), 75–79.

Heckman, J. J., Singer, B., 1984. A method for minimizing the impact of distributional assumptions in econometric-models for duration data. Econometrica 52 (2), 271–320.

Hedeker, D., Siddiqui, O., Hu, F. B., 2000. Random-effects regression analysis of correlated grouped-time survival data. Statistical Methods in Medical Research 9 (2), 161–179.

Holen, A., 1977. Effects of unemployment insurance entitlement on duration and job search outcome. Industrial and Labor Relations Review 30 (4), 445–450.

Holmlund, B., 1998. Unemployment insurance in theory and practice. Scandinavian Journal of Economics 100 (1), 113–141.

Human Resources Development Canada, 1997-2002. Employment insurance monitoring and assessment report.

Human Resources Development Canada, 2000. Reconnecting social assistance recipients to the labour market: Lessons learned (final report). Tech. rep.

Human Resources Development Canada, 2001a. EI reform and multiple job holding. Tech. rep.

Human Resources Development Canada, 2001b. An evaluation overview of seasonal employment. Tech. rep.

Human Resources Development Canada, 2001c. The impact of EI reform on gappers. Tech. rep.

Jones, S. R. G., Riddell, W. C., 1995. The measurement of labor-force dynamics with longitudinal data - the labor-market activity survey filter. Journal of Labor Economics 13 (2), 351–385.

Jovanovic, B., 1979a. Firm-specific capital and turnover. Journal of Political Economy 87 (6), 1246–1260.

Jovanovic, B., 1979b. Job matching and the theory of turnover. Journal of Political Economy 87 (5), 972–990.

Jovanovic, B., 1984. Matching, turnover, and unemployment. Journal of Political Economy 92 (1), 108–122.

Kesselman, J. R., 2000. Payroll taxes in the finance of social security. In: Berry, A. (Ed.), Labor Market Policies in Canada and Latin America: Challenges of the New Millennium. Kluwer Academic Publisher.

Lacroix, G., Audenrode, M. V., 2000. An assessment of various components of bill c-12 on the duration of unemployment spells. Tech. rep., Human Resources Development Canada.

Lancaster, T., 1990. The econometric analysis of transition data. Cambridge University Press.

Lee, C.-I., 2000. The impact of taxing unemployment insurance benefits on unemployment duration and post-unemployment earnings. International Tax and Public Finance 7 (4-5), 521.

Lemieux, T., MacLeod, W. B., 2000. Supply side hysteresis: The case of the Canadian unemployment insurance system. Journal of Public Economics 78 (1-2), 139–170.

Meyer, B. D., 1990. Unemployment insurance and unemployment spells. Econometrica 58 (4), 757–782.

Milbourne, R. D., Purvis, D. D., Scoones, W. D., 1991. Unemployment insurance and unemployment dynamics. Canadian Journal of Economics 24 (4), 804–826.

Moffitt, R., 1985. Unemployment insurance and the distribution of unemployment spells. Journal of Econometrics 28 (1), 85–101.

Mortensen, D. T., 1977. Unemployment insurance and job search decisions. Industrial and Labor Relations Review 30 (4), 505–517.

Mortensen, D. T., 1978. Specific capital and labor turnover. Bell Journal of Economics 9 (2), 572–586.

Mortensen, D. T., 1982. Property-rights and efficiency in mating, racing, and related games. American Economic Review 72 (5), 968–979.

Mortensen, D. T., Pissarides, C. A., 1994. Job creation and job destruction in the theory of unemployment. Review of Economic Studies 61 (3), 397–415.

Nakamura, A., Wong, G., 2000. Canada's social security programs and payroll taxes. In: Berry, A. (Ed.), Labor Market Policies in Canada and Latin America: Challenges of the New Millennium. Kluwer Academic Publisher.

Nakamura, A. O., Wong, G., Diewart, W. E., 2000. New approaches to public income support in canada. Tech. Rep. 00-09, Department of Economics, University of British Columbia.

Phipps, S., 1990. Quantity-constrainted household responses to UI reform. Economic Journal 100 (399), 124–40.

Phipps, S., 1991. Behavioural response to UI reform in constrained and unconstrained models of labour supply. Canadian Journal of Economics 24 (1), 34–54.

Rudner, K. L., 1998. The 1998 annotated Employment Insurance statues. Carswell, Ontario.

Shannon, M., Kidd, M. P., 2000. Institutional specifics and unemployment insurance eligibility in Canada: How sensitive are employment duration effects? Empirical Economics 25, 327–350.

