HEALTH INSURANCE AS A PRODUCTIVE FACTOR*

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Abstract

In this paper, we present a less explored channel through which health insurance impacts productivity: by offering health insurance, employers reduce the expected time workers spend out of work in sick days. We develop a model that embodies this impact of health coverage in productivity. In our model, offering health insurance has an impact on the probability that a worker gets sick, missing workdays, as well as the probability that he recovers and gets back to work. Through this framework, we match several features empirically observed about the connection between labor market and health insurance coverage: Companies that offer health insurance will be larger in equilibrium, as well as they will offer a higher wage. We calibrated the model using US data for 2004 and show that an increase of 10% in health insurance premium generates a reduction of 11.65% in the proportion of worker with health coverage, as well as an increase in the measure of sick workers in steady state by 6.14%. We also showed that investments on preventive medicine has a larger impact on health coverage and the fraction of sick workers in equilibrium than curative medicine.

Finally, using data from the Household Component of the Medical Expenditure Panel Survey (MEPS) we found evidence supporting our hypothesis that health insurance reduces the number of sick days a worker needs.

**Keywords:** Health, Health Insurance, Labor Market, Labor Mobility.

**JEL Codes:** E20, E24, E25, E62, I10, J32, J63, J78

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1 Introduction

The main characteristic of the US health system is the presence of employers as the main source of insurance for the population at work age (18 to 64 years old). This generates an interaction between health care and labor markets that is unique to US: As health insurance costs outside the workplace are prohibitive to most workers, employers can distinguish themselves by offering health coverage to their employees, obtaining a hiring edge over firms that do not offer insurance. On the other hand, as health costs increased, labor force’s health coverage became a main source of variable costs for employers. As seen in the last decade, the rising on health care costs is followed by a decrease in the fraction of workers covered by their employers, increasing the number of uninsured from 36.5 million in 1994 to 45.7 million in 2008, representing now 17.4% of the non-elderly population. The interaction between labor market and health insurance in a scenario of rising health care costs also seemed to be harmful to labor productivity: In order to save in health care costs, several employers hire workers as part-time or contract employees. Similarly, many workers decide not to move to a job that seems a better match in order to not be uninsured in the meantime. Therefore, a better understanding of the impacts of employer-based health insurance on labor market outcomes seems fundamental to estimate the real costs of the US health insurance system.

In this paper, we present a second channel through which health insurance impacts productivity: by offering health insurance, employers reduce the expected time out of work in two ways: by reducing the probability a worker gets sick (preventive medicine) and/or increasing the probability a worker recovers from illness (curative medicine). Our empirical results using data from the Medical Expenditure Panel Survey (MEPS) show that a worker with health coverage misses on average $3.65$ workdays per year less than workers without health coverage$^1$. This reduction in workdays lost implies that workers become a more valuable asset for the firm.

We develop an on-the-job search model that embodies this impact of health coverage in productivity. In our model, employers decide not only which wages to offer, but also if they offer or not a health care option to their employees. Offering health insurance has an impact on the probability that a worker gets sick, missing workdays, as well as the probability that he recovers and gets back to work. Through this framework, we are able to match several features empirically observed about the connection between labor market and health insurance coverage: Companies that offer health insurance will be larger in equilibrium, as well as they will offer a higher wage. The reason for higher wage is derived from the productivity boost of health insurance: Once employees are working more in expected terms, losing a worker becomes more costly for a firm, and therefore firms offer higher wages to avoid workers accepting

$^1$As usual, we controlled for observables and endogeneity.
outside offers. These results are also corroborated by our empirical findings with the MEPS: Increases in firm size as well as wages augment the probability of a worker having health insurance coverage, being these variables more important than other worker specific characteristics, as previous general health condition or health habits or addictions.

Once we calibrate the model using US data for 2004, we are able to evaluate a series of changes in the sector: We show that an increase in 10% on health insurance premium reduces the proportion of workers with health coverage by 11.65%, as well as an increase in the number of workers sick in steady state by 6.14%. Finally, we study the difference in impact of improvements on preventive versus curative care. We consider the case of a governmental investment on medical research that make preventive methods 10% more efficient and compare that to the case in which such investment was made to improve curative methods (again, method becomes 10% more efficient). Our results show that, even though both medical advances have positive impacts, choosing to invest on Preventive instead of Curative represents a gain of 13.4% in labor force’s health coverage and a reduction of 5.53% in the number of sick workers in steady state.

In the next section, we discuss the related literature. The model is described in section 3, while comparative statics and policy experiments are presented in section 4. Section 5 describes the data and our empirical results are presented in section 6. Finally, section 7 concludes the paper

2 Related Literature

Several papers have tried to explain the predominance of employer provided health insurance in US. There are two current leading explanations for this phenomenon. One explanation has to do with the US tax system, where firms have a tax benefits when they provide a nondiscriminatory health insurance to their employees. Gruber and Poterba (1996) estimate that the tax-induced reduction in the "price" of employer-provided health insurance is about 27% on average. Woodbury and Huang (1991), Gruber and Poterba (1994) and Gentry and Peress (1994) conclude that taxes are an important factor in the provision of fringe benefits, although, not surprisingly, there is a wide range in the magnitude of the estimates. A second possible explanation is the cost advantage that employers have to reduce adverse selection and lower administrative expenses through pooling. These two factors together reduce the cost of providing insurance in large firms relative to small groups. Brown et. al. (1990) and Brugemann and Manovskii (2009) have mentioned these factors as the reasons why large firms are much more likely to offer health insurance than are small firms.

Regarding to the effect of health insurance provision on wages, the empirical literature is still inconclusive. The conflicting evidence highlights the difficult identification issues associated with isolating the
impact of health insurance, as separate from other factors, on labor market outcomes. In principle, we should expect that employees pay all cost of employer-provided health insurance through lower wages, since health, similarly to general human capital, can be kept by the worker as she moves from a job to another. However, surprisingly Monheit et al. (1985) estimate a positive relationship between the two. Nevertheless, this result seems not to be robust, since Gruber (1994), Gruber and Krueger (1990), and Eberts and Stone (1985), using different datasets and methods\(^2\), find that most cost of the benefit is reflected in lower wages. Subsequent research in this area was aware of the possible endogenous relation between health provision and wages. One possible explanation for the endogenous relation of these variables is that healthy individuals are more productive and obtain a higher wage, but a reason of why they are healthy is the fact that they have health insurance. Several papers have tried to handle this problem looking for instrumental variables to obtain more accurate measure this relation health-wage. Leibowitz (1983) uses health insurance expenditures as an instrumental variable. He uses the RAND Health Insurance Study 17 to estimate the wage/fringe benefit tradeoff. RAND Health Insurance Study actually contacted employers to obtain information on employer health insurance expenditures before survey respondents were enrolled in the study. Once using this "ideal" dataset, Leibowitz again estimates a positive effect of employer health insurance expenditures on wages.

In spite of the vast empirical literature in this subject, few theoretical models tried to explain the empirical findings. In the last few years some papers have tried to accomplish this literature gap: Brugemann and Manovskii (2009) develop a quantitative equilibrium model that features tax deductibility of employer-provided coverage, non-discriminatory restrictions, fixed cost of coverage to understand labor market flows and to explain why the smaller firms are less likely to provide coverage than large firms. Dey and Flinn (2005) present an equilibrium model of health insurance provision by firms and wage determination. They investigate the effect of employer-provided health insurance on job mobility rates and economic welfare using an on-the-job search model with Nash-bargaining. They found an equilibrium in which not all employment matches are covered by health insurance, wages at jobs providing health insurance are larger (in a stochastic sense) than 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. They also found that the employer-provided health insurance system does not lead to any serious inefficiencies in mobility decisions.

Our paper is different from the previous papers in several ways: Differently from Brugemann and Manovskii (2009), we have homogeneous firms, while the difference in productivity is generated en-

\(^2\)Gruber (1994) uses statewide variation in mandated maternity benefits, Gruber and Krueger (1990) employs 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 negatively affected by health insurance provision.
dogenously through the health insurance decision. Therefore, we obtain the result even if firms do not have different firm costs. Our model also delivers the results without the presence of adverse selection, which is fundamental for Brugermann and Manovskii’s model, even though they didn’t find empirical evidence to support it. Our model differs from Dey and Flinn in two ways: first, we don’t assume that firms that do not offer health coverage has necessarily a larger exogenous job destruction rate. Second, differently from Dey and Flinn, we analyze the question about firm size and health insurance provision. In our model the fraction of firms not offering health coverage is endogenous and depend on the health insurance cost. So we can make statements about the fraction of firms offering health coverage in equilibrium.

3 Model

There is a continuum of risk neutral workers (measure \( m \)). While unemployed the worker receives a job offer with probability \( \lambda_0 \). When employed, the worker receives a job offer with probability \( \lambda_1 \). Once received, the offer can be accepted or rejected. There is no recall. While unemployed, the worker receives \( b \) (unemployment insurance or the utility of leisure). All agents discount future income at rate \( r \).

We assume risk neutral firms with measure normalized to 1. Firms offer a contract that is comprised of health insurance coverage and an hourly wage. To offer health coverage, the firm has to pay an up-front cost \( C \). Since the costs of insurance are shared by firm and worker, we allow an employee to decide if she wants coverage or not once it is offered. If yes, she has to pay a flow cost of \( c_e \) per period. Otherwise, nothing is paid. We do not assume that health is part of the worker’s utility function, but health insurance affects the probability that a worker gets sick \( \pi \) (preventive medicine) and/or the expected time she stays sick \( (\frac{1}{\rho}) \). For instance, a worker who has health insurance has a lower probability to get sick \( \pi_L \) than a worker without coverage \( \pi_H \), that is, \( \pi_H \geq \pi_L \), as well as a higher probability of healing \( (\rho_L \geq \rho_H) \).

The proportion of firms not offering health insurance is \( \gamma_H \), while the proportion of firms offering it is \( \gamma_L \); these proportions being pin down in equilibrium. We assume that the (potentially trivial) distribution of wages offered by firms providing health insurance is given by \( F_L(z) \), while the distribution of wages offered by firms which don’t provide it is \( F_H(z) \). From now on, we will call firms providing health insurance as low-risk firms, firms of type \( L \), while firms not providing it will be called as high-risk firms, firms of type \( H \).

A sick worker receives only a fraction of her wage \( \alpha \in (0, 1) \). This assumption follows from the findings of the most recent available data from the Bureau of Labor Statistics’ National Compensation
Survey (NCS) (covering March 2008) that shows that 39 percent of private-sector workers in the United States have no paid sick days or leave. Whenever paid leaves are available, they cover around 60% of the regular salary a worker receives. Since this value is not taxed, the amount can represent up to 80% of the regular wage. Similarly, a sick employee has a potentially higher job destruction rate ($\delta_S$) than a healthy employee ($\delta$), $\delta_S \geq \delta$. Finally, we assume that sick workers incur in additional medical costs of $\chi$. Since health insurance covers most costs to its members, we have $\chi_L \leq \chi_H$.

In this section, we will derive the steady state equilibrium in the labor market. We will first look at the workers’ optimal decision. Subsequently, we will look at the firm’s optimization problem, and how firms’ choice on health insurance coverage and wages will depend on workers’ and competitors’ behavior. All proofs and further calculations are in the appendix.

