Welfare and Mobility Effects of Employer-Provided Health Insurance*

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Abstract

Recent research suggests that employer-provided health insurance reduces job mobility, yet doesn't quantify the welfare cost of this friction. This paper examines the impact of the employment-based health insurance system on both job turnover rates and efficiency. Using data from the 1990 to 1993 panels of the Survey of Income and Program Participation, I find significant distortions in job turnover rates between two and forty-eight percent. The corresponding efficiency losses are quite small and suggest that the existence of employer-provided health insurance reduces productivity by one to three percent.

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1 Introduction

Recent research suggests that employer-provided health insurance may be a serious deterrent to job mobility. Individuals with high demand for health insurance (e.g., those with pre-existing medical conditions, large families, pregnant wives etc.) may forego more productive job opportunities for fear of losing their health insurance benefits. It is claimed that if the wages paid in uninsured jobs are not signficantly high enough to offset the expected benefit of health insurance, these employees will be locked into their current jobs. Most empirical studies - e.g., Cooper and Manheit (1993), Madrian (1994), Buchmueller and Valletta (1996), and Anderson (1998) - have estimated the reduction in job mobility rates due to employer-provided health insurance on the order of 20% to 40%. Two other studies, Kapur (1998) and Gilleskie and Lutz (1999) find little or no evidence of so-called "job-lock".[1]

Since job mobility is an important factor in the efficiency of an economy, any mechanism, institution, or policy that prevents workers from seeking the most productive worker-firm match may inhibit the economy from reaching an efficient outcome. Despite the potentially negative impact on overall welfare in the economy under the present employment-based health insurance system, there has been almost no effort in the literature to quantify these effects. As Gruber (1998) points out,

> "While there is some uncertainty about the empirical importance of job lock, it pales in comparison to the uncertainty about its normative implications."

In this paper I analyze the effects of employer-provided health insurance on job mobility and, more importantly, quantify the subsequent welfare losses. At the core of these issues lies the question of how individuals make employment decisions when faced with potential productivity-improving job opportunities. While there are many ways to model the decision-making process, a search theoretic framework that explicitly allows employed workers to search for better jobs seems like a natural starting point. Therefore, the primary goal of this research is to develop and estimate an on-the-job (OTJ) search model that incorporates employer-provided health insurance

[1] See Gruber (1998) and Gilleskie and Lutz (1999) for recent reviews of the literature. Holtz-Eakin et al. (1996) examine a similar question of how employer-provided health insurance affects the decision to become self-employed.

benefits into the individual labor market decision-making process. The relatively simple structure of the model yields strong behavioral implications that workers must follow when deciding whether to accept a new job opportunity and, in particular, employment decisions can be characterized by a system of reservation wages that define minimal conditions for job changes to occur.

Even within a model in which workers make optimal employment decisions, the existence of job-lock is possible if employers are not fully able to pass along the costs of insurance to workers in the form of lower wages. If this is the case, certain workers (i.e., high demand workers) will earn rents in jobs that provide insurance and since future employers likewise cannot fully condition on health insurance demands, these workers will forego some productivity-enhancing job opportunities. The extent to which this actually occurs is an empirical question and depends on two factors; how much employers pass along the costs of insurance and what jobs, measured in terms of productivity, provide health insurance.

The empirical literature devoted to the study of health insurance induced job-lock uniformly avoids any discussion of a theoretical model that is consistent with the job-lock phenomenon. On the other hand, Gruber (1998) describes a compensating wage differentials model with imperfect information, based on the work of Rosen (1986), that clearly explains how the existence of employer-provided health insurance may cause individuals to forego more productive job opportunities or job-lock. While this model fails to explain some salient features of the data (e.g., the strong positive correlation between wages and the provision of health insurance), it provides a useful framework to analyze the effects of health insurance on job turnover rates and, subsequently, economic efficiency. I base my estimates of job-lock and welfare losses on a variation of this model.

Using data from the 1990 to 1993 panels of the Survey of Income and Program Participation (SIPP), I find relatively small, yet significant effects of employer-provided health insurance on job turnover rates. For individuals with a high willingness to pay for health insurance, I estimate reductions in mobility between two to eight percent and for individuals with a low willingness to pay, I find reductions on the order of ten to sixteen percent. In addition, following Anderson (1998), I find estimates of job-push (i.e., the existence of health insurance causes individuals to leave jobs more quickly) from two to forty-eight percent depending on the demand for health insurance. These distortions lead to very small efficiency losses. While the estimates suggest significant effects on productivity, the losses are usually less than one percent and, at the maximum, lead to only a three percent loss.

It must be noted that while the search model used in this paper provides a useful framework to analyze the welfare and mobility effects of employer-provided health insurance, it is by no means without fault. Most importantly, since the model only considers workers' decisions and makes no attempt at modeling firm decisions or how the form of compensation affects productivity, the efficiency calculations presented here should be viewed with some caution. In order to satisfactorily measure the welfare effects of employer-provided insurance and to analyze policy, a more comprehensive model that includes a notion of labor market equilibrium is needed. In addition, since the measure of health insurance benefits only indicates whether the individual receives employer-provided coverage, any variance in the generosity of the insurance is ignored. I return to these considerations in the concluding section.

The rest of the paper is organized as follows. Section two describes the labor market environment facing all agents and characterizes the optimal decision-making process. In section three, I describe the data, based on the 1990 to 1993 panels of the Survey of Income and Program Participation (SIPP), used in the empirical work and in section four I define the maximum likelihood estimator. Section five presents the estimation results for a variety of specifications. In section six, I present the implied estimates of job-lock and the corresponding efficiency losses. Section seven concludes.

2 Job Search and Employment Decisions

The fundamental question underlying the study of job-lock is how individuals make labor market decisions. While many candidate modeling strategies are available, the most straightforward and perhaps simplest to implement is a model of labor market search where individuals continue to receive new job offers when employed. This section is devoted to developing the model. In the first subsection, I present the basics of the search environment and in the second subsection, I derive the behavioral restrictions of the model which provide the basis for all the empirical work.

2.1 Environment

In this subsection, I describe a model of job search that accounts for the existence of employer-provided health insurance. The model is formulated in continuous time and assumes stationarity of the labor market environment. The framework of the model is based on Flinn and Heckman (1982) with two important extensions. First, individuals search over three states: unemployment, employment with health insurance coverage, and employment without health insurance coverage. The states are denoted n, 1, and 0, respectively. Second, since one focus of this paper is to characterize the effects of employer-provided health insurance on turnover decisions, the model allows both voluntary quits (i.e., job-to-job transitions) and nonvoluntary dismissals (i.e., employment-to-unemployment transitions).[2] By allowing for both voluntary and nonvoluntary exits, it is possible to more precisely define the factors driving the observed difference in mobility rates between the two types of jobs.

There exists an invariant, exogenously-determined job offer distribution which is given by $F(w,d)$ where w is an hourly wage rate and $d \in \{0,1\}$ indicates whether the employer provides health insurance coverage. Since the measure of health insurance coverage is binary, I can rewrite the offer distribution in terms of the probability that an offer includes insurance coverage, p, and the conditional wage offer distributions, denoted $F_1(w)$ and $F_0(w)$.

All individuals begin their lives in unemployment and I assume that it is optimal for them to search. The instantaneous utility flow in the unemployment state is b, which can be positive or negative. When a searcher receives a job offer, which happens at rate λ_n if the individual is currently unemployed and at rate λ_d if the individual is currently employed at a job with health insurance coverage d, he decides whether to accept or reject the offer.[3] In addition, I assume that all jobs terminate exogenously at rate η_d. Finally, the

[2] In this sense, the model developed and estimated in this paper deviates from other multidimensional search models that do not allow for on-the-job search. Blau (1991) estimates a model where individuals search over wages and hours of work. He assumes that once a job is accepted it is kept for the remainder of the individual's working life. Khandker (1988) considers a search model over wages and a composite non-wage job attribute that allows for different job separation rates, but does not allow job-to-job transitions.

[3] I assume that on-the-job search is costless which implies that all employed workers continue to search and receive job offers. This assumption is not crucial to analysis and since these costs would not be identified by the estimation procedure, I simply normalize them to zero.

instantaneous utility flow of working at the job (w, d) is represented by the mapping $u(w, d) = w + \alpha d$. With this specification, I am treating health insurance as a perfect substitute for wages and hence the parameter α could be thought of as the willingness to pay for employer-provided health insurance coverage.

Note that I am making the testable assumptions that the exogenous termination rate and the employed job arrival rate depend on the worker's current health insurance status. It may be the case that one of the reasons why firms provide health insurance is to increase the overall health of its workforce which may lead to a lower rate of "critical" illness that renders workers incapable of performing their jobs. On the other hand, the assumption that the offer arrival rates for the two types of jobs differ is made to account for other non-wage benefits that may affect employment behavior. For example, the likelihood that an individual has access to an employer-provided pension plan is significantly higher if his current job provides health insurance. Since I do not have access to complete information about other non-wage benefits, I attempt to capture (albeit in an ad hoc manner) this high correlation among non-wage benefits by allowing the arrival rates to differ.

