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AN EQUILIBRIUM MODEL OF HEALTH INSURANCE PROVISION AND WAGE DETERMINATION

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CONFERENCE DRAFT

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Abstract

We investigate the effect of employer-provided health insurance on job mobility rates and economic welfare using a search, matching, and bargaining framework. In our model, health insurance coverage decisions are made in a cooperative manner that recognizes the productivity effects of health insurance as well as its nonpecuniary value to the employee. The resulting equilibrium is one in which not all employment matches are covered by health insurance, wages at jobs providing health insurance are larger (in a stochastic sense) then those at jobs without health insurance, and workers at jobs with health insurance are less likely to leave those jobs, even after conditioning on the wage rate. We show that for inefficient mobility decisions to occur in our framework requires that firms be heterogeneous with respect to their costs of providing health insurance. We estimate the primitive paramters of the model using data from the SIPP 1996 panel and find that the empirical implications of the estimated model are in accord with both the data and anecdotal evidence. Heterogeneity in the distribution of firm costs of health insurance does lead to some inefficient (in the short-run) mobility decisions, but the vast majority of moves from job to job are associated with productivity improvements.

1 Introduction

Health insurance is most often received through one's employer in the United States. According to U.S. Census Bureau statistics, almost 85 percent of Americans with private health insurance gain their coverage in this manner. This strong connection between employment decisions and health insurance coverage has resulted in a substantial amount of research exploring the possible explanations for and impacts of this linkage. One branch of the literature has investigated the relationship between employer-provided health insurance and job mobility. In spite of a substantial amount of research on the issue, the relationship between health insurance coverage and mobility rates has not as yet been satisfactorially explained. Basing their arguments largely on anecdotal evidence, many proponents of healthcare reform claim that the present employment-based system causes some workers to remain in jobs they would "rather" leave since they are "locked in" to their source of health insurance. While it is true that individuals with employer-provided health insurance are less likely to change jobs than others (Mitchell, 1982; Cooper and Manheit, 1993), the claim that health insurance is the cause of this result has not been established. Madrian (1994) estimates that health insurance leads to a 25 percent reduction in worker mobility, while Holtz-Eakin (1994) finds no effect, even though they use an identical methodology. Building on their approach, Buchmueller and Valletta (1996) and Anderson (1997) arrive at an estimate of the negative impact of health insurance on worker mobility that is slightly larger (in absolute value) than Madrian's estimate, while Kapur (1998) concludes there is no impact of health insurance on mobility. The most recent and only paper in this literature that attempts to explicitly model worker decisions, Gilleskie and Lutz (2002), finds that employment-based health insurance leads to no reduction in mobility for married males and a relatively small (10 percent) reduction in mobility for single males. Using statewide variation in continuation of coverage mandates, Gruber and Madrian (1994) find that an additional year of coverage significantly increases mobility, which they claim establishes that health insurance does indeed cause reductions in mobility. It must be noted that while this literature has extensively examined how the employment-based health insurance system affects mobility, the more pressing welfare implications have largely been ignored (Gruber and Madrian (1997) and Gruber and Hanratty (1995) are notable exceptions).

If health insurance coverage is strictly a nonpecuniary part of the compensation package offered by an employer, like a corner office or reserved parking space, the theory of compensating differentials would predict a negative relationship between the cost (or provision) of health insurance and wages conditional on the value of the employment match. Somewhat surprisingly (from this perspective), Monheit et al. (1985) estimate a positive relationship between the two. Subsequent research has attempted to exploit exogenous variation from a variety of sources in order to accurately identify the "effect" of health insurance on wages. Gruber (1994) uses statewide variation in mandated maternity benefits, Gruber and Krueger (1990) employ industry and state variation in the cost of worker's compensation insurance, and Eberts and Stone (1985) rely on school district variation in health insurance costs to estimate the manner in which wages are affected. All three conclude that most (more than 80 percent) of the cost of the benefit is reflected in lower wages. In addition, Miller (1995) estimates significant wage decreases for individuals moving from a job without insurance to a job with insurance. Hence, the research that examines to what extent health insurance costs are passed on to employees finds that a majority of the costs are borne by employees in the form of lower wages.

These results from the two branches of the literature seem inconsistent on the face of it. If individuals are bearing the cost of the health insurance being provided to them by their employer, why are they apparently less likely to leave these jobs? In addition, the absence of a conceptual framework that is consistent with many of the empirical findings on "job lock" and the indirect costs of health insurance to workers means that few policy implications can be drawn from the empirical results that have been obtained.

In this paper we attempt to provide such a framework by developing and estimating an equilibrium model of employer-provided health insurance and wage determination. The model is based on a continuous-time stationary search model in which unemployed and employed agents stochastically uncover employment opportunities characterized in terms of idiosyncratic match values. Firms and searchers then engage in Nash bargaining to divide the surpluses from each potential employment match. In contrast to traditional matching-bargaining models (e.g., Flinn and Heckman, 1982; Diamond, 1982; and Pissarides, 1985), we allow employee "compensation" to vary over both wages and health insurance coverage. In our framework, health insurance has two potential welfare impacts on the worker-firm pair. First, by inducing the employee to utilize health care services more frequently it increases his productivity in the sense of reducing the frequency of negative health outcomes that lead to the termination of the match. Due to search frictions, the preservation of an acceptable match provides a benefit to both the employer and the employee. Second, at least some individuals may exhibit a "private" demand for health insurance. We view this demand as mainly arising from the existence of uncovered dependents in the employee's household.

The main novelty in our modeling framework is our view of health insurance as a productive factor in an employment match, in addition to any direct utility-augmenting effects it may have. As a result, the level of health insurance coverage is optimally chosen given the value of the productivity match and idiosyncratic characteristics of the worker and firm. The productivity-enhancing nature of health insurance is modeled as follows. Since an employment contract may terminate due to the poor health of the employee, we view health insurance coverage as reducing the rate of "exogenous" terminations from this source. There is some support for our assumption in the empirical literature. Levy and Meltzer (2001) provide a very thorough survey of empirical research examining the relationship between health insurance coverage and health outcomes. With special reference to results from large-scale quasi-experimental studies and the Rand randomized experiment the authors conclude that there exists solid evidence to "suggest that policies to expand insurance can also promote health." Since we find overwhelming support for our assumption in the course of estimating the model,[1] our results could be taken as adding further (admittedly indirect) support to the proposition that health insurance improves health.

Starting from this premise, we are able to derive a number of implications from the model that coincide with both anecdotal and empirical evidence. Most basically, the model implies that not all jobs will provide health insurance, workers "pay" for health insurance in the form of lower wages, and jobs with health insurance coverage tend to last longer than those without (both unconditionally and conditionally on wage rates).

In order to explicitly investigate the "job lock" phenomenon, it is necessary for us to allow for on-the-job search with resulting job-to-job transitions. This necessitates that we model the process of negotiation between a worker and two potential employers which we are able to accomplish after making some stringent assumptions regarding the information sets of the the agents involved in the bargaining game. This is the first attempt to estimate such a model in a Nash bargaining context, though using French worker-firm matched data Postel-Vinay and Robin (2000) estimate

[1] We do not impose the theoretical restriction when the model is estimated, yet find that the estimated rate of "involuntary" job separations for the uninsured is an order of magnitude higher than is the rate for the insured.

an equilibrium assignment model that includes renegotation. They assume that firms appropriate all of the rents from the match, which is a limiting case of the Nash bargaining model we employ.

Estimates of the primitive parameters characterizing the model using data from the 1996 panel of the Survey of Income and Program Participation (SIPP) tend to support the model specification. In particular, we find that the rate of "involuntary" separations from jobs without health insurance is about 8 times greater than at jobs with health insurance. We find broad conformity with the implications of the model on a number of other dimensions as well. The raw data suggests that jobs providing health insurance are substantially longer than those that do not provide it, though due to substantial amounts of right-censoring of spell lengths the precise magnitude of the difference is difficult to determine. Model estimates imply that the ratio is on the order of 6. The model also does a reasonably good job of fitting the observed conditional wage distributions (by health insurance status) and the unconditional distribution of wages.

We are also able to look at the claim that nonuniversally-provided health insurance leads to inefficient mobility decisions. We demonstrate that for inefficient mobility decisions to occur requires that firms be heterogeneous in the costs of providing health insurance. In our framework, individual heterogeneity in the "private" demand for health insurance (i.e., as a preference shifter) does not cause, in itself, inefficient turnover decisions, even though this tends to be the focus of attention in the empirical job lock literature. Our estimates of the firm heterogeneity distribution suggests that there are differences in costs of providing health insurance, possibly associated with firm size or industry (not modeled here), but that the proportion of high cost providers is quite small. Thus the prerequisite for inefficient mobility to occur, competition between a high cost and low cost firm over a particular worker's services, occurs infrequently and as a result there are not a great many instances of "inefficient" turnover.

Due to data limitations and also for reasons of tractability we have decided to only consider whether health insurance is provided or not and additionally assume that the employer's direct cost of purchasing health insurance is exogenously determined. In reality the provision of health insurance involves many complicating features, both at the plan level and with respect to the costs that employers face. In particular, plans may cover both the worker (who supplies the productivity) and his family. Implicit in our empirical work is the assumption that health insurance coverage is extended to other family members. Moreover, for various reasons insurance contracts usually involve cost-sharing and risk-sharing features (e.g., deductibles, co-payment rates, and annual maximums, etc.). While these features are undoubtedly important factors in the decision-making process, the data requirements necessary to consider these elements are well beyond the scope of any currently available dataset. In a similar vein, employers can either purchase coverage from an insurance provider with whom they may be able to bargain over the premiums based on employee demographics or self-insure. By allowing firm-level heterogeneity in the cost of health insurance provision we are capturing (in admittedly indirect manner) some of these features. Lastly, although perhaps most importantly, our model ignores the relative tax advantage of compensation in the form of health insurance benefits. While the favored tax status of health insurance affects the wage and health insurance distribution, we argue that this cannot be the entire explanation for the role employers play in the provision of health insurance in the United States and the inclusion of tax parameters will not change the qualitative features of our model.

The remainder of the paper is structured as follows. In Section 2 we develop our search-theoretic model of the labor market with matching and bargaining. We begin by setting out the modeling framework in the absence of on-the-job (OTJ) search after incorporating simple forms of heterogeneity on the suppy and demand sides of the market. We then extend the model to allow for OTJ search and rigorously define and discuss the issue of inefficient turnover. Section 3 contains a discussion of the data used to estimate the equilibrium model, while Section 4 develops the econometric methodology. Section 5 presents the estimates of the primitive parameters and the implications of estimates for observable duration and wage distributions. In Section 6 we offer a brief conclusion.

2 A Model of Health Insurance Provision and Wage Determination

In this section we describe the behavioral model of labor market search with matching and bargaining. The model is formulated in continuous time and assumes stationarity of the labor market environment. We begin by laying out the structure of the most general model we will consider and then proceed by describing the solutions to some leading special cases. In this way we hope to illustrate which features of the theoretical structure are primarily responsible for capturing various empirical relationships between the dependent variables in which we are interested and to develop some intuition. The dependent variables of interest are wages, the event of being covered by employer-provided health insurance, and the durations of occupany of various labor market states. In each case we derive the decision rules utilized by searchers in determining when to accept an employment match and we characterize the equilibrium distribution of wages and employer-provide health insurance.

The key premise of the model is that health insurance has a positive impact on the productivity of the match. As is standard in most search-matching-bargaining frameworks, the instantaneous value of a worker-firm pairing is determined by a draw (upon meeting) from a nondegenerate distribution $G(\theta)$. This match value persists throughout the duration of the employment relationship as long as the individual remains "healthy." A negative health shock while employed at match value θ reduces the value of the match to 0 and results in what we will consider an exogenous dissolution of the employment relationship.[2] Thus an adverse health shock is considered to be one, potentially important, source of job terminations into unemployment. To keep the model tractable we have assumed that a negative health shock on one job does not affect the labor market environment of the individual after that job is terminated. Thus one should think of these health shocks as being largely employer- or job task-specific.

The role of health insurance in reducing the rate of separations into unemployment is presumed to result from covered employees more intenstively utilizing medical services than non-covered employees. As a result, the rate of separations due to inability to perform the job task associated with the match θ will be lower among covered employees. If all other reasons for leaving a job and entering the unemployed state are independent of health insurance status, the wage, and the match value, then $\eta(1) < \eta(0)$, where $\eta(d)$ is the flow rate from employment into unemployment for those in health insurance status d, with $d = 1$ for those with employer-provided health insurance and $d = 0$ for those who are uncovered.

In this manner the purchase of health insurance can extend the expected life of the match for any given match value θ through it's "direct" impact on health status. We will also consider other indirect effects of health insurance on match longevity that operate through sorting. In its most

[2] It is not strictly necessary that the value of the match be reduced to 0, since any new value of θ that would make unemployment more attractive than continued employment at the firm would do. The value 0 serves as a convenient normalization.

simple form, assume that there exist two types of individuals and two types of firms. Individuals possess an instantaneous (indirect) utility function given by

$$u_{\xi}(w,d) = w + \xi d,$$

and where $\xi \in \{\xi_1, \xi_2\}$ with $\xi_2 > \xi_1 = 0$. Individuals of type $\xi = 0$ will then behave as classic expected wealth maximizers and exhibit only a "derived demand" for health insurance as a productive factor in an employment relationship. Those individuals with $\xi = \xi_2$ have some "private" demand for health insurance and maximize a different objective. Let the proportion of the population with a private demand for health insurance be denoted by $\delta \equiv p(\xi = \xi_2) \in [0,1]$.

The heterogeneity on the demand side of the market relates to the cost to the firm of providing health insurance coverage. While modeling the cost of providing such coverage is an interesting issue in itself, here we simply assume that these costs are exogenously determined. The premium paid by a firm of type i is given by ϕ_i, with $\phi_2 > \phi_1 > 0$. We denote the population proportion of firms that pay a high cost for health insurance by $\pi \equiv p(\phi = \phi_2) \in [0,1]$.

Given the nature of the data available to us (from the supply side of the market), firms are treated as relatively passive agents throughout. In particular, we assume that the only factor of production is labor, and that total output of the firm is simply the sum of the productivity levels of all of its employees. Then if the firm "passes" on the applicant – that is, does not make an employment offer – its "disagreement" outcome is 0 [it earns no revenue but makes no wage payment]. With the additional assumption that there are no fixed costs of employment to firms, the implication is that employment contracts are negotiated between workers and firms on an individualistic basis, that is, without reference to the composition of the firm's current workforce.

All individuals begin their lives in the nonemployment state, and we assume that it is optimal for them to search. The instantaneous utility flow in the nonemployment state is b, which can be positive or negative. When an unemployed searcher and a firm meet, which happens at rate λ_n, the productive value of the match (θ) is immediately observed by both the applicant as is the firm and worker type, ϕ and ξ respectively. After both parties have been fully informed as to the value of θ a division of the match value is proposed using a Nash bargaining framework. If both parties realize a positive surplus the match is formed, and if not the searcher continues his quest for an acceptable match. Let V_{ξ}^{N} denote the value of unemployed search to a searcher of type ξ, and denote by $Q_{\xi}(\theta, \phi)$ the value of the match θ with a firm of type ϕ if he receives all of the surplus. Then since the disagreement value of the firm is 0, all matches with $Q_{\xi}(\theta, \phi) \geq V_{\xi}^{N}$ will be accepted by an unemployed searcher of type ξ and a type ϕ firm.[3] Let the value of an employment match of (θ, ϕ) that pays wage w and has health insurance coverage indicator d to the employee be denoted $V_{\xi}^{E}(w, d; \theta, \phi)$, and let the value of the same match to the firm be given by $V_{\phi}^{F}(w, d; \theta)$. Then given an acceptable match, the wage and health insurance coverage level are determined by

$$(w,d)(\theta, \phi, \xi, V_{\xi}^{N}) = \arg\max_{w,d} (V_{\xi}^{E}(w, d; \theta, \phi) - V_{\xi}^{N})^{\alpha} V_{\phi}^{F}(w, d; \theta)^{1-\alpha},$$

where $\alpha \in (0,1)$ is the bargaining power of the individual.

Employed agents meet new potential employers at rate λ_e. To keep the model tractable we assume that there is full information among all parties as to the types associated with the current (θ, ϕ) and the potential match (θ', ϕ'), as well as the searcher's type, ξ. This means that each firm knows the match value of the individual at the other firm with which it is competing for the worker's

[3] This claim is predicated on $V_{\xi}^{N} > 0$, which we assume to be the case..

services as well as that firm's type (ϕ). While these are strong informational assumptions, they are relatively inconsequential for the empirical analysis conducted below given the nature of the data available to us.

We will show that a competing employment opportunity (θ',ϕ') will be preferred to the current one (θ,ϕ) whenever $Q_\xi(\theta', \phi') > Q_\xi(\theta, \phi)$. When this is the case, the new wage and health insurance pair will be given by

$$(w, d)(\theta', \phi', \xi, Q_\xi(\theta, \phi)) = \arg\max_{w,d}(V_\xi^E(w, d; \theta', \phi') - Q_\xi(\theta, \phi))^\alpha V_\phi^F(w, d; \theta')^{1-\alpha}.$$

Even if a new employment opportunity will not ultimately be accepted, i.e., $Q_\xi(\theta', \phi') \leq Q_\xi(\theta.\phi)$, an alternative offer may help the employee obtain more of the surplus from his current match. For this to occur it must be the case that $Q_\xi(\theta', \phi') > V_\xi^E(w, d; \theta, \phi)$. If so, when confronted with the outside option the current contract will be renegotiated and the new terms of the employment bargain will be given by

$$(w, d)(\theta, \phi, \xi, Q_\xi(\theta', \phi')) = \arg\max_{w,d}(V_\xi^E(w, d; \theta, \phi) - Q_\xi(\theta', \phi'))^\alpha V_\phi^F(w, d; \theta)^{1-\alpha}.$$

The receipt of outside offers during an employment match provides a rationale for wage growth on the job, as well as allowing for the possibility for a change in health insurance coverage. As we work through the various special cases in proceeding to the most general framework considered we will see how the implications for efficient turnover decisions and wage growth change as the structure of the model is modified. We begin by describing the model under the conditions of no on-the-job (OTJ) search. This allows us to generate some intuition regarding the nature of the labor market equilibrium. Following this discussion, we turn to the more interesting and relevant case in which offers arrive to employed individuals as well.

2.1 The Model without On-the-Job Search ($\lambda_e = 0$)

The model considered in this section assumes that there is no on-the-job search ($\lambda_e = 0$). To begin our discussion we will assume that all firms face the same price of health insurance, ϕ. As described above, individuals are differentiated in terms of their demand for health insurance. Since we are assuming that any individual's private demand for health insurance is a permanent characteristic, we can essentially think of each type of agent as inhabiting their own labor market - although both labor markets are identical except for the preferences of the searchers who participate in them.

As mentioned above, we will assume that an individual's type is perfectly observable by all potential employers. Justification for this assumption proceeds along the following lines. Since individuals have linear utility functions, no differences in the valuation of insurance are produced by differences in attitudes toward risk. Instead, we assume that differences in the "private" demand for health insurance are produced by the desire to cover the health expenses of children and other family members. Since these characteristics of an applicant would seem to be potentially observable by employers, we believe that the perfect observability assumption is not too inappropriate given the structure of our model.

Consider the market consisting of type ξ agents. As is the case in all of the models we set the disagreement value of the firm to 0. The disagreement outcome for the unemployed searcher is simply the value of continued search, V_ξ^N. Then given an acceptable match value θ for the type ξ individual, we can write the outcome of the Nash bargaining problem as

$$(w,d)(\theta,\xi,V_\xi^N) = \arg\max_{w,d}(V_\xi^E(w,d) - V_\xi^N)^\alpha \left(\frac{\theta - w - d\phi}{\rho + \eta(d)}\right)^{1-\alpha}.$$

Note that the firm's share of the match are the discounted (expected) instantaneous profits. The numerator $\theta - w - d\phi$ is the instantaneous profit given a total surplus flow of θ, an instantaneous wage payment of w, and an insurance premium ϕ that is paid in the event that health insurance is purchased (i.e., $d = 1$). The denominator is the sum of the discount rate and the rate of match dissolution, which depends on whether health insurance has been purchased or not.

