Unemployment Insurance Programs and the Choice to Leave the Labor Force

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Abstract

Theoretical search-based analyses of the impact of US state reforms to unemployment insurance (UI) programs have ignored the worker's possibility of exiting from (or returning to) the labor market in response to this reform. In this paper I introduce the choice by individuals of working age to participate in the labor market.

I extend a search and matching model of the labor market to incorporate the choice by those of working-age population to participate in the labor market. The propensity to participate is rising in the expected income from labor-market participation – a weighted average of the payoffs from working and from being unemployed. UI reform that lowers the UI payment reduces the expected income from job search and discourages inidividuals from participating in the labor market. The incentive effects of reducing UI payments have the outcomes derived in the literature for those who continue to participate in the labor market, but there is also a group of previously participating individuals who choose to exit the labor force.

I test these theoretical predictions with observed conditional transition probabilities among employment, unemployment and "not in the labor force" after an extraordinary UI reform in North Carolina in mid-2013. The reduction in the size and duration of UI payments led to no significant increase in employment but a significant increase in those exiting the labor force when compared to conditional transition probabilities for the rest of the US states.

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1. Introduction.

Unemployment insurance (UI) is a state-contingent redistributive policy: in jurisdictions offering UI, those unemployed through no choice of their own receive a weekly payment for a fixed period to offset partially the loss in income associated with unemployment. The parameters of this policy – for example, the maximum weekly payment and the maximum number of weeks of payments – are set by state officials, while the Federal government offers extended support in times of extreme unemployment.

Baily (1978) laid out the fundamental cost-benefit tradeoff in setting the size and duration of UI payments. For a risk-averse unemployed worker there is the marginal benefit of income-smoothing: increasing the size of the UI payment towards the size of the wage received when employed. At the same time, however, the existence of the UI program creates a moral hazard in job search: unemployed workers will search less intensively, thus remaining unemployed longer. This is the marginal social cost of the program. The subsequent literature addressed this dilemma through a successively more realistic set of models of the labor market.[1] These studies, and others in the same vein, share a common simplifying assumption: that all workers are participating in the labor market both before and after any change to the UI policy.[2]

The decision to participate (or not) in the labor market is an important choice by those of working age. The labor-market participation rate in the US in April 1998 of the working-age population was 67 percent, while in April 2019 was 62.8 percent.[3] Elsby et al. (2015) and Krusell et al. (2018) demonstrate the importance of this decision for labor-market fluctuations. Elsby et al. (2015) concludes that up to one-third of cyclical movements in unemployment are due to movements into and out of the labor force. Ignoring the effect of UI policy on labor-force participation leads to a major misunderstanding of the impact of these reforms.

In this paper I extend a standard labor-search matching model to include the labor-market participation choice. I demonstrate that the observed labor flows after UI policy change depends critically on the elasticity of labor-force participation with respect to increased UI payments. UI payments enter the expected payoff for individuals considering participation in the labor market. As these payments are increased more individuals will choose to enter, or not to leave, the labor force. Analysis that ignores this fact will overstate the employment increases possible from UI reforms that reduce UI weekly payments and/or the maximum number of weeks that the unemployed can receive payments.

I present a brief theoretical literature review in section 2 and the theoretical model in section 3. The critical extension to the current literature is the maintained hypothesis of heterogeneity in non-

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[1] Baily (1978) defines an optimality condition contingent on three variables: the elasticity of unemployment durations with respect to increased UI payments, the gap between wage and UI payment, and the worker's coefficient of risk aversion. Chetty (2006, 2008) demonstrates that the optimality condition applies under more general conditions governing worker behavior and constraints. Mitman and Rabinovich (2015) derive optimal parameters for a UI program in a Diamond-Mortensen-Pissarides matching model of the labor market. Landais, Michaillat and Saez (2018a) derive an optimality condition applicable to a family of labor-market matching models.

[2] Popp (2017) is an exception to this statement: it models the potential participant's labor choice in a world with unemployment insurance and a three-state labor market following on the work of Krusell et al. (2010).

[3] Civilian Labor Force Participation, seasonally adjusted. Federal Reserve Bank of St. Louis, on 15 May 2019.

pecuniary search costs of potential labor-market participants that leads some working-age individuals to exit the labor market.[4] This leads to a labor-market participation choice that is a function of this heterogeneity as well as of the equilibrium conditions of the labor market. Section 4 describes the comparative statics of changing the size of the UI payment, providing a contrast between the results for a fixed-participation labor market and a labor market in which the degree of labor-market participation is endogenous. Section 5 describes the calibration of this model and reports numerical solutions for two comparative-static simulations of the model. The benchmark case of the model is calibrated to generate reasonable benchmark average values of employment and unemployment. There is then a UI reform case that simulates the reduction in UI payments to those unemployed when labor-market participation is insensitive to the reform. The second simulation examines the impact of the same UI reform when labor-force participation is a choice of the working-age individual. These numerical results demonstrate that endogeneity of the labor force leads to very different labor-market equilibria: the unemployment rate falls in each case, but in the endogenous labor-force participation case this is largely due to individuals of working age choosing not to participate in the labor market. Section 6 reports a reformulation of the model using a wage-bill-based UI tax to fund the program: this is more often observed, but also more distorting to labor-market outcomes. Labor-market participation decisions remain sensitive to the level of UI payments. Section 7 examines evidence from an unanticipated UI policy reform in North Carolina in mid-2013 that illustrates the importance in incorporating the choice to participate in the labor force when interpreting results. When modeled properly, in terms of conditional probabilities of transition by workers from one labor state to another, North Carolina's residents respond to UI reform with a significantly larger exit of the labor force than those in the rest of the US. There is no significant effect of the reform on employment, while the sign of the effect is negative rather than positive. Section 8 concludes.

2. Literature Review on the Theory of UI Reform Impact.

This paper's contribution is at the intersection of two important strands of the literature: analysis of unemployment-insurance policies and explanation of the working-age decision to participate in the labor market.

The seminal works in the welfare impact of UI policy (e.g., Baily (1976), Chetty (2006)) were partial equilibrium in nature. They identified the fundamental tension between an individual's private utility gains from income-smoothing vs. social marginal cost of moral hazard in job search. Subsequent research by Mitman and Rabinovich (2015, 2017) and Landais et al. (2018a, 2018b) examined the question in a general-equilibrium framework built on labor-search matching models. These introduced firm-side labor-market frictions and reaffirmed the tension that Baily (1976) identified in welfare effects.

[4] Popp (2017) and Krusell et al. (2011, 2018) also introduce worker-level heterogeneity, but they assume heterogeneity in the productivity of workers that leads to lower pecuniary payoffs for lower-productivity workers.

These earlier papers were steady-state in nature: beginning from an equilibrium without UI, is the introduction of a UI policy welfare-improving in the new steady state? Chetty (2008) and others then extended this to a multiple-period analysis with the possibility of unemployment spells.

The theoretical literature is also bifurcated into those theoretical papers that derive optimal UI policy rules and those, typically calibrated, papers that examine a more general macroeconomic impact. The seminal papers in this area derived theoretical rules for optimal UI policy based upon the fundamental tension identified by Baily (1976). Shavell and Weiss (1979), Chetty (2006), Michelacci and Ruffo (2015), Mitman and Rabinovich (2015) and Landais et al. (2018a) rederived these optimality rules for more complicated economic environments. Others addressed the roots of general macroeconomic impact of increased UI benefits. Mitman and Rabinovich (2014), for example, concluded that increased UI benefits in the Great Recession led to a slower economic recovery.

These papers differ greatly in modeling choices but have a common feature: they all consider only two labor states – employment and unemployment. In this paper I introduce the third possible labor state – out of the labor force. As noted above, the work of Krusell et al. (2010, 2011) provides a theoretical model linking shocks to worker productivity and labor-market search frictions to joint determination of labor-force participation, employment and unemployment. Elsby et al. (2015) and Krusell et al. (2018) document the empirical significance of this labor-market choice. I demonstrate in what follows that ignoring the effect of UI policy on labor-force participation can lead to a misunderstanding of the impact of these reforms.

There is a largely empirical literature that documented the effects of UI reform during the Great Recession, but the results of this statistical analysis yielded quite varied conclusions. Hagedorn et al. (2015) documented the moral-hazard effects of increased UI benefits in the context of the Great Recession and concluded that there are significant quantitative gains in employment creation from reduced UI benefits: in fact, they found that individuals increased their labor-force participation as a result of reduced benefits. Boone et al. (2016) challenged the empirical results of Hagedorn et al. (2015), finding that the results disappeared when alternative specifications and more recent data are used.

Kroft et al. (2016) explored the empirical links between unemployment duration and labor-force participation during the Great Recession. Rothstein (2011) and Farber, Rothstein and Valletta (2015) found a significant empirical link between reduced UI benefits and exit from the labor force in addition to an effect on job search intensity. According to Farber, Rothstein and Valletta (2015), "the phasing out of extended and emergency benefits reduced the unemployment rate mainly by moving people out of the labor force rather than by increasing the job finding rate." Figura and Barnichon (2014) used the past 35 years of data on Extended Unemployment Benefits in the US to measure the impact of increased benefits on labor-market participation: in contrast to Farber, Rothstein and Valletta (2015), they found a near-zero impact on labor force participation.

