Unemployment Insurance Programs and the Choice to Leave the Labor Force

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25 December 2021

Abstract

I extend a labor-market search and matching model of equilibrium with unemployment insurance (UI) program to incorporate the choice to participate in the labor market. UI reform that lowers the UI payment increases search intensity but discourages labor-market participation. Reducing UI payments has the moral-hazard effects derived in the literature but also a non-participation effect.

UI reform in North Carolina in mid-2013 provides an empirical test of the model using data from the Current Population Survey. The reduction in size and duration of UI payments led to no significant increase in employment but a significant increase in those exiting the labor force.

JEL Codes: E24, E65, J64, J65

Keywords: Unemployment Insurance, labor force participation, job creation, job-market transition

Thanks to Paul Gaggl, David Guilkey, Lutz Hendricks, Stan Rabinovich, Wayne Vroman, participants in seminars at the University of North Carolina at Chapel Hill and at the Southern Economic Association meeting, and two referees for their incisive comments and suggestions.

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 and persistent unemployment.

During the financial crisis and subsequent recession in the United States, ten states responded by decreasing the maximum duration for an individual to receive UI payments.[1] North Carolina, in addition, changed its law to lower the weekly payment to UI recipients. These states attributed the changes to the fiscal stress of funding the UI program during the recession (Congressional Research Service, 2019), but also to the expected impact of increased search intensity by both unemployed workers and firms that would speed the economic recovery within the state (Balfour and Tucker, 2016).

Baily (1977) laid out the fundamental cost-benefit policy tradeoff in setting the size and duration of UI payments. For a risk-averse unemployed worker there is the marginal benefit of income-smoothing by increasing income while unemployed towards the size of the wage received when employed. There is also the marginal social cost of the program as the existence of the UI program creates a moral hazard in job search: unemployed workers will search less intensively, thus remaining unemployed longer. The subsequent literature addressed this dilemma through a successively more realistic set of models of the labor market.[2]

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.[3] The decision to participate (or not) in the labor market is an important choice by those of working age. In Figure 1 I depict the share of US individuals between the ages 25 and 54 in the Current Population Survey (CPS) who report themselves "not in the labor force".[4] A locally weighted

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[1] General Accounting Office (GAO, 2015) reports that these were Arkansas, Florida, Georgia, Idaho, Illinois, Kansas, Michigan, Missouri, North Carolina and South Carolina.

[2] Baily (1977) 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.

[3] 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).

[4] These shares are calculated from individuals in this age group in a longitudinally linked sample from the CPS. Monthly observations are aggregated to obtain quarterly averages. There are approximately 60,000 individual observations each quarter in the sample for the US. The "not in the labor force" designation is assigned to individuals who responded to the labor force question in the survey with "not in the labor force – retired", "not in labor force – disabled", or "not in labor force – other". There are many reasons why

least-squares regression is used to smooth the series over time.[5] There is a clear positive trend over the time period, but there is also evidence of individual choice to leave the labor force in the aftermath of recession episodes and to return as the economy approaches full employment. 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.

Since labor-force participation is an individual's choice, ignoring the effect of UI policy on the labor-force-participation choice can lead to major misunderstandings of the impact of these reforms. In this paper I extend a standard labor-market search-and-matching model to include the labor-market participation choice. I demonstrate that the observed labor flows after UI policy change depend 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 literature review in section 2 and the theoretical model in section 3.[6] The critical extension to the current literature is the maintained hypothesis of heterogeneity in non-pecuniary search costs of potential labor-market participants that leads some working-age individuals to exit the labor market rather than search for employment.[7] This leads to a labor-market participation choice that is a function of worker 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 labor-market participation is endogenous. These numerical results demonstrate that when labor-force participation is endogenous UI reform to reduce the value of payments leads to very different labor-market outcomes. The unemployment rate falls in each case, but in the endogenous labor-force participation case this is in part due to individuals of working age choosing not to participate in the labor market. Section 5 presents empirical evidence from the 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 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 is observed in the rest

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those of working age might exit the labor force, including continuing education and retirement. The 25-54 age range is chosen to exclude individuals not in the labor force due to these reasons.

[5] The Stata command *lpoly* is used to create the polynomial average indicated by the orange line. The vertical shaded areas illustrate periods of recession in the US as identified by the National Bureau of Economic Research (NBER).

[6] To focus the text on the principal findings, I have moved derivations and less central analysis to an online appendix at pconway.web.unc.edu/online-appendix-unemployment-insurance-programs-and-the-choice-to-leave-the-labor-force. Twelve appendices are provided at that site. I identify the relevant appendix with a capital letter, as for example, online Appendix A or online Appendix K.

[7] 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.

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 6 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 theoretical welfare impact of UI policy (e.g., Baily 1977; Chetty 2006) were partial equilibrium in nature. They identified the fundamental tension of increased UI payment or duration between an individual's private utility gains from income-smoothing and the social marginal cost of moral hazard in job search. Subsequent research by Mitman and Rabinovich (2015; 2020), Landais et al. (2018a; 2018b) and others 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 (1977) identified in welfare effects.

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 (1977). 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. Petrongolo and Pissarides (2001) in their survey of labor-market matching-function research reports a small positive influence of the existence of unemployment insurance programs on re-employment probability in the outcomes of individual workers. Mitman and Rabinovich (2020) 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. McCall (1970) provides an early theoretical derivation of the labor-market-participation decision, as well as a definition of "discouraged workers", as a function of an individual's cost of job search. Pissarides (1976) examines labor-market-participation in a sequential-search framework.[8] Sattinger (1995) presents a first examination of the "labor-market-participation effect" of increased unemployment compensation in a model without moral hazard: as UI payments increase, the labor force expands, employment increases, and the unemployment rate rises. The work of Krusell et al. (2010; 2011) provides a theoretical model linking shocks to worker productivity and labor-market search frictions to joint

[8] Its introduction of utility-based search costs in considering a family's joint labor-market participation decision is in the spirit of the non-pecuniary search costs introduced in this paper.

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 UI reforms by combining analysis of moral hazard and labor-force-participation.

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 through a regression-discontinuity analysis based on state borders 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.[9] Chodorow-Reich et al. (2019) examine the macroeconomic effects of changing UI benefits through a measurement-error approach that indicates only minor effects of UI policy changes on state-level unemployment outcomes.

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. They found that the unemployment rate fell in North Carolina relative to a control group of Southern states and that this was due to a rise in employment and fall in unemployment. While the authors use the same database as in this paper, they differ significantly in their research design. In online appendix G I provide a detailed crosswalk from the Depken and Gaggl (2018) results to those of this paper. While their results hold in aggregate, examination of the differing decisions of employed, unemployed and "not in the labor force" individuals provides a more precise picture of private decision-making in response to UI reform.

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 effect of restricting UI payments on current recipients. In this paper I complement that effect with the non-

[9] Boone et al. (2021) challenged the empirical results of Hagedorn et al. (2015), finding that the significant results disappeared when alternative specifications and more recent data are used. Dieterle et al. (2020) also finds the Hagedorn et al. (2015) results are greatly diminished when a careful regression-discontinuity design is used in estimation.

participation effect of this reform on those not currently receiving benefits.

This paper brings these two strands of the literature together. First, I present a theoretical model of a job-search economy with UI payments that has an endogenous labor-force participation decision. I demonstrate that the labor-force-participation decision is sensitive to the setting of UI policy. Second, I examine historical job-flows data from the CPS 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. The conditional transition probability from unemployment to non-participation rises significantly with this reform. The expected moral-hazard effect of UI reform on the unemployment to employment transition probability is positive, but in the data it is negative and insignificantly different from zero: this suggests that the labor-force-participation effect dominated the moral-hazard effect in the North Carolina episode.

3. The Model.

I present a general-equilibrium model with three labor states.[10] The three labor states -- employment (E_t), unemployment (U_t) and non-participation (N_t) in time t – are fundamental to analysis. For simplicity in modeling I focus upon two consecutive periods to incorporate the empirical fact that not all employed workers search for a new job in each period.[11] The labor-market choice of working-age individuals is the central modeling contribution, while modeling of the firm follows closely Landais et al. (2018a).

3.1. Workers and job-separation shocks. I begin in period zero with an equilibrium distribution of working-age individuals: the employed (E_o), unemployed (U_o) and those not in the labor force (N_o). The unemployed differ from those not in the labor force by their decision to search for a job in period zero, though they were not successful in that period. Period one begins with (1-σ) percent of E_o jobs eliminated through firm closures or other involuntary termination. The σE_o workers continue with employment with certainty into 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.[12]

3.2. Labor market, matching and worker utility. The labor market for job searchers is characterized by a constant-returns-to-scale matching function $\ell_1 = m(e_1,v_1)$.[13] ℓ_1 is the number

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

[11] The theoretical analysis of this paper is comparative-static in nature: the equilibrium is defined, and then a reform to UI policy is introduced as a random shock. The comparative-static effects thus do not provide the adjustment path from pre-shock equilibrium to post-shock equilibrium. The speed and monotonicity of adjustment are of importance, and the empirical sections of this paper will provide evidence on adjustment. Extending this theoretical model to include adjustment, as in Mukoyama (2013), is a step for future research.