The value of employment to the worker is derived as follows. Over a small interval of time ε assume that at most one event occurs and at the end of the "period" the agent will receive her wage payment. Then the value of her job is

$$V_\xi^E(w,d) = (1+\rho\varepsilon)^{-1}\{(w+\xi d)\varepsilon + \eta(d)\varepsilon V_\xi^N + (1-\eta(d)\varepsilon)V_\xi^E(w,d) + o(\varepsilon)\},$$

where $o(\varepsilon)$ is a term with the property that $\lim_{\varepsilon\to 0}(o(\varepsilon)/\varepsilon) = 0$. Collecting terms and taking limits (as $\varepsilon \to 0$) we find

$$V_\xi^E(w,d) = \frac{w + \xi d + \eta(d)V_\xi^N}{\rho + \eta(d)}.$$

Then the worker's surplus at the job is given by

$$V_\xi^E(w,d) - V_\xi^N = \frac{w + \xi d - \rho V_\xi^N}{\rho + \eta(d)},$$

and the bargaining problem becomes

$$\max_{w,d}(\rho + \eta(d))^{-1}(w + \xi d - \rho V_\xi^N)^\alpha(\theta - w - d\phi)^{1-\alpha}.$$

Given that d is a discrete choice that assumes the value 0 or 1, to solve this problem we find the maximum value of the Nash objective conditional on $d = 0$ and $d = 1$. It will be convenient to define the Nash bargaining objective function by Ξ, which in the case of this specification takes the form

$$\Xi(w,d;\theta,\xi,V_\xi^N) = (\rho + \eta(d))^{-1}(w + \xi d - \rho V_\xi^N)^\alpha(\theta - w - d\phi)^{1-\alpha}.$$

We first then solve the conditional optimization problem

$$\hat{w}(d;\theta,\xi,V_\xi^N) = \arg\max_w \Xi(w,d;\theta,\xi,V_\xi^N),\ d = 0,1.$$

This yields the two "indirect" welfare functions conditional on health insurance presence, $\hat{\Xi}(d;\theta,\xi,V_\xi^N) \equiv \Xi(w(d;\theta,\xi,V_\xi^N),d;\theta,\xi,V_\xi^N),\ d = 0,1$. Then the equilibrium bargaining outcomes are given by the functions

$$(w,d)(\theta,\xi,V_\xi^N) = \begin{cases} (\hat{w}(0;\theta,\xi,V_\xi^N),0) & \Leftrightarrow \quad \hat{\Xi}(1;\theta,\xi,V_\xi^N) < \hat{\Xi}(0;\theta,\xi,V_\xi^N) \\ (\hat{w}(1;\theta,\xi,V_\xi^N),1) & \Leftrightarrow \quad \hat{\Xi}(1;\theta,\xi,V_\xi^N) \geq \hat{\Xi}(0;\theta,\xi,V_\xi^N) \end{cases}$$

In this specification of the model it is relatively straightforward to characterize the set of points of θ (given ξ and V_ξ^N) that will result in the employee-employer pair buying health insurance. For any given value of V_ξ^N there exists a corresponding critical match value $\theta_\xi^* \equiv \rho V_\xi^N$ that has the property that all matches $\theta \geq \theta_\xi^*$ will be accepted and all others rejected by a type ξ searcher. Now if health insurance is not purchased, then

$$\begin{aligned}
\hat{w}(0;\theta,\xi,V_\xi^N) &= \arg\max_w \Xi(w,0;\theta,\xi,V_\xi^N) \\
&= \alpha\theta + (1-\alpha)\theta_\xi^*,
\end{aligned}$$

while if it is purchased

$$\begin{aligned}
\hat{w}(1;\theta,\xi,V_\xi^N) &= \arg\max_w \Xi(w,1;\theta,\xi,V_\xi^N) \\
&= \alpha(\theta-\phi) + (1-\alpha)(\theta_\xi^* - \xi).
\end{aligned}$$

An acceptable match value of $\theta \geq \theta_\xi^*$ will result in health insurance being purchased if and only if $\hat{\Xi}(1;\theta,\xi,V_\xi^N) \geq \hat{\Xi}(0;\theta,\xi,V_\xi^N)$. Now

$$\begin{aligned}
\hat{\Xi}(0;\theta,\xi,V_\xi^N) &= \left(\frac{\alpha\theta + (1-\alpha)\theta_\xi^* - \theta_\xi^*}{\rho+\eta(0)}\right)^\alpha \left(\frac{\theta - \alpha\theta - (1-\alpha)\theta_\xi^*}{\rho+\eta(0)}\right)^{1-\alpha} \\
&= \frac{\alpha^\alpha(1-\alpha)^{1-\alpha}}{\rho+\eta(0)}(\theta-\theta_\xi^*).
\end{aligned}$$

When health insurance is purchased the value of the problem is

$$\begin{aligned}
\hat{\Xi}(1;\theta,\xi,V_\xi^N) &= \left(\frac{\alpha(\theta-\phi) + (1-\alpha)(\theta_\xi^*-\xi) + \xi - \theta_\xi^*}{\rho+\eta(1)}\right)^\alpha \times \\
&\quad \left(\frac{\theta - \alpha\left(\theta-\phi\right) - (1-\alpha)\left(\theta_\xi^*-\xi\right) - \phi}{\rho+\eta(1)}\right)^{1-\alpha} \\
&= \left(\frac{\alpha\left(\theta-\phi-\theta_\xi^*+\xi\right)}{\rho+\eta(1)}\right)^\alpha \left(\frac{(1-\alpha)\left(\theta-\phi-\theta_\xi^*+\xi\right)}{\rho+\eta(1)}\right)^{1-\alpha} \\
&= \frac{\alpha^\alpha\left(1-\alpha\right)^{1-\alpha}}{\rho+\eta(1)}\left(\theta-\phi-\theta_\xi^*+\xi\right).
\end{aligned}$$

Then the employer-employee pair will be indifferent regarding the purchase of health insurance when

$$\begin{gathered}
\hat{\Xi}(1;\theta_\xi^{**},\xi,V_\xi^N) - \hat{\Xi}(0;\theta_\xi^{**},\xi,V_\xi^N) = 0 \\
\Rightarrow \frac{\alpha^\alpha\left(1-\alpha\right)^{1-\alpha}}{\rho+\eta(1)}\left(\theta_\xi^{**}-\phi-\theta_\xi^*+\xi\right) - \frac{\alpha^\alpha(1-\alpha)^{1-\alpha}}{\rho+\eta(0)}(\theta_\xi^{**}-\theta_\xi^*) = 0 \\
\Rightarrow \theta_\xi^{**} = \theta_\xi^* + \frac{\rho+\eta(0)}{\eta(0)-\eta(1)}(\phi-\xi). \qquad (1)
\end{gathered}$$

There is a strong implication that follows from this last line. If the individual's private valuation of health insurance, ξ, is greater than the cost of health insurance to the firm, it will be optimal for all employment matches to include the provision of health insurance. That is, with $\phi \leq \xi$, the expression $(\rho+\eta(0))(\phi-\xi)/(\eta(0)-\eta(1)) \leq 0$, which implies that $\theta_\xi^{**} \leq \theta_\xi^*$. This simply means that all acceptable matches involving type ξ agents will include health insurance. To simplify the derivation and presentation of results below we will rule this situation out by assuming that $\phi_j > \xi_i$ for all $i, j \in \{1, 2\}$. In this case, since $\eta(0) - \eta(1) > 0$ and

$$\partial(\hat{\Xi}(1;\theta,\xi,V_\xi^N) - \hat{\Xi}(0;\theta,\xi,V_\xi^N))/\partial\theta \propto \eta(0) - \eta(1) > 0,$$

then $\theta_\xi^{**} > \theta_\xi^*$, and all matches $\theta \in [\theta_\xi^*, \theta_\xi^{**})$ will result in an employment contract without health insurance while all $\theta \in [\theta_\xi^{**}, \infty)$ will include health insurance "provided" by the employer. Since in the data we observe a large number of employment relationships that do not include health insurance, we know that there are a substantial proportion of labor market participants with a type $\xi < \phi$ and a large proportion of matches in the interval $[\theta_\xi^*, \theta_\xi^{**})$ for these types of searchers.

The final task is to characterize the value of search V_ξ^N (which simultaneously defines θ_ξ^*). Employing the $\varepsilon-$period formulation we can write this value as

$$\begin{aligned} V_\xi^N &= (1+\rho\varepsilon)^{-1}\{b\varepsilon + \lambda_n\varepsilon \int \max[V_\xi^E(w(\theta,\xi,V_\xi^N), d(\theta,\xi,V_\xi^N)), V_\xi^N]dG(\theta) \\ &\quad +(1-\lambda_n\varepsilon)V_\xi^N + o(\varepsilon)\}. \end{aligned}$$

After a bit of manipulation, we can write the steady state critical value for establishing an employment match, θ_ξ^*, as

$$\begin{aligned} \theta_\xi^* &= b + \alpha\lambda_n\{(\rho+\eta(0))^{-1}\int_{\theta_\xi^*}^{\theta_\xi^{**}} \left(\theta - \theta_\xi^*\right) dG\left(\theta\right) \\ &\quad + (\rho+\eta(1))^{-1}\int_{\theta_\xi^{**}}^{\infty} \left(\theta - \phi - \theta_\xi^* - \xi\right) dG\left(\theta\right)\}, \end{aligned}$$

where θ_ξ^{**} is as defined in [1].

The value of health insurance is of course greater to a type ξ_2 individual than to a type ξ_1. This results in the following property of the decision rules.

Proposition 1 $\theta_{\xi_2}^* > \theta_{\xi_1}^*$ *and* $\theta_{\xi_2}^{**} < \theta_{\xi_1}^{**}$

Proof: See Appendix A.

We now add firm heterogeneity in the cost of providing health insurance to the model. As stated above, there are two firm types ($\phi_2 > \phi_1 > 0$) and we have assumed that there is no directed search in the sense that the probability of an encounter with a high cost employer is always π no matter what the individual searcher's type.

The cost of adding heterogeneity of this form is increased complexity of notation, though conceptually no new major issues arise. With two types of firms and two types of individuals we can show that decision rules continue to have the critical value property.[4] Critical values for job acceptance and health insurance acquisition now possess two state variables and are of the form $\theta_{\xi,\phi}^*$ and $\theta_{\xi,\phi}^{**}$. Before discussing the rules in more specificity, we begin by supplying a few observations concerning their qualitative characteristics.

Proposition 2 *Given* $\theta_{\xi,\phi_j}^{**} > \theta_{\xi,\phi_j}^*$, $j = 1, 2$, *then* $\theta_{\xi,\phi}^* = \theta_\xi^*$.

[4] In fact, the critical value property will hold no matter how many types of firms and individuals are present in the market given the way in which the heterogeneity has been introduced. The restriction to two types on both sides of the market has been made to simplify the computational task we face when estimating the model.

Proof: If $\theta^{**}_{\xi,\phi_j} > \theta^{*}_{\xi,\phi_j}$, $j = 1, 2$, then there exist acceptable matches θ that result in an employment contract without health insurance for a type ξ searcher at each type of firm. Since the only difference between firms is the cost of health insurance per worker, when health insurance is not purchased the value of working at the firm is independent of its type. Thus an individual indifferent between continued search and employment without health insurance will be indifferent with respect to the marginally acceptable firm's cost of health insurance.■

In this case, which we will assume to hold throughout the paper, we have one critical value for job acceptance for each type ξ searcher. The critical values for the acquisition of health insurance are of the form

$$\theta^{**}_{\xi,\phi} = \theta^{*}_{\xi} + \frac{\rho + \eta(0)}{\eta(0) - \eta(1)}(\phi - \xi).$$

We see that the difference in the critical values associated with the health insurance acquisition decision are independent of the individual's private demand, that is

$$\begin{aligned} \theta^{**}_{\xi,\phi_2} - \theta^{**}_{\xi,\phi_1} &= \frac{\rho + \eta(0)}{\eta(0) - \eta(1)}(\phi_2 - \phi_1) \\ &> 0. \end{aligned}$$

Since both types of individuals have a reservation employment value that is independent of firm type, the critical value θ^{*}_{ξ} can be found as follows. Begin with

$$\begin{aligned} V^N_\xi &= (1 + \rho\varepsilon)^{-1}\{b\varepsilon + \lambda_n\varepsilon[\pi \int \max[V^N_\xi, V^E_\xi(w(\theta, \phi_2, \xi, V^N_\xi), d(\theta, \phi_2, \xi, V^N_\xi))]dG(\theta) \\ &\quad +(1 - \pi) \int \max[V^N_\xi, V^E_\xi(w(\theta, \phi_1, \xi, V^N_\xi), d(\theta, \phi_1, \xi, V^N_\xi))]dG(\theta)] \\ &\quad +(1 - \lambda_n\varepsilon)V^N_\xi + o(\varepsilon)\}, \end{aligned}$$

where we have added the additional argument ϕ to the functions that determine the equilibrium wage and health insurance outcomes since firms are now heterogeneous with respect to this parameter. After rearranging terms and taking limits, we arrive at

$$\begin{aligned} \theta^{*}_{\xi} &= b + \alpha\lambda_n\{(\rho + \eta(0))^{-1}[\pi \int_{\theta^{*}_{\xi}}^{\theta^{**}_{\xi,\phi_2}} (\theta - \theta^{*}_{\xi})dG(\theta) \\ &\quad +(1 - \pi) \int_{\theta^{*}_{\xi}}^{\theta^{**}_{\xi,\phi_1}} (\theta - \theta^{*}_{\xi})dG(\theta)] \\ &\quad +(\rho + \eta(1))^{-1}[\pi \int_{\theta^{**}_{\xi,\phi_2}} (\theta - \phi_2 - \theta^{*}_{\xi} - \xi)dG(\theta) \\ &\quad +(1 - \pi) \int_{\theta^{**}_{\xi,\phi_1}} (\theta - \phi_1 - \theta^{*}(\xi) - \xi)dG(\theta)]\}. \end{aligned}$$

Since $\theta^{**}_{\xi,\phi}$ is a function of θ^{*}_{ξ} for each value of ϕ, this equation contains one unknown, θ^{*}_{ξ}, that is uniquely determined for each value of ξ.

In concluding this section we discuss the implications of the model without OTJ search for the conditional distribution of wages (given health insurance status) and the marginal accepted wage distribution. We will begin by deriving the conditional distribution of wages given health insurance status.

For a type ξ individual, the wage distribution given $d=1$ is

$$m\left(w|d=1;\xi,\phi\right)=\begin{cases}\frac{\alpha^{-1}g\left(\frac{w-(1-\alpha)(\theta^*_\xi-\xi)}{\alpha}+\phi\right)}{\tilde{G}(\theta^{**}_{\xi,\phi})} & w\geq \underline{w}^{(1)}_{\xi,\phi}\\ 0 & w<\underline{w}^{(1)}_{\xi,\phi}\end{cases} \tag{2}$$

where $\underline{w}^{(1)}_{\xi,\phi}=\theta^*_\xi-\xi+\alpha\left(\frac{\rho+\eta(1)}{\eta(0)-\eta(1)}\right)(\phi-\xi)$ represents the smallest possible wage for a job that provides health insurance. Now the conditional probability that an acceptable match between a type ξ individual and type ϕ firm results in health insurance is

$$p(d=1|\xi,\phi)=\frac{\tilde{G}(\theta^{**}_{\xi,\phi})}{\tilde{G}(\theta^*_\xi)},$$

so that

$$m(w,d=1|\xi,\phi)=\begin{cases}\frac{\alpha^{-1}g\left(\frac{w-(1-\alpha)(\theta^*_\xi-\xi)}{\alpha}+\phi\right)}{\tilde{G}(\theta^*_\xi)} & w\geq \underline{w}^{(1)}_{\xi,\phi}\\ 0 & w<\underline{w}^{(1)}_{\xi,\phi}\end{cases}.$$

The conditional density of wages given no health insurance is

$$m\left(w|d=0,\xi,\phi\right)=\begin{cases}\frac{\alpha^{-1}g\left(\frac{w-(1-\alpha)\theta^*_\xi}{\alpha}\right)}{\tilde{G}(\theta^*_\xi)-\tilde{G}(\theta^{**}_{\xi,\phi})} & w\in[\underline{w}^{(0)}_\xi,\overline{w}^{(0)}_{\xi,\phi})\\ 0 & w\notin \underline{w}^{(0)}_\xi,\overline{w}^{(0)}_{\xi,\phi})\end{cases}, \tag{3}$$

where $\underline{w}^{(0)}_\xi=\theta^*_\xi$ and $\overline{w}^{(0)}_{\xi,\phi}=\theta^*_\xi+\alpha\left(\frac{\rho+\eta(0)}{\eta(0)-\eta(1)}\right)(\phi-\xi)$. The wage $\underline{w}^{(0)}_\xi$ is the minimum paid at jobs without health insurance to a type ξ individual, while $\overline{w}^{(0)}_{\xi,\phi}$ represents the supremum of the set of possible wages at an uninsured job for an individual of type ξ working at an employer of type ϕ. The unconditional (w,d) probability function is

$$\begin{aligned}m(w,d)=&\sum_{j=1}^{2}\sum_{i=1}^{2}p(\xi=\xi_i)p(\phi=\phi_j)\\ &\times\{\chi[\underline{w}^{(0)}_{\xi_i}\leq w\leq\overline{w}^{(0)}_{\xi_i,\phi_j}]\frac{\alpha^{-1}g\left(\frac{w-(1-\alpha)\theta^*_{\xi_i}}{\alpha}\right)}{\tilde{G}\left(\theta^*_{\xi_i}\right)}\}^{1-d}\\ &\times\{\chi[\underline{w}^{(1)}_{\xi_i,\phi_j}\leq w]\frac{\alpha^{-1}g\left(\frac{w-(1-\alpha)(\theta^*_{\xi_i}-\xi_i)}{\alpha}+\phi_j\right)}{\tilde{G}(\theta^*_{\xi_i})}\}^{d}.\end{aligned}$$

Note that since $\eta(0)-\eta(1)>0$, then $\underline{w}^{(1)}_{\xi_i,\phi_j}<\overline{w}^{(0)}_{\xi_i,\phi_j}$ for all i and j pairs. Thus there exists an interval of wages that both jobs with and without health insurance will pay even though there is perfect separation in θ space between match values that result in health insurance provision and those that do not. The size of this interval of overlap in the wage space is most directly related to the size of the health insurance premium and the bargaining power of searchers (α).

The marginal wage density implied by the model without OTJ search is simply

$$m(w) = \sum_{j=1}^{2} \sum_{i=1}^{2} p(\xi = \xi_i) p(\phi = \phi_j)$$

$$\times \{ \chi[\underline{w}^{(0)}_{\xi_i} \leq w < \overline{w}^{(0)}_{\xi_i,\phi_j}] \frac{\alpha^{-1} g\left(\frac{w-(1-\alpha)\theta^*_{\xi_i}}{\alpha}\right)}{\tilde{G}\left(\theta^*_{\xi_i}\right)}$$

$$+\chi[\underline{w}^{(1)}_{\xi_i,\phi_j} \leq w] \frac{\alpha^{-1} g\left(\frac{w-(1-\alpha)(\theta^*_{\xi_i}-\xi_i)}{\alpha} + \phi_j\right)}{\tilde{G}(\theta^*_{\xi_i})} \}.$$

Figures 1 and 2 represent some of the features of the model in a graphical and easily understood form. The model parameters used to prepare the graphs are based on estimates of the equilibrium model obtained when using SIPP data.[5] For simplicity our illustration assumes no heterogeneity on the worker or firm side of the market.

Figure 1 plots the estimated probability density function of job matches in the population, which is assumed to belong to the lognormal family of distributions. The lower dotted line represents the critical match value for leaving unemployment, θ^*, which is estimated to be approximately 6.85. The dotted line to the right represents θ^{**}, which is the critical match value for the match to provide health insurance coverage (its estimated value is 15.77). The likelihood that an unemployed searcher who encounters a potential employer will accept a job is the size of the area to the right of θ^*. The probability that an unemployed searcher accepts a job that doesn't provide health insurance is then given by the probability mass in the area between the two critical values divided by the probability of finding an acceptable match, which in this case is about .56.

The wage densities conditional on health insurance status are displayed in Figure 2.a. We can clearly discern the area of overlap between these two densities. Since both of these p.d.f.s are derived from slightly different mappings of the same p.d.f. $g(\theta)$, it is not surprising that they share general features in terms of shape. Note that the wage density conditional on not having health insurance is always defined on a finite-length interval $[\underline{w}^{(0)}, \overline{w}^{(0)})$, while the range of wages conditional on having health insurance is unbounded as long as the matching distribution G has unbounded support.

