Stony Brook University

A Structural Model of Taxation and Unemployment Insurance on Search Dynamics

A Dissertation presented

by

Yoo Bin Kim

to

The Graduate School

in Partial Fulfillment of the

Requirements

for the Degree of

Doctor of Philosophy

in

Economics

Stony Brook University

May 2014

Stony Brook University

The Graduate School

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Abstract of the Dissertation

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2014

The thesis studies the effects of taxation and Unemployment Insurance program on the labor market search and employment dynamics of high school graduates in the U.S. We develop a dynamic life-cycle model of job search with institutional features of taxes and UI benefits, and examine the interaction between them to derive the effects on the optimization problem of single agents; labor force participation decisions, consumption, asset accumulation, labor status transitions, welfare, and the reservation wage. Knowing the effect of taxation and unemployment benefit is twofold and theoretically ambiguous, we estimate the model using a sub-sample of the National Longitudinal Survey of Youth 1979 with NLSY Geocode variables, and fit the model to the data by the Simulated Method of Moments. Given the SMM estimates, we conduct several policy experiments involving changes in the benefit rates, maximum duration that the benefits can be paid, deduction amounts, and income tax rates. We find that the disincentive to work dominates the incentive effect under the current Unemployment Insurance and taxation policies. The maximum benefit-paying period extension and increase in the UI replacement rate raise search and unemployment duration, but decrease wage earnings, assets, consumption, and sacrifice individuals' Wealth in turn. Increase in tax rates raises the unemployment duration and the first accepted wages, but lowers reemployment rate, wage earnings,

assets, and consumption. Allowing tax exemption at the lowest tax brackets lowers the first unemployment duration, average search duration, and first accepted wage, but raises individual wealth. The income tax effects proposed by our policy experiments more stands out in high income tax area due to the higher unemployment rate.

To my loving family. The work is dedicated to my beautiful wife Jieun, daughter Olivia, and son Aiden for their sincere love and patience throughout my life. I love you.

To my parents, Soo-il and Songhak, and sister, Cherry. Thank you for your unconditional and continued support and giving me a chance to further my studies. I am the man I am today because of your love. I love you.

To my parents in law, Sun-woo and Myunghee. I also dedicate this work to my father in law who passed away during my studies here, and my mother in law, loving and more supportive person yet to meet. I can always feel you are watching us with the greatest smile. I love you.

To my dog, Puko. Just always be there, buddy.

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Acknowledgements

I would like to sincerely thank Dr. Hugo Benítez-Silva, Dr. Silvio Rendon, Dr. Warren Sanderson, and Dr. Selcuk Eren for their guidance and encouragement during my graduate studies at State University of New York at Stony Brook. I also thank participants of conferences at Southwestern Society of Economists, Eastern Economic Association, The New York State Economics Association, and South Economic Association for their valuable comments.

This research was conducted with restricted access to Bureau of Labor Statistics (BLS) data. The views expressed here do not necessarily reflect the views of the BLS.

Chapter 1

Introduction

The effects of the taxation and Unemployment Insurance program on labor supply have aroused considerable interest throughout most fields in Economics, since a large share of the government revenue is financed by the individual income tax, and unemployment benefits are a critical source of those who are currently not working. Particulary, the macro effects of these programs, such as welfare and equilibrium effect in the context of the optimal tax and benefit rates, have been studied extensively and received the most attention amongst the issues considered[1]. The micro-level effects of taxes and welfare programs on labor supply, however, have been paid less attention respectively, but should not be overlooked as it provides valuable insights in comprehending the macro economic conditions of the economy. Furthermore, the financial incentives of taxation and Unemployment Insurance system are more emphasized under the current labor market frictions and the recession, hence the Impact of the taxation and Unemployment Insurance on the labor market is more emphasized. These market frictions cause a significant distortion on job search and matchings, so that individuals are greatly exposed to the unemployment. The common variables in search framework help identify the incentive to work, such as the reservation wage,

[1]See Baily (1978), Shimer (1999), Acemoglu (2001), and Chetty (2006), etc.

unemployment duration, and unemployment rate. Therefore, the purpose of this thesis is analyzing how the optimal strategies of individuals respond to the tax and Unemployment Insurance mechanism by using a structural dynamic life-cycle model of job search. The optimal decision behavior respond to the inter-temporal effects of taxes and the unemployment compensation on individuals' lifetime labor force participation decisions, labor status transitions, consumption, and asset accumulation, as well as the search-related variables.

As the effect of taxation and Unemployment benefit is hard to identify and the model specification may not allow for a closed-form solution due to the complexity of the model, we solve and test the problem with numeric analysis. The ambiguity of effects of the taxation and Unemployment benefits on incentive to work describes that the effect is twofold so that there exist incentive and disincentive effect on the labor supply, and the intuition is as follows.

The disincentive effects of the unemployment compensation on incentive to work (reemployment incentives) has been well understood in the economics literature. Since Wisconsin state enacted an Unemployment Insurance law first in the United States (1932), the Unemployment Insurance program has become administered by the federal and state governments. It is designed to subsidize individuals who became unemployed and qualify for the eligibility requirements of Unemployment Insurance program. The unemployment benefits have considered as a critical source of income for those who became unemployed through no fault of their own. Since the benefits are no longer available once the unemployed agent returns to work, unemployment compensation is thought to bring with an unintended side effect that discourages

employment. In other words, increase in generosity of the unemployment compensations causes the unemployed to stay unemployed for a longer time, makes a long job search, and delays their returns to work. Empirical evidences also support that the hazard rate decreases with unemployment duration, so that long-term unemployment problem could arise. Interestingly but ironically, this implies that the unemployment insurance program pays the unemployed for being unemployed so that the Unemployment benefits become preferable to the wage incomes, which may create the unemployment trap or long-term unemployment problem.

The Unemployment Insurance replacement rate is often used to measure the generosity of the Unemployment Insurance benefits, which is the average Unemployment Insurance benefit amount as a percent of average weekly wage[2]. Therefore, higher Unemployment Insurance replacement rate implies more generous Unemployment Insurance benefits, and greater the disincentive to take a job offer in turn. Thus, those unemployed who receive the unemployment benefit may want to stay unemployed longer than those who do not receive the benefits.

On the other hand, the existence of the institutional features of the Unemployment Insurance, such as the benefit ceiling and maximum benefit-paying period, may work as a suppressor of the disincentive effects of the Unemployment Insurance policy (Mortensen 1970, 1977). This implies that both qualified and unqualified individuals for the Unemployment Insurance benefits will be affected by the changes in UI schedules as follows: First, the unemployed workers who are currently not eligible for the

[2]There are two types of Replacement rates commonly used. 1) Replacement rate = Weighted average of (claimant's weekly benefit amount / (Normal hourly wage×40Hours)). 2) Replacement rate = Weighted average of the weekly benefit amount / Weighted Average(Normal hourly wage×40Hours). *Source: United States Department of Labor.*

benefit, e.g. voluntary quitters, new entrants, benefit exhaustees, would find a job quicker to meet the eligibility requirement by searching more intensively or lowering their reservation wage. Second, qualified unemployed workers (the current benefit recipients) are also influenced by the same effects, although disincentive effects on employment offset during the remaining period that benefits can be paid. Therefore, improvement in Unemployment Insurance schedule makes current employment go further due to the possible labor market fluctuations in their life paths (the positive probability to be laid-off in the future), so that current employees would also be affected by the same impact. In sum, the effect of Unemployment Insurance on employment is theoretically ambiguous if the institutional features of Unemployment Insurance are taken into account, so that the effect has to be empirically and numerically tested.

The effect of taxation on the incentive to work is also theoretically twofold. First, the Substitution effects may occur so that taxes lower individual's take-home-pay or after-tax income, and they could lose their incentives to work (disincentive). Second, its disincentive effects on incentive to work may be offset by taxation if the tax system is progressive (Pissarides (1983), Ljungqvist and Sargent (1997)). Since progressive taxation takes higher percentage of income from high-wage jobs than low-wage jobs, the expected payoffs from high-wage jobs decrease as the tax system becomes more progressive. Then, the low-wage job is relatively more preferable so that the agents do not wait for a high-wage job offer, but find employment sooner by lowering their reservation wages.

In addition, changes in tax parameters may also affect after-tax distribution of

wage incomes. (Barnett, Caudill, and Jackson, 1989). Increase in tax rates reduces the mean wage offers of the after-tax wages, gives upward pressure to the reservation wage, and raises search duration. However, it may be offset by the downward pressure to the reservation wages from reduced wage offer dispersion, then the reward from holding out for a better job would be worse off, hence individuals find employment quicker than otherwise by lowering their reservation wage.

Although theory suggests taxation policy affects people's incentive to work in either way as explained above, we notice that it is difficult to estimate the sole impact of taxation on employment incentives, and empirical evidences hardly support it. Among the factors affecting incentives to work and labor force participation decisions, such as flexibility of labor market, mobility of labor supply, financial market variables, and monetary policies, micro-level effect of taxation programs on either intensive or extensive margin would be easily criticized due to this identification problem. The relation between progressivity of taxation and unemployment rate is hard to be verified as it is not convincible to define tax parameters as the most informative variable to explain the incentives to work.

Therefore, we suggest that the effect of taxation on incentive to work has to be examined within the implication of interaction between taxation and Unemployment Insurance program. The rationale behind their interaction is that the Unemployment Insurance benefits are also considered as taxable income. While employed individuals are commonly imposed federal and state income tax which vary with their income profiles, together with flat rate Unemployment Insurance tax, states typically with-

hold a flat rate of Unemployment Insurance benefits to cover taxes. The fact that Unemployment Insurance benefits and wage earnings face different taxation schedules implies the value of a dollar from wage income would be less than a dollar from the Unemployment benefits, hence increase in lower tax brackets would make unemployment benefits even more favorable, while increase in upper tax brackets may offset this effect since more progressive taxation program may raise the incentives to work as discussed above.

While we examine the effect of the unemployment insurance, we point that our object is far from minimizing the unemployment nor the distortion brought by tax and the Unemployment Insurance. Lending from macro perspectives, zero unemployment would not be optimal as literatures found a positive full-employment unemployment rate above 0% as an acceptable level due to non-cyclical unemployment, hence frictional unemployment and structural unemployment (Tobin, 1980). Considering that labor supply and demands are heterogenous, there are certainly people who became or stayed being unemployed to search for a work or transition for job turnover due to mismatch of the labor supply and labor demand. The reasons could be several; searching for a new job due to the mismatch, going back to school for human capital accumulation, or disutility from the work. Seasonal type of unemployment also take place in. Having the unemployment rate above 0% may also help suppress inflation from accelerating based on Non-Accelerating Inflation Rate of Unemployment (NAIRU). The Full Employment and Balanced Growth Act of 1879 defined the full employment rate as 3% for among individuals aged twenty and

over or more than 4% among individuals aged sixteen and over (Public law 95-523, Section 4, (e), Oct.27.1978). We do notice the full employment is far to be reached by these types of unemployment. Nevertheless, it is important to examine the labor supply mechanism of the suggested programs and their impacts to provide deeper insights to understand the bigger picture, that is the labor market. However, modeling financial incentives to reduce unemployment may have an interesting bite for policy discussions. Although the macro economic conditions are not much introduced in the dynamic model, we try to capture them by having exogenous shocks such as the lay-off probability[3]. It is critical to account for this involuntary unemployment, especially when analyzing the inter-temporal labor supply behavior, since the state dependence differs significantly by involuntary and voluntary unemployment (Haan and Uhlendorff, 2007). The matching problem is also counted in the model by having job offer probability and offer duration affected by the search variables.

In addition, we are also aware of the significance of analysis on the optimal level of taxation and Unemployment Insurance. However, the purpose of the thesis is not to implement a tax or Unemployment Insurance system to minimize the distortion and inefficiency as mentioned above, but it is limited to a micro model of labor supply[4]. Furthermore, the income tax may not induce significant economic distortions considering that it is generally accepted as one of the best possible way to ease the inequality in income distribution. Therefore, the optimization problem involves maximizing individuals' utility or welfare measured in consumption equivalent units rather than a social welfare function of a social planner.

[3]See Pissarides (2002) for the job search in business cycles.
[4]See Shephard (2010) for equilibrium effect of tax programs on search.

The remainder of the thesis is organized as follows. The next chapter discusses the relevant literatures. In Chapter 3, we review the Unemployment Isurance Program, taxes, and the Earned Income Tax Credit. Chapter 4 presents the dynamic model of the labor supply choice with taxes, Unemployment Insurance benefits, and the EITC. Chapter 5 presents the data, sample selection, and the estimation technique and the result. In Chapter 6, we conduct policy experiments to simulate the effect of the EITC, Unemployment Insurance, and income taxes on the variables in our interest with regional comparison. Chapter 8 concludes.

Chapter 2

Literature Review

Among several studies that analyze the micro effect of Unemployment Insurance and taxation system, Pissarides (1983), as quoted earlier, is the pioneering work to analyze the interaction between the Unemployment Insurance benefits and taxes using an equilibrium model of stochastic job match. It shows that the Unemployment Insurance has clear disincentive effects on employment due to higher reservation wage, while it can be offset by the progressive income tax. In his setup, the analysis are restricted to the risk neutral agents in infinite horizon and steady-state setting[5]. Unemployment Insurance benefits are assumed to be an arbitrary level , i.e. the benefit amounts are not a portion of past wages, and eligible for both voluntary employed and involuntary employed individuals. On-the-job-search is not allowed, hence there is no job-to-job transitions observable.

Blundell, Duncan, and Meghir (1998), using British tax reforms of the 1980's and the changing wage dispersion, empirically tested the effect of changes in wage rates and non-labor income on female labor supply. They notice that the British tax system raises an identification and estimation problems due to the discontinuities of British tax systems, sample compositions, and aggregate shocks. By combining a structural approach with instrumental variables, they extended the difference of

[5]Standard job search model generally assumes infinite or exogenous search horizon. Flinn and Heckman(1982), Meyer (1990) and Wolpin(1987, 1992), Krueger and Meyer (2002)

differences estimator and compare after-tax wage, income, and hours by groups, and show the effect of the tax reform would be different by each group's identity, and find negative income effects for women with children.

Card and Levine (2000) examined the effect of the offered benefit extension in the state of New Jersey to the adoption of 13 weeks of the extended unemployment in 1996, which is the impact of unemployment benefit extension on the distribution and the benefit receiving period of the benefit recipients. They find that the policy raised the fraction of claimants who exhausted the benefits by 1% to 3% and the average recipients collect the unemployment benefits for one extra week. The prolonged unemployment duration by the outcome of the extended unemployment insurance further affects job offer probabilities in turn. Using Belgian youth data, Cockx and Picchio (2011) examined the long-term unemployment duration on the transition probability from unemployment to employment for the 9 months of unemployment benefit periods after graduation. They found the one year delay of job market entry lowers the probability of accepting job offers from 60% to 16% for men and from 47% to 13% for women, which also implies the effects differs in male and female labor force, but it does not affect the first accepted wage after graduation. On the other hand, the past employment experience increases the wages for the future employment spell by 2.5% for additional one year of tenure period, lowers layoff rate, and the effect is greater for the female labor force.

The effect of the job loss, especially by layoff, on labor supply decision is also prevalent in search literature. Stevens (1997) examined the long-term effect of the job displacement on wage earnings using the Panel Study of Income Dynamics. She found

a substantial persistent effect of job displacement that lowers the expected earnings and wages by 9% 6 or more years after the displacement. Thus, he emphasized the importance of the further investigation on the job transition following displacement and job retention following reemployment.

Along with the impact of the changes in the benefit extension, the impact of the UI replacement rate has also examined in other dimensions. Fredriksson and Soderstrom (2008) estimated the impact of the unemployment compensation on unemployment using Swedish regional data. They shows that increase in generosity of the unemployment benefits contributes to higher unemployment and removing the benefit ceilings reduces the dispersion of regional unemployment, which implies the actual generosity of the UI compensation matters for regional unemployment. Increase in the replacement rate of 5 percent points raised unemployment by 25 percent in his settings. He argues the aggregate time series data may create severe identification problem so that estimation can be biased[6]. Thus, our thesis is also done in this vein so that we examine the impact of the level and changes in the taxes and Unemployment Insurance on labor supply in different regions.

Manning (2001) analyses the impact of the changes in tax system (both average and marginal taxes) on incentive to work using a search model in a infinite static framework. He argued there is no proper reason to believe that people can freely choose their hours of work, which is the standard presumption made in the canonical search model, and relaxes this assumption to investigate the robustness of the

[6]Rogers (1997) studied the relationship between unemployment duration and the spatial distribution of employment by analyzing access to employment. The access to employment differs across regions and information. Analysis on Replacement rates in County level differences is also done with the Welfare State Entitlement data set (Vliet and Caminada, 2012)

conventional results. Hence, in his setting, there is no flexibility in hours worked and the individuals consume their all income each period. He shows that the changes in tax rates have different effects at work by cases depending on the effectiveness of job search. Assuming off-the-job search are more or equally effective with on-the-job search and leisure is a normal good, an increase in the tax rate lowers the reservation wage and increases work. In other cases, its effect is ambiguous to be explained.