[12] This separation between the continuing employed and the group of workers searching in period one addresses the "stock-flow" issue of matching addressed in Coles and Smith (1998) and is important in calibrating the model to US labor-status data.

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

of workers in period 1 who match with a job, while e_1 is the job-search effort by workers and v_1 is the number of vacancies employers list in aggregate. I represent this with

$$f(v_1/e_1) = m(1,v_1/e_1) = f(\theta_1) = \theta_1^{\eta} \qquad\qquad \theta_1 = v_1/e_1 \tag{1}$$

θ_1 is the vacancy/effort ratio and an indicator of market tightness in period 1. A higher value indicates a tighter market from the point of view of the firm. The elasticity of matching with respect to market tightness is denoted η. The probability that a labor-market participant will be matched with a vacancy can be represented as $e_1 f(\theta_1)$. The probability that a vacancy is filled is then $q(\theta_1)$. In a tight labor market, the employer has more difficulty in filling vacancies.

$$q(\theta_1) = f(\theta_1)/\theta_1 = \theta_1^{\eta-1} \tag{2}$$

Total utility for working-age individuals is the sum of utility from consumption and disutility from job search. Individuals have a constant-relative-risk-aversion utility function V(.) in real consumption. For those employed, real income is equal to the wage w_1 and $V(w_1)$ is the utility of the associated consumption. For those unemployed qualifying for unemployment insurance (UI), real income is received from the payment $C^u{}_1$ and utility is $V(C^u{}_1)$.[14] For those out of the labor force there is a minimal informal real income z: for calibration it will be set below $C^u{}_1$ such that $V(z) = 0$.[15] The constant-relative-risk-aversion coefficient is denoted χ.

Individuals share a common disutility of search intensity with elasticity γ and differ only in their heterogeneous disutility of job search g independent of and in addition to the degree of effort.[16] 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 all those searching incur these costs. Those remaining outside the labor force and those with continuing jobs have search effort $e_1 = 0$ and $\psi(0,g) = 0$ in period one.

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[14] In practice, some unemployed individuals are not eligible for UI payments. That is consistent with the simplest explanation for the matching function (see, for example, Petrongolo and Pissarides (2001)). For these, matches do not occur either due to coordination problems (job-seekers randomly overapply for some jobs and pass on others) or to information asymmetries (job seekers don't know about some vacancies). Those who are eligible for UI are separated from previous employment for no fault of their own. In the model of this section, the $(1\text{-}\sigma)Eo$ terminated workers will meet the eligibility requirements, as will many of the individuals carried forward in U_o. Anyone returning to the labor force from N_o, by contrast, will not meet eligibility requirements. In the derivations of this section I will distinguish those qualifying for UI payments from those who do not.

[15] 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 calibrated to ensure positive utility for the ranges of real income under consideration and to set $V(z) = 0$. z=0.1 is imposed; it is consistent with informal opportunities that offer less real income than the UI payment for those not in the labor force.

[16] McCall (1970) suggests that this cost is due to heterogeneous access or processing of information. McFadyen and Thomas (1997) describe the heterogeneous psychological costs associated with job search.

Those who enter the labor force for the first time, those returning to the labor force, or those who have exhausted their UI payments for the year, will have a potentially different search intensity ($\bar{e}_1$) and will not receive $C^u{}_1$ if unsuccessful in search.

Individual utility in period one ($\mathcal{U}^E, \mathcal{U}^u, \mathcal{U}^{FE}, \mathcal{U}^{Fu}, \mathcal{U}^c$ and $\mathcal{U}^N$) can then be summarized by labor-force and UI status as in Table 1.

3.3. Initial choice: participate or not? Those of working age without a job continuing into period one must decide (a) whether to search for work and (b) what search intensity (e_1) to use prior to knowing whether they will be employed.[17] The expected payoff $P(w_1,C^u{}_1,\theta_1,e_1,g)$ of participating in the labor force for an individual of type g who will qualify for UI payments in period one is:

$$P(w_1,C^u{}_1, \theta_1,e_1,g) = e_1 f(\theta_1)\ \mathcal{U}^E(w_1,e_1,g) + (1-e_1 f(\theta_1))\ \mathcal{U}^u(C^u{}_1,e_1,g) \qquad (3)$$

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

$$P(w_1,C^u{}_1, \theta_1,e_1,g) < 0 \text{ if } g > e_1 f(\theta_1)(V(w_1) - V(C^u{}_1)) + V(C^u{}_1) - e_1{}^\gamma \qquad (4)$$

I 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.[18]

$$g_1 = e_1 f(\theta_1)(V(w_1) - V(C^u{}_1)) + V(C^u{}_1) - e_1{}^\gamma \qquad (5)$$

For non-participants in period 1, the disutility of searching is too large to justify labor-force participation. ($1-g_1$) is the share of the working-age population not in the labor force in period one.[19] Increasing $C^u{}_1$ will (other things equal) encourage individuals of working age to participate in the labor force.

First-time entrants to the labor force, newly returned workers from out of the labor force and those who have exhausted UI benefits will not qualify for UI payments. Their payoff is a special case of equation (3). This defines a potentially different cut-off value of g for participation in the labor force that I label $\bar{g}_1$.

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[17] In practice, some workers practice on-the-job search and transition directly from one job to the next without taking on the search costs described here. Those individuals are included among the σE_o not facing unemployment.

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

[19] Given this formulation, a steady state with $g_o = g_1$ will lead to no change in the share of non-participants. 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.

$$P(w_1,z,\theta_1,\bar{e}_1,g) = \bar{e}_1 f(\theta_1)\ \mathcal{U}^E(w_1,\bar{e}_1,g) + (1-\bar{e}_1 f(\theta_1))\ \mathcal{U}^F(z,\bar{e}_1,g) \quad (6)$$

$$\bar{g}_1 = \bar{e}_1 f(\theta_1)(V(w_1) - V(z)) - \bar{e}_1^{\gamma} \quad (7)$$

3.4. Optimal job-search intensity and labor-force participation. Each searching individual qualifying for UI payments with $g \leq g_1$ maximizes

$$\max_{e_1}\ e_1 f(\theta_1)(V(w_1) - V(C^u{}_1)) + V(C^u{}_1) - e_1^{\gamma} - g \quad (8)$$

I define $\Delta V(w_1,C^u{}_1) = V(w_1) - V(C^u{}_1)$ as the difference in utility between being employed and receiving UI payments. The first-order condition from this maximization leads to a common optimal job search intensity for these individuals.[20]

$$e_1^* = [[\theta_1^{\eta}\ \Delta V(w_1,C^u{}_1)]/\gamma]^{(1/(\gamma-1))} \qquad \text{for noncontinuing workers with } g \leq g_1 \quad (9)$$

Making a UI program more generous (increasing $C^u{}_1$ for given values of θ_1 and w_1) will reduce optimal search intensity by those who participate in the labor force. This is the moral-hazard effect of Baily (1977) and the subsequent literature. A tighter labor market (from the firm's perspective), by contrast, will encourage greater effort.[21]

Those not eligible for UI payments will have a different optimal search-intensity choice.

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[20] This is the interior solution. There can be corner solutions as well with the expected probability of successful search equal to one. Online Appendix A provides details.

[21] This theoretical formulation embodies the simplifying assumption that all labor-force participants first search for jobs. After the matching process, then everyone either works for a wage, is unemployed and receives UI payments, or is out of the labor force. The search intensity is the same for all individuals qualifying for UI payments because they all prefer earning a wage to settling for UI payments. In practice job termination and job search are occurring at each point in time. UI payments typically coincide with search activity. Many states require evidence of active searching when the unemployed are receiving UI payments. That search requirement is treated as a minimum and less than the optimal search intensity.

We could think of a minimum search requirement (e^m) as calibrated to ensure that the optimal search intensity is in fact observed. In other words, an individual might prefer $C^u{}_1$ with no search to w_1 with optimal search. The requirement of e^m is less than the optimal search intensity but is large enough so that w_1 with optimal search is preferred to $C^u{}_1$ with minimal search. Mathematically, it ensures that $V(w_1)-\psi(e_1,g) > V(C^u{}_1) - \psi(e^m,g)$ or $V(w_1)-V(C^u{}_1) > \psi(e_1,g) - \psi(e^m,g)$.

$$\max_{e_1} \; e_1 f(\theta_1)V(w_1) - e_1^{\gamma} - g \tag{10}$$

$$\bar{e}_1^* = [[\theta_1^{\eta} V(w_1)]/\gamma]^{(1/(\gamma-1))} \quad \text{for a noncontinuing worker with } g \leq \bar{g}_1 \tag{11}$$

This is also the optimality condition for those who have exhausted UI payments for the year. Comparison of e_1^* and $\bar{e}_1^*$ reveals that those not eligible for UI payments will search with greater intensity.[22]

Those qualifying for UI payments in the labor force have $g \leq g_1$. Substituting equation (9) into equation (5) yields the expression:

$$g_1 = V(C^u{}_1) + (\gamma-1)[\theta_1^{\eta} \Delta V(w_1,C^u{}_1)/\gamma]^{(\gamma/(\gamma-1))} \tag{12}$$

Labor-force participation is increased directly by the utility gain from an increase in $C^u{}_1$ but is separately reduced by the impact of increased $C^u{}_1$ on job-search effort through $\Delta V(w_1,C^u{}_1)$. The net effect is ambiguous.

