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Equilibrium Policy Experiments and the Evaluation of Social Programs

The Self-Sufficiency Project

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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 the 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 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 for individuals to delay exit from welfare in order to qualify for the program. Together, the feedback effects substantially change the cost–benefit conclusions implied by the partial equilibrium experimental evaluation.

Introduction

Considerable attention has focused on the reform of unemployment insurance (UI) and income assistance (IA) 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 a policy may have very different implications when it is implemented for the general population than when it is implemented for 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 labour market. These effects violate the stable unit treatment value assumption (SUTVA) invoked to justify partial equilibrium analysis. Heckman, Lochner, and Taber (1998) consider increased subsidies to college tuition and find that the resulting increase in the number of individuals attending college increases the supply of college graduates and reduces their wages. In this case, the effect of the tuition policy depends on the number of college graduates in the labour market.

Second, programs may directly affect those who are not treated within the program. As discussed by Heckman and Smith (1998), standard treatment effects literature assumes 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 UI benefits 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 behaviour of all workers in the labour market. In particular, the bonus increased the gain to employment for workers eligible to receive it, resulting in increased search effort and employment. Some of the increase in employment was in jobs that may otherwise have been held by workers not eligible for the bonus. This displacement directly affected a subset of the labour force not treated within the program.

Studies, such as those mentioned above, indicate the equilibrium effects of large-scale policies may be substantial. With regard to the college tuition subsidies studied by Heckman et al. (1998), they estimate that the general equilibrium effects on enrolment rates are 10 times smaller than those obtained from a partial equilibrium analysis. Davidson and Woodbury (1993) estimate the displacement of workers ineligible for UI benefits offset 30 to 60 per cent 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 labour market. In addition to the matching and wage determination process, our model incorporates key features of the IA and UI programs, both of which constitute important aspects of the economic context and are likely to have important feedback effects on the labour 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 behaviour 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 IA to leave the IA system and seek employment. 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 SSP (Card & Hyslop, forthcoming; Ferrall, forthcoming; Kamionka & Lacroix, forthcoming). Similar, but less generous, income supplement programs have been studied in the United States. (See Auspos, Miller, & Hunter, 2000, on the Minnesota Family Investment Program and Bos et al., 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. SSP provides financial incentives by offering temporary earnings supplements to individuals on IA. Individuals must remain on IA for 12 months to become eligible for income supplements; once they do, they receive a supplement if they obtain

[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.

employment and leave IA within the following 12 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 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 UI program (Employment Insurance) and the interactions between the IA and UI programs and the labour 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 IA recipients may reduce 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 IA 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 IA program, and individuals may stay on IA longer 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 IA 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 SSP is imposed in partial equilibrium to determine how well the model simulations replicate the labour 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 SSP in the model, calibrate the model using the parameters obtained in the first stage, and simulate the equilibrium effects that result from introducing SSP as policy. This last stage allows us to quantify the

[2] One part of the SSP experiment randomly assigned new IA recipients to control and program groups. Program group members were 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, between the program and control groups, in the fraction of respondents collecting IA in 12 of 13 months after the start of the welfare spell.

displacement, wage and entry effects of SSP, and provides a more complete picture of the potential implications of implementing SSP as policy.

Three main results emerge from the equilibrium program evaluation. First, introducing an earnings supplement to the IA program has implications for unemployed workers, as the increase in employment for IA recipients coincides with a decrease in re-employment rates for those individuals receiving UI benefits. Second, although the introduction of an earnings supplement increases the rate of exits to employment from IA, it does so at lower equilibrium wages, as workers are willing to accept lower starting wages so they can benefit from the supplement payments. Surprisingly, the wages of other workers in the economy increase slightly as the increased value of IA, due to the introduction of the earnings supplement, transfers bargaining power from firms to workers. This 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 IA program increases and a higher fraction of individuals remain on IA long enough to qualify for the supplement after the policy change.

Incorporation of the equilibrium effects substantially changes the cost–benefit conclusions. 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 the 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.

The Model

In this section we present the model of the labour 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 insurance (UI) benefits (U), or on income assistance (A).[3] This allows us to consider how workers, unemployed individuals, and income assistance (IA) recipients interact in the labour market. The model builds on the equilibrium search model of Davidson and Woodbury (1993), where individuals maximize expected lifetime income by choosing their labour market state and the intensity with which they search for work if not employed.[4] We extend Davidson and Woodbury (1993) to incorporate the IA program, minimum wages, and time limitations for entry to, and exit from, the UI 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 UI and IA programs are incorporated in the model.[5] First, individuals face time limitations regarding entry to, and exit from, the UI system. Individuals entering employment from IA or who have exhausted their UI benefits become eligible to receive UI 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 entering employment with unused benefits retain their unused benefit months and accumulate additional months with each month worked. Second, individuals who exhaust their UI benefits and do not secure a job are assumed to transit directly to IA. Finally, it is assumed that individuals can remain on IA indefinitely or transit to employment if they contact a firm with a vacancy; IA recipients cannot transit directly from IA to UI. In the following sections we describe the problems faced by each type of individual and by firms in the model.

WORKERS

The value of employment for a worker depends on job tenure t and UI 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 UI 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 by $\bar{u}$. An individual not working 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

[3] Throughout this paper, we use the term “unemployed” to mean collecting UI benefits. In the model all jobless individuals are actively seeking employment; they are distinguished by whether they are receiving UI 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 model could easily be modified to correspond to the institutions present in the United States, the United Kingdom, or other developed countries.

which case workers transit to IA if they have not yet qualified for UI benefits, $i = 0$, and transit to UI otherwise. With probability $(1 - \delta)$, workers remain employed in the next month.

It is assumed that individuals returning to work before their UI benefits expire retain their remaining UI 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 UI eligibility i, β is the discount rate, V^A is the value of being on IA, and $V^U(i)$ is the value of being unemployed with i benefit periods remaining. All notation is defined in Table 1.

IA RECIPIENTS

IA recipients receive IA benefits (b_a) and pay search costs $c_a[p(0)^z]$ every month they remain on IA, 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 the optimal search effort for individuals with i months of UI 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 IA recipients contact a firm with a vacancy, they transit to employment. Otherwise, they remain on IA in the next period. The value function for an IA recipient is

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

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

UNEMPLOYED INDIVIDUALS

Unemployed agents receive exogenous UI benefits (b_u) and pay search costs $c_u[p(i)^z]$. We make the simplifying assumption that UI benefits are independent of the individual's preseparation 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 UI 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 IA. The value function for unemployed individuals with i months of benefits remaining is

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

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; $P(t)$ denotes the surplus generated by a worker–firm pair of tenure t. With probability δ, the match separates and the firm is left with a vacancy in the following month. 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 are denoted by $\Pi(t, i)$.

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

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

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).

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

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.

SEARCH TECHNOLOGY

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

Workers

The probability of a firm having a vacancy is 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, as 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 of a worker being offered a job is

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

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

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

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 respective contact probabilities for IA recipients and unemployed individuals with i periods of UI receipt remaining. 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 labour market state and program eligibility combination, is described by

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

[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.

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

Firms

From the firm's perspective, the probabilities of meeting potential workers on UI or IA benefits are the fraction of workers on these benefits who 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.

EQUILIBRIUM WAGE DETERMINATION

After meeting in the labour market, a firm and a worker bargain over wages by making alternating wage offers until both sides find the offer acceptable. It is assumed both parties have equal bargaining power, but may have different threat points. The equilibrium of this game is the Nash co-operative 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 the current labour 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 cannot fall below the minimum wage $\underline{w}$. The equilibrium wage is $\max\{w(t,i), \underline{w}\}$, where $w(t,i)$ solves

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

and $V^i \in \{V^A, V^U(i)\}$ is the value of the outside option i. We now define the steady state conditions governing the evolution of the economy.