### 3.1 Worker’s Problem

From the framework outlined above, the expected discounted lifetime income when a worker is unemployed and healthy, $V_0$, can be expressed as the solution of the following equation:

$$rV_0 = b + \lambda_0 \sum \gamma_i \int \max \{V_i(z) - V_0, 0\} dF_i(z) + \pi_H (D_0 - V_0)$$

where $b$ can be seen as unemployment insurance as well as utility of leisure. A job offer arrives with a probability $\lambda_0$. A fraction $\gamma_H$ of offers comes from firms that don’t offer health insurance while the remainder comes from firms offering health coverage. Wages offered are seen by workers as draws from equilibrium distributions $F_i(z)$, where $i \in \{H, L\}$. $D_0$ is the value of being an unemployed sick worker. We assume that unemployed workers don’t have health insurance and that the only way a worker can obtain health insurance is through his employer. Notice that $D_0$ is given by:

$$rD_0 = b - \chi_H + \rho_H (V_0 - D_0)$$

where $\chi_H$ is an additional cost of being sick without health coverage, while $\rho_H$ is the probability a sick worker without coverage recovers. Rearranging the above expression and substituting it back, we have:

$$rV_0 = b + \lambda_0 \left[ \sum \gamma_i \int_{R_i}^{\infty} (V_i(z) - V_0) dF_i(z) \right] + \pi_H \left( \frac{b - \chi_H - rV_0}{r + \rho_H} \right)$$

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3 Using the same approach as Burdett and Mortensen (1998), we assume that the distributions of wages, $F_i(z)$, $i \in \{H, L\}$ are given and we focus on the optimal workers’ decisions given these distributions. We assume the distributions are well-behaved: continuous, and differentiable (e.g. no mass points); we will derive these properties later.

4 This is a simplifying assumption based on the very low percentage of the working population that has private insurance.
where $R_U^H$ and $R_U^L$ are the unemployed’s reservation wage for working in a health-coverage company and no health-coverage company, respectively.

Once a worker is employed at a firm that does not offer health insurance, the value of holding a job with wage $w$ at this company is:

$$rV_H (w) = w + \lambda_1 \sum_{i=H,L} \gamma_i \int_{R_i^H(w)} (V_i (z) - V_H (w)) dF_i (z) + \delta (V_0 - V_H (w)) + \pi_H (D_H (w) - V_H (w))$$

where $\lambda_1$ is the probability a job offer arrives. As before, a fraction $\gamma_H$ of offers comes from firms that don’t offer health insurance while the remainder comes from firms offering health coverage. Offers above the reservation wage $R_H^i (w) \in \{H, L\}$ are accepted. As expected, reservation wages can differ depending on the company offering health coverage or not. A job match between a firm and a healthy worker is destroyed with probability $\delta$. Finally, $D_H (w)$ is the value of being sick while holding a job that pays a wage rate of $w$ at a company that does not offer health coverage:

$$rD_H (w) = \alpha w - \chi_H + \rho_H (V_H (w) - D_H (w)) + \delta_S (D_0 - D_H (w))$$

where $\alpha$ is the reduction in wages given by the sick leave. We will assume from here on that $\alpha \leq \frac{r+\delta_S}{r+\delta+\lambda_1}$. As mentioned before, a worker without health insurance heals with probability $\rho_H$ and a job match is destroyed with probability $\delta_S \geq \delta$ if the worker is sick.

In the case in which a firm offers health coverage, we need to take into account the worker’s decision of accepting the coverage or not. Therefore, the value of holding a job at wage $w$ in a company that offers health coverage is:

$$V_L (w) = \max \{V_L (w,y) , V_L (w,n)\}$$

where $y$ and $n$ indicate if the worker accepted or not the coverage, respectively. But notice that $V_L (w,n) = V_H (w)$. Therefore:

$$rV_L (w) = \max \{V_L (w,y) ; V_H (w)\}$$

where:

$$rV_L (w,y) = w-c_e + \lambda_1 \sum_{i=H,L} \gamma_i \int_{R_i^L(w)} (V_i (z) - V_L (w,y)) dF_i (z) + \delta (V_0 - V_L (w,y)) + \pi_L (D_L (w) - V_L (w,y))$$

As mentioned before, in this case the worker pays a flow cost of $c_e$. We assume that this cost is paid even when the worker is sick, which implies that the value of being a sick worker at this company

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5The fact that the optimal policy is a reservation policy is straightforward and standard. If one accepts wage $w_1$ as part of an optimal policy, then any wage $w_2 > w_1$ for firms that are otherwise identical, gives more utility and hence should be accepted as well.
is given by:

\[ rD_L(w) = \alpha w - c_e - \chi_L + \rho_L (V_L(w, y) - D_L(w)) + \delta S (D_0 - D_L(w)) \]

Notice that a firm would only pay the cost \( C \) if the worker opts to buy insurance, while a worker would only buy the offered health coverage if at the offered wage \( w^\Delta \), \( V_L(w^\Delta, y) \geq V_H(w^\Delta) \). In Appendix A we show that a worker would buy the coverage offered if the wage received \( w^\Delta \) is larger than a threshold \( \tilde{w} \).

**Finding reservation wages:** In principle, we could have four types of job-to-job transitions to consider (two kinds of transition between companies of different types, two kinds between companies of the same type.). However, it is trivial that the reservation wage for transitions between jobs at the same type of firm is simply the present wage, i.e.

\[ R_i(w_i) = w_i. \]

When we consider the transition between different types of firms, the following simple result simplifies the problem.

**Lemma 1** Given that \( V_i(w) \) is continuous and strictly increasing in \( w \) for both \( i = L, H \), for a wage \( x \) at a no health-coverage firm, and a wage \( y \) at a firm with health-coverage, the following should hold

\[ R^L_H(y) = x \iff R^H_L(x) = y. \]

Hence, we can find a function \( \omega^* \), such that for \( x = \omega^*(y) \),

\[ R^L_H(y) = \omega^*(y), \text{ and } R^H_L(x) = \omega^{-1}(x) \]

The function \( \omega^* \) is continuous and strictly increasing.

In Appendix B, we show that \( \omega^*(w) > w \), i.e. that the function \( \omega^*(\cdot) \) is above the 45 degree line, as well as that \( \frac{d\omega^*(w)}{dw} > 1 \), for every wage above the threshold \( \tilde{w} \). These properties not only imply that all wages can be rescaled into ‘health-coverage firm equivalent’ wages without loss of generality\(^7\), but they also show that workers will ask a wage premium to work in a company that does not offer health coverage (\( \omega^*(w) > w \)) and this premium is increasing with the wage rate (\( \frac{d\omega^*(w)}{dw} > 1 \)).

Since by definition, \( w_H \) and \( w_L = \omega^{-1}(w_H) \) have the same utility values, we can also replace \( V_H(w_H) \) by \( V_L(\omega^{-1}(w_H)) \) in the integrals of the value function, and integrate over the cumulative

\(^6\)A particular case of the result above is \( R^H_L(R^L_H) = R^H_L \)

\(^7\)Of course, we alternatively could rescale all solid wages into risky firm equivalents.
distribution of low-risk firm equivalent wages in the economy, $F(z)$ (notice the absence of the subscript!), which we define as follows:

$$F(z) = \gamma_L F_L(z) + (1 - \gamma_L) F_H(\omega^*(z))$$

Once we have this adjustment, the only thing that matters for the worker’s decision is the wage level in terms of ‘health-coverage firm equivalent’ terms.

### 3.2 Firm’s Problem

In this section, we take the behavior of workers as given, and derive the firms’ optimal response. Firms post wages that maximize their profits taking as given the distribution of wages posted by their competitors ($F_i(w)$, $i \in \{H, L\}$) and the distribution of wages healthy employed workers are currently earning at other firms, given by distributions $G_i(w)$, $i \in \{H, L\}$. We will assume here that all distributions are stationary and well-behaved.

As we saw previously, a worker’s decision only depends on whether an offer is higher in terms of equivalent wage to health coverage firms. Therefore, we can construct a cumulative distribution of employed workers’ equivalent-wages as follows:

$$G(w) = (1 - v_H) G_L(w) + v_H G_H(\omega^*(w))$$

where $v_H$ is the proportion of healthy employed workers in no health-coverage companies.

When a firm is choosing the optimal wage level, it has to take in consideration the amount of active workers they can attract at any given wage. For this reason, before we analyze the firm’s wage decision, let’s derive the firm’s labor force:

$$\frac{dl_i(w)}{dt} = \lambda_0 u + \lambda_1 G(w)(m - u - s_e - s_u) + \rho_i d_i(w) - [\delta + \pi_i + \lambda_1 (1 - F(w))] l_i(w)$$

where $d_i(w)$ is the amount of sick workers the firm keeps in any given period, while $u$, $s_e$, $s_u$ is the measure of healthy unemployed workers, sick employed workers and sick unemployed workers in the economy, respectively. Therefore, every period a firm receives an inflow of unemployed workers at rate $\lambda_0$, an inflow of currently employed workers at rate $\lambda_1 G(w)$, and an inflow coming from previously sick employees at rate $\rho_i$. Similarly, every period it loses worker at rate $\delta$ to unemployment, $\lambda_1 (1 - F(w))$ to other firms and $\pi_i$ to sickness. Since in steady state we have $\frac{dl_i(w)}{dt} = 0$, we have, after substituting $d_i(w)$:

$$l_i(w) = \frac{\lambda_0 u + \lambda_1 G(w)(m - u - s_e - s_u)}{\delta + \lambda_1 (1 - F(w)) + \frac{\delta s_e}{\rho_i + \delta_S} \pi_i} \tag{★}$$

where $i \in \{H, L\}$. 

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Note that the steady state amounts of workers are different, even when equivalent wages are offered, because of different outflows into sickness. Since \( \pi_H \geq \pi_L \) and \( \rho_L \geq \rho_H \), with at least one inequality strict, \( l_L > l_H \) at any ‘health-coverage firm equivalent’ wage. In terms of the total amount of sick workers kept, the result is ambiguous, although we know that companies that offer health coverage keeps a smaller fraction of its labor force in sick leave at any period in time. For any wage offered lower than \( R^*_i \), \( l_i(w) = 0 \). As is standard in on-the-job search models build, we focus on the maximization of steady state profits\(^8\).

**Profit Maximization** In the equilibrium every wage in distributions \( F_L, F_H \) must be optimal: this means necessarily that all wages offered by firms of the same type must yield the same profit. Thus, for a health coverage firm’s maximization, the following must be true in equilibrium

\[
\pi_L = \max_w (p - w) l_L(w) - \alpha wd_L(w) - C, \quad \text{given } F(w), G(w),
\]

\( F_L(w) \subseteq \{ w' | w' \in \arg \max (p - w) l_L(w) - \alpha wd_L(w) - C \} \).

And, for a firm that does not offer health coverage:

\[
\pi_H = \max_w (p - \omega^* (w)) l_H(w) - \alpha \omega^* (w) d_H(w) \quad \text{given } F(w), G(w),
\]

\( F_H(\omega^*(w)) \subseteq \{ \omega^*(w') | w' = \arg \max (p - \omega^* (w)) l_H(w) - \alpha \omega^* (w) d_H(w) \} \).

However, we do not know yet how the distributions \( F(w), F_L(w_L), F_H(w_H) \) look like. All we know at this stage is that in the equilibrium, every equivalent-wage in the support of \( F(w) \) must be offered by either a firm offering or not offering health coverage.

To construct the wage offer (firm wage) distributions, we need to know more than just this. The next proposition will help us by telling what kind of wages each type of firm is offering. In the process, it will already tell us more about compensating differentials.