For those individuals not eligible for UI payments, the cut-off for labor-force participation is given by $\bar{g}_1$.

$$\bar{g}_1 = \bar{e}_1^* (\theta_1^{\eta} V(w_1)) - \bar{e}_1^{*\gamma} \tag{13}$$

Employment supply ($\ell^s{}_1$) is rising with the size of the labor force, with the tightness of the labor market, and with the relative utility gain for the employed.

$$\begin{aligned} \ell^s{}_1 &= \sigma E_o + (g_1 - \sigma E_o)\, e_1^* f(\theta_1) \\ &= \sigma E_o + (g_1 - \sigma E_o)\, [\, \theta_1^{(\eta\gamma/(\gamma-1))} [\Delta V(w_1,C^u{}_1)/\gamma]^{(1/(\gamma-1))} \,] \end{aligned} \tag{14}$$

[22] The expression in (10) represents the interior solution to the individual's choice. Since the probability of finding a job cannot be larger than 1, the value of $\bar{e}_1$ is the smaller of the expression in (10) and $(1/f(\theta_1))$. Increasing search intensity raises the probability of securing a job – but search intensity in excess of the amount necessary to secure a job with probability 1 will be welfare-reducing. See online Appendix H for details.

3.5. The representative firm. The firm is introduced to endogenize the degree of market tightness. I follow a decreasing-return-to-scale specification of the production function found in Michaillat (2012) and Landais et al. (2018a). The firm hires ℓ^d_1 employees and pays a real wage w_1. 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 inclusion of two occupations in each firm incorporates decreasing labor productivity as the labor market tightens.

The total number of employees then can be defined:

- Total employee demand = 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 $\tau(\theta_1) = \rho/(q(\theta_1) - \rho) \qquad \tau' > 0$ (15)

Firms pay a tax denoted t as a percent of firm profit to fund the UI program.[23]

Production follows the simple technological function

$$y(n_1) = \mu n_1^{\delta} \tag{16}$$

with μ a total factor productivity (TFP) coefficient, n_1 the total number of production workers and $\delta \in (0\ 1)$ the economies-of-scale coefficient. Given θ_1 and w_1 the producer chooses ℓ^d_1 to maximize after-tax profit π_1:

$$\underset{\ell_1}{\text{Max}}\ \pi_1 = (1\text{-}t)(y(\ell^d_1 /(1 + \tau(\theta_1))) - w_1 \ell^d_1) \tag{17}$$

Profit-maximizing hiring $\ell^d_1(\theta_1,w_1,\sigma)$ is decreasing in w_1, θ_1 and σ with this decreasing-returns-to-scale technology. This leads to hiring of

$$\ell^d(\theta_1,w_1,\sigma) = (1/(1+ \tau(\theta_1)))^{\delta/(1-\delta)}(\mu\delta/w_1)^{1/(1-\delta)} - \sigma E_o\, \tau(\theta_1) \tag{18}$$

[23] 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 explore the implications of that UI tax in online Appendix D.

Labor demand is rising with increased TFP μ and falling with increased wage w_1. 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 less need for recruiters and for new hires. The unemployment rate (u_1) is defined.

$$u_1 = (g_1 - \ell_1)/g_1 \tag{19}$$

3.6. **Conditional transitional probabilities of labor force status in period one.**

For the empirical tests below, I derive the conditional transition probabilities from labor status k in period zero to labor status m in period 1 (c_{km}) for each combination k, m ϵ (U, E, N). For example, the conditional transition probability from unemployment in period zero to employment in period one is:

$$\begin{aligned} c_{UE} &= (g_1/g_o)\, e_1^{*} f(\theta_1) && \text{for } g_1 < g_o \\ &= e_1^{*} f(\theta_1) && \text{otherwise} \end{aligned} \tag{20}$$

When labor-force participation shrinks from period 0 to period 1 ($g_1 < g_o$), the conditional probability of transitioning from unemployment to employment is reduced by the share of U_o that leaves the labor force. Otherwise (i.e., when labor-force participation is constant or increasing), the conditional probability will only change with the endogenous search intensity and labor-market tightness. The asymmetry stems from the labor-force-participation decision: if $g_1 > g_o$ and an individual was initially in the labor force then that individual will not choose to exit the labor force. By contrast, the conditional probability of transitioning from unemployment in period zero to not in the labor force in period 1 can be written:

$$\begin{aligned} c_{UN} &= ((g_o - g_1)/g_o) && \text{for } g_1 < g_o \\ &= 0 && \text{otherwise} \end{aligned} \tag{21}$$

The asymmetry is evident: when labor-force participation shrinks, this conditional probability grows larger, while when labor-force participation expands those in the labor force will have zero probability of leaving. The specifications of the nine conditional transition probabilities defined in the model are presented in online Appendix B.

3.7. The government's UI program. The UI program provides C^u_1 to the eligible unemployed. As the replacement rate $R_1 = C^u_1/w_1$ rises the program becomes more generous to the unemployed relative to those employed. The government pays for the UI payment through a profit tax t_1 levied on the firms. The rate is

$$t_1 = (g_1-\ell_1)\, C^u{}_1/(y_1 - w_1\ell_1) \tag{22}$$

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

$$y_1 = (g_1-\ell_1)\, C^u{}_1 + \ell_1\, w_1 + (1-t_1)\pi_1. \tag{23}$$

The wage is determined through Nash bargaining over the after-tax surplus $S_1 = (1-t_1)(y_1 - w^m\ell_1)$ as in Pissarides (2000). The minimum wage w^m is received by all employed workers, but w_1 includes as well the share ν of the surplus that labor receives in the Nash bargain.

$$w_1 = w^m + \nu(1-t_1)((y_1/\ell_1) - w^m) = w^m(1- \nu(1-t_1)) + \nu(1-t_1)(y_1/\ell_1) \tag{24}$$

Total product is thus divided among three groups: business owners receive the after-tax profit, workers receive $w_1\ell_1$, and the unemployed receive $C^u{}_1$ financed by the tax t.

4. Comparative statics in job flows.

The research questions of this paper 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 rate will be denoted by use of "^" over the variable.[24]

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 TFP fixed in what follows.

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

- The elasticity of job-search intensity by UI-eligible individuals with respect to a one-percent increase in UI payments from equation (9) for constant θ_1 and w_1 is defined as ω_c.

$$- \omega_c = ((\chi-1)/(\gamma-1))(1/(1-R_1^{\chi-1})) \qquad < 0 \tag{25}$$

[24] For simplicity in exposition I present the derivations for σ=0 and ν=0. The implications follow through for other values of these as shown in online Appendix A.

ω_c is defined to be positive but an increase in $C^u{}_1$ will have an unambiguously negative effect on job-search intensity. The effect is larger in absolute value for larger $C^u{}_1$ through its effect on R_1. This follows from the moral-hazard effect of increased benefits on job-search intensity.

Defining $\varepsilon = V(C^u{}_1)/g_1$, the labor-force-participation elasticity with respect to one-percent increase in UI payment for UI-eligible individuals for constant θ_1 and w_1 is derived from equation (12)

$$\kappa_c = [\varepsilon(\chi\text{-}1) - \gamma(1\text{-}\ \varepsilon)\omega_c] \tag{26}$$

κ_c is ambiguous in sign: the first component is the positive marginal utility benefit of rising UI payments on expected income, while the second component represents the negative marginal utility cost in search intensity of increasing the replacement rate.[25] Labor-force participation will rise with an increase in κ_c for given degree of labor-market tightness.

As is shown below, the relative size of these two elasticities determines whether the moral-hazard effect or the labor-force-participation effect will dominate in response to a UI-payment increase.

It is also important to consider the impact of an increase in UI payments on those individuals not eligible for UI benefits – first-timers in the labor market, those who have been out of the labor market for some time, or those who have exhausted their benefits. The ω_c elasticity for this group derived from equation (11) is zero for fixed θ_1 and w_1. The κ_c elasticity derived from equations (12) and (13) is zero for this group as well. There will be effects of increased $C^u{}_1$ through the general-equilibrium determination of θ_1 and w_1. I will explore those implications through incorporation in the simulation model presented below.