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 labour market equals 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 labour market by 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 on IA are denoted by A. The final group are unemployed individuals (U), who can remain unemployed for 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 labour 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 below.

Employment

As above, let $m(0)$ and $m(i)$ denote the probabilities that IA recipients and UI recipients with i periods of benefits remaining, respectively, match with a firm. The flow into the first period of employment includes those workers from IA and UI 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

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

IA Benefits

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

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

UI Benefits

Employed workers who are separated from their jobs and who are eligible for the maximum months of UI 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 UI state when benefits run out due to the time limitations in the UI program:

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

Baseline Model Calibration

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 Self-Sufficiency Project (SSP) was implemented. The parameters for the model include monthly income assistance (IA) and unemployment insurance (UI) benefits (b_a and b_u, respectively), the size of the labour 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 below.

Monthly IA benefits (b_a) are based on the average IA incomes from 1990 to 2000 reported by the National Council of Welfare (2002). IA incomes by province are provided for the subgroups 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 IA population.[8] The calibrated IA benefits are equal to $\$482$ per month in New Brunswick and $\$695$ in British Columbia. UI 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 earnings sample is limited to individuals with less than post-secondary education, as we are attempting to isolate that segment of the labour market most similar to individuals receiving IA. The earnings data are based on the usual hourly wage for the latter subpopulation, as reported in the monthly Labour Force Survey (LFS), 1997 to 2000, assuming a 37.5 hour work week.[9] Earnings, IA benefits, and UI benefits are all converted to 1992 dollars using the all-goods consumer price index (CPI).[10] The resulting monthly UI benefits level is $\$1,174$ 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 labour 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. 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, Krebs, Morissette, & Zhang (2001) and is based on the average for the retail trade and consumer services, and labour-intensive tertiary manufacturing sectors, both of which have average incomes similar to our sample. Therefore,

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

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

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

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 LFS (1990 to 2000). Job tenure is only reported for individuals listed as 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 LFS (1990 to 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 the search are allowed to differ, depending on whether individuals are receiving UI or IA, to capture the notion that searching may be less costly while unemployed. For example, unemployed individuals may have access to better search technologies through UI offices than do IA recipients. The search cost parameters, c_a and c_u, are chosen to match the fraction of the population in each labour 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 IA recipiency rates presented in Table 2.

The labour 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 IA and UI benefit receipt. We adopt the following definitions in the 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 UI or IA income during the month. Unemployed workers are defined as individuals who are either unemployed or not in the labour force, and report receiving UI benefits. Finally, IA recipients are either unemployed or not in the labour force, and report receiving IA benefits. We exclude all individuals who do not fit these criteria, such as those who report working full time and those receiving either UI or IA benefits. Similarly, we exclude those reporting they are unemployed or not in the labour force, but not receiving any UI or IA benefits. We use parameter estimates for our search cost function from Christensen, Lentz, Mortensen, Neumann, & 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 & Woodbury (1993). We assess the sensitivity of our results to these parameters in the "Sensitivity Analysis" section. The cost of posting a vacancy, ξ, is calibrated so 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

[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 quits report holding jobs of shorter durations.

[12] The Survey of Labour Income Dynamics is the Canadian analogue of the US Survey of Income and Program Participation.

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 the match surplus values in the model that 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 IA or UI. 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 analyses, 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 UI benefits. The length of the UI 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 (Lin, 1998).

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 British Columbia to $\$5.50$ and to $\$5.00$ in New Brunswick to match the legislated minimum wage in both provinces 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.

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 UI 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 UI eligibility status.[13] The estimated search costs for IA recipients are approximately six times higher than for those receiving UI benefits in British Columbia and approximately three times higher than for those receiving UI benefits in New Brunswick, as illustrated in Table 2. Combined with lower benefits while on IA, the difference in search costs across labour market states generates substantial differences in the conditional re-employment probabilities. The re-employment

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

probabilities for the unemployed and for those receiving IA are presented in Figure 1. The figure plots the conditional re-employment probabilities for an individual eligible for the maximum number of months of UI benefits when beginning a jobless spell. The probability of transiting to employment increases as the individual approaches the exhaustion of UI benefits, because the search effort is the greatest just before benefits run out. The probability of exiting to employment once UI benefits are exhausted is substantially lower than while collecting UI benefits.

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

Partial Equilibrium Program Analysis

In this section we introduce the Self-Sufficiency Project (SSP) 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 with those generated in the data. This exercise provides evidence of how well our model and simulated experiment replicate the outcomes generated by the true experiment. It is important to emphasize that the partial equilibrium version of the model is the appropriate comparison to the experiment, because the experiment affected only 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 income assistance (IA) recipients.

SSP DATA

The Canadian SSP experiment focused on long-term IA recipients.[14] 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.[15] Individuals assigned to the treatment group were informed 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 depended on their labour market earnings.[16] In particular, the supplement payment equalled one half of the distance between the earnings of the recipient and a benchmark earnings level, set at $37,000 in British Columbia and $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 12 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. It 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, IA payments, and earnings supplement payments for up to 36 months after random assignment. Third, administrative data on monthly IA payments are available for three years prior to the SSP and for 36 months following random assignment.[17]

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[14] 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.

[15] Kamionka and Lacroix (forthcoming) 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.

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

[17] Data are available on IA payments for some respondents for an extended period. Data will be available for up to 54 months

The data contain information on 5,686 recipients in the main study: 2,827 control group members and 2,859 treatment group members. From the main study, the following restrictions are placed on the baseline sample. First, 280 males are eliminated from the sample so our analysis can focus on a homogeneous group (single mothers) within the study.[18] Second, 13 observations with inconsistent information are removed from the sample,[19] 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, of which 2,290 are members of the control group and 2,303 are members of the treatment group.[20]

Table 4 contains descriptive statistics for the control and treatment groups from the baseline surveys in British Columbia and New Brunswick. As expected, there were few significant differences between the two groups at the baseline interview.[21] The vast majority of respondents had worked at some point in their lives; however, less than 20 per cent were working at the baseline interview and over 20 per cent were looking for work. Those working at the baseline interview tended to have low wages and limited attachment to the labour force as indicated by the low annual hours and months worked during the previous year. By design, the sample members had a strong attachment to the IA program before random assignment: on average, respondents collected IA in 30 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 when comparing the treatment and control groups 36 months after the implementation of SSP. First, IA respondents in the treatment group were responsive to the financial incentives inherent in 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 were 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, SSP does not appear to have a beneficial effect on the wages earned by treatment group members: the mean wage for the treatment group was below that for the corresponding control group, although this difference is not statistically significant.

SIMULATING THE SSP IN PARTIAL EQUILIBRIUM

The following additions are made to the model to incorporate SSP.[22] First, individuals on IA face several time constraints. IA recipients become eligible for SSP after they have been on IA a minimum of 12 months. Once eligible, individuals have 12 months to find full-time

following random assignment in the near future.

[18]This is a relatively innocuous assumption, as 95 per cent of the individuals in SSP are female.

[19]In particular, seven individuals reported their age at the baseline survey to be less than 19 and six individuals reported their total number of children as zero. To be included in the study, individuals had to be single parents and at least 19 years of age.

[20]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.