Storer, P., Audenrode, M. A. V., 1995. Unemployment insurance take-up rates in Canada: Facts, determinants, and implications. Canadian Journal of Economics 28 (4a), 822.

Sweetman, A., 2000. The impact of EI on those working less than 15 hours per week. Tech. rep., Human Resources Development Canada.

Torelli, N., Trivellato, U., 1993. Modelling inaccuracies in job-search duration data. Journal of Econometrics 59 (1-2), 187–211.

Van den Berg, G. J., 1990. Nonstationarity in job search theory. Review of Economic Studies 57 (2), 255–277.

Van den Berg, G. J., 2000. Duration models: Specification, identification, and multiple durations. In: Heckman, J. J., Leamer, E. (Eds.), Handbook of Econometrics. Vol. V. North-Holland, Amsterdam.

Van den Berg, G. J., Lindeboom, M., 1998. Attrition in panel survey data and the estimation of multi-state labor market models. Journal of Human Resources 33 (2), 458–478.

Welch, F., 1977. What have we learned from empirical studies of unemployment insurance. Industrial and Labor Relations Review 30 (4), 451–461.

Appendix A

Proofs

Proof (For Proposition 2.3.1)

If $\forall t \geq N_e + 1$, assume existence of unique reservation wage for each week, then the reservation wage for these different weeks will be the same because of the stationarity of the problem for this part. Without loss of generosity, set $t = N_e + 1$, then the value function could be writhen as in (A.1)

$$V(w, N_e{+}1) = \max\left\{W(N_u), w + \beta\eta \int V(x, N_e + 1)dF(x) + \beta(1-\eta)V(w, N_e + 1)\right\} \tag{A.1}$$

Let the reservation wage be $w^{e\star}$. Then, we have two equations that define $w^{e\star}$ as follows,

$$\begin{aligned} V(w^{e\star}, N_e + 1) &= w^{e\star} + \beta\eta \int V(x, N_e + 1)dF(x) \\ &\quad + \beta(1-\eta)V(w^{e\star}, N_e + 1) && \text{(A.2)} \\ V(w^{e\star}, N_e + 1) &= W(N_u) && \text{(A.3)} \end{aligned}$$

Substituting (A.3) to (A.2), we have

$$W(N_u) = w^{e\star} + \beta\eta \int V(x, N_e + 1)dF(x) + \beta(1-\eta)W(N_u) \tag{A.4}$$

Rearranging terms in above equation, we then have

$$\beta\eta \int V(x, N_e + 1)dF(x) = -w^{e\star} + (1 - \beta(1 - \eta))W(N_u) \tag{A.5}$$

Substituting (A.5) to (A.1), we have

$$\begin{aligned} V(w, N_e + 1) &= \max\{W(N_u), w - w^{e\star} + (1 - \beta(1 - \eta))W(N_u) \\ &\quad + \beta(1 - \eta)V(w, N_e + 1)\} \end{aligned} \tag{A.6}$$

Rearranging terms in above equation, we then have (2.2). That means

$$\beta\eta \int V(x, N_e + 1)dF(x) = \beta\eta W(N_u) + \beta\eta \int_{w^{e\star}} \left\{ \frac{w - w^{e\star}}{1 - \beta(1 - \eta)} \right\} dF(x) \tag{A.7}$$

Substituting (A.5) to (A.7), we then have (2.3). ∎

Proof (For Proposition 2.3.2)

This proposition can be proved by induction as follows:

First, let's consider the case when $i = 1$, that is for week N_e.

The value function at week N_e is

$$V(w, N_e) = \max\left\{W(0), w + \beta\eta \int V(x, N_e + 1)dF(x) + \beta(1 - \eta)V(w, N_e + 1)\right\} \tag{A.8}$$

Assuming existence and uniqueness of the reservation wage at week N_e, $w^{e\star}_{Ne-1}$, we have,

$$V(w_{N_e}^{e\star}, N_e) = w_{N_e}^{e\star} + \beta\eta \int V(x, N_e + 1) dF(x) + \beta(1-\eta) V(w_{N_e}^{e\star}, N_e + 1) \tag{A.9}$$

$$V(w_{N_e}^{e\star}, N_e) = W(0) \tag{A.10}$$

Obviously, $w^{e\star} > w_{N_e}^{e\star}$. This could be shown by noticing $V(w^{e\star}, N_e) = W(N_u)$ from (A.8), the assumption $W(N_u) > W(0)$, and (A.10).

This inequality could then be used in the last term of (A.9) to calculate the exact value of $w_{N_e}^{e\star}$.

