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Equilibrium Policy Experiments and the Evaluation of Social Programs

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Abstract

This paper makes three contributions to the literature on program evaluation. First, we construct a model that is well-suited to conduct equilibrium policy experiments and we illustrate effectiveness of general equilibrium models as tools for the evaluation of social programs. Second, we demonstrate the usefulness of social experiments as tools to evaluate models. In this respect, our paper serves as the equilibrium analogue to LaLonde (1986) and others, where experiments are used as a benchmark against which to assess the performance of non-experimental estimators. Third, we apply our model to the study of the Canadian Self-Sufficiency Project (SSP), an experiment providing generous financial incentives to exit welfare and obtain stable employment. The model incorporates the main features of many unemployment insurance and welfare programs, including eligibility criteria and time-limited benefits, as well as the wage determination process. We first calibrate our model to data on the *control* group and simulate the experiment within the model. The model matches the welfare-to-work transition of the *treatment* group, providing support for our model in this context. We then undertake an equilibrium evaluation of the SSP. Our results highlight important feedback effects of the policy change, including displacement of unemployed individuals, lower wages for workers receiving supplement payments and higher wages for those not directly treated by the program. The results also highlight the incentives of individuals to delay exit from welfare in order to qualify for the program. Together, the feedback effects change the cost-benefit conclusions implied by the partial equilibrium experimental evaluation substantially.

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1 Introduction

Considerable attention has focused on the reform of unemployment insurance and welfare systems in recent years, especially those reforms that attempt to "make work pay" by providing incentives for individuals to exit programs to stable employment. Many potential reforms have been evaluated using social experiments, where small subsets of the population are randomly assigned to treatment and control groups, the treatment group is subjected to the potential policy reform and the difference in outcomes between the groups provides an estimate of the mean impact of the policy.

The resulting treatment effects literature provides useful estimates of the effect of treatment on those individuals participating in the program within an experiment, where typically a small number of individuals are affected by the policy. However, such estimates may be of limited usefulness if the policy evaluated in the experiment is implemented in general. A growing body of research indicates that a policy may have very different implications when it is implemented for the general population than when it is implemented on only a small number of participants for evaluation purposes.

As outlined in Calmfors (1994) and elsewhere, such general equilibrium effects of programs represent a critical component of social cost benefit analysis. Consider two examples of such effects. First, programs may have indirect effects on both participants and non-participants by changing the equilibrium of the labor market. These effects violate the "stable unit treatment value" (SUTVA) assumption invoked to justify partial equilibrium analysis. Heckman, Lochner, and Taber (1998) consider increasing subsidies to college tuition and find that the resulting increase in the number of individuals who attend college has the effect of increasing the supply of college graduates and reducing their wages. In this case, the effect of the tuition policy depends on the number of college graduates in the labor market.

Second, programs may directly affect those who are not treated within the program. As discussed by Heckman and Smith (1998), the standard treatment effects literature assumes that the outcomes for individuals not treated by the program within an experiment are the same as the outcomes non-participants would experience if the program is implemented more widely. This need not be the case. For example, consider the US Unemployment Insurance Bonus experiments, where individuals starting a spell of unemployment were offered a cash payment if they obtained employment within a limited time period. Davidson and Woodbury (1993) estimate the displacement effects of the bonus program that would result from changes in the search behavior of all workers in the labor market. In particular, the bonus increases the gain to employment for workers eligible to receive it, resulting in increased search effort and employment. Some of the increase in employment will be in jobs that may otherwise have been held by workers not eligible for the bonus. This displacement directly affects a subset of the labor force not treated within the program.

Existing studies, such as those mentioned above, indicate that the equilibrium effects of large-scale policies may be substantial. With regard to the college tuition subsidies studied by Heckman, Lochner and Taber (1998), they estimate that the general equilibrium effects on enrollment rates are 10 times smaller than those obtained from a partial equilibrium analysis. Davidson and Woodbury (1993) estimate that the displacement of UI-ineligible workers offsets 30-60 percent of the gross employment effect of the bonus program. This has a strong effect on the estimated net impact of the program from society's point of view. As a result, general equilibrium program evaluations can lead to very different conclusions regarding the cost-benefit performance of a program.

In this paper, we make three contributions to the literature. First, we construct a dynamic, general equilibrium model that is well-suited for conducting policy experiments and we use the model as a tool for evaluating social programs. Our model is based on the search model of Davidson and Woodbury (1993). Within the model, the amount of time required to find a job can be reduced by increased search effort on the part of the worker. Once workers and firms meet, they bargain over wages in an environment where wages reflect the value of the match and the value of the outside options faced by both parties. This framework is ideally suited for many equilibrium program evaluations, as it explicitly considers the effect of changes in financial incentives introduced by social programs on the intensity with which individuals search for jobs and on the process by which wages are determined in the labor market. In addition to the matching and wage determination process, our model incorporates key features of the welfare and unemployment insurance programs, both of which constitute important aspects of the economic context and are likely to have important feedback effects on the labor market.

Studying the potential general equilibrium effects that may result from implementing a small-scale social experiment as a large-scale policy is difficult without the use of an equilibrium model. However, the degree of confidence that can be placed on policy experiments generated within a model depends to a large extent on how well the model captures the behavior of individuals affected by the policy. The second contribution of our paper is to demonstrate the usefulness of social experiments as tools to evaluate equilibrium models. In this respect, our paper serves as an analogue to work by Lalonde (1986) and others, where experiments are used as a benchmark against which to assess the performance of non-experimental estimators.[1] We informally test the ability of our model to replicate the outcomes produced by a social experiment without the use of experimental data. The ability of the model to replicate the experimental findings greatly increases our confidence in the results from our general equilibrium program evaluation.

The third contribution of this paper is to apply our methodology to the equilibrium evaluation of the Canadian Self-Sufficiency Project (SSP), a policy designed to provide incentives for individuals on Income Assistance (IA) to leave the welfare system and seek employment. The SSP was operated as a demonstration program in two provinces, British Columbia and New Brunswick, from 1992 to 1999. A growing literature has begun to look at various aspects of the Self-Sufficiency Project (Card and Hyslop, 2002; Ferrall, 2000; Kamionka and Lacroix, 2002). Similar, but less generous, income supplement programs have been studied in the United States; see Auspos, Miller, and Hunter (2000) on the Minnesota Family Investment Program and Bos, Huston, Granger, Duncan, Brock, and McLoyd (1999) on the Wisconsin New Hope program. Bloom and Michalopoulos (2001) provide an overview of the experimental literature and compare these programs to other approaches. The SSP provides financial incentives by offering temporary earnings supplements to individuals on IA. Individuals must remain on IA twelve months to become eligible for income supplements; once they do, they receive a supplement if they obtain employment and leave Income Assistance within the following twelve months. The model is augmented to incorporate the main features of the SSP. In particular, the model allows for time limits in determining eligibility for receipt of the supplement, consistent with the one-year time limit in the experiment, allows individuals to receive the earnings supplement for up to

[1]In parallel work, Todd and Wolpin (2002) use the data from the experimental evaluation of Mexico's Progresa program to test their dynamic model of fertility and child schooling.

three years while employed, and allows the earnings supplement to depend on the wages received by eligible recipients. The time limitations for entry to and exit from the Canadian unemployment insurance program (Employment Insurance) and the interactions between the welfare and unemployment programs and the labor market are also incorporated in the model, including the role of minimum wages.

After constructing the model, three potential feedback effects of implementing the SSP as policy are considered. First, we consider the displacement effects of the program: an increase in employment for Income Assistance recipients may result in a reduction in employment opportunities for other workers. Second, we examine the impact of the policy on the determination of wages: workers receiving the supplement may be willing to accept lower wages in equilibrium. As a result, wage growth in the presence of the supplement must be high enough to offset the initial decline in wages if individuals are to stay off welfare once the supplement payments end. The increased attractiveness of work for those offered the supplement may also translate into wage changes for workers not offered the supplement as it becomes easier for firms to fill vacancies and the outside options of workers change. Finally, we consider entry and exit effects resulting from the introduction of the SSP as policy, as outlined by Berlin, Bancroft, Card, Lin, and Robins (1998): the availability of the supplement payments may increase the attractiveness of entering the Income Assistance Program and individuals may stay on welfare for longer periods in order to become eligible for the supplement.[2]

To carry out our analysis, we adopt the following strategy. First, we calibrate the equilibrium model in the absence of the program using data on wages, unemployment rates and IA and Employment Insurance (EI) program use from publicly available, non-experimental data and from data on the experimental control group. The parameters calibrated in the first stage include the discount rate, search friction parameters, and exogenous job separation rates: parameters that are, in theory, invariant to changes in the Income Assistance program.

The second stage entails simulating the SSP experiment within our calibrated model using the parameters obtained in the first stage. Simulated program and control groups are constructed and the Self-Sufficiency project is imposed in partial equilibrium to determine how well the model simulations are able to replicate the labor market outcomes of the treatment and control groups in the SSP experimental data. Results from this exercise lend much support to our parsimonious model, as the simulated experimental outcomes match the experimental data quite closely. In particular, the welfare-to-work transition rates for the simulated treatment and control groups during the 36 months following random assignment are the same as for their counterparts in the experimental data. Finally, we incorporate the features of the SSP in the model, calibrate the model using the parameters obtained in the first stage and simulate the equilibrium effects that result from introducing the SSP as policy. This last stage allows us to quantify the displacement, wage and entry effects of the SSP and provides a more complete picture of the potential implications of implementing the SSP as policy.

Three main results emerge from the equilibrium program evaluation. First, introducing

[2]One part of the SSP experiment randomly assigned new IA recipients to control and program groups where the program group was informed that, if they remained on welfare for 12 months, they would become eligible to receive the supplement. The reported "delayed exit effect" from this experiment was a 3.1 percentage point difference in the fraction of respondents collecting IA in 12 out of 13 months after the start of the welfare spell between the program and control groups.

an earnings supplement to the welfare program has implications for unemployed workers, as the increase in employment for income assistance recipients coincides with a decrease in re-employment rates for those individuals receiving unemployment benefits. Second, although the introduction of an earnings supplement increases the rate of exits to employment from welfare, it does so at lower equilibrium wages, as workers are willing to accept lower starting wages so as to benefit from the supplement payments. Surprisingly, the wages of other workers in the economy increase slightly, as the increased value of welfare due to the introduction of the earnings supplement transfers bargaining power from firms to workers. This result is primarily due to the fact that the minimum wage limits the ability of firms to extract the surplus generated by the supplement from the worker. Finally, the simulation results indicate the presence of entry and delayed exit effects, as the transition rate into the welfare program increases and a higher fraction of individuals remain on welfare long enough to qualify for the supplement after the policy change.

Incorporation of the equilibrium effects changes the cost-benefit conclusions substantially. In partial equilibrium, the policy change is predicted to result in a net gain to society in both provinces. Taking the equilibrium effects into account suggests the gain to the program is approximately one-tenth of estimated gain from the partial equilibrium exercise in New Brunswick. In British Columbia, the cost benefit conclusions are completely reversed as the general equilibrium program evaluation suggests the program would have a net cost to society. These cost benefit findings further illustrate the importance of equilibrium program evaluation.

2 The Model

In this section, we present the model of the labor market that we use to conduct equilibrium program evaluations. Three segments of the market are incorporated in the model: individuals may be employed (E), unemployed and receiving unemployment benefits (U) or on income assistance (A).[3] This feature of the model allows us to consider how workers, unemployed individuals and income assistance recipients interact in the labor market. The model builds on the equilibrium search model of Davidson and Woodbury (1993), where individuals maximize expected lifetime income by choosing their labor market state and the intensity with which they search for work if not employed.[4] We extend Davidson and Woodbury (1993) to incorporate the welfare program, minimum wages, and time limitations for entry to and exit from the unemployment insurance program. Workers bargain with firms over wages that depend on the tenure of the match, the minimum wage, and on the outside options of both parties. Through this channel, the model generates predictions regarding the way starting wages vary depending on the state from which the individual is entering employment. It is further assumed that the value of the match surplus increases with job tenure, generating on-the-job wage growth in the model.

Key features of typical unemployment and welfare programs are incorporated in the model as follows.[5] First, individuals face time limitations regarding entry to and exit from

[3]Throughout this paper we use the term unemployed to mean collecting unemployment benefits. In the model, all jobless individuals are actively seeking employment; they are distinguished by whether they are receiving unemployment benefits or social assistance benefits.

[4]The model of Davidson and Woodbury (1993) is based on work by Diamond (1982), Mortensen (1982) and Pissarides (1984).

[5]The program details correspond to those in place in Canada at the time of the SSP experiment. Our

the unemployment system. Individuals who enter employment from income assistance or who have exhausted their unemployment benefits become eligible to receive unemployment benefits after I months of full time employment. The number of benefit months subsequently increases by one month for each additional month of employment, from a minimum of $\underline{u}$ months up to a maximum of $\bar{u}$ months. Workers who enter employment with unused benefits retain their unused benefit months and accumulate additional months with each month worked. Second, individuals who exhaust their unemployment benefits and do not secure a job are assumed to transit directly to welfare. Finally, it is assumed that individuals can remain on welfare indefinitely or transit to employment if they contact a firm with a vacancy; welfare recipients cannot transit directly from welfare to unemployment. In the following sections, we describe the problems faced by each type of individual and by firms in the model.

2.1 Workers

The value of employment for a worker depends on her job tenure t and unemployment eligibility status i, where $i \in \{0, 1, ..., \underline{u}, ..., \bar{u}\}$. The number of months an individual with no benefits must work to qualify for unemployment is I. For every period an individual works beyond I, i increases by 1. The maximum number of benefit months an individual can accumulate is denoted $\bar{u}$. If the individual were not working she would therefore be unemployed with i periods of benefits remaining, $i \in \{0, ...\bar{u}\}$. With probability δ, jobs are exogenously destroyed in the subsequent month, in which case workers transit to welfare if they have not yet qualified for unemployment benefits, $i = 0$, and transit to unemployment otherwise. With probability $(1 - \delta)$, workers remain employed in the next month.

It is assumed that individuals who return to work before their unemployment benefits expire retain their remaining unemployment benefit eligibility. Finally, workers experience on the job wage growth for a maximum of T months, after which the wage remains constant, where it is assumed $T > \bar{u}$. The value function for a worker with outside option i and with job tenure t is:

$$V^E(t,i) = \begin{cases} w(t,0) + \beta[(1-\delta)V^E(t+1,0) + \delta V^A] & \text{if } t < I \text{ and } i = 0, \\ w(t,0) + \beta[(1-\delta)V^E(t+1,\underline{u}) + \delta V^U(\underline{u})] & \text{if } t = I \text{ and } i = 0, \\ w(t,i) + \beta[(1-\delta)V^E(t+1,i+1) + \delta V^U(i+1)] & \text{if } 0 < i < \bar{u} \text{ and } I \le t < T, \\ w(t,\bar{u}) + \beta[(1-\delta)V^E(t,\bar{u}) + \delta V^U(\bar{u})] & \text{if } i = \bar{u} \text{ and } I \le t < T, \\ w(T,\bar{u}) + \beta[(1-\delta)V^E(T,\bar{u}) + \delta V^U(\bar{u})] & \text{if } t \ge T, \end{cases} \tag{1}$$

where $w(t,i)$ is the wage for a person with tenure t who has unemployment eligibility i, β is the discount rate, V^A is the value of being on income assistance, and $V^U(i)$ is the value of being unemployed with i benefit periods remaining. All notation is defined in Table 1.