Two recent papers perform event studies based upon idiosyncratic state-level policy UI policy reforms. Depken and Gaggl (2018) examined the empirical record in North Carolina in response to its policy reform of 1 July 2013. It used the individual-level data of the Current Population Survey to investigate systematic differences in employed and unemployed in response to that

reform, and found that the unemployment rate fell in North Carolina relative to a control group of Southern states and was due to a rise in employment and fall in unemployment. These results are diametrically opposed to what I report here, despite using the same database; I attribute this differential to my theory-grounded focus on the transition from one labor state to another rather than a series of regressions on the current labor state of unemployed and employed individuals. Johnston and Mas (2018) examined labor-force responses to an unexpected reduction in UI benefits observed in Missouri in 2011. The authors used administrative data to track those benefit recipients – the unemployed -- directly affected by the reduction. They use a regression discontinuity design to estimate a marginal effect of maximum duration on UI receipt of 0.45 – in other words, reducing the maximum potential duration of UI for an individual by 10 weeks will reduce the expected duration of the individual in UI by 4.5 weeks. There is no such response for individuals who had exhausted their benefits. These results highlight the "moral hazard" nature of UI policy on recipients. In this paper I integrate that effect with the "non-participation" effect of this reform on those not currently receiving benefits.

Popp (2017) presents a partial-equilibrium model of analysis of UI policy for potential workers with a labor-force-participation decision. His calibrated results indicate the small welfare impact of UI programs as currently implemented by the states: their exclusion of many individuals otherwise eligible and their strict limits on the size and duration of UI benefits lead in his calculations to welfare impact of less than 0.1 percent in moving from no UI program to the one that incorporates realistic limits. He does not address the impact of policy change on labor-force participation that is highlighted in this paper.

This paper makes two contributions in bringing these two strands of the literature together. First, I present a theoretical model of a job-search economy with a UI policy that has an endogenous labor-force participation decision. I demonstrate that this decision is potentially sensitive to the setting of UI policy and calibrate the model to demonstrate the quantitative effects of UI policy reform. Second, I examine historical job-flows data from the US Current Population Survey for those with ages between 25 and 54 during 2013 to identify the impact of the UI policy reform introduced by North Carolina on 1 July 2013. As theory predicts, the conditional transition probability from unemployment to non-participation rises significantly with this reform. The impact of the reform on the unemployment to employment transition probability is negative and insignificantly different from zero.

3. The Model.

I present a two-period general-equilibrium model with three labor states.[5]

A. Initial distribution of workers. I begin in period zero with an initial equilibrium distribution of working-age individuals: the employed (E_o), unemployed (U_o) and those not in the

[5] Landais, Michaillat and Saez (2018a) presents a generic matching model that nests three well-known equilibrium labor-market matching models. That paper's exposition is the starting point for this paper's model.

labor force (N_o). The unemployed differ from those not in the labor force by their determination to search for a job in period zero.

B. Involuntary separation. Period one begins with $(1-\sigma)$ percent of E_o jobs eliminated through firm closures or other involuntary termination. The σE_o workers continue with employment with certainty in period one. The $(1-\sigma)E_o$ terminated workers join the U_o and N_o individuals in choosing whether to search for jobs in period one.

C. Labor market and matching. The labor market for non-continuing workers is characterized by a constant-returns-to-scale matching function m(e,v).[6]

$$\ell = m(e,v) \tag{1}$$

ℓ is the number of workers in the period who match with a job, while e is the aggregate job-search effort by workers and v is the aggregate number of vacancies listed by employers. Given the constant-returns-to-scale matching function, I without loss of generality represent it with

$$f(v/e) = m(1, v/e) = f(\theta) \qquad \theta = v/e\ ,\ \ f'(\theta) > 0 \tag{2}$$

θ is the indicator of market tightness. A higher value indicates a tighter market from the point of view of the firm. I denote the elasticity with respect to market tightness as $\eta = f'(\theta)\theta/f(\theta)$. Given the definition of the function f(v/e), the probability that a labor-market participant will be employed can be represented as $ef(\theta)$.

In a tight labor market, the employer has more difficulty in filling vacancies. I can also define the probability that a vacancy is filled as $q(\theta)$.

$$q(\theta) = f(\theta)/\theta \quad \text{with} \quad q' < 0 \tag{3}$$

D. Working-age individuals. There are three groups of working-age individuals: the employed, the unemployed, and those out of the labor force. Total utility for these individuals is the sum of utility from income and disutility from job search.

Individuals have a constant-relative-risk-aversion utility function V(.) in real income. For those employed, real income is equal to the wage w and utility from employment income is V(w). For

[6] Time subscripts are excluded in this section when the represented action is resolved within a single period.

the unemployed, real income is received from the unemployment-insurance (UI) payment C^u and utility is $V(C^u)$. For those out of the labor force, there is no real income and $V(0) = 0$.[7]

Individuals share a common disutility of search intensity with parameter γ and differ only in their heterogeneous disutility of job search g independent of and in addition to the degree of effort. The total disutility of job search per individual in period one is then $\psi(e_1,g) = e_1^{\gamma} + g$ if she chooses to search in period one, and 0 otherwise. The decision to search precedes an individual learning her labor status, and so both the employed and the unemployed incur these costs. Those out of the labor force or with guaranteed employment have $\psi(e_1,g) = 0$.

Individual utility in period one can then be summarized by labor-force status.

For continuously employed worker g: $\mathcal{U}^C(g) = V(w)$

For newly employed worker g: $\mathcal{U}^E(g) = V(w) - \psi(e_1,g)$

For unemployed worker g: $\mathcal{U}^u(g) = V(C^u) - \psi(e_1,g)$

For g out of the labor force: $\mathcal{U}^N(g) = 0$

Those searching for a job in period one must choose a search intensity (e_1) prior to knowing whether they will be employed. They choose to participate in the job market based on the expected utility of participation. γ is a commonly held search-effort disutility parameter greater than 1; g ε [0 1] indicates the disutility of undertaking search for individual g.

E. Initial choice: participate or not? Those of working age without a job continuing into period one must decide whether to search for work. The expected payoff $P(e_1,g)$ of participating in the labor force for an individual g in period one is:

$$P(e_1,g) = e_1 f(\theta)\ \mathcal{U}^E(e_1,g) + (1-e_1 f(\theta_1))\ \mathcal{U}^u(e_1,g) \tag{4}$$

This expected payoff can be negative for large values of g. Substituting for $\mathcal{U}^E$ and $\mathcal{U}^u$:

[7] In the analysis that follows I use the specific functional form $V(X) = ((\iota X)^{(1-\chi)} - \Gamma)/(1-\chi)$ for $X = C^u$, w. χ is the coefficient of relative risk aversion and is greater than one. Γ and ι are constants set to ensure positive utility for the relevant ranges under consideration and to calibrate $V(.1) = 0$. Given the utility specification it will not be possible to have $V(0) = 0$ for those out of the labor force. $V(.1) = 0$ is consistent with informal opportunities for that offer less real income than the UI payment for those not in the labor force.

$$P(e_1,g) < 0 \text{ if } g > e_1 f(\theta)(V(w) - V(C^u)) + V(C^u) - e_1^{\gamma}$$

For exposition, assume that individual values of g are distributed uniformly on the unit line. I define a cutoff value of g, denoted g_1, such that the expected payoff from participating in the labor force in period one is just zero. Individuals with $g \geq g_1$ will choose not to participate in job search.[8]

$$P(e_1,g_1) = 0$$

$$g_1 = e_1 f(\theta_1)(V(w) - V(C^u)) + V(C^u) - e_1^{\gamma} \tag{5}$$

For non-participants, the disutility of searching is too large to justify labor-force participation. Given the distribution of g, $N(\theta_1,w,C^u) = (1-g_1)$ is the share of the working-age population not in the labor force in period one.[9] That share is declining in the real income of being employed, the real income of being unemployed, and the tightness of the labor market.

$$\partial N/\partial w < 0;\ \ \partial N/\partial C^u < 0;\ \partial N/\partial \theta < 0$$

Making a UI program more generous will (other things equal) encourage individuals of working age to participate in the labor force.

F. How much job-search effort? Each non-continuing worker with $g \leq g_1$ maximizes

$$\max_e \quad e_1 f(\theta_1)(V(w) - V(C^u)) + V(C^u) - e_1^{\gamma} - g$$

The first-order condition from this maximization is:

$$f(\theta_1)(V(w) - V(C^u)) - \gamma e_1^{\gamma-1} = 0 \tag{6}$$

This leads to a common optimal job search effort level for these individuals. I define $\Delta V = V(w) - V(C^u)$ as the difference in utility between being employed and being unemployed.

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[8] There was a similar cut-off g_o in period zero that defined the separation between U_o, E_o and N_o.

[9] Given this formulation, a steady state with $g_o = g_1$ will lead to no change in the share $N(\theta,w,C^u)$. Those in N_o will choose to remain in N_1, and those in the labor force in period zero ($E_o + U_o$) will remain in the labor force in period one. With g_1 not equal to g_o, we will observe transitions either from N_o to U_1 and E_1, or from E_o and U_o to N_1.

$$e_1^* = [[f(\theta_1)\Delta V]/\gamma]^{(1/(\gamma-1))} \qquad \text{for noncontinuing worker with } g < g_1 \qquad (7)$$

Making a UI program more generous (increasing C^u for given values of θ_1 and w) will reduce optimal effort by those who participate in the labor force, while increasing the wage for given values of θ_1 and C^u will increase optimal job-search effort. Optimal effort is increasing in labor-market tightness θ_1.

Those not in the labor force and those with continuing jobs have search effort $e_1 = 0$.