4.1 For constant g_1: The Moral Hazard effect of increasing $C^u{}_1$ The moral-hazard response to an increase in $C^u{}_1$ works through its effect on labor-market tightness θ_1. Holding g_1 constant, equilibrium market tightness is determined by labor-market equilibrium.

$$\hat{\theta}_1 = (\omega_c/\varphi)\ \hat{C}^u{}_1 - ((1/(1\text{-}\delta)) + \omega_w)/\varphi)\ \hat{w}_1 \tag{27}$$

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

where $\alpha_1 = \delta(1\text{-}\eta)\tau_1 > 0$. Market tightness is increasing with a rise in $C^u{}_1$ due to the reduction in optimal search intensity. The coefficient ω_c measures the direct impact and is divided by the general-equilibrium search-friction terms in the coefficient φ. The term $\eta\gamma/(\gamma\text{-}1)$ is the coefficient of demand-side search cost related to labor tightness, while α_1 is an aggregate of the costs to the firm of recruiting workers.

[25] In simulations reported in online Appendix C, κ_c is positive for parameters calibrated to match the US economy and for a wide range of numerical replacement rates.

With the increase in market tightness there is a decline in equilibrium employment and output. The unemployment rate will rise. Labor-force participation (g_1) is unchanging by assumption. The observed wage will fall with the increase in C^u_1 through both the increase in market tightness and the reduction in surplus to be distributed in wage bargaining due to the increased tax. This fall in wage will further reinforce the direct effects of increased C^u_1 on market tightness and thus on the other endogenous variables. It will also reduce the optimal search effort for the UI-ineligible individuals.

The conditional transition probabilities can be derived in "growth rate" form as well. For example, defining $\xi_1 = (e_1^* f(\theta_1)/(1- e_1^* f(\theta_1))$ as the ratio of those unemployed who find jobs to those who do not,

$$\hat{c}_{UU} = [\xi_1\ \alpha_1\ \omega_c/(\varphi(1\text{-}\delta))\ ]\ \hat{C}^u \qquad > 0 \tag{28}$$

$$\hat{c}_{UE} = [-\ \alpha_1\ \omega_c/(\varphi(1\text{-}\delta))]\ \hat{C}^u \qquad < 0 \tag{29}$$

$$\hat{c}_{UN} = 0 \tag{30}$$

If labor-force participation is exogenous and fixed, then the two remaining conditional probabilities out of unemployment or of employment will change in equal and opposite effect in response to a change in UI payments. Equations (28), (29) and (30) illustrate the impact on transition probabilities out of unemployment, and those out of employment are reported in the online Appendix B.

4.2. For variable g_1: Balancing Moral Hazard and Labor-Force Participation effects. When labor-force participation responds to labor-market tightness and the size of the UI payment, comparative-static effects are potentially very different. For positive κ_c and unchanging labor-market tightness, an increase in UI payment leads to greater labor-force participation. [26] Greater labor-market tightness will also increase labor-force participation.

With the endogeneity of g_1, equilibrium labor-market tightness is no longer unambiguously increasing in C^u. $\hat{\theta}_1^+$ is the equilibrium response in this case:

$$\hat{\theta}_1^+ = ((\omega_c - \kappa_c)/\varphi^+)\ \hat{C}^u_1 - (((1/(1\text{-}\delta)) + \omega_w + \kappa_w)/\varphi^+)\ \hat{w}_1 \tag{31}$$

$$\varphi^+ = [\varphi + (\eta\gamma/(\gamma\text{-}1))(1\text{-}\varepsilon)] > 0$$

The numerator includes the elasticity of search intensity (ω_c) as well as the elasticity of labor-market participation (κ_c). When labor-force participation rises labor-market tightness will be reduced, other things equal. While ω_c is unambiguously positive the numerator will be smaller

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[26] The sign and magnitude of κ_c is in theory ambiguous. In the calibration to labor-market parameters to aggregate US outcomes in the next section, κ_c is greater than zero and is declining in magnitude as C^u_1 increases.

than ω_c for positive κ_c.[27] The denominator remains unambiguously positive while its size is larger than φ due to the adjustment costs in labor-force participation. Increased C^u_1 in this economy has the ambiguous effects on labor-market tightness illustrated in equation (30): the positive impact through reduced search effort remains as in the exogenous-g case, but there is now a countervailing effect proportional to κ_c due to increased labor-force participation that will reduce labor-market tightness. The increase in C^u_1 will increase the profit tax and reduce the bargained w_1, and that will once again reinforce the impact of increased C^u_1 on the other endogenous variables.

Individuals ineligible for UI payments will not respond directly to an increase in C^u_1, but in this case will also reduce search intensity due to the induced fall in the bargained wage. This leads to an ambiguous effect on the group's cutoff $\bar{g}_1$.

The comparative-static effects of a one-percent increase in UI payment are reported for both exogenous-g_1 and for the unconstrained case in the two columns of Table 2. Positive κ_c is a sufficient condition for increased C^u_1 to raise labor-market participation. Under this condition the labor-market-tightness elasticity will be lower than in the previous case, and for sufficiently large κ_c it could be negative. Equilibrium output and employment respond to increased C^u_1 through the same labor-market-tightness effect, but the magnitude of the elasticity will be proportional to $(\omega_c-\kappa_c)/\varphi^+$ rather than ω_c/φ. The unemployment rate will rise for the same reason as in the earlier case, as indicated by the second term in the bracket. It will also rise due to increased labor-force participation as illustrated by the first term in the bracket. The wage will be reduced through the taxation channel but the labor-market-tightness effect is now ambiguous.

The comparative statics summarized in Table 2 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 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.

4.3. Calibration and Solution of the General-Equilibrium Model. I have calibrated the model to fit the aggregate equilibrium outcomes in the US in the period before the financial crisis. The specifics of the calibration are provided in online Appendix C, while the parameters used and sources of data matched in calibration are reported in Table 3. The parameter ψ is not used in the theoretical model but is added to the simulation model to measure the share of unemployed that believe themselves eligible for UI payments.[28] Those unemployed individuals believing themselves ineligible are modeled as governed by $\bar{g}_1$ and $\bar{e}_1^*$.

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[27] $\omega_c - \kappa_c$ can also be written as $[(1+\gamma(1-\varepsilon))\omega_c - \varepsilon(\chi-1)]$. The first term is the moral-hazard effect on market tightness, increased by its effect on labor-market participation. The second term is the welfare improvement due to an increase in UI payments received when unemployed. The second term will dominate for large C^u_1 or large risk aversion parameter χ and in those cases labor-market participation will rise and tightness will decline as C^u_1 rises.

[28] Vroman (2009) reports that in the early 2000s the percentage of individuals who were eligible for UI payments but did not file to receive them was 50 percent. The major reason given for not applying was that they thought they were not eligible.

Including labor-force non-participation as a choice in this model has four important implications for the benchmark equilibrium (with equilibrium values reported in Table 3):

- "Not in the labor force" (denoted N_1) becomes an endogenous 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 rises with θ_1.
- Labor market equilibrium is characterized by a higher θ_1.

  Higher θ_1 leads to a lower share of employment in equilibrium. The share of unemployed is also smaller, as a fraction of the working-age population chooses N_1
- The elasticity of labor-force participation with respect to C^u_1 (κ_c) is positive but smaller than the elasticity of effort with respect to C^u_1 (ω_c). θ_1, ℓ_1 and y_1 are reduced by the impact of C^u_1, while changes to e_1 and u_1 are larger than in the fixed-labor-force participation case.

Table 4 reports two comparative-static simulations of the impact of UI reform: the first with g_1 fixed at the labor-force-participation ratio of 0.668 and the second with g_1 determined endogenously in the model. In the sections that follow, "UI reform" refers to a reduction in the value of UI payments to those qualifying. The UI reform introduced in simulation is one that lowers the replacement rate R_1 from 42 percent of the wage to 28 percent of the wage.[29]

The theoretical predictions of Table 2 for fixed g_1 are confirmed in simulation in the second column of results in Table 4. In comparing the results in the second column with the results of the Benchmark case in column 1, θ_1 falls with UI reform. The worker's optimal search intensity rises. 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 employed and not needing to search, $\mathcal{U}^{Ce}$ remains the same. $\mathcal{U}^e$, the utility of the wage reduced by the average disutility of increased search effort, falls due to greater search intensity e_1^*. For the unemployed, $\mathcal{U}^u$ is reduced both because of the reduction in C^u_1 and the disutility of increased search effort. The utility for workers ineligible for UI payments (or believe themselves ineligible) is less than that for those eligible due to the greater optimal search intensity of those ineligible; this utility is 9 percent lower after UI reform. Total worker utility falls slightly due both to non-pecuniary search cost and to falling UI payments to the unemployed. The after-tax profit rate for the firm rises.

When labor-force participation adjusts in response to the same UI reform, the key theoretical finding of this paper is replicated: UI reform that reduces UI payments leads to a reduction in labor-market participation. This is evident in the third column of results in Table 4. 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_1" 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_1. The unemployment rate falls after the UI reform, but that is due in part to increased non-participation in the labor force. Total worker utility

[29] Landais et al. (2018b) calculates the effective replacement rate for the US that controls for both payments and durations of state UI programs. It reports that this effective replacement rate was 42 percent on average prior to the Great Recession and was 28 percent by the end of 2014. I use these two values to calibrate this simulation.