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

[22]The Appendix provides the details of the model incorporating SSP.

employment in order to receive supplement payments. An individual securing a job before the eligibility period ends 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 lifetime. Once the eligibility period for the supplement payments expires, individuals return to the regular IA system. Second, eligible individuals who find work receive supplement payments that are a function of their wage on obtaining employment. As in the baseline version of the model, wages are allowed to increase with job tenure. One goal of SSP is to provide workers with enough time to experience sufficient wage growth so employment remains an attractive alternative once the earnings supplement expires. On-the-job wage growth, which results from increases in the surplus created in worker–firm matches in our model, captures this particular feature of the program.

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.

To compare our model's predictions with the experimental impacts, we first recalibrate the model on the subsample of single mothers, as this is the population considered in the experiment. In particular, we recalibrate wages and UI and IA benefits on the subsample 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.[23] The wage and benefit parameters for the population of single mothers are presented in Table 6, and indicate that single mothers receive higher IA benefits and lower wages than the rest of the population studied in our model. As a result, the benefit of transiting from IA to employment is lower for single mothers than it is for the broader population in the general model. This produces a lower search effort for single mothers in the model and, consequently, lower re-employment probabilities.

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 IA 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 IA who is offered the SSP supplement. Again, this is done in partial equilibrium, implying any change in behaviour 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.

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

Figures 2 and 3 compare the IA survival rates for the control and treatment groups in the experiment, and in the simulation for British Columbia and New Brunswick, respectively.[24] The basic pattern matches the experimental data very well. Both the simulation and the experiment indicate the SSP top-up program substantially increases the exit rate from IA to work, with the impact ending once eligibility expires. It is very encouraging that the model correctly predicts not only the basic pattern, but also matches the proportion of control and treatment group individuals remaining on IA 36 months after random assignment.

As an additional test of how well the model predicts behaviour, we reproduce the "Applicant" study within the model. The Applicant study was a separate experiment conducted on a sample of 3,315 single parents in their first month of IA receipt in the Vancouver metropolitan area. This sample was randomly assigned to treatment and control groups, where treatment group members were told they would become eligible for the SSP program if they remained on IA for 12 months. The difference between the fraction remaining on IA 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).[25] 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 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 the model captures the fundamental dynamics introduced by the SSP supplement, which increases our confidence in the general equilibrium analysis that follows.

[24]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 IA 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 per cent who were employed.

[25]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.

The General Equilibrium Impacts of SSP

In this section we incorporate the Self-Sufficiency Project (SSP) 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 SSP, and will include this information in their decision-making process; the fact that SSP exists will have equilibrium effects, just as the existence of unemployment insurance (UI) benefits and the income assistance (IA) program have equilibrium effects in the baseline model. Second, the SSP policy in the general equilibrium simulations applies to all IA recipients, rather than just to single-parent IA recipients as in the experiment.[26] We focus on all IA 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 IA recipients: single mothers and all other IA 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 IA recipients come at the expense of reduced employment for others in the labour market? Second, what impact does offering an earnings supplement have on the distribution of wages in the economy? Finally, does the existence of SSP increase the entry rate to IA and delay exit during the prequalifying period? We now discuss the answer to each question in turn.

THE DISPLACEMENT EFFECT

The expected durations of joblessness are presented in the top half of Table 7. The average duration of IA spells is substantially reduced under SSP, as SSP-eligible individuals face greater incentives to exit the IA program. The model predicts a decrease in expected IA 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 one day (0.03 months) in New Brunswick and by three days (0.09 months) in British Columbia. The policy change, in essence, increases the likelihood unemployed workers will exhaust their benefits and transit to IA, as unemployed workers are displaced in the labour market by IA recipients. The total jobless duration in British Columbia increases for those who begin a spell of 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 UI or IA due to the large decrease in IA recipiency durations.

The predicted change in employment and IA durations has different implications for the aggregate employment rate across provinces due to the relatively large fraction of the

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

population eligible for supplement payments in New Brunswick compared with British Columbia. Table 8 suggests that the fraction of contacts the firm makes with SSP-eligible workers is 10 per cent in New Brunswick in contrast to 3.7 per cent in British Columbia. The flow of individuals from IA to employment is thus much higher in New Brunswick after 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.

THE WAGE EFFECT

As discussed in Section 3, starting wages differ depending on whether the worker transits from IA or UI, and depending on the length of the unemployment spell. Once the SSP 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 five per cent 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) who transited to employment from the first period of IA 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 transiting 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 SSP policy. For example, UI recipients in British Columbia who are one month away from exhausting benefits receive starting wages that are 13 per cent higher after the introduction of SSP. The 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 cannot extract additional surplus out of workers, because of the minimum wage. At the same time, the value of entering IA has increased due to the introduction of the supplement. As a result, the outside options of UI recipients and IA recipients who are not eligible to receive the supplement improve.

THE ENTRY EFFECT

As discussed earlier, the equilibrium unemployment rate increases slightly with the introduction of SSP, 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 SSP 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 UI benefit exhaustion. However, since the value of transiting to IA has increased following the policy change, the search effort for unemployed workers in the SSP world does not rise to the same extent as in the baseline economy. As a result, a larger fraction of unemployed workers transit from UI to IA after the policy change.

The search behaviour of IA recipients also changes following the policy change. Figures 6 and 7 compare the survival rates for individuals entering IA in the baseline and SSP worlds 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 IA 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, as a result of the increased search effort by supplement-eligible IA recipients, appears to outweigh the entry effects, as the average duration of IA spells declines following the imposition of the SSP policy.

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 SSP in partial equilibrium with the general equilibrium effects highlighted above. The differences in survival rates for IA recipients in the partial equilibrium model compared with 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 IA recipients into employment. Both factors are consistent with greater incentives to exit IA 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 & Woodbury, 1993; Heckman, Lochner, & Taber, 1998).

Reconsidering the Costs and Benefits of SSP

In this section we look at the benefits of implementing the Self-Sufficiency Project (SSP) 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 behaviour 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 SSP are "new jobs," leading to an increase in aggregate output. Finally, wages do not change from the baseline economy. In other words, we assume 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 the SSP cost information presented in Michalopoulos et al. (2002). First, we calculate the direct costs of administering the SSP policy. Michalopoulos et al. (2002, Table 7.7) estimate the net average cost per individual eligible for SSP at $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 system costs totalling $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.[27] The estimated cost of SSP services weighted by the number of individuals eligible for SSP in the partial equilibrium version of our model, is $128,276 per 1,000 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 SSP policy for both provinces. We multiply the difference in the value of the transfer payments by the dead weight loss associated with the taxes necessary to finance the difference in transfers, estimated at 0.5. The dead weight loss of the change in transfer payments is, therefore, estimated as $486,381 per 1,000 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 SSP for both provinces. In the partial equilibrium version of the model, the value of monthly output increases after the SSP policy is introduced. In particular, we predict output to increase, per 1,000 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, SSP more than pays for itself; there is a net

[27] See, for example, Diewert (1988) and Dahlby (1994) for Canada, and Browning (1987) for the United States.

gain from the program of $2,188,337 per 1,000 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, income assistance (IA), and IA recipiency yields dramatically different cost–benefit estimates: after taking the equilibrium effects into account, the net gain from implementing the SSP 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 SSP policy yields a net cost of $1,036,922 per 1,000. 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.

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 recalibrated in the baseline model for each combination of β and z. Lower values for β serve to reduce the incentives of individuals on unemployment insurance (UI) benefits and those on income assistance (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 UI and IA. 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 recalibrated values for c_a and c_u are presented in the top four rows of tables 11 and 12.

First, we consider the sensitivity of our partial equilibrium measure of the estimated impact of the Self-Sufficiency Project (SSP) on income assistance survival rates. For comparison, 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 IA. 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, Lentz, Mortensen, Neumann, and Wervatz (2002) with the behaviour 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 labour 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. For British Columbia the partial equilibrium analysis consistently results in a net gain for SSP, and the general equilibrium analysis consistently reports a net loss. In each specification for New Brunswick the general equilibrium analysis also consistently predicts a net gain for SSP that is substantially smaller than that predicted by the partial equilibrium analysis.