2.2 Decision Rules

In a simple search model with on-the-job (OTJ) search, individual employment decisions can be fully characterized by the unemployment reservation wage and the structural parameters of the model since job-to-job transitions must be accompanied by a wage increase. That is, the employment reservation wage equals the current wage. In the extended model with two different employment states, characterizing labor market decisions becomes slightly more complicated. This subsection is devoted to deriving individual decision rules for transitions out of unemployment and for job-to-job transitions.

Given the framework of the model, the value of employment at the job (w, d) is easily determined. Consider an infinitesimally small period of time Δt. Over this period, four options exist. The individual may receive a new offer with insurance, receive a new offer without insurance, lose his job, or neither get a new offer nor lose his job. Then,

$$\begin{aligned} V_d(w) &= \frac{(w+\alpha d)\Delta t}{1+\rho\Delta t} + \frac{1-\eta_d\Delta t-\lambda_d\Delta t}{1+\rho\Delta t}V_d(w) + \frac{\eta_d\Delta t}{1+\rho\Delta t}V_n \\ &+\frac{\lambda_d p\Delta t}{1+\rho\Delta t}\int \max\{V_d(w), V_1(w')\}\, dF_1(w') \\ &+\frac{\lambda_d(1-p)\Delta t}{1+\rho\Delta t}\int \max\{V_d(w), V_0(w')\}\, dF_0(w') + \frac{o(\Delta t)}{1+\rho\Delta t} \end{aligned} \tag{1}$$

where $(1+\rho\Delta t)^{-1}$ is an infinitesimal discount factor associated with the small interval Δt, $\eta_d\Delta t$ is the approximate probability of the employment contract dissolving by the end of Δt, $\lambda_d p\Delta t$ is the approximate probability of receiving one offer that includes insurance by the end of Δt, $\lambda_d(1-p)\Delta t$ is the approximate probability of receiving one offer that does not provide insurance by the end of Δt, V_n is the value of unemployment, and $o(\Delta t)$ is a term that has the property that $\lim_{\Delta t\to 0} o(\Delta t) = 0$. Note that when a worker at the job (w, d) receives a new job offer, (w', d'), he chooses the option that maximizes his expected present discounted value, $\max\{V_d(w), V_{d'}(w')\}$. Collecting terms and taking the limit of (1) as $\Delta t \to 0$, we have

$$\begin{aligned} V_d(w) &= (\rho+\eta_d+\lambda_d)^{-1}\{w+\alpha d+\eta_d V_n \\ &+\lambda_d p\int \max\{V_d(w), V_1(w')\}\, dF_1(w') \\ &+\lambda_d(1-p)\int \max\{V_d(w), V_0(w')\}\, dF_0(w')\} \end{aligned} \tag{2}$$

Turning to the value of unemployment, we begin with the Δt-period formulation which is

$$\begin{aligned} V_n &= \frac{b\Delta t}{1+\rho\Delta t} + \frac{1-\lambda_n\Delta t}{1+\rho\Delta t}V_n + \frac{\lambda_n p\Delta t}{1+\rho\Delta t}\int \max\{V_n, V_1(w)\}\, dF_1(w) \\ &+\frac{\lambda_n(1-p)\Delta t}{1+\rho\Delta t}\int \max\{V_n, V_0(w)\}\, dF_0(w) + \frac{o(\Delta t)}{1+\rho\Delta t} \end{aligned} \tag{3}$$

where $\lambda_n\Delta t$ is the approximate probability of encountering one potential employer over the interval. As in the OTJ search case, when an unemployed searcher receives a job offer, (w, d), he chooses the option that yields the higher value, $\max\{V_n, V_e(w, d)\}$. Rearranging terms and taking limits, we have

$$\begin{aligned} V_n &= (\rho+\lambda_n)^{-1}\{b+\lambda_n p\int \max\{V_n, V_1(w)\}\,dF_1(w) \\ &\quad +\lambda_n(1-p)\int \max\{V_n, V_0(w)\}\,dF_0(w)\} \end{aligned} \tag{4}$$

The system of value functions, (2) and (4), provide the basis on which all employment decisions are made. Consider an individual currently in the unemployment state who receives a job offer, (w, d). We know that if $V_d(w) \geq V_n$, the worker will accept the job offer. Therefore, the unemployment reservation wages are defined as the wages that make the individual indifferent between continued search and employment or

$$V_n = V_d(w_d^*),\ d = 0, 1. \tag{5}$$

Next, consider an individual currently employed at the job (w, d) who receives a new offer (w', d'). Again, we know that he will accept this job only if $V_{d'}(w') \geq V_d(w)$. For every possible triple (w, d, d'), we can define the employment reservation wage according to the following equation

$$V_d(w) = V_{d'}(\xi_{dd'}(w)),\ d = 0, 1,\ d' = 0, 1. \tag{6}$$

Note that in the case where $d = d'$, that the reservation wage is the current wage or $\xi_{dd}(w) = w$.

Hence, individual employment decisions can be completely characterized by a pair of unemployment reservation wages, w_1^* and w_0^*, and a pair of reservation wage functions for job-to-job transitions that involve a change in the provision of health insurance, $\xi_{10}(w)$ and $\xi_{01}(w)$.[4] To summarize, the behavioral restrictions of the model are:

$$\text{In unemployment} \left\{ \begin{array}{l} \text{accept } (w, d) \text{ if } w \geq w_d^* \\ \text{reject } (w, d) \text{ if } w < w_d^* \end{array} \right. \tag{7}$$

$$\text{In employment at } (w, d) \left\{ \begin{array}{l} \text{accept } (w', d') \text{ if } w' \geq \xi_{dd'}(w) \\ \text{reject } (w', d') \text{ if } w' < \xi_{dd'}(w) \end{array} \right. \tag{8}$$

where $d, d' \in \{0, 1\}$.

[4] The proofs of these results are straightforward and follow directly from the Intermediate Value Theorem and a number of boundary conditions that guarantee that there is at least one job that is not acceptable and at least one job that is acceptable. The formal proof is available from the author.

3 Data

The model is estimated using data from the 1990 to 1993 panels of the Survey of Income and Program Participation (SIPP). The SIPP interviews individuals at four month intervals (or waves) for up to nine waves. Among other things, the SIPP collects detailed monthly information regarding individuals' demographic characteristics (e.g., sex, race, highest grade attended, marital status, etc.) and labor force activity. These data include monthly earnings, number of weeks worked, average hours worked during the month, as well as whether the individual changed jobs during the month. In addition, the SIPP gathers data for a variety of health insurance variables including whether an individual's private health insurance is employer-provided at each interview. For the empirical work in this study, the sample is restricted to a relatively homogeneous group. In particular, I select only white males between the ages of 22 and 50 with at least a high school education. In addition, any individual who reports attendance in school, self-employment, non-participation in the labor force, service in the military, or participation in any welfare program (e.g., AFDC, WIC, or Food Stamps) over the sample period is excluded.

Consistent with Wolpin (1987) and Flinn (1999b), the basis of the empirical work in this paper is a labor market "cycle" which is simply characterized by the labor market activity betweeen an initial unemployment spell and a return to unemployment. Due to the stationarity of the model, this is a particularly convenient method for classifying the data. In addition, to avoid the additional computational burden associated with observing a left censored employment spell, I select only those individuals with at least one unemployment spell over the observation period of the SIPP and ignore all information prior to first observing them in the unemployment state. After implementing this selection criterion and the conditions for inclusion described above, I have 1,706 different individuals in the sample. Since it is possible for an individual to contribute more than one cycle to the data (since a new cycle begins when the previous cycle ends), this sample of individuals contributes 2,213 total labor market cycles.

To clarify, all individuals in the sample are initially in the unemployment state. If the observation period of the SIPP ends before I observe a transition, the cycle only consists of a censored unemployment spell. If I observe a transition to employment, the observed cycle ends for two possible reasons, censoring or a transition to unemployment, and continues if another employment spell is observed. This process continues until the observation period ends or a transition to unemployment occurs. In practice, since going beyond the second employment spell becomes computationally burdensome, I choose to truncate cycles after the second employment spell. Since only twenty labor market cycles have three or more employment spells, this should not lead to a noticeable efficiency loss in the estimates.

Table 1 presents the number of labor market cycles that follow each possible path. Three numbers should be highlighted. First, for transitions out of unemployment, slightly more than sixty percent of the accepted jobs provide health insurance. Second, for both insured and uninsured jobs, the number of jobs that end exogenously is much greater than the number of jobs that end due to a transition to a new job. Third, the job-to-job transition rates differ substantially depending on the insurance status of the initial job. For insured jobs, more than 84% of job-to-job transitions are to another job that provides insurance, while for uninsured jobs, only 47% of the transitions are into jobs with health insurance.