G. How many will be in the labor force? Those in the labor force have $g \leq g_1$. Substituting equation (6) into equation (5) yields the expression:

$$g_1 = (\gamma-1)\, e_1^{*\gamma} + V(C^u) \qquad (8)$$

Labor-force participation rises (by definition) as g_1 rises. It is increased directly by an increase in C^u but is reduced by the impact of increased C^u on job-search effort. The net effect is ambiguous a priori.

H. How many will be employed? The aggregate number of those finding work will depend upon g_1, the optimal search effort and the expected payoff from finding a job:

$$\begin{aligned} \ell^s_1 &= \sigma E_o + (g_1 - \sigma E_o)\, e_1^* f(\theta_1) \\ &= \sigma E_o + (g_1 - \sigma E_o)\, [\, f(\theta_1)^{(\gamma/(\gamma-1))}\, [\Delta V/\gamma]^{(1/(\gamma-1))}\,] \end{aligned} \qquad (9)$$

Employment is rising with the size of the labor force, with the tightness of the labor market, and with the wage offered to the employed. It is falling other things equal with an increase in the UI payment: this is the partial-equilibrium effect associated with moral hazard.

I. The representative firm. The firm hires ℓ^d_1 employees and pays a real wage w. There are two occupations. Workers (denoted n_1) are used in producing output using production function $y(n_1)$. Recruiters (denoted $\ell^d_1 - n_1$) post vacancies. Posting one vacancy requires ρ recruiters. Recruiting ℓ^d_1 employees requires posting $[\ell^d_1 / q(\theta_1)]$ vacancies.

The total number of employees then can be defined:

- Total employees = ℓ^d_1

- Total producers $n_1 = \ell^d_1 (1- \rho/q(\theta_1))$
- Total recruiters $\ell^d_1 - n_1 = \ell^d_1 \rho/q(\theta_1)$
- The recruiter-producer ratio is $\tau(\theta_1) = \rho/(q(\theta_1) - \rho)$ $\quad \tau' > 0$ (10)

Firms pay a tax denoted t as a percent of firm profit to fund the UI program.[10]

Production is a perfectly competitive process. Given θ_1 and w the producer chooses ℓ^d_1 to maximize after-tax profit π_1 :

$$\text{Max}_\ell\ \pi_1 = (1\text{-}t)(y(\ell^d_1 /(1 + \tau(\theta_1))) - w\ell^d_1) \tag{11}$$

With first order condition:

$$y'(n_1) = (1+ \tau(\theta_1))w \tag{12}$$

Profit-maximizing hiring $\ell^d(\theta_1,w,\sigma)$ is decreasing in w, θ_1 and σ for decreasing-returns-to-scale technology. I make this technology specific by defining $y(n_1) = \mu n_1^\delta$, with μ a total factor productivity (TFP) coefficient and $\delta\ \varepsilon\ (0\ 1)$ the economies-of-scale coefficient. This leads to profit-maximizing hiring of

$$\ell^d(\theta_1,w,\sigma) = (1/(1+ \tau(\theta_1)))^{\delta/(1-\delta)}(\mu\delta/w)^{1/(1-\delta)} - \sigma E_o\, \tau(\theta_1) \tag{13}$$

Demand is rising with increased total factor productivity μ and falling with increased wage w. Labor demand is also falling with increases in θ_1: given the need to hire more and more recruiters as θ_1 rises, a smaller share of those hired are put to work in production. As σ rises, there is need for fewer recruiters and thus labor demand falls for that reason as well.

J. The government UI program. The UI payment provides C^u to the unemployed. As the replacement rate $R = C^u/w$ rises the program becomes more generous to the unemployed relative to the benchmark group of those employed.

The government pays for the UI payment through the profit tax levied on the firms. The rate is

[10] In fact, state governments have a UI tax (t^e) levied on the wage bill of firms to fund their UI program. This introduces an additional incentive effect that complicates interpretation of the model. I will explore the implications of that tax in a later section.

$$t_1 = (g_1 - \ell_1)\, C^u/(y_1 - w\ell_1) \tag{14}$$

with ℓ_1 the equilibrium quantity of labor. The material balance constraint is

$$y_1 = (1 - N_1 - \ell_1)\, C^u + \ell_1\, w + (1 - t_1)\pi_1. \tag{15}$$

K. The wage mechanism. In this model, even small adjustments to the wage lead to large adjustments in equilibrium. I will thus report a series of equilibrium outcomes in which wages do not respond to changes in either θ_1 or C^u, and then will discuss how those results will be altered when w responds to changes in these variables.

4. Comparative statics in job flows.

The research questions we have focus on job flows, and in this section it will be most convenient to work with the expressions in terms of growth rates. The growth rates will be defined as percentage changes over period-zero values and will be denoted by a "hat". For example, the determinants of search effort from (7) are (with constant relative risk-aversion coefficient $\chi > 1$):

$$\gamma \hat{e}_1^{\,*} = (\gamma\eta/(\gamma-1))\, \hat{\theta}_1 + (\chi-1)(\gamma/(\gamma-1))(\, R^{\chi-1}/(1-R^{\chi-1}))\, \hat{w} - (\chi-1)\,(\gamma/(\gamma-1))(1/(1-R^{\chi-1})\, \hat{C}^u \tag{16}$$

Search intensity is rising in increasing labor-market tightness and wage, while it is falling with increases in UI payment. The labor-force participation decision from (8) is:

$$\hat{g}_1 = ((\gamma-1)e_1^{\gamma}/g_1)\, \gamma \hat{e}_1^{\,*} + (C^{u(1-\chi)}/g_1)\, \hat{C}^u \tag{17}$$

As g_1 rises, the working-age population not in the labor force falls. As is evident in (17), increasing either e_1^* or C^u leads to a direct increase in labor-force participation. As (16) illustrates, however, an increase in C^u will also reduce ΔV and thus optimal e_1^*. The net effect of increased C^u on g_1 is ambiguous in sign.

The number of vacancies listed from (2) is:

$$\hat{v}_1 = \hat{\theta}_1 + \hat{e}_1^* \tag{18}$$

The number of vacancies listed rises with labor-market tightness and with the search effort of workers.

For labor flows I will simplify the analytical expressions in this section using the condition $\sigma = 0$.[11] Labor supply growth from (9) can be written:

$$\widehat{\ell^s}_1 = (g_1/\ \ell^s)[\ \hat{g}_1 + (\gamma\eta/(\gamma-1))\ \hat{\theta}_1 + ((\chi-1)/(\gamma-1))[(\ R^{\chi-1}/(1-R^{\chi-1}))\ \hat{w} - (1/(1-R^{\chi-1}))\ \hat{C}^u) \tag{19}$$

Labor supply rises with increased labor-force participation, with increased labor-market tightness, and with an increase in wage. Increased C^u has a direct effect of reducing labor supply through reducing ΔV and optimal search intensity.

For constant productivity and wage, labor demand growth is

$$\widehat{\ell^d}_1 = -\ \alpha_1\ \hat{\theta}_1 \tag{20}$$

$$\alpha_1 = ((1-\eta)\tau_1 q_1/\rho)(\delta/(1-\delta))(\tau_1/(1+\tau_1)) > 0$$

and output growth is

$$\hat{y}_1 = \delta\ \widehat{n_1} = \delta\ [\widehat{\ell^d}_1 - \tau_1(1+\eta)\ \hat{\theta}_1]$$

$$= -\ \delta\ [\alpha_1 + \tau_1\ (1-\eta)]\ \hat{\theta}_1 \tag{21}$$

An increase in labor tightness leads to a reduction in labor demand through the elasticity α_1. As labor tightness rises, more workers are diverted from production into worker-search activities for the firm.[12] Real output in the economy is also falling as labor-market tightness rises.

Growth in the unemployment rate (u_1) in the economy for constant wage is represented in equilibrium as

[11] This does not change the qualitative conclusions but makes the logic more transparent.

[12] When the UI tax is levied on the wage bill of the firm rather than the profits, the tax represents a direct channel of distortion due to rising UI payments. I will outline that in a later section.

$$\hat{u}_1 = -(\ell_1/(g_1-\ell_1))[(\eta\gamma/(\gamma-1))\,\hat{\theta}_1 - ((\chi-1)/(\gamma-1))(1/(1-R^{\chi-1}))\hat{C}^u] \tag{22}$$

It is rising with an increase in the UI payment as more of those of working age are drawn into the labor force. It is falling with an increase in labor-market tightness.

Equilibrium in the labor market is observed if $\widehat{\ell^s}_1 = \widehat{\ell^d}_1$. This equality defines the equilibrium degree of labor-market tightness θ_1^*. This equilibrium value will differ depending upon whether potential workers can choose to enter and/or exit the labor force. I examine two cases: one of fixed participation (exogenous g_1) and a second of labor participation choice (endogenous g_1). I hold wage and productivity fixed in what follows.

The theoretical message of this paper can be defined in terms of two elasticities.

- From equation (16), the elasticity of job-search intensity with respect to a one-percent increase in UI benefits (C^u) is

$$\omega(C^u) = ((\chi-1)/(\gamma-1))(1/(1-R^{\chi-1})) \tag{23}$$

This elasticity is defined to be positive but in (16) the increase in C^u will have an unambiguously negative effect on job-search intensity. The effect is larger in absolute value for larger C^u. This represents the moral-hazard effect of increased benefits on job-search intensity.

- From equations (16) and (17), the labor-force-participation elasticity of labor-market participation with respect to a one-percent increase in UI benefits is

$$\kappa(C^u) = (1/g_1)\,[\iota C^{u(1-\chi)} - \gamma e_1^{\gamma}\,(\chi-1)/(1-R^{\chi-1})]. \tag{24}$$

This is ambiguous in sign: the first component of $\kappa(C^u)$ is the positive impact of rising UI payments on expected income, while the second component represents the negative effect of increasing the replacement rate on search intensity. Labor-force participation will rise with an increase in $\kappa(C^u)$ for given degree of labor-market tightness.