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_1" case. Pre-tax profits rise, and after-tax profits rise by more as the amount of tax collected for UI payments falls. The minimum wage for this simulation is 0.90 and the simulated wage including labor's share of the surplus is 0.904. There is little impact on the wage in these simulations due to the calibrated small bargaining share of labor.

Figure 2 illustrates the equilibrium shares of the working-age population unemployed and not in the labor force at various replacement rates R_1 for the calibrated model. Low replacement rates lead to low unemployment and large shares outside the labor force. As the replacement rate rises, other things equal, 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 model presented here uses the simplification that UI payments are financed through corporate taxes to maintain the focus on the impact of UI payments on labor-force participation. It is more realistic to think of the financing for UI payment through taxes on the wage bill. This introduces a distortion to the firm's hiring decision that complicates the expressions presented but does not change the qualitative results. In the online Appendix D I present simulations based on that payment mechanism. The tax on the wage bill introduces a new distortion to market equilibrium and thus lower welfare on average. The conclusions here on the quantitative importance of the labor-force participation decision are replicated in that model as well.

The model inclusive of labor force participation provides clear predictions for the conditional probability of working-age individuals switching among U_t, N_t and E_t status from period 0 to a post-UI reform period 1. I test those predictions for the UI reform observed in North Carolina in the next section.

5. An Empirical Test of the Relative Importance of the Labor-Market-Participation Effect.

The theoretical model provides clear and testable predictions of changing labor status in response to UI policy reform.

- The direct test of the importance of modeling labor-market participation will examine the individual choice to enter or exit the labor force in response to UI reform. UI reform that creates a less-generous UI program for recipients will cause labor-force exit: c_{UN} will rise. c_{EN} will rise as well to the extent that employed workers are separated from their jobs and may choose not to incur search costs.
- The indirect test will be to test the response of c_{UE} and c_{UU} in response to UI reform. A dominant moral-hazard effect to a less-generous UI payment will lead to c_{UE} rising and c_{UU} falling; a dominant labor-market-participation effect will lead to both c_{UE} and c_{UU} falling while c_{UN} is rising.

5.1. Calculating the conditional transition probabilities for the US.

Using the CPS, I construct the month-by-month labor status -- employed (E_{it}), unemployed (U_{it}), or not in the labor force (N_{it}) -- for individual i in month t.[30] The repeated individual responses over successive months in the CPS sample are used to generate the observed labor-market conditional transitions.[31] The observed shares of individuals transitioning from one labor status in period t to each of the three possible labor states in period t+1 is the statistic of conditional transition probability. The theory of the previous section was for individuals still potentially in the labor force. To eliminate individuals who might be too young or too old to be active labor-market participants, I restrict the sample to those with ages between 25 and 54 inclusive.

5.2. A state-level test of the Moral-Hazard and Labor-Force-Participation responses to UI reform.

I use a difference-in-differences event-study test to identify the effect of UI reform. North Carolina provides an excellent event study. The month-to-month conditional transition probabilities for individuals are grouped by quarter. The treatment group includes individuals resident in North Carolina. The control group includes individuals living in the rest of the United States (ROUS). The event study will test whether the conditional transition probabilities of the treatment state differ from those observed in the control group. Statistical significance is measured at the 95 percent level of confidence.

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 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 $535 to $350. Second, the number of weeks for which recipients are eligible for benefits fell from 26 (or as many as 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 ended on 1 July 2013 in North Carolina; for the rest of the US they were eliminated as of 31 December 2013.[32] I interpret

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[30] The assignment to labor status each month is based upon the response to the labor force question in the survey. The individual is classified employed if responding "employed – at work" or "employed – absent". The individual is classified unemployed if responding "unemployed – looking" or "unemployed – on layoff". The individual is classified "not in the labor force" if responding "not in labor force – retired", "not in labor force – disabled", or "not in labor force – other". IPUMS-CPS (University of Minnesota, www.ipums.org) created the unique identifiers used in intertemporal matching of individuals.

[31] This use of CPS 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 undertaken to check the results reported here. All robustness checks led to qualitatively similar results and significance levels to those reported here.

[32] There were other features of the North Carolina UI reform as well: the state (a) increased the maximum experience rating (tax) that employers would have to pay the UI Trust Fund by 0.06 percentage points of

these changes as a reduction in C^u_t that is observed in North Carolina but not in the rest of the US at that time. It is also a UI reform not driven by systematic differences in labor-market outcomes in North Carolina: the timing of the reform relative to reform (or non-reform) in other states was independent of labor-market transition outcomes in previous quarters.[33]

Given the quarterly conditional transition probabilities from U_t, N_t and E_t into U_{t+1}, N_{t+1} and E_{t+1} in the CPS sample, the null hypothesis is that these probabilities for North Carolina (NC) were not statistically different from those in the rest of the US (ROUS) during the period immediately before and after UI reform. Alternative hypothesis 1 is that the conditional transition probabilities in NC differed significantly from those of ROUS in the directions predicted by the "moral hazard" effect. Alternative hypothesis 2 is that the conditional transition probabilities in NC differed significantly from those of ROUS in the direction predicted by the "labor-force-participation" effect.

I implement this with a linear-regression specification. The data are the individual responses of labor status in the CPS. I sort the data into three subsets (indexed j) dependent upon whether the individual's initial labor status is E_{it}, U_{it} or N_{it}. For each data subset I define three binary variables taking the value 1 if the period t+1 labor status is equal to k = E_{it+1}, U_{it+1} or N_{it+1} and 0 otherwise. I then denote the dependent variable in the regression as $L_{ijkst+1}$ with j indexing the labor status in period t, k indexing the labor status in period t+1 and s indexing the state of residence. $L_{iUEst+1}$, for example, is a binary variable taking the value 1 if for individual i the period-t labor status was U_{it} , period-t+1 labor status was E_{it+1} and individual i's state of residence is s, and 0 otherwise.

For each of these subsets, I run three regressions of the form:

$$L_{ijkst+1} = \alpha_{jk} + \Sigma_{t=2}\, \beta_{jkt}\, I_t + \Sigma_t\, \gamma_{jkt}\, I_t * I_i^{NC} + \varepsilon_{ijkt} \qquad (31)$$

The coefficient α_{jk} is the intercept for the (j,k) equation: the conditional transition probability from j to k in period 1. I_t is a binary variable taking the value of 1 for period t and 0 otherwise, and $\alpha_{jk} + \beta_{jkt}$ is the period-t conditional transition probability from labor status j to labor status k for the ROUS. I_i^{NC} is a binary variable taking the value 1 if individual i lives in North Carolina and 0 otherwise. γ_{jkt} is the difference between the (j,k) conditional probability in NC and in the ROUS and corresponds to Δc_{jkt} , the difference between the conditional transition probabilities in NC and

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the wage bill; (b) eliminated "substantial fault" as partial disqualification from receiving unemployment insurance benefits; (c) changed the definition of "suitable work," which forced anyone who has received at least 10 weeks of payments to accept any work that pays at least 120% of their weekly benefit amount; and (d) removed the health exclusion that allowed people to receive UI payments if they had to leave a job due to disability or health problems. I treat the first three as de minimis changes. The role of disability in the decision to leave the labor force is an important alternative explanation, and I report findings on this in section 5.3. Thank you to a referee for highlighting these other features.

[33] In the aftermath of the 2008 recession, all states faced increased draws from their UI state trust funds, and most incurred debts to the Federal UI Trust Fund. As a result, the decision to reform UI policy in North Carolina was in response to those previous unemployment-heavy quarters. The point of this paragraph is a narrower one: North Carolina faced similar financial pressures to other states, but only North Carolina undertook such a major reduction in UI payments and in maximum number of weeks in eligibility.

in ROUS. The random error term is denoted ε_{ijkt}; in estimation and hypothesis testing it is clustered by household.

Table 5 reports the difference in conditional transition probability between NC and the ROUS as well as statistical tests of the significance of this difference for each quarter in 2013.[34] Figures 3 and 4 illustrate the findings from this analysis and extend it to previous and following quarters.

Figure 3 illustrates the test of significance for Δc_{UNt}, the difference in the conditional probability of transition from U_{it} to N_{it+1} in a given quarter t between North Carolina and ROUS. 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 provides the measure of γ_{UNt} , or Δc_{UNt}. A positive value in period t indicates that residents of North Carolina are more likely than those in ROUS to transition from unemployment to "not in the labor force" during the period observed.[35] In the period prior to implementation of the UI reform, Δc_{UNt} is insignificantly different from zero. Beginning in the third quarter of 2013 (2013 q3), however, Δc_{UNt} 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 those unemployed of working age choosing to exit the labor force in NC relative to the ROUS.[36] These results support the second alternative hypothesis – the labor-force-participation effect.