Table 2 presents the mean wages for a number of labor market events as well as the mean spell durations for each labor market state. The data show two facts that are well supported in the literature. First, jobs with insurance tend to last much longer than jobs without health insurance. Due to censoring, it is difficult to say exactly what the difference in the mean spell duration is, but since the mean duration for both censored and uncensored spells are longer for insured jobs, it is clear that insured jobs tend to have longer durations than uninsured jobs. Second, jobs with insurance tend to pay higher wages than jobs without insurance. In terms of mean wages for the first job following an unemployment spell, the mean wage in an insured job is almost $5 greater than the mean wage in an uninsured job.

It is interesting to note that the wages in jobs that end with a transition to another job tend to be lower than wages in all jobs. It seems as though individuals in relatively low paying jobs, regardless of the health insurance status, leave their jobs. In addition, wages in insured jobs that follow another employment spell tend to be lower than those accepted directly out of unemployment, while wages in uninsured jobs that follow an employment spell tend to be higher than those accepted directly out of unemployment. These statistics lend some crude support to the behavioral model developed above.

4 Maximum Likelihood Estimator

As discussed in Section 2.2, the model yields strong behavioral implications that lead quite naturally to maximum likelihood estimation. While deriving the likelihood function is straightforward given the behavioral restrictions, there are two issues that complicate the matter. First, there are a number of job-to-job transitions that do not satisfy the behavioral implications of the model. For instance, of the 65 job-to-job transitions where both jobs provide health insurance, in 21 transitions the reported wage in the second job is lower than the reported wage in the first job. For the econometric model to be consistent with these observations, it is necessary to introduce measurement error in observed wages. Second, employment decisions are made according to the unemployment reservation wages, w_1^* and w_0^*, and the reservation wage functions, $\xi_{10}(w)$ and $\xi_{01}(w)$. Similar to Flinn (1999b) and Stern (1989), the unemployment reservation wages are estimated as free parameters. In general, computing the reservation wage functions is not an easy task and at some level is always an approximation. Therefore, I proceed by taking a convenient approximation to the system of value functions that enables me to directly compute these functions. The approximation procedure is detailed in Appendix A.

To begin, measured wages, $\widetilde{w}$, are related to true wages, w, by

$$\widetilde{w} = w\varepsilon \tag{9}$$

where ε is independently and identically distributed on the positive real line with distribution F_ε and density f_ε.[5]

To fix ideas before presenting the likelihood function for any labor market cycle, consider the following example. An individual is first observed in unemployment. This spell lasts t_n months and is followed by a transition into the job $(\widetilde{w}, 1)$. This job continues for t_e months and then terminates with a transition back to unemployment. The likelihood of a completed unemployment spell of duration t_n that ends with a transition to a job with insurance is just

$$f_n(t_n, d = 1) = \lambda_n p \widetilde{F}_1(w_1^*) \exp(-h_n t_n)$$

where $h_n = \lambda_n(p\widetilde{F}_1(w_1^*) + (1-p)\widetilde{F}_0(w_0^*))$ and represents the hazard rate of exiting the unemployment state. The true wage at this job must be greater

[5] See Flinn (1999b) for a detailed discussion of alternative strategies for making the econometric model consistent with the observed data.

than the unemployment reservation wage for transitions into the covered sector, so $w \geq w_1^*$, and the true wage density is simply the conditional wage density scaled by the survivor probability or

$$m(w) = \frac{f_1(w)}{\widetilde{F}_1(w_1^*)}, w \geq w_1^*.$$

Conditional on any possible true wage the observed wage density is given by

$$m(\widetilde{w} \mid w) = w^{-1} f_\varepsilon \left(\frac{\widetilde{w}}{w} \right)$$

where w^{-1} is the Jacobian of the transformation from ε to $\widetilde{w}$. The likelihood of a completed spell at the job $(w, 1)$ of duration t_e that ends with a transition to the unemployment state is just

$$f_e(t_e, n \mid w, d = 1) = \eta_1 \exp(-h_1(w) t_e)$$

where $h_1(w) = \eta_1 + \lambda_1(p\widetilde{F}_1(w) + (1-p)\widetilde{F}_0(\xi_{10}(w)))$ and represents the total hazard rate of exiting the job $(w, 1)$. Integrating over all possible true wages, the likelihood contribution for this cycle equals

$$\begin{aligned} l(t_n, \widetilde{w}, d = 1, t_e) &= \int_{w_1^*} \lambda_n p \widetilde{F}_1(w_1^*) \exp(-h_n t_n) \\ &\quad \times w^{-1} f_\varepsilon \left(\frac{\widetilde{w}}{w} \right) \eta_1 \exp(-h_1(w) t_e) \frac{f_1(w)}{\widetilde{F}_1(w_1^*)} dw. \end{aligned}$$

Turning to the likelihood contribution for every possible labor market cycle, let me first define some notation: t_n is the initial unemployment duration, c_n indicates whether the unemployment spell is censored, $\{j_i\}_{i=1,2,3}$ indicates whether the labor market cycle contains an i^{th} employment spell, $\{c_i\}_{i=1,2}$ indicates whether the i^{th} employment spell is censored, $\{t_i\}_{i=1,2}$ is the duration of the i^{th} employment spell, $\{\widetilde{w}_i\}_{i=1,2}$ represents the observed wage in the i^{th} job, and $\{d_i\}_{i=1,2}$ is the health insurance status of the i^{th} job. Note that while I am restricting my attention to the first two jobs in any cycle, I do utilize observed transitions out of the second employment state in forming the likelihood. For these transitions, I do not differentiate between the two employment states, but only between the employment and unemployment states.

Letting x represent the data just described and β represent the vector of parameters to be estimated, the likelihood contribution for any cycle can be written as

$$\begin{aligned} l(x,\beta) &= \int_{w^*_{d_1}} \int_{\xi_{d_1 d_2}(w_1)} h_n(d_1)^{1-c_n} \exp(-h_n t_n) \qquad (10) \\ &\times \left\{ \frac{1}{w_1} f_\varepsilon \left(\frac{\widetilde{w}_1}{w_1} \right) \exp(-h_{d_1}(w_1) t_1) \left(h_{d_1}(w_1, d_2)^{j_2} \eta_{d_1}^{1-j_2} \right)^{1-c_1} \right\}^{j_1} \\ &\times \left\{ \frac{1}{w_2} f_\varepsilon \left(\frac{\widetilde{w}_2}{w_2} \right) \exp(-h_{d_2}(w_2) t_2) \left(h_{d_2}(w_2, e)^{j_3} \eta_{d_2}^{1-j_3} \right)^{1-c_2} \right\}^{j_2} \\ &\times \frac{f_{d_1}(w_1)}{\widetilde{F}_{d_1}\left(w^*_{d_1}\right)} \frac{f_{d_2}(w_2)}{\widetilde{F}_{d_2}\left(\xi_{d_1 d_2}(w_1)\right)} dw_2 dw_1 \end{aligned}$$

where

$$\begin{aligned} h_n(d) &= \lambda_n (pd + (1-p)(1-d)) \widetilde{F}_d(w^*_d) \\ h_n &= \lambda_n \left(p\widetilde{F}_1(w^*_1) + (1-p) \widetilde{F}_0(w^*_0) \right) \\ h_d(w) &= \eta_d + \lambda_d \left(p\widetilde{F}_1(\xi_{d1}(w)) + (1-p) \widetilde{F}_0(\xi_{d0}(w)) \right) \\ h_d(w, d') &= \lambda_d (pd' + (1-p)(1-d')) \widetilde{F}_{d'}(\xi_{dd'}(w)) \\ h_d(w, e) &= \lambda_d \left(p\widetilde{F}_1(\xi_{d1}(w)) + (1-p) \widetilde{F}_0(\xi_{d0}(w)) \right). \end{aligned}$$

Denoting N as the number of cycles, the log likelihood function equals

$$\ln L = \sum_{i=1}^{N} \ln l(x_i, \beta).$$

It is clear that the estimator depends crucially on the reservation wage functions, ξ_{10} and ξ_{01}. As discussed in Section 2.2, these functions are implicitly defined by indifference between employment at the the jobs (w, d) and $(\xi_{dd'}(w), d')$. In theory, it is feasible to solve for the (discretized) complete system of value of functions, defined by equations (2) and (4), and implicitly compute the reservation wage functions.[6] When considering observable

[6] Solving for the system of value functions requires first discretizing the set of possible wages and then using the contraction mapping to compute the value functions at the discrete wage points. It is then possible to smooth over all wages using an n^{th} degree polynomial and, given these functions, the reservation wage functions can be solved for implicitly.

measures that affect labor market possibilities and the willingness to pay for health insurance, this approach becomes infeasible since the value functions will be individual specific. Therefore, I choose to approximate the system of value functions using a second order Taylor series approximation which allows me to directly compute the reservation wage functions since a closed form solution exists that depends solely on the estimated parameters. This approach greatly reduces the computational burden of the estimation procedure and, in practice, the corresponding reservation wage functions compare quite well to the reservation wage functions implicitly computed by solving the entire system. Figure 1 presents the reservation wage functions for the two computational methods and reveals that almost no difference exists between the methods.