A. **If g_1 is exogenous**, the share of the working-age population out of the labor force is fixed. Job-search intensity by the prospective worker depends both upon labor tightness (positively) and on the UI payment (negatively) as in (16). The term $\eta\gamma/(\gamma-1)$ is the coefficient of demand-side search cost related to labor tightness.

Equilibrium market tightness is derived by equating (19) and (20).

$$\widehat{\ell^s}_1 = \widehat{\ell^d}_1 :$$

$$\hat{\theta}_1 = (\omega(C^u)/\varphi)\ \hat{C}^u \tag{25}$$

$$\varphi = \eta(\gamma/(\gamma\text{-}1)) + \alpha_1(\ell_1/g_1) > 0$$

In labor-market equilibrium, market tightness is increasing with a rise in C^u. The coefficient $\omega(C^u)$ is the direct effect, divided by the search cost terms summarized by the coefficient φ. The larger the search frictions, the smaller the adjustment in equilibrium employment in response to a change in UI payment.

Combining the direct effect of UI payment with the impact on output through market tightness yields the comparative-static predictions of Table 1. Four of these are unambiguous with increases in UI payment: employment is falling, output is declining, search intensity is reduced, and the unemployment rate will rise. The number of vacancies may be rising or falling with increases in UI payment as it increases market tightness but reduces search effort.[13] Labor-force participation (g_1) is unchanging by assumption.

Table 1: **Comparative-statics results: one-percent increase in C^u**

	Exogenous g_1	Endogenous g_1
$\hat{\theta}$	$\omega(C^u)/\varphi \quad > 0$	$(\omega(C^u)\text{-}\kappa(C^u))/\varphi'$
$\hat{g}_1$	----------	$[(e_1^{\gamma}/g_1)\eta\gamma\omega(C^u) + \kappa(C^u)\ \varphi]\ /\ \varphi'$
$\hat{e}$	$-(\omega(C^u)/\varphi)(\alpha_1(\ell_1/g_1)+\eta) \quad < 0$	$-\ (\eta/(\varphi'(\gamma\text{-}1)))[\kappa(C^u) + \omega(C^u)(\gamma e_1^{\gamma}+\alpha(\gamma\text{-}1)\ell_1/\eta)]$
$\hat{v}$	$(\omega(C^u)/\varphi)(1\text{-}\alpha_1(\ell_1/g_1)\text{-}\eta)$	$(\omega(C^u)/\varphi')(1\text{-}\alpha\text{-}\eta(1+\gamma e_1^{\gamma}/g_o))\text{-}(\kappa(C^u)/\varphi')(1+(\eta/(\gamma\text{-}1)))$
$\widehat{\ell}$	$-\ \alpha_1\omega(C^u)/\varphi \quad < 0$	$-\ (\alpha(\omega(C^u)\text{-}\kappa(C^u)))/\varphi'$
$\hat{y}$	$-\ \delta(\alpha_1+\tau_1(1\text{-}\eta))\omega(C^u)/\varphi \quad < 0$	$-\ (\alpha+\tau(1\text{-}\eta))(\omega(C^u)\text{-}\kappa(C^u))/\varphi'$
$\hat{u}$	$(\ell/(g_1\text{-}\ell_1))\alpha_1\omega(C^u)/\varphi \quad > 0$	$(\ g_1/(\varphi'(g_1\text{-}\ell)))\ [(\gamma\eta/(\gamma\text{-}1))\kappa(C^u) + \omega(C^u)\ (\alpha+\gamma e_1^{\gamma}\eta/g_1)]$

B. For endogenous g_1, a change in UI payment introduces a third component to social welfare. Increasing the UI payment induces individuals to return to the labor force because the expected value of participation is higher; this larger labor force has an important effect on labor-market equilibrium and social welfare.

[13] The coefficients α_1 and η are generally fractions in this model, and α_1 will be rather small. The presumption in the exogenous-g_1 case is that vacancies rise with an increase in UI payments.

The determinants of output and search intensity remain as in (16) and (21). The labor-force participation decision becomes responsive to labor-market tightness and the size of the UI payment. Drawing on equation (8) and defining $\kappa(C^u)$ as the direct impact of increased UI payment on labor-force participation, I obtain an expression analogous to that of (17).

$$\hat{g}_1 = \{(1/g_1)[e_1^{\gamma}(\gamma\eta/(\gamma-1))\hat{\theta}_1)] + \kappa(C^u)\,\hat{C}^u\} \tag{26}$$

For positive $\kappa(C^u)$ and unchanging labor-market tightness, an increase in UI payment leads to greater labor-force participation. Greater labor-market tightness will also increase labor-force participation.[14]

With the endogeneity of g_1, equilibrium labor-market tightness takes on a different value.

$$\widehat{\ell^s}_1 = \widehat{\ell^d}_1 :$$

$$\hat{\theta}_1 = (\omega^{\#}(C^u)/\varphi^{\#})\,\hat{C}^u \tag{27}$$

$$\omega^{\#}(C^u) = [\omega(C^u) - \kappa(C^u)]$$

$$\varphi^{\#} = [\varphi + (\eta\gamma/(\gamma-1))e_1^{\gamma}/g_1] > 0$$

The numerator $\omega^{\#}(C^u)$ includes the elasticity of search intensity ($\omega(C^u)$) as well as the elasticity of labor-market participation ($\kappa(C^u)$). When labor-force participation rises labor-market tightness will be reduced, other things equal. While $\omega(C^u)$ is unambiguously positive $\omega^{\#}(C^u)$ will be negative for large positive values of $\kappa(C^u)$. The denominator remains unambiguously positive while its size is larger due to the adjustment in labor-force participation. Increased C^u in this economy has the ambiguous effects on labor-market tightness illustrated in equation (27): the positive impact through reduced search effort remains as in the exogenous-g case, but there is now a countervailing effect due to increased labor-force participation that when positive will reduce labor-market-tightness. The comparative-static effects of a one-percent increase in UI payments are reported for this case in the final column of Table 1.

Positive $\kappa(C^u)$ is a sufficient condition for increased C^u to raise labor-market participation. Increased C^u once again reduces job-search effort through $\omega(C^u)$. The "positive $\kappa(C^u)$" condition also ensures that the direct effect of C^u on employment will be negative, while the indirect effect through labor-force participation will be positive. Real output will be declining as search intensity falls, just as in the case with exogenous g_1, but can be increasing due to the expansion in labor-force participation. If $\kappa(C^u)$ is positive and larger than $\omega(C^u)$ then the net effect of increased UI

[14] The sign and magnitude of $\kappa(C^u)$ is in theory ambiguous. In the following calibration, $\kappa(C^u)$ is greater than zero and is declining in magnitude as C^u increases.

payment will be increased θ_1, employment and real output. With endogenous g_1, the growth in vacancies is reduced: the direct effect is nearly the same as with exogenous g_1 but the second term is negative. The unemployment rate can rise for the same reason as in the earlier case, as indicated by the second term in the bracket. It can also rise due to increased labor-force participation as illustrated by the first term in the bracket: those out of the labor force can choose to re-enter.

C. The Impact of Changing UI Payments. The comparative statics summarized in Table 1 illustrate the bias that can be built into policy prescriptions about UI policy if labor-force participation is ignored. First, theory predicts that labor-force participation will change with an increase in UI payments. Second, the predicted negative impact on search effort will be understated when labor-force participation is ignored. Third, the growth in vacancies will be overstated and may in fact be reversed. The negative output and employment growth when labor-force participation is ignored will be overstated, and possibly reversed, in the complete model. Finally, the increase in the unemployment rate is understated through its neglect of those entering the labor force. In the next section, I examine these results in a calibration of this model.

5. Calibration and Numerical Solution.

The benchmark model is calibrated to fit the aggregate equilibrium outcomes in the US in the period before the financial crisis. I then undertake two comparative-static simulations: the first with g_1 fixed at 0.666 and the second with g_1 determined endogenously in the model. The simulation results are reported in Table 2.

A. Parameter values of the model. The total-factor-productivity parameter μ is set at .97. The matching parameter η is set equal to 0.5, and δ at 0.9 generates the desired decreasing-returns-to-scale in technology. The value of ρ chosen results in 2.5 percent of employees working in recruiting, as Landais et al. (2018b) reported from the 1997 National Employment Survey. The wage and disutility of search effort γ are chosen jointly to generate the 66.6 percent labor-force participation rate observed in 2000. The UI benefit is set at $C^u = .370$ in the benchmark simulation to generate a replacement rate ($R = C^u/w$) of 0.42.[15] The UI benefit is reduced to $C^u = .264$ in the UI-reform simulations to yield a replacement rate of 0.30 post-reform. The elasticities of importance ($\kappa(C^u)$ and $\omega(C^u)$) are determined from these calibrated parameters and the resulting equilibrium in the labor market. E_o, N_o, U_o and σ are set to 0.64, 0.33, 0.03 and 0.81 respectively to ensure a steady state in benchmark equilibrium: without exogenous shocks, E_1, N_1 and U_1 will equal their previous-period values.

B. Equilibrium values in the benchmark simulation.

Including non-participation as a choice in this model has three important implications for equilibrium:

[15] Landais et al. (2018b) reported that the effective replacement rate for the period 1990-2014 is 0.42. After 2014 (and the many UI reforms) it reported that the effective average replacement rate across the US was 0.28.