$\forall w \in [w_{N_e}^{e\star}, w^{e\star}]$, we have

$$\begin{aligned} V(w, N_e) &= w + \beta\eta \int V(x, N_e + 1) dF(x) + \beta(1-\eta) V(w, N_e + 1) \\ &= w + \beta\eta \int V(x, N_e + 1) dF(x) + \beta(1-\eta) W(N_u) \end{aligned} \tag{A.11}$$

Thus, $\forall w \in [w_{N_e}^{e\star}, w^{e\star}]$, $\frac{\partial V(w,Ne)}{\partial w} = 1$. We then can backup $w_{N_e}^{e\star}$, considering this slope, $V(w^{e\star}, N_e) = W(N_u)$, and $V(w_{N_e}^{e\star}, N_e) = W(0)$. This is illustrated at figure 2.2. And formally,

$$w_{N_e}^{e\star} = w^{e\star} - \frac{W(N_u) - W(0)}{1} = w^{e\star} - \frac{V(w^{e\star}, N_e) - W(0)}{\sum_{s=0}^{1-1} (\beta(1-\eta))^s} \tag{A.12}$$

Thus, we have proved (2.4) for $i = 1$.

Also, $\frac{\partial V(w,Ne)}{\partial w} = 1, \forall w \in [w_{N_e}^{e\star}, w^{e\star}]$, as derived in (A.11) proved the middle case of (2.5) for $i = 1$.

$\forall w > w^{e\star}$, it is easy to see $V(w, Ne) = V(w, Ne+1) \Longrightarrow \frac{\partial V(w,Ne)}{\partial w} = \frac{\partial V(w,Ne+1)}{\partial w} =$

$(1-\beta(1-\eta))^{-1}$; while $\forall w < w^{e\star}_{N_e}$, $V(w, Ne) = W(0) \Longrightarrow \frac{\partial V(w,Ne)}{\partial w} = 0$. By these, (2.4)is proved for $i = 1$.

Notice, $\forall w \geq w^{e\star}$, $V(x, N_e + 1) = V(x, N_e)$, and $\forall w < w^{e\star}$, $V(x, N_e + 1) = W(Nu) = V(w^{e\star}, N_e) > V(x, N_e)$, thus $\int V(x, N_e + 1)dF(x) > \int V(x, N_e)dF(x)$. That means (??) as well as (2.7) are true for $i = 1$ and by this Proposition 2.3.2 is proved for $i = 1$.

Second, let's consider the general case when $i = k+1$, assuming Proposition 2.3.2 is true for all i, s.t. $i \leq k, \forall k \geq 1$.

The value functions when $i = k + 1$ and $i = k$ are,

$$V(w, N_e + 1 - k) =$$
$$\max\left\{W(0), w + \beta\eta \int V(x, N_e + 2 - k)dF(x) + \beta(1-\eta)V(w, N_e + 2 - k)\right\} \tag{A.13}$$

$$V(w, N_e - k) =$$
$$\max\left\{W(0), w + \beta\eta \int V(x, N_e + 1 - k)dF(x) + \beta(1-\eta)V(w, N_e + 1 - k)\right\} \tag{A.14}$$

I show $w^{e\star}_{N_e-k} > w^{e\star}_{N_e+1-k}$ by contradiction.

The indifference conditions at these two weeks give us the following equality condition,

$$\begin{aligned}
& w^{e\star}_{N_e-k} + \beta\eta \int V(x, N_e + 1 - k) dF(x) + (1 - \beta(1-\eta)) V(w^{e\star}_{N_e-k}, N_e + 1 - k) \\
= \; & W(0) \\
= \; & w^{e\star}_{N_e+1-k} + \beta\eta \int V(x, N_e + 2 - k) dF(x) \\
& + (1 - \beta(1-\eta)) V(w^{e\star}_{N_e+1-k}, N_e + 2 - k)
\end{aligned}$$