While examining the effect of income taxes, the Earned Income Tax Credit plays a critical role on labor supply behavior, since it largely repays the payroll taxes of workers with low to moderate wage earnings. Considering the key goal of the EITC is to redistribute incomes in the place where an unequal distribution exist, the EITC is considered as one of the more efficient way to aim the low income family without large distortion in their labor supply decisions. If not considered, there could be distortion in the asset accumulation of these workers, and estimation would be biased in turn. Keane and Moffitt (1998) conducted a pioneering work in estimating a structural model of labor supply and transfer programs. It examined the effect of the changes in EITC, Aid to Families with Dependent Children (AFDC), food stamp and other income subsidies using simulation estimation methods to recover household parameters. They found the EITC expansion raised the labor force participation and hours of work once participation effects are considered. Eissa and Liebman (1996) examined the female labor supply responses to the Tax Reform Act of 1986 which expanded the EITC by comparing single mothers to single mothers without children. They found single mothers with children increase their labor force participation by 1.4 percent comparing to single mothers without children. Meyer

and Rosenbaum (2001) estimate a structural model of employment to estimate the effect of the tax and the EITC policy along with other welfare programs, and found the labor supply decision is reflected by total taxes. Wu (2005) also examined the welfare and labor supply effect of the EITC on single mothers using a piecewise linear approximation and nonparametric structural labor supply function and data from the Current Population Survey March Supplement 1992-1997. The EITC is found to have little effect on the average hours of work of poor single mothers despite that it increases the family income of all affected group. Grogger (2003) found the EITC is a critical factor affecting the 2000's decrease in welfare use and increase in labor supply. Using the March CPS data from 1979-2000, His result shows that a $1,000 increases in the benefit ceiling causes 3.5% increase in employment and 1.2 weeks of work, and 7.2% for a $2,000 increases in benefit ceiling and 2.5 weeks of work. While many literature study the short-term effect of the EITC, Blank (2012) addresses the long-term effect of the EITC on employment, wages, job stability, and poverty of single mothers by estimating a dynamic discrete choice model using the PSID data. The model allows experience accumulation, heterogenous job offer rate, and the costs of employment transitions. She found that the EITC has significant positive impact on the part-time employment, and suggest the number of hours worked to be an institutional feature of the EITC schedule.

Shimer and Werning (2006) developed a dynamic model of job search to test for the optimal level of Unemployment Insurance. He argued the best measure of the micro-level welfare (individual welfare) of an unemployed workers is the after-tax reservation wage, although the degree of estimates precision remained questionable

due to the high responsiveness of the reservation wage to the unemployment benefits and other labor market policies. Therefore, a policy which raises the average after-tax reservation wage increases the benefit of individuals.

We notice that most of the studies examining the labor supply model of taxation and Unemployment Insurance rely on a static framework or derive a reduced-form specifications. However, a static labor supply model has not been effective for explaining inter-temporal labor supply decisions of individuals such as reemployment and job-to-job transitions, so as reduced-form approach does not estimates the fundamental parameters associated with the labor supply, hence estimates might not be precise. In addition, Heckman (1981) provided the significant evidence on true state dependence of the labor supply, and Haan and Uhlendorf (2007) also emphasized the needs for estimating the inter-temporal labor supply behavior in a dynamic setting. However, he applies the inter-temporal labor supply model with demand side rationing for estimation with involuntary unemployment.

Therefore, we combine a dynamic structural modeling with empirical estimation, that is, we propose a structural-form dynamic life-cycle model with taxation and Unemployment Insurance program to pin down the behavioral parameters using the Simulated Method of Moments. Implementing these two programs allows more detailed model of income earnings and unemployment benefits, so that it would give better understanding of work incentive of the individuals.

Chapter 3

Policy Review

3.1 Unemployment Insurance

In Chapter 3, we review the institutional details of the Unemployment Insurance and Taxation. Unemployment Insurance Benefits (also called unemployment compensation or unemployment insurance) are federal-state joint program for social benefits paid to former employees to provide temporary financial assistance for covering their basic needs. First enacted in the state of Wisconsin by Unemployment Insurance law in 1932, the Unemployment Insurance was nationally established by Social Security Act of 1935. The Unemployment Insurance is funded by the Federal Unemployment Tax Act (FUTA) which also covers the costs of administering other job service programs in each state. Employers must pay these taxes in general if the paid wage to workers are more than $1,500 in any quarter of a calendar year, or if they had at least one worker during any day of a week during 20 weeks in a calendar year. The current effective FUTA rate (on and after July 1, 2011) is 0.6%[7]. To be eligible for the benefits, the individual must have become unemployed through no fault of their own (i.e. typically through layoff due to downsizing of a company rather than personal performance) and who meet other state eligibility requirements for

[7]The FUTA tax rate is 6.0% of taxable wages of employees, and the taxable wage base is the first $7,000 paid in wages to each employee during a calendar year. However, the employer may be allowed a maximum credit of 5.4%, then the full credit reduces the tax rate from 6.0% to 0.6% which is the net FUTA tax rate.

the wage level or time worked during a base period to receive the benefits to qualify, which vary across the states. It implies that each state administers its own unemployment insurance program under the guidance of the federal government, hence states governments determine the eligibility for the unemployment compensation, benefit amounts, and the period length that the benefit can be paid. Therefore, the parameters in Unemployment Insurance applied in the model are also state-specific. The general amount of the benefits for eligible workers are around 40-50% up to a maximum amount depending on state law. Table 2 shows the average, minimum and maximum weekly benefit amounts by states in 2013. In the model, the individuals who voluntarily quit their job are not eligible for the benefit, but those who face the exogenous lay-off shock get the unemployment benefits in the model. In addition, an individual must be qualified for the State requirements or institutional details of the unemployment insurance to be eligible for the unemployment benefits as follows:

1. The unemployed person must have been employed and paid certain wages[8].

2. The person must be ready, willing and able to work. That is, he/she has to search actively for a job.

3. Benefit amounts are based on reported covered quarterly earnings while working. The amount of earnings and the number of quarters worked are used to determine the length and value of the unemployment benefit. In New York, the benefit

[8]The amount depends on the state requirement. In New York, the unemployed must have worked for at least two calendar quarters in his/her base period and paid at least $1,600 in wages. The base period also differ from state to state. In most States, the base period usually refers to the first four out of the last five completed calendar quarters prior to the time in which the claim is effective. Other eligibility requirements are not applied to simplify the model.

rate is one twenty-sixth of the high quarter wages paid in the base period with the maximum weekly rate of $405.

4. State governments set the maximum amount and the maximum period that benefits can be paid. Regular unemployment benefit amounts are paid for up to 26 weeks in most states, but extended unemployment benefits may be available during times of high unemployment, e.g. an unemployed agent can only receive 26 times his/her full weekly rate (may apply for extension) for a maximum of 26 weeks in New York[9].

The Unemployment Insurance compensation in the model is designed as:

$$b_t = \max(min_b, \min(\tau \cdot w_{t-1}, max_b)) \tag{1}$$

, where τ is the benefit rate on Unemployment Insurance compensation, min_b and max_b is the minimum and the maximum weekly benefit rates. In addition, the unemployment benefits are considered as taxable income. If the benefit recipients take the option to have this taxes withheld, 10% of the unemployment benefits are withheld in most states. We further assume all job search expenses are tax deductible, hence job search costs are not taken into account in the model[10]. We apply the all institutional features of the Unemployment Insurance compensation

[9]Since American Recovery and Reinvestment Act passed in Feb 2009, Extended Unemployment benefit has been available in some states for a specific purpose. the maximum benefit period has extended to 99 weeks depending on state legislation, although many states have been reducing the period to scale back the unemployment benefits as the unemployment rate falls.

[10]To have the job search expenses to be tax-deductible, the unemployed should keep track of their job search costs to report at the tax return. Deductible job search expenses includes travel and transportation expenses, resume, employment and outplacement agency fees and phone calls.

in the model[11]. Thus, we are able to conduct policy experiments on estimating the changes of the Unemployment Insurance parameters on labor participation decisions, unemployment, consumption and asset accumulation.

Table 1: Unemployment Rate, Minimum and Maximum Weekly Unemployment Benefit, 2010

State	UR	Min	Max	State	UR	Min	Max
Alabama	6.6	45	265	Montana	5.7	127	446
Alaska	6.4	56	442	Nebraska	3.9	70	362
Arizona	8.0	122	240	Nevada	10.2	16	402
Arkansas	7.4	81	451	New Hampshire	5.3	32	427
California	9.2	40	450	New Jersey	8.7	87	624
Colorado	7.0	25	513	New Mexico	6.9	76	457
Connecticut	7.8	15	666	New York	7.9	64	405
Delaware	6.8	20	330	North Carolina	8.5	46	535
DC	8.5	50	359	North Dakota	3.0	43	516
Florida	7.7	32	275	Ohio	7.3	115	557
Georgia	8.4	44	330	Oklahoma	5.2	16	386
Hawaii	4.8	5	534	Oregon	8.0	122	524
Idaho	6.5	72	357	Pennsylvania	7.7	70	581
Illinois	9.2	51	562	Puerto Rico	13.7	7	133
Indiana	7.9	37	390	Rhode Island	9.5	45	707
Iowa	4.8	59	486	South Carolina	8.0	42	326
Kansas	5.5	114	456	South Dakota	3.9	28	333
Kentucky	8.3	39	415	Tennessee	8.3	30	325
Louisiana	6.4	10	247	Texas	6.4	62	440
Maine	6.8	65	558	Utah	4.5	26	479
Maryland	6.7	50	430	Vermont	4.2	69	425
Massachusetts	6.9	33	1101	Virginia	5.6	54	378
Michigan	8.8	117	362	Virgin Island	3.1	33	491
Minnesota	5.2	24	610	Washington	7.1	143	604
Mississippi	9.0	30	235	West Virginia	6.6	24	424
Missouri	6.6	35	320	Wisconsin	6.9	54	363
				Wyoming	4.7	33	459

Source: Department of Labor, Comparison of State Unemployment Laws.

[11]See Atkinson and Micklewright (1991) for the significane of treating the instituional features of the unemployment benefit

3.2 Taxation Program

In this section, we discuss the personal income tax (income tax withholding) and Unemployment Insurance tax (FUTA tax) to be applied in the model. These taxes are generally imposed on both employers and employees. Although payroll taxes are consist of the Federal and State income tax, Social Security Tax, Medicare Tax, and Unemployment Insurance tax, we regret that we exclude the Social Security Tax and Medicare Tax in the model. Since the model are only able to capture the last employment spell, but not the complete employment spell in the life cycle, we do not implement the Social Security retirement benefits or disability benefit. Therefore, the Social Security tax without having the Social Security benefit will lead a bias in the asset accumulation, so as the Medicare tax.

Personal income tax T^p is collected on a wage-basis, where the effective tax rate increases as the amount to which the rate is applied increases. Tax rates increases progressively as income increases. Since the model and the data correspond from the calendar year of 1979, the Federal income tax schedules from years 1979 are parameterized in the model. Table 2 shows the federal income tax schedule for the years 2012-2013.

However, since the state income tax schedule vary across states and the model does not have 'States' as state variable, we generalize the case by grouping states into 4 regions to estimate the impact of taxes and identify state effects. We split

Table 2: Federal Income Tax: Single, 2012-2013.

Taxable income		Tax
$0	$8,025	10%
$8,025	$32,550	15% + $802.50
$32,550	$78,850	25% + $4,481.25
$78,850	$164,550	28% + $16,056.25
$164,550	$357,700	33% + $40,052.25
over $357,700		35% + $103.791.25

up the states into four groups by referring State Individual Income Tax Table (See A4. Federation of Tax Administors, Feb 2010): 1. States without an income tax, 2. States with flat income tax, 3. States with low average personal income tax (Range: 3.22%-6.9%) , 4. States with high average personal income tax(7.0%-13.3%), and estimate how changes in the income tax schedule affect each region. Table 3 shows the grouping of the states.

After grouping states to 4 regions, we choose a representative state for each region to implement a 'Regional income tax schedule' as a representative income tax in each region. Region 1 does not apply, since these states does not have personal income tax. Therefore, the Michigan state income tax schedule has selected for region 2, Mississippi for region 3, and New York State for region 4. Table 4 shows the devised Regional income tax schedule.

Unemployment Insurance tax is a financing source of the unemployment compensation, denoted as T^{ui}. Since Unemployment Insurance is employment-related insurance, it is purchased through, and paid by employers in principle. However, as

there are many studies lending both theoretical and empirical support for the wage and insurance trade-off, we adopt the idea that employees actually pay for their insurance benefit in the form of reduced or forgone wages, or we can consider a case that employers pay the tax and fully shift the burden onto employees alternatively. Therefore, UI tax is subtracted from an individual's wage income in this model. UI tax is covered by the Federal Unemployment Tax Act(FUTA), which authorize the Internal Revenue Service(IRS) to finance the cost of administering the Unemployment Insurance and other job services. At this point in time, the FUTA tax rate is 6.0 percent of taxable wages of employees who meet some requirements, but up to 5.4 percent can be offset if employers pay the UI tax in a timely manner, which implies the general net FUTA rate is 0.6 percent with $\$7,000$ of the taxable wage base. The existence of this ceiling implies the maximum net FUTA tax amount is $\$42.00(.006 \times \$7,000)$ per year.

However, UI tax applied in this model only captures the main feature of its original system in real, not the whole features to simplify the model so that we only consider the net FUTA tax rate.

$$T^{ui}(w) = \begin{cases} \tau_{ui} * w & \text{if } w \leq TT^{ui} \\ \tau_{ui} * TT^{ui} & \text{if } w > TT^{ui} \end{cases} \tag{2}$$

, where τ_{ui} is the net UI tax rate, and TT^{ui} is the taxable wage base or ceiling.

Table 3: States by Personal Income Tax

No Income Tax (Region 1)		**Flat Income Tax (Region 2)**		**Low Income Tax (Region 3)**		**High Income Tax (Region 4)**	
States	%	**States**	%	**States**	%	**States**	%
Alaska	-	Colorado	4.63	Alabama	5.0	Arkansas	7.0
Florida	-	Illinois	5.0	Arizona	4.54	California	12.3
Nevada	-	Indiana	3.4	Connecticut	6.7	Hawaii	11.0
South Dakota	-	Massachusetts	5.20	Delaware	6.6	Idaho	7.4
Texas	-	Michigan	4.25	Georgia	6.0	Iowa	8.98
Washington	-	North Carolina	5.8	Kansas	4.8	Maine	7.95
Wyoming	-	Pennsylvania	3.07	Kentucky	6.0	Minnesota	9.85
Tennessee	-	Utah	5.0	Louisiana	6.0	New Jersey	8.97
New Hampshire	-			Maryland	5.75	New York	8.82
				Mississippi	5.0	Vermont	8.95
				Missouri	6.0	Wisconsin	7.65
				Montana	6.9	Dist. Columbia	8.95
				Nebraska	6.84		
				New Mexico	4.9		
				North Dakota	3.22		
				Virginia	5.75		
				West Virginia	6.5		
n Sample	**693**	**n Sample**	**950**	**n Sample**	**1,086**	**n Sample**	**1,502**

Table 4: Regional income tax schedules

Region 2	Region 3 Taxable Income		Rate	Region 4 Taxable Income		Rate
	0	5000	3.00	0	8,200	4.00
	5000	10000	4.00	8,200	11,300	4.50
Flat	over 10000		5.00	11,300	13,350	5.25
Income Tax				13,350	20,550	5.90
4.25				20,550	77,150	6.45
				77,150	205,850	6.65
				205,850	1,029,250	6.85
				205,850	1,029,250	6.85
				205,850	1,029,250	6.85
				over 1,029,250		8.82

3.3 Earned Income Tax Credit

Enacted in 1975, the Federal Earned Income Tax Credit (EITC) is a refundable tax credit to certain employed workers with low to moderate wage income under $51,567 in 2013, and the requirement should be met to be eligible for the benefit, which depends on recipient's tax filing status. The amount of the Earned Income Tax Credit benefit depends both on the income of the recipient, filing status and the number of children. The Earned Income tax credit has been designed to be effective for low-income household especially to those who have qualifying children. Therefore, EITC benefits offset taxes and provide a supplement for wage income, and plays a critical role in equalizing income distributions especially in the place where an unequal wage differential exists (Wu, Perloff, and Golan, 2006). For the single recipients who earned the wage income below $14,350 without a qualifying child, they can receive a very small Earned Income Tax Credit benefit up to $487.00, which is the maximum Earned Income Tax Credit benefit for single. The maximum Earned Income Tax Credit benefit for the recipients with one qualifying child goes upto $3,250, $5,372 for those who have two qualifying children, and $6,044 with three or more qualifying children. Literatures find the EITC benefit has a significant effect on employment, so that it increases the work effort of single mothers, and ease the unequal wage distribution between the wealthy and the poor. To implement the EITC, we assume the EITC depend only on the number of the children not other states

for the simplification, considering the EITC benefit amount mostly varies across the number of the children. The actual amount of the EITC is calculated via TAXSIM, and the EITC schedule in the dynamic model is constructed by interpolation within the true value of the EITC amount.