In Figure 2.b we plot the marginal wage density. The interval of overlap in the wage distribution adds a "bulge" to a density that otherwise resembles the parent lognormal density. Recall that wages in the interval of the bulge are the only ones that can be *either* associated with health insurance or not. Wages in the right tail are always associated with jobs that provide health insurance while those to the left of the bulge are associated with jobs that do not provide health insurance.

We complete this section by defining the steady state unemployment rate and health insurance coverage rates for the simple case in which there is no OTJ search, which will serve to fix ideas. The analagous expressions for the OTJ case are considerably more involved notationally and can only be computed using numerical methods. We will carry out these calculations using the estimated model parameters below.

[5] We have only estimated the model when allowing for OTJ search, the case discussed immediately below. The critical values and wage distributions discussed in this section pertain to the case in which an individual is entering a job directly from the unemployment state.

We begin by considering the steady state unemployment rate in the case of heterogeneous workers and firms. The average length of an unemployment spell for a type ξ individual under our stationarity assumptions is $E(t_u|\xi) = [\lambda_n \tilde{G}(\theta^*_\xi)]^{-1}$. The average duration of an employment spell is constructed as follows. Without OTJ search, the only way a job can end is through an involuntary exit, and the rate of exit is $\eta(d)$, so that the average duration of employment is $[\eta(d)]^{-1}$. Given that a type ξ employee is matched with a type ϕ firm we have:

$$E(t_e|\xi,\phi) = \frac{p(d=0|\xi,\phi)}{\eta(0)} + \frac{p(d=1|\xi,\phi)}{\eta(1)},$$

so that

$$E(t_e|\xi) = (1-\pi)E(t_e|\xi,\phi_1) + \pi E(t_e|\xi,\phi_2).$$

Then the steady state unemployment rate is

$$u = (1-\delta)\frac{E(t_u|\xi_1)}{E(t_u|\xi_1)+E(t_e|\xi_1)} + \delta\frac{E(t_u|\xi_2)}{E(t_u|\xi_2)+E(t_e|\xi_2)}.$$

Using similar arguments we define the steady state health insurance coverage rate. The probability that a type ξ individual is covered by health insurance when employed is

$$p(d=1|\xi) = (1-\pi)\frac{\tilde{G}(\theta^{**}_{\xi,\phi_1})}{\tilde{G}(\theta^*_\xi)} + \pi\frac{\tilde{G}(\theta^{**}_{\xi,\phi_2})}{\tilde{G}(\theta^*_\xi)},$$

so that the steady state health insurance coverage rate in the entire population is

$$hc = \sum_{i=1}^{2} p(\xi=\xi_i)\frac{\frac{p(d=1|\xi_i)}{\eta(1)}}{\frac{1}{\lambda\tilde{G}(\theta^*_{\xi_i})} + \frac{p(d=1|\xi_i)}{\eta(1)} + \frac{p(d=0|\xi_i)}{\eta(0)}}.$$

2.2 On-the-Job Search ($\lambda_e > 0$)

In the previous subsection we assumed that there was no contact between employed individuals and new potential employers. Given the large number of job-to-job transitions in our data this assumption is clearly counterfactual. We now generalize the model to allow for such meetings, which are assumed to occur at the exogenously-determined rate λ_e. For simplicity we assume that on-the-job search is costless. We will also follow the strategy of the previous subsection and begin our discussion by ignoring firm heterogeneity; we do allow individuals to differ in their demand for health insurance.

As in the case of nonemployed search, when a currently-employed individual meets a new potential employer we assume that both sides immediately observe the value of the (new) potential match θ'.[6] Whether or not the individual leaves the old firm for the new one and the worker's employment contract after meeting the new potential empoyer depend critically on the information sets of the old and new firm and the nature of the bargaining process. In order to greatly simplify the bargaining procedure, we assume that all parties in the negotiation process (the two firms and the worker) are fully informed as to the values of θ and θ'. We also assume that the firms

[6] Note that workers will only report meetings with new firms that have the possibility of increasing their welfare. This point is discussed below.

issue alternating offers, that all offers are credible, and that the negotiation process is completed instantaneously. As in Postel-Vinay and Robin (2000), these assumptions result in a Bertrand type of competition in which the firm with the highest value of θ' "wins" since that firm can offer a contract of higher value to the employee and still earn a nonnegative profit. As long as the firm responding to the other firm's offer is able to at least match that offer (in terms of value to the worker) and still earn positive profits, her next offer to the agent is simply the solution to the Nash bargaining problem with the value of the other firm's current offer serving as the threat point. If instead the value of the competing firm's offer is at least as large as the total value of the match to the firm considering a response, a contract that exhausts that total value is offered. The result of this bargaining process will be that the firm with the largest match value will win the competition between the two firms and the value of the employment contract at that firm will be the solution to the Nash bargaining problem with the maximal value to the worker at the competing (dominated) firm serving as the threat point.

Let us introduce a bit of notation before proceeding. For an employed agent of some fixed type ξ, we denote their current labor market state by $(w, d; \theta)$ and any potential new state by $(w', d'; \theta')$. When an individual is unemployed, for purposes of defining the equilibrium wage and health insurance provision functions we will say that their current match value is θ^*_ξ, which is that value of θ required for an unemployed searcher and a firm to initiate an employment contract. We start by considering the rent division problem facing a currently employed agent who encounters a new potential employer.

Say that a currently-employed agent with a contract given by $(w, d; \theta)$, $\theta \geq \theta^*_\xi$, meets a new potential employment match with value (θ'). We assume that the potential match will only be reported to the current employer if the employee has an incentive to do so. One situation in which this will clearly be the case is when $\theta' > \theta$.[7] Under our bidding mechanism, a potential match such as this will result in the individual moving to the other firm after the "last" offer by his current firm. The value of the offer of the dominated firm serves as the threat point of the employee in the Nash bargaining problem faced by the employee with his new firm. We let $Q_\xi(\theta)$ denote the value to a type ξ individual of receiving all of the surplus at a match of value θ, which is the threat point whenever $\theta' > \theta$. Then the Nash bargaining objective function (when $\theta' > \theta$) is given by

$$\begin{aligned}\Xi(w', d'; \theta', \xi, Q_\xi(\theta)) &= \{V^E_\xi(w', d'; \theta') - Q_\xi(\theta)\}^\alpha \\ &\quad \times V^F(w', d'; \theta', \xi)^{1-\alpha},\end{aligned}$$

where $V^F(w', d'; \theta', \xi)$ denotes the new firm's value of the problem (recall that each firm's threat point is assumed to be zero) given that the match is with a type ξ individual. For the moment we will simply posit the existence of an employment contract outcome that is a function of the highest and the next best match value; if these values are θ and $\tilde{\theta}$, respectively, then the wage function is $w_\xi(\theta, \tilde{\theta})$ and the health insurance provision function is $d_\xi(\theta, \tilde{\theta})$. The firm's value of the current

[7] This condition implies mobility when there is no firm heterogeneity in the cost of providing health insurance, but is not when such heterogeneity exists. The mobility condition in this case is developed below.

employment contract with a type ξ individual is defined as follows:

$$\begin{aligned} V^F(w,d;\theta,\xi) &= (1+\rho\varepsilon)^{-1}\{(\theta-w-d\phi)\varepsilon+\eta(d)\varepsilon\times 0 \\ &\quad +\lambda_e\varepsilon\int_{\hat{\theta}_\xi(w,d)}^{\theta} V^F(w_\xi(\theta,\tilde{\theta}),d_\xi(\theta,\tilde{\theta}))\,dG(\tilde{\theta}) \\ &\quad +\lambda_e\varepsilon\,G(\hat{\theta}_\xi\,(w,d))\,V^F(w,d;\theta,\xi)+\lambda_e\varepsilon\,\tilde{G}(\theta)\times 0 \\ &\quad +(1-\lambda_e\varepsilon-\eta(d)\varepsilon)\,V^F(w,d;\theta,\xi)+o(\varepsilon)\}, \end{aligned}$$

where $\hat{\theta}_\xi(w,d)$ is defined as the maximum value of θ for which the contract (w,d) would leave the firm with no profit given that the individual is type ξ. Any encounter with a potential firm in which the match value is less than $\hat{\theta}_\xi(w,d)$ will not be reported by the employee, whereas any new match value $\theta' > \theta$ obtained by the employee will result in a separation. After rearranging terms and taking limits, we have

$$\begin{aligned} V^F(w,d;\theta,\xi) &= [\rho+\eta(d)+\lambda_e\tilde{G}(\hat{\theta}_\xi(w,d))]^{-1} \\ &\quad \times\{\theta-w-d\phi+\lambda_e\int_{\hat{\theta}_\xi(w,d)}^{\theta} V^F(w_\xi(\theta,\tilde{\theta}),d_\xi(\theta,\tilde{\theta});\theta,\xi)\,dG(\tilde{\theta})\}. \end{aligned}$$

For the employee, the value of employment at a current match value θ and wage and health insurance provision status (w,d) is given by

$$\begin{aligned} V_\xi^E(w,d;\theta) &= (1+\rho\varepsilon)^{-1}\{(w+\xi d)\varepsilon+\eta(d)\varepsilon V_\xi^N \\ &\quad +\lambda_e\varepsilon\int_{\hat{\theta}_\xi(w,d)}^{\theta} V_\xi^E(w_\xi(\theta,\tilde{\theta}),d_\xi(\theta,\tilde{\theta});\theta)\,dG(\tilde{\theta}) \\ &\quad +\lambda_e\varepsilon\int_{\theta} V_\xi^E(w_\xi(\tilde{\theta},\theta),d_\xi(\tilde{\theta},\theta);\tilde{\theta})\,dG(\tilde{\theta}) \\ &\quad +\lambda_e\varepsilon\,G(\hat{\theta}_\xi(w,d))V_\xi^E(w,d;\theta) \\ &\quad +(1-\lambda_e\varepsilon-\eta(d)\varepsilon)\,V_\xi^E(w,d;\theta)+o(\varepsilon)\}. \end{aligned}$$

Note that when an employee encounters a firm with a new match value lower than his current one but sufficiently great that it can be used to increase his share of the match surplus [i.e., a new draw $\tilde{\theta}$ such that $\theta > \tilde{\theta} > \hat{\theta}(w,d)$], his new value of employment at the current firm becomes $V_\xi^E(w_\xi(\theta,\tilde{\theta}),d_\xi(\theta,\tilde{\theta});\theta)$. Instead, when the match value at the newly-contacted firm exceeds that of the current firm, mobility results. The value of employment at the new firm is given by $V_\xi^E(w_\xi(\tilde{\theta},\theta),d_\xi(\tilde{\theta},\theta);\tilde{\theta})$ – that is, the match value at the current firm becomes the determinant of the "threat point" faced by the new firm and plays a role in the determination of the new wage. Finally, when the match value at the new firm is less than $\hat{\theta}_\xi(w,d)$, the contact is not reported to the current firm since it would not result in any improvement in the current contract. Because of this selective reporting, the value of employment contracts must be monotonically increasing both within and across consecutive job spells. Declines can only be observed following a transition into the unemployment state.

After rearranging terms and taking limits, we have

$$\begin{aligned} V_\xi^E(w,d;\theta) &= [\rho+\eta(d)+\lambda_e\tilde{G}(\hat{\theta}_\xi(w,d))]^{-1} \\ &\quad \times\{w+\xi d+\eta(d)V_\xi^N+\lambda_e\int_{\hat{\theta}_\xi(w,d)}^{\theta} V_\xi^E(w_\xi(\theta,\tilde{\theta}),d_\xi(\theta,\tilde{\theta});\theta)\,dG(\tilde{\theta}) \\ &\quad +\lambda_e\int_\theta V_\xi^E(w_\xi(\tilde{\theta},\theta),d_\xi(\tilde{\theta},\theta);\tilde{\theta})\,dG(\tilde{\theta})\}. \end{aligned}$$

With a new match value of $\theta'>\theta$, the surplus attained by the individual at the new match with respect to the value he could attain at the old match after extracting all of the surplus associated with it is

$$V_\xi^E(w_\xi(\theta',\theta),d_\xi(\theta',\theta),\theta')-Q_\xi(\theta),$$

where

$$Q_\xi(\theta)=V_\xi^E(w_\xi(\theta,\theta),d_\xi(\theta,\theta),\theta),$$

with $w_\xi(\theta,\theta)$ and $d_\xi(\theta,\theta)$ indicating the wage and health insurance outcomes of a type ξ individual when his match values at the two competing firms are identical. Then

$$\begin{aligned} Q_\xi(\theta) &= [\rho+\eta(d_\xi(\theta,\theta))+\lambda_e\tilde{G}(\theta)]^{-1} \\ &\quad \times\{w_\xi(\theta,\theta)+\xi d_\xi(\theta,\theta)+\eta(d_\xi(\theta,\theta))V_\xi^N+\lambda_e\int_\theta V_\xi^E(w_\xi(\tilde{\theta},\theta),d_\xi(\tilde{\theta},\theta),\tilde{\theta})\,dG(\tilde{\theta})\}, \end{aligned}$$

where we have used the fact that $\hat{\theta}_\xi(w_\xi(\theta,\theta),d_\xi(\theta,\theta))=\theta$.

The model is closed after specifying the value of nonemployment. Passing directly to the steady state representation of this function, we have

$$\begin{aligned} V_\xi^N &= [\rho+\lambda_n\tilde{G}(\theta_\xi^*)]^{-1} \\ &\quad \times\{b+\lambda_n\int_{\theta_\xi^*} V_\xi^E(w(\tilde{\theta},\theta_\xi^*),d(\tilde{\theta},\theta_\xi^*),\tilde{\theta})\,dG(\tilde{\theta})\}, \end{aligned}$$

where θ_ξ^* is the critical match value associated with the decision to initiate an employment contract for a type ξ individual.

When an employed agent meets a new potential employer, the solution to the Nash bargaining problem at the firm for which $\theta'>\theta$ is

$$(w_\xi,d_\xi)(\theta',\theta)=\arg\max_{w,d}\Xi(w,d;\theta',\xi,Q_\xi(\theta)).$$

When an unemployed agent meets an acceptable firm we can write the solution to the bargaining problem as

$$(w_\xi,d_\xi)(\theta,\theta_\xi^*)=\arg\max_{w,d}\Xi(w,d;\theta,\xi,\rho^{-1}\theta_\xi^*),$$

since $\theta_\xi^*\equiv\rho V_\xi^N$.

An important characteristic of this specification of the model is *efficient bargaining*, that is, when confronted with a choice between two employers with associated match values θ and θ', the individual always accepts employment at the employer associated with the higher match value. This property holds for all types of searchers (indexed by ξ), so that individual heterogeneity on the searchers side cannot produce "job lock" or "job push." As we will see at the end of this section, it is necessary to have firm heterogeneity for "inefficient"[8] mobility decisions to occur.

We can now characterize the wage and health insurance decisions in the case of OTJ search. First we state and prove the following important result.

Proposition 3 *Let $\theta' > \theta$ where θ represents the next best match value available to the employee at the time a bargain is made. The decision to acquire health insurance is $d_\xi(\theta', \theta) = d_\xi(\theta')$ and the wage is $w_\xi(\theta', \theta)$.*

Proof: See Appendix B.

The health insurance decision has the same structure in the OTJ case as it did when $\lambda_e = 0$, which is that the decision depends only the match value at the employer. Furthermore, the decision to acquire health insurance has a critical value property. The total surplus $T(d; \theta, \xi)$ is increasing in θ for all ξ, and $T(0; \theta^*_\xi, \xi) > T(1; \theta^*_\xi, \xi)$ for each ξ. Then since $\partial T(1; \theta, \xi)/\partial\theta > \partial T(0; \theta, \xi)/\partial\theta$, $\theta > \theta^*_\xi$, there exists a unique value θ^{**}_ξ such that $T(1; \theta^{**}_\xi, \xi) = T(0; \theta^{**}_\xi, \xi)$. The decision rule for acquiring health insurance is then $d(\theta, \xi) = 1$ if and only if $\theta > \theta^{**}_\xi$.

To this point we have ignored firm heterogeneity which we now consider. As was true in the no OTJ search case, we assume that for each type of agent at each type of firm there exist match values that will result in an employment contract without health insurance. Under this assumption, the characterization of the job acceptance decision for an unemployed searcher is little different than what we had before, namely there exist values θ^*_ξ that are used to determine an acceptable job match without health insurance at either type of firm, ϕ_1 or ϕ_2. The ordering $\theta^*_{\xi_2} > \theta^*_{\xi_1}$ continues to hold as well.

We can also continue to characterize the health insurance decision in terms of critical value policies. In this case there are four critical values, one for each searcher and firm combination. We denote the critical value for a type ξ individual receiving heath insurance at a type ϕ firm by $\theta^{**}_\xi(\phi)$. We have the following ordering properties of these values:

$$\begin{aligned} \theta^{**}_{\xi_2}(\phi) &\leq \theta^{**}_{\xi_1}(\phi),\ \phi = \phi_1, \phi_2 \\ \theta^{**}_\xi(\phi_1) &\leq \theta^{**}_\xi(\phi_2),\ \xi = \xi_1, \xi_2. \end{aligned}$$

When there exists firm heterogeneity "inefficient" mobility decisions will in general occur. By an inefficient mobility decision we mean simply that when confronted with a choice between θ and θ', where $\theta' > \theta$, the individual (optimally) opts for θ. The reason for this is that, from a type ξ searcher's perspective, an employment contact now is characterized by the two values (θ, ϕ). Since the value of the potential match is a function of both, when confronted with a choice between (θ', ϕ') and (θ, ϕ), the decision rule cannot generally be only a function of θ' and θ'.

The potential for inefficiency, by which we really only mean that (θ, θ') is not a sufficient statistic for the mobility decision, only arises in certain cases. Clearly, when two potential matches exist with the same type of firm the individual will always choose the one with the highest value of θ, or

$$V^E_\xi(\theta', \phi, \theta, \phi) > V^E_\xi(\theta, \phi, \theta', \phi) \Leftrightarrow \theta' > \theta,\ \phi = \phi_1, \phi_2,$$

where the first two arguments refer to the in the function V^E_ξ refer to the selected firm's match and cost type and the last two arguments refer to the same characteristics of the rejected firm. Thus

[8]By inefficiency here we mean that the highest match value is not always taken. In the context of this model it is doubtful that this is the correct criterion to use as will be discussed more fully below.

inefficienct mobility decisions can never occur when the searcher's choice is between two firms of the same type. In this case the values (θ, θ') are sufficient for characterizing the mobility decision.

Now consider the case in which the agent faces a choice between firms of different cost types. Say that his current match is at a low cost firm and that the potential match is with a high cost firm. Since the value of working at a low cost firm can never be less than the value of working at a high cost firm, the match values at the high cost firm will have to be at least as large as the match value at the low cost firm for mobility to occur. If the individual would not purchase health insurance at either firm then the types of the firms are irrelevant. In such a case, the match values at the two firms are (conditionally) sufficient for the mobility decision and no inefficient mobility can result (and in this case the value of working at either firm at the same match value is equal). Now consider the case in which the match value at the low cost firm results in the purchase of health insurance. Let the current (low cost firm) employment match be characterized by (θ, ϕ_1) and the potential (high cost firm) employment match be characterized by (θ', ϕ_2). If both matches would result in health insurance being purchased, the agent must be compensated for the increased cost of health insurance. In this case, there exists a critical value $V_\xi^E(\theta, \phi_1, \tilde{\theta}, \phi_2) = V_\xi^E(\tilde{\theta}, \phi_2, \theta, \phi_1)$ where $\tilde{\theta}(\theta, \phi_1) > \theta$. It is also possible that there could exist a draw of θ' at the high cost firm that resulted in mobility but did not result in health insurance. In such an instance it is also necessary to compensate the individual for the loss of health insurance (whatever the value of ξ) and this also implies that the critical match value $\tilde{\theta}(\theta, \phi_1) > \theta$. Thus there will always be a "wedge" between the critical match value required for mobility and the current match value θ at the low cost firm whenever the individual has health insurance at the low cost firm. This wedge generates something analagous to what is know as "job lock" in the empirical literature that studies mobility, wage, and health insurance outcomes. This occurs when an individual passes on the higher match at a high cost firm to keep a lower match at a low cost firm.