2.2 Welfare Recipients

Welfare recipients receive welfare benefits (b_a) and pay search costs $c_a[p(0)^z]$ every month they remain on welfare, where z is the elasticity of search costs with respect to search effort,

model could easily be modified to correspond to the institutions present in the US, the UK, or other developed countries.

c_a is a parameter capturing the disutility of search effort and $p(i)$ is optimal search effort for individuals with i months of unemployment benefits remaining. The cost of search depends directly on the intensity with which individuals search within the model. In particular, for values of $z > 1$, the marginal cost of search increases as search effort increases. If welfare recipients contact a firm with a vacancy, they transit to employment. Otherwise, they remain on welfare in the next period. The value function for a welfare recipient is

$$V^A = \max_{p(0)} \Big\{ b_a - c_a[p(0)^z] + \beta \Big[m(0)V^E(1,0) + (1 - m(0))V^A \Big] \Big\}, \tag{2}$$

where $m(0)$ is the match rate for welfare recipients. The only reason welfare recipients are not employed is because an employment opportunity is not available and the only way a welfare recipient can increase the likelihood of finding a job is through increased search effort. As we will see below the match rate $m(0)$ is determined in part by search effort $p(0)$.

2.3 Unemployed Individuals

Unemployed agents receive exogenous unemployment benefits (b_u) and pay search costs $c_u[p(i)^z]$. We make the simplifying assumption that unemployment benefits are independent of the individual's pre-separation earnings. With probability $m(i)$, individuals contact a firm with a vacancy and transit to employment in the next month. If individuals remain unemployed in the next month, it is assumed they can continue to collect unemployment benefits until benefits are exhausted. Following the last month of eligibility, individuals can either transit to employment, if a job opportunity is available, or transit to welfare. The value function for unemployed individuals with i months of benefits remaining is

$$V^U(i) = \begin{cases} \max_{p(i)} \Big\{ b_u - c_u[p(i)^z] + \beta \Big[m(i)V^E(1, i-1) + (1 - m(i))V^U(i-1) \Big] \Big\} & 1 < i \leq \bar{u}, \\ \max_{p(i)} \Big\{ b_u - c_u[p(i)^z] + \beta \Big[m(1)V^E(1,0) + (1 - m(1))V^A \Big] \Big\} & i = 1. \end{cases} \tag{3}$$

2.4 Firms

Production takes place when there is a match between one firm and one worker; the number of firms can alternatively be interpreted as the number of jobs in the economy. In every period, each firm has the option of filling a vacancy, if one exists, by hiring a worker or keeping the vacancy open. If matched with a worker, firms earn profits that depend on the surplus generated by the match and pay wages, determined in equilibrium, that depend on the worker's outside options and the minimum wage. Profits depend on the worker's tenure to allow match-specific capital to increase the productivity of the match over time. Denote the surplus generated by a worker-firm pair of tenure t by $P(t)$. With probability δ the match separates and the firm is left with a vacancy in the following month. Denote the profits of a firm matched with a worker with outside option i, $i \in \{0, 1, ..., \underline{u}, ..., \bar{u}\}$ and match tenure t as $\Pi(t, i)$.

The expected future profits for matches of job tenure t and workers with outside option

i are

$$\Pi^E(t,i) = P(t) - w(t,i) + \begin{cases} \beta[\delta\Pi^V + (1-\delta)\Pi^E(t+1,0)] & \text{if } i=0 \text{ and } t<I, \\ \beta[\delta\Pi^V + (1-\delta)\Pi^E(t+1,\underline{u})] & \text{if } i=0 \text{ and } t=I, \\ \beta[\delta\Pi^V + (1-\delta)\Pi^E(t+1,i+1)] & \text{if } 0<i<\bar{u} \text{ and } t<T, \\ \beta[\delta\Pi^V + (1-\delta)\Pi^E(t+1,\bar{u})] & \text{if } i=\bar{u} \text{ and } t<T, \\ \beta[\delta\Pi^V + (1-\delta)\Pi^E(T,\bar{u})] & \text{if } t\geq T, \end{cases} \quad (4)$$

where match tenure beyond T no longer increases profits.

If a firm has a vacancy, the value of the vacancy is determined by the probability of meeting an unmatched worker, by the profits the firm expects to make from the match, and by the costs of posting a vacancy (ξ)

$$\Pi^V = -\xi + \beta\Big[\sum_{i=0}^{\bar{u}} q(i)\Pi^E(1,i) + \Big(1 - \sum_{i=0}^{\bar{u}} q(i)\Big)\Pi^V\Big], \quad (5)$$

where $q(i)$ is the probability a firm matches with a worker with outside option i. Firms will post vacancies unless the expected profit from doing so is negative. Thus in the steady state equilibrium the number of firms in the economy will be determined by the condition that the expected profits from posting a vacancy are zero. Note that this also requires a free entry assumption.

2.5 Search Technology

Assume there is no on-the-job search in the economy. The probability that a jobless individual receives a job offer depends on the probability the worker contacts a firm and the probability a firm has a vacancy.

2.5.1 Workers

The probability a firm has a vacancy is simply the total number of vacancies divided by the total number of firms

$$\frac{V}{F}.$$

If a firm has a vacancy, it will hire a worker and pay a wage which is the outcome of Nash bargaining between the worker and the firm, discussed in detail below. Let applications for jobs arrive according to a Poisson process, where λ is the average number of applications filed by workers at each firm. It is further assumed that firms randomly draw workers from the applicant pool if there is more than one applicant.[6] The probability a worker is offered a job is:

$$\frac{1-e^{-\lambda}}{\lambda}.$$

The conditional re-employment probabilities for unemployed workers and workers on social assistance can then be expressed as the product of the above components, multiplied by the

[6] Alternatively, we can consider the length of a period tending to zero and work in continuous time, where there is zero probability of more than one application arriving simultaneously. As we wish to take the model to data, we work with discrete periods.

worker's search effort

$$m(i) = \frac{p(i)V}{\lambda F}\left(1 - e^{-\lambda}\right), \tag{6}$$

where

$$\lambda = \frac{1}{F}\left(\sum_{i=1}^{\bar{u}} p(i)U(i) + p(0)A\right). \tag{7}$$

Recall, $p(0)$ and $p(i)$ are the contact probabilities for welfare recipients and unemployed individuals with i periods of UI receipt remaining, respectively. The contact probabilities are choice variables for the workers within the model and can be interpreted as search effort. Workers determine the optimal level of search effort by equating the marginal benefit from an increase in search effort with its marginal cost.[7] The optimal level of search effort, for each labor market state and program eligibility combination, is described by:

$$\begin{aligned} p(0) &= \left(\frac{\beta m(0)}{c_a z}\left[V^E(1,0) - V^A\right]\right)^{\frac{1}{z}}, \\ p(i) &= \left(\frac{\beta m(i)}{c_u z}\left[V^E(1,i-1) - V^U(i-1)\right]\right)^{\frac{1}{z}}, \qquad 1 < i \leq \bar{u}. \\ p(1) &= \left(\frac{\beta m(1)}{c_u z}\left[V^E(1,0) - V^A\right]\right)^{\frac{1}{z}}, \qquad i = 1. \end{aligned} \tag{8}$$

2.5.2 Firms

From the firm's perspective, the probabilities of meeting potential workers from unemployment and welfare are the fraction of workers from unemployment and welfare that transit to employment, divided by the total number of vacancies

$$q(i) = \frac{m(i)U(i)}{V} \qquad \text{and} \qquad q(0) = \frac{m(0)A}{V}, \tag{9}$$

respectively.

2.6 Equilibrium Wage Determination

After meeting in the labor market, a firm and a worker bargain over wages by making alternating wage offers until both sides find the offer acceptable. It is assumed that both parties have equal bargaining power, but may have different threat points. The equilibrium of this game is the Nash cooperative bargaining solution and results in workers and firms splitting the surplus of a match evenly. The surplus of the match from the worker's perspective is the difference between employment at the equilibrium wage and the worker's outside option, which depends on their current labor market state and program eligibility. The surplus from the perspective of the firm is the difference between the profits the firm receives at the equilibrium wage and the value of leaving the vacancy open. It is further assumed that the bargaining process is constrained such that the wage can not fall below the minimum wage $\underline{w}$. The equilibrium wage is $\max\{w(t,i), \underline{w}\}$, where $w(t,i)$ solves

$$V^E(t,i) - V^i = \Pi^E(t,i) - \Pi^V. \tag{10}$$

[7]In determining the marginal cost and benefit of search effort λ is held constant under the assumption that each worker believes her impact is small relative to total labor supply.

where $V^i \in \{V^A, V^U(i)\}$ is the value of the outside option i. In the following section, we define the steady state conditions that govern the evolution of the economy.

2.7 Steady State Conditions

Let E denote the steady state number of jobs occupied by workers and V the number of vacancies. By definition, the total number of jobs in the labor market is equal to the total number of occupied jobs and the total number of vacancies

$$F = E + V. \tag{11}$$

Denote the total number of individuals in the labor market L. The total number of individuals can be decomposed into three groups. First the employed, who are distinguished both by their current job tenure and their current outside option

$$E = \sum_{t=1}^{T} \sum_{i} E(t,i) + \bar{E},$$

where $\bar{E}$ is the group of workers no longer experiencing on-the-job wage growth. The second group are on income assistance, denoted A. The final group are unemployed individuals (U), who can remain unemployed for up to a maximum of $\bar{u}$ periods

$$U = \sum_{i=1}^{\bar{u}} U(i),$$

where $U(i)$ indicates the number of unemployed persons with i periods of benefits remaining.

The total number of individuals in the labor market can therefore be expressed as the sum of the above components

$$L = E + A + U. \tag{12}$$

Using the above definitions, we can describe the conditions governing the steady state, where the flows in and out of every employment state must be equal over time. The steady state conditions for each state and eligibility combination are discussed in turn below.

Employment

As above, let $m(0)$ and $m(i)$ denote the probabilities that welfare recipients and unemployment recipients with i periods of benefits remaining, respectively, match with a firm. The flow into the first period of employment includes those workers from welfare and unemployment who receive job offers. They are indexed by their respective outside options as this will determine their progression of benefit entitlements. In subsequent periods, the inflow consists of workers who were employed in the previous period and who were not exogenously separated from their jobs

$$\begin{aligned}
E(1,0) &= m(0)A + m(1)U(1) \\
E(1,i) &= m(i+1)U(i+1), \quad 0 < i < \underline{u} \\
E(t,0) &= (1-\delta)E(t-1,0), \quad 1 < t < I \text{ and } i = 0 \\
E(t,i) &= (1-\delta)E(t-1,i-1), \quad 1 < t < T \text{ and } i > 0 \\
\delta\bar{E} &= (1-\delta)E(T,\bar{u}).
\end{aligned}$$

Welfare
The flow into Income Assistance includes those employed workers who were exogenously separated from their jobs and ineligible for unemployment benefits and unemployed workers no longer eligible for unemployment benefits. The flow out of welfare includes welfare recipients who find employment. The steady state condition for welfare is the following:

$$\delta \sum_{t=1}^{I} E(t,0) + (1-m(1))U(1) = m(0)A. \tag{13}$$

Unemployment
Employed workers who are separated from their jobs and who are eligible for the maximum months of unemployment benefits flow into the first period of unemployment, $U(\bar{u})$. For $U(i)$ where $0 < i < \bar{u}$, the inflow consists of unemployed workers from the previous period who did not find jobs, and workers separated from their jobs who qualify for less than the maximum number of benefit months. All workers flow out of the unemployment state when benefits run out due to the time limitations in the unemployment insurance program

$$\begin{aligned} \delta \sum_{t} E(t,\bar{u}) &= U(\bar{u}) \\ \delta \sum_{t} E(t,i-1) + (1-m(i+1))U(i+1) &= U(i) \qquad \text{if } 0 < i < \bar{u}. \end{aligned} \tag{14}$$

In the next section, we calibrate the baseline economy and discuss some of its features.

3 Baseline Model Calibration

3.1 Parameter Selection

In this section, we calibrate the model presented above to data on the Canadian economy. The model is calibrated for British Columbia and New Brunswick, the two provinces in which the SSP experiment was implemented. The parameters for the model include monthly welfare and unemployment benefits (b_a and b_u, respectively), the size of the labor force (L), the number of firms (F), the job separation rate (δ), the cost of posting a vacancy (ξ), the discount factor (β), and the search friction parameters (c_a, c_u, z). In addition, we calibrate the match surplus for each of the first 48 months of job tenure ($P(1)$–$P(48)$), with one additional match surplus for all jobs of a longer duration ($P(49)$). The values of all the calibrated parameters are presented in Table 2 and discussed in detail below.

Monthly welfare benefits (b_a) are based on the average welfare incomes from 1990 to 2000 reported by the National Council of Welfare (2002). Welfare incomes by province are provided for the sub-groups of single employable persons, persons with disabilities, single parents with one child, and couples with two children. We take a weighted average for these groups, with the weights reflecting their size in the welfare population.[8] The calibrated welfare benefits are equal to $482 per month in New Brunswick and $695 in British Columbia. Unemployment insurance benefits (b_u) are set at 55 per cent of average earnings for the population of individuals who have not completed post-secondary education. The

[8]The population shares are based on those reported for British Columbia in Barrett and Cragg (1998). In the absence of equivalent data for New Brunswick we use the same shares as for British Columbia.

earnings sample is limited to individuals with less than post-secondary education, as we are attempting to isolate that segment of the labor market most similar to individuals receiving Income Assistance. The earnings data are based on the usual hourly wage for the latter sub-population, as reported in the monthly Labour Force Survey (1997-2000), assuming a 37.5 hour work week.[9] Earnings, welfare benefits and unemployment benefits are all converted to 1992 dollars using the all-goods CPI.[10] The resulting monthly unemployment benefits level is \$1174 in British Columbia and \$887 in New Brunswick.

The model is homogeneous of degree zero in L and F; we can therefore normalize the size of the labor force to 100 without loss of generality. The number of firms in the economy will be estimated in the baseline model, and is identified using the observed vacancy rate in the economy. Equation (11) determines V endogenously as a function of F and E. In order to estimate F we use the additional relationship between F and V given by the vacancy rate (v)

$$\frac{V}{F} = v.$$

The vacancy rate of 3.20 is taken from Galarneau et al. (2001) and is based on the average for the retail trade and consumer services and labor-intensive tertiary manufacturing sectors, both of which have average incomes similar to our sample. Therefore, using equation (11), and for a given value of E,

$$F = \frac{E}{(1 - 0.032)}.$$

The job separation rate in the model (δ) is constant and can be directly estimated by the average job tenure for individuals with no completed post-secondary education in the monthly Labour Force Survey (1990-2000). Job tenure is only reported for individuals currently employed in the data: we do not have direct information on separations. However, average job tenure is observed and in the model is equal to

$$\frac{\sum_{t=1}^{\infty} tE(t)}{E} = \frac{E(1)\sum_{t=1}^{\infty} t(1-\delta)^{t-1}}{E(1)\sum_{t=1}^{\infty}(1-\delta)^{t-1}} = \frac{1}{\delta}.$$

Average job tenure in the Labour Force Survey (1990–2000) for those with less than post-secondary education is 72.91 months in British Columbia and 77.76 in New Brunswick; therefore the separation rates are equal to 0.0137 and 0.0129, respectively.[11]

The costs of search are allowed to differ depending on whether individuals are receiving unemployment insurance or welfare to capture the notion that searching may be less costly while unemployed. For example, unemployed individuals may have access to better search technologies through unemployment offices than do welfare recipients. The search cost parameters, c_a and c_u, are chosen to match the fraction of the population in each labor force state in the data. In particular, we can recover c_a and c_u as the search friction parameters that yield the employment, unemployment and welfare recipiency rates presented in Table 2.