In Figure 4, I report the impact of this UI reform on Δc_{UEt}. If the moral-hazard effect of UI reform dominates the labor-market-participation effect, then UI reform will lead to positive Δc_{UEt}. UI reform is not associated with significant Δc_{UEt} in any of the 20 quarters illustrated here. Rather than causing relatively more transition to employment from unemployment, the point estimates are zero or negative in four of the six quarters immediately following implementation – a result consistent with the labor-force-participation effect but not the pure moral-hazard effect.

It is fair to ask whether the UI reform simply caused greater churning of participation states: perhaps these significant Δc_{UNt} were offset by significant Δc_{NUt}, or by Δc_{NEt} followed by Δc_{EUt}. Table 5 provides the event-study results for all possible transitions during the four quarters of 2013.[37] The null hypothesis of no differences between NC and ROUS cannot be rejected in almost all other transitions. The signs of the differences are consistent with the theoretical predictions of Table 2. The direct test of the labor-force-participation effect illustrated in Figure 3 is found with Δc_{UNt}: we can reject the null hypothesis in favor of this alternative. The lack of a moral-hazard effect illustrated in Figure 4 is reported in Δc_{UEt}: there is a negative impact on the probability of transition from unemployment to employment, not the positive impact predicted by the moral-hazard effect.

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[34] The notation Δc_{jk} for j, k ϵ (U, E, N) refers to the difference c_{jk} for NC minus c_{jk} for ROUS.

[35] The coefficient associated with this difference in transition probability is indicated by the black dot in the figure, while the blue vertical interval indicates the 95-percent confidence interval around that coefficient.

[36] These statistics are presented in online Appendix K. I also provide there a summary table indicating the small number of times between 2000q1 and 2013q3 that the conditional transition probabilities in North Carolina differed significantly from those in the ROUS.

[37] The coefficients and confidence intervals of Figures 3 and 4 for the four quarters of 2013 are reported in Table 4 in the Δc_{UNt} and Δc_{UEt} blocks.

The labor-force-participation effect also predicts that Δc_{ENt} will be positive as is evident in Table 5 post-UI reform. The indirect hypothesis tests are based on Δc_{UUt} and Δc_{UEt}. 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 for NC relative to ROUS: those conditional probabilities are reduced as the conditional probability to transition out of the labor force has increased. By all measures, the elasticity of labor-force participation with respect to UI payments is dominant in this pattern of changed conditional probabilities.[38]

The significant differences between NC and ROUS in response to UI reform are in nearly all cases associated with the implementation of the reform in the third quarter of 2013. In 2013q2, though, we observe a significant positive coefficient for Δc_{EEt} and a negative coefficient for Δc_{EUt}. This is an announcement effect following the first-quarter 2013 vote on the UI reform legislation, but one that is associated with discouraged frictional unemployment rather than moral hazard.

The regressions from which these results are drawn span the period 2000-2019. As reported in the online appendix, there are very few significant coefficients to distinguish North Carolina's conditional transition probabilities from those of the ROUS in the period 2000q1-2013q2. This is consistent with the maintained hypothesis that North Carolina's behavior is indistinguishable from that of the ROUS prior to the UI reform.

5.3. What Role does Disability Play?

Those "Not in the Labor Force" (NILF) include individuals who self-report disability status. In the CPS, respondents indicate whether their declaration of NILF is in fact associated with a disability. For the period 2000q1 to 2019q4, only 5 percent of the respondents reported themselves unemployed. Of these, 18.5 percent reported a transition to NILF in the following month. (Among the others, 57.7 precent reported remaining unemployed and 23.8 percent reported being employed.) Within the 18.5 percent, the majority of respondents attributed their transition to NILF to activities outside the labor force (e.g., unpaid childcare) or being discouraged workers; disability was given as an explanation by only 1.4 percent of these. Retirement was given as an explanation by 0.5 percent of these respondents.

During the period of UI reform in North Carolina the significant increase in U-to-N transition probability in North Carolina was almost entirely attributed to activities outside the workforce or to being a discouraged worker. Significant differences between North Carolina and the ROUS in transitions citing disability were observed in 2014q1 and 2014q2, but in magnitude these effects were ¼ as common as those citing activities outside the workforce or being a discouraged worker. Details are provided in online Appendix F.

[38] 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 in this sample are undertaken at the household (rather than individual) level.

5.4. Do those in persistent unemployment spells transition differently from others?

The theory presented earlier suggests that individuals who have exhausted their state UI payments for the year will respond differently to the reduction in UI payment value associated with this reform: they will search more intensively but will have reduced labor-force participation. Re-estimation of the conditional transition probabilities out of unemployment while controlling for the length of the individual's current unemployment spell supports this prediction in the case of North Carolina. The details can be found in online Appendix I.

5.5. Other robustness checks. As a check for these empirical results, I have redone the analysis using different control groups: instead of comparing North Carolina to the rest of the US, I also used the group of Southern states as comparator and created a synthetic-control comparator as proposed by Abadie, Diamond and Hainmuller (2010). I also redid the analysis using the CPS sample weights in a weighted-least-squares regression and in using a subset of observations to lessen the importance of repeated observations of an individual. The statistical results of these robustness checks are reported in online appendix D. The conclusions reported above are unchanged.

6. Conclusions.

The decision to participate in the labor market is an important determinant of labor-market equilibrium. I nest that decision in a theoretical labor-search and matching model. 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 reductions in UI payments – increased employment, increased output, lower unemployment rate due to more intensive search – are artifacts of the assumption that the decision to participate in the labor force is invariant to the policy reform. Once the choice of labor-force participation is incorporated in the analysis, I demonstrate that there is another set of likely outcomes from UI reform that reduces the value of UI payments – 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 return to the employer rises.

In an empirical analysis using labor-force-status transition data from the Current Population Survey, I demonstrate that the outcomes associated with UI reform in North Carolina reflect the dominance of labor-force-participation effects over the moral-hazard effects.

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.

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Table 1: Welfare payoffs by class of worker

For continuously employed worker g:	$\mathcal{U}^{C}(w_1,g) = V(w_1)$
For searching and UI-eligible employed worker g:	$\mathcal{U}^{E}(w_1,e_1,g) = V(w_1) - \psi(e_1,g)$
For searching and UI-eligible unemployed worker g:	$\mathcal{U}^{u}(C^{u}{}_1,e_1,g) = V(C^{u}{}_1) - \psi(e_1,g)$
For searching non UI-eligible employed worker g:	$\mathcal{U}^{FE}(w_1,\bar{e}_1,g) = V(w_1) - \psi(\bar{e}_1,g)$
For searching non UI-eligible unemployed worker g:	$\mathcal{U}^{Fu}(z,\bar{e}_1,g) = V(z) - \psi(\bar{e}_1,g)$
For g out of the labor force:	$\mathcal{U}^{N}(g) = V(z) = 0$

Table 2: **Comparative-statics results: one-percent increase in C^u**		
	Exogenous g_1	Endogenous g_1
$\hat{\theta}_1$	$\omega_c/\varphi \quad > 0$	$(\omega_c - \kappa_c)/\varphi^+$
$\hat{e}_1^*$	$- [\omega_c/\varphi](\eta+(\alpha_1/(1- \delta))) \quad < 0$	$- (\omega_c/\varphi^+)[\eta+(\alpha_1/(1-\delta))] - \varepsilon(\chi-1)/\varphi^+ \quad < 0$
$\hat{g}_1$	----------------------------	$(1/\varphi^+)[\varphi\varepsilon(\chi-1) - (1-\varepsilon)\gamma\omega_c(\eta+\alpha_1/(1-\delta))]$
$\hat{\ell}$	$- (\alpha_1 /(1- \delta))(\omega_c/\varphi) \quad < 0$	$- (\alpha_1/(1- \delta))((\omega_c - \kappa_c))/\varphi^+$
$\hat{y}$	$- (\alpha_1 /(1- \delta))(\omega_c/\varphi) \quad < 0$	$- \delta (\alpha_1/(1- \delta))(\omega_c - \kappa_c)/\varphi^+$
$\hat{u}$	$(\ell/(g_1-\ell_1))(\alpha_1/(1-\delta))(\omega_c/\varphi) > 0$	$(\ell_1/(g_1-\ell_1))(\eta\gamma/(\gamma-1))[\omega_c(\varepsilon+\gamma(1-\varepsilon))+\varepsilon(\chi-1)]/\varphi^+ \quad > 0$
$\hat{w}_1$	$-[(w_1-w^m)/w_1)/(t/(1-t))/\varphi]$ $-(\alpha_1 /(1- \delta))(\omega_c/\varphi) \quad < 0$	$-[(w_1-w^m)/w_1)/(t/(1-t))/\varphi^+]-(\alpha_1 /(1- \delta))((\omega_c-\kappa_c)/\varphi^+) \quad < 0$

Table 3: Parameters used in calibration.