5 Estimation Results

I consider two alternate specifications, one that allows a limited form of heterogeneity and one that treats all individuals the same. In the specification with heterogenous agents, I allow the primitive parameters of the model to be restricted functions of individual characteristics, X. As discussed above, the selection criteria that I use in constructing the data restrict the sample to a relatively homogenous group. Most importantly, all sample members are white males between the ages of 22 and 50 with at least a high school education. Therefore, I only consider two additional observables, whether the individual attended college and whether the individual has children. These individual characteristics will almost certainly affect the demand for health insurance and the distribution of job offers and, in addition, may affect the arrival rates (e.g., individuals with children may search more intensively) and the termination rates.

It is well-known that with the type of data available in the SIPP, identification of primitive parameters requires that parametric assumptions be made regarding the conditional wage distributions, F_1 and F_0 (Flinn and Heckman, 1982). I assume that the conditional wage distributions, $F_d(w)$, $d = 0, 1$, are log normal with parameters μ_d and σ_d. In addition, I assume that the measurement error distribution is also log normal with parameters μ_ε and σ_ε, but in order to ensure that the observed wage equals the true wage in expectation, I restrict $\mu_\varepsilon = -.5\sigma_\varepsilon^2$.

5.1 Maximum likelihood estimates without observables

Table 3 presents the maximum likelihood estimates for the four different specifications that do not condition on observable characteristics. The first specification places no restrictions on the parameters of the model. The second specification restricts the dismissal rates and the third specification restricts the employed job arrival rates to be identical between the two types of jobs. Finally, specification four assumes away the existence of health insurance and estimates the classical reservation wage model with OTJ search.

The first thing to note is the strong rejection of the three alternative specifications in favor of the unrestricted model. These results are important in two dimensions. First, ignoring the presence of health insurance will lead to drastically incorrect predictions of employment behavior. For comparison sake, estimates of the reservation wage model without health insurance suggest that almost 98% of job offers out of unemployment are accepted. This implies a low rate of voluntary unemployment. On the other hand, the unrestricted model predicts that only 73% of job offers are accepted by unemployed agents and a very high rate of voluntary unemployment. The estimates suggest that since the probability that an offer includes the provision of health insurance is relatively low, $p = 0.46$, that some unemployed individuals are "waiting" to get an offer from the insured sector.

Second, health insurance appears to have both direct effects (i.e., the positive value associated with its provision) and indirect effects on employment decisions. Specifically, by taking a job with health insurance the individual lowers the rate at which he returns to unemployment, but also decreases his chances of receiving new offers. As discussed above, a potential explanation for why employers provide health insurance is to increase the overall health of its workforce which may lead to a lower rate of illness that renders workers incapable of working. The estimates lend support to this hypothesis. Workers without health insurance are two and a half times more likely to be "dismissed" than workers with health insurance coverage. In addition, interpreting the difference in job arrival rates as a measure of the likelihood that a new job offer is at least as generous as the current job along other non-wage dimensions, the estimates suggest that jobs without health insurance are much less likely to include other non-wage benefits than insured jobs.

The primitive parameters are often difficult to interpret, so Table 4 presents some more easily interpreted statistics. Focusing on the unrestricted model, the implied estimates of the wage offer distributions suggest that jobs that provide health insurance tend to pay significantly higher wages than jobs without health insurance. Even at the minimum possible wage with health insurance, w_1^*, only 34% of jobs not offering health insurance will have a higher wage. The dramatic dominance of the insured distribution over the uninsured distribution implies a relatively small transition probability from insured to uninsured jobs. Furthermore, the estimated value of employer-provided health insurance implies that an individual is willing to have his wages cut by $1.55 per hour to have health insurance coverage. Adding this benefit to the already dominant insured distribution suggests that the possibility of distortions in job turnover (at least from insured to uninsured jobs) may not be very likely.

The model does a reasonably good job of fitting the conditional wage distributions observed in the data as the two graphs in Figure 2 demonstrate. The figures plot the estimated densities of the first wage observed after an unemployment spell conditional on health insurance status against the relevant histogram of sample wage rates. While it is true that allowing for measurement error that follows a log normal distribution acts to smooth out differences between the predictions of the model and the data, the measurement error assumption is restrictive enough that its presence cannot be the sole explanation for the high degree of correspondence between the predicted and observed distributions.

5.2 Maximum likelihood estimates with observables

In order to estimate the model that conditions on education and children, each parameter is assumed to be a function of a linear index and the transformation that maps the index into the parameter values is dictated by model restrictions on the parameter space. The rate parameters (i.e., η_1, η_0, λ_1, λ_0, and λ_n), the reservation wages, w_1^* and w_0^*, and the shape parameter of the log normal wage distributions, σ_d, are restricted to be positive, so the transformation exponentiates the linear index. For example, $\eta_1(X) = \exp\left(X\beta_{\eta_1}\right)$. The means of the log normal wage distributions are unrestricted, so these parameters simply equal the linear index. The probability that a job includes health insurance is restricted to be in the unit interval so that $p = \exp\left(X\beta_p\right) / \left(1 + \exp\left(X\beta_p\right)\right)$. Finally, the standard deviation on the measurement error distribution is assumed to be the same for all sample members and the instantaneous discount rate ρ is assumed to be fixed and known.

Table 5 presents the maximum likelihood estimates for the four different groups considered. There are three results that warrant further discussion. First, a likelihood ratio test of the restricted model (i.e., the model with no observables) versus the unrestricted model that conditions on education and the presence of children strongly rejects the restricted model. This test suggests that significant differences in labor market outcomes exist among the various groups.

Second, the probability that a job offer includes the provision of health insurance depends crucially on individual characteristics. This result implies sorting on either the part of workers (e.g., high demand individual choose occupations that tend to have a high rate of health insurance coverage) or on the part of employers. The compensating differentials equilibrium with imperfect information assumes that employers cannot selectively provide health insurance benefits based on individual characteristics, so I interpret these estimates as evidence of sorting by workers.[7]

Lastly, the differences in the termination rates and employed job arrival rates persist among the four groups. In each case, the termination rate at insured jobs is about two and a half times less than the rate at uninsured jobs. Similarly, the rate at which new offers are received is between one and a half and three times greater at uninsured jobs. The persistence of these differences across groups will have important consequences for the estimated distortions in job mobility rates.

Again, these parameter estimates are somewhat difficult to interpret, so Table 6 presents more easily interpreted summary measures for the four different groups. The willingness to pay for health insurance varies significantly among the four groups considered. The effects of children and education are both positive with a slightly larger impact of education. Note that the point estimates of the willingness to pay for individuals without college, regardless of whether they have children or not, are negative, but not significantly

[7] A more comprehensive equilibrium model should be considered to fully explain the estimated differences in the probability of receiving a job offer that provides health insurance. If employers know that high demand types are sorting into their occupations or industries, they should respond to this over time.

different than zero.[8]

In addition, children and education have positive effects on the conditional wage offer distributions individuals face. For example, the mean wage offer of an insured job for an individual with children is about $3 more if he attended college. Likewise, for an individual who attended college, the differences in the mean wage offers for individuals with and without children are $2.30 and $2.80 for insured and uninsured job, respectively. As we will see in the next section, the strong correlation between the willingness to pay for insurance and wages (i.e., high demand types tend to receive more generous wage offers) will dampen the negative effects of employer-provided health insurance on job turnover.

6 Job-lock, Job-push, and Efficiency Losses

In the model estimated above, employment dynamics are the result of optimal decision-making so any distortion in job turnover is necessarily due to the process by which wages and the provision of health insurance are determined. While the model I am estimating assumes an exogenously-determined joint distribution of wages and health insurance levels, the behavioral model is consistent with any number of explanations for this distribution is determined. For the purposes of this paper, the most intuitive modeling strategy follows the model of equalizing wage differences with imperfect information set forth by Rosen (1986).

6.1 Interpretation

Assume that employers cannot observe a worker's true willingness to pay for health insurance, but simply knows the average willingness to pay, denoted $\overline{\alpha}$. This assumption accounts for two ex post identical possibilities. The first is that employers truly cannot observe worker demands on a case by case basis. The second possibility is that due to the tax code, employers are legislated against discriminating on a person by person basis. In either case, employers

[8] The parameters are estimated based on the approximation to the value functions discussed in the Appendix. The procedure to estimate the structural parameters of the model, on which the implied estimates are based, does not impose a non-negativity constraint. Furthermore, due to the differential termination and employed job arrival rates there is no sense in which the willingness to pay necessarily should be greater than zero.

will not be able to perfectly lower wages by the worker's willingness to pay. This is critical for the existence of job-lock and the extent to which wages can be conditioned on worker's private value of health insurance provision determines the magnitude of the subsequent welfare loss.