The labor force states are estimated from the 1993-94 longitudinal wave of the Survey of Labour Income Dynamics (SLID).[12] Unlike the LFS, the SLID has separate data on social assistance and unemployment benefit receipt. We adopt the following definitions in the

[9]The Canadian Labour Force Survey is the analogue of the U.S. Current Population Survey.

[10]All figures are reported in Canadian dollars, where \$1Cdn is approximately equal to \$0.63US.

[11]This measure of job tenure does not take quits into account. As a result, we may overestimate the job separation rate as individuals moving between jobs because of quits report holding jobs of shorter durations.

[12]The SLID is the Canadian analogue of the U.S. Survey of Income and Program Participation.

data to maintain consistency with the model. We define employed workers as individuals who are employed in the first week of the month and report no unemployment or welfare income during the month. Unemployed workers are defined as individuals who are either unemployed or not in the labor force and report receiving unemployment benefits. Finally, welfare recipients are individuals who are either unemployed or not in the labor force and report receiving social assistance benefits. We exclude all individuals who do not fit these criteria, such as those who report working full time and receiving either unemployment benefits or social assistance. Similarly, we exclude those reporting they are unemployed or not in the labor force, but not receiving any unemployment or social assistance benefits. We use parameter estimates for our search cost function from Christensen, Lentz, Mortensen, Neumann and Wervatz (2002), whose estimates of the elasticity of search costs imply $z = 1.8457$, and we set the monthly discount factor β equal to 0.9835, corresponding to an annual discount factor of 0.82 as in Davidson and Woodbury (1993). We assess the sensitivity of our results to these parameters in Section 7 below. The cost of posting a vacancy, ξ, is calibrated so that the value of a vacancy is equal to zero.

The match surplus values for different match tenure levels are calibrated as follows. We do not directly observe the match surplus; however, we do observe the average wage for workers with different tenure levels in the data. We can therefore use the wage and tenure information from the LFS for the sample of individuals with less than post-secondary education to infer the match surplus values in the baseline economy. In particular, we estimate a wage profile that is cubic in job tenure and determine what match surplus values in the model generate the equilibrium wage profile in the data.

The first periods of employment in the model differ from later periods of employment, as the model allows starting wages to differ depending on whether the worker's outside option is welfare or unemployment. However, it is not possible to separate out the starting wages in the data for individuals with different outside options. In the model, all matches are assumed to have the same match surplus value, but workers may receive different wages, as they face different outside options when bargaining with firms. Therefore, when estimating the starting wages for workers in each of the first $\bar{u}$ periods of employment, we restrict the average of the wage for each month in the model to equal the average wage for a worker with the corresponding tenure in the data. The match surplus is exogenous in the model, and unlike the wage distribution, should be invariant to the policy changes considered later in the paper. Therefore, when conducting equilibrium policy analysis, we take the match surpluses calculated here as given and compute new wage distributions following the policy change.

Before examining the characteristics of the baseline model, we must specify the length of time a worker is eligible for unemployment benefits. The length of the unemployment eligibility period in Canada depends on the unemployment rate in the region of residence and on the worker's previous job tenure. We match the eligibility periods in the model using the eligibility rules in both provinces during the 1990s. This implies that in British Columbia (New Brunswick), a worker is entitled to 5 (7) months of benefits after working 4 (3) months, and to 10 (12) months of benefits after working 9 (8) months or more.[13]

Finally, we calibrate the minimum wage in both provinces, as the minimum wage serves as a constraint on the wage bargaining process in the model. We set the minimum wage in

[13]Information on EI eligibility rules is from `http://www.hrdc-drhc.gc.ca/ae-ei/de_app/2.0_e.shtml`. Information on EI Program Characteristics is from `http://www14.hrdc-drhc.gc.ca/ei-ae/ratesc.htm`.

British Columbia to 5.50 and to 5.00 in New Brunswick to match the legislated minimum wages in both provinces at the beginning of the SSP experiment. We use the minimum wage that was in place at the beginning of the SSP experiment (Michalopoulos et al., 2002) and abstract from increases in the minimum wage over the remaining course of the experiment.

3.2 Characteristics of the Baseline Model

Given b_a, b_u, L, F, z, δ, β, ξ, and data on wages, the baseline model is a system of 377 equations and unknowns for British Columbia. Due to the longer unemployment insurance benefit period, the number of equations and unknowns for New Brunswick is 383. Solving the baseline model yields estimates for c_a, c_u, $P(1) - P(49)$, and wages $w(t, i)$ for each unemployment eligibility status.[14] The estimated search costs for welfare recipients are approximately six times higher than for those receiving unemployment benefits in British Columbia and approximately three times higher than for those receiving unemployment benefits in New Brunswick, as illustrated in Table 2. Combined with lower benefits while on welfare, the difference in search costs across labor market states generates substantial differences in the conditional re-employment probabilities. The re-employment probabilities for the unemployed and for those on social assistance are presented in Figure 1. The figure plots the conditional re-employment probabilities for an individual who is eligible for the maximum number of months of unemployment benefits when beginning a jobless spell. The probability of transiting to employment increases as the individual approaches the exhaustion of unemployment benefits, for search effort is greatest just before benefits run out. The probability of exiting to employment once unemployment benefits are exhausted is substantially lower than while collecting unemployment benefits.

The model also produces a distribution of starting wages that depends on whether the individual is coming from social assistance or unemployment, and on the number of unemployment benefit periods remaining. In particular, since the unemployment program provides more generous benefits than welfare, an individual entering employment from the first period of unemployment will command a higher wage than an individual entering from welfare. Although starting wages differ, the wage profile is the same across all workers after the 10^{th} month. The reason this is the case is that it is assumed all workers who separate from their jobs and are eligible for unemployment transit to the EI system. Table 3 captures the empirical feature that the starting wages available to those on social assistance are very low; this is a primary motivation behind the SSP. In fact, individuals transiting to employment from welfare earn the minimum wage. Wages are initially low, as workers are willing to accept relatively low wages before they are eligible for unemployment benefits. However, once the outside options of workers improve, wages begin to rise.

4 Partial Equilibrium Program Analysis

In this section, we introduce the Self-Sufficiency Project in the model as an experiment in much the same way it was implemented. We simulate the effects of the program in *partial equilibrium* and compare the outcomes to those generated in the data. This exercise provides evidence on how well our model and simulated experiment are able to replicate the outcomes generated by the true experiment. It is important to emphasize that the partial

[14] Estimates of the match surplus values and wages are available from the authors upon request.

equilibrium version of the model is the appropriate comparison to the experiment because the experiment only affected a small subset of the economy and as such is not expected to have equilibrium impacts, as compared to a change in policy affecting all welfare recipients.

4.1 The Self-Sufficiency Project Data

The Canadian SSP experiment focused on long-term welfare recipients.[15] The universe for the experiment was long-term single parent IA recipients ages 19 and older in British Columbia and New Brunswick from November 1992 to March 1995. This universe was sampled at random. Of those selected, 6,028 recipients volunteered to participate in the experiment and were subsequently placed in treatment and control groups by random assignment.[16] Individuals assigned to the treatment group were informed that they were to receive an earnings supplement if they found a full-time (30 hours per week) job within one year and left income assistance. The supplement received by members of the treatment group depends on their labor market earnings.[17] In particular, the supplement payment equals one-half of the distance between the earnings of the recipient and a benchmark earnings level, set at \$37,000 in British Columbia and at \$30,000 in New Brunswick. Once eligible, individuals could receive the supplement for up to three years. Individuals in the treatment group who were not able to secure full-time employment within the twelve months following random assignment were not eligible to receive the supplement. Individuals in the control group were not eligible for the supplement.

The experimental data include three sets of detailed information on the treatment and control group members. First a baseline survey was conducted prior to random assignment and provides information on standard demographic characteristics of recipients and their households, as well as information on employment and earnings over the past year. Second, monthly survey data are available on employment, earnings, Income Assistance payments and earnings supplement payments for up to 36 months after random assignment. Third, administrative data on monthly Income Assistance payments are available for three years prior to the SSP and for 36 months following random assignment.[18]

The data contain information on 5,686 recipients in the main study: 2,827 control group members and 2,859 program group members. From the main study, the following restrictions are placed on the baseline sample. First, 280 males are eliminated from the sample so that our analysis can focus on a homogeneous group (single mothers) within the study.[19] Second, 13 observations with inconsistent information are removed from the sample[20] and 324 cases missing information on hours, earnings and other relevant characteristics are eliminated. From the 36-month follow-up survey, an additional 476 cases with missing hours and earnings information are also removed. The remaining sample contains 4,593 respondents,

[15]In particular, individuals had to receive welfare in at least 11 months during the last year including the current month to be included in the experiment.

[16]Kamionka and Lacroix (2002) examine the potential for randomization bias in the (partial equilibrium) experimental impact estimates due to refusals to participate in the experiment. They find evidence that the published estimates understate the true impact of the SSP treatment.

[17]No other sources of income affected the calculation of the earnings supplement.

[18]Data is available on IA payments for some respondents for an extended time period. Data will be available for up to 54 months following random assignment in the near future.

[19]This is a relatively innocuous assumption, as 95% of the individuals in the SSP are female.

[20]In particular, 7 individuals report their age at the baseline survey to be less than 19 and 6 individuals report their total number of children is zero. To be included in the study, individuals had to be single parents and at least 19 years of age.

of which 2,290 are members of the control group and 2,303 are members of the program group.[21]

Table 4 contains descriptive statistics for the control and treatment groups from the baseline survey in British Columbia and New Brunswick. As expected, there are few significant differences between the two groups at the baseline interview.[22] The vast majority of respondents have worked at some point in their lives; however, less than 20% are working at the baseline interview and over 20% are looking for work. Those working at the baseline interview tend to have low wages and limited attachment to the labor force as indicated by the low annual hours and months worked over the course of the previous year. By design, the sample members have a strong attachment to the IA program prior to random assignment: on average, respondents collected IA in 30 out of the 36 months leading up to the baseline survey.

Table 5 compares the experimental outcomes of the treatment and control groups in the months following random assignment. Several interesting findings emerge upon comparison of the treatment and control groups 36 months after the implementation of the SSP. First, IA respondents in the treatment group appear to be responsive to the financial incentives inherent in the SSP: over one-third of the treatment group members received SSP payments at some point during the 36 months following random assignment. Second, individuals in the treatment groups for both British Columbia and New Brunswick are significantly more likely to have looked for work over the 36 months between random assignment and the follow-up survey and spent more months employed and fewer months on IA than those individuals not offered the earnings supplement. Third, the SSP does not appear to have a beneficial effect on the wages earned by treatment group members: the mean wage for the treatment group is below that for the corresponding control group, although this difference is not statistically significant.

4.2 Simulating the Self-Sufficiency Project in Partial Equilibrium

The following additions are made to the model to incorporate the Self-Sufficiency Project.[23] First, individuals on welfare face several time constraints. Welfare recipients become eligible for SSP after they have been on income assistance a minimum of 12 months. Once eligible for SSP, individuals have 12 months to find full-time employment in order to receive supplement payments. If an individual secures a job before the eligibility period ends, she can receive the supplement while employed for a maximum of 36 months. Consistent with the SSP treatment implemented in the experiment, individuals have one eligibility period for the treatment during their lifetimes. Once the eligibility period for the supplement payments expires, individuals return to the regular welfare system. Second, eligible individuals who find work receive supplement payments that are a function of their wage upon obtaining employment. As in the baseline version of the model, wages are allowed to increase with job tenure. One goal of the SSP is to provide workers with enough time to experience sufficient wage growth so that employment remains an attractive alternative once the earnings supplement expires. On-the-job wage growth, which results from increases in the

[21] The control group contains 1,061 recipients from New Brunswick and 1,229 from British Columbia, while the treatment group consists of samples of 1,072 and 1,231 respondents from New Brunswick and British Columbia, respectively.

[22] One exception is that the average number of months on IA prior to random assignment is lower for the control group than for the program group in British Columbia.

[23] Appendix A provides the details of the model incorporating the SSP.

surplus created in worker-firm matches in our model, captures this particular feature of the program.

4.3 A Comparison of the Simulated Impacts and the Experimental Impacts in Partial Equilibrium

We now compare the predicted partial equilibrium effects of SSP to those found in the SSP experiment. This comparison represents an empirical test of our model, in the same spirit as the comparisons of experimental and non-experimental partial equilibrium estimates in LaLonde (1986) and other, similar papers in the treatment effects literature. It is important to emphasize that we do not use any information on the SSP treatment group in the calibration of our model.

In order to compare our model's predictions to the experimental impacts, we first recalibrate the model on the sub-sample of single mothers, as this is the population considered in the experiment. In particular, we recalibrate wages and unemployment and social assistance benefits on the sub-sample of single mothers, and recalibrate the search friction (c_a) to match the welfare to work transition rate of the control group in the experiment. The search friction for the unemployed is retained from the baseline model.[24] The wage and benefit parameters for the population of single mothers are presented in Table 6, and indicate that single mothers receive higher social assistance benefits and lower wages than the rest of the population studied in our model. As a result, the benefit of transiting from social assistance to employment is lower for single mothers than it is for the broader population in the general model. This produces lower search effort for single mothers in the model, and consequently, lower re-employment probabilities.

In order to mimic the experimental design of the SSP, the model is simulated in partial equilibrium, using a fixed wage profile, to obtain the conditional re-employment probabilities. After recalibrating and simulating the model, we select those individuals who received social assistance benefits for 12 months. The re-employment probabilities from this simulated sample represent the simulated control group. We then use the estimated parameters and solve for the re-employment probabilities for an individual on welfare who is offered the SSP supplement. Again, this is done in partial equilibrium, implying any change in behavior will not have an impact on any other individuals, or on the wage distribution. The re-employment probabilities in this instance represent the treatment group in our simulation.

Figures 2 and 3 compare the income assistance survival rates for the control and treatment groups in the experiment and in the simulation for British Columbia and New Brunswick, respectively.[25] The basic pattern matches the experimental data very well. Both the simulation and the experiment indicate that the SSP top-up program increases the exit rate from social assistance to work substantially, with the impact ending once eligibility expires. It is very encouraging that the model correctly predicts not only the basic pattern,

[24] The data sources for this exercise are the same as for the original model.

[25] To maintain comparability between our model and the experimental data we condition on not being employed full-time in the month of random assignment and consider exits to full-time employment as the end of an income assistance spell. In the model, receiving social assistance and employment are mutually exclusive states, while in the data they are not. This is due to lags in the receipt of social assistance payments, as well as the definition of full-time employment in the SSP data: "being employed full-time during any portion of the month." Conditioning on not being employed at random assignment gives us an appropriate group for comparison with the model at the expense of dropping the 25 percent who were employed.

but also matches the proportion of control and treatment group individuals remaining on income assistance 36 months after random assignment.