But before that, let’s present formally the result previously mentioned that no firm that offer health-coverage will offer a wage below \( \tilde{w} \).

**Lemma 4** Any firm that pays the up-front cost \( C \) will offer a wage that induces the workers to buy join the health insurance plan.

Now we are ready to present the result that allow us to pin down the wage distributions:

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\(^8\)See Coles (2001) for a discussion of this focus
Theorem 1  Suppose that \( w_L \) and \( w_H \) are profit maximizing equivalent-wages offered in equilibrium by firms providing and not providing health insurance, respectively. For these wages it holds that

\[
w_L \in \arg \max_w \left\{ (p - w) l_L(w) - \omega d_L(w) - C \right\}, \quad w_H \in \arg \max_w \left\{ (p - \omega^*(w)) l_H(w) - \omega^* d_H(w) \right\}
\]

Then, we must have \( w_L \geq w_H \). Moreover, the sets of equivalent-wages offered by health-coverage firms, and likewise by no health-coverage firms, are connected sets.

The importance of this proposition is that it shows that the compensating wage differentials demanded by the worker for an increase in health risk are not ‘supplied’ by the other side of the market. In the labor market equilibrium, firms which not provide health insurance cannot profitably compete in wages with firms providing it, especially when the required compensating differential becomes large. As a result, they prefer to make more profit per worker and to keep this worker for a short period than to pay higher wage rates and have the risk to exogenously lose the worker right away. Firms offering health insurance on the other hand, pay higher wages to attract and keep the workers for a longer period since they have already invested in health insurance to keep them healthy and therefore more productive.

An important last remark is that since all firms are identical at the beginning of each period, they all must have the same profit, otherwise either all firms will invest in health insurance or no firm will invest in it. Therefore, the fraction of firms not investing in health insurance \( \gamma_H \) is endogenously determined by the following equal profit condition. For any wages \( w_L \) and \( w_H \) offered in equilibrium by firms offering and not offering health coverage, respectively, we have:

\[
\pi_L = \left( p - \left[ 1 + \frac{\alpha \pi_L}{\rho_L + \delta_S} \right] w_L \right) l_L(w_L) - C = \left( p - \left[ 1 + \frac{\alpha \pi_H}{\rho_H + \delta_S} \right] w_H \right) l_H(w_H) = \pi_H
\]

Clearly, depending on the parameters, we may have three possible outcomes:

1.) All firms offer health insurance;
2.) No firm offers health insurance;
3.) A fraction \( (1 - \gamma_H) \in (0, 1) \) offers health insurance.

As expected, in the next section, our discussion will focus in the third case.

We are now ready to define the steady state equilibrium formally:

Definition 1  A steady state equilibrium in the labor market is a tuple \( \{ R^H_U, \omega^*(\cdot), F_L(\cdot), F_H(\cdot), G_L(\cdot), G_H(\cdot), u, s_e, s_u, \gamma_H \} \), such that

1. Given \( \{ F_L, F_H \} \), \( R^H_U \), \( \omega^* \) follow from worker’s optimization

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2. Given \( \{F_L, F_H, G_L, G_H, u, s_e, s_u, R_U^H, \omega^*\} \) firms maximize; for every \( w_L \in F_L \), it holds that 
\[
\pi_L = \left( p - \left[ 1 + \frac{\alpha_L}{\rho_L + \delta_S} \right] w_L \right) t_L(w_L) - C, \quad \text{while for every} \quad w_L \notin F_L \Rightarrow \pi_L \geq \left( p - \left[ 1 + \frac{\alpha_L}{\rho_L + \delta_S} \right] w_L \right) t_L(w_L) - C, \]
where \( t_L(w_L) \) is given by (★), and \( F(w), G(w) \) are derived according to their definition. Similar condition for \( w_H \).

3. \( G_L, G_H \) are stationary distributions, \( u \) is stationary unemployment for healthy workers, \( s_e \) is stationary measure of sick employees, \( s_u \) is stationary measure of sick unemployed workers, given the optimal decisions of workers in (i), and firms in (ii);

The first two items have been covered in the last two sections. We can show existence and characterize the equilibrium by using the results presented up to now to construct stationary distributions, in particular those in (iii), and find the unemployment rate, as well as the measure of sick workers employed and unemployed.

In Appendix C, we explicitly characterize these equilibrium distributions (and outline the existence of a steady state equilibrium by construction, in the process.).

4 **Discussion and Policy Analysis**

The benefits of an equilibrium analysis is that it possibilities us to analyze the impact of changes in policy, while taking into account the overall effect and potential externalities of such measure. In this section, we present some policy exercises in order to evaluate the impact of changes in health costs and health treatments (preventive vs. curative) on relevant endogenous variables, such as the measure of firms offering health coverage, the measure of workers with health coverage, measure of sick workers in steady state, and unemployment.

We calibrated the parameters in our model according to the data for the American economy in 2004. The unit of time we will consider is 1 month. First of all, labor product \( p \) is obtained from the output per worker provided by the Bureau of Economic Analysis (BEA) through the Survey of Current Business for 2004\(^9\). Unemployed benefits \( b \) are set to 36% of monthly average wage, which is the national average according to the National Employment Law Center. The measure of worker relative to the number of firms, \( m \), is obtained from the 2004 Census, by dividing the total number of employer firm by the number of paid employees. For the labor-market arrival rates, we use the estimates by Jolivet et. al. (2002), based on data from the Panel Study of Income Dynamics (PSID) for 1994-1997. The probabilities of getting sick and healing were derived from our estimates of number of days lost using the MEPS dataset described in the next section. Cost of health insurance is pin down

\(^9\)We also calculated \( p \) as the GDP per employed worker for 2004, which gave us similar qualitative results.
by taking into account the 2004 average premium of an individual health insurance plan reported by the Kaiser Family Foundation. Finally, the disutility of getting sick is determined by the average cost of health services in the MEPS data set. The calibrated parameters are presented in the table below:

<table>
<thead>
<tr>
<th>Calibration</th>
</tr>
</thead>
<tbody>
<tr>
<td>$p$</td>
</tr>
<tr>
<td>7477</td>
</tr>
</tbody>
</table>

The model does a reasonably good job matching the measure of firms offering health insurance in equilibrium and the measure of workers with health insurance in equilibrium. The model underestimates the percentage of workers unemployed in equilibrium, although this is probably related to a problem with the PSID as presented by Brown et. al. (1996). Wages are also higher than the expected. One potential issue here is that the PSID has been criticized of having noisy and often inconsistent measures of job turnover, which result from questions on job tenure that are somewhat ambiguous. In order to overcome that criticism, we present in Appendix D the results of a calibration in which the labor-market arrival rates are derived from the NLSY by Bowlus, Kiefer, and Neumann (1995) with results that are qualitatively similar.

Let's start considering the impact of rising health insurance costs on the measure of firms that offer coverage in equilibrium. This is initially tricky once the cost is divided among firm and employees. According to Buchmueller and Monheit (2009), the share of premiums paid directly by employees has remained constant over the past decade at around 15 percent for single coverage and 25 percent for family coverage. Therefore, we will assume that the worker pays 20 percent of the cost while the company pays the rest of it. The graph below summarizes our results:

---

10 This probability is hard to pin down from the data. We tried several values and it does not change the results significantly.

11 Brown and Light (1992) show that the coefficients from probit estimation using PSID turnover measures as the dependent variable are quite sensitive, both in sign and magnitude, to how one cleans the data.
As we can see, an increase in health insurance costs reduces steeply the fraction of firms offering health coverage in equilibrium. Since firms offering health coverage tend to be larger in equilibrium, the reduction in health coverage among workers is not as pronounced, but it is still significant. As expected, both the measure of workers’ sick and unemployed in steady state go up\(^\text{12}\).

Considering an increase in 10% of the health insurance premium, while keeping the share paid by employee and firm constant, we have the following result, where the first column represents the values of the current calibration:

<table>
<thead>
<tr>
<th>Benchmark</th>
<th>Higher Premium</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 - (\gamma_H)</td>
<td>0.4482</td>
</tr>
<tr>
<td>1 - (v_H)</td>
<td>0.7359</td>
</tr>
<tr>
<td>(\frac{(s_e + s_u)}{m})</td>
<td>0.0114</td>
</tr>
<tr>
<td>(\frac{s_e}{m})</td>
<td>0.01071</td>
</tr>
<tr>
<td>(\frac{u}{m})</td>
<td>0.031462</td>
</tr>
</tbody>
</table>

Therefore, an increase in 10% in the price of health insurance generates a reduction in health coverage of 11.65%, as well as an increase in the measure of sick workers in steady state by 6.14%.

Another interesting topic is to evaluate which would be the better health insurance coverage, one that reduces the probability a worker gets sick (preventive medicine - reduction in \(\pi\)) or one that reduces the time a worker stays sick (curative medicine - reduction in \(\rho\)).

Let’s consider initially the case of preventive medicine. The impact of changing the probability a worker gets sick by having health insurance on \(1 - \gamma_H\), \(1 - v_H\), \(s_e + s_u\) and \(u\) as a fraction of \(m\) is given below:

\(^{12}\)This results are qualitatively independent from \(\delta_s > \delta\).
A similar exercise to evaluate curative medicine gives us the following graphs:

Although this is not a conclusive exercise, it seems that preventive medicine has a bigger impact than curative one. In order to further investigate the impact of investments in preventive versus curative medicine, let’s consider the following exercise: Let’s assume that the government has as its main goals to reduce the measure of workers sick, as well as increase the measure of workers with health insurance. In order to achieve such goal the government can invest a given amount on scientific advances on preventive or curative medicine. This investment can reduce the probability a worker gets sick or increase the probability that he or she recovers once sick in 10%. Considering that only workers with health insurance could benefit from the medical advance, which choice would be the best? The following table compares the results of both cases to the benchmark calibrated model:
<table>
<thead>
<tr>
<th></th>
<th>Benchmark</th>
<th>Preventive</th>
<th>Curative</th>
</tr>
</thead>
<tbody>
<tr>
<td>$1 - \gamma_H$</td>
<td>0.4482</td>
<td>0.4623</td>
<td>0.4610</td>
</tr>
<tr>
<td>$1 - v_H$</td>
<td>0.7359</td>
<td>0.7471</td>
<td>0.7461</td>
</tr>
<tr>
<td>$\frac{(s_u + s_w)}{m}$</td>
<td>0.0114</td>
<td>0.01077</td>
<td>0.01083</td>
</tr>
<tr>
<td>$\frac{u}{m}$</td>
<td>0.0315</td>
<td>0.031442</td>
<td>0.031443</td>
</tr>
</tbody>
</table>

As expected, even though both investments have a positive impact, the preventive medicine has a higher impact than curative one. From the results above, we can see that choosing to invest on Preventive instead of Curative represents a gain of 13.4% in health coverage and a reduction of 5.53% in the number of sick workers in steady state. Another important result that we would like to emphasize is that a more efficient health treatment - preventive or curative - increases the probability a firm will offer health insurance as well as the probability a worker holds health insurance, even without any other external force pushing in that direction (such as tax benefits or other kinds of incentives).

Clearly, this is just a first step in this topic. Natural extensions of this exercise need to consider differences in cost of investments, as well as differences in cost of treatments in both cases, as well as a deeper discussion of social welfare.