Let ϕ represent the fixed cost of providing health insurance and m denote the worker's marginal product. The joint distribution of wages and the provision of health insurance in a perfectly competitive labor market can be characterized by the following:

$$w = \begin{cases} m - \overline{\alpha} & \text{if the firm provides health insurance} \\ m & \text{if the firm does not provide health insurance} \end{cases} \tag{11}$$

and when the total employer costs of providing health insurance (i.e., wages and the health insurance premium) are lower than the employer costs of not providing insurance, the firm will choose to cover the worker. Therefore, if $\phi \,\square\, \overline{\alpha}$ the firm will provide insurance.

The implications of the model are clear. Firms that face a relatively low cost of health insurance will provide coverage and will earn rents. In addition, worker's with a high private value of health insurance (i.e., $\alpha > \overline{\alpha}$) will also earn rents since the compensating differential is lower than their willingness to pay. Note that without further assumptions, this model is incapable of explaining the observed positive relationship between wages and health insurance benefits.

Within this model, it is easy to see how the existence of employer-provided health insurance may lead to distortions in job turnover rates away from the efficient level and therefore lead to welfare losses. Consider a high demand individual (i.e., $\alpha > \overline{\alpha}$) in the job $(w, d = 1)$. Given the equilibrium described above, we can infer that the marginal product associated with this job is

$$m = w + \overline{\alpha}.$$

Now assume that the agent receives an offer from a new firm at which his marginal product is $m' > m$, but this firm has a high cost of insurance and subsequently does not provide health insurance. Note that the firm's decision to provide health insurance is independent of the marginal product of the worker. According to the optimal decision rules developed above, the individual will change jobs only if

$$\begin{aligned} & w' \geq \xi_{10}(w) \\ \Rightarrow \quad & m' \geq \xi_{10}(m - \overline{\alpha}). \end{aligned}$$

Since the individual has a high demand for health insurance, $\xi_{10}(m - \overline{\alpha}) > m$, which implies that some proportion of productivity-improving job opportunities will be passed on due to the presence of health insurance.[9]

An identical argument holds for low demand individuals in jobs without health insurance who get new offers from firms providing health insurance. Conditional on the marginal product of the job, the wage in a job that provides insurance is lower than the wage without coverage due to the compensating differential. Since the necessary condition for a worker to change from an uninsured job to an insured job is

$$\begin{aligned} w' &\geq \xi_{01}(w) \\ \Rightarrow \quad m' - \overline{\alpha} &\geq \xi_{01}(m) \end{aligned}$$

it may be the case that some low demand individuals will pass up more productive jobs that provide insurance.

Employer-provided health insurance may also lead to an increase in job turnover rates, a phenomenon Anderson (1998) calls "job-push." Consider an individual with a high willingness to pay for health insurance who currently occupies a job without health insurance. At the hourly wage w, the individual will accept a job without health insurance if the wage attached to that job is greater than $\xi_{01}(w)$, while only jobs with a wage greater than $w - \overline{\alpha}$ are productivity improving. Hence, if $\xi_{01}(w) < w + \overline{\alpha}$, the individual will be "pushed" into insured jobs that result in productivity declines. A similar story holds for low demand individuals occupying jobs with health insurance.

Figure 3 graphically fixes the notion of job-lock and job-push that I am considering in this paper. In the top panel, a high willingness to pay individual (i.e., $\alpha > \overline{\alpha}$) occupies the job $(12, 1)$. According to the equilibrium discussed above, the individual should accept any uninsured job that pays a wage greater than $12 + \overline{\alpha}$. However, since the individual earns rents from his insured job, he only accepts an uninsured job if the wage is greater than $\xi_{10}(12)$. Therefore, all uninsured jobs with wages $w \in [12 + \overline{\alpha}, \xi_{10}(12)]$ are rejected even though they would result in a productivity improvement. I consider this job-lock.

In the bottom panel, the same individual occupies the job $(12, 0)$. In this case, the individual should only accept an insured job if the attached wage is

[9] Due to the differential termination rates and employed offer arrival rates, it is not directly evident that the reservation wage for insured to uninsured transitions is greater than the current wage. In fact, the estimates suggest that at relatively low wages this is not the case.

greater than $12-\overline{\alpha}$. Since the individual places a high value on the provision of employer-provided health insurance, he is willing to accept any insured job that pays a wage greater than $\xi_{01}(12) < 12-\overline{\alpha}$. Any insured job that is accepted in spite of the fact that it leads to a productivity decline causes job-push.

6.2 Estimates

The definitions of job-lock and job-push follow directly from the interpretations discussed above. Formally, job-lock at any job (w,d) is defined as the percent difference between the optimal turnover rate (i.e., the turnover rate if the individual accepted all productivity-improving jobs) and the actual turnover rate. Similarly, job-push at the job (w,d) is the percent difference between the turnover if only productivity-improving jobs are accepted and the actual rate. Integrating over possible wages, yields estimates of job-lock and job-push of the following form:

$$joblock_1 = \int_{w_1^*} \left[\frac{(1-p)\left(\widetilde{F}_0(w+\overline{\alpha})-\widetilde{F}_0(\xi_{10}(w))\right)}{p\widetilde{F}_1(w)+(1-p)\widetilde{F}_0(w+\overline{\alpha})}\right]^{\chi(w)} \frac{f_1(w)}{\widetilde{F}_1(w_1^*)} \tag{12}$$

$$joblock_0 = \int_{w_0^*} \left[\frac{p\left(\widetilde{F}_1(w-\overline{\alpha})-\widetilde{F}_1(\xi_{01}(w))\right)}{p\widetilde{F}_1(w-\overline{\alpha})+(1-p)\widetilde{F}_0(w)}\right]^{\chi(w)} \frac{f_0(w)}{\widetilde{F}_0(w_0^*)} \tag{13}$$

$$jobpush_1 = \int_{w_1^*} \left[\frac{(1-p)\left(F_0(w+\overline{\alpha})-F_0(\xi_{10}(w))\right)}{p\widetilde{F}_1(w)+(1-p)\widetilde{F}_0(w+\overline{\alpha})}\right]^{\chi(w)} \frac{f_1(w)}{\widetilde{F}_1(w_1^*)} \tag{14}$$

$$jobpush_0 = \int_{w_0^*} \left[\frac{p\left(F_1(w-\overline{\alpha})-F_1(\xi_{01}(w))\right)}{p\widetilde{F}_1(w-\overline{\alpha})+(1-p)\widetilde{F}_0(w)}\right]^{\chi(w)} \frac{f_0(w)}{\widetilde{F}_0(w_0^*)}. \tag{15}$$

where $\chi(w)$ indicates whether job-lock or job-push exists at w.[10] For example, if $\xi_{10}(w) < w+\overline{\alpha}$, then the individual is not considered to be "locked"

[10]There is an issue of what wage distributions to integrate over to compute these estimates. In the above definitions, I integrate over the accepted wage distribution for jobs immediately following an unemployment spell. An alternative is to simulate the steady state conditional wage distributions and to integrate over these distributions. These distributions are depicted in Figure 4.

at the job $(w,1)$. Note that when the termination and job arrival rates are identical across employment states, an individual willing to pay more than the average person for health insurance will always be locked into insured jobs and never locked into uninsured jobs. The exact opposite is true for individuals who are willing to pay less than the average.