As an additional test on how well the model predicts behavior we reproduce the entry-effects experiment within the model. The entry-effects experiment was a separate experiment conducted on a sample of 3,315 single parents in their first month of Social Assistance receipt in the Vancouver metropolitan area. This sample was randomly assigned to treatment and control groups, where the treatment group was told that they would become eligible for the SSP program if they remained on Income Assistance for 12 months. The difference between the fraction remaining on Income Assistance in the program and treatment groups 12 months after random assignment is estimated by Berlin, Bancroft, Card, Lin, and Robins (1998) to be 3.1 with a standard deviation of 1.6. We conduct the same experiment in our model in partial equilibrium. The model predicts an entry-effect of 4.3 percentage points in British Columbia, which is within three quarters of a standard deviation of the effect estimated by Berlin et al. (1998).[26] The model is thus able to predict the magnitude of the experimental entry-effect quite well.

Comparing the model predictions with the experimental impacts we can see that the model correctly predicts both the degree of delayed exit associated with the expectation of receiving the SSP benefit in the future (the entry effect) as well as the increased transition rate into employment that becoming eligible for the SSP program induces. This comparison indicates that the model captures the fundamental dynamics introduced by the SSP supplement, which increases our confidence in the general equilibrium analysis that follows.

5 The General Equilibrium Impacts of the SSP Policy

In this section we incorporate the SSP program as policy in the general equilibrium model. There are two key differences between the partial equilibrium analysis of the last section and the following general equilibrium simulations. First, all workers and firms are now aware of the SSP program, and will include this information in their decision making process; the fact that the SSP program exists will have equilibrium effects, just as the existence of unemployment benefits and the social assistance program have equilibrium effects in the baseline model. Second, the Self-Sufficiency policy in the general equilibrium simulations applies to all welfare recipients, rather than just to single parent welfare recipients as in the experiment.[27] We focus on all welfare recipients in our general equilibrium model for two reasons. First, it simplifies our analysis substantially. If the SSP were limited to single mothers, the model would have to be extended to allow for two types of welfare recipients: single mothers and all other welfare recipients. This extension would require a large increase in the size of the state space. Second, if the SSP policy were adopted, it would likely apply to all IA recipients rather than just to single parents, both for political reasons related to equal treatment and to avoid incentive effects of SSP on marital dissolution and on out-of-wedlock childbearing.

Our discussion regarding the implementation of SSP as policy focuses on the three questions raised in the introduction. First, does an increase in the employment rate for welfare recipients come at the expense of reduced employment for others in the labor market?

[26] The New Brunswick simulation predicts an entry effect of 1.3 percentage points, which is within one and a half standard deviations of the point estimate for British Columbia.

[27] See Appendix A for details on this version of the model.

Second, what impact does offering an earnings supplement have on the distribution of wages in the economy? Finally, does the existence of the SSP program increase the entry rate to Income Assistance and delay exit during the pre-qualifying period? We now discuss the answer to each question in turn.

5.1 The Displacement Effect

The expected durations of joblessness are presented in the top half of Table 7. As expected, the average duration of income assistance spells is substantially reduced under the SSP program, as SSP-eligible individuals face greater incentives to exit the welfare program. The model predicts a decrease in expected welfare duration of approximately 71 days (2.37 months) in New Brunswick and 32 days (1.1 months) in British Columbia. In contrast, the expected duration of unemployment spells for those eligible for the maximum number of months increases by approximately 1 day (0.03 months) in New Brunswick and by 3 days (0.09 months) in British Columbia. The policy change, in essence, serves to increase the likelihood an unemployed worker exhausts their benefits and transits to welfare, as unemployed workers are displaced in the labor market by welfare recipients. The total jobless duration in British Columbia increases for those who begin a spell in unemployment, while the total jobless duration decreases for those exiting employment to IA. In New Brunswick, the expected jobless duration falls regardless of whether the worker transits to unemployment or welfare due to the large decrease in IA recipiency durations.

The predicted change in employment and welfare durations has different implications for the aggregate employment rate across provinces due to relatively large fraction of the population that is eligible for supplement payments in New Brunswick as compared to British Columbia. Table 8 suggests that the fraction of contacts the firm makes with SSP eligible workers is 10% in New Brunswick in contrast to 3.7% in British Columbia. The flow of individuals from Income Assistance to employment is thus much higher in New Brunswick after the SSP is introduced than in British Columbia. As a result, employment rates and vacancies rise slightly in New Brunswick whereas they decline in British Columbia following the introduction of SSP.

5.2 The Wage Effect

As discussed in Section 3, starting wages differ depending on whether the worker transits from social assistance or unemployment and depending on the length of the unemployment spell. Once the Self-Sufficiency policy is in place, starting wages also differ depending on whether the worker is transiting from an SSP-eligible state. Table 9 displays the average earnings, over the first three months of employment, for workers transiting to employment from selected states. Several patterns are worth discussion.

First, individuals eligible to receive supplement payments in British Columbia experience a 5% reduction in wages. In New Brunswick, supplement eligible workers do not experience a reduction in wages. The reason supplement-eligible workers do not experience large reductions in wages, if any, is due to the fact that firms are constrained to pay them at least the minimum wage. The income of workers receiving supplement payments, as a result, rises substantially: for example, before the policy change an individual in British Columbia (New Brunswick) that transited to employment from the first period of welfare would earn, on average, \$938 (\$813) per month over the first three months of employment.

In contrast, the same worker would expect to receive $\$1,989$ ($\$1,656$) in earnings and supplement payments if she transits to employment during the first month she is eligible to receive supplement payments following the policy change.

Surprisingly, other workers experience an increase in wages following the introduction of the Self-Sufficiency policy. For example, unemployment recipients in British Columbia who are one month from exhausting benefits receive starting wages that are 13% higher after the introduction of the SSP program. One's initial intuition may be that they should receive a lower wage; the reason they do not is because supplement-eligible workers do not experience a large decline in wages because of the minimum wage. As a result, the introduction of the supplement does not result in a gain in bargaining power for the firm. Firms can not extract additional surplus out of workers because of the minimum wage. At the same time, the value of entering welfare has increased due to the introduction of the supplement. As a result, the outside options of unemployment recipients and welfare recipients that are not eligible to receive the supplement improve.

5.3 The Entry Effect

As discussed earlier, the equilibrium unemployment rate increases slightly with the introduction of the SSP program, the result of a lower re-employment probability for unemployed workers. The fall in re-employment probabilities for unemployed workers is due in large part to the fact that unemployed workers exert less search effort after the policy change. The difference in search effort for unemployed workers in the baseline and in the model following the introduction of the Self-Sufficiency policy is presented in Figures 4 and 5 for British Columbia and New Brunswick, respectively. In general, search effort for unemployed workers increases in the months leading up to unemployment benefit exhaustion. However, since the value of transiting to welfare has increased following the policy change, search effort for unemployed workers in the SSP world does not rise to the same extent as it did in the baseline economy. As a result, a larger fraction of unemployed workers transit from unemployment to welfare after the policy change.

The search behavior of welfare recipients also changes following the policy change. Figures 6 and 7 compare the survival rates for individuals entering social assistance in the baseline world and the SSP world for British Columbia and New Brunswick, respectively. The survival rate is higher in the first 15 months after the policy change than in the base case. This finding is indicative of the presence of entry effects, due to the fact that individuals have incentives to remain on welfare long enough to become eligible to receive the supplement. Although survival rates are higher in the first 15 months after the policy change, the subsequent decrease in survival rates that results from the increased search effort of supplement-eligible welfare recipients appears to outweigh the entry effects, as the average duration of welfare spells declines following the imposition of the SSP.

5.4 A Comparison of the Simulated Impacts in Partial Equilibrium and General Equilibrium

To gauge the importance of general equilibrium effects in the simulated economy, we compare the simulated impacts of the Self-Sufficiency program in partial equilibrium to the general equilibrium effects highlighted above. The difference in survival rates for welfare recipients in the partial equilibrium model as compared to the general equilibrium model are presented in Figures 8 and 9 for British Columbia and New Brunswick, respectively. The impact of the policy change is slightly greater in the partial equilibrium version of the model. This result is not surprising for two reasons. First, wages do not fall in the partial equilibrium model after the workers become eligible for the supplement. Second, re-employment probabilities do not decline in response to the increased flow of welfare recipients into employment. Both factors are consistent with greater incentives to exit welfare for employment when equilibrium effects are not taken into account. Our results are also consistent with smaller impacts of similar policy changes when equilibrium effects are taken into account, as discussed in the Introduction (Davidson and Woodbury, 1993; Heckman, Lochner and Taber, 1998).

6 Reconsidering the Costs and Benefits of the Self-Sufficiency Project

In this section, we look at the benefits of implementing the Self-Sufficiency policy relative to the costs. To highlight the importance of equilibrium effects, we conduct our cost-benefit analysis on both the partial equilibrium and the general equilibrium results. Our analysis has two limitations worth noting. First, SSP was found to have both positive and negative effects on other variables of interest such as marriage and child outcomes. We ignore outcome variables other than earnings, as they are beyond the scope of this paper. Second, we do not consider any additional costs or benefits associated with moving from the baseline steady state to the SSP steady state.

We start with the partial equilibrium cost-benefit analysis. In this case, the following assumptions are imposed. First, the only individuals who change their behavior in response to the policy change are those who have been on income assistance for 12 months. Second, any jobs obtained as a result of the SSP program are 'new jobs', leading to an increase in aggregate output. Finally, wages do not change from the baseline economy. In other words, we assume that there are no displacement effects, no entry and delayed exit effects, and no wage effects.

Our cost-benefit analysis, presented in Table 10, draws on SSP program cost information presented in Michalopoulos, Tattrie, Miller, Robins, Morris, Gyarmati, Redcross, Foley, and Ford (2002). First, we calculate the direct costs of administering the Self-Suffciency policy. Michalopoulus et al. (2002, Table 7.7) estimate that the net average cost per individual eligible for the SSP program is $1,367 in British Columbia and $1,127 in New Brunswick. In addition, SSP increases the costs of administering other transfer programs and generates management information systems costs totaling $251 and $296 per eligible person in British Columbia and New Brunswick, respectively. The total program costs for each province are subsequently multiplied by 1.5, an estimate of the marginal social cost of a tax dollar.[28] The estimated cost of SSP program services weighted by the number of individuals eligible for SSP in the partial equilibrium version of our model, is $128,276 per 1000 individuals in the population for British Columbia and $306,917 in New Brunswick.

Second, we calculate the total value of transfer payments in the baseline economy and in the economy under the Self-Sufficiency Policy for both provinces. We multiply the difference in the value of the transfer payments by the deadweight loss associated with the taxes

[28] See, e.g., Diewert (1988) and Dalhby (1994) for Canada and Browning (1987) for the U.S.

necessary to finance the difference in transfers, estimated at 0.5. The deadweight loss of the change in transfer payments is therefore estimated as \$486,381 per 1000 individuals in the British Columbia population and \$1,065,590 for New Brunswick.

Third, we calculate total output in the baseline economy and in the economy under the Self-Sufficiency Project for both provinces. In the partial equilibrium version of the model, the value of monthly output increases after the Self-Sufficiency policy is introduced. In particular, we predict output to increase, per 1000 in the population, by \$2,316,968 in British Columbia and by \$5,039,752 in New Brunswick after the imposition of the policy change. Finally, we add the direct costs of the program to the additional cost of taxes for the increase in transfers and subtract the gain in the value of output. Under these assumptions the SSP program more than pays for itself; there is a net gain from the program of \$2,188,337 per 1000 in British Columbia and \$4,732,834 in New Brunswick.

The equilibrium effects of the policy change the cost-benefit conclusion drawn from the partial equilibrium analysis substantially. Performing the same calculations using the general equilibrium values for output, social assistance, and welfare recipiency yields dramatically different cost-benefit estimates: after taking the equilibrium effects into account, the net gain from implementing the Self-Sufficiency policy in New Brunswick is only $\$522,325$ approximately one-tenth the size of the net gain predicted by the partial equilibrium analysis. In British Columbia, the Self-Sufficiency policy yields a net cost of \$1,036,922 per 1000. These findings highlight the importance of conducting general equilibrium evaluations of programs, rather than relying solely on the findings from partial equilibrium social experiments, to guide policy.

7 Sensitivity Analysis

Evidence on the extent to which our results are sensitive to the choice of the discount factor (β) and the elasticity of search costs with respect to search effort (z) is presented in Table 11 for British Columbia and Table 12 for New Brunswick. It is worth emphasizing that the search friction parameters c_a and c_u are re-calibrated in the baseline model for each combination of β and z. Lower values for β serve to reduce the incentives of individuals on unemployment and those on IA to search as the value of employment falls. Lower values of c_a and c_u are required to match the transitions into employment from unemployment and Income Assistance. A similar argument holds for z. If search costs become more elastic (a higher value for z), then lower search costs are necessary to match the transition into employment. The re-calibrated values for c_a and c_u are presented in the top four rows of Tables 11 and Table 12.

First, we consider the sensitivity of our partial equilibrium measure of the estimated impact of SSP on income assistance survival rates. For comparison purposes, we also present the experimental impact constructed from the data. Lowering the discount factor increases the simulated impact of the policy in partial equilibrium. This occurs because lower values of c_a and c_u associated with the decrease in the discount factor result in a higher exit rate from welfare. As search costs become less elastic with respect to search effort, the shape of the cost function changes such that the simulated IA survival rate is greater than the experimental counterpart during the 12 months of supplement eligibility. The consistency of Davidson and Woodbury's (1993) estimate of the discount factor and of the search elasticity parameter estimated by Christensen et al. (2002) with the behavior of participants in the Canadian SSP is quite striking.

Next, we consider the sensitivity of the general equilibrium program evaluation to changes in the parameters outlined above. In general, the predicted labor force composition is relatively insensitive to the changes in parameter estimates, as are the number of firms and vacancies. It is also important to note that the cost benefit conclusions do not change in any of the specifications: the partial equilibrium analysis consistently results in a net gain of the SSP program and the general equilibrium analysis consistently reports a net loss for British Columbia. In each specification for New Brunswick, the general equilibrium analysis also consistently predicts a net gain of the program that is substantially smaller than that predicted by the partial equilibrium analysis.

8 Alternative Versions of the Self-Sufficiency Policy

One of the main advantages to the approach taken in this paper is that we are able to explore the implications of changing the program parameters of the Self-Sufficiency Project within our framework. To this end, we consider three alternative versions of the Self-Sufficiency Policy and simulate the predicted outcomes of each policy in general equilibrium. First, we consider changes in the generosity of the earnings supplement for eligible income assistance recipients. In particular, we reduce the earnings ceiling by 25% in each province, to $27,750 in British Columbia and to $22,500 in New Brunswick. Second, we reduce the supplement payment period from 36 months to 12 months. Finally, we require new IA recipients to remain on welfare for 24 months, as opposed to 12, to qualify for SSP. Results of each policy experiment are presented in Table 13.