Alternative Versions of the Self-Sufficiency Policy

One main advantage 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 (SSP) within our framework. To this end, we consider three alternative versions of the SSP 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 (IA) recipients. In particular, we reduce the earnings ceiling by 25 per cent in each province, to $27,750 in British Columbia and $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 IA 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, by increasing the eligibility period to 24 months, and reducing the 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 insurance benefits or to remain on IA 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. This reduces the fraction of unemployed workers exhausting 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.

Conclusion

This paper makes three important contributions to the literature. First, we construct a model that is well suited for 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 (SSP). We find 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 they can 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 income assistance 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 SSP, 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.

Tables and Figures

Table 1: Summary of Notation Used

A	Steady state number of workers on income assistance
b_a	Income assistance benefits
b_u	Unemployment insurance benefits
c_a	Parameter capturing the disutility of search effort in the cost of search function for income 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 labour force
$m(0)$	Conditional probability an income assistance recipient finds a job and transits to employment next period
$m(i)$	Conditional probability of re-employment with i months of unemployment insurance benefits remaining
$p(0)$	Search effort for those on income 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 insurance 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 insurance benefit months
$\bar{u}$	Maximum number of unemployment insurance 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 income assistance
$V^E(t,i)$	The value function for an employed worker in the tth period of employment with unemployment insurance 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 tth 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
$\Pi^E(t,i)$	Firm's expected future profit from a match of tenure t, with a worker with unemployment insurance eligibility i
Π^V	Firm's value of a current vacancy

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

	New Brunswick	British Columbia
	($)	($)
Income assistance benefits, monthly (b_a)[1]	482	695
Unemployment insurance benefits, monthly (b_u)[2]	887	1174
Search costs, income assistance (c_u)	0.2950	0.3281
Search costs, unemployment insurance (c_u)	0.1030	0.0526
Unemployment insurance benefits qualifying months[3]		
Minimum	3	4
Maximum	8	9
Unemployment insurance benefit months		
Minimum $(\underline{u})$	7	5
Maximum $(\bar{u})$	12	10
Average job tenure, months $(1/\delta)$[4]	77.76	72.91
Employment rate (E)[5]	80.70	90.15
Unemployment rate (U)	7.84	5.80
Income assistance rate (A)	11.46	4.05
Minimum wage $(\underline{w})$[6]	5.00	5.50
Average hourly wage[4]	9.92	13.14
Average wage, tenure > 48 months	12.25	16.14
Exogenous job separation rate (δ)[7]	0.0129	0.0137
Monthly discount rate (β)[8]	0.9835	0.9835
Elasticity of search costs with respect to effort (z)[9]	1.8457	1.8457
Cost of posting a vacancy (ξ)	$8,779$	$9,445$
Number of firms (F)[10]	83.40	92.99
Vacancy rate (V/F)[11]	3.20	3.20

Notes: All values are in 1992 Canadian dollars.

[1] National Council of Welfare (2002).

[2] Unemployment insurance benefits are based on 55 per cent of average monthly earnings from Labour Force Survey (1997 to 2000).

[3] Information on EI eligibility rules is from `http://www.hrdc-drhc.gc.ca/ae-ei/de_app/2.0_e.shtml`.

[4] Labour Force Survey (1997 to 2000).

[5] Survey of Labour and Income Dynamics (1993–94 longitudinal file). We define employed workers as individuals who are employed in the first week of the month and report no unemployment insurance or income assistance income during the month. Unemployed workers are defined as individuals who are either unemployed or not in the labor force and report receiving unemployment insurance benefits. Finally, income assistance recipients are individuals on income assistance who are either unemployed or not in the labour force and report receiving income assistance benefits.

[6] Minimum wage at the beginning of the SSP experiment (Michalopoulos, 2002).

[7] Inverse of average job tenure in the Labour Force Survey (1997 to 2000).

[8] This corresponds to an annual discount rate of 0.82, the rate used for all figures and tables in Davidson & Woodbury (1993).

[9] From Christensen et al. (2002).

[10] The number of firms is determined given values for E and V/F.

[11] Galarneau et al. (2001), based on the average for retail trade and consumer services and labour-intensive tertiary manufacturing sectors.

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

Source: Authors' calculations based on model simulation.

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

	British Columbia Program Group	British Columbia Control Group	New Brunswick Program Group	New Brunswick Control Group
Ever worked for pay	0.957	0.945	0.939	0.925
	(0.005)	(0.006)	(0.007)	(0.008)
Working at baseline	0.168	0.170	0.182	0.192
	(0.010)	(0.010)	(0.011)	(0.012)
Looking for work	0.219	0.229	0.218	0.238
at baseline	(0.011)	(0.012)	(0.012)	(0.013)
Enrolled in school	0.160	0.157	0.121	0.123
at baseline	(0.011)	(0.010)	(0.010)	(0.010)
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	4842	3389	3423
	(236)	(280)	(175)	(197)
Months employed	6.81	6.76	7.21	6.91
(in last year)	(0.220)	(0.235)	(0.225)	(0.213)
Hours worked	596.6	609.3	627.7	609.3
(in last year)	(29.8)	(32.9)	(33.2)	(28.3)
Months on IA prior	29.3	28.6*	31.3	31.0
to RA (in last 3 years)	(0.227)	(0.234)	(0.221)	(0.224)
Duration of most recent	25.5	24.6	27.9	27.6
IA spell prior to RA	(0.301)	(0.310)	(0.313)	(0.316)
(in last 3 years)				

Notes: Standard errors in parentheses.
*Difference between the control and treatment group means statistically significant at the 95 per cent level.
RA = Random Assignment
Source: Calculations from 36-month follow-up survey data. (Wages, earnings, months employed, hours worked conditioned on non-zero values.)

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

	British Columbia			New Brunswick		
	Treatment Group	Control Group	Impact	Treatment Group	Control Group	Impact
Looked for work since baseline	0.70	0.59	0.11*	0.73	0.64	0.09*
	(0.017)	(0.018)		(0.017)	(0.018)	
Ever received SSP payments	0.36			0.37		
	(0.01)			(0.02)		
Average hourly wage	8.44	8.99	−0.55	5.96	6.07	−0.11
	(0.217)	(0.251)		(0.084)	(0.109)	
Earnings (in 36 months after RA)	12,938	9,763	3,175*	10,440	7,728	2,712*
	(568)	(648)		(426)	(457)	
Hours (in 36 months after RA)	1,516	1,055	461*	1,683	1,189	494*
	(55)	(51)		(60)	(52)	
Months employed (in 36 months	12.6	9.9	2.7*	13.9	10.9	3.0*
after RA)	(0.4)	(0.4)		(0.4)	(0.4)	
Months on IA (in 36 months	26.9	29.7	−2.8*	24.0	28.5	−4.5*
after RA)	(0.3)	(0.3)		(0.4)	(0.3)	
Duration of most recent IA spell	22.2	26.1	−3.9*	19.9	24.3	−4.1*
After RA (in 36 months after RA)	(0.4)	(0.4)		(0.4)	(0.4)	
Months on SSP supplement	6.0			7.2		
(in 36 months after RA)	(0.3)			(0.3)		

Notes: Standard errors in parentheses.
*Difference between the control and treatment group means is statistically significant at the 95 per cent level.
RA = random assignment
Source: Calculations from 36-month follow-up survey data. (Wages, earnings, months employed, hours worked conditioned on non-zero values.)