Chapter 4

The Model

In this section, we derive a dynamic life-cycle search model to analyze the impact of taxation and Unemployment Insurance benefits on labor supply.

4.1 Model Assumption

Consider an individual who seeks to maximize the expected lifetime utility $U(\cdot)$ over consumption with the subjective discount factor $\beta \in (0, 1)$. The individual does not have flexibility over his/her hours of work, but works for the fixed hours of work, implying job offers arrive as wage-hours of work packages(Diamond, 1980). The utility function in this model takes a form of a Constant Relative Risk Aversion (CRRA),

$$U(c_t) = \frac{c_t^{1-\gamma}-1}{1-\gamma} + (\zeta_1 + \zeta_2 \log(t))$$

, where γ is the coefficient of risk-aversion and the second part of the equation implies the time-dependent leisure premium or disutility of work of the individual. This agent lies in a finite decision horizon through his/her working age (from high school graduation to the retirement), after which he retires and drops out of the labor force with no bequest motives. By using notations, he works for T periods, retires at T_R and lives for T_E periods. After he retires, it is assumed that there is no income source available, hence he lives off his savings afterwards.

Therefore, after applying taxation schedule described earlier, after-tax wage is given by:

$$\omega_t(w) = w_t - T_t(w_t) \tag{3}$$

, ω_t is the after-tax wage, w_t denotes the before tax wage, and T_t is the sum of Federal income tax, State personal income taxes, and Unemployment Insurance tax (FUTA tax).

Then, the individual's income level at each period is split into the following specifications:

$$I_t = \begin{cases} \omega_t(w_t) + eitc_{t,N} & \text{if employed} \\ b_t(w_{t-1}) & \text{if unemployed (by lay-off)} \\ 0 & \text{if unemployed (by own decision), or exhausted of UI benefits} \end{cases} \tag{4}$$

, where $eitc_{t,N}$ is the federal Earned Income Tax Credit amount which depends on t the tax year and n the number of children. We assume that children in the household are all qualified fot the EITC benefit, and there is no search cost incurred, since it is tax-deductible as mentioned earlier. Then, the budget constraint is

$$A_{t+1} = (A_t + I_t - c_t)(1 + r),\ a_{t+1} \geq 0 \tag{5}$$

letting A_0 present the initial asset level, the individual chooses sequential decision rules over his/her consumption level ($C_t^e,\ C_t^u$) and asset level at next period (A_{t+1}^e, A_{t+1}^u) regarding his labor status each period. There is no restriction for saving, but

there exist the natural borrowing limit B_t so that individuals can borrow up to the sum of their future income to pay back and to smooth the consumption across the time (Aiyagari 1994).

If unemployed, he is assumed to actively search for work as commonly assumed in search theory[12], spends search cost c as commonly assumed in search theory, and receives one i.i.d (independent and identically distributed) offer x with probability of λ^u each period drawn from a known wage offer distribution $F(\cdot)$ with $x \in [\overline{w}, \underline{w}]$, $0 < \underline{w} < \overline{w} < \infty$, and finite mean Ew. Therefore, jobs differ in their wage offers, but not in working hours as assumed earlier. He can either accept the offer to be matched with an employer or reject the offer to remain unemployed. Once an offer is rejected, it cannot be recalled at any point of time. If he/she becomes unemployed through no fault of his/her own[13], he gets the unemployed benefit b which depends on his past wage profiles during a specified period[14], or no potential income from any source otherwise.

While employed, his/her current wage depends on the two components, the initial wage offer with the current employer, o, and the number of the periods worked with the current employer, k_t, with an upper bound $\overline{k}$: $\omega(o, k_t) = o \exp(\kappa_1 k_t + \kappa_2 k_t^2)$. Therefore, his/her wage grows as the worker spends more years with the current em-

[12]By this assumption, we define the unemployment duration is the same as the search duration in our model. However, it is conditional on the reasons of the unemployment, and search duration and unemployment duration might be different. We have this assumption to capture the eligibility of the unemployment compensation that only active searchers can eligible for the benefits. Krueger and Mueller (2011) finds the the search duration declines over the the unemployment spell.

[13]For the details of the eligibility requirement for the Unemployment Insurance benefit, see section 3.1 for the details

[14]The maximum period that the UI benefits can be paid in the model is 2 quarters. See section 3.1

ployer until reaching the upper bound considering human capital accumulation. An employed individual faces a risk of being laid off (exogenous job loss) with probability of θ, yet there is also a chance to get an another wage offer from other potential employers brought by on-the-job-search with probability of λ^e.

The individual's decision rules involve the reservation wage w* at which he/she is indifferent between accepting an job offer to be employed and being unemployed. Denote $V_t^e(A_t, w_t)$ the expected value of accepting an job offer w_t when the individual holds asset A_t, and $V^u(A_t, b_t, s_t)$ the value of rejecting an offer and remaining unemployed when the individual receives the unemployment benefits b_t for s_t periods. Since V^u is independent of w_t and V^e is increasing in wages, the reservation wage $w*$ is the unique solution satisfying $V^u(A_t, w_{t-1}, k_{t-1}, s_t) = V_t^e(A_t, w*_t, 0)$. Therefore, the individual's optimal strategy is rejecting the job offer when $o_t < w*_t$ and accepting the offer when $o_t > w*_t$. Therefore, the following transitions can take place in a sequential manner while employed:

If not laid off and received an wage offer from another employer which is brought by on-the-job-search, he can accept the offer to change his career (at a new employer), reject the offer to stay with the current employer, or reject the offer and voluntarily quit his current job to be unemployed (i.e. not eligible for the unemployment benefit).

If not laid off and not received an wage offer, he can either stay in the current job or become unemployed (i.e. voluntary quit; not eligible for the unemployment benefit).

If laid off and received an wage offer, he can either accept the offer to change his career or reject it to become unemployed (i.e. eligible for the unemployment benefit until the benefit exhausts).

If laid off and not received any wage offer, he is obliged to be unemployed (i.e. eligible for the unemployment benefit until the benefit exhausts).

4.2 Dynamic Modelling

The model is based on the canonical model of job search pioneered by Mortensen (1986) and Rust (1997). It also has been largely affected and motivated by Rendon (2004).

We first construct the present discounted value function of being retired (i.e. out of labor force), V_t^R, $t = T_R, ..., T_E$ with asset level A_t, and it is defined as:

$$V_t^R(A_t) = \max_{\{A\}_{s=t+1}^{T_E}} \sum_{s=t}^{T_E} \beta^{s-t} U\left(A_s - \frac{A_{s+1}}{1+r}\right), \tag{6}$$

with $A_{T_{E+1}} = 0$, since there is no bequest motives, where β is the discount factor and $\beta \in (0, 1)$.

The expected present value function for the employed with asset holdings A_t and

after-tax wage ω_t depends on initial wage offer o and the number of periods of current employment (tenure) k_t as well as the type of the taxation applied:

$$V_t^e(A_t, o, k_t, N_t) = \max_{A_{t+1}^e \geq B_{t+1}} \left\{ U\left(A_t + \omega_t(w_t(o,k_t), N_t) - \frac{A_{t+1}^e}{1+r} \right) + \beta \cdot \delta_t \int \left[(1-\theta) \right.\right.$$

$$\left(\lambda^e \int \max[V_{t+1}^e(A_{t+1}^e, \omega_{t+1}(x,0), N_{t+1}), V_{t+1}^e(A_{t+1}^e, \omega_{t+1}(w_{t+1}(o,k_{t+1}), N_{t+1})),\right.$$

$$\left. V_{t+1}^u(A_{t+1}^u, 0, N_{t+1})] dF(x) + (1-\lambda^e) \max[V_{t+1}^e(A_{t+1}^e, \omega_{t+1}(w_{t+1}), N_{t+1}), V_{t+1}^u(A_{t+1}^u, 0, N_{t+1})] \right)$$

$$\left. \left. + \theta(1-\lambda^e) V_{t+1}^u(A_{t+1}^u, b_{t+1}, N_t) \right] \right\} dG(N).$$

$$, k_{t+1} = \overline{k} \text{ if } k_t = \overline{k}, \tag{7}$$

where N_t is a 2×1 vector that has two entries of number of the children who is qualified for the EITC benefit in the household, and the period after the delivery of the youngest child. We construct the second entry which enables to tracks the time gap between the last delivery and the current period by using the unemployment duration s_t and the tenure period k_t. The number of children follows a stochastic Markov process with probability transition matrices depending on the time t. Therefore, $G(N_t)$ denotes the set of the probability distribution of the number of children next period if current number of children is N_t. We construct the transition function $G(N_t)$ using NLSY79 sub-sample. The transition matrix is 4/times4 lower triangular matrix by assuming the maximum number of children to be 3 and there is no get-out

of the number of children next period. Furthermore, since the time unit in the model is quarters, we assume the number of children can be added 2 quarters after the last delivery. Therefore, transition probability becomes zero if the duration is less than 2 quarters. Appendix shows the transition matrix from the year of 1979 to 1994 after which the data is not observable in NLSY79, we use the average transition matrix thereafter.

The Unemployment compensation b_{t+1} is compelled to be zero (i.e. not eligible for the unemployment insurance) if unemployment is the result of a voluntary quit. The solution of the problem, reservation wage w^*, which depends on the level of asset holdings and unemployment benefit, satisfies by definition, $w_t^*(A, b, s) = \{w | V_t^e(A, w, 0) \geq V_t^u(A, b, s) > V_t^e(A, w-1, 0)$.

Then, Let V_t^u, in the form of Bellman's equation of dynamic programming, denotes the expected present value given asset holding A_t for the unemployed at time t:

$$
\begin{aligned}
V_t^u(A_t, w_{t-1}, k_{t-1}, s_t, N_t) = \max_{A_{t+1}^u \geq B_{t+1}} \Bigg\{ & U\left(A_t + b_t(w_{t-1}, k_{t-1}, s_t) - \frac{A_{t+1}^u}{1+r}\right) \\
& + \beta \cdot \delta_t \int \Bigg[\lambda^u \int \max[V_{t+1}^e(A_{t+1}^e, w(x), N_{t+1}), V_{t+1}^u(A_{t+1}^u, b_{t+1}, N_{t+1})] dF(x) + \\
& (1-\lambda^u) V_{t+1}^u(A_{t+1}^u, b_{t+1}, N_{t+1}) \Bigg] \Bigg\} dG(N) \\
& , b_{t+1} = 0 \text{ if } s_t \geq \overline{s}.
\end{aligned}
\tag{8}
$$

V_t^u also depends on his/her past income profile w_{t-1} during the base period, the number of periods he/she has been employed with an employer k_{t-1}, and the current spell of unemployment duration s_t, since the amount of unemployment compensation to each claimant, b_t, depends on those state variables. The number of children N_t does not affects neither the budget constraint and the current utility of the individual, Since the EITC benefit is only available for the paid workers, it does not affect the budget constraint of the unemployed[15].

The last constraint implies the regulation on the maximum period that benefits can be paid. Hence, once the unemployment compensation is exhausted, there needs a fresh employment spell to get the unemployment benefits, or no compensation otherwise. The wage offer distribution $F(\cdot)$ is assumed to be not affected by the tax and transfer system, so that pre-tax and after-tax distribution of wages are the same, although most general equilibrium models suggest there would be some impact of the tax system on the pre-wage distribution (Manning 2001). We assume the effect is small and ignorable for now, but the study on the effect of taxation and transfers on wage offer distribution will be followed to relax this assumption.

Figure 1 and figure 2 depicts the policy rules for asset accumulation, reservation wages and the expected accepted wages when taxation applied and taxation excluded in the model respectively. As the effect of taxation program on incentive to work is difficult to identify among factors not captured in the model, e.g. aggregate shocks, real business cycle, and health condition, etc., it would be only identifiable by testing the effect of taxation on the search variables given the existing Unemployment

[15]We assume the number of the children only affect the amount of the EITC benefit. Joint utility or household production is not considered in the model.

Insurance system. That is, the variations of each policy rule between figure 1 and figure 2 help to identify the effect of taxation on incentive to work.

Figure 1.a presents the conditional reservation wage profiles depending on asset levels at period 1. They are increasing functions in asset levels, which implies wealthier agents are more selective[16]. The benchmark is the reservation wages of the individual who has received the Unemployment Insurance compensation for 1 quarter since he/she claimed the unemployment benefit. If the individual gets the UI benefits for 1 more quarter, the individual lowers his/her reservation wages to find a job sooner since he/she is no longer eligible for the benefits next period[17], hence employment becomes more favourable than last period in turn. Back to the benchmark, an individual who is getting higher unemployment benefits (who had higher past wage profiles) has a higher reservation wage than the benchmark agent, but their reservation wages become the same once the benefits exhaust.

Figure 1.b illustrates the expected accepted wages conditional on the given reservation wages. Along with the reservation wages, the expected accepted wage is also increasing in asset levels, but the difference in the accepted wages are smaller than that of reservation wage, since it is assumed that the arrival rate and the wage offer distribution are not affected by the length of the unemployment spells as mentioned, which implies random hiring from the demand side of labor market. (See Berg (1994) for treatment for the arrival rate on duration of the search.) We do notice, however, in the standard search model the returns to search is assumed to be a decreasing

[16]See Bloeman and Stancanelli (2001) for impact of wealth on the reservation wage.

[17]The maximum period that benefits can be paid is assumed to be 26 weeks as in New York, it is equivalent to around 2 quarters in the model. Therefore, the unemployment insurance benefits exhaust after 2 quarters.

function in search duration along with the other assumption that employers may use information for screening applicants by their labor status, experience, or unemployment duration (See Blanchard and Diamond (1993) for the effect of the search duration on rankings). This assumption on ranking will be tested in the model.

Figure 1.c and 1.d illustrates the policy rules for asset accumulation at period 1. When employed, the individual accumulate wealth to smooth their consumptions against income shock until reaching a steady level of wealth, e.g. it is an insurance for the future unemployment spells. While unemployed and getting unemployment benefits, the individual uses their previously accumulated wealth to finance search for a job and consumption. If the unemployment benefit is more than enough to maintain the consumption, the individual saves some portion of the benefits until he/she can afford to do so, and decumulate wealth thereafter, similar to the employed agents.

Sub-figures in figure 2 are listed in the same order as figure 1. When taxation comes in the model, the unemployment benefits become relatively more valuable than otherwise, since the wage earnings of the employed individuals face higher tax liabilities as mentioned earlier. The variance of reservation wages between the two figures is around $500 all over. Considering that the past quarterly wage of un unemployed agent with quarterly unemployment benefits of $2187 is $4768, his/her total tax liabilities from wage earnings is $1058.655 using the tax parameters in the model. The variance of the reservation wages is less than the tax liabilities, since the unemployment benefit is not permanent, but constrained by the maximum period that benefits can be paid. Therefore, the unemployed individuals may stay unemployed

and search for longer period by raising their reservation wages to maintain their consumption level. The expected accepted wages also increase as the reservation wages increase in turn, but at a lower rate. If an worker faces the income taxation schedules, he/she accumulates wealth to smooth consumption as before, but reaches at the steady state quicker than the unemployed, then starts to decumulate assets thereafter. The variation of the policy rule of the unemployed is not effective, since they are not affected by the taxation schedule as much as the employed individuals.