In general, reducing the size of the supplement payments and reducing the eligibility and supplement payment periods are predicted to improve the cost-benefit performance of SSP without resulting in reductions in employment in British Columbia. This finding is due to a reduction in the entry effect: individuals are less willing to exhaust their unemployment benefits or to remain on welfare for longer periods as SSP becomes less generous. In contrast, the only policy change to improve the cost-benefit calculation in New Brunswick is to lower the earnings ceiling. Lowering the earnings ceiling in New Brunswick reduces the fraction of unemployed workers that exhaust their benefits, but still results in a delayed exit effect from IA. Alternatively, restricting the time limits for eligibility and benefit payments results in a reduction in the employment rate for this sector of the economy.

9 Conclusion

This paper makes three important contributions to the literature. First, we construct a model that is well-suited to conduct equilibrium program evaluations of a wide variety of social policies. Second, we illustrate the potential of the model as a tool for policy analysis in our evaluation of the Canadian Self-Sufficiency Project. We find that equilibrium wages fall for those treated by the program after the introduction of the earnings supplement, as workers are willing to accept lower starting wages so as to benefit from the supplement payments. However, wages of other workers in the economy increase slightly as the existence of the SSP, along with the minimum wage, improves the bargaining power of workers. Furthermore, the simulation results indicate the presence of entry effects, as a higher fraction of individuals remain on welfare to become eligible for the supplement after the policy change. All three effects have important implications for the cost-benefit performance of the policy: although partial equilibrium estimates suggest a net gain to the Self-Sufficiency Project, equilibrium estimates suggest otherwise. Finally, we show that this parsimonious model is able to generate the partial equilibrium outcomes of the experiment itself using non-experimental data. Determining the success of this framework in the evaluation of other social programs is the goal of future work.

Table 1: Summary of Notation Used

A	Steady state number of workers on social assistance
b_a	Social assistance benefits
b_u	Unemployment insurance benefits
c_a	Parameter capturing the disutility of search effort in the cost of search function for social assistance
c_u	Parameter capturing the disutility of search effort in the cost of search function for unemployed
E	Steady state number of employed workers
$E(t,i)$	Steady state number of employed workers eligible for i unemployment insurance benefit months in jobs of tenure t
$\bar{E}$	Steady state number of workers no longer experiencing wage growth
F	Number of firms (jobs)
L	Total labor force
$m(0)$	Conditional probability a social assistance recipient finds a job and transits to employment next period
$m(i)$	Conditional probability of re-employment with i months of unemployment benefits remaining
$p(0)$	Search effort for those on social assistance
$p(i)$	Search effort for the unemployed with i benefit months remaining
$P(t)$	Match surplus for a worker firm match of tenure t
$q(i)$	Firm's probability of meeting a potential worker with i months of unemployment benefits remaining
T	Match tenure beyond which match surplus no longer increase
I	Number of months required to qualify for minimum unemployment insurance benefits
$\underline{u}$	Minimum number of unemployment benefit months
$\bar{u}$	Maximum number of unemployment benefit months
U	Steady state number of workers receiving unemployment insurance benefits
V	Steady state number of vacancies
V^A	The value function for a worker on social assistance
$V^E(t,i)$	The value function for an employed worker in the t^{th} period of employment with unemployment benefit eligibility i
$V^U(i)$	The value function for an unemployed worker with i months unemployment insurance benefits remaining
$w(t,i)$	The wage for a worker in the t^{th} month of employment with unemployment eligibility i
$\underline{w}$	Minimum wage
z	The elasticity of search cost with respect to search effort
β	Discount factor
δ	Exogenous job separation rate
λ	The average number of applications filed by workers at each firm
ξ	The per period cost to a firm of posting a vacancy
$\Pi^E(t,i)$	Firms' expected future profit from a match of tenure t, with a worker with unemployment eligibility i
Π^V	Firms' value of a current vacancy

Table 2: Moments and Parameters for the Baseline General Equilibrium Model

	New Brunswick	British Columbia
Social assistance benefits, monthly (b_a)	482	695
Unemployment benefits, monthly (b_u)	887	1174
Search costs, social assistance (c_u)	0.2950	0.3281
Search costs, unemployment (c_u)	0.1030	0.0526
UI qualifying months		
Minimum	3	4
Maximum	8	9
UI benefit months		
Minimum ($\underline{u}$)	7	5
Maximum ($\bar{u}$)	12	10
Average Job Tenure, Months ($1/\delta$)	77.76	72.91
Employment Rate (E)	80.70	90.15
Unemployment Rate (U)	7.84	5.80
Social Assistance Rate (A)	11.46	4.05
Minimum Wage ($\underline{w}$)	5.00	5.50
Average Hourly Wage	9.92	13.14
Average wage, tenure > 48 months	12.25	16.14
Exogenous job separation rate (δ)	0.0129	0.0137
Monthly discount rate (β)	0.9835	0.9835
Elasticity of search costs w.r.t effort (z)	1.8457	1.8457
Cost of posting a vacancy (ξ)	$8,779$	$9,445$
Number of firms (F)	83.40	92.99
Vacancy Rate (V/F)	3.20	3.20

Table 3: Starting wages for workers entering employment from various jobless states, selected months

	British Columbia			New Brunswick		
Enter from:	Month 1	Month 5	Month 10	Month 1	Month 5	Month 10
A	894	1,010	1,657	813	1,128	1,283
$U(1)$	894	1,010	1,657	992	1,128	1,283
$U(2)$	1,116	1,121	1,657	1,309	1,128	1,283
$U(3)$	1,294	1,217	1,657	1,351	1,128	1,283
$U(4)$	1,444	1,302	1,657	1,389	1,128	1,283
$U(5)$	1,573	1,376	1,657	1,424	1,154	1,283
$U(6)$	1,684	1,968	1,657	1,456	1,179	1,283
$U(7)$	1,780	1,968	1,657	1,487	1,203	1,283
$U(8)$	1,865	1,968	1,657	1,515	1,514	1,283
$U(9)$	1,939	1,968	1,657	1,542	1,514	1,283
$U(10)$	–	–	–	1,567	1,514	1,283
$U(11)$	–	–	–	1,590	1,514	1,283
Weighted Mean	1,526	1,585	1,657	1,211	1,244	1,283

Table 4: Sample Statistics From Baseline Survey and Income Assistance Records

	British Columbia		New Brunswick	
	Program Group	Control Group	Program Group	Control Group
Ever worked for pay	0.9578	0.9455	0.9394	0.9255
	(0.0057)	(0.0065)	(0.0073)	(0.0081)
Working at Baseline	0.1682	0.1701	0.1828	0.1923
	(0.0107)	(0.0107)	(0.0118)	(0.0121)
Looking for Work at Baseline	0.2193	0.2295	0.2183	0.2385
	(0.0118)	(0.0120)	(0.0126)	(0.0131)
Enrolled in School at Baseline	0.16	0.157	0.1213	0.1235
	(0.0105)	(0.0104)	(0.0100)	(0.0101)
Average Hourly Wage	7.86	8.26	5.82	5.73
(in last year)	(0.18)	(0.20)	(0.14)	(0.12)
Earnings (in last year)	4470.25	4842.29	3389.65	3423.21
	(236.90)	(280.30)	(175.85)	(197.92)
Months Employed (in last year)	6.8087	6.759	7.2069	6.9101
	(0.2203)	(0.2346)	(0.2250)	(0.2132)
Hours Worked (in last year)	596.6892	609.343	627.708	609.3678
	(29.8783)	(32.9181)	(33.161)	(28.2562)
Months on IA Prior to RA	29.2851	28.5924*	31.3041	31.0283
(in last 3 years)	(0.2267)	(0.2338)	(0.2208)	(0.2244)
Duration of most Recent IA Spell	25.5467	24.6143	27.8834	27.5985
Prior to RA (in last 3 years)	(0.3013)	(0.3098)	(0.3132)	(0.3164)

Sources: Calculations from 36-month follow-up survey data. Wages, earnings, months employed, hours worked conditioned on non-zero values.

Notes: Standard errors in parentheses. *Difference between the control and treatment group means statistically significant at the 95% level. Random Assignment is denoted RA.

Table 5: Sample Statistics From 36 Month Follow-Up Survey and Income Assistance Records

	British Columbia		New Brunswick	
	Treatment Group	Control Group	Treatment Group	Control Group
Looked for Work Since Baseline	0.7038	0.5913*	0.7345	0.6396*
	(0.0168)	(0.0175)	(0.0170)	(0.0175)
Ever Received SSP Payments	0.359		0.3666	
	(0.0145)		(0.0152)	
Average Hourly Wage	8.44	8.99*	5.96	6.07
	(0.14)	(0.36)	(0.08)	(0.11)
Earnings (in 36 months after RA)	12938.39	9762.51*	10440.06	7728.26*
	(568.49)	(647.79)	(425.64)	(456.58)
Hours (in 36 months after RA)	1515.52	1054.81*	1682.646	1188.816*
	(55.3058)	(50.7728)	(59.7964)	(51.7826)
Months Employed (in 36 months	12.6337	9.8781*	13.9051	10.9476*
after RA)	(0.3881)	(0.3734)	(0.4223)	(0.3970)
Months on IA (in 36 months	26.9691	29.6870*	24.046	28.4817*
after RA)	(0.3350)	(0.2959)	(0.4017)	(0.3352)
Duration of most Recent IA Spell	22.1568	26.0868*	19.8532	24.2750*
After RA (in 36 months after RA)	(0.4022)	(0.3755)	(0.4350)	(0.4023)
Months on SSP Supplement	5.9963		7.2258	
(in 36 months after RA)	(0.2940)		(0.3451)	

Sources: Calculations from 36-month follow-up survey data. Wages, earnings, months employed, hours worked conditioned on non-zero values.

Notes: Standard errors in parentheses. *Difference between the control and treatment group means is statistically significant at the 95% level.

Table 6: Moments and Parameters for Single Mothers without Completed Postsecondary Education

	New Brunswick	British Columbia
Social assistance benefits, monthly (b_a)	737	927
Unemployment benefits, monthly (b_u)	695	952
Average Job Tenure, Months ($1/\delta$)	47.28	46.68
Average Hourly Wage	7.78	10.65
Average wage, tenure > 48 months	8.22	11.12
Wage growth equation w(t) =	$6.04 + 0.0418t$	$7.89 + 0.0891t$
	$-0.0000736t^2$	$-0.000378t^2$
	$+5.51e - 8t^3$	$+6.10e - 7t^3$
Exogenous job separation rate (δ)	0.0211	0.0214
Monthly discount rate (β)	0.9835	0.9835
Elasticity of search costs w.r.t effort (z)	1.8457	1.8457

Table 7: Labor Force Composition — Baseline and SSP Models

	British Columbia		New Brunswick	
	Baseline	SSP	Baseline	SSP
Expected UI duration, months	5.07	5.16	8.26	8.29
Expected IA duration, months	31.03	29.96	33.09	30.72
Expected jobless duration, months	8.33	8.73	19.70	19.12
Employment Rate	90.15	89.72	80.70	81.22
Unemployment Rate	5.80	5.92	7.84	7.91
Income Assistance Rate	4.05	4.36	11.46	10.87
Number of Firms	93.13	92.67	83.40	83.94
Number of Vacancies	2.98	2.95	2.67	2.72

Table 8: Probability of a Firm Matching with a Worker, by SSP Eligibility Status

	British Columbia		New Brunswick	
	Base Model	SSP Model	Base Model	SSP Model
Any worker	0.4149	0.4162	0.3879	0.3858
Non SSP elibible worker	–	0.4007	–	0.3468
SSP eligible worker	–	0.0155	–	0.0390

Table 9: Average Monthly Earnings — First Three Months

	British Columbia		New Brunswick	
Entering employment from:	Baseline	SSP	Baseline	SSP
$U(\bar{u})$	2,070	2,085	1,787	1,814
$U(1)$	972	1,097	873	986
$A(1)$		967		813
$A(12)$		987		813
$SSP(1)$		894		813
with SSP top-up		1,989		1,656
$SSP(12)$		894		813
with SSP top-up		1,989		1,656
$A(0)$	938	967	813	813
Mean wage	1,563	1,593	1,220	1,243
SD wage	407	672	365	378
Mean income	1,563	1,634	1,220	1,328
SD income	407	390	365	377

Table 10: Cost-Benefit Analysis–SSP Applied to All Income Assistance Recipients

	British Columbia		New Brunswick	
	Partial Equilibrium	General Equilibrium	Partial Equilibrium	General Equilibrium
Direct Costs				
SSP program service costs	1,367	1,367	1,127	1,127
Net SSP admin costs	251	251	296	296
Number eligible for SSP	53	63	144	154
Total Direct Costs	85,517	102,698	204,612	219,056
Multiplied by MSC	128,276	154,047	306,917	328,584
Indirect Costs				
Change in UI Payments	-	95,414	-	41,647
Change in IA Payments	-192,426	144,375	-393,624	-192,384
Change in SSP Payments	1,165,188	1,648,983	2,524,805	3,214,167
Total Change in transfers	972,762	1,888,772	2,131,180	3,063,430
Adjusted for MSC	486,381	944,386	1,065,590	1,531,715
Change in output	2,316,968	-884,011	5,039,752	871,733
Net gain from program	2,188,693	-1,085,766	4,732,834	522,325

Notes: Costs are calculated over five years for a labor force normalized to 1000.

Table 11: Sensitivity to the choice of β and z — British Columbia

Parameters	Base	SSP Simulations				
β		0.82	0.77	0.87	0.82	0.82
z		1.85	1.85	1.85	1.75	2.00
c_a		0.33	0.26	0.40	0.37	0.28
c_u		0.05	0.04	0.06	0.07	0.03
12 Month Impact	−0.178	−0.173	−0.186	−0.159	−0.201	−0.140
35 Month Impact	−0.123	−0.118	−0.127	−0.108	−0.137	−0.096
Labor Force Composition						
Employment	90.15	89.72	89.63	89.75	89.76	89.76
Unemployment	5.80	5.92	5.96	5.91	5.92	5.90
Income Assistance	4.05	4.36	4.41	4.35	4.32	4.34
Firms	93.13	92.67	92.56	92.70	92.72	92.71
Vacancies	2.98	2.95	2.94	2.95	2.96	2.95
Cost–Benefit Analysis						
Partial Equilibrium		(2,189)	(2,429)	(2,185)	(1,847)	(2,141)
General Equilibrium		1,086	1,322	1,030	1,020	984

Notes: Authors' calculations based on model simulations. The search friction parameters, c_a and c_u are re-calibrated in the baseline model for each combination of β and z. Costs are per capita costs over five years.

Table 12: Sensitivity to the choice of β and z — New Brunswick

Parameters	Base	SSP Simulations				
β		0.82	0.77	0.87	0.82	0.82
z		1.85	1.85	1.85	1.75	2.00
c_a		0.29	0.25	0.36	0.32	0.26
c_u		0.10	0.09	0.12	0.13	0.08
12 Month Impact	−0.140	−0.164	−0.174	−0.156	−0.179	−0.140
35 Month Impact	−0.090	−0.101	−0.107	−0.096	−0.110	−0.086
Labor Force Composition						
Employment	80.70	81.22	81.20	81.12	81.24	81.05
Unemployment	7.84	7.91	7.93	7.91	7.92	7.90
Income Assistance	11.46	10.87	10.86	10.98	10.84	11.05
Firms	83.37	83.94	83.91	83.83	83.95	83.75
Vacancies	2.67	2.72	2.71	2.71	2.72	2.70
Cost-Benefit Analysis						
Partial Equilibrium		(4,733)	(4,898)	(4,537)	(4,917)	(4,507)
General Equilibrium		(522)	(492)	(342)	(548)	(225)

Notes: Authors' calculations based on model simulations. The search friction paramters, c_a and c_u are recalibrated in the baseline model for each combination of β and z. Costs are per capita costs over five years.