Table 6: Moments and Parameters for Single Mothers Without Completed Post-secondary Education

	New Brunswick	British Columbia
Income assistance benefits, monthly (b_a)	737	927
Unemployment insurance 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 $w(t) =$	$6.04 + 0.0418t$ $-0.0000736t^2$ $+5.51e - 8t^3$	$7.89 + 0.0891t$ $-0.000378t^2$ $+6.10e - 7t^3$
Exogenous job separation rate (δ)	0.0211	0.0214
Monthly discount rate (β)	0.9835	0.9835
Elasticity of search costs with respect to effort (z)	1.8457	1.8457

Notes: See Table 2 for sources.

Table 7: Labour Force Composition — Baseline and SSP Models

	British Columbia		New Brunswick	
	Baseline	SSP	Baseline	SSP
Expected unemployment insurance benefits duration, months	5.07	5.16	8.26	8.29
Expected income assistance 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

Note: The sources for the baseline values of the labour force, number of firms, and vacancy rate are given in Table 2. All other values are generated by the model.

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 eligible worker	–	0.4007	–	0.3468
SSP eligible worker	–	0.0155	–	0.0390

Source: Authors' calculations based on model simulations.

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

Note: SD = standard deviation
Source: Authors' calculations based on model simulations.

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]	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[2]	128,276	154,047	306,917	328,584
Indirect Costs				
Change in unemployment insurance payments	–	95,414	–	41,647
Change in income assistance 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[3]	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 labour force normalized to 1000.
MSC = marginal social cost
[1] The direct costs are taken from Michalopoulos et al. (2002, Table 7.7).
[2] The direct costs are multiplied by the marginal social cost (MSC) of a tax dollar, estimated to be 1.5 (Diewert 1988; Dalhby 1994; Browning 1987).
[3] The marginal social cost of the increase in transfers is just the dead weight loss associated with a tax and transfer system: 0.5.

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

Parameters	Base	SSP Simulations				
Annual discount rate (β)		0.82	0.77	0.87	0.82	0.82
Elasticity of search costs (z)		1.85	1.85	1.85	1.75	2.00
Search costs, social assistance (c_a)		0.33	0.26	0.40	0.37	0.28
Search costs, unemployment (c_u)		0.05	0.04	0.06	0.07	0.03
12-month impact[1]	−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
Labour force composition						
Employment	90.15	89.72	89.63	89.75	89.76	89.76
Unemployment insurance	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: net gain from program						
Partial equilibrium		2,189	2,429	2,185	1,847	2,141
General equilibrium		–1,086	–1,322	–1,030	–1,020	–984

Notes: The search friction parameters, 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.

[1] For the 12- and 35-month impacts, the values in the Base column refer to the impact in the data. The other columns refer to model simulations.

Source: Authors' calculations based on model simulations.

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

Parameters	Base	SSP Simulations				
Annual discount rate (β)		0.82	0.77	0.87	0.82	0.82
Elasticity of search costs (z)		1.85	1.85	1.85	1.75	2.00
Search costs, social assistance (c_a)		0.29	0.25	0.36	0.32	0.26
Search costs, unemployment (c_u)		0.10	0.09	0.12	0.13	0.08
12-month impact[1]	-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
Labour force composition						
Employment	80.70	81.22	81.20	81.12	81.24	81.05
Unemployment insurance	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: net gain from program						
Partial equilibrium		4,733	4,898	4,537	4,917	4,507
General equilibrium		522	492	342	548	225

Notes: 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.

[1] For the 12- and 35-month impacts, the values in the Base column refer to the impact on the data. The other columns refer to model simulations.

Source: Authors' calculations based on model simulations.

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					
			Labour Force Composition		
Employment	90.15	89.72	89.99	89.89	89.87
Unemployment insurance	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 gain from program		
Partial equilibrium		2,189	2,256	1,969	1,477
General equilibrium		−1,086	−567	−710	−705
New Brunswick					
			Labour force composition		
Employment	80.70	81.22	81.24	81.06	80.88
Unemployment insurance	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 gain from program		
Partial equilibrium		4,733	4,733	4,045	3,275
General equilibrium		522	593	276	65

Source: Authors' calculations based on model simulations.

Figure 1: **Re-employment Probabilities Beginning With First Period of Unemployment Insurance Benefits**

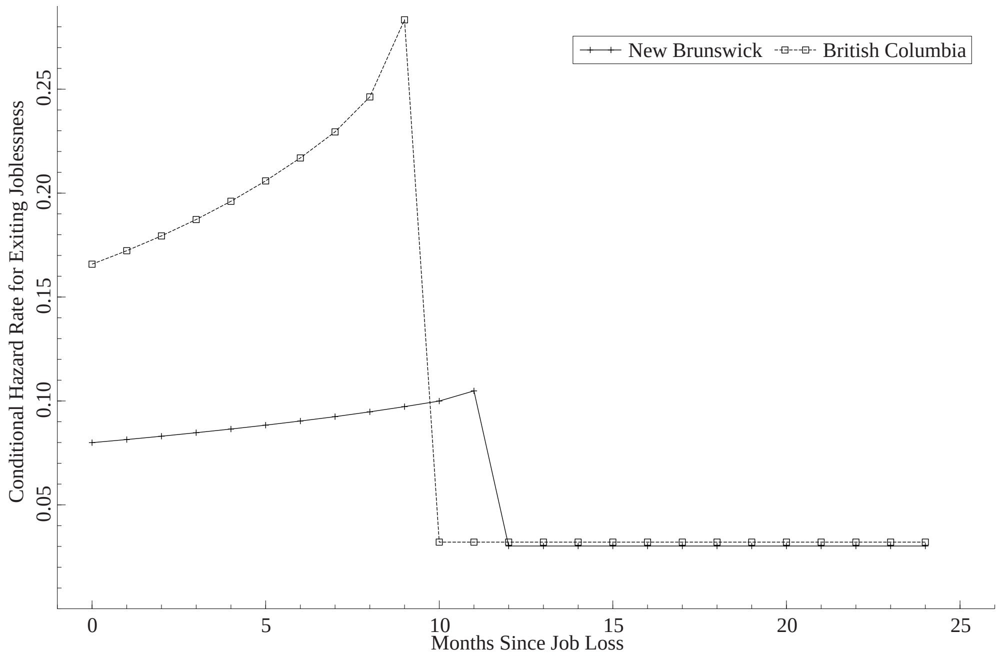
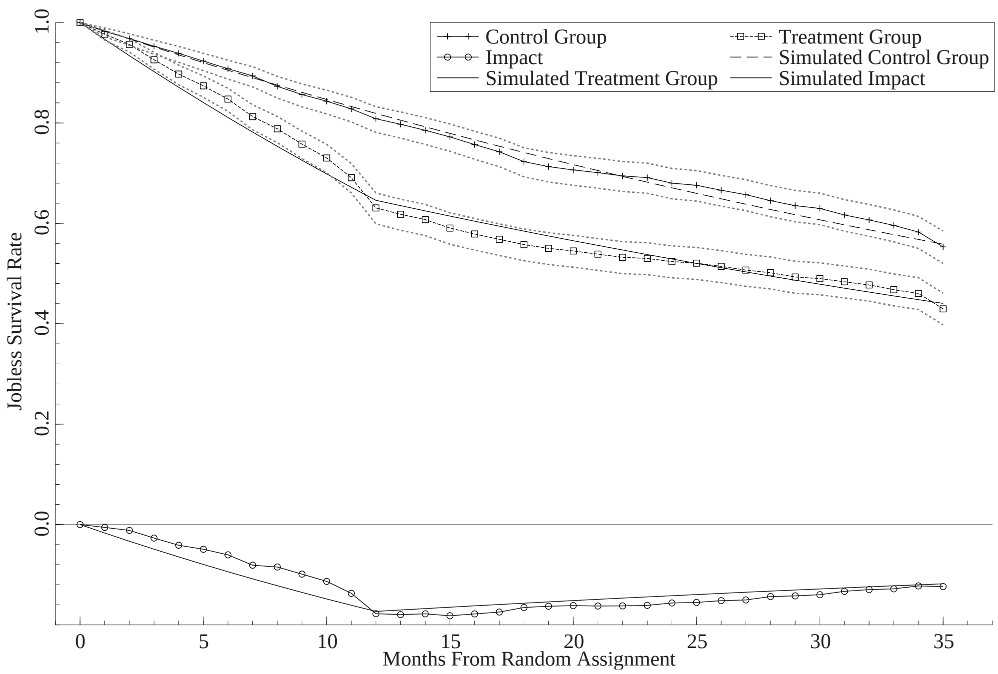
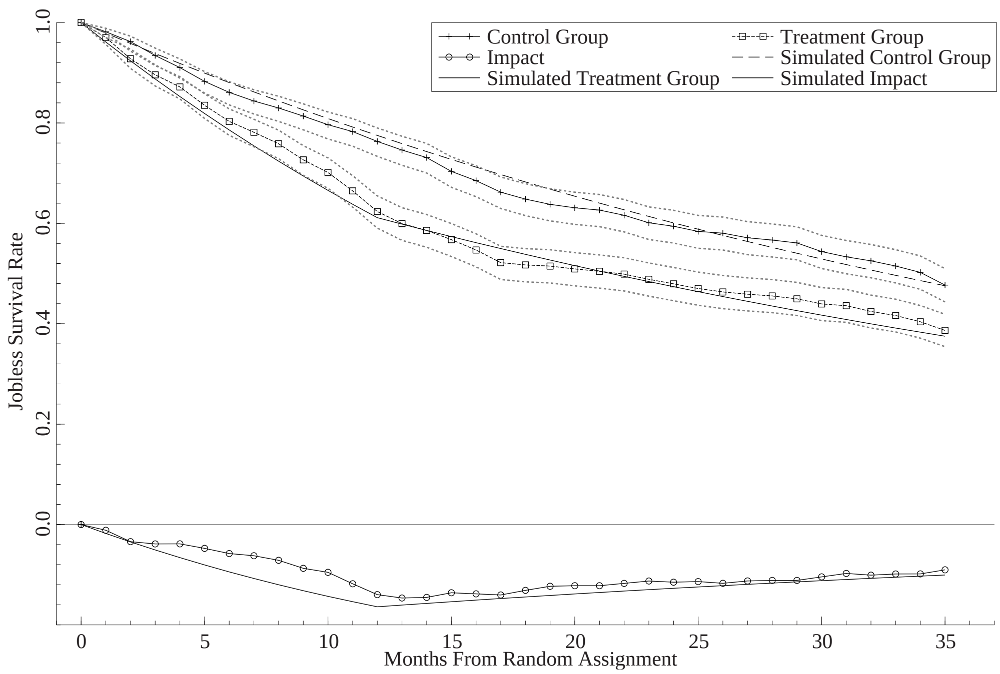