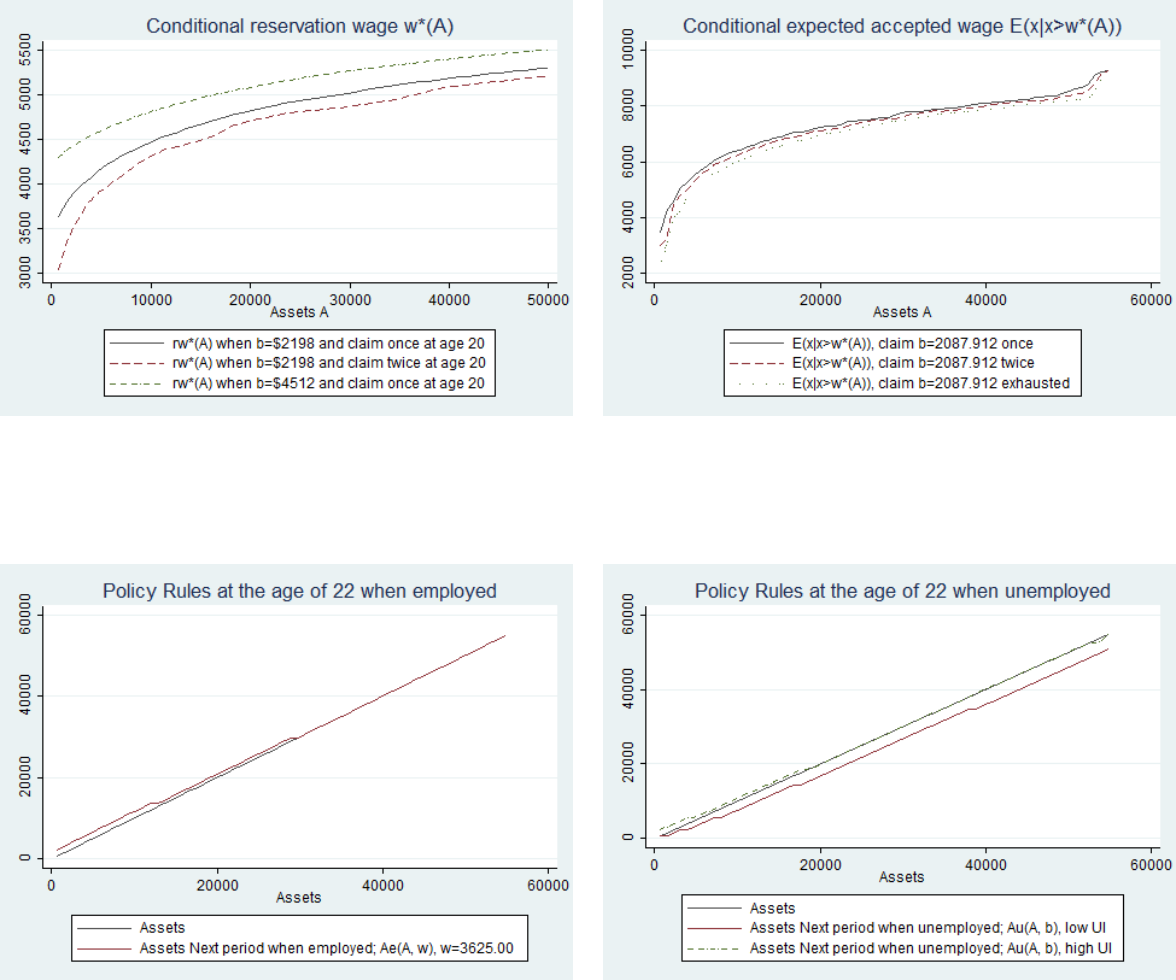

Figure 1: Reservation Wages, Expected Accepted Wages, Policy Rules for Assets When Employed and Unemployed, [Taxation not applied].

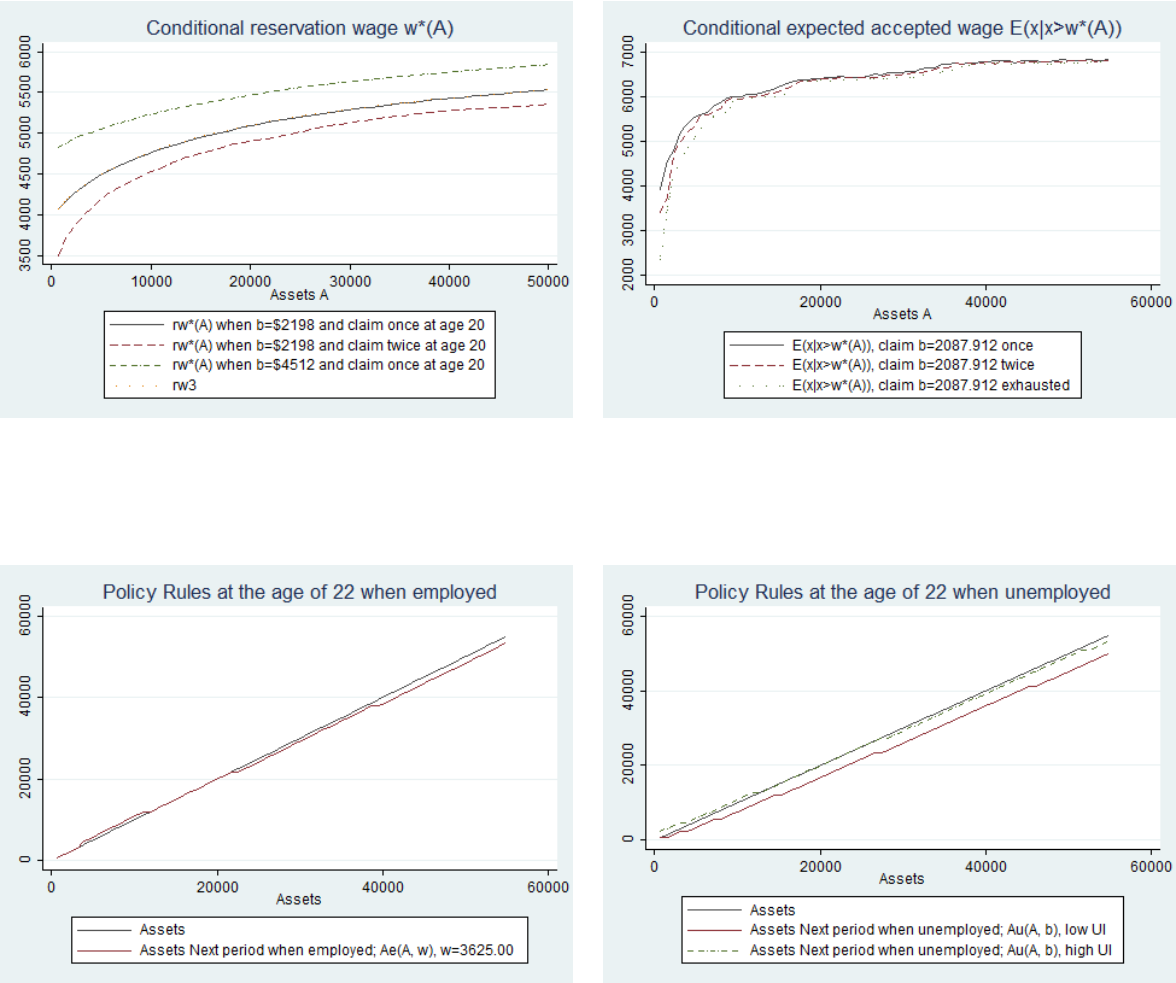

Figure 2: Reservation Wages, Expected Accepted Wages, Policy Rules for Assets When Employed and Unemployed, [Taxation applied].

Chapter 5

Data and Estimation

We estimate the model using the National Longitudinal Survey of Youth79 (NLSY79) sub-sample from the years 1979-2008. The NLSY79 is a panel data surveys conducted by the U.S. Department of Labor's Bureau of Labor Statistics, which consists of national representative sample of 12,686 youth born in the year of 1957-1964 when they were aged 14-21 when first interviewed in 1979. Since its commencement in 1979, the survey was conducted annually through 1994, and biennially thereafter, and contains information related to personal characteristics, labor market behavior (labor status and transitions), educational experiences, family background (marital status, household composition, fertility, and child care), government program participation, military experience, health issues, income and assets. Conclusively, we observe weekly arrays of employment status, hours worked at each job (if an individual holds dual jobs), reason for unemployment together with wealth and wage earnings.

Our sample is high school graduated male household heads, who had never got college degrees or above, nor served in the military[18]. Since the model does not capture the labor productivity or search intensity and assumes workers are identical in labor productivity, high school graduates are selected to exclude wage differential

[18]The model corresponds more to a male than a female labor supply. See Triest (1990) for discussion on the gender difference of income tax impact on the labor supply.

across labor markets which differ in productivity[19]. In addition, we exclude individuals born before 1961 whose career started before 1978 to construct a complete employment spell so that there is no left-censored observation. Our analysis is based on calendar quarters as the basic unit of time, so that we aggregate the data to quarters, and construct the complete work history and the moment transitions. Detailed explanation is provided in the Appendix.

5.1 Taxes

Since this thesis aims to study the micro-level effects of the income tax and unemployment benefits, we compute taxes at the individual level. Tax schedules vary with each individual by the wage earnings and residence of states, and we use the NLSY Geogode data and NBER TAXSIM program to calculate the income tax liabilities, and after tax earnings in turn. The taxes in the model include the Federal income tax, State income tax, and Unemployment Insurance tax. In addition, we assume employees bear the employers' share of the payroll taxes in the form of wages.

NLSY79 Geocode Data is available on a limited basis and includes specified data with the geographic region of the respondents' state, county, and metropolitan statistical area of residence. Along with original NLSY79 data, these variables are used to link respondents with publicly available information on state taxation policy, local economic conditions and other characteristics of communities, hence state-specific

[19]See Acemoglu and Shimer (1999) for the impact of Unemployment Insurance on productivity. Christensen, Lentz, Mortensen, Neumann, Werwatz (2004) and Yoon (1981) provides good explanation on the search intensity and the wage paid.

factors can be applied to construct a derivative data affected by state laws and regulations, e.g. wage earnings after state-taxes and state level unemployment compensation. By knowing respondents' residence of states, we can compute state income taxes by using states' tax codes.

TAXSIM is a micro-simulation model of the U.S federal and state income tax systems, which covers 1960-2013 for federal tax and 1977-2011 for state tax system. It enables to calculate the federal and state income liabilities from the uploaded data by users. By putting our sample inputs from NLSY79, the TAXSIM returns Federal, State tax income liabilities, and Earned Income Credit (Total Federal) for the years 1979-2008 that we use.

5.2 Descriptive Statistics

5.2.1 NLSY79

Table 5 shows the descriptive statistics on sex, race, marital status, number of children, education level, average asset, average wage, average weekly unemployment benefit amount, and average unemployment rate of the full NLSY79 data before the sample selection. It shows 51.32% are male and 35.28% hold high school graduates. Since our sample is the male high school graduates who born before 1961, it takes 33.49% out of 12,686 NLSY79 respondents in the year of 1979.

Table 5: Descriptive Statistics in 1979, NLSY79

Variables		percentage
Sex		
	Male	51.32%
	Female	48.68%
Race		
	Hispanic or Latino	15.71%
	Black non-hispanic	25.02%
	Non-Black non-Hispanic	59.20%
Marital Status		
	Ever married	83.29%
	Ever divorced	31.29%
Number of Chilren		
	0	73.12%
	1	11.55%
	2	9.54%
	3	5.12%
Education		
	Less than high school diploma	13.87%
	High school graduates, no college	39.28%
	College or associate's degree	19.17%
	Bachelor's degree or higher	25.21%
Others		
	Avg. Asset	$5,093
	Avg. Wage	$3,714
	Avg. Weekly Benefit Amount	$357.18
	Avg. Unemployment rate	64.65%

5.2.2 Our sample

We have sample size of 4,249 male high school graduates who was born before 1961 in the year of 1979, and the sample size of each tax region is reported earlier in Table 3.

Table 6 reports the demographical statistics of the samples in all 4 regions in 4th quarter in the year of 1979. It shows the there are 14.9% of Hispanic or Latinos, 16.78% of Black non-hispanics, and 61.79% of non-black and non-hispanic individuals. 23.29% of the sample have experienced the marriage, and the majority of the samples has no children, not surprising considering the age of the high school graduates, 2.7% has 1, 0.60% has2, and 12.00% has 3 children.

Table 6: Summary statistics 1, all regions, 4th Q, 1979

Variables		Percentage
Race		
	Hispanic or Latino	14.90%
	Black non-hispanic	16.78%
	Non-Black non-Hispanic	61.79%
Marital Status		
	Ever married	23.29%
	Ever divorced	11.14%
Number of Chilren		
0		93.57%
1		2.70%
2		0.60%
3		2.00%

Table 7 reports summary statistics for job transitions in our sample (including all regions) right after the high school graduation. It shows Average first unemployment duration and employment transitions such as employment to employment, employ-

ment to unemployment, unemployment to unemployment, and unemployment to employment transitions by reasons. The average first unemployment duration (from high school graduation till first employment) is 3.52 quarters. 37.27% out of total unemployed become employed in the next quarter, and 56.85% stays unemployed. Out of total employed individuals, 52.15% stayed employed, 23.13% of these workers stayed with the same employer, 9.28% quit their job voluntarily and found a new employer, and 19.19% were laid off and accepted a job offer. 67.24% of current workers became unemployed by lay-off, 23.48% quit their job and became unemployed, and 11.28% became unemployed by other reasons.

Table 8 shows the reasons of job loss of the unemployed in the 4th quarter, 1979. Reasons of job loss for both transition from unemployment to employment and the transition from employment to employment can be attained from this statistics. Voluntary quit mostly implies job losses without meeting the eligibility requirement of the Unemployment Insurance benefits. Our sample shows the portion of voluntary quitters (61.63%) are more than those who were laid off (38.37%). Among the reasons of the job loss, layoff by job elimination took the highest percentage of 24.01%. Among the voluntary quitters, 29.02% out of the sample quit to take another job, which implies they received either on-the-job offer or off-the-job offer depending on the labor status.

Table 9 reports average assets, average quarterly wage, and total unemployment rate by income tax regions in the calendar years 1986, 1996, and 2008. Region 4, the states with the income tax rate generally shows the highest unemployment rate and lowest average wage income in our sample. The unemployment rate in 1996 is

the highest among 3 years due to the 1996 recession. Average weekly unemployment benefits ranges from $300-$400 across the states, but the amount has not shown a lot of changes across time, which implies the unemployment benefit schedules has not changed much.

Table 7: Summary Statistics 2, all regions, 1979

Variables	
Average first unemployment duration spell	3.5213 (quarters)
Unemployment to employment	37.27%
Unemployment to unemployment	56.85%
Employment to employment	52.15%
stay with current employer	71.13%
quit and turn-over	9.28%
lay-off and turn-over	19.19%
Employment to unemployment	43.15%
by voluntary quit	23.48%
by lay-off	67.24%
by other reasons	11.28%

Table 8: Reasons of job loss, 4th quarter in 1979

Reason	Description	
Layoff		38.37%
	Layoff, job eliminated	24.01%
	Discharged or fired	14.36%
Voluntary Quit		61.63%
	Work place closed	4.90%
	Quit look for another job	1.38%
	Quit to take another job	20.04%
	Moved to another geographical area	0.19%
	Quit to spend more time with family	0.90%
	Quit because didn't like job, boss, coworkers, pay	0.24%
	Quit to attend training	9.80%

Table 9: Average Asset, Average Quarterly Wage, % Unemployed by regions

year	Region	Avg. Asset	Avg. Wage	Avg. WBA	% Unemp
1986	1	8791	6824	$385.85	10.45
	2	8012	5424	$368.21	12.97
	3	9014	5781	$379.98	12.36
	4	8913	5381	$401.32	17.32
1996	1	16983	7291	$299.50	15.25
	2	9961	7114	$309.14	14.15
	3	14991	6812	$378.24	14.21
	4	11871	7368	$402.50	16.14
2008	1	29049	12179	$368.12	8.18
	2	20124	8901	$365.23	9.17
	3	25761	9021	$389.71	11.17
	4	24923	8539	$397.13	15.15

5.3 Estimation: Simulated Method of Moments

Simulated method of moments (SMM, also called the method of simulated moments) is an estimation technique which allows us to obtain GMM estimators by generating simulated data according to the dynamic model. The procedure involves computing policy rules for each parameter set, so that we generate the simulated life cycle paths using these sequence of choices. The simulated data is to be matched to the true observed data, then the SMM estimate is a parameter set which minimize the distance between the moments of the simulated data and the moments of the observed data, where the estimated parameter set $\Theta = \{\mu_w, \sigma_w, \lambda_e, \lambda_u, \kappa_1, \kappa_2, \gamma, \iota\}$ minimizes the weighted average distance function:

$$g(\Theta) = \sum_{j=1}^{J} \frac{(m_j - \hat{m}_j)^2}{\hat{m}_j}, \tag{9}$$

where m and $\hat{m}$ are predicted moments to calculate and the observed sample moments, respectively.

The moment conditions used in the estimation consists of probability transition matrices of realizing each choice distributions as follow:

1. Wage distributions (4 moments, 29 years)
2. Asset distributions (4 moments, 29 years)
3. Employment status (2 moments, 29 years)

4. Unemployment transitions from employment (2 moments, 29 years)

5. Employment transitions from unemployment (2 moments, 29 years)

5.4 Estimation Results

The parameter set recovered by the simulated method of moments are reported in table 10 and 11. The discount rate and the interest rate are not estimated, but fixed at 0.98 and 0.015 respectively. In Region 4, the mean of the log wage distribution is 7.132781, lower than the sample mean of 8.155. The standard deviation is estimated at 0.258. The offer arrival rate while employed is 0.2461, overestimated to the same parameter found by Rendon (2006), but the offer arrival rate while unemployed is underestimated at 0.8182. The lay-off rate is 0.083. The parameter in wage growth function is 0.0099 (linear) and -0.00039 which implies the wage increases at a decreasing rate over time. The degree of risk aversion is 1.5103 and the tightness of the borrowing constraint is 0.0932. The monetary value of the leisure premium is 0.01521. The parameter estimates correspond to the data and literature rationally overall.