Table 13: Alternative SSP policy simulations

	Base Case	Standard SSP	3/4 SSP Top-up	SSP Top-up for 12 months	24 months on IA to qualify
British Columbia					
		Labor Force Composition			
Employment	90.15	89.72	89.99	89.89	89.87
Unemployment	5.80	5.92	5.85	5.87	5.86
Income Assistance	4.05	4.36	4.16	4.23	4.27
Firms	93.13	92.67	92.96	92.85	92.84
Vacancies	2.98	2.95	2.97	2.96	2.97
		Cost-Benefit—Net Cost of Program			
Partial Equilibrium		(2,189)	(2,256)	(1,969)	(1,477)
General Equilibrium		1,086	567	710	705
New Brunswick					
		Labor Force Composition			
Employment	80.70	81.22	81.24	81.06	80.88
Unemployment	7.84	7.91	7.84	7.85	7.86
Income Assistance	11.46	10.87	10.92	11.09	11.26
Firms	83.37	83.94	83.96	83.76	83.58
Vacancies	2.67	2.72	2.72	2.70	2.70
		Cost-Benefit—Net Cost of Program			
Partial Equilibrium		(4,733)	(4,733)	(4,045)	(3,275)
General Equilibrium		(522)	(593)	(276)	(65)

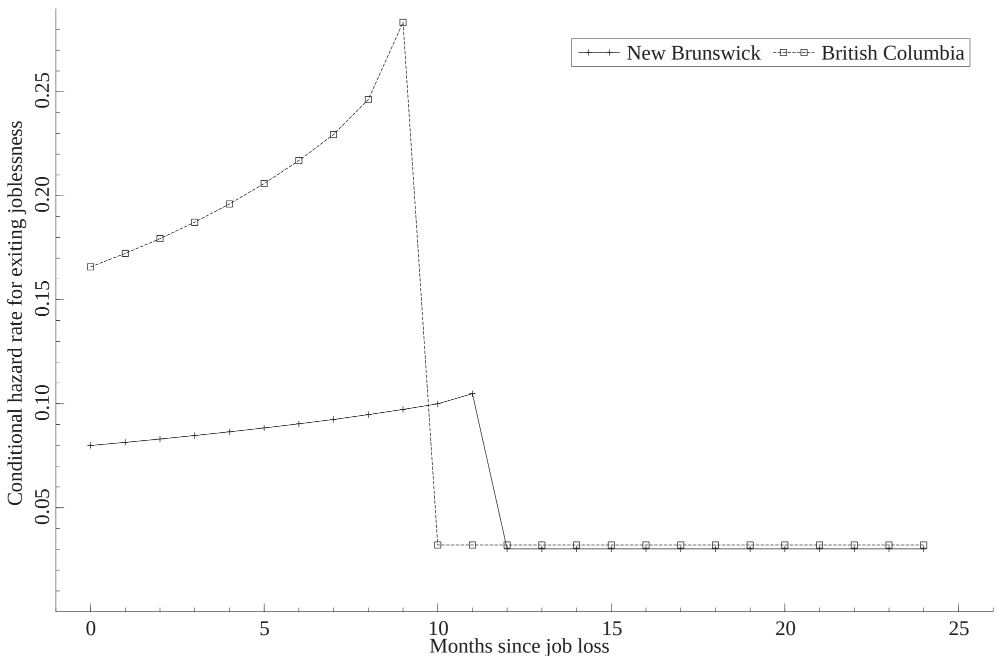

Figure 1: Re-employment Probabilities Beginning with First Period of Unemployment Benefits

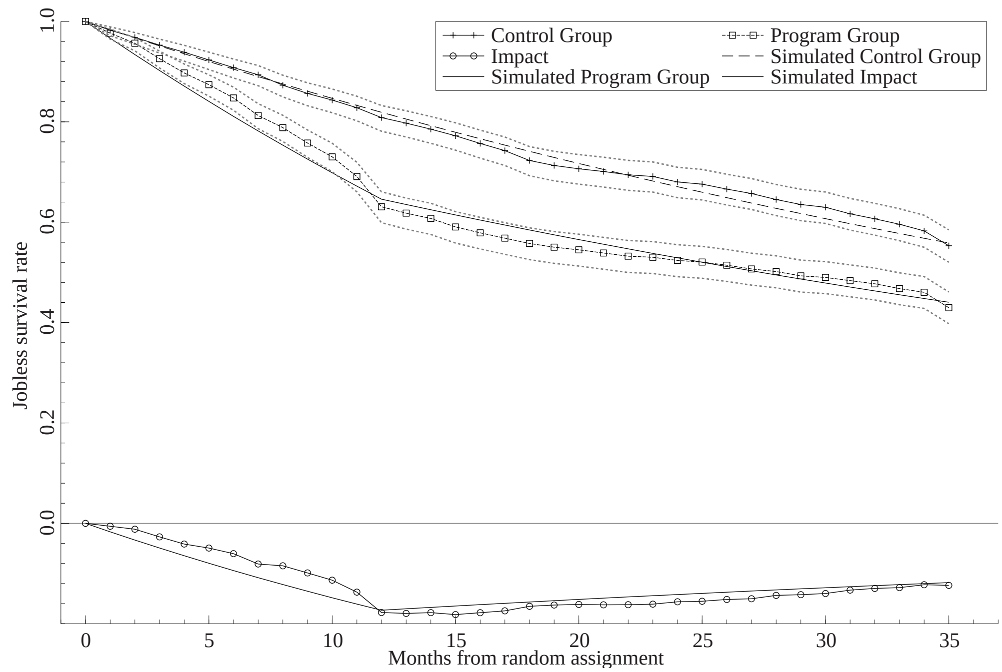

Figure 2: Simulated Partial Equilibrium Impact of SSP—British Columbia. The dotted bands are point wise 95 per cent confidence intervals for the data.

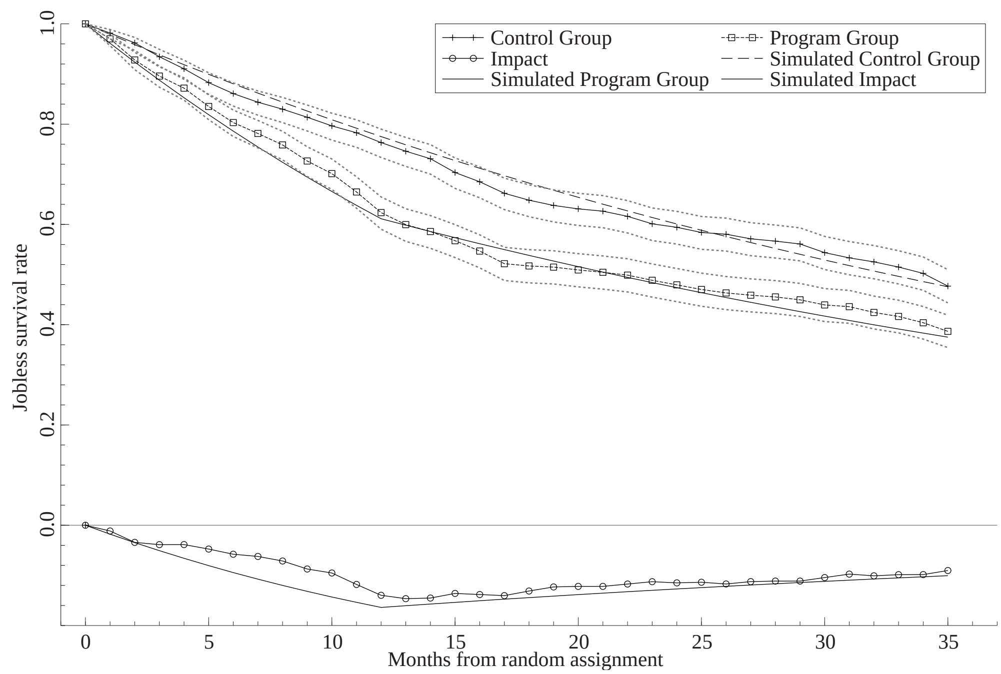

Figure 3: Simulated Partial Equilibrium Impact of SSP—New Brunswick. The dotted bands are point wise 95 per cent confidence intervals for the data.

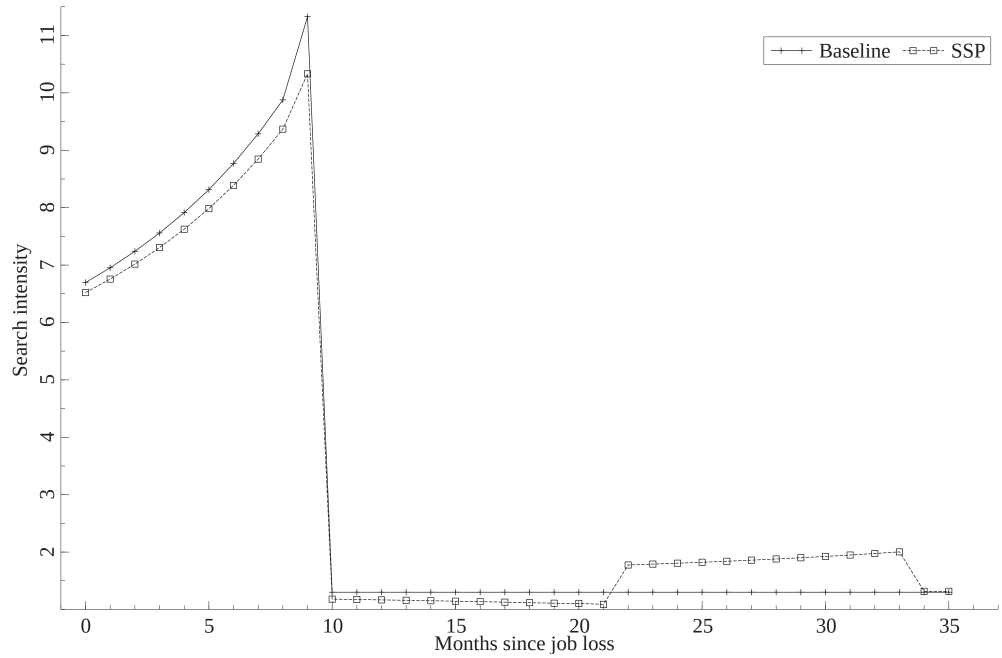

Figure 4: Search Intensity for Those Starting with Maximum Unemployment Benefits—British Columbia

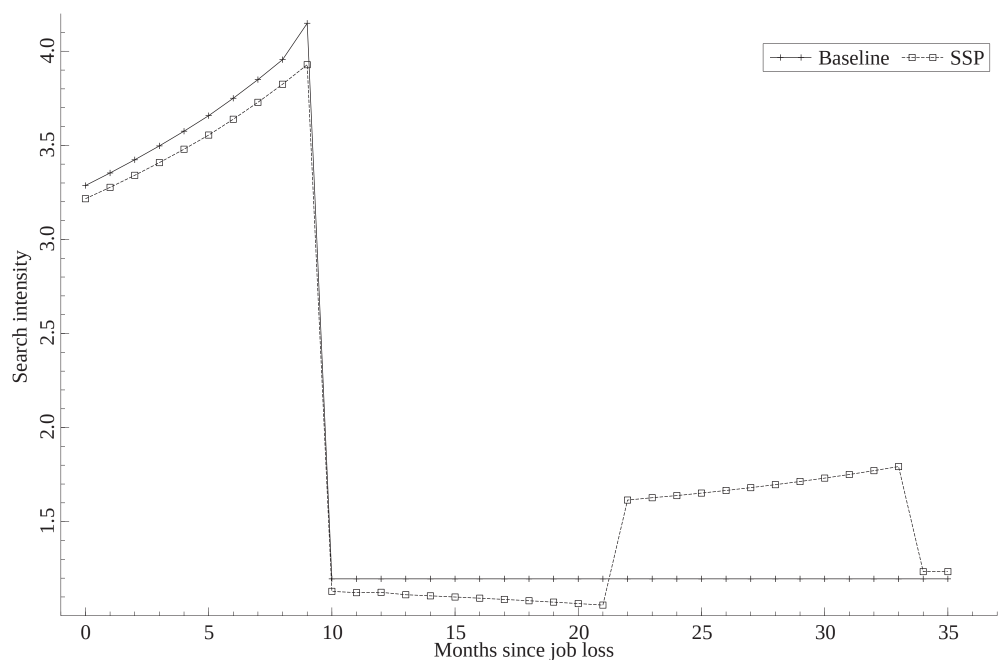

Figure 5: Search Intensity for Those Starting with Maximum Unemployment Benefits—New Brunswick

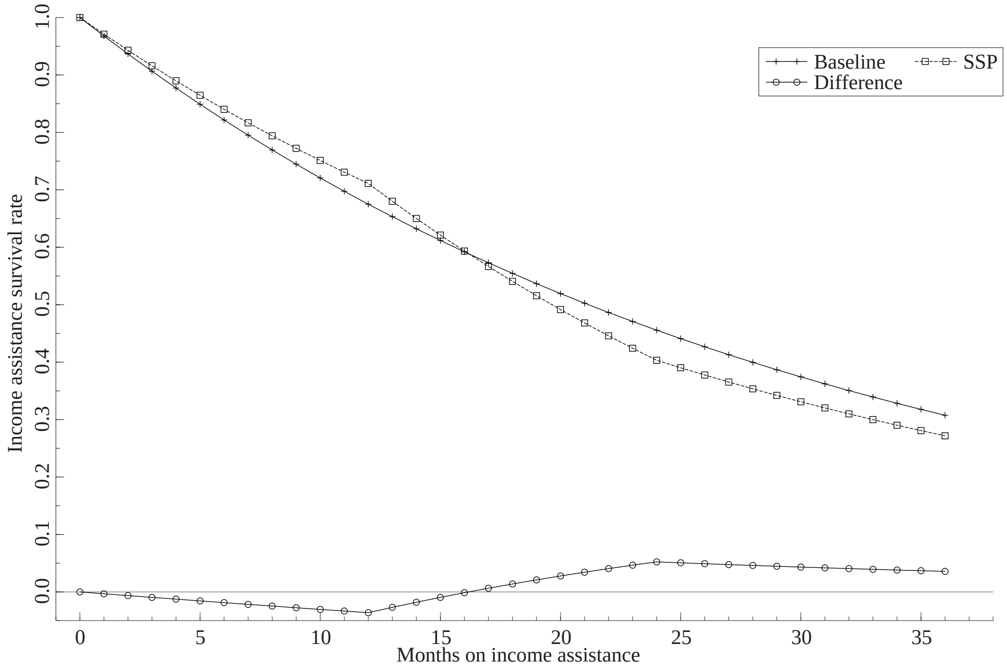

Figure 6: Survival Probability, Starting from Social Assistance — British Columbia