Figure 2: Simulated Partial Equilibrium Impact of SSP — British Columbia



Note: The dotted bands are point wise 95 per cent confidence intervals for the data.

Figure 3: Simulated Partial Equilibrium Impact of SSP — New Brunswick



Note: The dotted bands are point wise 95 per cent confidence intervals for the data.

Figure 4: **Search Intensity for Those Starting With Maximum Unemployment Insurance Benefits — British Columbia**

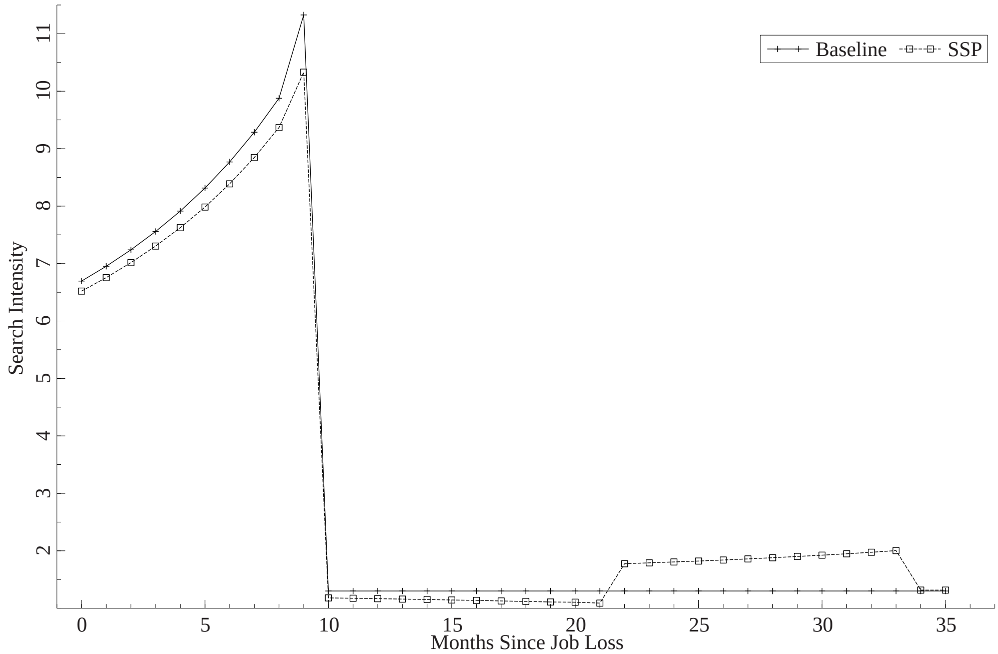


Figure 5: **Search Intensity for Those Starting With Maximum Unemployment Insurance Benefits — New Brunswick**

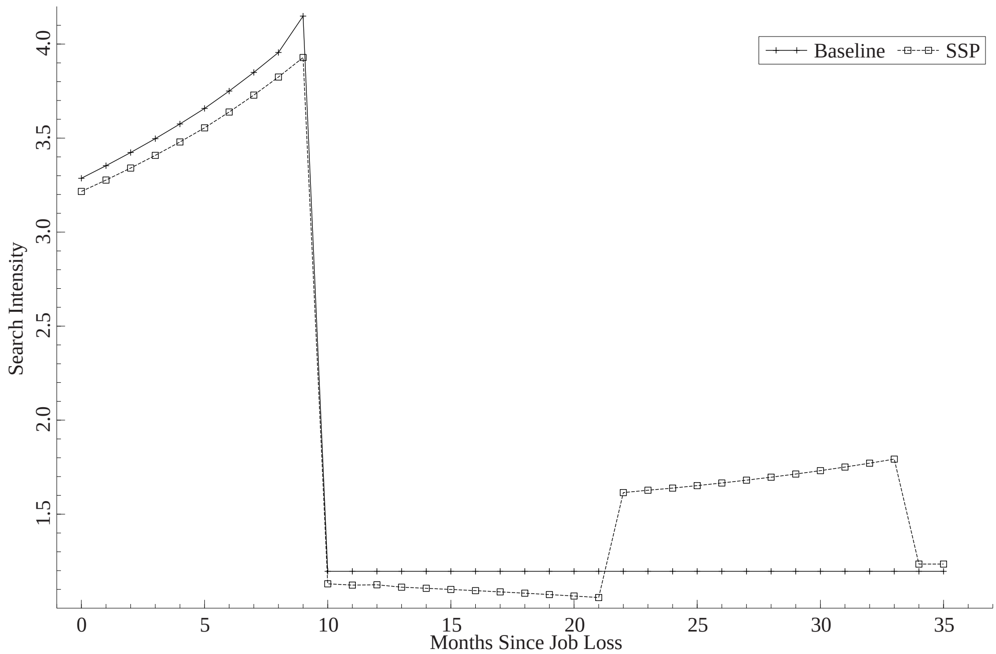


Figure 6: Survival Probability, Starting From Income Assistance — British Columbia