In order to determine the effect of job-lock on efficiency, I compute the percent reduction in productivity resulting from individuals rejecting productivity-improving job offers. At the job $(w,1)$, the corresponding productivity is $m = w + \overline{\alpha}$, but we know all jobs $(w',0)$ where $w' \in [w + \overline{\alpha}, \xi_{10}(w)]$ are rejected. These jobs would have resulted in productivities equal to $m' = w'$, so that the resulting percent loss in productivity is

$$\int_{w+\overline{\alpha}}^{\xi_{10}(w)} \frac{w' - (w + \overline{\alpha})}{w + \overline{\alpha}} f_0(w')\, dw'.$$

Integrating over all possible insured jobs results in the measure of welfare loss due to job-lock of

$$losslock_1 = \int_{w_1^*} \int_{w+\overline{\alpha}}^{\xi_{10}(w)} \left[\frac{w' - (w + \overline{\alpha})}{w + \overline{\alpha}} \right]^{\chi(w,w')} f_0(w') \frac{f_1(w)}{\widetilde{F}_1(w_1^*)} dw' dw. \qquad (16)$$

where $\chi(w,w')$ indicates whether the individual rejects w' even though it is productivity-improving. Note that the estimated efficiency loss does not take into account the duration of the loss, but simply measures the relative loss in dollars per hour. Similarly, I define the losses due to job-lock at uninsured jobs and job-push as

$$\begin{aligned}
losslock_0 &= \int_{w_0^*} \int_{w-\overline{\alpha}}^{\xi_{01}(w)} \left[\frac{w' + \overline{\alpha} - w}{w} \right]^{\chi(w,w')} f_1(w') \frac{f_0(w)}{\widetilde{F}_0(w_0^*)} dw' dw \qquad (17) \\
losspush_1 &= \int_{w_1^*} \int_{\xi_{10}(w)}^{w+\overline{\alpha}} \left[\frac{w + \overline{\alpha} - w'}{w + \overline{\alpha}} \right]^{\chi(w,w')} f_0(w') \frac{f_1(w)}{\widetilde{F}_1(w_1^*)} dw' dw \qquad (18) \\
losspush_0 &= \int_{w_0^*} \int_{\xi_{01}(w)}^{w-\overline{\alpha}} \left[\frac{w - (w' + \overline{\alpha})}{w} \right]^{\chi(w,w')} f_1(w') \frac{f_0(w)}{\widetilde{F}_0(w_0^*)} dw' dw. \qquad (19)
\end{aligned}$$

Table 7 presents the estimates of (12)-(19). The results indicate that employer-provided health insurance does indeed lead to significant distortions in job turnover away from the optimal rates, but relatively small effects on efficiency. The first two rows of the table show that individuals with $\alpha > \overline{\alpha}$ are locked into jobs with health insurance with subsequent reductions in job turnover rates between 5 and 7.5 percent. Likewise, individuals with a low demand for health insurance are locked into uninsured jobs resulting in 10.6 to 11.2 percent reductions in mobility. The next two rows of the table indicate that health insurance also causes signficant increases in turnover rates. For the two high willingness to pay groups, the presence of employer-provided health insurance leads to a 23 to 48 percent increase in job turnover. For low demand types, the effects are smaller, but they are also "pushed" into uninsured jobs. The subsequent losses are small. The rejection of uninsured jobs by high demand types lead to only a 0.26 to 0.50 percent loss in productivity, while the acceptance of productivity-decreasing jobs leads to a 0.44 to 0.60 percent loss. The relative losses caused by socially sub-optimal decision-making on the part of low demand types lead to 1.2 to 3.1 percent losses in productivity.

7 Conclusion

This paper provides strong empirical evidence of the distortionary effects of employer-provided health insurance on job turnover rates. Using a search theoretic model to explain individual employment decisions and given an underlying assumption of labor market equilibrium based on a model of equalizing differences with imperfect information, the structural model leads to well-defined notions of job-lock and job-push, as well as the subsequent efficiency losses. The estimates reveal that employer-provided health insurance leads to significant distortions in job turnover patterns away from the efficient level. Estimates range from 2 to 48 percent depending on individual characteristics and the transition in question. In spite of these distortions, the subsequent welfare losses are rather small and at a maximum equal a three percent loss. Usually the estimated loss is less than one percent.

While the structural approach used in this paper provides evidence supporting the hypothesis that employer-provided health insurance significantly distorts job turnover away from efficienct levels, but that this does not lead to substantially productivity losses, the model is limited in a number of aspects. Most importantly, the model only considers employees' decisions and ignores firm decisions and the corresponding labor market equilibrium. The estimates of job-lock, job-push, and the subsequent welfare losses are based on a model of equalizing differences with imperfect information that is not capable of explaining some important features of the data. Certainly a more comprehensive equilibrium model should be considered in future work.

A Computing the Reservation Wage Functions

In this appendix, I detail the method of approximation used to compute the reservation wage functions, $\xi_{10}(w)$ and $\xi_{01}(w)$. Recall that the value functions, represented by equations (2) and (4), provide the basis on which all employment decisions are made. Taking a second order Taylor series approximation to the functions $V_1(w)$ and $V_0(w)$ around the unemployment reservation wages yields

$$V_1(w) \simeq V_n + \frac{1}{\delta_1}(w - w_1^*) + \frac{\pi_1}{2(\delta_1)^2}(w - w_1^*)^2 \tag{20}$$

$$V_0(w) \simeq V_n + \frac{1}{\delta_0}(w - w_0^*) + \frac{\pi_0}{2(\delta_0)^2}(w - w_0^*)^2 \tag{21}$$

where

$$\begin{aligned}
\delta_1 &= \rho + \eta_1 + \lambda_1\left(p\widetilde{F}_1(w_1^*) + (1-p)\widetilde{F}_0(w_0^*)\right) \\
\delta_0 &= \rho + \eta_0 + \lambda_0\left(p\widetilde{F}_1(w_1^*) + (1-p)\widetilde{F}_0(w_0^*)\right) \\
\pi_1 &= \lambda_1\left(pf_1(w_1^*) + (1-p)f_0(w_0^*)\left.\frac{\partial\xi_{10}(w)}{\partial w}\right|_{w_1^*}\right) \\
\pi_0 &= \lambda_0\left(pf_1(w_1^*)\left.\frac{\partial\xi_{01}(w)}{\partial w}\right|_{w_0^*} + (1-p)f_0(w_0^*)\right)
\end{aligned}$$

Following equation (6), the reservation wage function $\xi_{10}(w)$ equates the value of being insured at wage w to the value of not having insurance at the reservation wage or $V_1(w) = V_0(\xi_{10}(w))$. Given the second order approximations, this indifference results in a quadratic equation in $\xi_{10}(w) - w_0^*$ that reduces to

$$(\xi_{10}(w) - w_0^*) - \frac{-b_0 + (b_0^2 - 4a_0 c_1(w))^{.5}}{2a_0} = 0 \tag{22}$$

where

$$\begin{aligned} a_0 &= \frac{\pi_0}{2(\delta_0)^2} \\ b_0 &= \frac{1}{\delta_0} \\ c_1(w) &= -\left(\frac{1}{\delta_1}(w - w_1^*) + \frac{\pi_1}{2(\delta_1)^2}(w - w_1^*)^2\right). \end{aligned}$$

Since the parameters π_1 and π_0 depend on the derivatives of the reservation wage functions evaluated at the unemployment reservation wages, in order to find a closed form solution we must compute the derivative of (22) evaluating at $w = w_1^*$. It is straightforward to show that

$$\begin{aligned} \left.\frac{\partial \xi_{10}(w)}{\partial w}\right|_{w_1^*} &= \frac{.5\,(b_0^2 - 4a_0 c_1(w))^{-.5}(-4a_0)\frac{\partial c_1(w)}{\partial w}}{2a_0} \\ &= -\frac{1}{b_0}\frac{\partial c_1(w)}{\partial w} \\ &= \frac{\delta_0}{\delta_1} \end{aligned}$$

Likewise,

$$\left.\frac{\partial \xi_{01}(w)}{\partial w}\right|_{w_0^*} = \frac{\delta_1}{\delta_0}$$

so the parameters π_1 and π_0 can be written strictly in terms of parameters of the model that are to be estimated, including the unemployment reservation wages.

Given the estimates of the model, I then solve for the discretized system of value functions and find the values of b and α that solve the two equations

$$\begin{aligned} V_n &= V_1(w_1^*) \\ V_n &= V_0(w_0^*). \end{aligned}$$

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Table 1: Transition Matrix

Transition 1	#	Transiton 2	#	Transition 3	#
Censored	448				
Insured job	1076	Censored	760		
		Unemployment	239		
		Insured job	65	Censored	50
				Unemployment	9
				Employment	6
		Uninsured job	12	Censored	4
				Unemployment	6
				Employment	2
Uninsured job	689	Censored	304		
		Unemployment	239		
		Insured job	69	Censored	56
				Unemployment	8
				Employment	5
		Uninsured job	77	Censored	45
				Unemployment	25
				Employment	7

Note: Based on the 1990 to 1993 panels of the Survey of Income and Program Participation. The sample includes white males between the ages of 22 and 50 with at least a high school education. See text for details on exclusion criteria. The sample consists of 2,213 labor market cycles which all begin with an unemployment spell.

Table 2: Descriptive Statistics

Statistic	**With Insurance**	**Without Insurance**
Mean wage out of unemployment	13.21 (6.36)	8.44 (4.90)
Mean wage for censored spells	13.34 (6.43)	8.64 (4.49)
Mean wage for transitions to another job	12.45 (5.36)	7.22 (3.37)
Mean wage from another job	12.52 (6.00)	8.58 (4.63)
Mean uncensored job spell duration	8.10 (5.71)	5.65 (4.31)
Mean censored job spell duration	14.42 (8.90)	9.04 (8.23)
Mean unemployment duration: uncensored	3.69 (3.43)	
Mean unemployment duration: censored	6.49 (6.66)	

Note: Wages are measured in dollars per hour. Durations are measured in months. Standard deviations are in parentheses.