The other possibility for inefficient mobility decisions occurs when the agent is currently employed at a high cost firm (θ, ϕ_2) and meets a low cost firm (θ', ϕ_1). If the agent would have no health insurance at either firm, then the mobility decision is made on the basis of the θ and θ' draws exclusively and is consistent with efficiency. When the current match at the high cost firm provides health insurance, then there once again exists a wedge between the current value of the match at the high cost firm and that required for mobility to the low cost firm. As before, define $V_\xi^E(\theta, \phi_2, \tilde{\theta}, \phi_1) = V_\xi^E(\tilde{\theta}, \phi_1, \theta, \phi_2)$, and we note that $\tilde{\theta}(\theta, \phi_2) < \theta$. When the match at the high cost firm doesn't result in health insurance, there still exists a wedge when the match at the low cost firm does. When an individual leaves a high cost firm match for a lower-valued match at a low cost firm we may term this as "job push" as in the empirical literature on the subject. Clearly "job lock" and "job push" are two sides of the same coin in our framework, with the distinction between the two solely arising from whether the current match is with a low cost or high cost firm.

The model is sufficiently complex that comparative statics results are not readily available. In light of this we will only graphically display some of the implications of the model, particularly those that differ from the specification in which $\lambda_e = 0$. In light of the relatively complicated renegotiation process it is diffiult to solve for the steady state wage distribution, which is the cross-sectional distribution that would be observed after the labor market had been running for a sufficiently long period of time. Figure 3 contains graphs of the simulated steady state conditional (on health insurance status) and unconditional wage distributions. The simulation on which these histograms are based is for one million labor market careers.

Figure 3.a plots the steady state conditional wage distributions. For individuals in jobs covered

by health insurance the shape of the distribution is rather unremarkable. The lowest value of the wage in this case is \$8.12 using point estimates of the model parameters. The steady state wage distribution for individuals holding jobs not providing health insurance is more unusual. We know that this distribution is bounded, and we note a precipitous drop in the "density" at relatively high wages in the support of the distribution. This drop is due to the small proportion of histories that could lead to such a high wage rate. For an individual to have a high wage without health insurance implies that he is working at a firm with a relatively high value of θ but one that is less than θ^{**}. If he is getting a high share of the surplus at this match, this firm has to bid against other firm(s) with match values less than θ but sufficiently close to it. In our case, since the critical match value is 15.77, the highest wage the could possibly be observed without health insurance is 15.77. Under our i.i.d. sampling assumptions, this is a very rare event.

The unconditional steady state wage distribution is plotted in Figure 3.b. As is to be expected, the upper tail of the density has a shape solely inherited from the relevant part of the conditional (on health insurance) wage density. Overall, the density is not very much at odds with what we typically observe in cross-sectional representative samples. The one possible exception to this claim pertains to the small but perceptible notch below the interval of overlap in the support of the two conditional wage distributions. This discontinuity in the density would be hidden if any amount of measurement error is added to the model, as we do when constucting the econometric specification below.

The current version of the model (with $\lambda_e > 0$) produces labor market histories more in congruence with those observed in the SIPP data, and moreover is the only one that can be used to look at the phenomenon of job lock. In the model without OTJ search, the exit rate from jobs with health insurance was tautologically lower than from jobs with health insurance, and in both cases the rates were independent of job duration. With OTJ search these implications are modified. For purposes of discussion we will only consider the case in which there is no heterogeneity on either side of the market. Adding only individual heterogeneity does not change the efficient turnover implication; however, adding firm heterogeneity implies the critical values for a move will not always be the current match value, as we discussed above.

Though the model with OTJ search continues to tautologically imply higher *nonvoluntary* exits from jobs without health insurance, there are now two possible routes by which a job spell may end. Given the efficient separations implied by the search and bargaining process in the absence of firm heterogeneity, we know that *voluntary* exits from a job spell occur whenever a job with a higher match value is located (independent of whether the current job provides health insurance or not). The instantaneous exit rate of a job with match value θ ($\theta \geq \theta^*$) is given by

$$r(\theta) = \eta(0)\chi[\theta^* \leq \theta < \theta^{**}] + \eta(1)\chi[\theta \geq \theta^{**}] + \lambda_e \tilde{G}(\theta),$$

so that the duration of time that individuals spend in a job spell conditional on the current match value is

$$f_e(t_e|\theta) = r(\theta)\exp(-r(\theta)t_e),\ t_e > 0.$$

Then the density of durations in a given job spell conditional upon health insurance status is

$$f_e(t_e|d) = \int f_e(t_e|\theta)\, dG(\theta|d).$$

The corresponding conditional hazard, $h_e(t_e|d) = f_e(t_e|d)/\tilde{F}_e(t_e|d)$, exhibits negative duration dependence for both $d = 0$ and $d = 1$. However, because $\eta(0) > \eta(1)$ and because the lowest value of θ for $d = 1$ exceeds the greatest value of θ for $d = 0$, the hazard out of jobs covered by health insurance exceeds the hazard out of jobs with health insurance at any value of t_e. Note that the limiting value (as $t_e \to \infty$) for the hazard in jobs without health insurance is $\lim_{t\to\infty} h_e(t_e|d = 0) = \eta(0) + \lambda_e\tilde{G}(\theta^{**})$, while the corresponding limiting value for jobs with health insurance is $\lim_{t\to\infty} h_e(t_e|d = 1) = \eta(1)$.

The job exit rates conditional on the current wage as well as health insurance status also have interesting properties. For a given (w, d) the hazard out of the job will be constant. We can write the hazard as

$$r(w, d) = \eta(d) + \lambda\tilde{G}(\theta(w, d)).$$

If it was the case that there was no overlap in the supports of the conditional wage distributions by health insurance, then w would be a sufficient statistic for the rate of leaving the job since then we could write $d(w) \Rightarrow r(w, d) = r(w, d(w)) = r(w)$, and (w, d) are required to completely characterize the job exit rate. We illustrate this point in Figure 4. For the set of wages consistent with either health insurance state, the value of d provides information on the value of θ associated with the match. For example, individuals paid \$10 an hour could be receiving health insurance or not. Those with health insurance are less likely to leave the job both because they are less likely to receive a negative health shock but also because $\theta(10, 1) > \theta(10, 0)$ and hence they are less likely to encounter a superior employment opportunity. In contrast with claims in the empirical literature on job lock, the fact that the hazard rate out of a job that is covered by health insurance is lower than the exit rate from one that is not (conditional on the wage or not) does not necessarily indicate that health insurance status distorts the mobility decision.

3 Data and Descriptive Statistics

Data from the 1996 panel of the Survey of Income and Program Participation (SIPP) are used to estimate the model. The SIPP interviews individuals every four months for up to twelve times, so that at the maximum an individual will have been interviewed relatively frequently over a four year period. The SIPP collects detailed monthly information regarding individuals' demographic characteristics and labor force activity, including earnings, number of weeks worked, average hours worked, as well as whether the individual changed jobs during the month. In addition, at each interview date the SIPP gathers data for a variety of health insurance variables including whether an individual's private health insurance is employer-provided.[9] With the exception of the private demand for health insurance, the primitive parameters of the model developed in this paper are assumed to be independent of observable individual characteristics. Though it would not in principle be difficult to allow the primitive parameters to depend on observables, we instead have attempted to define a sample that is relatively homogeneous with respect to a number of demographic characteristics. In particular, only white males between the ages of 25 and 54 with at least a high school education have been selected. In addition, any individual who reports attendance in school, self-employment, military service, or participation in any government welfare program (i.e., AFDC,

[9]There are several issues involved in constructing a meaningful employer-provided health insurance variable. First, there is a timing problem since the insurance variable can change values only at the interview month, while a job change can occur at any time. Second, there are job spells in which the individual reports employer-provided coverage for some part of the spell and no coverage for the remainder of the spell.

WIC, or Food Stamps) over the sample period is excluded.[10] Although the format of the SIPP data makes the task of defining job changes fairly difficult, in other respects the survey information is well-suited to the requirements of this analysis since it follows individuals for up to four years and includes data on both wages and health insurance at the each job held during the observation period.

Table 1 contains some descriptive statistics from the sample of individuals used the empirical analysis. Our sample consists of 10,121 individuals who meet the inclusion criteria discussed above. Since there is no time invariant unobserved heterogeneity in the model (because θ draws are i.i.d. and ξ remains constant over an individual's life), we construct labor market "cycles" in a manner similar to Wolpin (1992) and Flinn (2002). A cycle begins with an unemployment spell, which could be right-censored (i.e., it may not end before the observation period is completed), and ends with a right-censored or complete employment spell. Therefore, we partion the full sample into two subsamples, one consisting of individuals who experienced unemployment at some point during the observation period and the other consisting of those who did not.[11] Approximately twenty-eight percent of the full sample, or 2,814 individuals, fall into the former group. For these individuals, we use information regarding the duration of time spent in the initial unemployment spell, the duration of time spent in the first job spell after the unemployment spell, and the wage and health insurance status of the first two two jobs in the employment spell following unemployment. In addition, we use marital status and children dummies as observable factors that influence the probability of having a high "private" demand for health insurance, and we use the length of the sample window as an exogenous factor that affects the probability of being observed in the non-employment state sometime during the panel. For the 7,307 individuals in the full sample whom we never observe in the unemployment state, we do not consider any labor market information but do include marital status and children dummies and the length of their sample windows in the empirical analysis. It is interesting to note the differences among individuals in the two groups. Sample members without an unemployment spell over their sample window are much more likely to be married and to have children. The lengths of the sample windows are not very different for the two subsamples.

The labor market data from the sample members with an unemployment spell provide a wealth of information regarding the relationship between health insurance coverage, wages, and job mobility. Notice that a slight majority (50.7%) of unemployment spells end with a transition into a job that provides health insurance. Perhaps the most striking feature of the data is the difference in the average wages of jobs conditional on health insurance provision. Jobs with health insurance have a mean wage about 41 percent higher than jobs without health insurance. In addition, we see that individuals who exit unemployment for a job with insurance are more likely to be married with children than individuals who take a job without health insurance.

From the information on the first job following an unemployment spell, it is quite clear that jobs with health insurance tend to last longer on average than jobs without health insurance. Another feature of the data that is interesting to note is the difference in initial wages for the various transitions out of jobs with health insurance. In particular, while the mean initial wage for all insured jobs is almost \$16, individuals who subsequently move into a job without insurance are

[10] Some individuals, about 3 percent of the sample, had missing data at some point during the panel. Since estimation depends critically on having complete labor market histories we have excluded these cases as well.

[11] The sample window is the length of time an individual remains in the SIPP. While the maximum length of the sample window is four years (or 208 weeks), a majority (52%) of sample members do not participate in all 12 waves of the survey. We measure the sample window from the initiation of the survey until the individual first fails to complete the survey.

earning \$11.41 on average. In addition, the mean wage in the subsequent uninsured job is \$16.14, well above the mean wage for uninsured jobs accepted directly out of unemployment. Finally, note the difference in the average wages of insured and uninsured jobs that follow a job without insurance. Jobs without insurance have a mean wage that is almost 6 percent larger than jobs with insurance. This is in marked constrast to the relationship between the average wages by health insurance status that are observed directly following an unemployment spell. The model constructed above is, on the face of it, consistent with all of these descriptive statistics, and in the following section we describe our attempt to recover the primitive parameters of the model from these data.

4 Econometric Specification

As stated above, the information used in the estimation process is best defined in terms of what we will refer to as an employment cycle. Such a cycle begins with an unemployment spell and is followed by an employment spell, which itself consists of one or more job spells (defined as continuous employment with a specific employer). Under our model specification we know that wages will generally change at each change in employer and can also change during a job spell at the time an alternative offer arrives that does not result in mobility but that does result in renegotiation of the employment contract. In terms of our model, an employment cycle is defined in terms of the following random variables

$$t^u, \{t_k^e\}_{k=1}^S, \{w_m, t_m^w\}_{j=1}^M, \{d_q, t_q^d\}_{q=1}^Q$$

where t^u is the length of the unemployment spell, t_k^e is the length of the job spell with the k^{th} employer during the employment spell, w_m is the m^{th} wage observation of the M that are observed during the employment spell, t_m^w is the time that the m^{th} wage came into effect, d_q is the q^{th} health insurance status observed during the employment spell of the Q distinct changes in status, and t_q^d is the time that the q^{th} health insurance status came into effect. Note that the total length of the employment spell (i.e., which is the length of the consecutive job spells) is $t_e = \sum_k t_k^e$ and the number of observed wages during the employment spell is at least as great as the number of jobs, or $M \geq S$. The $\{d_q\}_{q=1}^Q$ is an alternating sequence of $1's$ and $0's$. Since we are assuming that no unemployed searcher will purchase health insurance, the process always begins with a 0 (since an employment cycle begins in the unemployment state). Other restrictions on the wage and health insurance processes will apply depending on the specification of searchers' utility functions and the form of population heterogeneity.

Because of the unreliability of wage change information over the course of a job spell, in our estimation procedure we only employ wages observed at the begining of a job spell and in terms of duration information we only use information on the duration of unemployment spells and the duration of job spells. Furthermore, to reduce the computational burden we consider (at most) the first two jobs in a given employment spell.

As is often the case when attempting to estimate dynamic models, we face difficult initial conditions problems. In our framework, and common to most stationary search models, entry into the unemployment state essentially "resets" the process. While we will utilize all cases in the data in estimating the model, our focus will be on those cases that contain an unemployment spell. The likelihood function is written in terms of the employment cycles referred to above, so that only those cases that contain an unemployment spell are "directly" utilized. Let Ψ take the value of

1 if a sample member experiences an unemployment spell at some point during their observation period and let it equal 0 when this is not the case. At the conclusion of our discussion of the likelihood contributions for sample members with $\Psi = 1$ we will derive the likelihood of this event. For present purposes, we simply state that it is a function of the length of the sample period, which we will denote T, and the individual's type ξ. Then let us denote $P(\Psi = 1|\xi, T)$ by $\omega_\xi(T)$. It is assumed that the length of the sample window is independently distributed with respect to all of the outcomes determined within the model.

For the sample cases in which $\Psi = 1$ the data utilized in our estimation procedure is given by $\{t^u, t_1^j, w_1, w_2, d_1, d_2\}$, where the two wage and health insurance status observations are those in effect at the beginning of the relevant job spell. The likelihood for these observations is constructed using simulations of the equilibrium wage and health insurance process in conjunction with classical measurement error assumptions regarding observed beginning of spell wage rates and health insurance statuses. In particular, corresponding to any "true" wage w that is in existence at any point in time we assume that there is an observed wage given by

$$\tilde{w} = w \exp(\varepsilon),$$

where ε is an independently and identically continuously distributed random variable. Our econometric specification will posit that ε is normally distributed with mean 0, so that

$$\ln \tilde{w} = \ln w + \varepsilon,$$

and $E(\ln \tilde{w}) = \ln w$. In terms of the observation of health insurance status, we will assume that the reported health insurance status at any point in time, $\tilde{d}$, is reported correctly with probability γ and incorrectly with probability $1 - \gamma$, independently of the actual state. Thus $\gamma = p(\tilde{d} = 1|d = 1) = p(\tilde{d} = 0|d = 0)$.

Measurement error essentially serves three purposes in our estimation framework. First, it reflects the reality that there is a considerable amount of mismeasurement and misreporting in all survey data (though admittedly it is not likely to be exactly of the form we assume). Second, it serves to smooth over incoherencies between the model and the qualitative features of the data. For example, under certain specifications of the instantaneous utility function the model implies that the probability of moving directly from a job covered by health insurance to a job without insurance is a probability zero event. Data exhibiting such patterns will produce a likelihood value of 0 at all points in the parameter space. Measurement error makes such observations possible at all points in the parameter space.

The third usage is related to the simulation method of estimation. This method is most effective when based on a latent variable structure. In our case, the latent variables correspond to the simulated values of the variables that appear in the likelihood function, which themselves have a simple mapping into the observed values as a result of our i.i.d. measurement error assumptions. Thus any simulated value will have positive likelihood no matter what the observed value. In this sense, measurement error serves as a "smoother" of the likelihood. Because of its particular properties, measurement error is not introduced into the duration measures. By the structure of the model, it is not necessary to smooth the likelihood with respect to this information.

The unit of analysis in our likelihood function is the individual. Individuals may be heterogeneous with respect to their private demand for insurance, though we do assume that their type does not change over the course of the sample period. This implies that the decision rules used by any given agent will be time invariant. Recall that for an individual of type ξ we denote the value of employment at a firm with match value θ and cost type ϕ when the next best alternative is at match value of θ' at a firm of cost type ϕ' by

$$V_{\xi}^{E}(\theta, \phi, \theta', \phi').$$

The characteristics (θ, ϕ) correspond to those of the higher value employment contract (from the point of view of the individual). In the presence of firm heterogeneity it need not be the case that $\theta \geq \theta'$, as is true when $\phi = \phi'$.

Corresponding to each set of state variables $(\theta, \phi, \theta', \phi')$ for an individual of type ξ is a unique wage and health insurance pair $(w_{\xi}^{*}, d_{\xi}^{*})(\theta, \phi, \theta', \phi')$. For an individual of type ξ at a current job with characteristics (θ, ϕ) let the set of alternative matches that would dominate the current match be denoted by $\Omega_{\xi}(\theta, \phi)$. As we have demonstrated above, this set is always connected and can be parsimoniously characterized as follows. For any type ξ agent with a current match (θ, ϕ), a potential match (a, b) dominates when

$$a > \tilde{\theta}_{\xi}(\theta, \phi, b).$$

When $\phi = b$, so that the individual meets a potential employer of the same type as her current employer, then

$$\theta = \tilde{\theta}_{\xi}(\theta, \phi, \phi)$$

for any type ξ. On the other hand, when $\phi \neq b$ we have

$$\begin{aligned} \tilde{\theta}_{\xi}(\theta, \phi_2, \phi_1) &\leq \theta \\ \tilde{\theta}_{\xi}(\theta, \phi_1, \phi_2) &\geq \theta. \end{aligned}$$

The individual's type will affect the size of the match differential required for a move to take place in these cases, though even individuals with no private demand for health insurance ($\xi = 0$) generally demand some differential.

Among the sample members for whom $\Psi = 1$ we will discuss three qualitatively distinct cases. The first case, in which the observation period ends while the individual is still in an on-going unemployment spell, is the simplest. In this situation, the only contribution to the likelihood is the density of the right-censored unemployment spell. We will then discuss the second case, in which the individual has one job spell in the employment cycle, either due to the fact that he moves into unemployment at the conclusion of the first job spell or due to the fact that the first job spell is right-censored. In this case the likelihood contribution is defined with respect to the density of the completed unemployment spell, the observed wage and health insurance status at the initiation of the first job, and the length of the first job (be it censored or not). The final case is that in which the individual has two consecutive job spells following the completion of an unemployment spell. In this case, the likelihood contribution is defined with respect to the duration of the unemployment spell, the duration of the first job spell, and the wages and health insurance statuses associated with the first two jobs (at their onset). We shall now consider these cases in the order of their complexity.