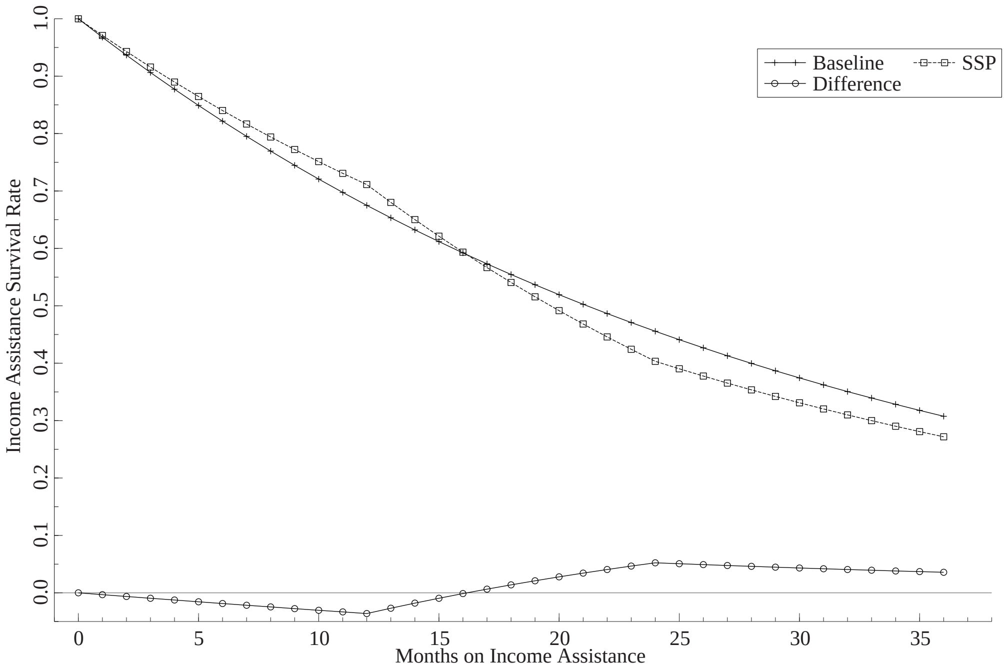


Figure 7: Survival Probability, Starting From Income Assistance — New Brunswick

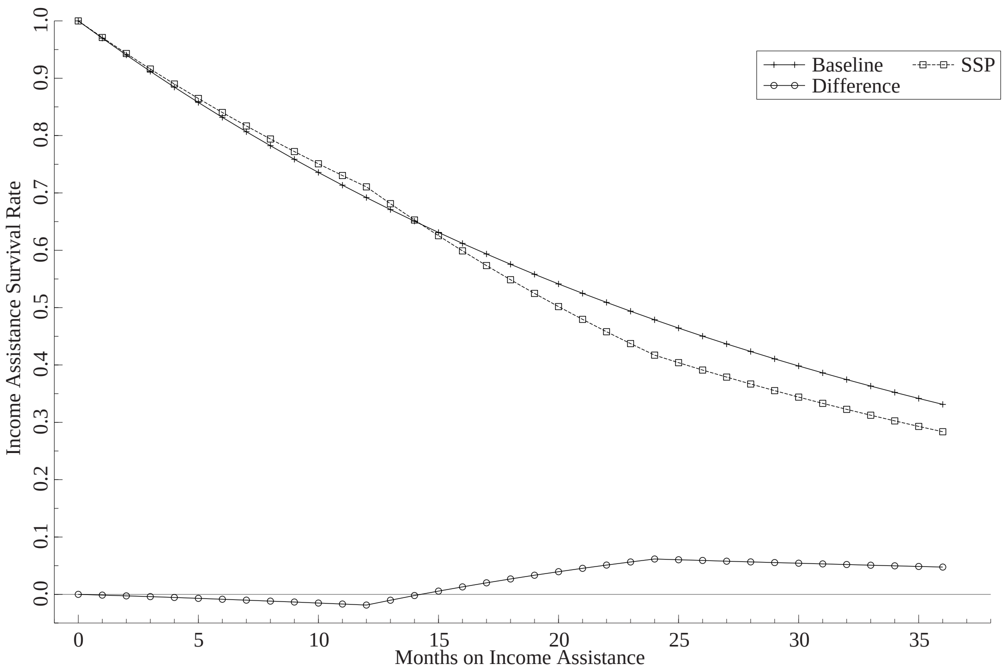


Figure 8: Survival Probability, Partial and Equilibrium Impacts — British Columbia

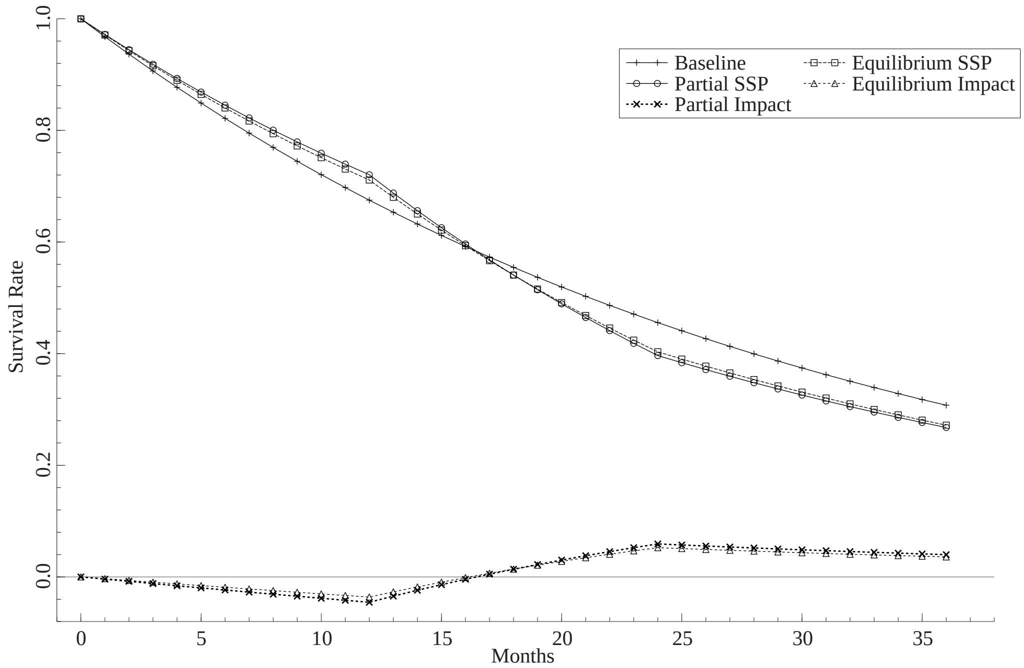
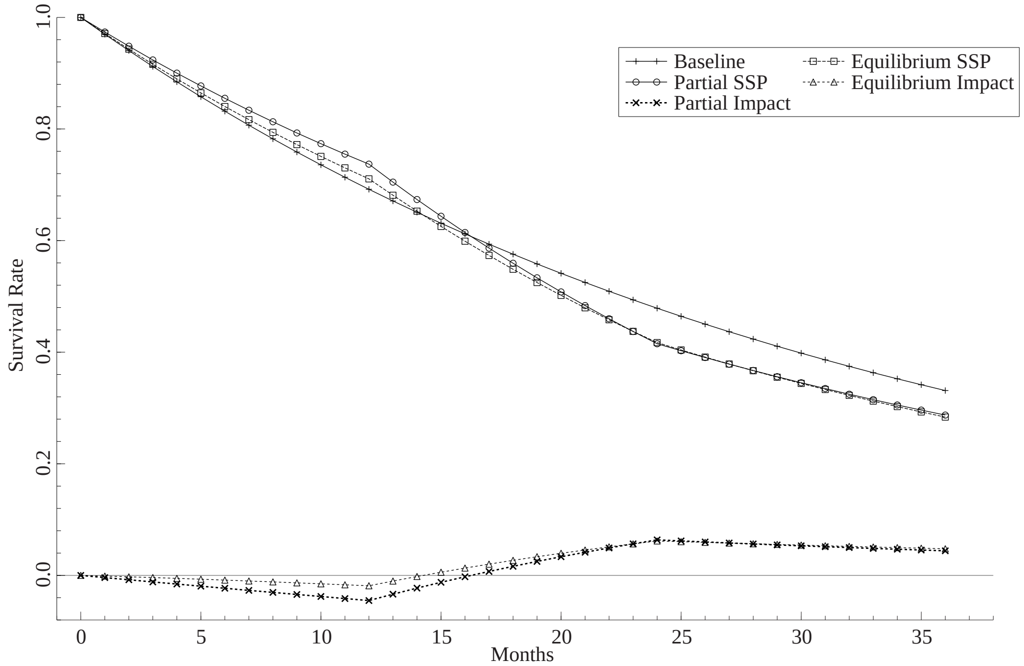