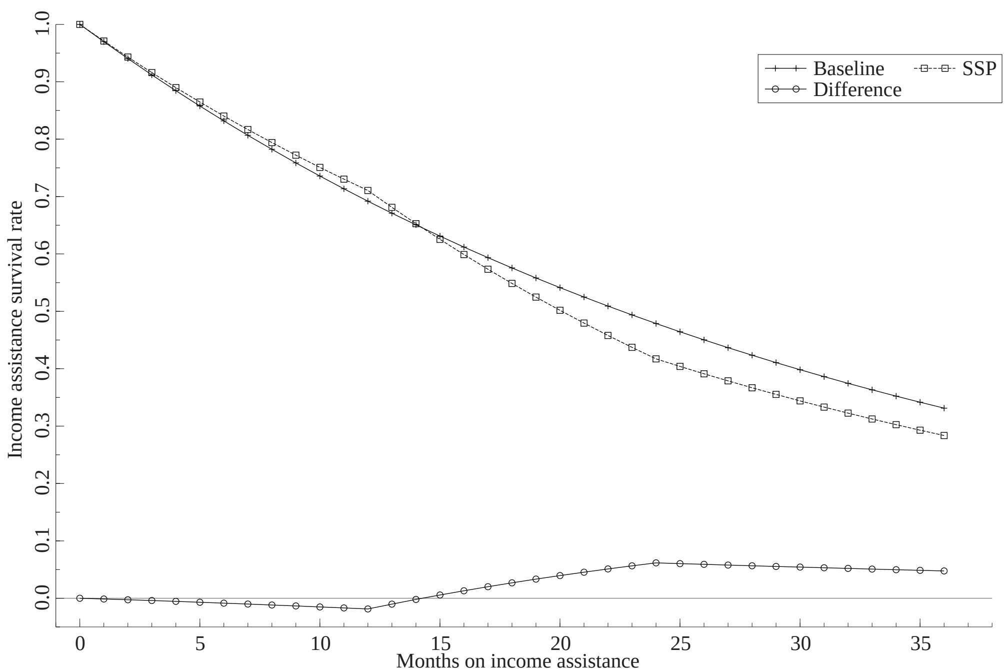

Figure 7: Survival Probability, Starting from Social Assistance — New Brunswick

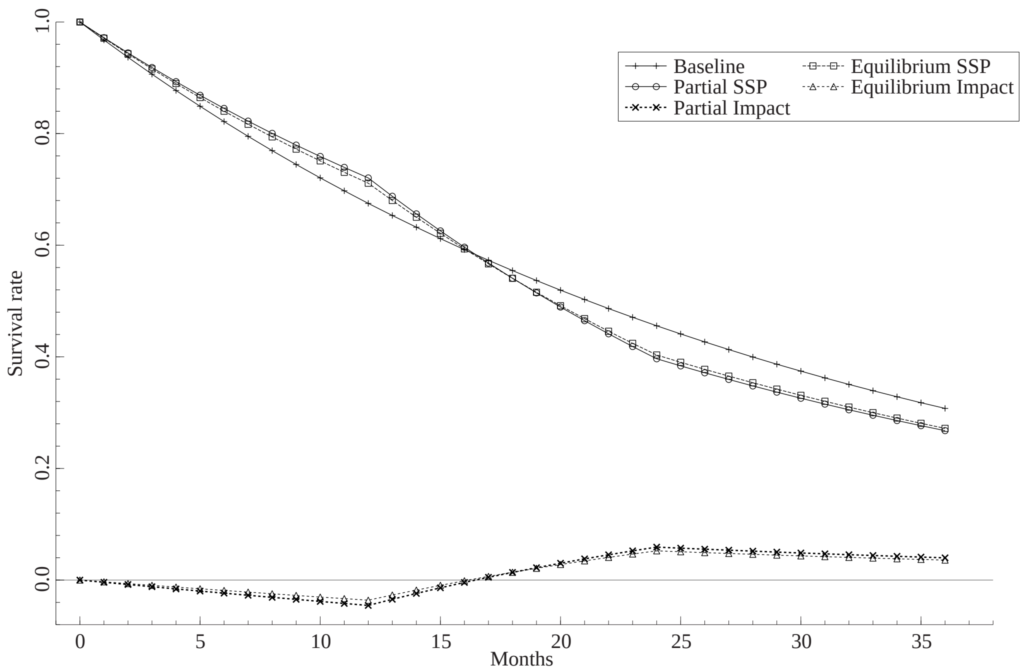

Figure 8: Survival Probability, Partial and Equilibrium Impacts — British Columbia

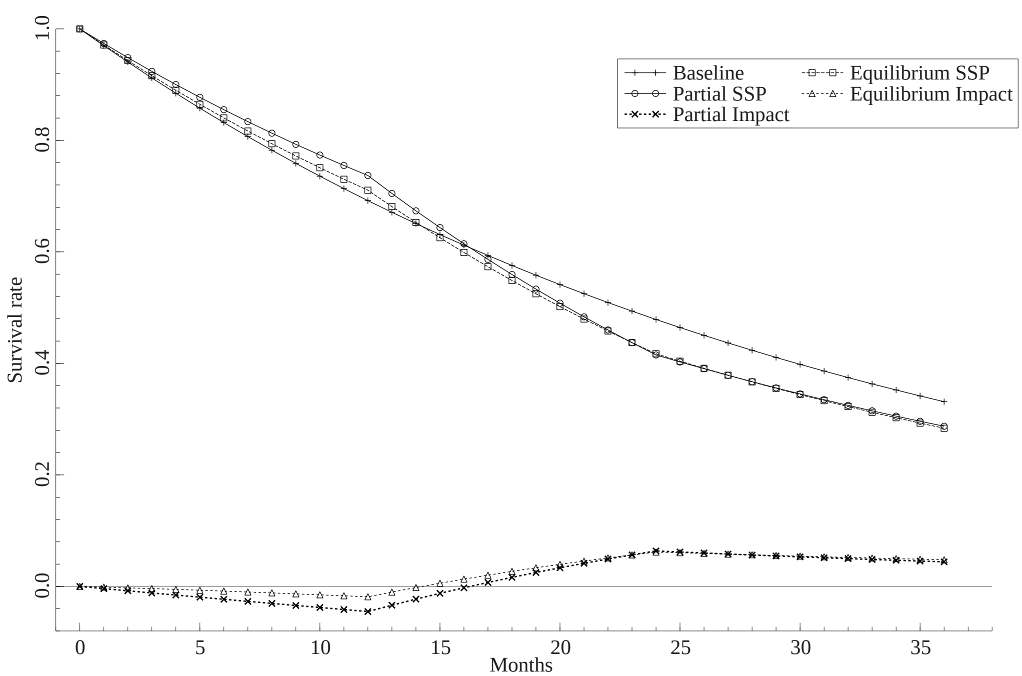

Figure 9: Survival Probability, Partial and Equilibrium Impacts — New Brunswick

A Model with Self-Sufficiency Project

The welfare program and the earnings supplement are modeled as follows. First, in addition to individuals on unemployment insurance, individuals on welfare also face several time constraints. Welfare recipients become eligible to receive the earnings supplement after they have been on assistance for T_{in} months. Individuals' eligibility expires after T_{out} months on welfare. If a worker secures a job before the eligibility period ends, they can receive the supplement while employed for a maximum of T_{end} months.[29] Second, individuals receive supplement payments that are a function of the wage upon obtaining employment.

Within the model, agents maximize expected lifetime income by choosing their labor market state and the intensity with which they search for work if not employed. It is assumed that all agents have full information regarding the existence and structure of the SSP and know the process by which they become eligible for the supplement. Workers bargain with firms over wages that depend on the tenure of the match and on the outside options of both parties. Through this channel, the model generates predictions regarding how starting wages vary depending on whether an individual is entering employment through EI or IA and on whether or not the individual is eligible for the supplement. One goal of the SSP to provide workers with enough time to experience sufficient wage growth to so they have an incentive to stay employed once the earnings supplement expires. On-the-job wage growth, through an increase in the surplus created in worker-firm matches, captures this particular feature of the program and is also incorporated in the model.

It is useful to expand the notation used in the base model in the following way. Let i index the jobless state an individual in currently in: $i \in \{\bar{u}, \ldots, \underline{u}, \ldots, 1, 0, -1, \ldots, -T_{in}, \ldots, -T_{out}\}$. Here positive i indicates the individual is jobless with i unemployment benefit months remaining. We use $0 \geq i \geq -T_{out}$ to index the welfare recipients, where the key indices are $i = 0$ in the first month on welfare, $i = -T_{in}$ in the first month of SSP eligibility, and $i = -T_{out}$ in the post eligibility period.

A.1 Workers

The value of employment for a worker depends on her job tenure t and program eligibility status i, where $i \in \{\bar{u}, \ldots, \underline{u}. \ldots, 1, 0, -1, \ldots, -T_{in}, \ldots, -T_{out}\}$. The number of months an individual with no benefits must work to qualify for unemployment is I. For every period an individual works after qualifying for benefits, i increases by 1. The maximum number of benefit months an individual can accumulate is denoted $\bar{u}$. If the individual were not working she would therefore be unemployed with i periods of unemployment benefits remaining, $i \in \{0, ...\bar{u}\}$. With probability δ, jobs are exogenously destroyed in the subsequent month, in which case workers transit to welfare if they have not yet qualified for unemployment benefits, $i = 0$, and transit to unemployment otherwise. With probability $(1 - \delta)$, workers remain employed in the next month.

It is assumed that individuals who return to work before their unemployment benefits expire retain their remaining unemployment benefit eligibility. Finally, workers experience on the job wage growth for a maximum of T months, after which the wage remains constant, where it is assumed $T > \bar{u}$. The value function for a worker needs to account for job tenure t, outside option i, and earnings supplement receipt $s \in \{0, 1\}$ where $s = 0$ indicates the worker is not eligible to receive the supplement.

[29] We use T_{in}, T_{out}, and T_{end} for generality. In the actual experiment the numbers were 12, 24, and 36 respectively.

A.1.1 Workers ineligible for the earnings supplement

The value function for a worker with job tenure t, outside option i, and not eligible for the earnings supplement ($s = 0$) is:

$$V^E(t,i,0) = \begin{cases} w(t,0,0) + \beta[(1-\delta)V^E(t+1,0,0) + \delta V^A(0)] & \text{if } t < I \text{ and } i = 0, \\ w(t,0,0) + \beta[(1-\delta)V^E(t+1,\underline{u},0) + \delta V^U(\underline{u})] & \text{if } t = I \text{ and } i = 0, \\ w(t,i,0) + \beta[(1-\delta)V^E(t+1,i+1,0) + \delta V^U(i+1)] & \text{if } 0 < i < \bar{u} \text{ and } I \leq t < T, \\ w(t,\bar{u},0) + \beta[(1-\delta)V^E(t,\bar{u},0) + \delta V^U(\bar{u})] & \text{if } i = \bar{u} \text{ and } I \leq t < T, \\ w(T,\bar{u},0) + \beta[(1-\delta)V^E(T,\bar{u},0) + \delta V^U(\bar{u})] & \text{if } t \geq T, \end{cases}$$

where $w(t,i,0)$ is the wage for a person with tenure t who has unemployment eligibility i, and earnings eligibility $s = 0$. β is the discount rate, $V^A(0)$ is the value of being in the first month of income assistance, and $V^U(i)$ is the value of being unemployed with i benefit periods remaining.

A.1.2 Workers eligible for the supplement

Employed workers that are eligible for the supplement receive labor market earnings and the supplement payment in the current month. The supplement received by the worker is a function of her wage. In particular, the worker receives one-half of the distance between her wage and an exogenous ceiling denoted $\tilde{w}$; in other words she receives the average of her market wage and the wage ceiling.[30] Individuals remain eligible for the supplement for T_{end} months once they leave Income Assistance and become employed. Therefore, workers continue to receive the supplement as long as the duration of the current employment spell is shorter than the allowed duration of the supplement payment period. With probability δ workers are exogenously separated from their jobs at which point they can transit to unemployment if eligible for EI or back to the first period of SSP eligibility ($i = -T_{in}$) if they do not yet qualify for unemployment benefits ($t < I$).[31] Employed persons no longer receiving the supplement ($t > T^E_{end}$) remain employed, or if they are exogenously separated from their job, transit to EI.[32] The value of being employed and in the states described above can be expressed as

$$V^E(t,i,1) = \begin{cases} \frac{1}{2}[w(t,-T_{in},1) + \tilde{w}] + \beta[(1-\delta)V^E(t+1,-T_{in},1) + \delta V^A(-T_{in})] & \text{if } t < I, \\ \frac{1}{2}[w(t,-T_{in},1) + \tilde{w}] + \beta[(1-\delta)V^E(t+1,\underline{u},1) + \delta V^U(\underline{u})] & \text{if } t = I, \\ \frac{1}{2}[w(t,i,1) + \tilde{w}] + \beta[(1-\delta)V^E(t+1,i+1,1) + \delta V^U(i+1)] & \text{if } \underline{u} < i < \bar{u} \\ \frac{1}{2}[w(t,\bar{u},1) + \tilde{w}] + \beta[(1-\delta)V^E(t+1,\bar{u},1) + \delta V^U(\bar{u})] & \text{if } i = \bar{u} \\ \frac{1}{2}[w(t,\bar{u},1) + \tilde{w}] + \beta[(1-\delta)V^E(t+1,\bar{u},0) + \delta V^U(\bar{u})] & \text{if } t = T_{end}, \end{cases}$$

where T_{in} is the number of months on welfare required to qualify for the SSP supplement and T_{end} is the number of months an individual can receive the supplement once employed.

[30] If the individual's earnings are above the income ceiling, they do not receive a supplement. For simplicity, we abstract from this case within the model as few individuals had earnings above the supplement ceiling in the data.

[31] In the actual SSP experiment, once individuals qualified for the earnings supplement they could transit between employment and unemployment and collect the supplement payments in any month they were employed full time during the 36 months after qualifying. We abstract from this in the model as it would add an unmanageable number of states. Instead we allow those who lose their job prior to qualifying for unemployment benefits to transit back to the first period of SSP qualification.

[32] It is assumed that $I < T_{end}$, which is consistent with the actual EI and IA programs.