5 Data and Summary Statistics

The data used for this paper come from the Household Component of the Medical Expenditure Panel Survey (MEPS). The MEPS HC is a nationally representative survey of the U.S. civilian non-institutionalized population. The MEPS-HC collects data from a sample of households through an overlapping panel design. Every year a new sample of households is selected to compose a new panel. Five rounds of interviews take place over a two and a half year period to collect the panel data. The purpose of this design is to provide continuous and current estimates of health care expenditures at both the person and household level for two panels for each calendar year.

The data used in this paper was collected from 2000 to 2007, that is, we are using information from panel 5 to panel 10. Under all these household surveys, 117,994 individuals were interviewed about demographic characteristics, health conditions, health status, access to care, satisfaction with care, health insurance coverage, income, and employment. Since our main focus here is to estimate the impact of health insurance on missing working days, we only consider employed individuals whose

---

13 The MEPS sampling frame reflects an oversample of minority groups such as blacks, Asians and Hispanics. MEPS also oversamples additional policy relevant sub-groups such as low income households.
Table I. Variable definitions and summary statistics

<table>
<thead>
<tr>
<th>Variable</th>
<th>Definition</th>
<th>Mean</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>DDNWRK</td>
<td># Days Missed Work Due Illness</td>
<td>1.730777</td>
<td>5.951099</td>
</tr>
<tr>
<td>WKINBD</td>
<td># Days Missed Work Stayed In Bed</td>
<td>3.340316</td>
<td>8.085312</td>
</tr>
<tr>
<td>HELD</td>
<td>=1 if Held Health Insurance</td>
<td>0.60141</td>
<td>0.489824</td>
</tr>
<tr>
<td>FAMSY</td>
<td>Family Size Of Responding</td>
<td>3.264459</td>
<td>1.640253</td>
</tr>
<tr>
<td>TTLPY</td>
<td>Person’s Total Income</td>
<td>33723.52</td>
<td>28607.87</td>
</tr>
<tr>
<td>MALE</td>
<td>=1 if Male</td>
<td>1.489801</td>
<td>0.499902</td>
</tr>
<tr>
<td>NUMEMP</td>
<td># of Employees in the worker's firm</td>
<td>153.45</td>
<td>185.544</td>
</tr>
<tr>
<td>AGE</td>
<td>Age In Years</td>
<td>42.64884</td>
<td>10.46273</td>
</tr>
<tr>
<td>UNION</td>
<td>=1 if Part of Union</td>
<td>0.187172</td>
<td>0.334409</td>
</tr>
<tr>
<td>ADSMOK</td>
<td>=1 if Smoke</td>
<td>0.230759</td>
<td>0.421328</td>
</tr>
<tr>
<td>PRIMARY</td>
<td>=1 if Mining or Natural Resources</td>
<td>0.003153</td>
<td>0.056059</td>
</tr>
<tr>
<td>SECONDARY</td>
<td>=1 if Construction or Manufacturing</td>
<td>0.030505</td>
<td>0.171975</td>
</tr>
<tr>
<td>TERCIAKY</td>
<td>=1 if Whole Sale and Retail Trade, Information, Health, Financial Services, Education and Other Services</td>
<td>0.109597</td>
<td>0.31239</td>
</tr>
<tr>
<td>REGION</td>
<td>Census Region</td>
<td>2.719768</td>
<td>1.08332</td>
</tr>
<tr>
<td>PCS</td>
<td>SAC: PHY COMPONENT SUMMARY</td>
<td>319.1634</td>
<td>78.38524</td>
</tr>
<tr>
<td>SICPAY</td>
<td>=1 if Paid Sick Leave</td>
<td>0.819146</td>
<td>1.539259</td>
</tr>
<tr>
<td>RTHLTHP</td>
<td>Perceived Health Status</td>
<td>0.914217</td>
<td>0.280063</td>
</tr>
<tr>
<td>ADINSA</td>
<td>SAC: DO NOT NEED HEALTH INSURANCE</td>
<td>0.85326</td>
<td>0.308786</td>
</tr>
<tr>
<td>ADINSB</td>
<td>SAC: HEALTH INSURANCE NOT WORTH COST</td>
<td>0.729832</td>
<td>0.44406</td>
</tr>
<tr>
<td>ADOVER</td>
<td>SAC: CAN OVERCOME ILLS WITHOUT MED HELP</td>
<td>0.75863</td>
<td>0.289882</td>
</tr>
<tr>
<td>OFREEMP</td>
<td>=1 if Health Insurance Offered</td>
<td>0.760135</td>
<td>0.427016</td>
</tr>
<tr>
<td>EDUCYR</td>
<td>YEARS OF EDUC WHEN FIRST ENTERED MEPS</td>
<td>3.371425</td>
<td>1.593687</td>
</tr>
</tbody>
</table>

Ages are between 18 and 65. After adjusting the sample with these requirements 43,140 data points are left.

We use two different variables measuring missing working days: missing working days due to illness (DDNWRK), and days missed work stayed in bed (WKNBID). Means and standard deviations of these variables are presented in Table I. Definitions and summary statistics for the explanatory variables are presented in Table I. The health measures include Physical Component Summary (PCS) scores formed from the answers to the Short-Form 12 questions, if the individual currently holds a health insurance (HELD), if receives sick leave (SICPAY) if the individual smoke (ADSMOK). The demographic variables include AGE, race (BLACK), sex (MALE), marital status (MARRIED), family size (FAMSY) and education (SCHOOL). The economic variables are if the individual is part of an union (UNION), the sector worked (PRIMARY, SECONDARY and TERCIAKY) and firm size (NUMEMP). Finally, since we account for the endogeneity problem of health insurance, as an explanatory variable for # days missed work, we are using some variables as instruments for health insurance. The main variables used as instruments for health insurance were family income (TTLPY), if it was offered health insurance to the individual (OFREEMP) and some questionnaires about the how the individual value health insurance: If you do not need Health Insurance (ADINSA), if you think that health insurance not worth cost (ADINSB) and if you can overcome ills without medical help (ADOVER).
5.1 Econometric Specification

The main goal of this section is to test a crucial hypothesis implicitly assumed in our paper, which is: If a worker holds health insurance, then she is going to miss less working days due to illness compared with a worker with similar characteristics but who is not covered by insurance. The decision to miss a working day can be treated within the random utility framework used in binary choice models. Denote by $U_{0i}$ the utility of not missing a working day while sick, while $U_{1i}$ is the utility of missing a working day. Let $U_0 = x_i'\beta_0 + \varepsilon_{0i}$ and $U_1 = x_i'\beta_1 + \varepsilon_{1i}$ where $x_i$ is a vector of covariates important to explain the number of days missed work and $\varepsilon_{ij}$ are random errors. Thus, If an individual misses an working day, we know that:

$$U_{1i} > U_{0i} \rightarrow \pi_{10} < x_i'(\beta_1 - \beta_0),$$

where $\pi_{10} = \Pr[\varepsilon_{0i} - \varepsilon_{1i}]$. Therefore, the decision to miss a working day can be represented by a Binomial Model. This is the model which motivates the Poisson econometric specification used in this section. Formally, let $X$ be the number of successes in a large number of $N$ independent Bernoulli trials with success probability $\pi_{10}$ of each trial being small. Then it is a well-known result that as $N \rightarrow \infty$ and $\pi_{10} \rightarrow 0$, and $N\pi_{10} = \mu > 0$, then this Binomial distribution function converges to a Poisson distribution function with parameter $\mu$. The above assertion is an application of a well-known argument used to justify the framework of count data models for the study of medical care utilization based on event counts. Here a day missed work is treated in the same way as a doctor consultation. This model can be generalized in a straightforward manner to allow for unobserved heterogeneity which will imply an overdispersed count model like the negative binomial. We provide empirical evidence suggesting overdispersion of number of days missed work due illness, and for this reason this article also analyzes the negative binomial family as the main specification.

5.1.1 Negative Binomial Specification

Let $y_i$ denote the number of days missed work due illness, which is obviously a count variable that takes non-negative integers values. The density function for the negative binomial (NB) model is given by:

$$\Pr[Y = m_i | \gamma, \lambda] = \frac{\Gamma(m_i + \gamma_i)}{\Gamma(\gamma_i)\Gamma(m_i + 1)} \left( \frac{\gamma_i}{\lambda_i + \gamma_i} \right)^{\phi_i} \left( \frac{\lambda_i}{\lambda_i + \gamma_i} \right)^{y_i},$$

where

$$\lambda_i = \exp(x_i'\beta)$$

18
and the precision parameter is given by:

$$\gamma_i = (1/\alpha)\lambda$$

where $\alpha$ is an overdispersion parameter. As a result of this specification, we have:

$$E(y_i|x_i) = \lambda_i$$

and

$$V(y_i|x_i) = \lambda_i(1 + \alpha)$$

this model is called negative binomial-1 (NB1) model.

5.1.2 Estimation Procedure

In the next session we present some empirical support for our hypothesis that if a worker holds health insurance, then she misses less working days. We account for the possible endogeneity of health insurance, since we could imagine that health insurance was only offered to healthy people, who naturally miss less working days. To deal with this problem, we will estimate our regression using a two-step procedure.

Let $m_i$ denotes the number of days missed work. We are assuming that $m_i$ follows a NB distribution in eq. (3). Then we know that:

$$\mu_i = E(m_i|h_i, x_i, u_i) = \exp(\beta_1 h_i + x_1^i \beta_2 + u_i)$$

(4)

Then, it is assumed that the error term $u_i$ is correlated with the dummy variable $h_i$ that assumes the value 1 when a worker holds health insurance. We also assume that the error term $u_i$ is uncorrelated with $x_i$, which is a vector of exogenous regressors.

In order to solve this endogeneity problem, we need to find instruments for the health insurance variable $h_i$. Hence, we specify a probit equation for the dummy variable $h_i$:

$$Pr[h_i = 1|x_{2i}] = \Phi(x'_{2i})$$

(5)

where $x_{2i}$ is a vector which may include some variables which affect days missed work, but also contains some variables which affect the probability of health insurance but only affect days missed work through $h_i$. Similarly as the linear case, a condition for a robust identification of eq. (4) is that there is available at least one valid excluded variable (instrument).
We also assume that there is a common latent factor \( \varepsilon \) which affects both \( h_i \) and \( m_i \) and this is the only source of dependence between them, after controlling for the influence of the observable variables \( x_1 \) and \( x_2 \). We can model this assumption as follows:

\[
u_i = \rho \varepsilon_i + v_i
\]

where \( v_i \) is independent on \( \varepsilon_i \).

Using this additional assumption, it is possible to show that:

\[
\mu_i = E(m_i|h_i, x_i, u_i) = \exp(\beta_1 h_i + x_0' \beta_2 + \rho \varepsilon_i)
\]  

(6)

If \( \varepsilon_i \) were observable, we could just include it as an additional regressor and this would solve the endogeneity problem. Since we cannot observe it, we replace it by a consistent estimate. Therefore, the first step of our estimation is to estimate eq. (5) and obtain the residuals \( \hat{e}_i \). Then we estimate the parameters of the negative binomial given in eq. (6) by replacing \( \varepsilon_i \) by \( \hat{e}_i \).

### 5.2 Results

Tables 2 and 3 report the results of our estimation procedure using different models and explanatory variables. To check consistency of our estimation, we not only estimate the Negative Binomial model, but also estimate a Poisson model with a robust standard error estimate\(^{14}\). In the first two tables, we have used an OLS estimator for health insurance in the first step of our procedure. In the table 3, we have used a Probit model in the first step, as described above. We use income as an instrumental variable for health insurance. We also used other variables which try to measure how the worker evaluate the importance of health insurance, assuming that if she thinks that the insurance does not worth its cost, then the probability to have health insurance is lower. Once results were similar, we omitted those tables.