If $w^{e\star}_{N_e-k} \le w^{e\star}_{N_e+1-k}$, then $V(w^{e\star}_{N_e-k}, N_e + 1 - k) = W(0)$, while we also know $V(w^{e\star}_{N_e+1-k}, N_e+2-k) \ge W(0)$ by the setup of the value function. Thus, $V(w^{e\star}_{N_e-k}, N_e + 1 - k) \le V(w^{e\star}_{N_e+1-k}, N_e + 2 - k)$. Also, we have assumed Proposition 2.3.2 is true for $i = k$, thus $\int V(x, N_e + 1 - k) dF(x) < \int V(x, N_e + 2 - k) dF(x)$. Therefore, we should have

$$\begin{aligned}
& w^{e\star}_{N_e-k} + \beta\eta \int V(x, N_e + 1 - k) dF(x) + (1 - \beta(1-\eta)) V(w^{e\star}_{N_e-k}, N_e + 1 - k) \\
< \; & w^{e\star}_{N_e+1-k} + \beta\eta \int V(x, N_e + 2 - k) dF(x) + (1 - \beta(1-\eta)) V(w^{e\star}_{N_e+1-k}, N_e + 2 - k)
\end{aligned}$$

which contradicts the equality condition above. Therefore $w^{e\star}_{N_e-k} > w^{e\star}_{N_e+1-k}$.

By assumption, we also now $w^{e\star}_{N_e-k} < w^{e\star}$ since $V(w^{e\star}, N_e - k) > W(0) = V(w^{e\star}_{N_e-k}, N_e - k)$.

Having clarified the range of $w^{e\star}_{N_e-k}$, we can rewritten (A.14) as follows,

$$\begin{aligned}
\forall w > w^{e\star},\; V(w, N_e - k) \;=\; & w + \beta\eta \int V(x, N_e + 1 - k) dF(x) \\
& + \beta(1-\eta) V(w, N_e + 1 - k)
\end{aligned}$$

$$\begin{aligned}\text{where } \frac{\partial V(w, N_e+1-k)}{\partial w} &= (1-\beta(1-\eta))^{-1} \\ \Longrightarrow \frac{\partial V(w, N_e-k)}{\partial w} &= (1-\beta(1-\eta))^{-1}\end{aligned}$$

$\forall w \in [w^{e\star}_{N_e-k}, w^{e\star}] \subset [w^{e\star}_{N_e+1-k}, w^{e\star}]$,

$$\begin{aligned}V(w, N_e-k) &= w + \beta\eta \int V(x, N_e+1-k)dF(x) \\ &\quad +\beta(1-\eta)V(w, N_e+1-k)\end{aligned}$$

$$\begin{aligned}\text{where } \frac{\partial V(w, N_e+1-k)}{\partial w} &= \sum_{s=0}^{k-1}(\beta(1-\eta))^s \\ \Longrightarrow \frac{\partial V(w, N_e-k)}{\partial w} &= \sum_{s=0}^{k}(\beta(1-\eta))^s\end{aligned}$$

$$\forall w < w^{e\star}_{N_e-k},\ V(w, N_e-k) = W(0) \Longrightarrow \frac{\partial V(w, N_e-k)}{\partial w} = 0$$

Therefore, (2.5) is true for $i = k+1$. Based on the slopes given above, it is obvious that (2.4) is also true for $i = k+1$.

Now comparing (A.13) and (A.14) , since there exists w, for example $w^{e\star}$, such that $V(w, N_e+1-k) > W(0)$, also we know $\int V(x, N_e+2-k)dF(x) > \int V(x, N_e+1-k)dF(x)$ and $V(x, N_e+2-k) \geq V(x, N_e+1-k)$, therefore, (??) and (2.7) are also true for $i = k+1$.

Finally, the proof is complete by considering the above two steps jointly. ∎

Proof (For Proposition 2.3.3) First of all, $\forall t \in N,\ s.t.\ t \in [1, Nu-1]$, the value function at an unemployed week with t weeks of benefit remaining is,

$$W(t) = B + \beta\lambda \int \max\{W(t-1), V(x,1)\}\, dF(x) + \beta(1-\lambda)W(t-1) \qquad \text{(A.15)}$$

It is then obvious that (2.8) is the just indifference condition of (A.15) which says the worker will get same payoff whether choosing to reject the offer or not at the reservation wage.

(2.9) is true because: (2.8) $\Rightarrow V(w_2^{u\star}, 1) = W(1) = B + W(0) = B + V(w_1^{u\star}, 1) \Rightarrow \Delta_1 = B$. Since $B > 0$, thus $w_1^{u\star} > w_0^{u\star}$.

(2.10) is true because: $\forall t \in N,\ s.t.\ t \in [2, Nu-1]$, (2.8)

$$\begin{aligned}
\Rightarrow \Delta_t &= V(w_{t+1}^{u\star}, 1) - V(w_t^{u\star}, 1) \\
&= W(t) - W(t-1) \\
&= \beta\lambda \int (\max\{W(t-1), V(x,1)\} - \max\{W(t-2), V(x,1)\})dF(x)
\end{aligned} \qquad \text{(A.16)}$$

That is

$$(\beta\lambda)^{-1}\Delta_t = \int (\max\{W(t-1), V(x,1)\} - \max\{W(t-2), V(x,1)\})dF(x) \qquad \text{(A.17)}$$

Now I should show (A.17) by induction.

$$0 < \int (\max\{W(t-1), V(x,1)\} - \max\{W(t-2), V(x,1)\})dF(x) < \Delta_{t-1}F(w_t^{u\star}) \qquad \text{(A.18)}$$

first, we need to show the proposition is true for $t = 2$.