Parameter	Calibrated		Variable	Value Matched	Source
δ	0.9		Decreasing-returns-to-scale production		
η	0.5		Match variable	0.5	Petrongolo and Pissarides (2001)
μ	0.98		u_1	5.8 percent	2000 value
w	0.90		Working-age population	1 (normalization)	
υ	0.95		Pre-tax profits/wages and salaries	0.139	BLS, 2000 values
C^u_1 (pre-reform)	0.37		R_1 (pre-reform)	0.42	Landais et al. (2018b), 1990-2014 average
C^u_1 (post-reform)	0.264		R_1 (post-reform)	0.28	Landais et al. (2018b), 0.28 average after 2014
γ	2.5		LFP rate	0.66	2000 value
E_o	0.64		E_1	0.64	Ensuring steady-state consistency
N_o	0.33		N_1	0.33	
U_o	0.03		U_1	0.03	
σ	0.81				
χ	2				Author's calculations
Γ	5/6		V(.1)	0	
ι	12		V(z)	V(z)> 0 for z>.1	
ρ	0.013		Share of workers in recruiting	.025	1997 National Employment Survey
ψ	0.5		Share of eligible unemployed applying for UI payments	0.5	Vroman (2009)

Table 4: Simulations of the Labor Search Model

	Benchmark	UI Reform: Exogenous g_1	UI Reform: Endogenous g_1
μ	0.988	0.988	0.988
ρ	0.013	0.013	0.013
C^u	0.378	0.252	0.252
C^e (= wage)	0.900	0.900	0.900
ΔC	0.522	0.648	0.648
$\omega(C^u)$	1.149	0.926	0.926
$\kappa(C^u)$	0.678	n.a.	0.273
θ_1	7.280	5.772	6.449
e^*_1	0.267	0.374	0.388
g_1	0.668	0.668	0.644
N	0.332	0.332	0.356
ℓ^s	0.629	0.654	0.642
Unemployment rate	0.058	0.021	0.003
y_1	0.630	0.655	0.643
τ	0.036	0.032	0.034
π_1	0.061	0.067	0.066
UI payment total	0.015	0.004	0.000
v_1 (vacancies)	1.944	2.159	2.502
$\bar{e}_1$	0.370	0.416	0.394
$\bar{g}_1$	0.657	0.629	0.644
$\mathcal{U}^{Ce}$	0.741	0.741	0.741
$\mathcal{U}^e$ (average $g < g_1$)	0.370	0.321	0.324
$\mathcal{U}^u$ (average $g < g_1$)	0.242	0.083	0.076
$\mathcal{U}^{FE}$ (average $g < g_1$)	0.323	0.295	0.322
$\mathcal{U}^{FU}$ (average $g < g_1$)	-0.418	-0.446	-0.419
Aggregate worker utility	0.374	0.368	0.368
After-tax π rate	0.078	0.096	0.103

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
	Δc_{EN}				Δc_{NN}				Δc_{UN}		
2013q1	0.001	0.004	0.30		-0.019	0.018	1.03		0.051	0.040	1.30
2013q2	-0.006	0.004	1.52		0.003	0.019	0.14		-0.027	0.041	0.64
2013q3	0.004	0.004	1.11		-0.033	0.020	1.64		**0.124**	0.044	2.79
2013q4	0.004	0.004	1.02		0.008	0.020	0.40		**0.093**	0.046	2.01
	Δc_{EU}				Δc_{NU}				Δc_{UU}		
2013q1	-0.003	0.003	0.83		0.008	0.012	0.70		-0.095	0.050	1.92
2013q2	-0.006	0.003	1.88		-0.000	0.012	0.02		0.074	0.052	1.41
2013q3	-0.002	0.003	0.81		-0.021	0.013	1.64		-0.079	0.056	1.42
2013q4	-0.004	0.003	1.21		0.003	0.012	0.25		**-0.126**	0.058	2.19
	Δc_{EE}				Δc_{NE}				Δc_{UE}		
2013q1	0.001	0.005	0.29		0.011	0.015	0.75		0.044	0.043	1.03
2013q2	**0.012**	0.005	2.38		-0.002	0.016	0.11		-0.047	0.045	1.04
2013q3	-0.002	0.005	0.37		**0.054**	0.016	3.29		-0.045	0.048	0.94
2013q4	-0.000	0.005	0.04		-0.010	0.016	0.65		0.033	0.050	0.67
N Obs	4,803,680				1,023,999				238,239		
Avg Obs per quarter	60,046				12,800				2,978		
Wald (159)											
	782.0	E to N			**690.6**	N to N			**937.8**	U to N	
	2066.2	E to U			**1997.2**	N to U			**4030.3**	U to U	
	758.5	E to E			**1190.6**	N to E			**3376.1**	U to E	

GLS estimation, with errors clustered by household.

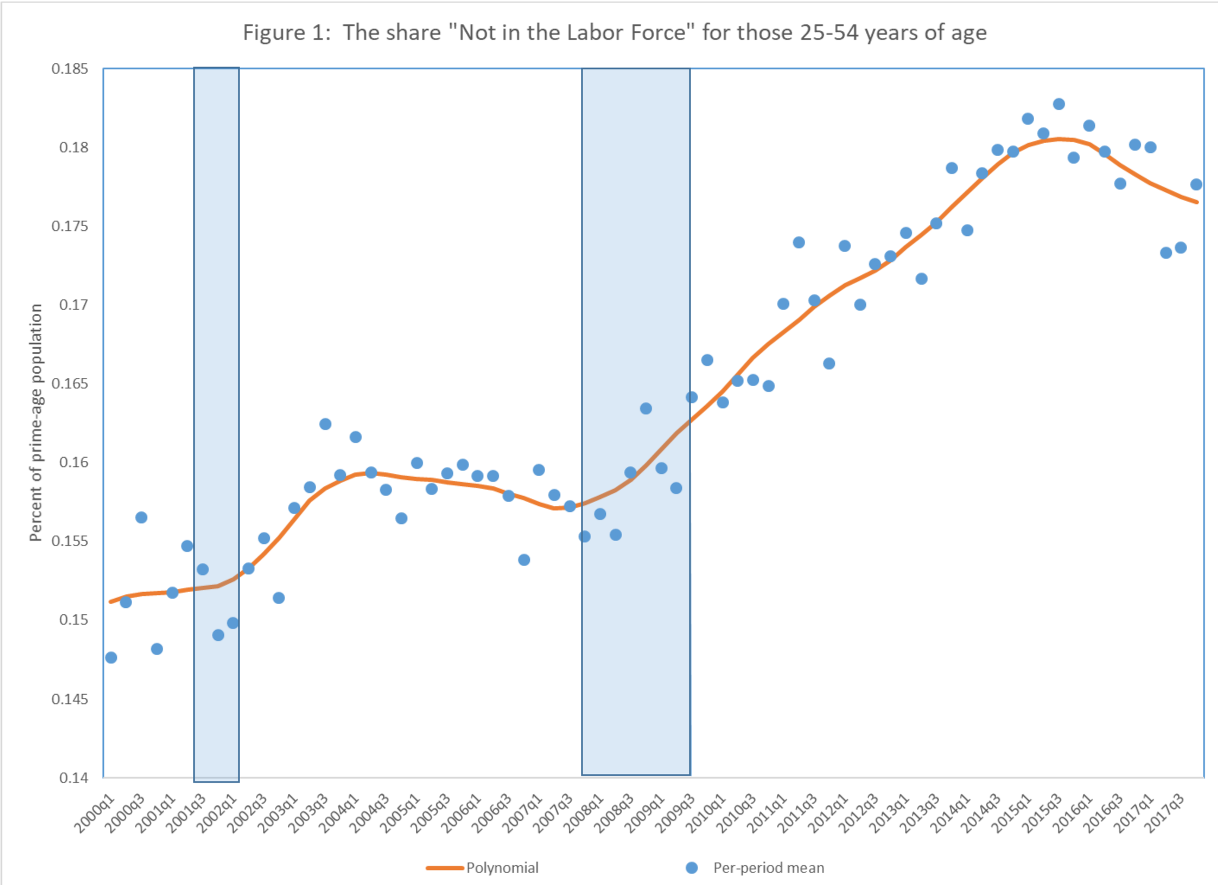
Figure Captions

Figure 1. The share "Not in the Labor Force" for those 25-54 years of age

Figure 2: Working-age population unemployed and "Not in the Labor Force"