A.2 Welfare Recipients

Individuals receiving IA become eligible for the earnings supplement after T_{in} months on IA. Using the same index i as we used for number of months of unemployment benefits we define the first month on Income Assistance as $i = 0$, and continue to count down. Thus an individual is eligible for the earning supplement in month $i = -T_{in}$, and becomes ineligible in month $i = -T_{out}$. Welfare recipients receive welfare benefits (b_a) and pay convex ($z > 1$) search costs $c_a[p(i)^z]$ in the current month. The cost of search is modeled in a manner consistent with Davidson and Woodbury (1993), where z is the elasticity of search costs with respect to search effort, c_a is a parameter capturing the disutility of search effort and $p(i)$ is search effort in period i. The cost of search depends directly on the intensity with which workers search within the model. Denote $m(i)$ the probability a welfare recipient finds a job and transits to employment in the next month. With probability $(1 - m(i))$ the welfare recipient remains on welfare. Welfare recipients eligible for the supplement receive welfare benefits in the current month. They remain eligible for the supplement as long as the duration of their welfare spell is less than the supplement eligibility period ($-T_{in} \geq i > -T_{out}$). For the duration of the time that they are eligible for the supplement, they receive a job offer with probability $m(i)$ and if an offer is received, they have the option of transiting to employment in the next month or remaining on IA. If they do not receive a job offer, they remain on welfare and, if the eligibility period has not expired, remain eligible to receive the supplement should they secure employment in the following month. If eligibility for the supplement expires in the next month and workers do not receive a job offer, they remain on welfare but are not eligible for the supplement should they receive a job offer. Once eligibility expires, individuals will not be eligible for the earnings supplement for the remainder of their duration on IA. The value function for welfare recipients in the states described above is

$$V^A(i) = \begin{cases} \max_{p(i)} \Big\{ b_a - c_a[p(i)^z] + \beta\Big[m(i)V^E(1, i-1, 0) + (1-m(i))V^A(i-1)\Big]\Big\} & 0 \geq i > -T_{in} \\ \max_{p(i)} \Big\{ b_a - c_a[p(i)^z] + \beta\Big[m(i)V^E(1, i-1, 1) + (1-m(i))V^A(i-1)\Big]\Big\}, & -T_{in} \geq i > T_{out} \\ \max_{p(i)} \Big\{ b_a - c_a[p(i)^z] + \beta\Big[m(i)V^E(1, i-1, 0) + (1-m(i))V^A(i-1)\Big]\Big\}, & i = T_{out} \end{cases}$$

A.3 Unemployed Individuals

Unemployed agents receive exogenous unemployment benefits (b_u) and pay search costs $c_u[p(i)^z]$. We make the simplifying assumption that unemployment benefits are independent of the individual's pre-separation earnings. With probability $m(i)$, individuals contact a firm with a vacancy and transit to employment in the next month. If individuals remain unemployed in the next month, it is assumed they can continue to collect unemployment benefits until benefits are exhausted. Following the last month of eligibility, individuals can either transit to employment, if a job opportunity is available, or transit to welfare. The value function for unemployed individuals with i months of benefits remaining is

$$V^U(i) = \begin{cases} \max_{p(i)} \Big\{ b_u - c_u[p(i)^z] + \beta\Big[m(i)V^E(1, i-1, 0) + (1-m(i))V^U(i-1)\Big]\Big\}, & 1 < i < \bar{u}, \\ \max_{p(i)} \Big\{ b_u - c_u[p(i)^z] + \beta\Big[m(1)V^E(1, 0, 0) + (1-m(1))V^A(0)\Big]\Big\}, & i = 1. \end{cases}$$

A.4 Firms

In every period, the firm has the option of filling a vacancy, if one exists, by hiring a worker or keeping the vacancy open. If matched with a worker, firms earn profits that depend on the surplus generated by the match and pay wages, determined in equilibrium, that depend on the worker's outside options, the minimum wage, and the worker's SSP supplement status. Profits depend on the worker's tenure to allow match-specific capital to increase the productivity of the match over time. Denote the surplus generated by a worker-firm pair of tenure t by $P(t)$. With probability δ the match separates and the firm is left with a vacancy in the following month. Denote the profits of a firm matched with a worker with outside option i, $i \in \{\bar{u}, \ldots, \underline{u} \ldots, 1, 0, -1, \ldots, -T_{in}, \ldots, -T_{out}\}$, match tenure t, and SSP supplement eligibility s by $\Pi(t, i, s)$.

The expected future profits for matches of job tenure t with workers with outside option i and SSP eligibility s are

$$\Pi^E(t,i,s) = \begin{cases} P(t) - w(t,0,0) + \beta[\delta\Pi^V + (1-\delta)\Pi^E(t+1,0,0)] & \text{if } 0 \geq i > -T_{in}, t < I, \text{ and } s = 0, \\ P(t) - w(t,0,0) + \beta[\delta\Pi^V + (1-\delta)\Pi^E(t+1,\underline{u},0)] & \text{if } i = 0, t = I, \text{ and } s = 0 \\ P(t) - w(t,i,0) + \beta[\delta\Pi^V + (1-\delta)\Pi^E(t+1,i+1,0)] & \text{if } 0 < i < \bar{u}, t < T, \text{ and } s = 0, \\ P(t) - w(t,\bar{u},0) + \beta[\delta\Pi^V + (1-\delta)\Pi^E(t+1,\bar{u},0)] & \text{if } i = \bar{u}, t < T, \text{ and } s = 0 \\ P(t) - w(t,i,1) + \beta[\delta\Pi^V + (1-\delta)\Pi^E(t+1,-T_{in},1)] & \text{if } -T_{in} \geq i, t < I, \text{ and } s = 1, \\ P(t) - w(t,-T_{in},1) + \beta[\delta\Pi^V + (1-\delta)\Pi^E(t+1,\underline{u},1)] & \text{if } -T_{in} = i, t = I, \text{ and } s = 1 \\ P(t) - w(t,i,1) + \beta[\delta\Pi^V + (1-\delta)\Pi^E(t+1,i+1,1)] & \text{if } \underline{u} < i < \bar{u}, t < T, \text{ and } s = 1, \\ P(t) - w(t,\bar{u},1) + \beta[\delta\Pi^V + (1-\delta)\Pi^E(t+1,\bar{u},1)] & \text{if } i = \bar{u}, t < T_{end}, \text{ and } s = 1 \\ P(t) - w(T_{end},\bar{u},1) + \beta[\delta\Pi^V + (1-\delta)\Pi^E(t+1,\bar{u},0)] & \text{if } i = \bar{u}, t = T_{end}, \text{ and } s = 1 \\ P(t) - w(t,i,0) + \beta[\delta\Pi^V + (1-\delta)\Pi^E(T,\bar{u},0)] & \text{if } t \geq T, \end{cases}$$

where match tenure beyond T no longer increases profits.

If a firm has a vacancy, the value of a vacancy is determined by the probability of meeting an unmatched worker, by the profits the firm expects to make from the match, and by the costs of posting a vacancy (ξ)

$$\Pi^V = -\xi + \beta\Big[\sum_i q(i)\Pi^E(1,i,s) + \Big(1 - \sum_i q(i)\Big)\Pi^V\Big],$$

where $s = 1$ if $-T_{in} \geq i > -T_{out}$ and $s = 0$ otherwise.

Firms will post vacancies unless the expected profit from doing so is negative. Thus in the steady state equilibrium the number of firms in the economy will be determined by the condition that the expected profits from posting a vacancy are zero.[33] Note that this requires also a free entry assumption.

A.5 Search Technology

Assume there is no on-the-job search in the economy. The probability that a jobless individual receives a job offer depends on the probability the worker contacts a firm and the probability a firm has a vacancy.

A.5.1 Workers

The probability a firm has a vacancy is simply the total number of vacancies divided by the total number of firms

$$\frac{V}{F}.$$

If a firm has a vacancy, it will hire a worker and pay a wage which is the outcome of Nash bargaining between the worker and the firm, discussed in detail below. Let applications for jobs arrive according to a Poisson process, where λ is the average number of applications filed by workers at each firm. It is further assumed that firms randomly draw workers from the applicant pool if there is more than

[33] Production takes place when there is a match between one firm and one worker; the number of firms can alternatively be interpreted as the number of jobs in the economy.

one applicant.[34] The probability a worker is offered a job is:

$$\frac{1-e^{-\lambda}}{\lambda}.$$

The conditional re-employment probabilities for unemployed workers and workers on social assistance can then be expressed as the product of the above components, multiplied by the worker's search effort

$$m(i) = \frac{p(i)V}{\lambda F}\left(1-e^{-\lambda}\right),$$

where

$$\lambda = \frac{1}{F}\left(\sum_{i=1}^{\bar{u}} p(i)U(i) + \sum_{i=-T_{out}}^{0} p(i)A(i)\right).$$

Recall, $p(i)$ are the contact probabilities of an individual in jobless month indexed by i. The contact probabilities are choice variables for the workers within the model and can be interpreted as search effort. Workers determine the optimal level of search effort by equating the marginal benefit from an increase in search effort with its marginal cost.[35] The optimal level of search effort, for each labor market state and program eligibility combination, is described by:

$$p(i) = \begin{cases} \left(\frac{\beta m(i)}{c_u z}\left[V^E(1,i-1,0) - V^U(i-1)\right]\right)^{\frac{1}{z}}, & i > 1 \\ \left(\frac{\beta m(i)}{c_u z}\left[V^E(1,i-1,0) - V^A(0)\right]\right)^{\frac{1}{z}}, & i = 1 \\ \left(\frac{\beta m(i)}{c_a z}\left[V^E(1,i-1,0) - V^A(i-1)\right]\right)^{\frac{1}{z}}, & 0 \geq i > T_{in} \\ \left(\frac{\beta m(i)}{c_a z}\left[V^E(1,i-1,1) - V^A(i-1)\right]\right)^{\frac{1}{z}}, & T_{in} \geq i > T_{out} \\ \left(\frac{\beta m(i)}{c_a z}\left[V^E(1,i-1,0) - V^A(T_{out})\right]\right)^{\frac{1}{z}}, & i = T_{out} \end{cases}$$

A.5.2 Firms

From the firm's perspective, the probabilities of meeting potential workers from unemployment and welfare are the fraction of workers from unemployment and welfare that transit to employment, divided by the total number of vacancies

$$q(i) = \frac{m(i)U(i)}{V}, \qquad \bar{u} \geq i > 0, \qquad \text{and} \qquad q(i) = \frac{m(i)A(i)}{V}, \qquad 0 \geq i \geq T_{out}$$

respectively.

A.6 Equilibrium Wage Determination

After meeting in the labor market, a firm and a worker bargain over wages by making alternating wage offers until both sides find the offer acceptable. It is assumed that both parties have equal bargaining power, but may have different threat points. The equilibrium of this game is the Nash cooperative bargaining solution and results in workers and firms splitting the surplus of a match evenly. The surplus of the match from the worker's perspective is the difference between employment at the equilibrium wage and the worker's outside option, which depends on their current labor market state and program eligibility, as well as on SSP supplement eligibility. The surplus from

[34] Alternatively, we can consider the length of a period tending to zero and work in continuous time, where there is zero probability of more than one application arriving simultaneously. As we wish to take the model to data, we work with discrete periods.

[35] In determining the marginal cost and benefit of search effort λ is held constant under the assumption that each worker believes her impact is small relative to total labor supply.

the perspective of the firm is the difference between the profits the firm receives at the equilibrium wage and the value of leaving the vacancy open. It is further assumed that the bargaining process is constrained such that the wage can not fall below the minimum wage $\underline{w}$. The equilibrium wage is $\max\{w(t,i,s), \underline{w}\}$, where $w(t,i,s)$ solves

$$V^E(t,i,s) - V^j(i) = \Pi^E(t,i,s) - \Pi^V.$$

where $V^j(i) \in \{V^A(i), V^U(i)\}$ is the value of the outside option i. In the following section, we define the steady state conditions that govern the evolution of the economy.

A.7 Steady State Conditions

Let E denote the steady state number of jobs occupied by workers and V the number of vacancies. By definition, the total number of jobs in the labor market is equal to the total number of occupied jobs and the total number of vacancies

$$F = E + V.$$

Denote the total number of individuals in the labor market L. The total number of individuals can be decomposed into three groups. First the employed, who are distinguished by their current job tenure, their current outside option, and their SSP supplement eligibility status

$$E = \sum_{t=1}^{T} \sum_i \sum_s E(t,i,s) + \bar{E},$$

where $\bar{E}$ is the group of workers no longer experiencing on the job wage growth. The second group are on welfare and are distinguished by their welfare duration, which determines their SSP eligibility:

$$A = \sum_{i=-T_{end}}^{0} A(i).$$

The final group are unemployed individuals (U), who can remain unemployed for up to a maximum of $\bar{u}$ periods

$$U = \sum_{i=1}^{\bar{u}} U(i),$$

where $U(i)$ indicates the number of unemployed persons with i periods of benefits remaining.

The total number of individuals in the labor market can therefore be expressed as the sum of the above components

$$L = E + A + U.$$

Using the above definitions, we can describe the conditions governing the steady state, where the flows in and out of every labor force state must be equal over time. The steady state conditions for each state and eligibility combination are discussed in turn below.

A.7.1 Employment

As above, let $m(i)$ denote the probabilities that jobless individuals from jobless state i match with a firm with a vacancy. The flow into the first period of employment includes those workers from welfare and unemployment who receive job offers. They are indexed by their respective outside options and their SSP eligibility as this will determine their progression of benefit entitlements. In subsequent periods, the inflow consists of workers who were employed in the previous period and who were not exogenously separated from their jobs

$$\begin{aligned}
E(1,i,0) &= m(i)U(i), \quad \underline{u} \geq i > 0 \\
E(1,i,0) &= m(i)A(i), \quad 0 \geq i > -T_{in} \\
E(1,i,1) &= m(i)A(i), \quad -T_{in} \geq i > -T_{out} \\
E(1,i,0) &= m(i)A(i), \quad i = -T_{out} \\
E(t,i,0) &= (1-\delta)E(t-1,i-1,0), \quad 1 < t < T, i > 0 \text{ and } s = 0 \\
E(t,i,1) &= (1-\delta)E(t-1,i-1,1), \quad 1 < t < T_{end}, \text{ and } s = 1 \\
E(t,i,0) &= (1-\delta)E(t-1,i-1,1), \quad t = T_{end}, \text{ and } s-1 = 1 \\
\delta\bar{E} &= (1-\delta)E(T,\bar{u}).
\end{aligned}$$

A.7.2 Welfare

The flow into the first period Income Assistance includes those employed workers who were exogenously separated from their jobs and ineligible for unemployment benefits and unemployed workers no longer eligible for unemployment benefits. The flow into first period of SSP eligibility includes those on welfare who have been on welfare long enough to qualify, plus those who were exogenously separated from jobs in which they were receiving the SSP supplement but not yet eligible for unemployment benefits. The flow into all other periods of income assistance comprise those workers in the previous period of income assistance who did not match with an employer. Finally, those individuals who did not find employment before SSP eligibility expired transit to $A(-T_{out})$, where the flow in and out of this state must be equal.

$$\begin{aligned}
\delta\sum_{t=1}^{I} E(t,0,0) + (1-m(1))U(1) &= A(0) \\
\delta\sum_{t=1}^{I} E(t,-T_{in},1) + (1-m(-T_{in}+1)A(-T_{in}+1) &= A(-T_{in}) \\
(1-m(i+1))A(i+1) &= A(i), \qquad 0 > i > -T_{out}, \text{ and } i \neq -T_{in} \\
(1-m(T_{out}+1)A(T_{out}+1) &= m(T_{out})A(T_{out}).
\end{aligned}$$

A.7.3 Unemployment

Employed workers who are separated from their jobs and who are eligible for the maximum months of unemployment benefits flow into the first period of unemployment, $U(\bar{u})$. For $U(i)$ where $0 < i < \bar{u}$, the inflow consists of unemployed workers from the previous period who did not find jobs, and workers separated from their jobs who qualify for less than the maximum number of benefit months. All workers flow out of the unemployment state when benefits run out due to the time limitations in the unemployment insurance program

$$\begin{aligned}
\delta\sum_{t} E(t,\bar{u},0) &= U(\bar{u}) \\
\delta\sum_{t}\sum_{i} E(t,i,0) + \delta\sum_{t\geq I}\sum_{i} E(t,i,1) + (1-m(i+1))U(i+1) &= U(i) \qquad \text{if } 0 < 1 < \bar{u}.
\end{aligned}$$

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