Before we start discussing the empirical results, it is important to notice that the overdispersion parameter alpha was always significant, indicating that our data is characterized by overdispersion. This support our choice of the Negative Binomial density distribution as our main model framework. We are mainly interested in the health coefficient, we have assumed that this coefficient is negative, that is, a worker who holds health insurance misses less days than a worker who does not have this insurance. In all specifications showed below, we found a negative and statistically significant coefficient for health. The Poisson and Binomial Negative models have similar coefficients for all specifications used. In all

\(^{14}\)When the data is characterized by overdispersion, we need to use a bootstrap method to compute robust standard errors for the Poisson model.
specifications this coefficient is in similar magnitude. So we believe that our empirical results here support our main paper hypothesis, which we use to derive the main model predictions.

Most of the other explanatory variables had the expected signal. The PC2 is an index measuring the worker health\(^{15}\), in almost all specifications its coefficients was negative, indicating that a healthier worker loses less working days. After we control for these health indexes, the variable indicating if the worker smokes is not significant for several of our model specifications. Family size has a negative impact too, which is expected once workers that have families tend to have more healthy habits than single workers. The results also show that males miss less working days than females. We didn’t find any impact of age in days of work missed, which tells us that age must be a proxy for other already controlled variables, as worker’s health conditions. We have used dummy variables indicating different economic activity sectors. We could not find a significant impact of secondary industries on days missed work. However, the dummy for tertiary industries, whenever it was statistically significant, was always negative, demonstrating that workers employed in this economic activity sector have a higher absence rate than the ones employed in other sectors. Finally, as indicated in Barmby and Stephan (2000), there is a positive relationship between absence and firm size.

6 Concluding Remarks

In this paper, we showed that health coverage has a positive impact on labor productivity, by reducing the number of sick days a worker needs to take. Our empirical results using data from the Medical Expenditure Panel Survey (MEPS) show that a worker with health coverage misses on average 3.65 workdays per year less than workers without health coverage. By introducing this productivity edge on a on-the-job search model in which employers post not only wages but also if they offer health coverage or not, we obtain in equilibrium that firms offering health coverage are bigger and offer higher wages on average. These results are also corroborated by our empirical findings with the MEPS: Increases in firm size as well as wages augment the probability of a worker having health insurance coverage, being these variables more important than other worker specific characteristics, as previous general health condition or health habits or addictions.

Once we calibrate the model using US data for 2004, we are able to evaluate a series of changes in the sector: We show that an increase in 10\% on health insurance premium reduces the proportion of workers with health coverage by 11.65\%, as well as an increase in the number of workers sick in steady state by 6.14\%. Finally, we study the difference in impact of improvements on preventive versus

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\(^{15}\)Physical Component Summary (PCS) scores formed from the answers to the Short-Form 12 questionnaire, which is a self-administered questionnaire (SAQ) designed to collect a variety of health status and health care quality measures from adults.
curative care. We consider the case of an governmental investment on medical research that make preventive methods 10% more efficient and compare that to the case in which such investment was made to improve curative methods (again, method becomes 10% more efficient). Our results show that, even though both medical advances have positive impacts, choosing to invest on Preventive instead of Curative represents a gain of 13.4% in labor force’s health coverage and a reduction of 5.53% in the number of sick workers in steady state.
Table 2

**First step regression: Linear Regression**

<table>
<thead>
<tr>
<th></th>
<th>famsy1</th>
<th>ttlpylx</th>
<th>male</th>
<th>firm size</th>
<th>age</th>
<th>age²</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Held</strong></td>
<td>-.03400</td>
<td>0.0000</td>
<td>0.02768</td>
<td>.00057</td>
<td>.01965</td>
<td>-.00021</td>
</tr>
<tr>
<td></td>
<td>(.00278)</td>
<td>(.00000)</td>
<td>(.008625)</td>
<td>(.000024)</td>
<td>(.0037)</td>
<td>(.00004)</td>
</tr>
</tbody>
</table>

1. St. Error in parenthesis

**Second Step: Bootstrapped Errors**

<table>
<thead>
<tr>
<th></th>
<th>Held</th>
<th>pcs2</th>
<th>famsy1</th>
<th>male</th>
<th>firm size</th>
<th>age</th>
<th>age²</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Held</strong></td>
<td>-1.6772</td>
<td>-.06828</td>
<td>-0.1146</td>
<td>-.39781</td>
<td>.00172</td>
<td>.026904</td>
<td>.0000347</td>
</tr>
<tr>
<td></td>
<td>(.49912)</td>
<td>(.003446)</td>
<td>(.01447)</td>
<td>(.06644)</td>
<td>(.000347)</td>
<td>(.02563)</td>
<td>(.0000347)</td>
</tr>
<tr>
<td><strong>pcs2</strong></td>
<td>-1.82218</td>
<td>-0.07145</td>
<td>-0.0731</td>
<td>-0.2237</td>
<td>0.00191</td>
<td>0.03598</td>
<td>0.003128</td>
</tr>
<tr>
<td></td>
<td>(.58221)</td>
<td>(.00401)</td>
<td>(.03339)</td>
<td>(.08248)</td>
<td>(.00401)</td>
<td>(.03128)</td>
<td>(.00401)</td>
</tr>
<tr>
<td><strong>famsy1</strong></td>
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<td>-.0130494</td>
<td>-.2124</td>
<td>-.6925</td>
<td>.001225</td>
<td>.0223311</td>
<td>.000016</td>
</tr>
<tr>
<td></td>
<td>(.58221)</td>
<td>(.00225)</td>
<td>(.01225)</td>
<td>(.0223311)</td>
<td>(.00225)</td>
<td>(.000016)</td>
<td>(.00225)</td>
</tr>
<tr>
<td><strong>male</strong></td>
<td>-1.6069</td>
<td>-1.3697</td>
<td>-0.1403</td>
<td>-0.3891</td>
<td>.001225</td>
<td>.0223311</td>
<td>.000016</td>
</tr>
<tr>
<td></td>
<td>(.4554)</td>
<td>(.00255)</td>
<td>(.01488)</td>
<td>(.02922)</td>
<td>(.00255)</td>
<td>(.000016)</td>
<td>(.00255)</td>
</tr>
<tr>
<td><strong>firm size</strong></td>
<td>-1.5539</td>
<td>-.0130494</td>
<td>-.2124</td>
<td>-.6925</td>
<td>.001225</td>
<td>.0223311</td>
<td>.000016</td>
</tr>
<tr>
<td></td>
<td>(.4554)</td>
<td>(.00255)</td>
<td>(.01488)</td>
<td>(.02922)</td>
<td>(.00255)</td>
<td>(.000016)</td>
<td>(.00255)</td>
</tr>
<tr>
<td><strong>age</strong></td>
<td>-0.0514</td>
<td>0.06899</td>
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1. St. Error in parenthesis
### Table 3

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1. St. Errors in parenthesis

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1. Bootstrapped St. Errors in parenthesis

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1. St. Error in parenthesis
7 References


Levy, Helen, and David Meltzer. 2001. What do we really know about whether Health Insurance affects Health? Working Paper no. 6, Economic Research Initiative on the Uninsured, University of Michigan, MI.


Appendix A

In this appendix, we look at \( V_L(w) = \max \{ V_L(w, y) ; V_H(w) \} \). A firm would only pay the cost \( C \) if the worker opts to buy insurance. Therefore, we can continue with \( V_L(w, y) \) and \( V_H(w) \) and at the end check that for any wage \( w^{\triangle} \) offered by a company that pays \( C \), \( V_L(w^{\triangle}, y) \geq V_H(w^{\triangle}) \). Given this, assuming that the value functions are increasing in \( w \) (which we are going to check later), we may have a cut off (that could be below zero) \( \bar{w} \), such that for \( w > \bar{w} \), \( V_L(w, y) > V_H(w) \) (this is only true if we have a single crossing condition - i.e., we will need log concavity. We can show by obtaining \( \frac{dV_L(w, y)}{dw} > \frac{dV_H(w)}{dw} \). So, first of all, let’s look at the conditions for the cut off.

First of all, let’s obtain \( \frac{dV_H(w)}{dw} \). Manipulating the integrals and using the result that, by definition \( V_L(R^L_H(w), y) = V_H(w) \), we have that:

\[
\frac{dV_H(w)}{dw} = \left[ 1 + \frac{\alpha \pi_H}{r + \rho_H + \delta_S} \right] \frac{1}{r + \delta + \frac{\pi_H (r + \delta_S)}{r + \rho_H + \delta_S} + \lambda_1 \left[ 1 - F(R^L_H(w)) \right]}
\]

where \( F(\cdot) \) is defined as follows:

\[
F(z) = \gamma_H F_H(R^H_L(z)) + (1 - \gamma_H) F_L(z)
\]

Notice that if \( w > \bar{w} \), we must have \( R^H_L(w) > w \) and \( R^L_H(w) < w \):

\[
V_H(R^H_L(w)) = V_L(w)
\]

and

\[
V_H(w) = V_L(R^L_H(w))
\]

Therefore, if \( R^H_L(w) > w \), for monotonicity of the value functions, we must have \( R^L_H(w) < w \). This implies that:

\[
\lambda_1 \left[ 1 - F(R^L_H(w)) \right] > \lambda_1 \left[ 1 - F(w) \right] , \text{ for any } w > \bar{w}
\]

Now, looking at the derivative for \( V_L(w, y) \), we obtain:

\[
\frac{dV_L(w, y)}{dw} = \left( 1 + \frac{\alpha \pi_L}{r + \rho_L + \delta_S} \right) \frac{1}{r + \delta + \frac{\pi_L (r + \delta_S)}{r + \rho_L + \delta_S} + \lambda_1 (1 - F(w))}
\]

We already know that the last term in the denominator is smaller for \( \frac{dV_L(w, y)}{dw} \). Now, notice that \( \frac{\pi_H}{r + \rho_H + \delta_S} > \frac{\pi_L}{r + \rho_L + \delta_S} \), to consider the impact of the increase in this value, let’s assume that \( x = \frac{\pi}{r + \rho + \delta_S} \)
and to simplify consider the last term in the denominator equals to \( \lambda_1 (1 - F(\bar{w})) \) (this actually helps \( \frac{dV_H(w)}{dw} \)). Then, we have that:

\[
\frac{d}{dx} \left( \frac{1 + \alpha x}{r + \delta + (r + \delta_S) x + \lambda_1 (1 - F(\bar{w}))} \right) = \frac{\alpha (r + \delta + \lambda_1 (1 - F(\bar{w}))) - (r + \delta_S)}{(r + \delta + (r + \delta_S) x + \lambda_1 (1 - F(\bar{w})))^2}
\]

and this is negative if:

\[
\alpha (r + \delta) - (r + \delta_S) < 0 \Rightarrow \alpha < \frac{(r + \delta_S)}{(r + \delta + \lambda_1 (1 - F(\bar{w})))}
\]

Since we assume that \( \alpha \leq \frac{r + \delta_S}{r + \delta + \lambda_1} \), this is always satisfied and we have the single-crossing property that we need.