Table 3: Maximum Likelihood Estimates: No Observables

Parameter	**Model 1**	**Model 2**	**Model 3**	**Model 4**
η_1	0.018 (0.001)	0.026 (0.001)	0.017 (0.001)	0.026 (0.001)
η_0	0.048 (0.003)	$= \eta_1$	0.049 (0.003)	$= \eta_1$
λ_1	0.026 (0.006)	0.022 (0.004)	0.038 (0.008)	0.028 (0.002)
λ_0	0.055 (0.013)	0.053 (0.009)	$= \lambda_1$	$= \lambda_1$
λ_n	0.255 (0.056)	0.238 (0.038)	0.251 (0.053)	0.191 (0.005)
μ_1	2.456 (0.028)	2.475 (0.020)	2.485 (0.019)	2.262 (0.019)
σ_1	0.378 (0.030)	0.381 (0.025)	0.358 (0.027)	0.483 (0.019)
w_1^*	6.398 (0.635)	5.434 (0.575)	5.322 (0.542)	3.667 (0.320)
μ_0	1.609 (0.255)	1.654 (0.203)	1.610 (0.243)	$= \mu_1$
σ_0	0.601 (0.090)	0.595 (0.076)	0.596 (0.085)	$= \sigma_1$
w_0^*	4.615 (0.338)	4.427 (0.312)	4.622 (0.326)	$= w_1^*$
p	0.456 (0.095)	0.473 (0.074)	0.440 (0.092)	-
σ_ε	0.321 (0.025)	0.299 (0.024)	0.316 (0.024)	0.268 (0.022)
Mean $\ln L$	-7.030	-7.060	-7.038	-7.194
LR test statistic		132.78	35.41	725.86

Note: Estimates are based on the following assumptions: the annual discount rate is set to 0.08 and the measurement error distribution is log normal with mean 1. Model 1 places no restrictions on the parameters. Model 2 restricts the dismissal rates η_d to be equal and model 3 restricts the job arrival rates in employment λ_d to be the same. Model 4 is a two state reservation wage model. Standard errors are in parentheses. The LR test statistic corresponds to a Likelihood Ratio test between Model 1 and the other three models.

Table 4: Implied Parameter Estimates: No Observables

Parameter	**Model 1**	**Model 2**	**Model 3**	**Model 4**
$E_1[w]$	12.523 (0.296)	12.775 (0.215)	12.790 (0.193)	10.790 (0.165)
$V_1[w]$	24.134 (1.154)	25.458 (0.951)	22.350 (0.776)	30.630 (1.002)
$E_0[w]$	5.987 (1.226)	6.242 (1.004)	5.974 (1.170)	-
$V_1[w]$	15.615 (4.894)	16.550 (4.024)	15.196 (4.580)	-
$\widetilde{F}_1(w_1^*)$	0.944 (0.038)	0.980 (0.017)	0.988 (0.012)	0.977 (0.011)
$\widetilde{F}_0(w_0^*)$	0.553 (0.143)	0.610 (0.114)	0.553 (0.137)	-
$\bar{t}_n$	5.361 (0.553)	5.361 (0.836)	5.361 (0.975)	5.361 (0.168)
α	1.553 (0.810)	2.412 (0.810)	-0.700 (0.423)	-
b	-18.740 (2.656)	-16.001 (1.833)	-18.864 (2.194)	-17.316 (1.429)

Note: Standard errors are in parentheses and are computed using the delta method, except for the parameters α and b. For these two parameters, the standard errors are simulated using the asymptotic distribution of the parameter estimates from Table 3. E_d denotes the mean wage offer and V_d denotes the variance of the wage offer conditional on health insurance status d.

Table 5: Maximum Likelihood Estimates: With Observables

Parameter	**College, Children**	**College, No Children**	**No College, Children**	**No College, No Children**
η_1	0.013 (0.002)	0.014 (0.002)	0.021 (0.002)	0.023 (0.002)
η_0	0.035 (0.005)	0.049 (0.005)	0.040 (0.005)	0.056 (0.005)
λ_1	0.018 (0.003)	0.024 (0.006)	0.020 (0.004)	0.027 (0.007)
λ_0	0.055 (0.009)	0.058 (0.013)	0.044 (0.008)	0.046 (0.011)
λ_n	0.239 (0.021)	0.227 (0.040)	0.239 (0.018)	0.228 (0.044)
μ_1	2.672 (0.033)	2.468 (0.049)	2.462 (0.034)	2.275 (0.047)
σ_1	0.330 (0.041)	0.433 (0.044)	0.242 (0.045)	0.317 (0.049)
w_1^*	7.136 (1.042)	6.034 (0.804)	7.342 (1.082)	6.208 (0.774)
μ_0	2.067 (0.181)	1.656 (0.203)	2.045 (0.103)	1.638 (0.168)
σ_0	0.558 (0.104)	0.633 (0.085)	0.397 (0.067)	0.450 (0.077)
w_0^*	4.583 (0.718)	4.724 (0.364)	4.337 (0.705)	4.470 (0.323)
p	0.705 (0.047)	0.437 (0.076)	0.650 (0.036)	0.376 (0.070)
σ_ε	0.324 (0.025)			
Mean $\ln L$	-6.959			
LR test statistic	314.25			

Note: Estimates are based on the following assumptions: the annual discount rate is set to 0.08 and the measurement error distribution is log normal with mean 1. Standard errors are in parentheses. The LR test statistic corresponds to a Likelihood Ratio test between the unrestricted model with no observables presented in column 1 of Table 3 and the model that conditions on education and children.

Table 6: Implied Parameter Estimates: With Observables

Parameter	**College, Children**	**College, No Children**	**No College, Children**	**No College, No Children**
$E_1[w]$	15.272 (0.444)	12.961 (0.509)	12.081 (0.353)	10.230 (0.409)
$V_1[w]$	26.813 (1.673)	34.614 (2.633)	8.785 (0.498)	11.080 (0.856)
$E_0[w]$	9.234 (1.238)	6.399 (1.022)	8.361 (0.695)	5.694 (0.795)
$V_1[w]$	31.199 (6.229)	20.162 (5.010)	11.951 (1.645)	7.283 (1.657)
$\widetilde{F}_1\,(w_1^*)$	0.984 (0.024)	0.939 (0.040)	0.974 (0.052)	0.922 (0.075)
$\widetilde{F}_0\,(w_0^*)$	0.835 (0.090)	0.565 (0.117)	0.927 (0.055)	0.623 (0.150)
$\bar{t}_n$	4.459 (0.359)	6.044 (0.667)	4.368 (0.410)	5.976 (0.875)
α	6.439 (2.159)	2.935 (1.276)	-0.394 (1.279)	-0.838 (0.789)
b	-37.418 (7.131)	-16.720 (3.353)	-16.031 (4.325)	-4.891 (1.929)

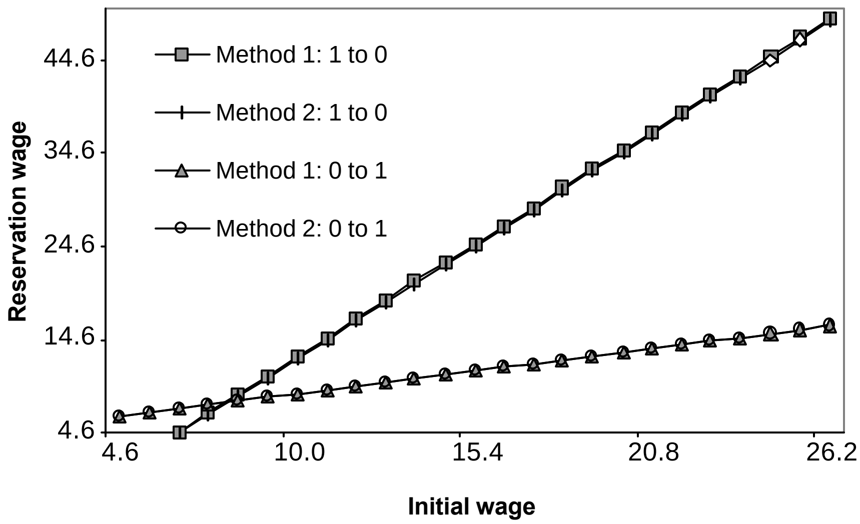
Note: Standard errors are in parentheses and are computed using the delta method, except for the parameters α and b. For these two parameters, the standard errors are simulated using the asymptotic distribution of the parameter estimates from Table 5. E_d denotes the mean wage offer and V_d denotes the variance of the wage offer conditional on health insurance status d.