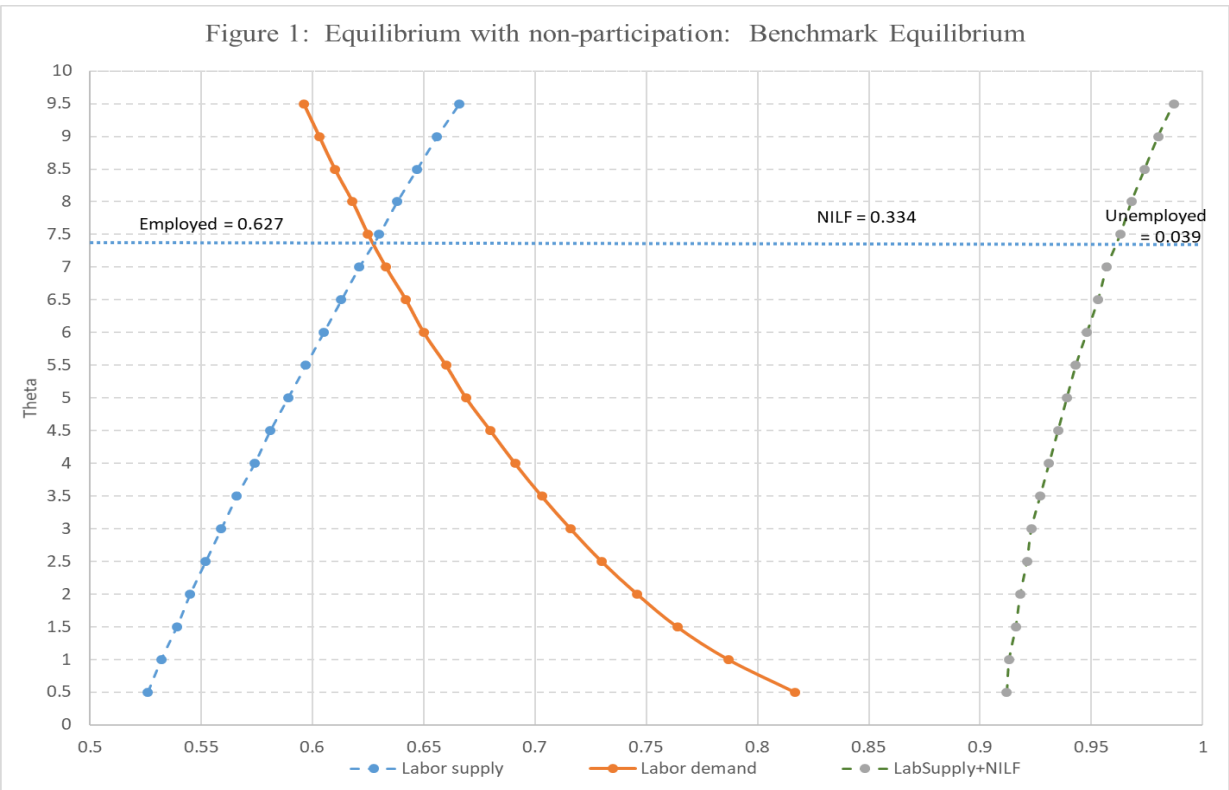
- N_1 becomes a new labor category. It is a large share of eligible labor at low θ_1, with declining share as θ_1 rises. The expected value of entering the labor force is rising in θ_1.
- Labor market equilibrium is characterized by a higher θ_1 than would be observed if N_1 were not considered.
- Higher θ_1 leads to a lower share of employment in equilibrium. The share of unemployed is also smaller, as a significant fraction of the working-age population chooses N_1.
- The elasticity of labor-force participation with respect to C^u ($\kappa(C^u)$) is positive but smaller than the elasticity of effort with respect to C^u ($\omega(C^u)$). The impact of C^u on θ_1, ℓ_1 and y_1 are reduced, while changes to e_1 and the unemployment rate are larger, than in the fixed labor-force participation case.

Table 2: Simulations of the Labor Search Model with Endogenous Participation Choice

		UI Reform:	UI Reform:
	Benchmark	Exogenous g_1	Endogenous g_1
μ	0.97	0.97	0.97
ρ	0.013	0.013	0.013
C^u	0.370	0.264	0.264
C^e (= wage)	0.882	0.882	0.882
ΔC	0.512	0.618	0.618
$\omega(C^u)$	1.148		
$\kappa(C^u)$	0.088		
θ_1	7.370	6.046	6.618
e^*_1	0.272	0.362	0.373
g_1	0.666	0.666	0.645
N	0.334	0.334	0.355
ℓ^s	0.627	0.657	0.640
Unemployment rate	0.058	0.024	0.007
y_1	0.637	0.657	0.648
τ	0.036	0.033	0.035
π_1	0.084	0.084	0.084
UI payment	0.014	0.004	0.001
v_1 (vacancies)	2.006	2.187	2.467
$\mathcal{U}^{Ce}$	0.739	0.739	0.739
$\mathcal{U}^e$ (average $g < g_1$)	0.367	0.327	0.332
$\mathcal{U}^u$ (average $g < g_1$)	0.236	0.105	0.111
Aggregate worker utility	0.481	0.477	0.465
After-tax π	0.070	0.080	0.084

Figure 1 illustrates the benchmark solution of labor-market equilibrium as reported in Table 2. The working-age population is normalized to one. Labor demand (the downward-sloping orange solid line) is plotted from (13). Employed labor (the upward-sloping dotted blue line) is derived from (9). The upward-sloping dashed green line represents the sum of employed and non-participants as a share of total working-age population; the difference between the value of the gray-green line and 1 at every θ is the share of the working-age population unemployed.[16]

The bottom four rows of Table 2 illustrate the welfare implications of this model. (I subtract the average cost g for each category of worker.) Each worker who remains employed in her period-zero job receives $\mathcal{U}^{Ce}$ of 0.739. Each searching worker who becomes employed receives $\mathcal{U}^{e}$ of 0.367, derived from the utility of the wage of 0.88 minus the disutility of worker search on average for those searching. Each searching worker who remains unemployed has the same search effort disutility but receives only the UI benefit of $C^{u} = 0.37$ with utility on net $\mathcal{U}^{u}$ of 0.236. Labor-force non-participants receive zero but find that better in expected value than participating in the labor market, given their higher non-pecuniary search costs.



Total worker welfare is given by total worker utility = 0.481, and is the weighted average of the unemployed, employed and non-participating utilities, with the weights equal to the share of each

[16] The "unemployment rate" reported in Table 2 differs from these percentages because that rate is the number of unemployed divided by the number participating in the labor force. In the second column, the ratio $(g_1 - \ell_1)/g_1 = (.039/.666) = 0.058$.

group in the total of working-age individuals. After-tax profits accrue to the employer and are not in utility units.

The remaining simulations illustrate the impact of UI reform. The reform used is one that lowers the replacement rate R (the ratio of UI payment to wage) from 42 percent of the wage to 30 percent of the wage. The simulation reported in the third column introduces that change while keeping labor-force participation constant. The simulation in the fourth column introduces the endogeneity of labor-force participation.

The theoretical predictions of Table 1 are confirmed in these simulations.[17] If we begin by comparing the second column of Table 1 to the "fixed g_l" simulation of Table 2, we observe that θ_l falls with UI reform. Search intensity rises while vacancies fall. Employment rises, as does output, while the unemployment rate falls. These are all results anticipated in the "moral hazard" argument of the theoretical literature.

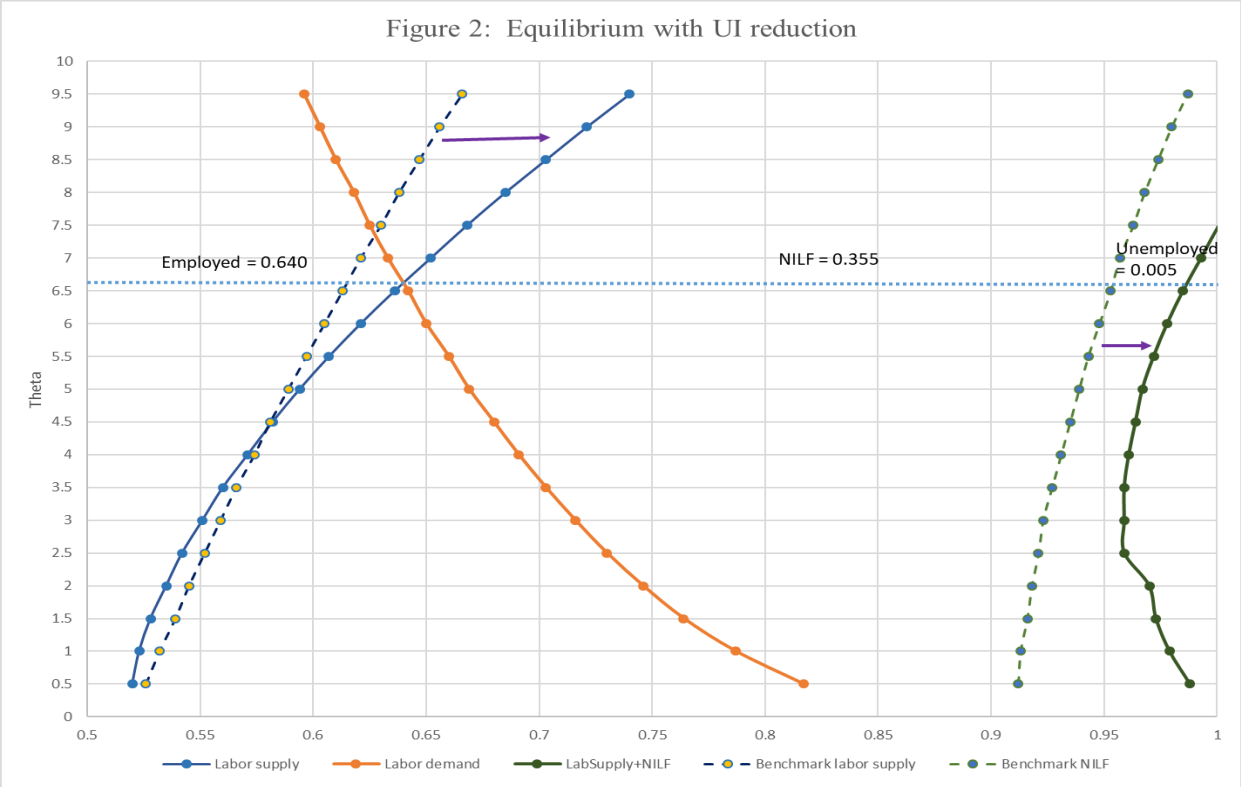
Worker welfare for those who do search is reduced in this equilibrium. For those not needing to search, $\mathcal{U}^{Ce}$ remains 0.739. $\mathcal{U}^{e}$, the utility of the wage reduced by the average disutility of increased search effort, falls from 0.367 to 0.327 due to greater search intensity e_l^*. For the unemployed, $\mathcal{U}^{u}$ is reduced both because of the reduction in C^u and the disutility of increased search effort. Total worker utility falls slightly due both to non-pecuniary search cost and to falling UI payments to the unemployed. After-tax profits rise.