Notice

$$\begin{aligned}
& \int \max\{W(2-1), V(x,1)\}dF(x) - \int \max\{W(1-1), V(x,1)\}dF(x) \\
= & \left[W(1)F(w_2^{u\star}) + \int_{x \geq w_2^{u\star}} V(x,1)dF(x)\right] - \left[W(0)F(w_1^{u\star}) + \int_{x \geq w_1^{u\star}} V(x,1)dF(x)\right] \\
= & \ W(1)F(w_2^{u\star}) - W(0)F(w_1^{u\star}) - \int_{w_1^{u\star}}^{w_2^{u\star}} V(x,1)dF(x) \text{ since } w_2^{u\star} > w_1^{u\star} \text{ from (2.9)} \\
= & \ W(1)F(w_2^{u\star}) - \int_{x \leq w_2^{u\star}} \max\{W(0), V(x,1)\}dF(x) \\
= & \int_{x \leq w_2^{u\star}} \left[W(1) - \max\{W(0), V(x,1)\}\right] dF(x) \\
& \left[\Rightarrow \int \max\{W(2-1), V(x,1)\}dF(x) - \int \max\{W(1-1), V(x,1)\}dF(x) > 0\right] \\
< & \int_{x \leq w_2^{u\star}} \left[W(1) - W(0)\right] dF(x) \\
= & \ \left[W(1) - W(0)\right] F(w_2^{u\star}) \\
= & \ \Delta_1 F(w_2^{u\star})
\end{aligned}$$

Thus $0 < \Delta_2 < \beta\lambda F(w_2^{u\star})\Delta_1$. Since $\Delta_2 > 0$, we have $w_3^{u\star} > w_2^{u\star}$.

Second, we need to prove if (A.17) is true $\forall t \in N,\ s.t.\ 2 \leq t \leq k \leq Nu$, *then it is also true for* $t = k+1$ *case .*

(A.17) is true when $t = k \Rightarrow w_{k+1}^{u\star} > w_k^{u\star}$, similarly we have,

$$
\begin{aligned}
& (\beta\lambda)^{-1}\Delta_{k+1} \\
= & \int \max\{W(k), V(x,1)\}dF(x) - \int \max\{W(k-1), V(x,1)\}dF(x) \\
= & \left[W(k)F(w^{u\star}_{k+1}) + \int_{x \geq w^{u\star}_{k+1}} V(x,1)dF(x)\right] \\
& - \left[W(k-1)F(w^{u\star}_{k}) + \int_{x \geq w^{u\star}_{k}} V(x,1)dF(x)\right] \\
= & W(k)F(w^{u\star}_{k+1}) - W(k-1)F(w^{u\star}_{k}) - \int_{w^{u\star}_{k}}^{w^{u\star}_{k+1}} V(x,1)dF(x) \\
& \text{since } w^{u\star}_{k+1} > w^{u\star}_{k} \text{ from above} \\
= & W(k)F(w^{u\star}_{k+1}) - \int_{x \leq w^{u\star}_{k+1}} \max\{W(k-1), V(x,1)\}dF(x) \\
= & \int_{x \leq w^{u\star}_{k+1}} \left[W(k) - \max\{W(k-1), V(x,1)\}\right] dF(x) \\
& \left[\Rightarrow \int \max\{W(k), V(x,1)\}dF(x) - \int \max\{W(k-1), V(x,1)\}dF(x) > 0\right] \\
< & \int_{x \leq w^{u\star}_{k+1}} \left[W(k) - W(k-1)\right] dF(x) \\
= & \left[W(k) - W(k-1)\right] F(w^{u\star}_{k+1}) \\
= & \Delta_k F(w^{u\star}_{k+1})
\end{aligned}
$$

Thus $0 < \Delta_{k+1} < \beta\lambda F(w^{u\star}_{k+1})\Delta_k$. Since $\Delta_{k+1} > 0$, we have $w^{u\star}_{k+2} > w^{u\star}_{k+1}$.

Finally, the proof is complete by considering the above two steps jointly. ∎