Table 12-15 provide the one-at-a-time parameter sensitivity studies to test the robustness of the results of the model, that is we move one parameter variable, and keep other parameters at their baseline values. It shows the effect of the recovered parameters on the variable variations of the model such as wages, assets, consumption and unemployment rates. Increase in the mean and the variance of log wages raise

wages, assets, and consumption, but also increases unemployment rates. Increase in both job offer probability when employed λ_e and unemployed λ_u also raise wage and consumption, but lowers unemployment rate due to more job matchings. However, they bring the opposite impact to the assets, while the on-the-job offer probability lowers asset levels, but the off-the-job offer probability raises the assets, which implies the effects depends on the relative effectiveness between the on-the-job and the off-the-job offer. Increase in the layoff probability θ raises the unemployment rate, hence lowers wages, assets, and consumption levels in turn. Increase in the parameters in wage functions implies faster wage growth with the tenure period, and it raises wages, assets, and consumption levels, but it has very small to no effect on unemployment. Higher coefficient of the risk aversion implies more risk averse individuals, hence it lowers unemployment rate, wages, and consumption, but still accumulate asset levels to hedge against future unemployment spells. Increase in the leisure premium brings more substitution on the incentive to work, hence it lowers wages, assets, consumption levels, and unemployment rate.

Table 10: Parameter Description

Prameters	Despription
μ_w	Mean of log wage dbn
σ_w	St. dev. of log wage dbn
λ_e	Prob. wage offer, employed
λ_u	Prob. wage offer, umemployed
θ	Prob. layoff
κ_1	Wage growth, linear
κ_2	Wage growth, quadrat
γ	Degree of risk aversion
ι	Tightness of the borrowing constraint
υ	Leisure premium
β	Discount factor
r	Interest rate

Table 11: Parameter Estimates

Param	Region1	Region 2	Region 3	Region 4	Note
μ_w	7.43212	6.87463	7.83124	7.132781	SMM
	(0.00934)	(0.01874)	(0.05239)	(0.02576)	
σ_w	0.895141	0.876545	1.000745	0.892491	SMM
	(0.00657)	(0.002564)	(0.06527)	(0.01978)	
λ_e	0.421331	0.389971	0.351844	0.246109	SMM
	(0.00921)	(0.01391)	(0.06342)	(0.04976)	
λ_u	0.792373	0.839261	0.835263	0.818161	SMM
	(0.00923)	(0.00893)	(0.00529)	(0.03454)	
θ	0.098371	0.07053	0.050123	0.083123	SMM
	(0.00898)	(0.00134)	(0.00494)	(0.002913)	
κ_1	0.8131E-02	0.8813E-02	0.7887E-02	0.986E-02	SMM
	(4.71E-04)	(5.78E-04)	(3.45E-04)	(6.5E-05)	
κ_2	-1.897E-04	-2.194E-04	-1.284E-04	-3.9E-04	SMM
	(1.1E-07)	(2.8E-07)	(1.2E-06)	(2.3E-07)	
γ	1.48765	1.49812	2.12345	1.510325	SMM
	(0.00781)	(0.01002)	(0.00912)	(0.01789)	
ι	0.08172	0.03234	0.13234	0.093182	SMM
	0.00341	0.00318	(0.00101)	(0.00672)	
υ	1.0121E-02	0.781E-03	0.9123E-03	1.521E-02	SMM
	(2.2E-04)	(1.8E-05)	(2.1E-04)	(2.6E-05)	
β		0.98			Calibration
r		0.015			Calibration

Table 12: Sensitivity check: Region 1

Parameters		μ_w	σ_w	λ_e	λ_u	θ	κ_1	κ_2	γ	υ
SMM		6.8746	0.8765	0.3899	0.8392	0.0705	8.81E-03	-2.19E-04	1.4981	7.81E-04
variation		0.0187	0.0025	0.0139	0.0089	0.0013	5.78E-04	2.80E-07	0.0100	1.80E-05
Period	value									
Wage 1980	3461.56	34.19	37.35	1.46	2.01	-25.31	0.02	7.8	-9.15	-41.15
Wage 1985	6819.41	38.72	40.17	1.89	4.12	-57.15	9.14	20.55	-12.44	-62.55
Wage 1990	7015.67	44.41	39.15	3.15	4.61	-96.69	19.99	61.12	-29.51	-103.77
Asset 1985	8799.41	79.98	69.76	-49.44	50.98	-157.14	77.61	81.55	78.12	-45.16
Asset 1990	15437.77	171.45	104.52	-78.61	101.71	-406.81	132.41	104.51	299.01	-90.14
Con. 1980	3014.59	15.98	16.76	12	49.51	-47.49	14.04	46.41	-39.51	-13
Con. 1985	5814.15	38.01	29.18	58	19.1	-119.08	61.55	72.82	-78.91	-40.12
Con. 1990	6243.18	48.71	44.11	67	87.15	-198.17	67.19	81.88	-98.14	-79.14
UR 1980	59.11	0.58	0.08	-1.15	-1.98	0.19	0.01	0	-1.05	-0.32
UR 1985	10.46	0.81	0.34	-1.68	-1.81	0.91	0.06	0.04	-1.83	-0.34
UR 1990	12.59	0.65	0.54	-2.03	-1.62	1.46	0.02	0.01	-2.19	-0.29

Table 13: Sensitivity check: Region 2

Parameters		μ_w	σ_w	λ_e	λ_u	θ	κ_1	κ_2	γ	υ
SMM		6.8746	0.8765	0.3899	0.8392	0.0705	8.81E-03	-2.19E-04	1.4981	7.81E-04
variation		0.01874	0.0025	0.0139	0.0089	0.0013	5.78E-04	2.80E-07	0.01002	1.80E-05
Period	value									
Wage 1980	3178.59	-15.59	31.19	2.12	1.12	-7.09	1.39	2.64	-3.12	-31.58
Wage 1985	5417.87	27.91	41.51	3.09	2.56	-35.69	22.21	22.01	-5.91	-98.61
Wage 1990	6548.97	29.23	49.79	3.18	3.19	-113.87	46.57	31.41	-6.25	-158.12
Asset 1985	8017.98	54.54	111.54	-21.03	46.71	-301.66	131.95	33.87	75.57	-101.46
Asset 1990	10378.25	176.51	166.41	-57.66	69.53	-398.75	194.43	78.51	268.47	-206.71
Con. 1980	2681.43	12.89	7.78	23	38.09	-90.01	30.31	20.58	-38.51	-37.47
Con. 1985	5142.87	37.19	23.68	41	42.56	-101.83	81.55	71.89	-67.46	-92.15
Con. 1990	7578.61	41.91	35.15	62	66.07	-201.99	162.19	101.31	-49.61	-191.48
UR 1980	59.17	0.13	0.25	-1.88	-1.69	0.57	0.19	0.23	-2.12	-1.31
UR 1985	12.98	0.21	0.29	-2.14	-0.97	2.87	0.49	0.67	-1.91	-1.58
UR 1990	13.56	0.31	0.37	-2.65	-1.29	2.31	0.48	1.12	-2.28	-1.59

Table 14: Sensitivity check: Region 3

Parameters		μ_w	σ_w	λ_e	λ_u	θ	κ_1	κ_2	γ	υ
SMM		7.8312	1.0007	0.24610	0.8352	0.0501	7.89E-03	-1.28E-04	2.1234	9.12E-04
variation		0.0523	0.0652	0.0634	0.0052	0.0049	3.45E-04	1.20E-06	0.00912	2.10E-04
Period	value									
Wage 1980	3043.18	22.78	35.28	1.17	1.76	-8.15	1.41	10.54	-2.55	-18.14
Wage 1985	5781.57	28.32	46.77	2.01	3.16	-27.43	21.76	22.69	-5.89	-89.76
Wage 1990	6749.14	33.99	53.91	3.21	3.78	-97.14	41.54	45.71	-6.79	-143.15
Asset 1985	9984.15	52.17	109.41	-26.45	67.85	-275.14	101.76	71.48	89.51	-39.14
Asset 1990	17635.76	126.54	167.41	-38.74	100.41	-439.61	205.97	115.66	314.54	-201.45
Con. 1980	2719.89	3.89	6.47	41	39.86	-81.54	18.41	16.71	-42.68	-15.41
Con. 1985	5431.65	27.95	37.78	56	46.14	-132.46	78.14	80.11	-79.77	-57.27
Con. 1990	6874.11	36.11	42.98	62	68.55	-198.12	101.43	98.47	-53.98	-169.59
UR 1980	71.38	0.15	0.18	-1.97	-1.64	0.39	0.57	0.12	-1.38	-0.79
UR 1985	12.35	0.32	0.31	-1.65	-1.12	2.14	0.79	0.41	-1.72	-1.01
UR 1990	15.69	0.33	0.49	-2.59	-1.68	1.92	0.47	-0.09	-1.95	-0.59

Table 15: Sensitivity check: Region 4

Parameters		μ_w	σ_w	λ_e	λ_u	θ	κ_1	κ_2	γ	υ
SMM		7.1327	0.8924	0.2461	0.8181	0.0831	9.86E-03	-3.90E-04	1.5103	1.521E-02
Variation		0.0257	0.0197	0.0497	0.0345	0.0029	6.50E-05	2.30E-07	0.0178	2.6E-05
Period	Value									
Wages 1980	3012.13	24.12	36.45	1.12	1.98	-9.31	0	6.19	-1.24	-21.72
Wages 1985	5931.14	31.79	49.79	1.96	4.34	-29.98	13.47	18.54	-2.41	-46.16
Wages 1990	6843.34	34.52	56.71	3.24	4.79	-98.71	24.18	39.12	-1.58	-105.99
Assets 1985	13219.14	53.14	112.62	-24.67	64.27	-299.84	78.78	45.21	100.95	-17.98
Assets 1990	19789.16	134.89	189.44	-39.75	91.86	-437.12	102.95	71.38	491.17	-142.56
Con. 1980	2891.57	2.72	8.65	49	41.45	-71.76	14.51	15.33	48.22	19.76
Con. 1985	5901.51	29.65	37.78	57	45.68	-141.54	53.44	61.72	89.31	-45.57
Con. 1990	7921.57	37.65	41.44	59	67.94	-213.65	57.76	78.36	53.22	-101.99
UR 1980	65.15	0.15	-0.21	-2.01	-1.67	0.45	-0.01	0	-1.41	0.29
UR 1985	14.97	0.34	0.36	-1.71	-1.29	1.47	-0.01	0.01	-1.21	0.49
UR 1990	16.17	0.36	0.57	-2.41	-1.05	1.78	0	0	-1.78	0.55