Figure 9: Survival Probability, Partial and Equilibrium Impacts — New Brunswick



Appendix: Model With the Self-Sufficiency Project

The income assistance (IA) program and the earnings supplement are modelled as follows. First, in addition to individuals on unemployment insurance, individuals receiving IA also face several time constraints. IA recipients become eligible to receive the earnings supplement after they have been receiving IA for T_{in} months. Eligibility expires after T_{out} months on IA. If workers secure a job before the eligibility period ends, they can receive the supplement while employed for a maximum of T_{end} months.[28] Second, individuals receive supplement payments that are a function of the wage on obtaining employment.

Within the model, agents maximize expected lifetime income by choosing their labour 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 Self-Sufficiency Project (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 from unemployment insurance (UI) benefits or IA, and on whether or not the individual is eligible for the supplement. One goal of SSP is to provide workers with enough time to experience sufficient wage growth 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 is 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 UI benefit months remaining. We use $0 \geq i \geq -T_{out}$ to index the IA 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.

WORKERS

The value of employment for a worker depends on 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 UI benefits 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 by $\bar{u}$. If the individual were not working she would therefore be unemployed with i periods of UI benefits remaining, $i \in \{0, \ldots \bar{u}\}$. With probability δ, jobs are exogenously destroyed in the subsequent month, in which case workers transit to IA if they have not yet qualified for UI benefits, $i = 0$, and transit to UI otherwise. With probability $(1 - \delta)$, workers remain employed in the next month.

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

It is assumed individuals returning 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.

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

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

where $w(t,i,0)$ is the wage for a person with tenure t who has UI 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.

Workers Eligible for the Earnings Supplement

Employed workers who are eligible for the supplement receive labour market earnings and the supplement payment in the current month. The supplement received is a function of the wage. In particular, the worker receives one half of the distance between the wage and an exogenous ceiling denoted by $\tilde{w}$; in other words she receives the average of her market wage and the wage ceiling.[29] Individuals remain eligible for the supplement for T_{end} months once they leave IA 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 job at which point they can transit to unemployment if eligible for UI or back to the first period of SSP eligibility ($i = -T_{in}$) if they do not yet qualify for UI benefits ($t < I$).[30]

[29] 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. In the model no individuals have earnings above the supplement ceiling.

[30] 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

Employed persons no longer receiving the supplement ($t > T^E_{end}$) remain employed, or if they are exogenously separated from their job, transit to UI.[31] The value of being employed and in the states described above can be expressed as

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

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

IA 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 the number of months of UI benefits, we define the first month on IA 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 $i = -T_{out}$. IA recipients receive IA benefits (b_a) and pay convex ($z > 1$) search costs $c_a[p(i)^z]$ in the current month. The cost of the search is modelled in a manner consistent with Davidson and Woodbury (1993), where z is the elasticity of search costs with respect to the search effort, c_a is a parameter capturing the disutility of the search effort, and $p(i)$ is the search effort in period i. The cost of search depends directly on the intensity with which workers search within the model. The probability an IA recipient finds a job and transits to employment in the next month is denoted by $m(i)$. With probability $(1 - m(i))$, the IA recipient remains on IA. IA recipients eligible for the supplement receive IA benefits in the current month. They remain eligible for the supplement as long as the duration of their IA spell is less than the supplement eligibility period ($-T_{in} \geq i > -T_{out}$). For the duration of the time 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 IA 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

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 before qualifying for UI benefits to transit back to the first period of SSP qualification.

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

not receive a job offer, they remain on IA 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 IA recipients in the states described above is

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

UNEMPLOYED INDIVIDUALS

Unemployed agents receive exogenous UI benefits (b_u) and pay search costs $c_u[p(i)^z]$. We make the simplifying assumption that UI benefits are independent of the individual's preseparation 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 UI 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 IA. The value function for unemployed individuals with i months of benefits remaining is

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

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. The surplus generated by a worker–firm pair of tenure t is denoted by $P(t)$. With probability δ, the match separates and the firm is left with a vacancy in the following month. 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 are denoted 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

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

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.[32] Note that this also requires a free entry assumption.

[32] 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.

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.

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.[33] 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 IA 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 a jobless month indexed by i. The contact probabilities are choice variables for the workers within the model and can be interpreted as the 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.[34] The optimal level of search effort, for each labour market state and program eligibility

[33] 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.

[34] 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 the total labour supply.

combination, is described by

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

Firms

From the firm's perspective, the probabilities of meeting potential workers from UI and IA are the fraction of workers from UI and IA who 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.

EQUILIBRIUM WAGE DETERMINATION

After meeting in the labour market, a firm and a worker bargain over wages by making alternating wage offers until both sides find the offer acceptable. It is assumed both parties have equal bargaining power, but may have different threat points. The equilibrium of this game is the Nash co-operative 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 the current labour market state and program eligibility, as well as on SSP supplement 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 cannot 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.

We now define the steady state conditions that govern the evolution of the economy.

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 labour market is equal to the total number of occupied jobs and the total number of vacancies

$$F = E + V.$$

The total number of individuals in the labour market is denoted by 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 labour market can therefore be expressed as the sum of the above components

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

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

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 IA and UI 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 employed in the previous period who were not exogenously separated from their jobs

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

Welfare

The flow into the first period of IA includes those employed workers who were exogenously separated from their jobs and ineligible for UI benefits and unemployed workers no longer eligible for UI benefits. The flow into the first period of SSP eligibility includes those on IA who have been on IA 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 UI benefits. The flow into all other periods of IA comprises those workers in the previous period of IA who did not match with an employer. Finally, those individuals who did not find employment before their SSP eligibility expired transit to $A(-T_{out})$, where the flow in and out of this state must be equal.

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

Unemployment

Employed workers separated from their jobs and eligible for the maximum months of UI 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 UI 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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