4.1 Unemployment Only

Recall that as long as an individual of type ξ would accept some match values at each type of firm (differentiated in terms of ϕ) that would not result in the purchase of health insurance, then the job acceptance match value for a type ξ person is independent of ϕ. Denote this value by θ_ξ^*. Then the hazard rate associated with unemployment for an individual of type ξ is given by

$$h_\xi^u = \lambda_n \tilde{G}(\theta_\xi^*),$$

and the density of unemployment spell durations for a type ξ individual is

$$f_\xi^u(t^u) = h_\xi^u \exp(-h_\xi^u t^u),$$

where t^u is the duration of the unemployment spell in the observation period. Since the hazard function out of unemployment is constant given the individual's type, it is irrelevant whether or not we observe the beginning of the unemployment spell.[12] Then the probability that an unemployment spell of duration t^u is on-going at the end of the sample period (e.g., is right-censored) given the individual's type is

$$L_\xi^{(1)}(t^u, \Psi = 1|T) = \omega_\xi(T) \exp(-h_\xi^u t^u).$$

Let the probability that the individual is a "high demand type" be denoted δ. Then the empirical likelihood in this case is given by

$$L^{(1)}(t^u, \Psi = 1|T) = \delta L_{\xi_2}^{(1)}(t^u, \Psi = 1|T) + (1-\delta) L_{\xi_1}^{(1)}(t^u, \Psi = 1|T).$$

4.2 One Job Spell Only

For all likelihood contributions that involve job spells we utilize simulation methods. We will describe the process by which we generate one sample path for an employment spell; for each individual in the sample we construct R such paths. If the minimum acceptable wage with each type of employer is the same, then the distribution of match draws in the first job spell is independent of the type of firm at which the individual finds employment. We simulate the match draw at the first firm by first drawing a value ζ_1 from a uniform distribution defined on $[0, 1]$, which we denote by $U(0, 1)$. The match draw itself comes from a truncated lognormal distribution with lower truncation point given by the common reservation wage θ_ξ^*. We have

$$\theta_\xi(\zeta_1) = \exp(\mu + \sigma \Phi^{-1}(1 - \Phi(\frac{\ln(\theta_\xi^*) - \mu}{\sigma})(1 - \zeta_1))).$$

The rate of leaving the unemployment spell is $h_\xi^u = \lambda \tilde{G}(\theta_\xi^*)$, so the likelihood of the completed unemployment duration of t^u is

$$h_\xi^u \exp(-h_\xi^u t^u).^{13}$$

Given that the firm is a high cost firm, the wage and health insurance decision are given by

$$(w_\xi^2, d_\xi^2) = X_\xi^u(\theta_\xi(\zeta_1), \phi_2),$$

[12] In a stationary model such as this one, the distribution of forward recurrence times of length-biased spells (i.e., those in progress at the time the sample window begins) is the same as the population distribution of completed spells (that are not length-biased). In our case, both distributions are negative exponential with parameter h_ξ^u.

[13] Note that this density is the same whether the individual began the sample window in this spell or whether it began after the observation period had commenced.

where the equilibrium values x_{ξ}^{j} are read as the value of choice x at the beginning of job spell 1 given a firm type of ϕ_j and an individual type of ξ, where $x = w, d$, and X^u denotes the equilibrium mapping from these state variables into the contract. The critical value for leaving the first firm will be equal to $\theta_{\xi}(\zeta_1)$ whenever another high cost employer is encountered, and otherwise is equal to $\tilde{\theta}_{\xi}(\theta_{\xi}(\zeta_1), \phi_2, \phi_1)$ when a low cost firm is met. The likelihood that the first job ends due to a quit of any kind is then

$$h_{\xi}^{q}(\zeta_1, \phi_2) = \lambda_e(\pi\tilde{G}(\theta_{\xi}(\zeta_1)) + (1-\pi)\tilde{G}(\tilde{\theta}_{\xi}(\theta_{\xi}(\zeta_1), \phi_2, \phi_1))).$$

Since the "total hazard" associated with the first job in the employment spell is simply the sum of the hazard associated with a voluntary quit and a nonvoluntary one, we have

$$h_{\xi}^{e}(\zeta_1, \phi_2) = h_{\xi}^{q}(\zeta_1, \phi_2) + \eta(d_{\xi}^{2}).$$

When the first employer is a low cost firm the situation is symmetric. The equilibrium wage and health insurance decisions are given by

$$(w_{\xi}^{1}, d_{\xi}^{1}) = X_{\xi}^{u}(\theta_{\xi}(\zeta_1), \phi_1).$$

The critical value that will induce job acceptance at a competing low cost firm is $\theta_{\xi}(\zeta_1)$, while a higher match is in general required if the individual is to accept employment at a high cost firm. The rate of leaving this job for another employer is

$$h_{\xi}^{q}(\zeta_1, \phi_1) = \lambda_e(\pi\tilde{G}(\tilde{\theta}_{\xi}(\theta_{\xi}(\zeta_1), \phi_1, \phi_2)) + (1-\pi)\tilde{G}(\theta_{\xi}(\zeta_1))),$$

and the total rate of leaving this job is

$$h_{\xi}^{e}(\zeta_1, \phi_1) = h_{\xi}^{q}(\zeta_1, \phi_1) + \eta(d_{\xi}^{1}).$$

If the first job in the employment spell is still in progress at the end of the sample period then it is right-censored and we have all of the information required to compute the likelihood contribution. Conditioning on the individual's type for the moment, the likelihood value associated with this particular simulation is given by

$$\begin{aligned}
L_{\xi}^{(2)}(t^u, \tilde{w}_1, \tilde{d}_1, t_1, c_1 = 1, \Psi = 1|\zeta_1, T) &= \omega_{\xi}(T) \times h_{\xi}^{u}\exp(-h_{\xi}^{u}t^{u}) \\
&\times \{\pi f(\tilde{w}_1|w_{\xi}^{2}) \times p(\tilde{d}_1|d_{\xi}^{2}) \times \exp(-h_{\xi}^{e}(\theta_{\xi}(\zeta_1), \phi_2)t_1) \\
&\qquad + (1-\pi) f(\tilde{w}_1|w_{\xi}^{1}) \times p(\tilde{d}_1|d_{\xi}^{1}) \times \exp(-h_{\xi}^{e}(\theta_{\xi}(\zeta_1), \phi_1)t_1)\},
\end{aligned}$$

where $c_1 = 1$ if the job spell is right-censored and is equal to 0 if not. The density $f(\tilde{w}_1|w_1)$ is generated from the measurement error assumption, as is $p(\tilde{d}_1|d_1)$. The term $\exp(-h_{\xi}^{e}(\zeta_1, \phi)t_1)$ is the probability that the first job spell has not ended after a duration of t_1 given that it is with a firm of type ϕ.

To form the likelihood contribution for the individual we have to average over a large number of simulation draws and over the possible individual types. Since both averaging operations are linear operations it makes no difference in which order we perform them. Then define the likelihood contribution for an individual with observed characteristics $(t^u, \tilde{w}_1, \tilde{d}_1, t_1, c_1 = 1, \Psi = 1, T)$ by

$$\begin{aligned}
L^{(2)}(t^u, \tilde{w}_1, \tilde{d}_1, t_1, c_1 = 1, \Psi = 1|T) = R^{-1}\sum_{r=1}^{R}\{&\delta L_{\xi_2}^{(2)}(t^u, \tilde{w}_1, \tilde{d}_1, t_1, c_1 = 1, \Psi = 1|\zeta_1(r), T) \\
&+ (1-\delta)L_{\xi_1}^{(2)}(t^u, \tilde{w}_1, \tilde{d}_1, t_1, c_1 = 1, \Psi = 1|\zeta_1(r), T)\},
\end{aligned}$$

where $\zeta_1(r)$ is the r^{th} draw from the $U(0,1)$ distribution.

For the case in which the first job spell is complete and ends in an unemployment spell, the conditional likelihood function is slightly different. The likelihood that an individual of type ξ with a first job draw of θ who is employed at a firm of type ϕ exits into unemployment at time t_1 is the density of durations into unemployment conditional on exiting into unemployment times the probability that the individual has not found a better job by time t_1. This is simply the survivor function associated with the "voluntary exits" density evaluated at t_1, so that the product of these two terms is

$$\begin{aligned} & \eta(d_\xi^j)\exp(-\eta(d_\xi^j)t_1) \times \exp(-h_\xi^q(\zeta_1,\phi_j)t_1) \\ = \; & \eta(d_\xi^j)\exp(-h_\xi^e(\zeta_1,\phi_j)t_1) \end{aligned}$$

when the first job spell was at a firm of type ϕ_j. Then we have

$$\begin{aligned} L_\xi^{(2)}(t^u,\tilde{w}_1,\tilde{d}_1,t_1,c_1=0,\Psi=1|\zeta_1,T) &= \omega_\xi(T) \times h_\xi^u \exp(-h_\xi^u t^u) \\ & \times \{\pi f(\tilde{w}_1|w_\xi^2) \times p(\tilde{d}_1|d_\xi^2) \times \eta(d_\xi^2)\exp(-h_\xi^e(\zeta_1,\phi_2)t_1) \\ & \quad + (1-\pi) f(\tilde{w}_1|w_\xi^1) \times p(\tilde{d}_1|d_\xi^1) \times \eta(d_\xi^1)\exp(-h_\xi^e(\zeta_1,\phi_1)t_1)\}, \end{aligned}$$

and the empirical likelihood contribution for this case is

$$\begin{aligned} L^{(2)}(t^u,\tilde{w}_1,\tilde{d}_1,t_1,c_1=0,\Psi=1|T) = R^{-1}\sum_{m=1}^{R} & \{\delta L_{\xi_2}^{(2)}(t^u,\tilde{w}_1,\tilde{d}_1,t_1,c_1=0,\Psi=1|\zeta_1(r),T) \\ & + (1-\delta) L_{\xi_1}^{(2)}(t^u,\tilde{w}_1,\tilde{d}_1,t_1,c_1=0,\Psi=1|\zeta_1(r),T)\}. \end{aligned}$$

4.3 Two or More Job Spells

When there exist two or more job spells we use only the information on the wage and health insurance status of the first two job spells as well as the duration of the first job in the employment spell. This simplifies our computational burden, and results in very little loss of information since only a small proportion of employment spells contain more than two jobs in our data.

To obtain the wage and health insurance associated with the second spell we proceed as follows. Conditional on the first job being with a high cost employer, for example, and given the first random draw of $\theta_\xi(\zeta_1)$, the individual has three ways to exit the first job spell. First, she may find employment with another high cost employer. The rate at which this occurs is $\lambda_e\pi\tilde{G}(\theta_\xi(\zeta_1))$. Second, she may find employment with a low cost employer, which occurs at rate $\lambda_e(1-\pi)\tilde{G}(\tilde{\theta}_\xi(\theta_\xi(\zeta_1),\phi_2,\phi_1))$. Third, she may exit the spell due to a forced termination, which occurs at rate $\eta(d_\xi^2)$. Then the likelihood that an individual of type ξ with match $\theta_\xi(\zeta_1)$ at a high cost firm finds another high cost firm job at first job spell duration t_1 is

$$\lambda_e\pi\tilde{G}(\theta_\xi(\zeta_1))\exp(-h_\xi^e(\zeta_1,\phi_2)t_1),$$

while the likelihood that she will find a job with a low cost firm is

$$\lambda_e(1-\pi)\tilde{G}(\tilde{\theta}_\xi(\theta_\xi(\zeta_1),\phi_2,\phi_1))\exp(-h_\xi^e(\zeta_1,\phi_2)t_1).$$

We draw a pseudo-random number ζ_2 from $U(0,1)$. If the individual finds a job in a high cost firm, determine her match value as

$$\theta_\xi^{2,2}(\zeta_1,\zeta_2) = \exp(\mu + \sigma\Phi^{-1}(1 - \Phi(\frac{\ln(\theta_\xi(\zeta_1)) - \mu}{\sigma})(1-\zeta_2))),$$

where $\theta_\xi^{2,2}(\zeta_1,\zeta_2)$ is an acceptable match value at the second job given that both jobs are with type ϕ_2 employers (the first term in the superscript corresponds to the employer type at the first job and the second term is the employer type at the second job). Then the wage and health insurance status at the second job are given by

$$(w_\xi^{2,2}, d_\xi^{2,2}) = X_\xi^e(\theta_\xi^{2,2}(\zeta_1,\zeta_2), \phi_2, \theta_\xi(\zeta_1), \phi_2),$$

where the superscripts on the wage and health insurance outcomes denote the types of the firms in both periods.

If the individual finds a job in a low cost firm, define

$$\theta_\xi^{2,1}(\zeta_1,\zeta_2) = \exp(\mu + \sigma\Phi^{-1}(1 - \Phi(\frac{\ln(\tilde{\theta}_\xi(\theta_\xi(\zeta_1),\phi_2,\phi_1)) - \mu}{\sigma})(1-\zeta_2))),$$

so that the wage and health insurance outcomes for this case are

$$(w_\xi^{2,1}, d_\xi^{2,1}) = X_\xi^e(\theta_\xi^{2,1}(\zeta_1,\zeta_2), \phi_1, \theta_\xi(\zeta_1), \phi_2).$$

Then the likelihood contribution for an individual whose first job was at a high cost firm with a match value of $\theta_\xi(\zeta_1)$ and who spent a duration of t_1 at that firm is given by

$$\begin{aligned}
L_\xi^{(3)}(t^u, \tilde{w}_1, \tilde{d}_1, t_1, \tilde{w}_2, \tilde{d}_2, \Psi = 1|\zeta_1,\zeta_2,\phi^{(1)} = \phi_2, T) &= \omega_\xi(T) \times h_\xi^u t^u \exp(-h_\xi^u t^u) \\
&\times \{\lambda_e \pi \tilde{G}(\theta_\xi(\zeta_1)) \exp(-h_\xi^e(\zeta_1,\phi_2)t_1) \times f(\tilde{w}_1|w_\xi^2) \times f(\tilde{w}_2|w_\xi^{2,2}) \\
&\times p(\tilde{d}_1|d_\xi^2) \times p(\tilde{d}_2|d_\xi^{2,2}) \\
&+ \lambda_e(1-\pi)\tilde{G}(\tilde{\theta}_\xi(\theta_\xi(\zeta_1),\phi_2,\phi_1)) \exp(-h_\xi^e(\zeta_1,\phi_2)t_1) \times f(\tilde{w}_1|w_\xi^2) \times f(\tilde{w}_2|w_\xi^{2,1}) \\
&\times p(\tilde{d}_1|d_\xi^2) \times p(\tilde{d}_2|d_\xi^{2,1})\}
\end{aligned}$$

We construct an analogous term for the case in which the first job is with a low cost employer, namely

$$\begin{aligned}
L_\xi^{(3)}(t^u, \tilde{w}_1, \tilde{d}_1, t_1, \tilde{w}_2, \tilde{d}_2, \Psi = 1|\zeta_1,\zeta_2,\phi^{(1)} = \phi_1, T) &= \omega_\xi(T) \times h_\xi^u t^u \exp(-h_\xi^u t^u) \\
&\times \{\lambda_e \pi \tilde{G}(\tilde{\theta}_\xi(\theta_\xi(\zeta_1),\phi_1,\phi_2)) \exp(-h_\xi^e(\zeta_1,\phi_1)t_1) \times f(\tilde{w}_1|w_\xi^1) \times f(\tilde{w}_2|w_\xi^{1,2}) \\
&\times p(\tilde{d}_1|d_\xi^1) \times p(\tilde{d}_2|d_\xi^{1,2}) \\
&+ \lambda_e(1-\pi)\tilde{G}(\theta_\xi(\zeta_1)) \exp(-h_\xi^e(\zeta_1,\phi_1)t_1) \times f(\tilde{w}_1|w_\xi^1) \times f(\tilde{w}_2|w_\xi^{1,1}) \\
&\times p(\tilde{d}_1|d_\xi^1) \times p(\tilde{d}_2|d_\xi^{1,1})\}.
\end{aligned}$$

The likelihood contribution for these particular draws of ζ_1 and ζ_2 for this type ξ individual is then

$$\begin{aligned}
L_\xi^{(3)}(t^u, \tilde{w}_1, \tilde{d}_1, t_1, \tilde{w}_2, \tilde{d}_2, \Psi = 1|\zeta_1,\zeta_2) &= \pi L_\xi^{(3)}(t^u, \tilde{w}_1, \tilde{d}_1, t_1, \tilde{w}_2, \tilde{d}_2, \Psi = 1|\zeta_1,\zeta_2,\phi^{(1)} = \phi_2, T) \\
&+ (1-\pi) L_\xi^{(3)}(t^u, \tilde{w}_1, \tilde{d}_1, t_1, \tilde{w}_2, \tilde{d}_2, \Psi = 1|\zeta_1,\zeta_2,\phi^{(2)} = \phi_1, T)
\end{aligned}$$

As was the case when there was only one job in the employment spell, the "unconditional" likelihood contribution is given by

$$L^{(3)}(t^u, \tilde{w}_1, \tilde{d}_1, t_1, \tilde{w}_2, \tilde{d}_2, \Psi = 1|T) = R^{-1} \sum_{r=1}^{R} \{\delta L_{\xi_2}^{(3)}(t^u, \tilde{w}_1, \tilde{d}_1, t_1, \tilde{w}_2, \tilde{d}_2, \Psi = 1|\zeta_1(r), \zeta_2(r))$$
$$+ (1-\delta) L_{\xi_1}^{(3)}(t^u, \tilde{w}_1, \tilde{d}_1, t_1, \tilde{w}_2, \tilde{d}_2, \Psi = 1|\zeta_1(r), \zeta_2(r))\}.$$

4.4 The Complete Likelihood

In forming the likelihood function contributions above, we have only used information from individuals who experienced unemployment at some point during the sample period (i.e., cases with $\Psi = 1$). We will now derive the likelihood of this event.

Let us say that the individual is randomly sampled at time τ and that his labor market experiences are observed until time $\tau + T$, where T is the length of the sampling window. Thus the individual can experience (at least one) unemployment spell over the interval $[\tau, \tau + T]$ in one of two distinct ways: (1) by being unemployed at time τ or (2) by being employed at time τ and exiting into unemployment prior to $\tau + T$.

We have already seen that under the stationarity assumptions of the model the hazard rate out of unemployment is h_ξ^u. Thus the mean duration of an unemployment spell for a type ξ individual is simply $(h_\xi^u)^{-1}$. A type ξ individual will utilize a set of decision rules adapted to his type, and will have a distribution of completed employment spell durations, which is the sum of consecutive job spells, that does not belong to the negative exponential family. The distribution will be a complicated function of all of the primitive parameters of the model, including the distribution of firm types ϕ. While there does not exist an analytic expression for this distribution, it will be stationary and can be approximated to any arbitrary degree of accuracy using simulation methods. Let the distribution of completed employment spell lengths for a type ξ individual be given by $F_\xi^e(t^e)$, with the mean of the distribution denoted μ_ξ^e.

The probability that a type ξ individual will be found in the unemployment state at a random sampling time τ in the steady state is given by the ratio of the average length of an unemployment spell to the average length of a labor market cycle, or

$$p_\xi^u = \frac{(h_\xi^u)^{-1}}{(h_\xi^u)^{-1} + \mu_\xi^e}.$$

This represents the probability that the sampling window begins with an unemployment spell.

To compute the probability that an individual enters an unemployment spell given that he began the sampling window in the employment state it is necessary to proceed as follows. Assume that the individual is in an employment spell of length $\tilde{t}$ when the sampling period begins. Then the probability that the employment spell will end before the completion of the sampling window is

$$\frac{F_\xi^e(\tilde{t} + T) - F_\xi^e(\tilde{t})}{1 - F_\xi^e(\tilde{t})}.$$

The distribution of on-going durations of an employment spell in progress at a randomly chosen date is well known to be given by

$$\frac{1 - F_\xi^e(\tilde{t})}{\mu_\xi^e},$$

and the probability that the individual is employed at the sampling time is $1-p^u_\xi$. Then the likelihood that an unemployment spell will start during the period $[\tau, \tau+T]$ given that the individual was employed at time τ is

$$\frac{F^e_\xi(\tilde{t}+T) - F^e_\xi(\tilde{t})}{\mu^e_\xi}.$$

Putting all of these elements together, we have that the probability that the individual will be in the unemployment state at some time during the randomly selected period $[\tau, \tau+T]$ is

$$\begin{aligned}
\omega_\xi(T) &= \frac{(h^u_\xi)^{-1}}{(h^u_\xi)^{-1} + \mu^e_\xi} \\
&\quad + \frac{\mu^e_\xi}{(h^u_\xi)^{-1} + \mu^e_\xi} \int_0^\infty \frac{F^e_\xi(\tilde{t}+T) - F^e_\xi(\tilde{t})}{\mu^e_\xi} d\tilde{t} \\
&= \frac{1}{(h^u_\xi)^{-1} + \mu^e_\xi} \{(h^u_\xi)^{-1} + \int_0^\infty (F^e_\xi(\tilde{t}+T) - F^e_\xi(\tilde{t})) d\tilde{t}\}.
\end{aligned}$$

Note that

$$\begin{aligned}
\lim_{T\to\infty} \omega_\xi(T) &= \frac{1}{(h^u_\xi)^{-1} + \mu^e_\xi} \{(h^u_\xi)^{-1} + \lim_{T\to\infty} \int_0^\infty (F^e_\xi(\tilde{t}+T) - F^e_\xi(\tilde{t})) d\tilde{t}\} \\
&= \frac{1}{(h^u_\xi)^{-1} + \mu^e_\xi} \{(h^u_\xi)^{-1} + \int_0^\infty (1 - F^e_\xi(\tilde{t})) d\tilde{t}\} \\
&= 1 \ \forall\, \xi.
\end{aligned}$$

This last result demonstrates that all nonrandomness in our subsample of individuals who experience an unemployment spell at some point in the observation period is attributable to the finiteness of the sampling window (given our assumption that the original sample to which we have access is randomly drawn). As the sampling window grows indefinitely large the model implies that the set of original sample members excluded by our unemployment spell requirement is of measure 0 so that nonrandom sampling problems are precluded.