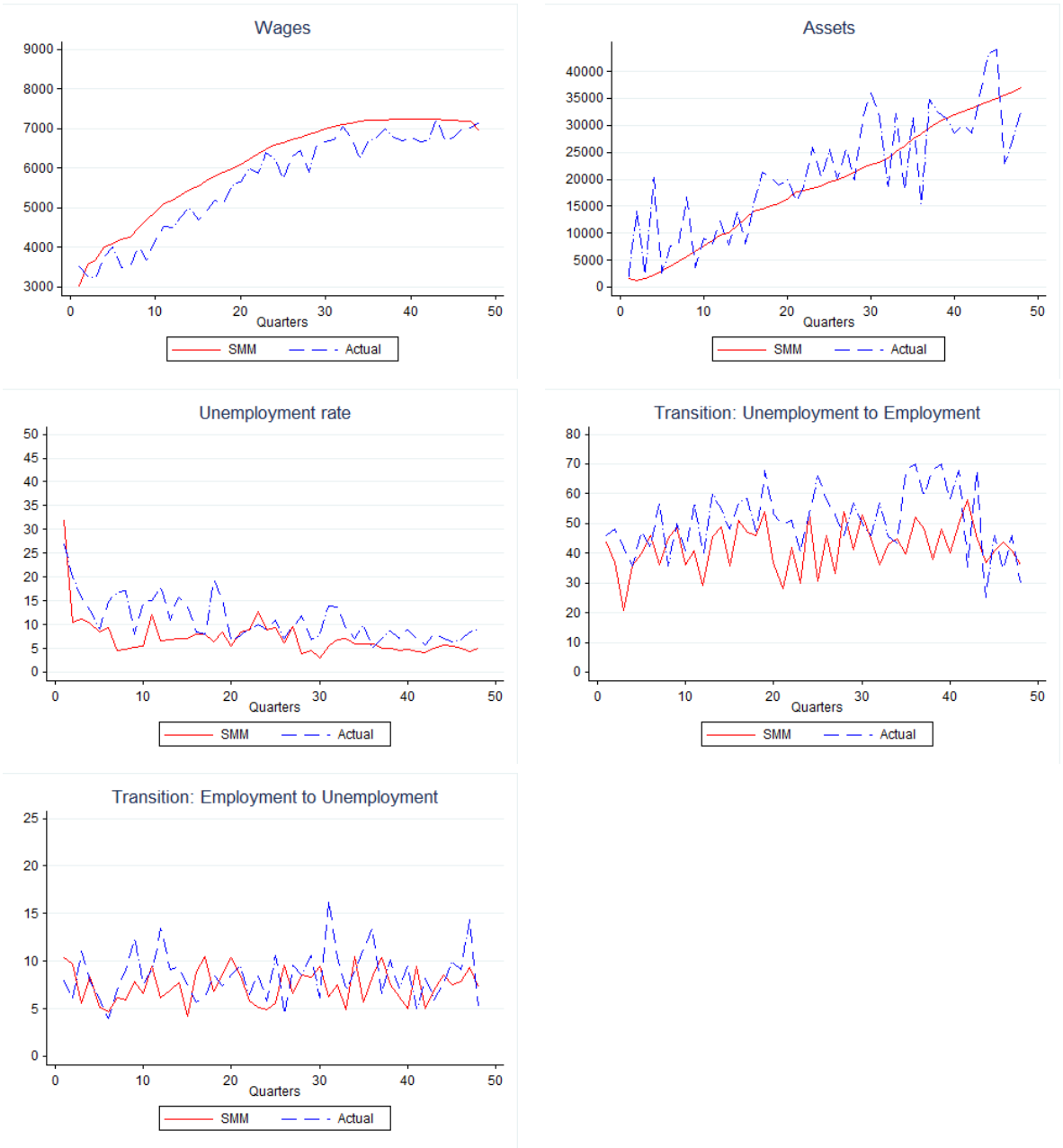

Figure 3: Actual and Predicted Variables, Region 1

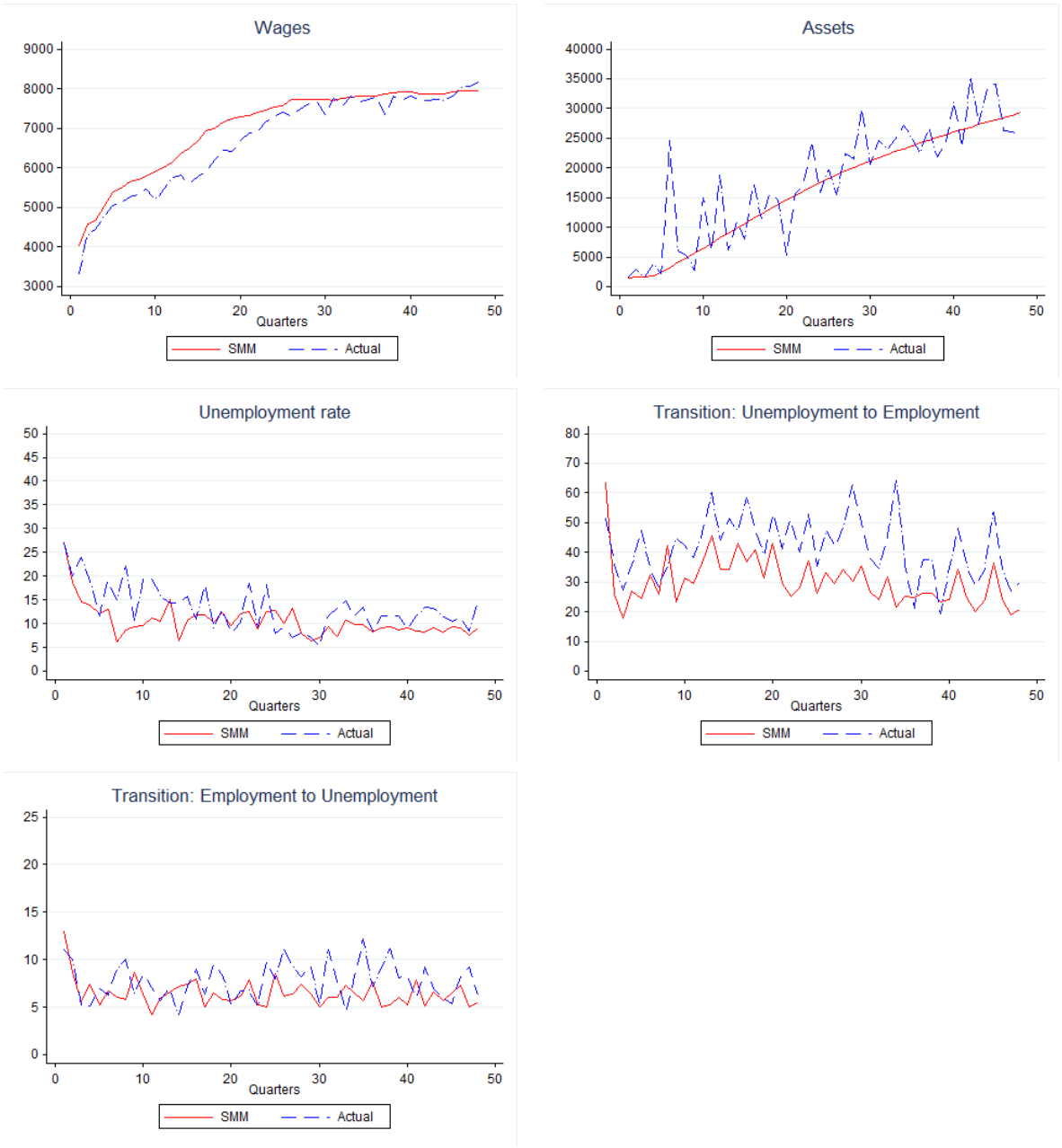

Figure 4: Actual and Predicted Variables, Region 2

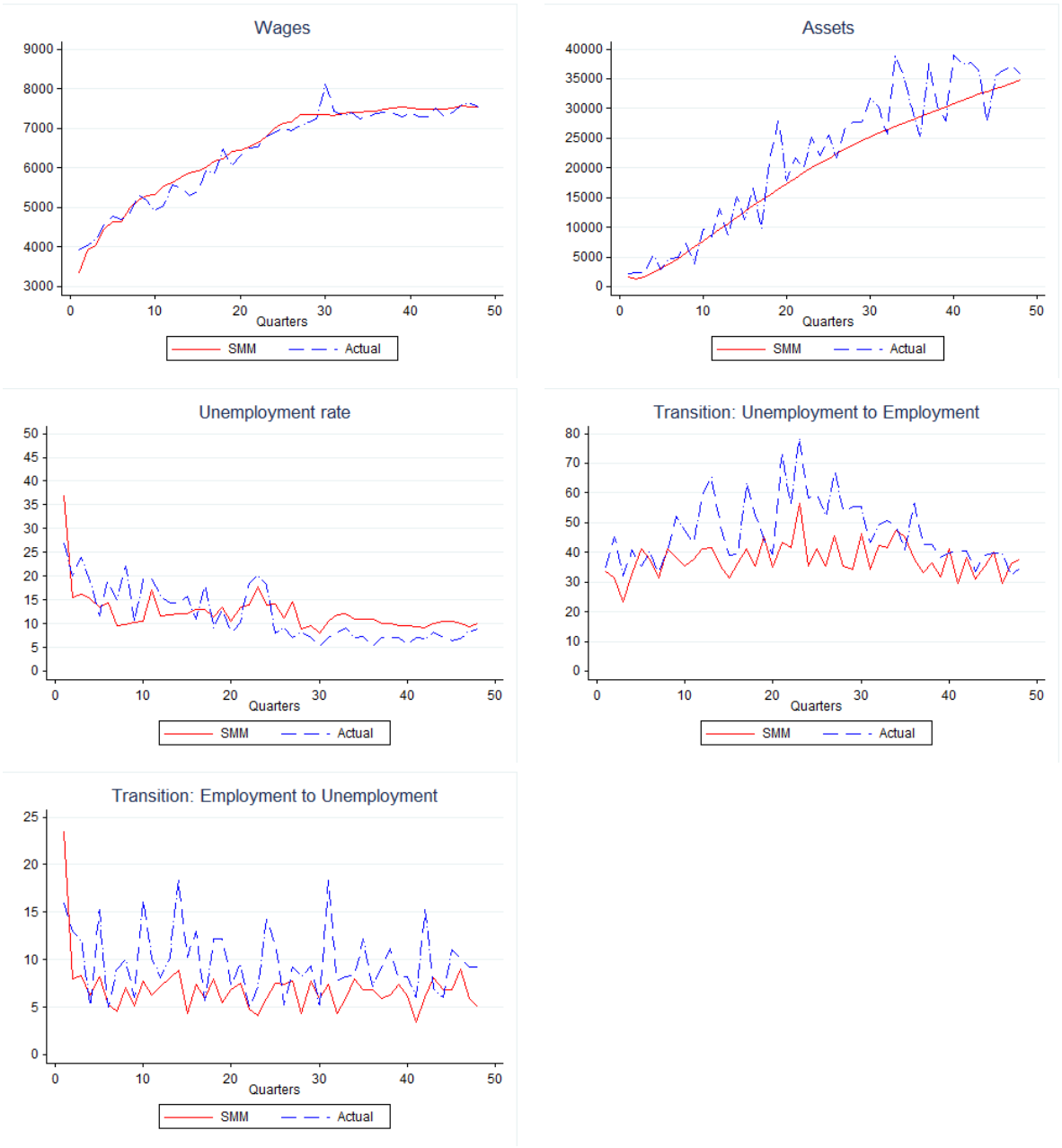

Figure 5: Actual and Predicted Variables, Region 3

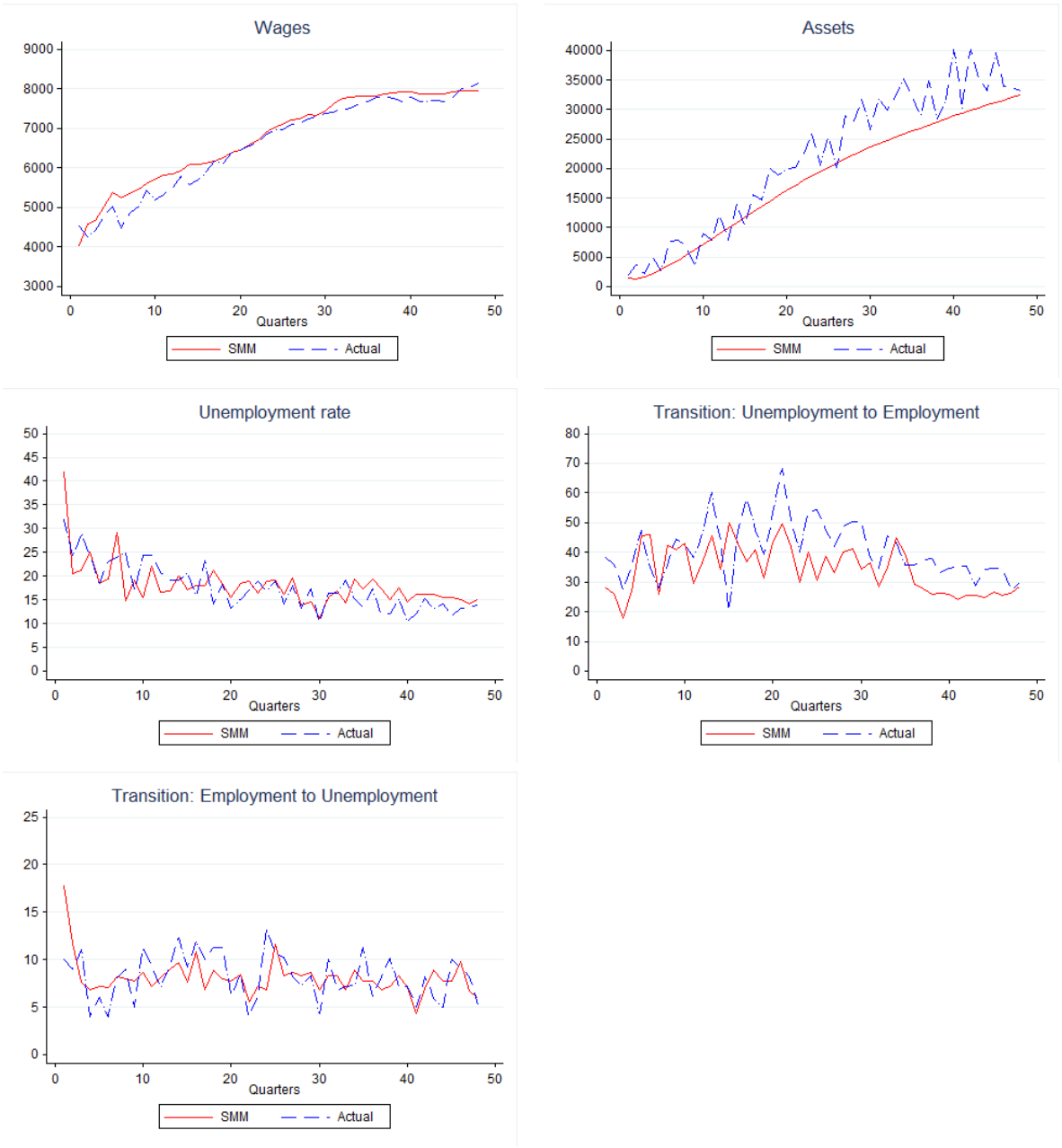

Figure 6: Actual and Predicted Variables, Region 4

Using the recovered parameters, we conduct the goodness of fit of the model by showing discrepancy between observed moments from the data and the moments simulated under our model. The goodness of model fit is reported in Figure 3-6. The reported distributions are wages, assets, unemployment rates, transition from unemployment to employment and transition from employment to unemployment. While the predicted moments presents a good replication of actual moments in all 4 regions, the transition from unemployment to employment tend to be under-predicted and wages are over-predicted. The simulated method of the moments performs generally well in recover the actual path overall.

Chapter 6

Policy Experiments

6.1 Impact of the Earned Income Tax Credit

In this section, we estimate the impact of the Earned Income Tax Credit. Table 16 shows the effect of the EITC benefits on the first unemployment duration, first accepted wage, average unemployment duration, unemployment rate, net wage income, asset holdings, consumption, and individual welfare measured by consumption equivalence. The numbers are the variance from the benchmark where the EITC benefit is excluded to the model with the EITC benefits.

The EITC seems to have very small to almost no impact on the first unemployment spell. It is because the EITC benefit is designed to be effective particulary to those who have qualifying children. The data shows 96.57% of the sample has no child, 2.70% with 1 child, 0.60% with 2, 0.12% with 3 children in 1979. We do not observe people having more than 4 children in the sample in the first year of the survey. Therefore, the EITC amount works to have an insignificant effect in the earlier years, but the effect increases with the fertility transition patterns. This implies the reason that the EITC benefit has no significant impact on first unemployment spell after the graduation and their first accepted wage. The impact in Region 4 is the greatest, although the EITC benefit lowers the first unemployment spell only by

0.22 week, and the first accepted wage by $38.

As the benefit amount of EITC grows by raised probability with having more children, the impact of the EITC on search duration and unemployment rate starts to stand out. The average search duration has decrease in all regions, which implies the EITC benefit gives the incentives to employment, since the EITC benefit is tied to the job, hence it affects in the same way for the reemployment rate and unemployment rate. The samples are relatively poorer individuals with low to less moderate income, they are less selective, hence has accepted low wage income by lowering reservation wage. This is a part of the possible explanation of decreasing net wage income across time. However, it helps in accumulating assets by receiving the benefit, and raising consumption levels. The EITC benefit stands more in Region 4, the high income taxed states with higher unemployment rate, the EITC amount gives more incentive to employment. The average unemployment duration has decreased by 1.83 week in region 4. The unemployment rate decreases at increasing rates by 0.876, 1.126 and 2.242 in 10th, 20th, and 49th quarters from the year of 1979. The EITC benefit seem to have a very small effect on wage income, since the layoff probability, job offer probability and distribution barely affected by the EITC benefits, although it contributes to the asset accumulation, consumption, and individual welfare.

However, we notice that there might exist the upward bias, since some of the institutional features of the EITC benefit are not fully implemented in the model. In addition to its complexity, There is a time gap between the EITC benefit payment and the time labor is supplied. Therefore, we leave implementing the more detailed model of the EITC for the future extension.

Table 16: Impact of the EITC Benefit

Target	Variance from the Benchmark			
	Region 1	Region 2	Region 3	Region 4
First Unemployment spell (week)	-0.12	-0.15	-0.18	-0.22
First accepted wage ($, quarterly)	-29	-19	-27	-38
Avg. unemp. duration (week)	-1.41	-1.13	-1.15	-1.83
Unemployment rate				
Δ%, 10th Q	-0.698	-0.752	-0.764	-0.876
Δ%, 20th Q	-1.589	-1.014	-1.343	-1.126
Δ%, 40th Q	-1.949	-1.373	-1.554	-2.242
Wage Incomes				
$, 10th Q	-29.15	-27.25	-30.24	-31.46
$, 20th Q	-30.14	-25.34	-29.38	-43.14
$, 40th Q	-51.56	-38.45	-50.14	-76.54
Assets				
$, 10th Q	+402	+357	+304	+398
$, 20th Q	+914	+764	+891	+1076
$, 40th Q	+3476	+3121	+2981	+3817
Consumption				
$, 10th Q	+71	+54	+60	+85
$, 20th Q	+206	+194	+185	+219
$, 40th Q	+491	+389	+483	+581
Wealth				
Δ%, 10th Q	+0.12	+0.06	+0.06	+0.14
Δ%, 20th Q	+0.29	+0.28	+0.31	+0.66
Δ%, 40th Q	+0.47	+0.35	+0.68	+1.12

6.2 Experiments on Unemployment Insurance

Using the parameter set recovered by the simulated method of moments, we conduct the policy simulations on Unemployment Insurance benefits and income taxation. The policy intervention in Unemployment Insurance benefits involve 3 regime changes to facilitate the comparison of the benchmark model in 4 regions: 1. Extension of the maximum period that benefits can be paid to 1 extra quarter; 2. Extension of the benefit paying period by 6 quarters; 3. Increase in the UI replacement rate by 10%. Table 17 to table 20 report the result of the policy experiment on the Unemployment Insurance benefit.

Extension of the maximum benefit-paid periods by 1 quarter lowers the first unemployment spell and the first accepted wage in all regions. Due to the extension of the benefit period, the UI benefit becomes more generous and attractive, hence the unemployed workers gain the incentive to find a job sooner by lowering reservation wage or search more intensively. Therefore, the outcome of the lower first accepted wage shares the same context. In Region 4, High income tax region which contains New Jersey State, it decreases the first unemployment duration by 1.08 weeks, which is similar to the result from Card and Levine (2000). The average unemployment duration has increased by 2.4 weeks in Region 4. Although the generosity of the Unemployment compensation brings the incentive effect on labor supply to some extent, the outcome shows the disincentives offset by seeing both reemployment and

unemployment rate increase. It sacrifices the wage income and asset accumulation, hence the consumption and the individual welfare in turn.

6 quarter extension of the benefit paying period has the same effect with smaller magnitude in terms of percentage changes compared to the 1 quarter benefit period extension. It raises the first unemployment duration by 3.6 weeks and average unemployment duration by 6.2 weeks. The reemployment rate shows increasing patterns across the year but at a decreasing rate, which means job search is more efficient in earlier years so that matching happens more at time. The individual welfare decreases substantially, it shows 10 to 20% decreases in the time frame, the unemployed decumulate their assets to smooth consumption and search for a job.

The effect of increases in the UI replacement rate can be explained in the same context as above. Increase in the benefit rate makes current employment spell more attractive so that unemployed finds a job sooner by lowering their reservation wages, so that reemployment rate went up 1-2% among the unemployed although the current benefit holders might stay unemployed longer until the benefit lapse so that it offset the incentive to work. Average accepted wages and average asset holdings show persistent decreases, along with consumption and individual welfare. The 6 quarter extension in benefit paid period increases the search duration by 1.6 weeks in region 1, 2.4 weeks in region 2, 1.9 weeks in region 3, and 2.5 weeks in region 4, it is overestimated compared to the 1 week increase in the benefit paid period from Meyer (1989), but the time frame is distant. Compared to the Swedish data, Eugster (2013) found the increase in the replacement rate by 10 percentage points raised the unemployment duration by 5.5%, which is bit overestimated than out result 2.76%-

3.2%. Our result is similar to Katz and Meyer (1990) who found that a week increase in potential benefit duration increased the average unemployment duration by 0.16 weeks.