Table 7: Estimates of Job-lock, Job-push, and Efficiency Losses

Statistic	**College, Children**	**College, No Children**	**No College, Children**	**No College, No Children**
Job-lock Estimates				
$joblock_1$	4.933 (1.644)	7.406 (2.265)	1.066 (1.197)	1.699 (1.373)
$joblock_0$	2.340 (2.357)	4.046 (3.492)	11.163 (8.224)	10.646 (6.796)
Job-push Estimates				
$jobpush_1$	0.647 (0.524)	1.899 (1.335)	6.020 (5.514)	10.443 (7.267)
$jobpush_0$	48.393 (27.430)	23.419 (9.554)	4.722 (6.983)	3.434 (2.954)
Estimates of Efficiency Losses				
$losslock_1$	0.507 (0.262)	0.264 (0.189)	0.006 (0.043)	0.009 (0.022)
$losslock_0$	0.519 (0.642)	1.045 (1.062)	2.217 (2.307)	3.069 (2.545)
$losspush_1$	0.276 (0.284)	0.268 (0.231)	1.704 (1.648)	1.147 (0.806)
$losspush_0$	0.597 (0.315)	0.437 (0.262)	0.007 (0.047)	0.013 (0.029)

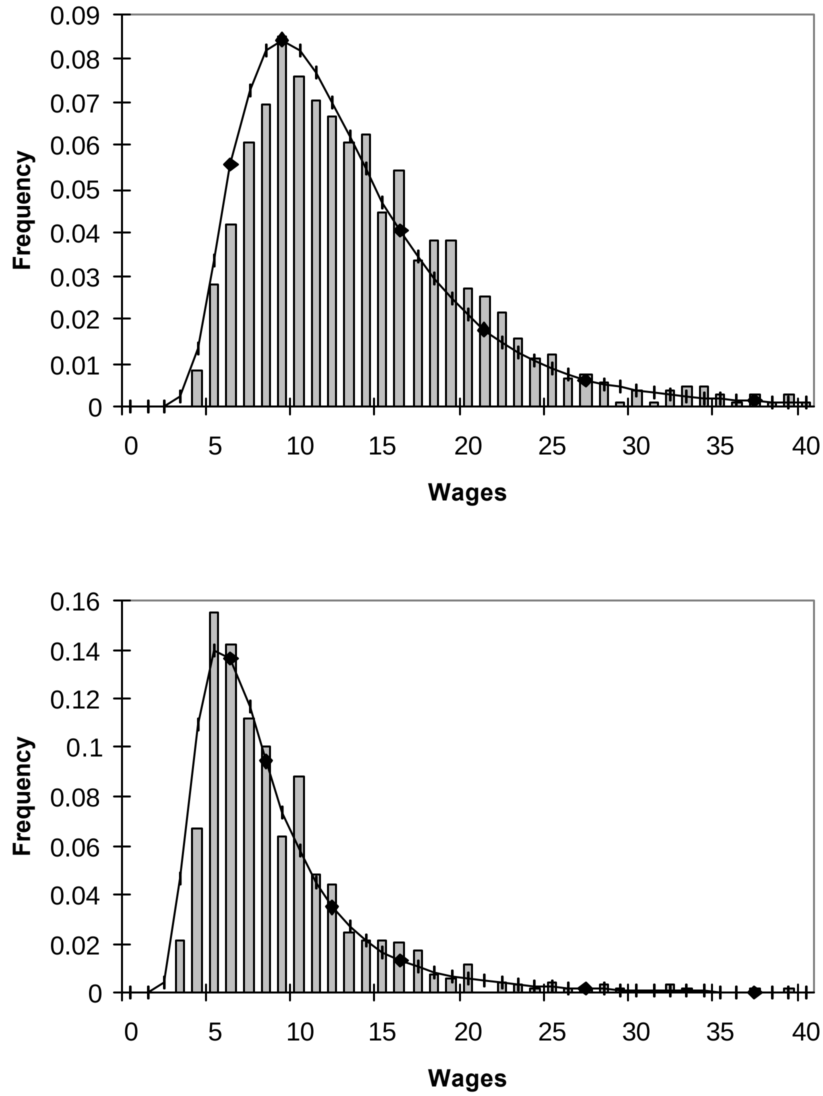
Note: Standard errors are in parentheses and are simulated using the asymptotic distribution of the parameter estimates from Table 5. The statistics $joblock_d$ and $jobpush_d$ represent the percent difference in optimal vs. actual turnover rates. The statistics $losslock_d$ and $losspush_d$ represent the percentage loss in productivity due to either job-lock or job-push. See text for details.

Figure 1: Reservation Wage Functions: Alternative Computational Methods



Note: Method 1 computes the reservation wage functions implicitly by solving the system of value functions. Method 2 computes the reservation wage functions directly according to the approximation to the value functions described in the Appendix. 1 to 0 indicates a transition from an insured job to an uninsured job and 0 to 1 indicates a transition from an uninsured job to an insured job. The figure is based on the parameter estimates for the unrestricted model with no observables presented in Table 3.

Figure 2: Actual vs. Predicted Wage Distributions

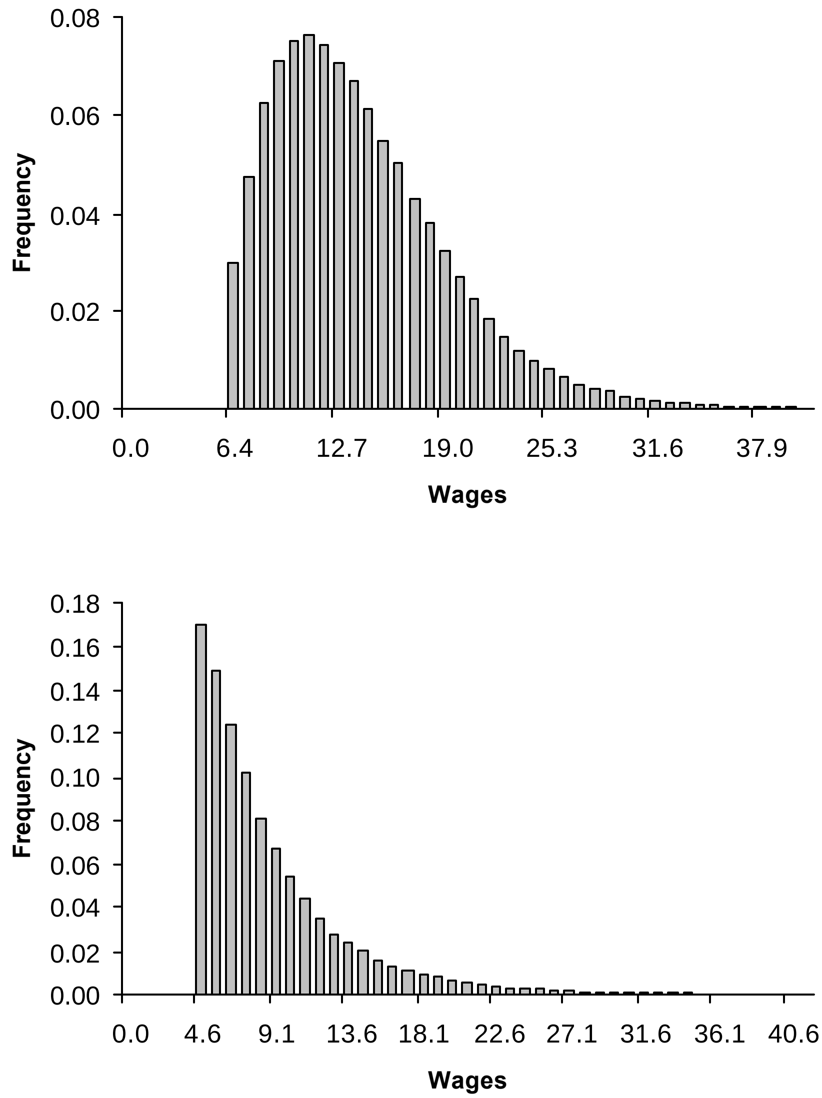


Note: The top panel depicts wages in insured jobs and the bottom panel depicts wages in uninsured jobs. Based on the parameter estimates for the unrestricted model with no observables presented in Table 3. Wages represent the hourly wage reported in the first job following an unemployment spell.

Figure 3: An Example

Note: In the top panel, the individual occupies a job with health insurance that pays a wage of $12 per hour. The shaded region depicts the set of productivity improving uninsured job offers that are rejected. In the bottom panel, the individual occupies a job without health insurance that pays a wage of $12 per hour. The shaded region depicts the set of productivity decreasing insured job offers that are accepted.

Figure 4: Steady State Wage Distributions



Note: The top panel depicts insured jobs and the bottom panel depicts uninsured jobs. Based on the parameter estimates for the unrestricted model with no observables presented in Table 3. The distribution is based on the simulated labor market histories for 500,000 individuals who began their working lives in the unemployment state. The minimum acceptable wage for an uninsured job is \$4.62. The minimum acceptable wage for an insured job is \$6.40.