The final specification of the likelihood function can now be derived. We have already specified the likelihood contributions for the individuals for whom $\Psi = 1$. For those individuals who do not experience an employment spell we only utilize the information that $\Psi = 0$. This probability is given by

$$p(\Psi = 0|T) = \delta(1 - \omega_{\xi_2}(T)) + (1-\delta)(1 - \omega_{\xi_1}(T)).$$

Let the set of individuals who were unemployed at some time in the sample period and who contribute only a right-censored unemployment spell to the likelihood (our Case 1 above) be given by Υ_1, the set of individuals with an unemployment spell followed by one job spell be given by Υ_2, and the set of individuals with unemployment and two consecutive job spells be denoted by Υ_3. Let the set containing the remaining individuals, those who experienced no unemployment during their sample observation periods, be denoted Υ_4. Then the likelihood of the sample is given by

$$\begin{aligned}
L &= \prod_{i\in\Upsilon_1} L^{(1)}(t^u_i, \Psi_i = 1|T_i) \prod_{i\in\Upsilon_2} L^{(2)}(t^u_i, \tilde{w}_{1,i}, \tilde{d}_{1,i}, t_{1,i}, c_{1,i} = 0, \Psi_i = 1|T_i) \\
&\quad \times \prod_{i\in\Upsilon_3} L^{(3)}(t^u_i, \tilde{w}_{1,i}, \tilde{d}_{1,i}, t_{1,i}, \tilde{w}_{2,i}, \tilde{d}_{2,i}, \Psi_i = 1|T_i) \prod_{i\in\Upsilon_4} p(\Psi_i = 0|T_i).
\end{aligned}$$

Maximization of the log of this function with respect to the primitive parameters of the model yields estimators with desirable asymptotic properties as long as the number of simulations R is growing at an appropriate rate with respect to the sample size. In our implemention we have set $R = 1000$ and have located the maximum likelihood estimators through the use of a simplex algorithm. To compute the standard errors of the estimates we have utilized bootstrap methods. We found the bootstrap approach attractive due to the discontinuites in the numerical likelihood that arose from the use of simulated match draws and due to the nature of the approximations used in solving the decision rules (see Appendix C). Although solving the model is computer intensive, it was feasible to reestimate each of the four specifications reported below 50 times each, and our bootstrap estimates of the standard errors are based on these replications.

5 Results

This section presents the estimation results based on the econometric model discussed in the previous section. It is well-known that with the type of data available to us identification of primitive parameters requires that parametric assumptions be made regarding the distribution G (Flinn and Heckman, 1982). We assume that the productivity distribution $G(\theta)$ is lognormal with parameters μ_θ and σ_θ. Furthermore, we assume a lognormal distribution for the measurement error distribution with parameters μ_ε and σ_ε.[14] It is exceedingly difficult to identify the bargaining power parameter α, even after making functional form assumptions regarding G. In light of this, we make the standard assumption of symmetry and accordingly set $\alpha = 0.5$. Rather than estimate the discount rate (ρ) freely, we fix it at 0.08 (annualized).

In the first subsection we report and discuss estimates for four specifications of the model. The initial specification assumes homogeneity on both sides of the market. The second specification allows firm heterogeneity (i.e., $\phi_1 \neq \phi_2$) only. The third specification considers both worker (i.e., $\xi_2 \neq \xi_1$) and firm heterogeneity, but assumes that the probability that an individual has a high demand for health insurance is independent of observable characteristics. The final specification again allows both worker and firm heterogeneity, but specifies that the probability an individual is a high demand type depends on observables such that

$$\delta(Z) = \frac{\exp(\delta_0 + \delta_1 Z_1 + \delta_2 Z_2)}{1 + \exp(\delta_0 + \delta_1 Z_1 + \delta_2 Z_2)}$$

where Z_1 is an indicator variable that takes the value 1 when the sample member is married and Z_2 is an indicator variable that takes the value 1 if he has children. Since it is somewhat difficult to interpret some of the primitive parameters, we also compute estimates of population moments that serve to characterize the stationary equilibrium. In the second subsection we derive and discuss measures of the amount of "inefficient" mobility present given the point estimates from two of the specifications we estimate.

5.1 Model Estimates

Table 2 presents the simulated maximum likelihood estimates for the various specifications of the model. For ease of exposition we will distinguish three subsets of the primitive parameters: (1) those parameters which are constant across specifications (i.e., the job offer arrival rates, λ_n

[14] We assume that $\mu_\varepsilon = -.5\sigma_\varepsilon^2$ to ensure that the observed ln wage equals the true ln wage in expectation.

and λ_e, the job dissolution rates, $\eta(1)$ and $\eta(0)$, the parameters characterizing the productivity distribution, μ_θ and σ_θ, the parameters that define the measurement error processes, σ_ε and γ, and the unemployment utility flow, b); (2) parameters that characterize the distribution of health insurance costs (i.e., ϕ_1, ϕ_2, and π); and (3) parameters that define the distribution of private demands for health insurance (i.e., ξ_2, δ_0, δ_1, δ_2). We will consider the first subset initially.

The first thing to note is the relative consistency of the estimates across the four specifications. For this reason, we base our discussion solely on the results from the most general specification with both worker and firm heterogeneity (including observable covariates) presented in column 4 of Table 2. Perhaps the most important result to note is that our estimates strongly support the premise of our model that $\eta(0) > \eta(1)$.[15] Durations are measured in weeks, so that our estimates imply that, on average, a job without health insurance will exogenously dissolve after approximately one and a half years, while a job with insurance will dissolve after approximately twelve years. The point estimate of λ_n (0.0630) implies that the mean wait between contacts (when unemployed) is about 16 weeks. In contrast, the point estimate of λ_e (0.0097) suggests that a contact between a new potential employer and a currently employed individual occurs about every two years. The standard error of the estimate of λ_e is sufficiently small that it is safe to say that employed search is an important source of turnover.

As was discussed in the previous section, for the model to fit the data requires that measurement error be incorporated. In some sense, the degree of measurement error required to provide an acceptable degree of fit of the equilibrium model to the data can be considered an index of the degree of model misspecification. The estimate of the standard deviation of the logarithm of the measurement error in log wage rates, σ_ε, takes a value (0.537) similar to that found in most similar studies. More interesting perhaps is the estimated amount of error in the measurement of health insurance coverage. The estimate of γ is found to be about 0.86, so that, in conjunction with the measurement error assumed to be present in wage rates, the probability of mismeasurement of health insurance status is approximately 14 percent.

Turning to the estimates of the parameters characterizing the distribution of health insurance costs, we find important similarities and interesting differences across the four specifications. First, the estimated mean cost of health insurance is relatively stable across the specifications. In the initial specification, in which all firms face the same cost, the point estimate of the cost of insurance is \$5.15 per hour. On the face of it, this estimate may appear high, but compared to the mean wage of insured jobs in the steady state (simulated to be \$20.59 per hour), we find that health insurance accounts for slightly more than 20 percent of total employer costs. In contrast to the relative stability of the average cost of insurance, the estimated variation in this distribution changes markedly across specifications. In the second specification, where we introduce only firm-level heterogeneity, we estimate that almost 38 percent of all firms face a high cost of health insurance and that the cost difference is slightly more than \$1 per hour. When we introduce worker heterogeneity, but do not condition on observable characteristics, we find that high cost firms represent only 9 percent of the population and that the cost differential is only \$0.08 per hour. Lastly, when we include observable searcher characteristics the percentage of high cost firms drops to 7, but the cost differential increases to \$1.80 per hour.

The estimated distribution of private health insurance demand varies substantially between the

[15] In our parameterization of the model, the log likelihood would still be well-defined even if the ordering of the estimated exogenous separation rates was not consistent with our assumption. The "incongruity," if you will, would be seen in an estimated value of the cost of insurance that was negative.

specification that does not include observables and the specification that does. In the latter case we estimate that high demand individuals are willing to pay \$0.17 for health insurance and that slightly more than 41 percent of the population has a high demand for health insurance. In the former specification, we find that high demand types are willing to pay \$1.85 for health insurance coverage and that approximately 45 percent of the population possesses a high demand for insurance coverage. We also find significant differences in the probability of being a high demand type. For example, an unmarried individual without children is a high demand type 7 percent of the time, whereas almost 75 percent of married individuals with children are high demand types.

The primitive parameters are often difficult to interpret, so in Tables 3, 4, and 5 we provide some more easily interpreted statistics computed under the estimated equilibria of the four specifications. In Table 3, we present the implied critical matches for transitions out of unemployment, θ^*_ξ, and for the provision of health insurance, $\theta^{**}_{\xi,\phi}$. We also compute the probability that a match is acceptable and the probability that an acceptable match results in the provision of health insurance. In addition, we estimate the mean unemployment spell duration and the probability that an individual of a given type is unemployed over the length of the sample window. To begin with our baseline specification with no heterogeneity, we find that nearly 96 percent of all potential matches are accepted out of unemployment and that nearly 44 percent of these matches result in the provision of health insurance. The mean unemployment duration is close to 18 weeks and nearly 27 percent of the population would be observed in the unemployment state sometime during the sample window. Moving to our most general specification, we find significant differences in the labor market outcomes of high and low demand workers and high and low cost firms. Specifically, we find that low demand individuals accept slightly more than 92 percent of matches out of the unemployment state, whereas 88 percent of matches are accepted by high demand workers. As a result, the mean unemployment duration is almost 1 week greater for a high demand individual. Perhaps more interestingly, we see big differences in the probability that an acceptable worker-firm match results in the provision of health insurance across worker and firm types. A high demand worker will have health insurance at 56 percent of low cost firms, but will gain coverage at only 36 percent of high cost firms. On the other hand, low demand workers will be insured at 38 percent of low cost firms and 24 percent of high cost firms. Finally, we see that low demand individuals are more likely than high demand workers, by 28.4 to 25.3 percent, to be observed in the unemployment state over the sample window.

Table 4 presents some summary statistics corresponding to the first job directly following an unemployment spell. Since the theoretical predictions of the model (in terms of equilibrium wages and job spell durations) are most clear following an unemployment spell and since most of our wage and health insurance data come from the first job following such a spell, these estimates provide a useful comparison between the theoretical (estimated) predictions of the model and the data. The results from the first three specifications indicate that approximately 44 percent of first jobs provide health insurance, that the mean wage in jobs with health insurance is close to 52 percent higher than the mean wage in jobs without insurance, and that (first) jobs with health insurance tend to last almost six times longer than jobs without health insurance. The estimates from the final specification point to some important features of the model. First, we find that almost 55 percent of high demand individuals have health insurance coverage while only slightly more than 37 percent of low demand workers have coverage. Second, we see that low demand workers actually earn \$2.38 per hour more, on average, than high demand workers at jobs with insurance coverage. This is not only due to the direct effect of the private demand on the wages, as captured by ξ_2, but also because high demand workers have health insurance coverage at relatively less productive matches than low demand workers. Third, we see that high demand workers earn slightly more than low demand workers at jobs without insurance, which is solely due to a composition effect. Lastly, we find that low demand workers have significantly longer job durations at insured jobs than high demand workers. While this result may seem paradoxical, remember that high demand individuals will have health insurance at relatively less productive matches. Therefore, even though high demand individuals may be less likely to leave a given employment match that results in the provision of health insurance than low demand individuals, the fact that a much larger proportion of matches provide insurance to these individuals more than compensates for the difference in mobility patterns.

The model does do a reasonably good job of fitting the conditional wage distributions observed in the data as Figures 5.a and 5.b demonstrate.[16] The figures plot the theoretical (estimated) densities of the first wage observed after an unemployment spell conditional on health insurance status against the relevant histogram of sample wage rates. Clearly the implications of the model are less satisfactory for the wage distribution associated with jobs without health insurance. While it is true that allowing for measurement error that follows a lognormal distribution acts to smooth out differences between the predictions of the equilibrium model and the data, the measurement error assumptions are restrictive enough that its presence cannot be the sole explanation of the high degree of correspondence between the predicted and observed distributions.

Table 5 presents some summary measures of the labor market in the steady state. The estimates are computed by simulating the labor market histories of 1,000,000 individuals (of each type) who begin their working lives in the unemployment state based on the parameter estimates of the four specifications. Turning immediately to the estimates from our final specification, we find some interesting results. First, although high demand types have longer unemployment spells and shorter first job spells, on average, they have a lower steady state unemployment rate than low demand individuals. The reason for this result can be seen from the fact that high demand individuals are much more likely (90.3 to 83.9 percent) than low demand individuals to have health insurance in the steady state and that jobs with health insurance tend to last much longer than jobs without health insurance. Second, we find that the mean wage of high demand types in insured jobs is approximately \$1.25 lower than the mean wage of low demand types. Recall that the implied difference in the mean wages in the first job following an unemployment spell is \$2.38. The main reason for the convergence in the mean wages over time is due to the fact that high demand individuals are more likely to be covered by health insurance and therefore less likely to have an exogenous dismissal back into the unemployment state.

5.2 Inefficiency Measures

In the homogeneous model all turnover is "efficient" in the sense that any job to job movement is associated with an improvement in the instantaneous productivity rate. As was noted above, with time-invariant heterogeneity inefficient turnover only occurs when firms differ in their cost of providing health insurance to a worker. As a result we will compute our inefficiency measures using point estimates from model specifications that include both worker and firm heterogeneity. Since we don't have a model that would allow us to solve for the steady state distribution of the indicator variables for being married or having children we will only use the two specifications that include

[16] We decided not to implement formal tests of model fit due to the large amount of censoring in the data.

firm heterogeneity but don't condition on covariates. The estimates from these two specifications appear in Columns 2 and 3 of Table 2. They differ only in that specification 2 does not include heterogeneity in the private demand for insurance on the part of searchers.

In computing the indices we use as a baseline the steady state joint distribution of (θ, ξ, ϕ) as a starting point.[17] Although in the population these characteristics are assumed to be independently distribution, systematic sorting will produce dependence in the steady state distribution. Since there is no analytic solution for the joint steady state distribution of these characteristics, this distribution is approximated using simulation methods. We denote this joint distribution by $p_{SS}(\theta, \xi, \phi)$.

Next we use the decision rules described in Section 2 to write a critical match value required to induce mobility from a job at a potential employer of type ϕ'. Define this critical match value as $\tilde{\theta}_\xi(\theta, \phi, \phi')$. Thus any potential employer of type (θ', ϕ') will successfully recruit the individual if and only if $\theta' > \tilde{\theta}_\xi(\theta, \phi, \phi')$. Using this function, the conditional probability of a job-to-job change given a contact with another firm is

$$\tilde{G}(\tilde{\theta}_\xi(\theta, \phi, \phi'))p(\phi'),$$

where $p(\phi')$ is the population proportion of type ϕ' firms.

Of all moves only a proportion will be inefficient in the sense of involving the choice of a job with a lower θ than that available at an alternative match. In the empirical literature on health insurance and mobility decisions a distinction is made between the case in which one stays at a firm with a lower θ than that an alternative firm, termed "job lock," and the situation in which an individual moves to a firm with a lower θ value, termed "job push." While the difference between the two is somewhat semantic, we can decompose the probability of an inefficient choice into these two sources using the following metric.

For an inefficient move to occur requires that the two firms currently competing for the searcher's services be of different types. For there to exist "job push" requires that the current employer be type ϕ_2 and the potential employer be of type ϕ_1. In the case of job push the critical value for leaving a match of θ is less than or equal to θ. The conditional probability that a move will be inefficient and be attributable to "job push" is then

$$\begin{aligned} p_{SS}(I_{JP}) &= \int_0^\infty \sum_{\xi \in \{\xi_1, \xi_2\}} \frac{[\tilde{G}(\tilde{\theta}_\xi(\theta, \phi_2, \phi_1)) - \tilde{G}(\theta)]}{\tilde{G}(\tilde{\theta}_\xi(\theta, \phi_2, \phi_1))} p(\phi_1) p_{SS}(\theta, \xi, \phi_2) d\theta \\ &> 0 \Leftrightarrow \phi_2 > \phi_1. \end{aligned}$$

For "job lock" to occur requires that the current employer be a low cost type and the potential employer be a high cost type. The critical match value in this case is greater than or equal to θ, and we have that the probability of inefficient mobility attributable to job lock is

$$\begin{aligned} p_{SS}(I_{JL}) &= \int_0^\infty \sum_{\xi \in \{\xi_1, \xi_2\}} \frac{[\tilde{G}(\theta) - \tilde{G}(\tilde{\theta}_\xi(\theta, \phi_1, \phi_2))]}{\tilde{G}(\theta)} p(\phi_2) p_{SS}(\theta, \xi, \phi_1) d\theta \\ &> 0 \Leftrightarrow \phi_2 > \phi_1. \end{aligned}$$

[17] Since specification 2 does not include heterogeneity in searchers' private demands for health insurance the steady state distribution is defined over (θ, ϕ) only.

The likelihood of inefficient mobility is simply the sum of these two probabilities, or

$$p_{SS}(I_T) = p_{SS}(I_{JP}) + p_{SS}(I_{JL}).$$

In Table 6 we report the computation of the inefficiency measures using point estimates from the specifications 2 and 3 reported in Table 2. Since there was almost no dispersion in the distribution of firm's costs under Specification 3, it is not surprising to find essentially no inefficient mobility when using those estimates. Using the estimates from Specification 2, however, we do find that approximately 7 percent of potential moves to better match values were not made. The proportion attributable to "job lock" and "job push" are virtually identical.

The inefficiency measures are small using estimates from either of the two specifications of the model. Thus, while there is some indication that the connection between employment and health insurance coverage may lead to some distortions when it comes to turnover decisions, the amount if misallocation would not appear to be significant.

We should also point out that our measures of inefficiency in turnover decisions are decidedly short-run and as such somewhat misleading. Consider the case of "job lock," for example. A worker with no private demand for health care (a type $\xi_1 = 0$) will always move to matches that produce the highest total surplus for the firm and the worker by definition. Staying at a lower match value at a low cost firm and passing on a (slightly) higher match value at a high cost firm is welfare maximizing after accounting for the insurance cost impact on the net surplus from the match.[18] Therefore for type ξ_1 individuals turnover decisions would always be efficient if total expected surplus maximization were the criterion. For type $\xi_2(> 0)$ individuals total expected surplus maximization is not the mobility decision criterion, so these individuals could make inefficient decisions from this perspective. The point is that the concept of inefficiency should vary with the specification of the model. The short-run measure that is our focus of attention in this section was selected because it seemed most analagous to the notion of inefficiency implicit in the existing empirical literature on wages, health insurance, and turnover decisions.

6 Conclusions

Researchers investigating the relationship between employer-provided health insurance, wages, and turnover have uncovered a number of empirical findings (not all of which are mutually consistent) that to date have not be explicable within an estimable dynamic model of labor market equilibrium. We propose such a model and show that it has implications for labor market careers broadly consistent with the existing empirical evidence on the subject. Using SIPP data we estimate the model and, for the most part, obtain reasonable results. The model is able to capture some of the most salient features of the data without undue reliance on the introduction of measurement error to improve fit.

We view one of the accomplishments of this paper as demonstrating theoretically and empirically that what may appear to be "job lock" is consistent with an equilibrium model in which all turnover is efficient. The model estimated here is innovative on at least two dimensions. First,

[18] For purposes of this discussion we are assuming that health insurance would be bought at either match. Of course, the individual could consider moving to the higher quality match at the high cost firm without health insurance. While the instantaneous surplus would be greater at such a job than that at current one, the fact that the life of the new contract will be shorter (on average) typically implies that such a contract will have a lower expected surplus than the current one and hence will not be observed.

we have estimated an equilibrium model in which jobs are (endogenously) differentiated along two dimensions: wages and health insurance provision. Second, the model allows for wage renegotiations with the employee's current firm. While empirical implementations of matching models (e.g., Miller, 1984; Flinn, 1986) are consistent with wage changes during an employment spell, they imply no dependence between the wages paid at successive employers. The bargaining models formulated and estimated here and in Postel-Vinay and Robin (2000) offer a more complete view of wage dynamics than other search-based models that are currently available.