The coefficients in the final column in Table 2 can be compared to the prediction from the third column of Table 1 and illustrate the impact of UI reform when the change in labor-force participation is incorporated. The UI payment is reduced by the same amount. The key finding of this paper is replicated: UI reform as implemented here leads to a reduction in labor-market participation. There is an increase in labor supply when compared to the benchmark, but the size of the increase is less than observed in the "exogenous g_l" case of the second column. Search intensity for those remaining in the labor market is increased, while labor-market tightness is less than in the benchmark but more than observed for exogenous g_l. The unemployment rate falls from 5.8 percent in the benchmark to 0.7 percent after reform, but that is due in large part to the increased non-participation in the labor force: N_l rises by 2 percent of the working-age population.

Figure 2 illustrates the impact of UI reform with endogenous labor-force participation. The demand for labor (the solid yellow line) is not changed by the reform. The supply of labor shifts to the right (to the solid blue line) leading to lower market tightness θ and somewhat higher employment. The change in labor force participation is also evident in the shift to the solid green line: the share of working-age population unemployed is very low, but this is largely due to individuals leaving the labor force.

[17] Recall that the comparative statics of Table 1 are derived for an increase in C^u. We should find the opposite sign from what is predicted there with this reform that reduces C^u.

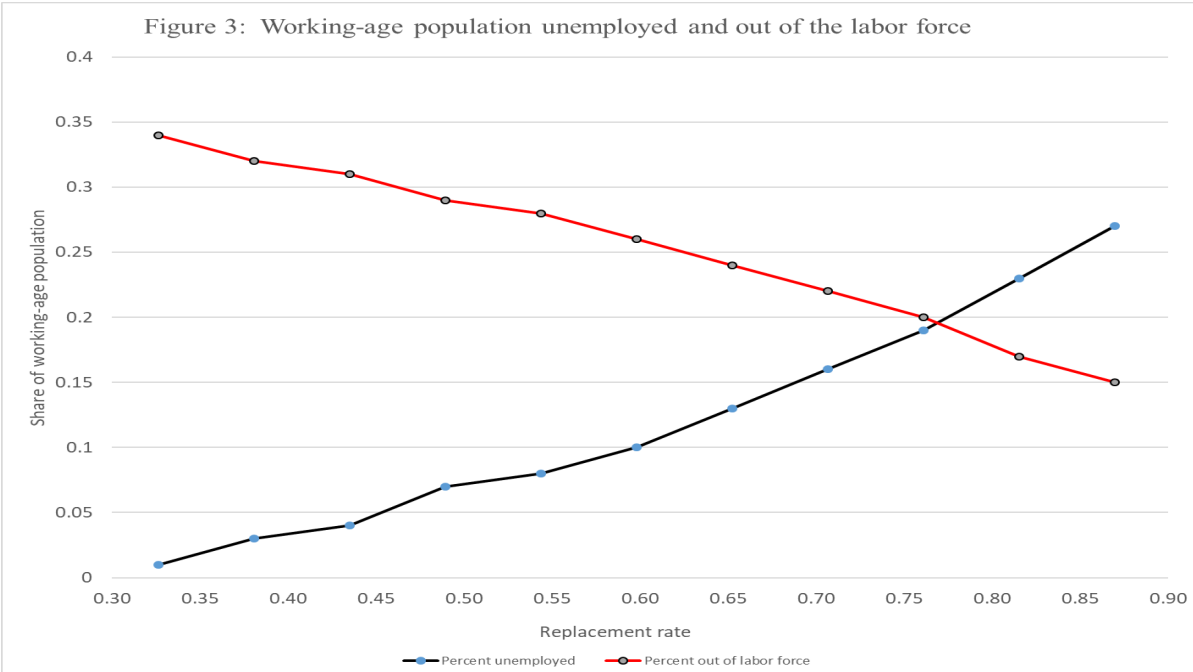
Total worker utility falls further in this simulation with the flight from the labor force. On the employer side, we observe that UI reform leads to a smaller increase in output than in the "exogenous g_l" case. Pre-tax profits are unchanged. After-tax profits rise, however, as the amount of tax collected for UI payments falls.



These simulations were all derived for constant wage. The impact of UI reform on wage could either be positive (if employers share their increased profit with employed workers) or negative (if the lower C^u represents a reduced "threat point" for employed workers in wage bargaining). A wage reduction will have an impact similar to a positive TFP shock on labor demand, but it will also lead to a reduction in the size of the labor force through an increase in N.

Figure 3 illustrates the share of the working-age population unemployed and the share not in the labor force at various replacement rates R. As is evident, low replacement rates lead to low unemployment and large shares outside the labor force. As the replacement rate rises, there is a movement from out of the labor force to unemployed. This reduces the increase in labor-market tightness and thus the supply-side search cost but increases the number of workers willing to take on the demand-side costs of search effort.

The results reported here are contingent on the calibration adopted here and so all results should be considered conditional on that calibration. Note, though, that this calibration generates shares of the population out of the labor force consistent with the aggregate US labor-market data.



6. Using a wage-bill-based UI tax to fund the UI payments.

In section 4, a corporate profit tax funds the UI payments. In fact, firms pay a UI tax per dollar paid in wages denoted t^e to fund the UI program. This tax introduces a distortion to the labor-demand decision. In this section, I explore the implications of that type of tax.

In this case, the producer chooses ℓ^d to maximize after-tax profit π:

$$\text{Max}_\ell\ \pi^e = y(\ell^d/(1+\tau(\theta))) - ((1+t^e)*w)\ \ell^d \tag{28}$$

With first order condition:

$$y'(n) = (1+\tau(\theta_1))\ ((1+t^e)*w) \tag{29}$$

Profit-maximizing hiring $\ell^d(\theta_1,w,t^e)$ is decreasing in w, t^e and θ_1 for decreasing-returns-to-scale technology.

$$\ell^d(\theta_1,w,t^e) = (1/(1+\tau(\theta_1)))^{\delta/(1-\delta)}(\mu\delta/((1+t^e)w))^{1/(1-\delta)}$$

$$t^e = (g_1-\ell_1)\ C^u/w\ell_1$$

There is an instability inherent in this tax scheme in equilibrium. For simplicity, consider the case of constant g_1, μ and w.

$$\widehat{\ell^d}_1 = (-1/(1-\delta))[((t^e/(1+t^e))\,\hat{t}^e + \alpha\,\hat{\theta}_1 \tag{30}$$

$$\hat{t}^e = \hat{C}^u - (g_1/(g_1-\ell))\,\widehat{\ell^d}_1 \tag{31}$$

$$\widehat{\ell^d} = -(1/((1-\delta)\varsigma_1))[((t^e/(1+t^e)\,\hat{C}^u + \alpha\,\hat{\theta}_1] \tag{32}$$

$$\varsigma_1 = [(1-\delta) - (t^e/(1+t^e))(g_1/(g_1-\ell_1))]$$

For $\varsigma_1 > 0$ we will observe the same qualitative results as in the previous section: as C^u rises or θ_1 rises, the demand for labor will fall. However $\varsigma_1 < 0$ is a believable outcome as well: as the number of unemployed tends to zero, the ratio $g_1/(g_1-\ell_1)$ will become very large and ς_1 will be negative. The instability is due to the distortion built into the hiring decision through the tax on the wage bill: increasing C^u causes a rise in t^e sufficient to reduce employment and cause a fiscal shortfall in funding the UI payments.

In Table 3, I repeat the simulations undertaken in the previous section using this UI tax. Given the instability, I do not solve endogenously for the equilibrium tax rate; instead, I impose a one percent tax on the wage bill.[18] If that tax rate does not cover the total cost of UI payments, I subtract the balance from corporate profit. All other parametric assumptions are identical to those of Table 2.