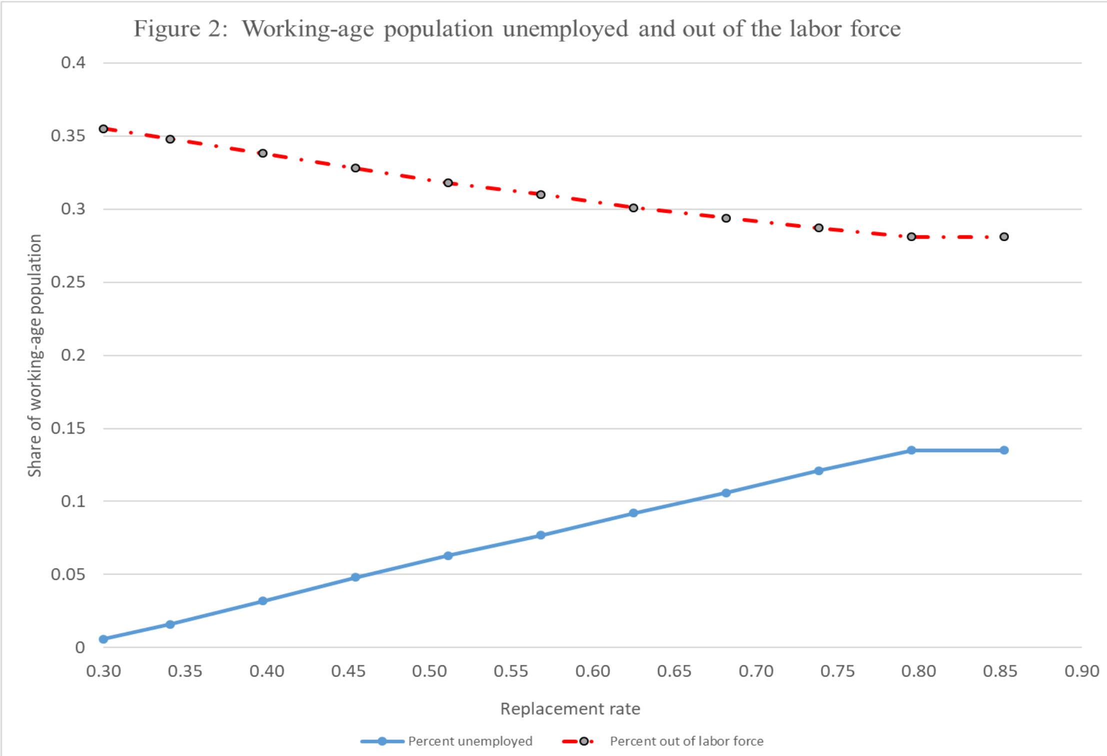
Figure 3: Transitions from Unemployment to Not-in-the-Labor-Force

Figure 4: Transitions from Unemployment to Employment.



Source: Current Population Survey, various months

Figure 1



Source: Author's calculations from repeated simulations using the calibration model.

Figure 2

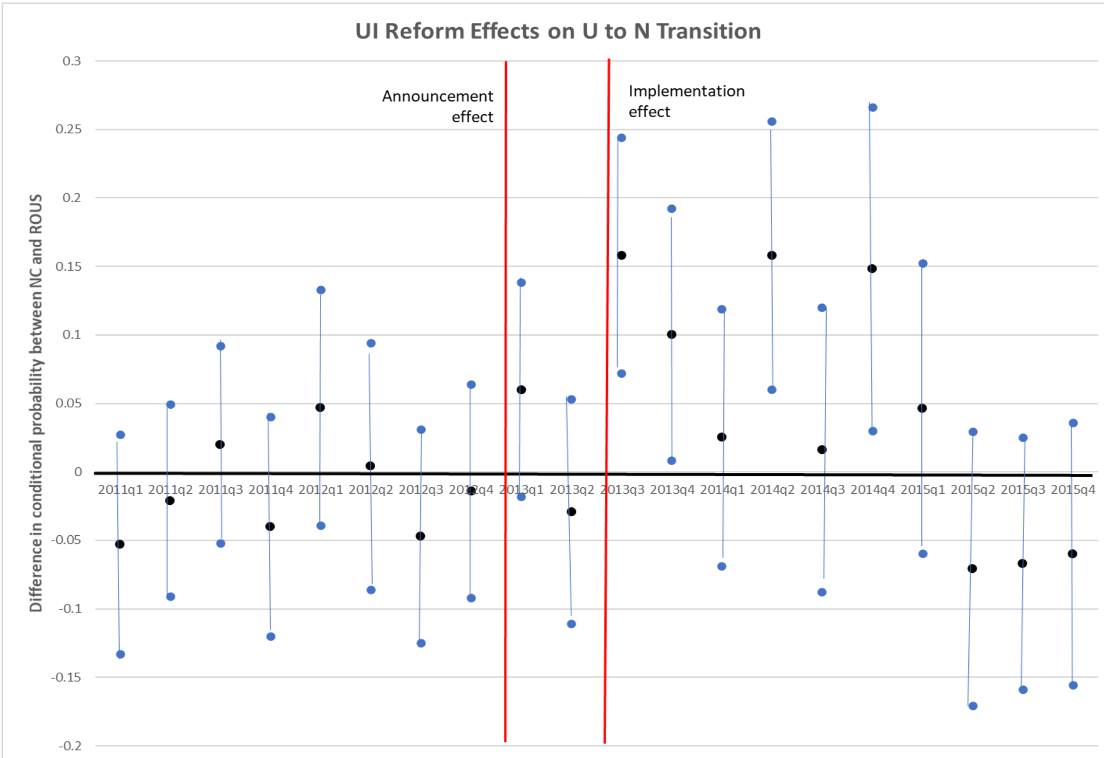

UI Reform Effects on U to N Transition
Announcement effect
Implementation effect
Difference in conditional probability between NC and ROUS
0.3
0.25
0.2
0.15
0.1
0.05
0
-0.05
-0.1
-0.15
-0.2
2011q1 2011q2 2011q3 2011q4 2012q1 2012q2 2012q3 2012q4 2013q1 2013q2 2013q3 2013q4 2014q1 2014q2 2014q3 2014q4 2015q1 2015q2 2015q3 2015q4

Figure 3

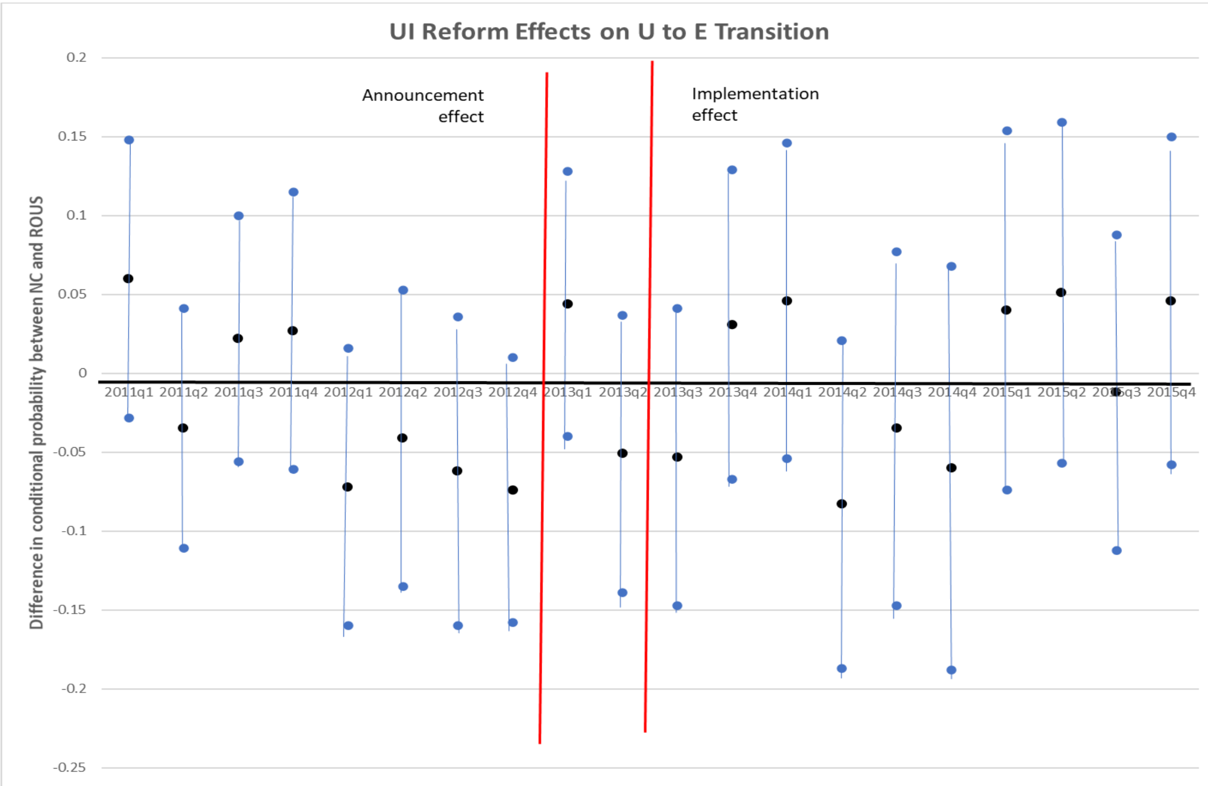

UI Reform Effects on U to E Transition
Difference in conditional probability between NC and ROUS
0.2
0.15
0.1
0.05
0
-0.05
-0.1
-0.15
-0.2
-0.25
Announcement effect
Implementation effect
2011q1 2011q2 2011q3 2011q4 2012q1 2012q2 2012q3 2012q4 2013q1 2013q2 2013q3 2013q4 2014q1 2014q2 2014q3 2014q4 2015q1 2015q2 2015q3 2015q4

Figure 4