To assess the quantitative significance of incomplete health insurance coverage for inefficient mobility outcomes, we had to expand the model to allow for heterogeneity in the populations of workers and firms. We showed that (time-invariant) worker differences in private demand for health insurance could not produce job lock; rather, firm heterogeneity in the costs of providing insurance was crucial. Our estimate of the distribution of firm costs implied that the distribution was almost degenerate. As a result, we conclude that the current system of employer-provided health insurance is not likely to lead to a significant proportion of inefficient mobility decisions.

A Proof of Proposition 1

Using the definitions of $\theta^*(\xi)$ and $\theta^{**}(\xi)$, we can rewrite $\theta^*(\xi)$ as

$$\begin{aligned}\theta^*(\xi) &= [\delta(\theta^*(\xi))]^{-1} \times \{(\rho+\eta(0))b + \alpha\lambda \int_{\theta^*(\xi)}^{\theta^{**}(\xi)} \theta\, dG(\theta) \\ &\quad +\alpha\lambda \left(\frac{\rho+\eta(0)}{\rho+\eta(1)}\right) \int_{\theta^{**}(\xi)}^{\infty} \theta\, dG(\theta) - \alpha\lambda\widetilde{G}(\theta^{**}(\xi)) \left(\frac{\eta(0)-\eta(1)}{\rho+\eta(1)}\right) \theta^{**}(\xi)\}.\end{aligned}$$

where $\delta(\theta^*(\xi)) = \rho + \eta(0) + \alpha\lambda\widetilde{G}(\theta^*(\xi))$. It is then straightforward to show that

$$\frac{\partial\theta^*(\xi)}{\partial\xi} = [\delta(\theta^*(\xi))]^{-1} \times \{-\alpha\lambda\widetilde{G}(\theta^{**}(\xi)) \left(\frac{\eta(0)-\eta(1)}{\rho+\eta(1)}\right) \frac{\partial\theta^{**}(\xi)}{\partial\xi}\}.$$

By the definition of $\theta^{**}(\xi)$ we know that

$$\frac{\partial\theta^{**}(\xi)}{\partial\xi} = \frac{\partial\theta^*(\xi)}{\partial\xi} - \frac{\rho+\eta(0)}{\eta(0)-\eta(1)}$$

which implies that

$$\frac{\partial\theta^*(\xi)}{\partial\xi} = \frac{\alpha\lambda\widetilde{G}(\theta^{**}(\xi))(\rho+\eta(0))}{(\rho+\eta(1))\delta(\theta^*(\xi)) + \alpha\lambda\widetilde{G}(\theta^{**}(\xi))(\eta(0)-\eta(1))} > 0.$$

Substituting $\partial\theta^*(\xi)/\partial\xi$ into $\partial\theta^{**}(\xi)/\partial\xi$ yields

$$\frac{\partial\theta^{**}(\xi)}{\partial\xi} = \frac{-(\rho+\eta(1))(\rho+\eta(0))\delta(\theta^*(\xi))}{(\eta(0)-\eta(1))\{(\rho+\eta(1))\delta(\theta^*(\xi)) + \alpha\lambda\widetilde{G}(\theta^{**}(\xi))(\eta(0)-\eta(1))\}} < 0.$$

■

B Proof of Proposition 3

The value of employment to a type ξ individual at a match θ when paid a wage w and with health insurance status d be given by

$$\begin{aligned} V_\xi^E(w,d;\theta) &= (\rho+\eta(d)+\lambda_e\widetilde{G}(\widehat{\theta}(w,d)))^{-1}\times\{w+\xi d+\eta(d)V_\xi^N \\ &\quad +\lambda_e\int_{\widehat{\theta}_\xi(w,d)}^{\theta}\widehat{V}_\xi^E(\theta,\widetilde{\theta})dG(\widetilde{\theta}) \\ &\quad +\lambda_e\int_{\theta}\widehat{V}_\xi^E(\widetilde{\theta},\theta)dG(\widetilde{\theta})\} \end{aligned}$$

where the function $\widehat{V}_\xi^E(x,y)$ represents the equilibrium value of employment to the worker of type ξ at a match x with next best option y and $\widehat{\theta}_\xi(w,d)$ represents the lowest match that the worker of type ξ will report to his current firm. Similarly, the value to the firm is given by

$$\begin{aligned} V^F(w,d;\theta,\xi) &= (\rho+\eta(d)+\lambda_e\widetilde{G}(\widehat{\theta}(w,d)))^{-1}\times\{\theta-w-\phi d+\eta(d)\times 0 \\ &\quad +\lambda_e\int_{\widehat{\theta}_\xi(w,d)}^{\theta}\widehat{V}^F(\theta,\widetilde{\theta};\xi)dG(\widetilde{\theta})\}, \end{aligned}$$

where $\hat{V}^F(x,y;\xi)$ denotes the equilibrium value to the firm of having a type ξ individual with a match value of x when the employee's next best match option is y. Define total surplus of the match as

$$\begin{aligned} T(w,d;\theta,\xi) &= V_\xi^E(w,d;\theta)+V^F(w,d;\theta,\xi) \\ &= (\rho+\eta(d)+\lambda_e\widetilde{G}(\widehat{\theta}_\xi(w,d)))^{-1}\times\{\theta+(\xi-\phi)d+\eta(d)V_n \\ &\quad +\lambda_e\int_{\widehat{\theta}_\xi(w,d)}^{\theta}\widehat{T}(\theta,\widetilde{\theta};\xi)dG(\widetilde{\theta}) \\ &\quad +\lambda_e\int_{\theta}\widehat{V}_\xi^E(\widetilde{\theta},\theta)dG(\widetilde{\theta})\} \end{aligned}$$

where the function $\widehat{T}(x,y;\xi)$ represents the total surplus of the match x involving a worker of type ξ with next best match option y in equilibrium. It is straightforward to show that the total surplus of the match is independent of the wage, or

$$\begin{aligned} \frac{\partial T(w,d;\theta,\xi)}{\partial w} &= 0 \text{ for all } (w,d;\theta,\xi) \\ \Rightarrow T(w,d;\theta,\xi) &= T(d;\theta,\xi). \end{aligned}$$

If $Q_\xi(d;\theta)$ denotes the maximum value a match value of θ could yield to a worker of type ξ given health insurance status d, it follows that

$$Q_\xi(d;\theta)=T(d;\theta,\xi)$$

Now we can redefine the Nash bargaining problem as

$$S_\alpha(d;\theta',\theta,\xi) = \max_{d,V_e}\{V_\xi^E(d;\theta',\theta) - Q_\xi(\theta)\}^\alpha\{Q_\xi(d;\theta') - V_\xi^E(d;\theta',\theta)\}^{1-\alpha},$$

where $Q_\xi(\theta) = \max[Q_\xi(0;\theta), Q_\xi(1;\theta)]$. It follows that, conditional on d,

$$\widehat{V}_\xi^E(d;\theta',\theta) = \alpha Q_\xi(d;\theta') + (1-\alpha)Q_\xi(\theta)$$

where

$$\begin{aligned}
Q_\xi(d,\theta') &= (\rho + \eta(d) + \lambda_e\widetilde{G}(\theta'))^{-1} \times \{\theta' + (\xi - \phi)d + \eta(d)V_\xi^N \\
&\quad + \lambda_e \int_{\theta'} \widehat{V}_\xi^E(\widetilde{\theta},\theta')dG(\widetilde{\theta})\}.
\end{aligned}$$

It follows that we can rewrite the Nash bargaining objective function as

$$S_\alpha(d;\theta',\theta,\xi) = \max_d \alpha^\alpha(1-\alpha)^{1-\alpha}\{Q_\xi(d;\theta') - Q(\theta)\},$$

and the solution in terms of the choice of health insurance is

$$d_\xi^*(\theta',\theta) = 1 \Leftrightarrow Q_\xi(1;\theta') > Q_\xi(0,\theta') \text{ for all } (\xi,\theta',\theta).$$

■

C Approximation of Decision Rules in the OTJ Search Model

In this appendix we present our strategy for deriving the equilibrium of the Nash bargaining model. We will consider the most general specification with both worker and firm heterogeneity. The computational burden of solving the model is quite substantial and since estimation of the model requires knowledge of the equilibrium wage functions, $w_\xi(\theta',\phi',\theta,\phi)$, and the critical matches for acceptance of an employment contract and the provision of health insurance, θ_ξ^* and $\theta_\xi^{**}(\phi)$, we are forced to approximate the system of value functions. After doing so we are able to efficiently solve for the equilibrium of the model without an excessive computational burden.

To begin, the value of an employment contract (w,d) at a match with characteristics (θ,ϕ) to a worker of type ξ is given by

$$\begin{aligned}
V_\xi^E(w,d;\theta,\phi) &= (\rho + \eta(d) + \lambda_e \textstyle\sum_{i=1}^2 p(\phi_i)\widetilde{G}(\hat{\theta}_\xi(w,d,\phi,\phi_i)))^{-1} \times \{w + \xi d + \eta(d)V_\xi^N \\
&\quad + \lambda_e \sum_{i=1}^2 p(\phi_i) \int_{\hat{\theta}_\xi(w,d,\phi,\phi_i)}^{\hat{\theta}_\xi(\theta,\phi,\phi_i)} \widehat{V}_\xi^E(\theta,\phi,\widetilde{\theta},\phi_i)dG(\widetilde{\theta}) \\
&\quad + \lambda_e \sum_{i=1}^2 p(\phi_i) \int_{\hat{\theta}_\xi(\theta,\phi,\phi_i)} \widehat{V}_\xi^E(\widetilde{\theta},\phi_i,\theta,\phi)dG(\widetilde{\theta})\}
\end{aligned}$$

where the function $\widehat{V}_\xi^E(x_1,x_2,y_1,y_2)$ represents the equilibrium value of employment to the worker of type ξ at a match with characteristics (x_1,x_2) with next best option (y_1,y_2), $\hat{\theta}_\xi(w,d,\phi,\phi_i)$

represents the lowest match at a ϕ_i-type firm that the worker of type ξ will report to his current ϕ-type firm, and $\hat{\theta}_\xi(\theta, \phi, \phi_i)$ represents the lowest match at a ϕ_i-type firm that will induce a worker of type ξ to leave his current match (θ, ϕ). It is important to note that the critical matches are implicitly defined by the equations

$$Q_\xi(\hat{\theta}_\xi(w, d, \phi, \phi_i), \phi_i) = V_\xi^E(w, d; \theta, \phi)$$

and

$$Q_\xi(\hat{\theta}_\xi(\theta, \phi, \phi_i), \phi_i) = Q_\xi(\theta, \phi).$$

The first equation implies that a worker will report a new match to his current employer if the new match has the potential of increasing his welfare, while the second equation says that the worker will leave his current firm if the new match has the potential of producing a value to the worker greater than what his current firm can offer.

Next, note that the maximum value of θ for which the contract (w, d) would leave a ϕ-type firm with no profit equals $\hat{\theta}_\xi(w, d, \phi, \phi) = w + d\phi$ and the equilibrium wage associated with the worker receiving all the rents from θ is $w^*(\theta, \phi, \theta, \phi) = \theta - d\phi$. Given these two implications of the model we then know that

$$V_\xi^E(w = \theta - d\phi, d; \theta, \phi) = Q_\xi\left(d, \theta, \phi\right).$$

Taking the first order Taylor series approximation to V_ξ^E with respect to w (around $w = \theta - d\phi$), we have

$$V_\xi^E(w, d; \theta, \phi) \approx Q_\xi(d, \theta, \phi) + (w - \theta + d\phi) \left.\frac{\partial V_\xi^E(w, d; \theta, \phi)}{\partial w}\right|_{w=\theta-d\phi}$$

Using Leibniz' rule, the derivative evaluated at $w = \theta - d\phi$ can be shown to equal

$$\left.\frac{\partial V_\xi^E(w, d; \theta, \phi)}{\partial w}\right|_{w=\theta-d\phi} = \frac{1}{\rho + \eta(d) + \lambda_e \sum_{i=1}^{2} p(\phi_i)\widetilde{G}(\hat{\theta}_\xi(\theta, \phi, \phi_i))} \equiv \frac{1}{\kappa(d)}.$$

Therefore,

$$V_\xi^E(w, d; \theta, \phi) \approx Q_\xi(d, \theta, \phi) + \frac{w - \theta + d\phi}{\kappa(d)}.$$

Using the fact that

$$V_\xi^E(w_\xi(\theta', \phi', \theta, \phi), d; \theta', \phi') = \widehat{V}_\xi^E(d, \theta', \phi', \theta, \phi) = \alpha Q_\xi(d', \theta', \phi') + (1 - \alpha)Q_\xi(\theta, \phi).$$

it follows that equilibrium wages, conditional on health insurance d, are given by the equation

$$w_\xi(\theta', \phi', \theta, \phi \mid d) = \theta' - d\phi' - (1 - \alpha)\kappa(d)(Q_\xi(d, \theta', \phi') - Q_\xi(\theta, \phi)). \tag{4}$$

Given the close relationship between the equilibrium outcome (both wages and the provision of health insurance) and the function $Q_\xi(d, \theta, \phi)$, the computation of the equilibrium follows a rather simple three-stage process. First, we solve the fixed point equations for $Q_\xi(d, \theta, \phi)$ and V_N^ξ for all d, θ, ϕ, ξ. Given these values, we determine the critical matches for the acceptance of an employment contract and the provision of health insurance according to the system of equations

$$\begin{aligned} Q_\xi(0, \theta_\xi^*, \phi_1) &= Q_\xi(0, \theta_\xi^*, \phi_2) = V_\xi^N \\ Q_\xi(1, \theta_\xi^{**}(\phi), \phi) &= Q_\xi(0, \theta_\xi^{**}(\phi), \phi) \end{aligned}$$

for $\xi \in \{\xi_1, \xi_2\}$ and $\phi \in \{\phi_1, \phi_2\}$. Finally, we compute the equilibrium wages according to equation [4] above.

References

[1] Anderson, Patricia (1997). "The Effect of Employer-Provided Health Insurance on Job Mobility: Job-Lock or Job-Push?" Unpublished manuscript, Dartmouth College.

[2] Buchmueller, Thomas and Robert Valletta (1996). "The Effects of Employer-Provided Health Insurance on Worker Mobility." *Industrial and Labor Relations Review*, 49, 439-455.

[3] Cooper, Philip and Alan Monheit (1993). "Does Employment-Related Health Insurance Inhibit Job Mobility?" *Inquiry*, 30, 400-416.

[4] Diamond, Peter (1982). "Wage Determination and Efficiency in Search Equilibrium." *Review of Economic Studies,* 49, 217-227.

[5] Eberts, Randall and Joe Stone (1985). "Wages, Fringe Benefits, and Working Conditions: An Analysis of Compensating Differentials." *Southern Economic Journal*, 52, 274-280.

[6] Flinn, Christopher (1986). "Wages and Job Mobility of Young Workers." *Journal of Political Economy*, 94, S88-S110.

[7] Flinn, Christopher (2002). "Labor Market Structure and Inequality: A Comparison of Italy and the U.S." *Review of Economic Studies* 69, 611-646.

[8] Flinn, Christopher and James Heckman (1982). "New Methods for Analyzing Structural Models of Labor Market Dynamics." *Journal of Econometrics 18,* 115-168.

[9] Gilleskie, Donna and Byron Lutz (2002). "The Impact of Employer-Provided Health Insurance on Dynamic Employment Transitions." *Journal of Human Resources* 37, 129-162.

[10] Gruber, Jonathan (1994). "The Incidence of Mandated Maternity Benefits." *American Economic Review*, 84, 622-641.

[11] Gruber, Jonathan and Maria Hanratty (1995). "The Labor-Market Effects of Introducing National Health Insurance: Evidence from Canada." *Journal of Business and Economic Statistics*, 13, 163-173.

[12] Gruber, Jonathan and Alan Krueger (1990). "The Incidence of Mandated Employer-Provided Insurance: Lessons from Workers' Compensation Insurance." Princeton Industrial Relations Section Working Paper #279.

[13] Gruber, Jonathan and Brigitte Madrian (1997). "Employment Separation and Health Insurance Coverage." *Journal of Public Economics,* 66, 349-382.

[14] Gruber, Jonathan and Brigitte Madrian (1994). "Health Insurance and Job Mobility: The Effects of Public Policy on Job-Lock." *Industrial and Labor Relations Review*, 48, 86-102.

[15] Holtz-Eakin, Douglas (1994). "Health Insurance Provision and Labor Market Efficiency in the United States and Germany," in Rebecca Blank and Richard Freeman, eds. *Social Protection Versus Economic Flexibility: Is There a Tradeoff?* Chicago: University of Chicago Press.

[16] Kapur, Kanika (1998). "The Impact of Health on Job Mobility: A Measure of Job Lock." *Industrial and Labor Relations Review,* 51, 282-298.

[17] Levy, Helen and David Meltzer (2001). "What Do We Really Know about whether Health Insurance Affects Health?" University of Michigan, Economic Research Initiative on the Uninsured Working Paper 6.

[18] Madrian, Brigitte (1994). "Employment-Based Health Insurance and Job Mobility: Is There Evidence of Job-Lock?" *Quarterly Journal of Economics,* 109, 27-54.

[19] Miller, Robert (1984). "Job Matching and Occupational Choice." *Journal of Political Economy*, 92, 1086-1120.

[20] Miller, Richard (1995). "Estimating Compensating Differentials for Employer-Provided Health Insurance Benefits." University of California, Santa Barbara, Working Papers in Economics.

[21] Mitchell, Olivia (1982). "Fringe Benefits and Labor Mobility." *Journal of Human Resources*, 17, 286-298.

[22] Pissarides, Christopher (1985). "Taxes, Subsidies, and Equilibrium Unemployment." *Review of Economic Studies,* 52, 121-134.

[23] Postel-Vinay, Fabien and Jean-Marc Robin. "Wage Dispersion with Heterogeneous Firm Technologies and Work Abilities: An Equilibrium Job Search Model for Matched Employer-Employee Data." Mimeo, Laboratoire d'Economie Appliquée de l'INRA, Ecole Normale Supérieure, Paris, October 2000.

[24] Wolpin, Kenneth (1992). "The Determinants of Black-White Differences in Early Employment Careers: Search, Layoffs, Quits, and Endogenous Wage Growth." *Journal of Political Economy*, 100, 535-560.

Table 1: Summary Statistics

Sample	Number	Marital Status	Children	Sample Window
Full sample	10,121	0.642	0.443	145.17 (75.14)
Without a non-employment spell during sample window	7,307	0.675	0.460	143.06 (77.05)
With a non-employment spell during sample window	2,814	0.558	0.397	150.64 (69.63)

From unemployment	Number	Spell duration	Initial Wage	Accepted Wage	Marital Status	Children
Right censored	755	17.26 (30.28)	-	-	0.466	0.336
To a job with health insurance	1,044	9.55 (11.18)	-	15.96 (10.30)	0.647	0.440
To a job without health insurance	1,015	12.27 (14.64)	-	11.30 (8.67)	0.529	0.397

From a job with health insurance	Number	Spell duration	Initial Wage	Accepted Wage	Marital Status	Children
Right censored	715	77.53 (57.31)	16.71 (10.29)	-	0.649	0.446
To unemployment	162	47.58 (34.97)	14.26 (10.62)	-	0.630	0.401
To a job with health insurance	144	48.80 (37.92)	14.89 (10.19)	16.98 (9.56)	0.660	0.472
To a job without health insurance	23	54.04 (48.34)	11.41 (4.78)	16.14 (18.18)	0.609	0.304

From a job without health insurance	Number	Spell duration	Initial Wage	Accepted Wage	Marital Status	Children
Right censored	478	44.83 (47.32)	11.75 (8.97)	-	0.552	0.379
To unemployment	314	22.14 (22.24)	10.99 (9.01)	-	0.446	0.373
To a job with health insurance	73	29.99 (25.17)	10.74 (7.32)	11.96 (5.76)	0.562	0.384
To a job without health insurance	150	27.97 (27.10)	10.78 (7.48)	12.67 (9.91)	0.613	0.513

Note: Based on the 1996 Survey of Income and Program Participation. The sample inlcudes white males aged 25-54 with at least a high school education. See text for further selection criteria. Wages are measured in dollars per hour and reported durations are in weeks. Standard deviations are in parentheses. The sample window measures the length of time (in weeks) an individual responds to the survey.