The first conclusion from this exercise is found by comparing the benchmark results in Tables 2 and 3. The distortion associated with this UI tax is a costly one: the share of the working-age population employed falls by three percentage points, and the share of the working age population out of the labor force rises by 1.3 percentage points. Real output falls by about four percent. Aggregate worker utility falls from 0.481 to 0.471 and after-tax profits fall from 0.070 to 0.061.

The second conclusion is that the two UI reform simulations exhibit very similar implications to those found in Table 2. UI reform has the expected "moral hazard" effects so long as g_1 is held fixed; employment and output grow strongly with the reform. When g_1 is allowed to change, though, there is a flow of potential workers out of the labor force. The unemployment rate falls sharply, but most of this is due to potential workers exiting the labor force. After-tax profits rise.

[18] The standard UI tax rate for new employers in North Carolina, for example, is 1.2 percent. That rate is reduced for employers that establish positive experience ratings.

Table 3: Simulations of the Labor Search Model with Endogenous Participation Choice and the UI tax on the wage bill

		UI Reform:	UI Reform:
	Benchmark	Exogenous g_1	Endogenous g_1
μ	0.97	0.97	0.97
ρ	0.013	0.013	0.013
C^u	0.370	0.264	0.264
C^e (= wage)	0.882	0.882	0.882
ΔC	0.512	0.618	0.618
$\omega(C^u)$	1.148	0.951	0.951
$\kappa(C^u)$	0.355	---	0.547
θ	5.471	4.555	5.234
e^*	0.246	0.329	0.344
g_1	0.653	0.653	0.622
N	0.347	0.347	0.378
ℓ^s	0.596	0.612	0.600
Unemployment rate	0.087	0.063	0.035
y	0.608	0.624	0.612
τ	0.031	0.028	0.031
π	0.082	0.083	0.083
UI payment	0.021	0.010	0.006
v (vacancies)	1.348	1.498	1.801
t^e	0.01	0.01	0.01
$\mathcal{U}^{Ce}$	0.739	0.739	0.739
$\mathcal{U}^e$ (average $g < g_1$)	0.383	0.352	0.360
$\mathcal{U}^u$ (average $g < g_1$)	0.252	0.130	0.218
Aggregate worker utility	0.471	0.465	0.448
After-tax π	0.061	0.072	0.082

7. A state-level test of the labor-force-participation decision in response to UI reform.

UI reform occurred in many states during the recession that followed the financial crisis in the US. UI reform in these cases involved reduction in C^u (or R) as well as a reduced period in which individuals could receive C^u. In exogenous-g_1 matching models, this has clear effects: search effort rises, labor-market tightness falls, employment and output rise. Once I allow for endogenous labor-force participation, the anticipated effects are quite different. When $\kappa(C^u)$ is positive, UI reform leads to a fall in search effort and a fall in labor-force participation. The impact on labor-market tightness is ambiguous, as is the impact on employment and output. The fall in labor-force participation causes these ambiguities.

I construct the transition matrix for an individual of working age from the theoretical analysis of the previous section and present it in Table 4. The first panel provides the steady-state conditional probabilities, using the simulated value for ef(θ) of 0.80 from the benchmark calibration and with continuation value for employment without search of σ=.81. Transition from "not in the labor force" N_o is solely to N_1 due to the fixed nature for each individual of the non-pecuniary costs of job search g: if an individual chose to be out of the labor force in period zero, she will also choose that in period one. Those employed in period zero can either transition to employment in period one through the "no-search" employment associated with σ or with probability ef(θ) through job search. This latter group will find itself unemployed with probability (1-ef(θ)). Those unemployed also can become employed in period one through job search with probability ef(θ) and will remain unemployed in period one with probability (1-ef(θ)).

Table 4: **Conditional Transition Probabilities from the Benchmark Model**

		I. Steady State		
	U_1	N_1	E_1	Total
U_o	(1-ef(θ)) = .20	$[g_1 = g_o]$: 0	ef(θ) = .80	1
N_o	$[g_1 = g_o]$: 0	$[g_1 = g_o]$: 1	$[g_1 = g_o]$: 0	1
E_o	(1-ef(θ))(1-σ) =.04	$[g_1 = g_o]$: 0	σ + ef(θ)(1-σ) = .96	1
	II. Comparative statics of UI Reform			
	U_1	N_1	E_1	Total
U_o	[ef(θ) rises]: Reduced probability [g_1 falls] Reduced probability	$[g_1 < g_o]$ Increased probability	[ef(θ) rises] Increased probability [g_1 falls] Reduced probability	0
N_o	$[g_1 < g_o]$: None	$[g_1 < g_o]$: None	$[g_1 < g_o]$: None	0
E_o	[ef(θ) rises]: Reduced probability [g_1 falls]: Reduced probability As σ rises, impact converges to zero.	$[g_1 < g_o]$: Increased probability As σ rises, impact converges to zero	[ef(θ) rises]: Increased probability [g_1 falls]: Reduced probability As σ rises, impact converges to zero	0

Source: analysis of previous sections

The second panel of Table 4 reports the comparative-static effects of UI reform on these conditional probabilities predicted by the model. The exogenous shock is a reduction in the UI payment C^u. The "moral hazard" effect of UI reform is found in the impact of increased search

intensity: this leads to a reduction in the conditional probability to enter unemployment and an increase in the conditional probability to be employed. The "labor-market-participation" effect of UI reform is seen in the increased conditional probability to transition from unemployment or employment into "not in the labor force". This also is associated with a reduction in the probability to transition into either employment or unemployment. I will test these predictions using data from North Carolina's UI reform of 2013.

The North Carolina legislature passed a sweeping reform to the UI law in North Carolina in early 2013, and North Carolina governor Pat McCrory signed the bill into law on 19 February 2013. The reform became law on 1 July 2013. There were two salient changes to the UI payment policy. First, maximum weekly benefits were cut from $530 to $350. Second, the number of weeks for which recipients are eligible for benefits fell from 26 (or up to 99, with Federal extensions) to 20. This eligibility limit was linked to the unemployment rate, so that as the unemployment rate fell the eligibility limit fell as well: it became 12 weeks in the last half of 2015. These reforms were so sweeping that the US Department of Labor ruled that the UI system in North Carolina had been qualitatively altered; it cut off the access of North Carolina residents to extended unemployment compensation payments as of 1 July 2013. While nine states reformed their UI programs during the financial-crisis downturn, North Carolina's reform was the only one of the nine to lose extended benefits for its residents (GAO, 2015). EUC benefits disappeared on 1 July 2013 in North Carolina; for the rest of the US they were eliminated as of 31 December 2013. I interpret these changes as a reduction in C^u that is observed in North Carolina, but not in the rest of the US, at that time.

While the Current Population Survey does not report information about welfare or search effort for respondents, it does provide the information necessary to address the outcomes of working-age population for labor status: employed (E), unemployed (U), and not in the labor force (N). I use panel data created from the Current Population Survey to create time-varying transition probabilities between employed, unemployed and non-participating labor status for individuals aged 25-54.[19] I test the difference in these transition probabilities for North Carolina against those for the rest of the US.

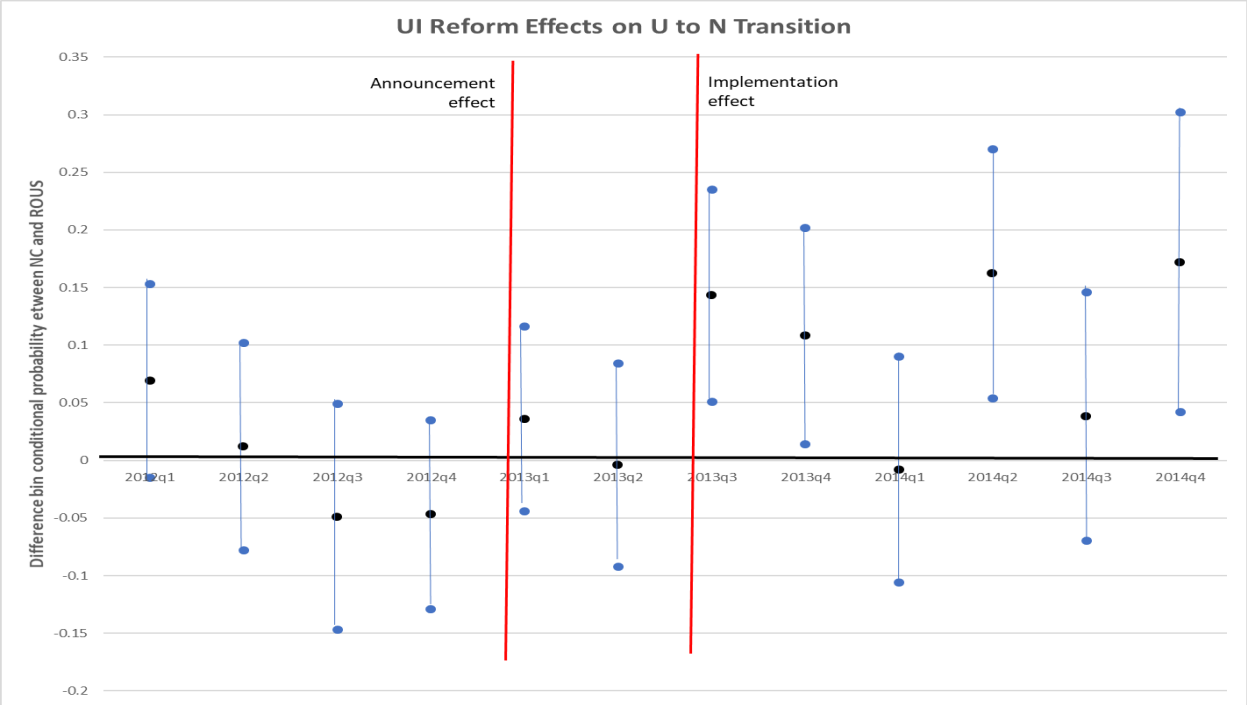
In an exogenous-g_o labor market, a reduction in C^u will cause the conditional transition probability into employment to rise and into unemployment to fall, while labor-force participation will be unchanging by assumption. Table 4 summarizes the predictions of an endogenous-g_o labor market: the conditional probability of transition into unemployment will be falling, into "not in the labor force" will be rising, and the conditional transition probability into employment will change ambiguously. The comparative-static effects of transition out of employment will converge to zero as σ, the share of employees in period zero who are offered a no-search continuation of their job into period one, rises toward 1.