Therefore, whenever \( \delta_S > \delta \), for any \( w > \bar{w} \), \( \frac{dV_L(w,y)}{dw} > \frac{dV_H(w)}{dw} \). Since \( V_L(\bar{w},y) = V_H(\bar{w}) \Rightarrow V_L(w) = V_L(w,y) \), for \( w > \bar{w} \). This also implies that for \( w > \bar{w} \), \( R_H^L(w) > w \), as we show in the Lemma B.1.

Now, let’s find an implicit expression for \( \bar{w} \). From \( V_L(\bar{w},y) = V_H(\bar{w}) \), we obtain:

\[
c_e = \pi_L (D_L(\bar{w}) - V_L(\bar{w},y)) - \pi_H (D_H(\bar{w}) - V_H(\bar{w}))
\]

Since:

\[
\pi_H (D_H(\bar{w}) - V_H(\bar{w})) = \frac{\pi_H}{r + \delta_S + \rho_H} \{ \alpha \bar{w} - \chi_H - (r + \delta_S) V_H(\bar{w}) + \delta_S D_0 \}
\]

and

\[
\pi_L (D_L(\bar{w}) - V_L(\bar{w},y)) = \frac{\pi_L}{r + \delta_S + \rho_L} \{ \alpha \bar{w} - c_e - \chi_L - (r + \delta_S) V_L(\bar{w},y) + \delta_S D_0 \}
\]

Substituting the terms inside parenthesis, we have:

\[
\left[ 1 + \frac{\pi_L}{r + \delta_S + \rho_L} \right] c_e = \left\{ \left( \frac{\pi_L}{r + \delta_S + \rho_L} - \frac{\pi_H}{r + \delta_S + \rho_H} \right) \left[ \alpha \bar{w} - (r + \delta_S) V_H(\bar{w}) + \delta_S D_0 \right] \right\}
\]

\[
\left. \quad + \frac{\pi_H}{r + \delta_S + \rho_H} \chi_H - \frac{\pi_L}{r + \delta_S + \rho_L} \chi_L \right\}
\]
9 Appendix B

Proof of Lemma 1:

Proof. At the reservation wage $y$ of a move from a solid firm with wage $x$ to a risky firm (i.e. we suppose that $y = R^H_L(x)$), and the reservation wage $R^L_H(y)$ of the reverse transition, it must be the case that

$$V_L(x) = V_H(R^H_L(x)) = V_H(y) = V_L(R^L_H(y)).$$

But then it follows that $R^L_H(y) = x$. Similarly, it follows if $R^L_H(y) = x$, then $R^H_L(x) = y$. By the strict monotonicity of the value functions the mapping $R^L_H(y) = x$ is unique. It is straightforward to see that the resulting function must be continuous and increasing, if the value functions are increasing and continuous. ■

Lemma B.1 $\omega^*(w) > w$.

Proof. From the previous result, we obtain through manipulations that:

from $V_H(R^L_H(w)) = V_L(w)$, we obtain:

$$\omega^*(w) = \frac{1}{1 + \frac{\alpha \pi_H}{r + \delta_S + \rho_L}} \left\{ 1 + \frac{\pi_L}{r + \delta_S + \rho_L} - \frac{\pi_H}{r + \delta_S + \rho_H} \right\} \left\{ \frac{\delta_S}{r + \rho_H} - \frac{\pi_L}{r + \delta_S + \rho_L} \right\}$$

Rearranging the expression obtained for $\omega^*(w)$, we have:

$$\omega^*(w) = w + \frac{\frac{\pi_H}{r + \delta_S + \rho_H} - \frac{\pi_L}{r + \delta_S + \rho_L}}{1 + \frac{\alpha \pi_H}{r + \delta_S + \rho_H}} \left\{ \frac{\alpha \bar{\omega} - \alpha \omega}{(r + \delta_S)(V_L(w, y) - V_H(\bar{w}))} \right\}$$

Rearranging the expressions for $V_L(w, y)$ and $V_H(\bar{w})$, we obtain:

$$V_L(w, y) - V_H(\bar{w}) = \left( 1 + \frac{\alpha \pi_L}{r + \rho_L + \delta_S} \right) \int_{\bar{w}}^{w} \frac{1}{r + \delta + \frac{\pi_L(r + \delta_S)}{r + \delta_S + \rho_L} + \lambda_1 (1 - F(z))} dz$$

$$> \left( 1 + \frac{\alpha \pi_L}{r + \rho_L + \delta_S} \right) \int_{\bar{w}}^{w} \frac{1}{r + \delta + \frac{\pi_L(r + \delta_S)}{r + \delta_S + \rho_L} + \lambda_1 (1 - F(\bar{w}))} dz$$

$$= \frac{\left( 1 + \frac{\alpha \pi_L}{r + \rho_L + \delta_S} \right)}{r + \delta + \frac{\pi_L(r + \delta_S)}{r + \delta_S + \rho_L} + \lambda_1 (1 - F(\bar{w}))} (w - \bar{w})$$

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Therefore, we have:

\[ \omega^* (w) > w + \left( \frac{\pi_H}{r + \rho_H + \delta_S} - \frac{\pi_L}{r + \rho_L + \delta_S} \right) \left\{ \frac{(r + \delta_S) \left( 1 + \frac{\alpha \pi_L}{r + \rho_L + \delta_S} \right)}{r + \delta + \frac{\pi_L (r + \delta_S)}{r + \delta_S + \rho_L} + \lambda_1 (1 - F(w))} - \alpha \right\} (w - \bar{w}) \]

Therefore, if:

\[ \frac{(r + \delta_S) \left( 1 + \frac{\alpha \pi_L}{r + \rho_L + \delta_S} \right)}{r + \delta + \frac{\pi_L (r + \delta_S)}{r + \delta_S + \rho_L} + \lambda_1 (1 - F(w))} > \alpha \]

the second term in the RHS is positive. Rearranging the above inequality, we have:

\[ \alpha < \frac{(r + \delta_S)}{r + \delta + \lambda_1 (1 - F(w))} \]

which is satisfied by \( \alpha \), once \( \alpha \leq \frac{r + \delta_S}{r + \delta + \lambda_1} \). ■

**Lemma B.2** \( \forall w > \bar{w}, \frac{d \omega^*(w)}{d w} > 1. \)

**Proof.**

\[ \omega^* (w) = w + \left( \frac{\pi_H}{r + \rho_H + \delta_S} - \frac{\pi_L}{r + \rho_L + \delta_S} \right) \left\{ \frac{\alpha \bar{w} - \alpha w}{r + \delta + \frac{\pi_L (r + \delta_S)}{r + \delta_S + \rho_L} + \lambda_1 (1 - F(\bar{w}))} + (r + \delta_S) (V_L (w, y) - V_H (\bar{w})) \right\} \]

\[ V_L (w, y) - V_H (\bar{w}) = \left( 1 + \frac{\alpha \pi_L}{r + \rho_L + \delta_S} \right) \int_{\bar{w}}^w \frac{1}{r + \delta + \frac{\pi_L (r + \delta_S)}{r + \delta_S + \rho_L} + \lambda_1 (1 - F(z))} dz \]

Taking the integral, we have:

\[ \frac{d (V_L (w, y) - V_H (\bar{w}))}{d w} = \frac{\left( 1 + \frac{\alpha \pi_L}{r + \rho_L + \delta_S} \right)}{r + \delta + \frac{\pi_L (r + \delta_S)}{r + \delta_S + \rho_L} + \lambda_1 (1 - F(w))} \]

Then:

\[ \frac{d \omega^*(w)}{d w} = 1 + \left( \frac{\pi_H}{r + \rho_H + \delta_S} - \frac{\pi_L}{r + \rho_L + \delta_S} \right) \left\{ \left( \frac{(r + \delta_S) \left( 1 + \frac{\alpha \pi_L}{r + \rho_L + \delta_S} \right)}{r + \delta + \frac{\pi_L (r + \delta_S)}{r + \delta_S + \rho_L} + \lambda_1 (1 - F(w))} - \alpha \right) \right\} \]

The second term is positive if:

\[ \alpha < \frac{(r + \delta_S)}{r + \delta + \lambda_1 (1 - F(w))} \]

Since the RHS of the inequality above is decreasing in \( w \), we have that it is satisfied for any \( w > \bar{w} \) if:
\[ \alpha < \frac{(r + \delta_S)}{r + \delta + \lambda_1 (1 - F(\bar{w}))} \]

Proof of Lemma 4:

**Proof.** Suppose that a firm that pays the upfront \(C\) and offers a wage lower than \(\bar{w}\). As we saw, the worker will not differentiate it from a firm that does not pay the upfront cost, therefore \(\omega^* (w) = w\). Therefore, at the end the number of workers this firm keeps in steady state \(l_H (w)\). Therefore:

\[\pi_L (w) = (p - w) l_H (w) - \alpha w d_H (w) - C = \pi_H (w) - C, \forall w < \bar{w}\]

Therefore, this firm would have a profitable deviation, which would be not pay the upfront cost \(C\) and become a \(H\) firm. ■

Proof of Theorem 1:

**Proof.** Suppose there exists \(w_B, w_A\), such that \(w_B > w_A\), and \(w_B\) is offered by a risky firm while \(w_A\) by a low-risk firm. Then it must be that

\[
(p - \left[1 + \frac{\alpha \pi_H}{\rho_H + \delta_S}\right] \omega^* (w_B)) l_H (w_B) \geq \left(p - \left[1 + \frac{\alpha \pi_H}{\rho_H + \delta_S}\right] \omega^* (w_A)\right) l_H (w_A) \tag{7}
\]

Now, note that:

\[
\frac{l_L (w)}{l_H (w)} = \frac{\delta + \lambda_1 (1 - F(w)) + \frac{\delta \alpha \pi_H}{\rho_H + \delta_S}}{\delta + \lambda_1 (1 - F(w)) + \frac{\delta L \pi_L}{\rho_L + \delta_S}} > 1
\]

Since \(\pi_H > \pi_L\) and \(\rho_L > \rho_H\).

By taking derivatives, we have:

\[
d\left(\frac{l_L (w)}{l_H (w)}\right) = \frac{\lambda_1 F' (w) \delta_S \left[\frac{\pi_H}{\rho_H + \delta_S} - \frac{\pi_L}{\rho_L + \delta_S}\right]}{\left\{\delta + \lambda_1 (1 - F(w)) + \frac{\delta \pi_L}{\rho_L + \delta_S}\right\}^2} > 0
\]

Therefore, this ratio is larger than 1 and increasing. In particular, it follows that:

\[
\frac{l_L (w_B)}{l_L (w_A)} > \frac{l_H (w_B)}{l_H (w_A)} \tag{8}
\]

To study the instantaneous profit per worker, notice:

\[
d\left(\frac{p - \left(1 + \frac{\alpha \pi_L}{\rho_L + \delta_S}\right) \omega^* (w)}{p - \left(1 + \frac{\alpha \pi_H}{\rho_H + \delta_S}\right) \omega^* (w)}\right) = \left\{ - \left(1 + \frac{\alpha \pi_L}{\rho_L + \delta_S}\right) \left(p - \left(1 + \frac{\alpha \pi_H}{\rho_H + \delta_S}\right) \omega^* (w)\right) + \left(1 + \frac{\alpha \pi_H}{\rho_H + \delta_S}\right) \frac{d\omega^* (w)}{dw} \left[p - \left(1 + \frac{\alpha \pi_H}{\rho_H + \delta_S}\right) \omega^* (w)\right] \right\} \frac{p - \left(1 + \frac{\alpha \pi_L}{\rho_L + \delta_S}\right) \omega^* (w)}{\left[p - \left(1 + \frac{\alpha \pi_H}{\rho_H + \delta_S}\right) \omega^* (w)\right]^2}
\]

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Now, for any \( w > \bar{w} \), \( \frac{d\omega^*(w)}{dw} > 1 \), which implies that:

\[
\frac{d}{dw} \left( \frac{p-(1+\frac{\alpha \pi L}{\rho L+\delta_S})w}{p-(1+\frac{\alpha \pi H}{\rho H+\delta_S})\omega^*(w)} \right) > 0
\]

since by Lemma 3, no firm that offers health insurance would offer a wage lower than \( \bar{w} \), there is no loss of generality.