Table 21, 22, and 23 shows the regional comparison of the policy intervention. The impact is the greatest in region 4 among the groups, where the unemployment rate is the highest and the lowest wage income. In general, the impact of increasing the generosity of the UI benefits is the greatest in high income states (Region 4). When the UI benefit is extended by 1 quarter, the first duration spell in Region 4 is decreased by 3.17 weeks. Since this policy experiments makes the Unemployment compensation more generous in terms of the benefit paying period, it brings incentive to receive the benefit. The high school graduates need the new (first) employment spell to be eligible for the befits, hence they find job sooner than otherwise by lowering their reservation wage. The expected accepted wage decreases in turn. This high income states seem to have higher unemployment rate than other regions due to the substitution effect from high income taxes, the impact of UI program has greater impact than other regions.

Table 17: Policy Experiment on UI benefits: Region 1

Quarter	Benchmark	Variations		
		EXT 1Q	EXT 6Q	Rate+10%
First Unemployment spell				
(quarters)	2.12	2.07	1.93	2.06
Avg. search duration				
(quarters)	1.69	1.79	1.73	1.70
First accepted wage				
(quarterly)	2987.76	2903.62	2901.80	2951.49
Reemployment rate				
10th Q	0.230	0.240	0.244	0.244
20th Q	0.424	0.463	0.445	0.462
40th Q	0.249	0.254	0.263	0.264
Unemployment rate				
10th Q	0.098	0.106	0.105	0.104
20th Q	0.100	0.110	0.106	0.102
40th Q	0.089	0.089	0.090	0.092
Net Incomes				
10th Q	5109.91	5022.68	5019.56	4962.89
20th Q	7296.86	7160.70	6924.57	6858.09
40th Q	7816.46	7364.12	7044.475	7001.82
Assets				
1st Q	1299.33	1277.54	1261.94	1275.29
20th Q	15046.79	13891.34	12523.59	13810.99
40th Q	25946.86	23954.46	19978.74	24652.70
Consumption				
1st Q	931.65	895.52	875.59	839.68
20th Q	5218.16	4760.579	4475.45	5077.79
40th Q	8771.15	8079.30	7717.47	8429.07
Wealth				
1st Q	1	0.961	0.939	0.901
20th Q	1	0.912	0.857	0.973
40th Q	1	0.921	0.879	0.961

Table 18: Policy Experiment on UI benefits: Region 2

Quarter	Benchmark	Variations		
		EXT 1Q	EXT 6Q	Rate+10%
First Unemployment spell				
(quarters)	2.769	2.684	2.516	2.691
Avg. search duration				
(quarters)	1.864	1.881	1.910	1.881
First accepted wage				
(quarterly)	2871.268	2787.952	2778.325	2778.994
Reemployment rate				
10th Q	0.4913	0.5034	0.5072	0.5018
20th Q	0.5723	0.6442	0.6060	0.6309
40th Q	0.2791	0.2897	0.2990	0.2981
Unemployment rate				
10th Q	0.1514	0.1639	0.1647	0.1605
20th Q	0.1589	0.1785	0.1739	0.1623
40th Q	0.1594	0.1660	0.1661	0.1644
Net Incomes				
10th Q	5891.442	5787.297	5728.306	5721.978
20th Q	6578.983	6345.248	6168.964	6078.891
40th Q	7523.131	6788.195	6554.628	6678.116
Assets				
1st	1563.161	1521.392	1500.608	1546.121
20th Q	14781.450	13189.798	11800.371	13514.679
40th Q	26943.150	24281.975	20144.769	25359.701
Consumption				
1st	1542.146	1453.184	1416.862	1517.826
20th Q	6023.442	5374.855	5013.732	5849.364
40th Q	7084.012	6463.360	5941.998	6729.669
Wealth				
1st	1	0.9423	0.9187	0.9842
20th Q	1	0.8923	0.8323	0.9711
40th Q	1	0.9123	0.8387	0.9499

Table 19: Policy Experiment on UI benefits: Region 3

Quarter	Benchmark	Variations		
		EXT 1Q	EXT 6Q	Rate+10%
First Unemployment spell				
(quarters)	2.876	2.796	2.620	2.795
Avg. search duration				
(quarters)	1.7346	1.7513	1.7866	1.7510
First accepted wage				
(quarterly)	3024.764	2930.823	2943.791	2927.557
Reemployment rate				
10th Q	0.3695	0.3780	0.3801	0.3774
20th Q	0.3597	0.4024	0.3781	0.3965
40th Q	0.3246	0.3348	0.3453	0.3467
Unemployment rate				
10th Q	0.1059	0.1143	0.1145	0.1122
20th Q	0.1123	0.1256	0.1211	0.1147
40th Q	0.0987	0.0999	0.1016	0.1018
Net Incomes				
10th Q	5324.78	5235.643	5217.592	5171.618
20th Q	6496.81	6320.291	6106.291	6002.967
40th Q	7463.68	6958.388	6641.182	6625.344
Assets				
1st Q	1476.432	1448.717	1432.113	1460.336
20th Q	17546.464	16009.039	14366.409	16042.728
40th Q	32700.491	30160.600	24891.613	30778.682
Consumption				
1st Q	1266.742	1206.316	1170.328	1246.763
20th Q	7849.641	7074.331	6593.776	7622.785
40th Q	8811.440	8105.626	7500.297	8370.691
Wealth				
1st Q	1	0.9523	0.9238	0.9842
20th Q	1	0.9012	0.8400	0.9711
40th Q	1	0.9198	0.8512	0.9499

Table 20: Policy Experiment on UI benefits: Region 4

Quarter	Benchmark	Variations		
		EXT 1Q	EXT 6Q	Rate+10%
First Unemployment spell				
(quarters)	3.1201	3.0211	2.8176	3.0198
Avg. search duration				
(quarters)	2.0014	2.0234	2.0523	2.0214
First accepted wage				
(quarterly)	3120.247	3012.476	2987.140	3002.130
Reemployment rate				
10th Q	0.3695	0.3787	0.3876	0.3791
20th Q	0.4009	0.4523	0.4276	0.4498
40th Q	0.2678	0.2787	0.2876	0.2873
Unemployment rate				
10th Q	0.1614	0.1787	0.1767	0.1732
20th Q	0.1594	0.1623	0.1765	0.1487
40th Q	0.1498	0.1567	0.1587	0.1376
Net Incomes				
10th Q	5681.44	5562.41	5523.87	5498.41
20th Q	6490.98	6123.42	5987.58	5983.34
40th Q	7945.13	7012.123	6873.14	6998.98
Assets				
1st Q	1563.16	1512.23	1487.14	1523.328
20th Q	15381.45	13233.81	12103.14	13376.87
40th Q	29103.15	25768.12	21323.87	26987.18
Consumption				
1st Q	1542.14	1412.41	1399.14	1513.38
20th Q	6023.44	5276.15	4987.41	5476.18
40th Q	7084.01	6298.19	5798.49	6439.76
Wealth				
1st Q	1	0.9158	0.9072	0.9813
20th Q	1	0.8759	0.8280	0.9091
40th Q	1	0.8890	0.8185	0.9090

Table 21: Regional comparison: UI Benefit Period Extension by 1 Quarter

	EXT 1Q			
	Region 1	Region 2	Region 3	Region 4
First Unemployment spell				
Δ%	-2.67	-3.05	-2.76	-3.17
Avg. search duration				
Δ%	0.91872	0.93	0.96	1.09
First accepted wage				
Δ%	-2.81	-2.90	-3.10	-3.45
Reemployment rate				
Δ%, 10th Q	1.98	2.45	2.31	2.50
Δ%, 20th Q	9.23	12.56	11.87	12.82
Δ%, 40th Q	2.12	3.78	3.12	4.06
Unemployment rate				
Δ%, 10th Q	7.87	8.27	7.92	10.71
Δ%, 20th Q	10.22	12.31	11.87	1.79
Δ%, 40th Q	0.12	4.12	1.23	4.62
Net Incomes				
Δ%, 10th Q	-1.70	-1.76	-1.67	-2.09
Δ%, 20th Q	-1.86	-3.55	-2.71	-5.66
Δ%, 40th Q	-5.78	-9.76	-6.77	-11.74
Assets				
Δ%, 1st Q	-1.67	-2.67	-1.87	-3.25
Δ%, 20th Q	-7.67	-10.76	-8.76	-13.96
Δ%, 40th Q	-7.67	-9.87	-7.76	-11.45
Consumption				
Δ%, 1st Q	-3.87	-5.76	-4.77	-8.41
Δ%, 20th Q	-8.76	-10.76	-9.87	-12.40
Δ%, 40th Q	-7.88	-8.76	-8.01	-11.09

Table 22: Regional comparison: UI Benefit Period Extension by 6 Quarter

	EXT 6Q			
	Region 1	Region 2	Region 3	Region 4
First Unemployment spell				
Δ%	-8.93	-9.122	-8.90	-9.69
Avg. search duration				
Δ%	2.67	2.46	2.99	2.54
First accepted wage				
Δ%	-2.87	-3.23	-2.67	-4.26
Reemployment rate				
Δ%, 10th Q	2.12	3.23	2.88	4.90
Δ%, 20th Q	4.87	5.898	5.12	6.64
Δ%, 40th Q	5.42	7.128	6.35	7.37
Unemployment rate				
Δ%, 10th Q	6.78	8.76	8.12	9.49
Δ%, 20th Q	6.17	9.42	7.87	10.70
Δ%, 40th Q	1.34	4.23	2.98	5.96
Net Incomes				
Δ%, 10th Q	-1.76	-2.76	-2.01	-2.77
Δ%, 20th Q	-5.10	-6.23	-6.01	-7.75
Δ%, 40th Q	-9.87	-12.87	-11.02	-13.49
Assets				
Δ%, 1st Q	-2.877	-4.00	-3.00	-4.86
Δ%, 20th Q	-16.76	-20.16	-18.12	-21.31
Δ%, 40th Q	-23.00	-25.23	-23.88	-26.73
Consumption				
Δ%, 1st Q	-6.01	-8.12	-7.61	-9.27
Δ%, 20th Q	-14.23	-16.76	-15.99	-17.20
Δ%, 40th Q	-12.01	-16.12	-14.88	-18.14

Table 23: Regional Comparison: 10% Increase in the UI Replacement Rate

	Replacement rate +10%			
	Region 1	Region 2	Region 3	Region 4
First Unemployment spell				
Δ%	-2.76	-3.87	-2.80	-3.21
Avg. search duration				
Δ%	0.83	0.78	0.94	0.99
First accepted wage				
Δ%	-1.21	-2.12	-3.21	-3.78
Reemployment rate				
Δ%, 10th Q	1.93	2.45	2.13	2.614
Δ%, 20th Q	8.98	11.99	10.23	12.18
Δ%, 40th Q	5.87	4.09	6.78	7.27
Unemployment rate				
Δ%, 10th Q	5.68	6.87	5.98	7.29
Δ%, 20th Q	1.99	2.47	2.11	2.87
Δ%, 40th Q	2.67	3.58	3.12	3.62
Net Incomes				
Δ%, 10th Q	-2.87	-3.65	-2.87	-3.22
Δ%, 20th Q	-6.01	-8.090	-7.60	-7.82
Δ%, 40th Q	-10.42	-12.37	-11.23	-11.90
Assets				
Δ%, 1st Q	-1.85	-2.43	-1.09	-2.54
Δ%, 20th Q	-8.21	-11.06	-8.57	-13.03
Δ%, 40th Q	-4.98	-6.11	-5.877	-7.27
Consumption				
Δ%, 1st Q	-9.87	-1.62	-1.57	-1.86
Δ%, 20th Q	-2.69	-4.01	-2.89	-9.08
Δ%, 40th Q	-3.90	-5.76	-5.00	-9.09

6.3 Experiments on the income tax

Table 24-27 reports the result of the policy experiment on income taxation in region 1 through Region 4. The outcome of the policy experiment depends on the relative magnitude of the disincentive and incentive impact of the income tax. The experiments involves 3 regime changes: 1. 1% increase in all tax brackets; 2. 1% decrease in all tax brackets; 3. No tax withholding below $5,000. The numbers in Table shows the percentage change of each policy regime from the benchmark, hence it helps to understand and identify the state effect of the policy regimes. It compares the region 3 and 4, the state group with the low state income tax and high state income tax withholdings. Region 1 and 2 are excluded in this comparison, since these two regions have no income tax and flat state income tax respectively, hence they are not compatible with the region 3 and 4 where progressive state income taxes exist.

The result from each policy regime shows the same effect on the labor supply in all regions although the magnitude of the impact varies across states. The first experiment shows that the overall impact of increase in tax rates lowers individuals' incentive to work. It also implies that the disincentive and substitution effect from great tax burden dominates the incentive effect, although it is offset by the incentive effect from the progressivity of the income tax schedule. It increases the first unemployment duration, average search duration, first accepted wage, and unemployment rate, this regime brings disincentive effect to the labor supply due to the substitution

effect. Due to this disincentive to the labor supply, it sacrifices the wage income, asset accumulation, consumption, hence individual welfare. Table 28 shows the impact of this experiment is greater in Region 4 than in Region 3. The 1% increase in the tax rates gives more burdens to those who has higher tax liabilities due to the design of the State income tax schedule in each regions. It makes the individuals with taxable income of more than $10,000 in Region 4 more suffered than the workers with the same amount of income in Region 3. It increase the first unemployment duration by 2.76 weeks, and the average unemployment duration by 5.16 weeks in Region 4. The result from the second policy experiment which is designed to decrease each tax brackets by 1% are also affected by the same effect, although there exists the difference in the magnitude of the policy experiments.

The Third experiment consists of allowing tax deduction for the first $5,000 of the taxable income. This tax cuts reduce the marginal tax rates so that it raises the after-tax compensation for the additional hours of work (intensive margin), hence there exist incentives to the labor supply. In Region 4, it increases the first unemployment duration by 2.4 weeks and average search duration by 1.3 weeks. The average individual wealth is improved in all ages, but it arrives at a peak 5 years after the high school graduation when the workers becomes 24-25 age old. The impact is bigger in Region 3 compared to Region 4 as predicted.

Table 24: Experiments on Federal Income tax: Region 1

Quarter	Benchmark	Variations		
		Inc 1% overall	Dec 1% overall	No tax below 5000
First Unemployment spell (quarters)	2.12783	2.29778617	1.94130442	1.98149913
Avg. search duration (quarters)	1.69123	2.1137647	1.56266946	1.58616775
First accepted wage (quarterly)	2987.764	3136.77275	2681.48532	2659.07181
Reemployment rate				
10th Q	0.23956	0.2312305	0.26926242	0.24530465
20th Q	0.42451	0.31974518	0.48012081	0.49235943
40th Q	0.2495	0.21986863	0.26915636	0.28251459
Unemployment rate				
10th Q	0.09875	0.12419215	0.09404259	0.07912176
20th Q	0.10012	0.11612648	0.08622666	0.08771743
40th Q	0.08975	0.11297518	0.07697229	0.08604934
Net Incomes				
10th Q	5109.91	4860.74415	5365.31863	5356.40542
20th Q	7296.86	6701.24651	7690.87877	7524.74094
40th Q	7816.46	7017.32858	8116.61206	8501.28351
Assets				
1st	1299.33	831.554309	1564.37695	1377.12912
20th Q	15046.79	12469.8166	17873.6304	16367.3414
40th Q	25946.86	23896.617	27938.541	27701.4645
Consumption				
1st	931.65	864.860012	996.722958	996.231978
20th Q	5218.16	4650.58074	6034.92206	6051.95533
40th Q	8771.15	8487.22787	9900.66361	10322.0911
Wealth				
1st	1	0.92831	1.069847	1.06932
20th Q	1	0.89123	1.156523	1.15978723
40th Q	1	0.96763	1.128776	1.176823

Table 25: Experiments on Flat State Income tax: Region 2

Quarter	Benchmark	Variations		
		Inc 1% overall	Dec 1% overall	No tax below $5000
First Unemployment spell (quarters)	2.76951	2.91945127	2.57204394	2.58735933
Avg. search duration (quarters)	1.86421	2.23383065	1.76791796	1.74932433
First accepted wage (quarterly)	2871.268	2989.65038	2676.39504	2508.37562
Reemployment rate				
10th Q	0.49134	0.47829984	0.53200477	0.50841063
20th Q	0.57232	0.47673111	0.62539123	0.66230587
40th Q	0.27917	0.25107014	0.29354446	0.3053512
Unemployment rate				
10th Q	0.15147	0.18779402	0.14649021	0.12287701
20th Q	0.15896	0.18261245	0.14584326	0.13742458
40th Q	0.15943	0.18930144	0.14528107	0.15183731
Net Incomes				
10th Q	5891.44	5698.08294	6051.21585	6113.01706
20th Q	6578.98	6366.01842	6731.21628	6826.88255
40th Q	7523.13	6908.28715	7686.85588	8262.45055
Assets				
1st Q	1563.16	1201.69644	1826.96357	1676.29527
20th Q	14781.45	13276.2845	16240.9112	15999.2493
40th Q	26943.15	26077.2241	27956.7513	29175.7402
Consumption				
1st Q	1542.146	1444.24132	1667.48592	1649.84485
20th Q	6023.442	5707.90399	6578.62265	6950.29311
40th Q	7084.012	6993.78294	7634.08553	7999.53554
Wealth				
1st Q	1	0.9312387	1.07352	1.069837
20th Q	1	0.9187236	1.102987	1.168763
40th Q	1	0.987364	1.074324	1.13512