Table 2: Simulated Maximum Likelihood Estimates

Parameter	Specification 1	Specification 2	Specification 3	Specification 4
λ_e	0.0097 (0.0004)	0.0098 (0.0003)	0.0106 (0.0005)	0.0097 (0.0005)
λ_n	0.0585 (0.0018)	0.0585 (0.0024)	0.0617 (0.0022)	0.0630 (0.0027)
η_1	0.0016 (0.0001)	0.0016 (0.0001)	0.0016 (0.0001)	0.0016 (0.0001)
η_0	0.0125 (0.0006)	0.0131 (0.0007)	0.0133 (0.0008)	0.0123 (0.0009)
μ_θ	2.6683 (0.0176)	2.6691 (0.0175)	2.5731 (0.0204)	2.6163 (0.0133)
σ_θ	0.4319 (0.0158)	0.4280 (0.0174)	0.4367 (0.0159)	0.4435 (0.0191)
σ_ε	0.5321 (0.0168)	0.5329 (0.0145)	0.5421 (0.0169)	0.5372 (0.0215)
γ	0.8653 (0.0139)	0.8662 (0.0147)	0.8650 (0.0155)	0.8593 (0.0074)
b	-9.6530 (0.1071)	-8.8524 (0.2746)	-5.6870 (0.4630)	-8.2321 (0.0596)
ϕ_1	5.1545 (0.2239)	4.7266 (0.2467)	4.2419 (0.2556)	5.1248 (0.2458)
ϕ_2	-	5.8024 (0.3106)	4.3211 (0.2538)	6.9187 (0.2604)
π	-	0.3758 (0.1424)	0.0877 (0.0187)	0.0692 (0.0048)
ξ_2	-	-	0.1720 (0.0149)	1.8543 (0.3795)
δ_0	-	-	-0.3538 (0.2705)	-2.6306 (0.3233)
δ_1	-	-	-	2.7509 (0.3111)
δ_2	-	-	-	0.9302 (0.0780)
Mean ϕ	5.1545	5.1309	4.2488	5.2489
δ			0.4125	0.4534
lnL	-29,373.372	-29,372.515	-29,365.995	-29,351.923

Note: Estimates based on the following assumptions: the annual discount rate is set to 0.08, the bargaining power parameter is set to 0.5, and the measurement error is log normal with mean 1. The model is estimated using the Nelder-Mead simplex algorithm and the standard errors are computed using bootstrap methods with 50 draws of the data. The parameters are defined in the text. Specification 1 assumes homogeneous workers and firms. Specification 2 allows firm-level heterogeneity only. Specification 3 considers both firm and worker heterogeneity but does not include observable characteristics. Specification 4 allows both firm and worker heterogeneity and considers observable factors that affects the probability an individual is a high demand type.

Table 3: Implied Parameter Estimates

Parameter	Specification 1	Specification 2	Specification 3		Specification 4	
	$\xi = \xi_1 = \xi_2$	$\xi = \xi_1 = \xi_2$	$\xi = \xi_2$	$\xi = \xi_1$	$\xi = \xi_2$	$\xi = \xi_1$
Critical matches						
Critical match out of unemployment	6.847	7.060	7.555	7.482	8.129	7.289
Critical match for provision of health insurance at a low cost firm	15.766	14.914	14.564	14.787	13.771	16.176
Critical match for provision of health insurance at a high cost firm	15.766	16.934	14.703	14.926	16.949	19.338
Behavior out of unemployment						
Probability match is acceptable	0.958	0.953	0.896	0.900	0.880	0.922
Probability acceptable match at low cost firm results in health insurance	0.436	0.492	0.451	0.434	0.562	0.383
Probability acceptable match at high cost firm results in heatlh insurance	0.436	0.372	0.442	0.425	0.358	0.236
Mean unemployment duration	17.854	17.955	18.071	17.991	18.029	17.201
Probability of non-employment spell over sample window	0.269	0.270	0.269	0.272	0.253	0.284

Note: Based on the parameter estimates presented in Table 2.

Table 4: Implied Parameter Estimates - Directly following an unemployment spell

Parameter	Specification 1	Specification 2	Specification 3		Specification 4	
	$\xi = \xi_1 = \xi_2$	$\xi = \xi_1 = \xi_2$	$\xi = \xi_2$	$\xi = \xi_1$	$\xi = \xi_2$	$\xi = \xi_1$
Proportion of jobs with insurance	0.436	0.447	0.450	0.434	0.548	0.373
Wages in jobs with insurance	16.34	16.24	16.06	16.29	14.57	16.95
	(11.57)	(11.49)	(11.35)	(11.46)	(10.82)	(11.89)
Wages in jobs without insurance	10.45	10.63	10.70	10.70	11.01	10.97
	(6.17)	(6.27)	(6.36)	(6.37)	(6.43)	(6.56)
Durations of jobs with insurance	312.84	306.66	303.96	308.48	294.93	341.04
	(117.56)	(117.18)	(116.95)	(116.33)	(121.27)	(114.59)
Durations of jobs without insurance	52.50	50.79	49.99	50.14	53.18	54.73
	(4.17)	(3.83)	(3.76)	(3.91)	(3.14)	(4.84)

Note: Based on the parameter estimates presented in Table 2. Wages are measured in dollars per hour and durations are reported in weeks. Standard deviations are in parentheses. The wage represents the first wage in the first job following an unemployment spell and incorporate the measurement error process.

Table 5: Implied Parameter Estimates - Steady State

Parameter	Specification 1	Specification 2	Specification 3		Specification 4	
	$\xi = \xi_1 = \xi_2$	$\xi = \xi_1 = \xi_2$	$\xi = \xi_2$	$\xi = \xi_1$	$\xi = \xi_2$	$\xi = \xi_1$
Unemployment Rate	0.044	0.045	0.044	0.045	0.039	0.047
Health Insurance Coverage Rate in the entire population	0.870	0.874	0.877	0.871	0.903	0.839
Health Insurance Coverage Rate in the employed population	0.910	0.915	0.918	0.912	0.940	0.881
Wages in jobs with insurance	20.59	20.53	20.06	20.17	19.15	20.49
	(14.68)	(14.70)	(14.41)	(14.47)	(14.23)	(14.61)
Wages in jobs without insurance	10.99	11.18	11.10	11.14	11.33	11.59
	(6.66)	(6.80)	(6.68)	(6.77)	(6.72)	(7.05)

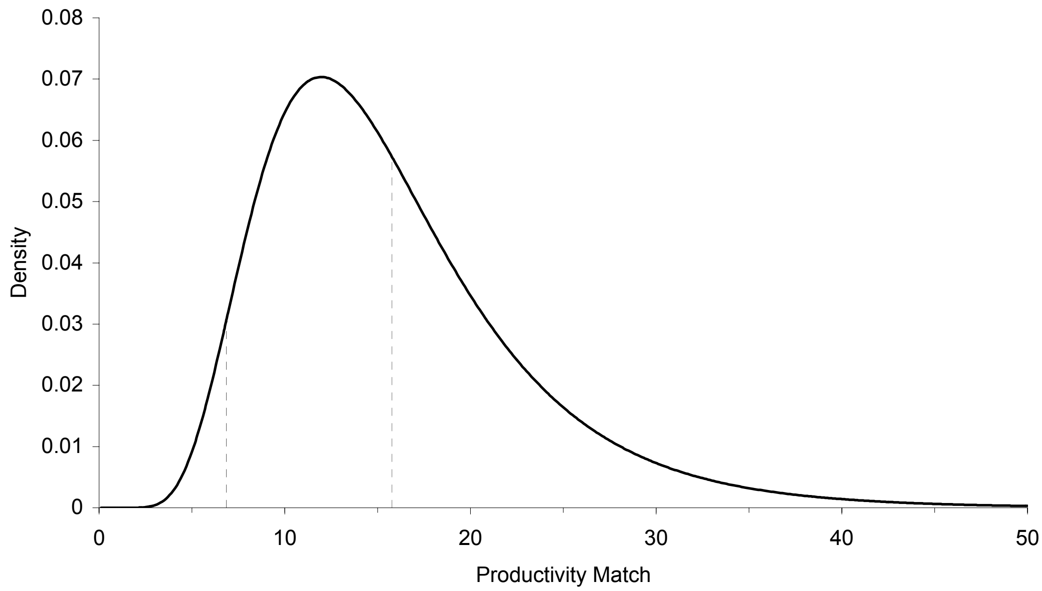
Note: Based on the parameter estimates presented in Table 2. The estimates are computed using the simulated labor market histories for 1,000,000 individuals (of each type) who begin their working lives in the unemployment state. Wages are measured in dollars per hour and incorporate the measurement error process.

Table 6: Measures of Short-Run Inefficiency

Parameter	Specification 2	Specification 3
Probability of "job-push"	0.0329	0.0010
Probability of "job-lock"	0.0393	0.0010
Index of Inefficiency ("job-push" + "job-lock")	0.0723	0.0020

Note: Based on the parameter estimates presented in Table 2. The estimates are computed using the simulated labor market histories for 1,000,000 individuals (of each type) who begin their working lives in the unemployment state. See text for details.

Figure 1. Productivity Density



Note: Based on the parameter estimates for the specification with no heterogeneity presented in Column 1 of Table 2. The dotted vertical lines represent the critical matches for transitions out of non-employment and for the provision of health insurance, respectively.

Figure 2a. Conditional Wage Densities

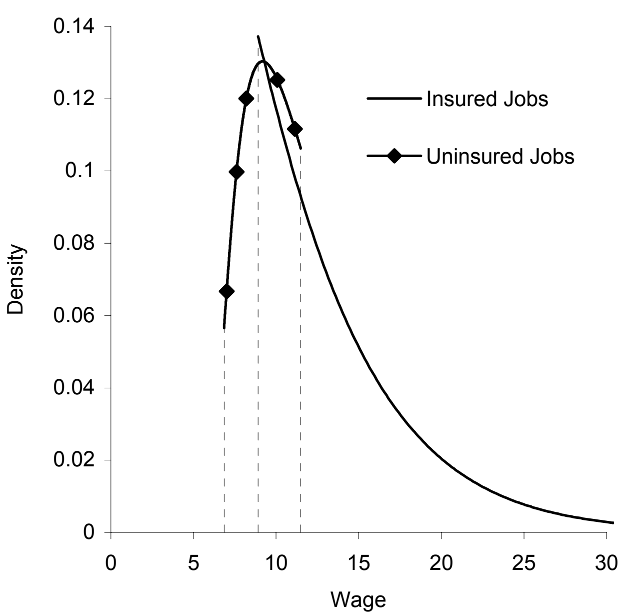
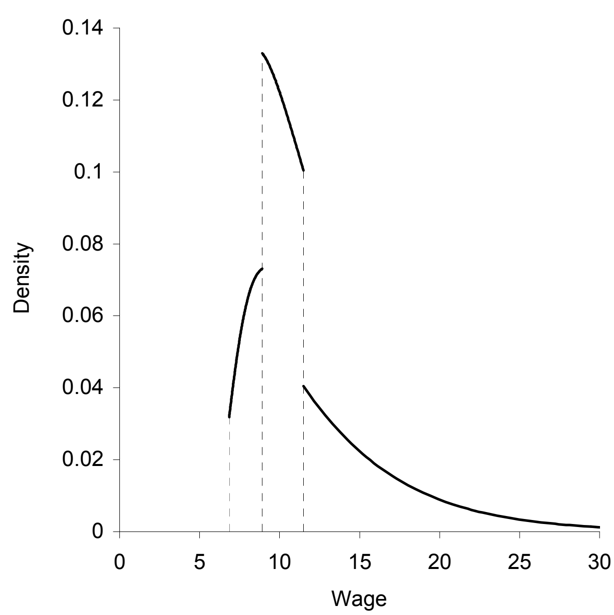


Figure 2b. Unconditional Wage Density



Note: Based on the parameter estimates for the specification with no heterogeneity presented in Column 1 of Table 2. Wages represent the first wage reported in the first job directly following a non-employment spell. The dotted vertical lines represent the minimum wage in an uninsured job, the minimum wage in an insured job, and the maximum wage in an uninsured job, respectively. See text for details.

Figure 3a. Steady State Conditional Wage Densities

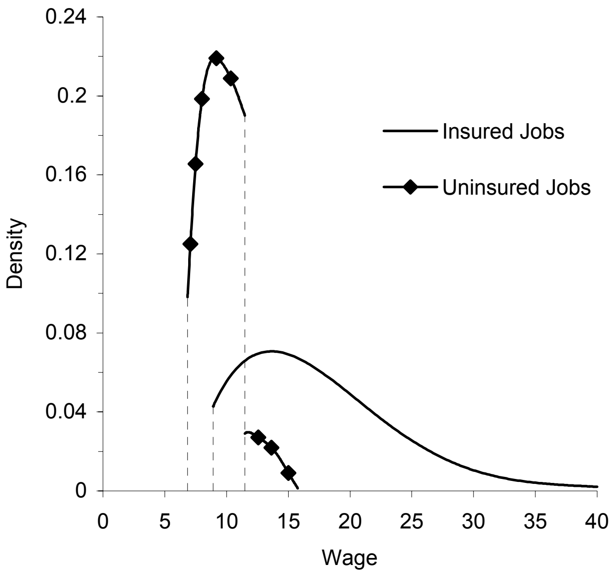
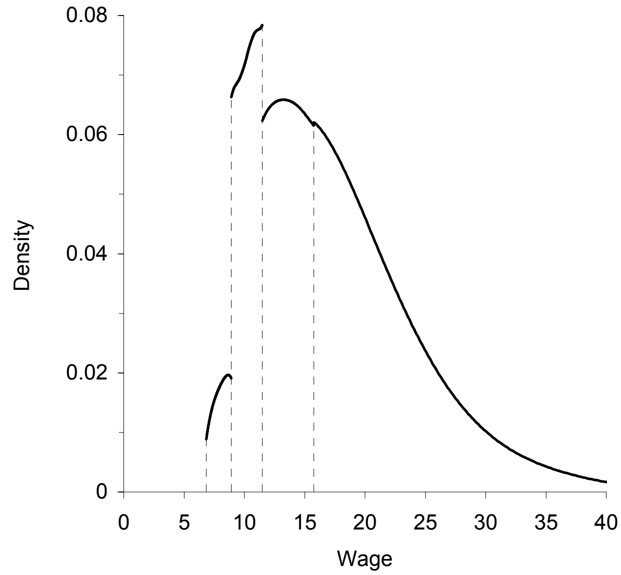
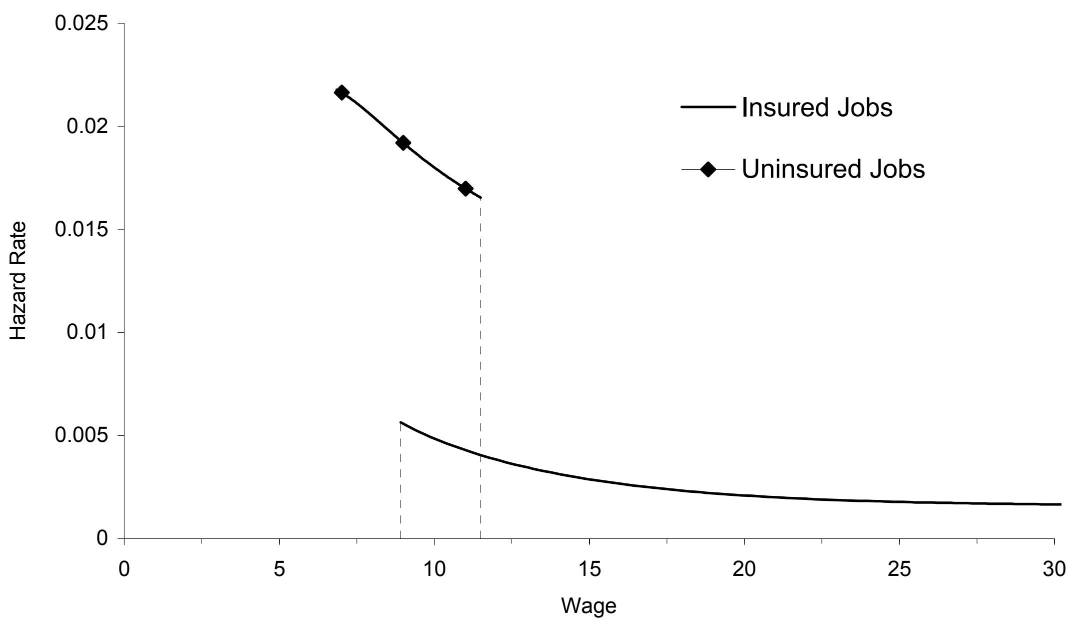


Figure 3b. - Steady State Wage Density



Note: Based on the parameter estimates for the specification with no heterogeneity presented in Column 1 of Table 2. The distributions are based on the simulated labor market histories of 1,000,000 individuals who began their working lives in the non-employment state. The dotted vertical lines represent the minimum wage for an uninsured job, the minimum wage for an insured job, the maximum wage for an uninsured job directly following a non-employment spell, and the maximum wage for all uninsured jobs, respectively. See text for details.

Figure 4. Hazard Rate Comparisons



Note: Based on the parameter estimates for the specification with no heterogeneity presented in Column 1 of Table 2. Wages represent the first wage in the first job following a non-employment spell. The hazard rate equals the weekly rate of exiting the current employment state, either through a dismissal to unemployment or a job change. The dotted vertical lines represent the minimum wage for an insured job and the maximum wage for uninsured job, respectively.

Figure 5a. Actual vs Predicted Wage Densities with Insurance

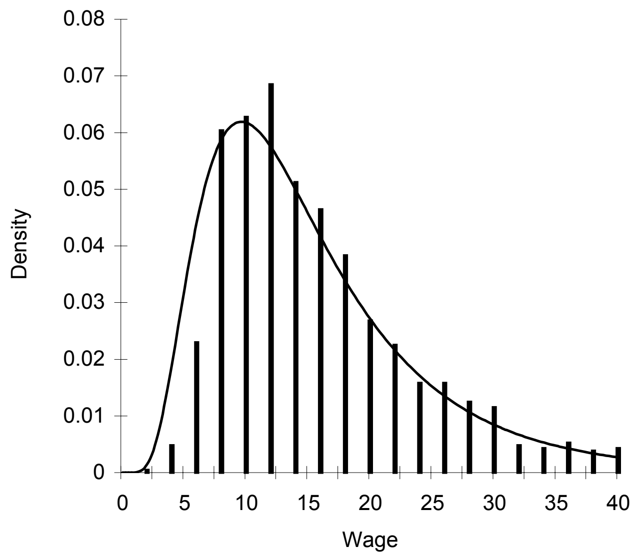
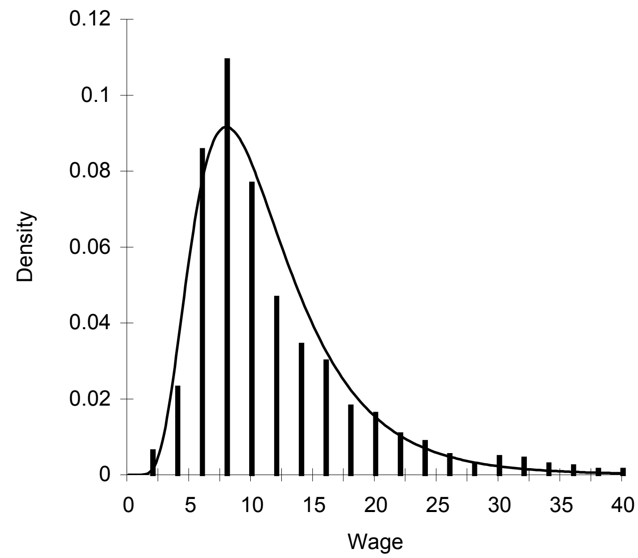


Figure 5b. Actual vs Predicted Wage Densities without Insurance



Note: Wages represent the first wage in the first job following an unemployment spell. The predicted wage distribution is based on the parameter estimates for the specification with both worker and firm heterogeneity presented in Column 4 of Table 2. The actual wage distribution is based on the 1996 panel of the SIPP.