Therefore:

\[
\frac{d}{dw} \left( \frac{p-(1+\frac{\alpha \pi L}{\rho L+\delta_S})w}{p-(1+\frac{\alpha \pi H}{\rho H+\delta_S})\omega^*(w)} \right) > 0
\]

But this means that

\[
\frac{p - w_B}{p - w_A} > \frac{p - \omega^*(w_B)}{p - \omega^*(w_A)}.
\]

Now, putting (8) and (9) together, it follows that (7) implies

\[
\left( p - \left[ 1 + \frac{\alpha \pi L}{\rho L + \delta_S} \right] w_B \right) l_L(w_B) - C \geq \left( p - \left[ 1 + \frac{\alpha \pi L}{\rho L + \delta_S} \right] w_A \right) l_L(w_A) - C,
\]

which contradicts that \( w_A \) was the profit maximizing choice of the solid firm. The connectedness follows (be it a bit loosely formulated here) from the fact that any 'holes' will give an opportunity for a profitable deviation by the next (higher) firm, it can increase instantaneous profit per worker, without losing workers faster, or gaining slower.

**Corollary B.1** The minimum wage posted by a firm that do not offer health insurance is \( R^H_U \), while the minimum wage posted by a firm that offers health insurance is \( \bar{w} \).

**Corollary B.2** There is no mass point in the distribution of offered wages.
10 Appendix C

Using the stationary offer distributions $F_L(w_L), F_H(w_H)$, and the optimal decisions of workers, we can derive the stationary distribution of workers of wages. Employing that all equivalent-wages offered by solid firms are higher, we can derive the stationary risky firm distribution. First, looking at the more general case to, to use derivatives to find the change in the wage distribution $G_L$ over time:

$$\frac{dG_L(w,t)}{dt} = \lambda_0 (1 - \gamma_H) F_L(w,t) u(t) + \lambda_1 (1 - \gamma_H) F_L(w,t) v_H (m - u - s_e - s_u)$$

$$- \left[ \lambda_1 (1 - \gamma_H) (1 - F_L(w,t)) + \delta + \pi_L \right] G_L(w,t) (1 - v_H) (m - s_e - s_u - u)$$

in steady state:

$$G_L(w) = \frac{[\lambda_0 u + \lambda_1 v_H (m - u - s_e - s_u)] (1 - \gamma_H) F_L(w)}{\lambda_1 (1 - \gamma_H) (1 - F_L(w,t))}$$

$$+ \rho_L S_L(w,t) (1 - s_H) s_e$$

while the proportion of sick employees at health-coverage firms working at wage $\leq w$

$$\frac{dS_L(w,t)}{dt} = \pi_L G_L(w,t) (1 - v_H) (m - s_e - s_u - u) - (\delta_s + \rho_L) S_L(w,t) (1 - s_H) s_e$$

in steady state:

$$S_L(w) = \frac{\pi_L G_L(w) (1 - v_H) (m - s_e - s_u - u)}{(\delta_s + \rho_L) (1 - s_H) s_e}$$

Similarly:

$$\frac{dG_H(w,t)}{dt} = \lambda_0 \gamma_H F_H(w,t) u(t) + \rho_H S_H(w,t) s_H s_e$$

$$- \left[ \lambda_1 \gamma_H (1 - F_H(w,t)) + \lambda_1 (1 - \gamma_H) + \delta + \pi_H \right] G_H(w,t) v_H (m - s_e - s_u - u)$$

Since in steady state $\frac{dG_H(w,t)}{dt} = 0$, we have:
\[ G_H (w) = \frac{\lambda_0 \gamma_H F_H (w, t) u (t) + \rho_H S_H (w, t) s_H s_e}{\lambda_1 \gamma_H (1 - F_H (w, t)) + \lambda_1 (1 - \gamma_H) + \delta + \pi_H} v_H (m - s_e - s_u - u) \]

while:

\[ \frac{dS_H (w, t)}{dt} = \pi_H G_H (w, t) v_H (m - s_e - s_u - u) - (\delta_S + \rho_H) S_H (w, t) s_H s_e \]
in steady-state, we have:

\[ S_H (w) = \frac{\pi_H G_H (w, t) v_H (m - s_e - s_u - u)}{\delta_S + \rho_H} s_H s_e \]

To obtain \( F_L (\cdot) \), we use the profit equality condition for all wages offered by companies that supply health insurance:

\[ \left( p - \left[ 1 + \frac{\alpha \pi_L}{\rho_L + \delta_S} \right] w_L^0 \right) \frac{\lambda_0 u + \lambda_1 G (w_L^0) (m - u - s_e - s_u)}{\rho_L + \delta_S + \pi_L} - C = \left( p - \left[ 1 + \frac{\alpha \pi_L}{\rho_L + \delta_S} \right] w_L \right) \frac{\lambda_0 u + \lambda_1 G (w_L) (m - u - s_e - s_u)}{\rho_L + \delta_S + \pi_L} - C \]

where \( F (z) = \gamma_H F_H (\omega^* (z)) + (1 - \gamma_H) F_L (z) \) and \( G (z) = v_H G_H (\omega^* (z)) + (1 - v_H) G_L (z) \). Then, since \( w_L^0 \) is the minimum wage offered by a company with health insurance and therefore it must be the highest wage offered by a company that does not offer health insurance from Theorem 1, we have that \( F (w_L^0) = \gamma_H \). Similarly, \( G (w_L^0) = v_H \). Therefore, introducing this values and the expression obtained previously to \( G (\cdot) \), we obtain:

\[ F_L (w) = \frac{\delta + \lambda_1 (1 - \gamma_H) + \frac{\delta_S}{\rho_L + \delta_S} \pi_L}{\lambda_1 (1 - \gamma_H)} \left[ 1 - \left( p - \left( 1 + \frac{\alpha \pi_L}{\rho_L + \delta_S} \right) w_L \right) \frac{1}{p - \left( 1 + \frac{\alpha \pi_L}{\rho_L + \delta_S} \right)} \right]^{\frac{1}{2}} \]

Using this expression we can obtain \( G_L (w) \) and \( S_L (w) \).

Now let’s look at \( F_H (\cdot) \). From previous results, we know that the minimum wage offered by a firm not offering health insurance is \( R_U^H \). Then, we have that:

\[ \left( p - \left( 1 + \frac{\alpha \pi_H}{\rho_H + \delta_S} \right) R_U^L \right) \frac{\lambda_0 u}{\rho_H + \delta_S + \pi_H} = \left( p - \left( 1 + \frac{\alpha \pi_H}{\rho_H + \delta_S} \right) \omega^* (w_H) \right) \frac{\lambda_0 u + \lambda_1 v_H G_H (\omega^* (w_H)) (m - u - s_e - s_u)}{\delta + \lambda_1 (1 - \gamma_H F_H (\omega^* (w_H))) + \frac{\delta_S}{\rho_H + \delta_S} \pi_H} \]

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Substituting \( G(\cdot) \) and rearranging, we have:

\[
F_H (\omega^* (w_H)) = \frac{[\delta + \lambda_1 + \frac{\delta_S}{\rho_H + \delta_S} \pi_H]}{\lambda_1 \gamma_H} \left\{ 1 - \left( \frac{p - \left( 1 + \frac{\alpha \pi_H}{\rho_H + \delta_S} \right) \omega^* (w_H)}{p - \left( 1 + \frac{\alpha \pi_H}{\rho_H + \delta_S} \right) R^L_U} \right)^{\frac{1}{2}} \right\}^{\frac{1}{2}}
\]

with few manipulations, we have:

\[
F_H (w_H) = \frac{[\delta + \lambda_1 + \frac{\delta_S}{\rho_H + \delta_S} \pi_H]}{\lambda_1 \gamma_H} \left\{ 1 - \left( \frac{p - \left( 1 + \frac{\alpha \pi_H}{\rho_H + \delta_S} \right) w_H}{p - \left( 1 + \frac{\alpha \pi_H}{\rho_H + \delta_S} \right) R^L_U} \right)^{\frac{1}{2}} \right\}^{\frac{1}{2}}
\]

Using the wage distributions obtained above, we are able to fully characterize the wage offered in equilibrium. From Theorem 1 we know that in equivalent-wage terms, no health-coverage firms pay lower wages than firms that offer health coverage. This means that the very lowest nominal wages \( (R^H_U) \) are always offered by the risky firms.\(^{16}\)

In this case, to fully characterize the wages offered in equilibrium we need to find the reservation wage, \( R^H_U \), and the maximum wage paid by firm which does not provide health insurance, \( \bar{w}_H \). With these information we are able to determine the high risk firms’ offered wage range, \( [R_0, \bar{w}_H] \), and the low risk firms’ wage range, \( [\bar{w}_L^L, \bar{w}_L] \).

First let’s find the highest wage offered by a firm which doesn’t offer health insurance (to find it, put \( F_H (w_H) = 1 \), and solve,

\[
\bar{w}_H = \left\{ 1 + \frac{\alpha \pi_H}{\rho_H + \delta_S} \right\} 1 - \left[ \left( \frac{\delta + \lambda_1 (1 - \gamma_H) + \frac{\delta_S}{\rho_H + \delta_S} \pi_H}{\delta + \lambda_1 + \frac{\delta_S}{\rho_H + \delta_S} \pi_H} \right)^{2} \times \left( p - \left( 1 + \frac{\alpha \pi_H}{\rho_H + \delta_S} \right) R^H_U \right) \right]^{\frac{1}{2}}
\]

Note that the value of \( \bar{w}_H \) depends crucially on \( \gamma_L \). Indeed, as \( \gamma_H \to 0 \), \( \bar{w}_H \to R_0 \). Since the dispersion of wages offered by risky companies on the interval \( [R_0, \bar{w}_H] \) are generated by the competition between no health-coverage companies, as the measure of no health-coverage companies reduces, this dispersion shrink to 0.

Similarly, we can derive the maximum wage paid by a solid company,

\[
\bar{w} = \left\{ 1 + \frac{\alpha \pi_L}{\rho_L + \delta_S} \right\} 1 - \left[ \left( \frac{\delta + \frac{\delta_S \pi_L}{\rho_L + \delta_S}}{\delta + \lambda_1 (1 - \gamma_H) + \frac{\delta_S \pi_L}{\rho_L + \delta_S}} \right)^{2} \times \left( p - \left( 1 + \frac{\alpha \pi_L}{\rho_L + \delta_S} \right) w_L^L \right) \right]^{\frac{1}{2}}
\]

Again, as \( \gamma_H \to 1 \), we have that \( \bar{w}_L \to w_L^L \).