Table 26: Experiments on Low Income tax: Region 3

Quarter	Benchmark	Variations		
		Inc 1% overall	Dec 1% overall	No tax below $5000
First Unemployment spell (quarters)	2.87617	2.96044178	2.72603393	2.6783988
Avg. search duration (quarters)	1.73461	1.99261589	1.67886189	1.62561578
First accepted wage (quarterly)	3024.764	3115.01388	2818.244	2606.55408
Reemployment rate				
10th Q	0.36952	0.3635116	0.39820344	0.38424057
20th Q	0.35974	0.30992428	0.38485838	0.42714089
40th Q	0.32467	0.2926413	0.33237767	0.36114343
Unemployment rate				
10th Q	0.10594	0.1248781	0.10343452	0.08457995
20th Q	0.11235	0.12692629	0.10476469	0.09653547
40th Q	0.09875	0.11616456	0.09335233	0.09404713
Net Incomes				
10th Q	5324.78	5120.58534	5517.11105	5544.37393
20th Q	6496.81	6341.86108	6656.37815	6976.76963
40th Q	7463.68	7147.82453	7533.68932	8389.08228
Assets				
1st	1476.43	1289.88898	1755.06187	1568.54004
20th Q	17546.46	15644.8624	19350.7625	19702.5216
40th Q	32700.49	32333.2962	33154.242	35929.1729
Consumption				
1st	1266.74	1190.57295	1331.70805	1357.07123
20th Q	7849.64	7359.94021	8389.39695	9008.48235
40th Q	8811.44	8602.17711	9475.29389	10661.7393
Wealth				
1st	1	0.95324	1.69837	1.07373
20th Q	1	0.92135	1.0743	1.17122
40th Q	1	0.998736	1.047638	1.1498238

Table 27: Experiments on State Income tax: Region 4

Quarter	Benchmark	Variations		
		Inc 1% overall	Dec 1% overall	No tax below $5,000
First Unemployment spell (quarters)	3.12012	3.34765	2.84742	2.91918
Avg. search duration (quarters)	2.00146	2.43435	1.86732	1.88198
First accepted wage (quarterly)	3120.247	3269.76	2809.53	2787.91
Reemployment rate				
10th Q	0.36952	0.40331	0.46416	0.42413
20th Q	0.40097	0.38413	0.44861	0.46019
40th Q	0.26788	0.23871	0.28651	0.29121
Unemployment rate				
10th Q	0.16143	0.20328	0.15416	0.13129
20th Q	0.15946	0.18376	0.13167	0.14125
40th Q	0.14983	0.18787	0.13016	0.14614
Net Incomes				
10th Q	5681.44	5443.91	5932.15	5898.53
20th Q	6490.98	6023.15	6832.16	6635.64
40th Q	7945.13	7187.14	8117.95	8431.16
Assets				
1st Q	1563.16	1001.32	1860.61	1645.23
20th Q	15381.45	12787.31	18234.81	16532.41
40th Q	29103.15	27873.49	30567.91	31049.53
Consumption				
1st Q	1542.146	1432.43	1674.98	1646.35
20th Q	6023.442	5382.15	6732.14	6913.31
40th Q	7084.012	6874.15	7932.46	7932.46
Wealth				
1st Q	1	0.92885	1.08136	1.06757
20th Q	1	0.96824	1.11765	1.14773
40th Q	1	0.970375	1.11976	1.10560

Table 28: State effect: Comparison bet. Region 3 and Region 4

	1% Increase		1% Decrase		No tax below $5000	
	Region3	Region4	Region3	Region4	Region3	Region4
First Unemployment spell						
Δ%	2.93	7.29	-5.22	-8.74	-6.87	-6.44
Avg. search duration						
Δ%	14.87	21.62	-3.21	-6.70	-6.28	-5.96
First accepted wage						
Δ%	2.98	4.79	-6.82	-9.95	-13.82	-10.65
Reemployment rate						
Δ%, 10th Q	-1.62	-3.23	7.76	11.36	3.98	1.75
Δ%, 20th Q	-13.84	-24.15	6.98	11.88	18.73	14.76
Δ%, 40th Q	-9.86	-10.88	2.37	6.95	11.23	8.70
Unemployment rate						
Δ%, 10th Q	17.87	25.92	-2.36	-4.55	-20.16	-18.67
Δ%, 20th Q	12.97	15.23	-6.75	-13.66	-14.07	-11.41
Δ%, 40th Q	17.63	25.38	-5.46	-13.12	-4.76	-2.46
Net Incomes						
Δ%, 10th Q	-3.83	-4.18	3.62	4.41	4.124	3.82
Δ%, 20th Q	-2.38	-7.20	2.45	5.25	7.38	2.22
Δ%, 40th Q	-4.23	-9.54	0.93	2.17	12.39	6.11
Assets						
Δ%, 1st Q	-12.63	-35.94	18.87	19.02	6.23	5.25
Δ%, 20th Q	-10.83	-16.86	10.28	18.55	12.28	7.48
Δ%, 40th Q	-1.12	-4.22	1.38	5.06	9.87	6.68
Consumption						
Δ%, 1st Q	-6.01	-7.11	5.12	8.61	7.13	6.75
Δ%, 20th Q	-6.23	-10.64	6.87	11.76	14.76	14.77
Δ%, 40th Q	-2.37	-2.96	7.53	11.97	20.99	11.97

Chapter 7

Conclusions

This thesis estimates the effect of taxation and Unemployment Insurance program on labor supply. We propose a dynamic life-cycle search model with exogenous income shock, and on-the-job search to study inter-temporal effect of these programs. We estimate the behavioral parameters by the Simulated Method of Moments, and conduct the policy experiments on Unemployment Insurance and taxation. Since the sole effect of taxation is difficult to be identified by itself, we examine the policy effects by looking into regions with different features of income tax schedules. We find that under the current Unemployment Insurance program, income tax schedules, and the EITC benefits, the disincentive effects dominates the incentive effects on employment, although institutional features might offset some of the disincentives. The income taxation makes the value gap between the unemployment benefits and wage earnings bigger, so that reservation wages increase as individuals face higher tax rates. Last, we conduct policy experiments on taxation and Unemployment Insurance program using the recovered parameters. The 1 quarter extension in Benefit-paid period increase the unemployment duration for 1.31 weeks in average, similar to 1 week increase from Card and Levine (2000). The 6 quarter extension in benefit paid period increases the search duration by 1.6 weeks in region 1, 2.4 weeks in region 2, 1.9 weeks in region 3, and 2.5 weeks in region 4 It causes persistent decrease in assets and consumption, and substantial decrease in individual's welfare. 1% increase in tax

rates in high income states raises the first unemployment duration by 2.76 weeks, and the average unemployment duration by 5.16 weeks. Allowing tax exemption below $5,000 in high income state area lowers first unemployment duration, average search duration, and first accepted wage, but raises individual wealth. The income tax effects proposed by our policy experiments more stands out in high income tax area due to the higher unemployment rate.

Future work will extend the model to examine the effect of the taxation and UI program on retirement decisions of the older individuals, and the effect on intensive margin (hours of work) of the labor force by allowing heterogenous productivity and flexibility over hours or work. The key here is to understand how individual or household labor supply behavior evolve from the early employment stage to the retirement decision along with welfare programs such as Social Security Old Age Benefits, Medicare, and Medicaid. In addition, as the institutional features of the government policies depends on other variables (marital status, tax filing status) which are not covered in this thesis, there is a need to expand the research dimension to the female labor supply or household level decision behavior to fully understand the labor supply mechanism.

Appendix

A1. Numerical Solutions of the Model

Since the dynamic problem of the model does not draw analytical solutions, we solve the problem numerically by discretization process of transferring continuous state variables into discreted features. Below is the parameters used in the discretization process.

Table 29: Parameters used in Discretization

Parameters		Values
$Ngrid_a$	Gridpoints in assets	61
a_{min}	Assets lower bound	-15,000
a_{max}	Assets upper bound	60,000
Δa	Grid size	$\frac{a_{max}-a_{min}}{Ngrid_a}$
$Ngrid_w$	Gridpoints in wages	21
w_{min}	Wages lower bound	1,000
w_{max}	Wages upper bound	10,000
Δw	Grid size	$\frac{w_{max}-w_{min}}{Ngrid_w}$
$Ngrid_b$	Gridpoints in UI benefits	21
b_{min}	UI lower bound	0
b_{max}	UI upper bound	4,860

As quarter is the time unit in the model, let T denote the entire working lifetime and assume it to be 162 quarters considering high school graduates work through the normal retirement age of 62. Since the estimation procedure is hardly tractable due

to the huge dimension of the states and time for simulation, we make the problem tractable as in Wolpin (1992) and Rendon(2004). Then, the individual is assumed to solve the dynamic problem over different period length using longer period lengths for the more distant future value functions. The optimization problem of the individual becomes:

Period length	115 quaterly periods	5 annual periods	3 biannual periods
Quarters	1, 2, ..., 115, 116	117, 118, ..., 135, 136	137, 138, ..., 161, 162

Solving the dynamic program by backwards induction, the individual's optimization occurs over two year periods from quarter 162 through 137, annually from quarter 136 through 117, and quarterly thereafter. Thus, the optimization occurs every quarter until we observe the data from NLSY79 in the years 1979-2008. Due to this periods adjustments, the dynamic problem has to be also adjusted to be appropriate to the period lengths. For the period length n=$\{1, 4, 8\}$, discount factor β, arrival rates (λ_e, λ_u), and displacement rate θ are adjusted as

$$\beta_n = \beta^n, \lambda_n^e = 1 - (1 - \lambda^e)^n, \lambda_n^u = 1 - (1 - \lambda^u)^n, \theta_n = 1 - (1 - \theta)^n. \tag{10}$$

Assets during the period of length n are adjusted as

$$a_n = (1 + r)^n a + I \sum_{j=1}^{n} (1 + r)^j - c_u \sum_{j=1}^{n} (1 + r)^j \tag{11}$$

, where $I = w_n(o, k_n) + eitc$ when employed and $I = b$ when unemployed.

Wage function with initial offer o, and tenure length k for periods of length n is converted to

$$w_n(o, k_n) = w \cdot exp(\alpha_{1n} k_n + \alpha_{2n} k_n^2) \tag{12}$$

, where $\alpha_{1n} = \alpha_1 n/2$, $\alpha_{2n} = \alpha_2 n^2/2$, and $k_n = 2k/n$.

Then, utility for a period of length n from consumption c is adjusted as

$$U_n(c) = \sum_{t=0}^{n} \beta^t U(c) = \frac{1-\beta^n}{1-\beta} U(q_n a_n + I - q_n \frac{a_n}{(1+r)^n}) \tag{13}$$

, where $q_n = \frac{(1+r)^n}{\sum_{j=1}^{n}(1+r)^j}$.

A2. Definition of the variables

This section explains the definition of the variables in the model.

An individual is considered to be employed if he/she reported to be employed and works more than 26 hours in the first week of the calendar quarter. Since the NLSY79 provides the weekly arrays of employment status and hours worked at dual jobs, we define the main job as the one with the most hours of work and other jobs

are ignored[20]. The weekly wages of individuals are then calculated using the hours of work and hourly wage rates of the main job, which are aggregated to quarters based on the calendar quarter.

From NLSY79, Assets or net family worth are available from the year of 1985 through 1994 each year except 1991, and the year of 1996, 1998, 2000, 2004 and 2008. NLSY79 imputes missing assets and debt values and topcodes top 2% of all values. All monetary values including assets and wages are converted to June 1990 inflation adjusted dollars.

Assets are consists of the five components:

1. market value of residential property that the respondent own

2. Total market value of farm/business/other property net total amount of debts on the same properties of the respondent

3. Total amount of money asset such as savings and checking accounts, bonds, common stock, money hold in IRA/KEOGH, 401K/403B, and CDs.

4. Market value of vehicles for own use

5. The value of the other items over $500 less the value of the other debt over $500.

NLSY79 has per monthly information on the amount of unemployment compensation that the respondent received. Since the time unit is quarter in the model, we aggregate the weekly unemployment compensation amount to the quarterly amount.

[20]Thus, part-time workers or workers who work less than 26 hours are defined as the unemployed in data. See Nazarov (2009) for a setting with both full-time and part-time workers.

Below is the variables that are used in the model (in NLSY79's original variable names) .

1. CASEID: Identification code

2. Date of birth (Month, year), age, marital status and sex of the respondents

3. Number of children in the household: to determine EITC amount

4. Labor Force Status

5. Hours worked and hourly rate of pay: to construct respondent's wage income and find the main job

6. Family net worth and Asset variables

7. Total tenure (in weeks) with employer: to construct wage income and wage evolution

8. Amount of the unemployment compensation R received per week: aggregated to quarterly benefit compensation amount

9. Reason left job if not working: to identify the reason they became unemployed (Layoff, voluntary quit)

A3. Transition Matrix, Number of Children, 1979-1994

Table 30: Fertility Transition Matrix

year		1979			
	n	0	1	2	3
	0	93.57	0	0	0
1980	1	2.07	62.69	0	0
	2	0.15	12.69	70	0
	3	0	0	20	66.67

year		1983			
	n	0	1	2	3
	0	91.71	0	0	0
1984	1	4.95	68.54	0	0
	2	0.42	17.98	78.77	0
	3	0.1	0.45	9.5	70

year		1980			
	n	0	1	2	3
	0	94.97	0	0	0
1981	1	2.57	66.67	0	0
	2	0.44	19.13	68.89	0
	3	0.02	0.55	11.11	80

year		1984			
	n	0	1	2	3
	0	90.49	0	0	0
1985	1	5.22	69.63	0	0
	2	0.65	17.79	73.79	0
	3	0.1	0.19	11.57	76.67

year		1981			
	n	0	1	2	3
	0	93.31	0	0	0
1982	1	3.89	60.32	0	0
	2	0.38	17.46	68.18	0
	3	0.05	0.79	13.64	50

year		1985			
	n	0	1	2	3
	0	88.69	0	0	0
1986	1	5.88	63.81	0	0
	2	0.97	24.36	77.05	0
	3	0.19	0.34	10.49	74.07

year		1982			
	n	0	1	2	3
	0	93.14	0	0	0
1983	1	4.93	67.37	0	0
	2	0.35	20.85	73.98	0
	3	0.14	0.3	13.82	91.67

year		1986			
	n	0	1	2	3
	0	86.78	0	0	0
1987	1	6.76	64.62	0	0
	2	0.63	20.27	72.6	0
	3	0.33	1.33	12.98	71.15

year		1987			
	n	0	1	2	3
	0	86.25	0	0	0
1988	1	8.24	61.57	0	0
	2	1.23	25.67	72.17	0
	3	0.29	0.47	13.91	83.33

year		1991			
	n	0	1	2	3
	0	88.17	0	0	0
1992	1	6.24	68.03	0	0
	2	1.7	21.64	84.45	0
	3	0.83	0.66	7.78	80.59

year		1988			
	n	0	1	2	3
	0	88.68	0	0	0
1989	1	6.55	69.84	0	0
	2	1.1	19.18	82.03	0
	3	0.21	0.88	10.85	80.09

year		1992			
	n	0	1	2	3
	0	88.17	0	0	0
1993	1	6.24	68.03	0	0
	2	1.7	21.64	84.45	0
	3	0.83	0.66	7.78	80.59

year		1989			
	n	0	1	2	3
	0	86.21	0	0	0
1990	1	7.83	69.31	0	0
	2	1.51	19.16	77.68	0
	3	0.32	0.58	9.63	82.04

year		1993			
	n	0	1	2	3
	0	88.57	0	0	0
1994	1	5.89	75.67	0	0
	2	1.2	15.38	84.31	0
	3	0.4	0.72	6.93	85.15

year		1990			
	n	0	1	2	3
	0	78.04	0	0	0
1991	1	5.42	61.19	0	0
	2	0.74	14.36	69.22	0
	3	0.35	0.83	7.38	70.18

year		1994			
	n	0	1	2	3
	0	82.35	0	0	0
1996	1	8.77	62.23	0	0
	2	1.88	23.05	80.29	0
	3	0.47	1.24	9.08	76.52

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