[19] This use of Current Population Survey data to examine the impact of UI reform is similar to that of Rothstein (2011), Farber, Rothstein and Valletta (2015) and Kroft, et al. (2016). Researchers beginning with Abowd and Zellner (1985) have raised issues associated with "chaining together" responses by individuals over successive months. Conway (2018) reports the extensive data corrections and robustness checks I undertook in this research. All robustness checks led to qualitatively similar results and significance levels to those reported here.

I calculate quarter-by-quarter conditional transition probabilities from U_t, N_t and E_t into U_{t+1}, N_{t+1} and E_{t+1} for the four quarters of 2013 for North Carolina and for the Rest of the US (ROUS). My null hypothesis is that these probabilities in North Carolina were not statistically different from those in the Rest of the US. The alternative hypothesis is that the transition into and out of labor force participation in North Carolina was significantly changed by the event of the UI reform. Table 5 reports the difference in conditional transition probability between North Carolina and the ROUS as well as statistical tests of the significance of this difference each quarter.

Figures 4 and 5 illustrate the findings from this analysis and extend it to previous and following quarters. In Figure 4 I focus on the conditional probability of transition from unemployment to "not in the labor force" in a given quarter.

Figure 4: Transitions from Unemployment to Not-in-the-Labor-Force



The horizontal axis indicates time in quarters of the year both prior to and subsequent to the North Carolina UI reform. The first vertical red line indicates the date that the legislature approved the change in UI policy; the second vertical red line indicates the date that the UI reform became law. The vertical axis measures the conditional difference in transition probability for North Carolina relative to the rest of the US. A positive value indicates that residents of North Carolina are more likely to transition from unemployment to "not in the labor force" during the quarter observed. The coefficient associated with this transition probability is indicated by the black dot; the blue vertical interval indicates the 95-percent confidence interval around that coefficient.

In the period prior to implementation of the UI reform, the "U_t to N_{t+1}" transition probability in North Carolina was insignificantly different from that of the rest of the US. Beginning in 2013 q3, however, the transition probability in North Carolina was significantly greater than that of the rest of the US in four of the next six quarters. This is associated with an increase in the percent of working-age population out of the labor force in North Carolina relative to the Rest of the US that persists through the next twelve quarters.[20]

In Figure 5, I report the impact of this UI reform on the conditional transition to employment. If the moral-hazard effect of UI reform dominates the labor-market-participation effect, then UI reform will lead to increased transition from unemployment to employment relative to what is observed in the Rest of the US. The "U_t to E_{t+1}" transition probability difference for North Carolina is illustrated in Figure 5.

Figure 5: Transition from Unemployment to Employment.

UI reform is not associated with significant differences between North Carolina and the rest of the US in any of the 12 quarters reported here. Rather than creating relatively more transition to employment from unemployment, the point estimates of the transition differential are zero or negative in five of the six quarters after implementation – a result consistent with the labor-force-participation effect dominating the moral-hazard effect.

It is fair to ask whether the UI reform simply caused greater churning of participation states: perhaps these significant "U_t-to-N_{t+1}" relative transitions were offset by significant N_t-to-U_{t+1} transitions, or N_t-to-E_{t+1} transitions followed by E_t-to-U_{t+1} transitions. Table 5 below provides the

[20] These statistics are not reported here but are summarized in Conway (2018) and are available upon request.

event-study results for all possible transitions during the four quarters of 2013. The null hypothesis of no differences between North Carolina and rest of the US cannot be rejected in almost all other transitions. The signs of the differences are consistent with the theoretical predictions of Table 4. In particular, the predicted negative transitions from U_t and N_t into U_{t+1} are observed in the data, though not significantly different from zero. Theory also predicts that the E_t-to-N_{t+1} transition probability will be larger in North Carolina, and that sign is evident in Table 5 post-UI reform. In the two cases of ambiguous effect (U_t-to-E_{t+1} and E_t-to-E_{t+1}) the sign indicates that the labor-market-participation effect outweighs the moral-hazard effect. Conway (2018) provides greater detail on the estimation strategy and the robustness checks undertaken in evaluating these results.

Table 5: Hypothesis Test of whether NC differs from ROUS in the period of the UI Reform

	γ_{jkt}	s_{jkt}	z		γ_{jkt}	s_{jkt}	Z		γ_{jkt}	s_{jkt}	z
	E to N				N to N				U to N		
2013q1	0.001	0.004	0.22		-0.020	0.020	0.91		0.036	0.040	0.90
2013q2	-0.005	0.004	1.25		-0.006	0.020	0.29		-0.004	0.044	0.10
2013q3	0.005	0.004	1.24		-0.018	0.021	0.83		**0.143**	0.046	3.07
2013q4	0.005	0.004	1.15		-0.007	0.020	0.35		**0.108**	0.047	2.27
	E to U				N to U				U to U		
2013q1	-0.002	0.004	0.54		0.015	0.013	1.20		-0.097	0.050	1.92
2013q2	-0.005	0.003	1.60		0.006	0.013	0.43		0.080	0.055	1.46
2013q3	-0.002	0.003	0.46		-0.023	0.014	1.65		-0.082	0.058	1.40
2013q4	-0.001	0.003	0.42		0.008	0.013	0.59		-0.108	0.060	1.81
	E to E				N to E				U to E		
2013q1	0.001	0.006	0.17		0.004	0.016	0.23		0.061	0.043	1.41
2013q2	**0.011**	0.005	1.98		-0.000	0.016	0.08		-0.080	0.047	1.69
2013q3	-0.004	0.005	0.70		**0.039**	0.017	2.25		-0.069	0.050	1.38
2013q4	-0.004	0.005	0.65		-0.000	0.016	0.02		-0.001	0.051	0.01
N Obs	3,969,815				840,957				204,181		
Avg Obs per quarter	55,136				11,680				2,836		
Wald (143)											
	522.3	E to N			**548.7**	N to N			**696.7**	U to N	
	1521.9	E to U			**1425.5**	N to U			**3018.0**	U to U	
	727.2	E to E			**989.8**	N to E			**2497.1**	U to E	

GLS estimation, with errors clustered by household.

The importance of the moral-hazard effect relative to the labor-force-participation effect should be evident in the conditional transition probabilities from unemployment to unemployment and employment in the next period. If the moral-hazard effect is dominant, these coefficients will be equal in size and opposite in sign. In fact, they have the same negative sign: those conditional

probabilities have shrunk as the conditional probability to transition out of the labor force has grown. Similarly, the moral-hazard effect should be evident in the conditional probabilities to transition from employment to either employment or unemployment in the following period. If the two are of equal size and opposite sign, the moral-hazard effect is dominant; instead, though, the two have the same negative sign while the changed conditional probability of transition from employment to out of the labor force is larger and positive. By all measures, the elasticity of labor-force participation with respect to UI payments is dominant in this pattern of changed conditional probabilities.[21]

8. Conclusions.

The decision to participate in the labor market is an important determinant of labor-market equilibrium. I introduce that decision in this paper. I consider the comparative statics of an exogenous change in UI payments and trace out its implications for labor-force aggregates, search intensity, and market-tightness metrics.

I demonstrate that the simple policy implications usually associated with reduction in UI payments – increased employment, increased output, lower unemployment rate – are artifacts of the assumption that the decision to participate in the labor force is invariant to the policy reform. Once that choice of labor-force participation is incorporated in the analysis, I demonstrate that there is another set of likely outcomes – reduced employment, reduced output, and lower unemployment rate due to increased exit of the working-age population from the labor force.

One striking effect of the reform in the calibration analysis is its uneven effect on welfare: welfare for both employed and unemployed workers falls with the reform. The after-tax profits of the employer rise.

I report results of an empirical analysis using labor-force transition data from the Current Population Survey to demonstrate that the outcomes associated with exit from the labor force cannot be rejected when a difference-in-difference study of the UI reform in North Carolina is considered. While there is some evidence of the moral-hazard effects of UI reform, its effects in the aggregate are dominated by the effects on labor-force participation.

The theoretical and empirical results reported here provide a theoretical structure and empirical reaffirmation for the Farber, Rothstein and Valletta (2015) observation about UI reform in the aftermath of the 2008 financial crisis: "the phasing out of extended and emergency benefits reduced the unemployment rate mainly by moving people out of the labor force rather than by increasing the job-finding rate". The theoretical results of this paper go further to suggest that the reduced replacement rate after UI reforms also plays a role in this dynamic.

[21] There is one significant change in conditional probability that is not consistent with the model's prediction: The probability of transitioning from N_t to E_{t+1} is both positive and significant in 2013 q3. This is a fruitful area for further study and may be an indication that some of the labor-force-participation decisions are undertaken at the household (rather than individual) level.

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