To obtain \( W_0^L \), we need to no compare the minimum wage asked by employees to accept health coverage once offered, \( \tilde{w} \) and the optimal wage \( W_0^L \) obtained calculating: \( \omega^* (W_0^L) = \bar{w}_H \), since once the constraint \( \tilde{w} \) is not binding, we can easily show that the wage set must be connected. Then:

\(^{16}\)Provided there is a positive mass of risky firms.
\[ w_0^L = \max \{ w_0^{L*}, \bar{w} \} \]

Finally, we can obtain an expression for \( R_H \), presented in the appendix.

To close the model, we use the profit equality condition to pin down \( \gamma_H \). We can show that the equilibrium is unique.

\[ \rightarrow u : \text{unemployed healthy:} \]

\[ \text{inflow: } \delta (m - u - s_e - s_u) + \rho_H s_u; \]
\[ \text{outflow: } \pi_H u + \lambda_0 u \]

Rearranging:

\[ u = \frac{\delta (m - s_e - s_u) + \rho_H s_u}{\pi_H + \lambda_0 + \delta} \]

\[ \rightarrow s_u : \text{sick out of job workers:} \]

\[ \text{inflow: } \delta s_s + \pi_H u; \]
\[ \text{outflow: } \rho_H s_u \]

Rearranging:

\[ s_u = \frac{\delta s_s + \pi_H u}{\rho_H} \]

Substituting it back in the expression for \( u \):

\[ u = \frac{\delta m + \left( \delta s - \delta \left(1 + \frac{\delta s}{\rho_H}\right)\right) s_e}{\lambda_0 + \delta + \frac{\delta \pi_H}{\rho_H}} \]

\[ \rightarrow s_e : \text{sick and employed workers:} \]

\[ \text{inflow: } v_H (m - u - s_e - s_u) \pi_H + (1 - v_H) (m - s_e - s_u - u) \pi_L; \]
\[ \text{outflow: } s_H s_e \rho_H + (1 - s_H) s_e \rho_L + \delta s s_e \]

Rearranging:

\[ s_e = \frac{(v_H \pi_H + (1 - v_H) \pi_L)(m - u - s_u)}{s_H \rho_H + (1 - s_H) \rho_L + \delta s + v_H \pi_H + (1 - v_H) \pi_L} \]

Now, equations to obtain the proportions : \( v_H, s_H \).
Then, equalizing $v_H$:

\[ \text{inflow: } \lambda_0 \gamma_H u + \rho_H s_H s_e; \]

\[ \text{outflow: } \delta v_H (m - s_e - s_u - u) + \pi_H v_H (m - s_e - s_u - u) + \lambda_1 (1 - \gamma_H) v_H (m - s_e - s_u - u) \]

Rearranging:

\[
v_H = \frac{\lambda_0 \gamma_H u + \rho_H s_H s_e}{\delta + \pi_H + \lambda_1 (1 - \gamma_H) (m - s_e - s_u - u)}
\]

Then substituting $v_H$:

\[ \text{inflow: } \pi_H v_H (m - s_e - s_u - u); \]

\[ \text{outflow: } \delta s_H s_e + \rho_H s_H s_e. \]

\[
s_H = \frac{\pi_H v_H (m - u - s_e - s_u)}{(\delta + \rho_H) s_e}
\]

Now, we are going to solve this system with 5 equations and 5 unknowns ($v_H$, $s_e$, $s_H$, $u$, $s_u$). Rearranging the above expressions, we have:

\[
\begin{aligned}
(m - u - s_e - s_u) &= \frac{(\delta + \rho_H) s_e s_H}{\pi_H v_H} \ (s_H) \\
(m - u - s_e - s_u) &= \frac{[\delta H \rho_H + (1 - s_H) \rho_L + \delta s] s_e}{\pi_H v_H + (1 - \pi_H) \pi_L} \ (s_e) \\
(m - u - s_e - s_u) &= \frac{\lambda_0 \gamma_H u + \rho_H s_H s_e}{[\delta + \pi_H + \lambda_1 (1 - \gamma_H)] v_H} \ (v_H) \\
\delta (m - u - s_e - s_u) + \rho_H s_u &= \pi_H u + \lambda_0 u \ (u) \\
\delta s_H s_e + \pi_H u &= \rho_H s_u \ (s_u)
\end{aligned}
\]

Then, substituting $(s_u)$ into $(u)$, we have:

\[
\begin{aligned}
(m - u - s_e - s_u) &= \frac{(\delta + \rho_H) s_e s_H}{\pi_H v_H} \ (s_H) \\
(m - u - s_e - s_u) &= \frac{[\delta H \rho_H + (1 - s_H) \rho_L + \delta s] s_e}{\pi_H v_H + (1 - \pi_H) \pi_L} \ (s_e) \\
(m - u - s_e - s_u) &= \frac{\lambda_0 \gamma_H u + \rho_H s_H s_e}{[\delta + \pi_H + \lambda_1 (1 - \gamma_H)] v_H} \ (v_H) \\
\delta (m - u - s_e - s_u) + \delta s_H s_e &= \lambda_0 u \ (u)
\end{aligned}
\]

Then multiplying $(u)$ by $\gamma_H$ and substituting into $(v_H)$, we have:

\[
\begin{aligned}
(m - u - s_e - s_u) &= \frac{(\delta + \rho_H) s_e s_H}{\pi_H v_H} \ (s_H) \\
(m - u - s_e - s_u) &= \frac{[\delta H \rho_H + (1 - s_H) \rho_L + \delta s] s_e}{\pi_H v_H + (1 - \pi_H) \pi_L} \ (s_e) \\
(m - u - s_e - s_u) &= \frac{(\delta s_H + \rho_H s_H) s_H}{[\delta + \pi_H + \lambda_1 (1 - \gamma_H)] v_H - \delta s_H} \ (v_H)
\end{aligned}
\]

Then, equalizing $(s_H)$ and $(s_e)$, we obtain:

\[
\frac{(\delta s + \rho_H) s_H}{\pi_H v_H} = \frac{[\delta H \rho_H + (1 - s_H) \rho_L + \delta s] s_e}{\pi_H v_H + (1 - \pi_H) \pi_L}
\]
$$s_H = \frac{\pi_H \nu_H (\rho_L + \delta_S)}{\pi_H \nu_H (\rho_L + \delta_S) + (1 - \nu_H) \pi_L (\rho_H + \delta_S)}$$

Similarly, equalizing \(s_H\) and \((v_H)\), we have:

$$\frac{(\delta_S + \rho_H) s_H}{\pi_H \nu_H} = \frac{(\delta_S \gamma_H + \rho_H s_H)}{[(\delta + \pi_H + \lambda_1 (1 - \gamma_H)) \nu_H - \delta \gamma_H]}$$

$$s_H = \frac{\pi_H \nu_H \delta_S \gamma_H}{\{[(\delta + \pi_H + \lambda_1 (1 - \gamma_H)) \nu_H - \delta \gamma_H] \delta_S + \rho_H - \rho_H \pi_H \nu_H\}}$$

Then, we have:

$$\begin{align*}
(\rho_L + \delta_S) \{[(\delta + \pi_H + \lambda_1 (1 - \gamma_H)) \nu_H - \delta \gamma_H] \delta_S + \rho_H - \rho_H \pi_H \nu_H\} \\
= \delta_S \gamma_H \{(v_H \pi_H + (1 - \nu_H) \pi_L) (\delta_S + \rho_H) + (\rho_L - \rho_H) \pi_H \nu_H\}
\end{align*}$$

From this expression we can obtain \(v_H\). Rearranging it, we have:

$$v_H = \frac{(\delta_S + \rho_H) \{\delta (\delta_S + \rho_L) + \delta_S \pi_L\}}{(\delta_S + \rho_H) \pi_L \delta_S \gamma_H + (\delta_S + \rho_H) (\delta_S + \rho_L) (\delta + \lambda_1 (1 - \gamma_H)) + \rho_L \delta_S \pi_H (1 - \gamma_H)}$$

Substituting this into \(s_H\), we have:

$$s_H = \frac{\pi_H (\delta_S + \rho_H) (\delta_S + \rho_L) \gamma_H \{\delta (\delta_S + \rho_L) + \delta_S \pi_L\}}{\pi_H (\delta_S + \rho_H) (\delta_S + \rho_L) \gamma_H [\delta (\delta_S + \rho_L) + \delta_S \pi_L] + \pi_L (1 - \gamma_H) (\delta_S + \rho_L) [(\delta_S + \rho_H) (\delta_S + \rho_L) (\delta + \lambda_1) + \rho_L \delta_S \pi_H]}$$

Few more calculations, we obtain:

$$s_e = \frac{\lambda_0 \rho_H \nu_H \pi_H + (1 - \nu_H) \pi_L}{\{[\delta_S + s_H \rho_H + (1 - s_H) \rho_L] (\lambda_0 \rho_H + \delta (\pi_H + \rho_H)) + [v_H \pi_H + (1 - \nu_H) \pi_L] (\lambda_0 (\rho_H + \delta_S) + (\pi_H + \rho_H) \delta_S)\}}$$

Substituting \(s_H\) and \(v_H\), we have:
$$s_e = \lambda_0 \rho_H \frac{(\delta_S + \rho_H)(\delta_S + \rho_L) + \delta_S \pi_L}{(\delta_S + \rho_H)\pi_L \delta_S \gamma_H + (\delta_S + \rho_H)(\delta_S + \rho_L)(\delta + \lambda_1(1 - \gamma_H) + \rho_L \delta_S \pi_H (1 - \gamma_H)) (\pi_H - \pi_L) + \pi_L} m$$
11 Appendix D

In this appendix, we present the calibration following the values obtained by Bowlus et. al. (1995), using the NLSY. Since they present results for whites and blacks separately, we consider the convex combinations of the parameters for whites and blacks with weights that represent the proportion of whites and minorities in the American population (70 and 30%, respectively). This gives us the following calibration:

<table>
<thead>
<tr>
<th>Calibration</th>
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<tbody>
<tr>
<td>$p$</td>
</tr>
<tr>
<td>7477</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>$\lambda_1$</th>
<th>$\pi_H$</th>
<th>$\pi_L$</th>
<th>$\rho_H$</th>
<th>$\rho_L$</th>
<th>$\delta$</th>
<th>$\delta_s$</th>
<th>$r$</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.0344</td>
<td>12.72</td>
<td>0.0908</td>
<td>4.09</td>
<td>12.72</td>
<td>0.02312</td>
<td>0.03$^{17}$</td>
<td>0.001</td>
</tr>
</tbody>
</table>

We can see that both on-the-job search, as well as job destruction are much higher than in the calibration with the PSID. By comparing the results of this calibration with the averages obtained in the data, we find that the measure of workers with health coverage and working for firms offering health coverage is much lower than the one seen in the data for the US economy. This is expected since NLSY is a much younger sample. Salaries are lower than the ones obtained from the PSID and closer to the US average, but with a much bigger dispersion.

Now, let’s repeat our previous exercises on changes in health insurance premium and investments on Curative versus preventive medicine:

1.) Changes in Health insurance cost:

$^{17}$This probability is hard to pin down from the data. We tried several values and it does not change the results significantly.
While an increase in 10% in the cost of health insurance premium - keeping the share paid by employee and firm constant gives us:

<table>
<thead>
<tr>
<th>Benchmark</th>
<th>Higher Premium</th>
</tr>
</thead>
<tbody>
<tr>
<td>$1 - \gamma_H$</td>
<td>0.4170 0.3525</td>
</tr>
<tr>
<td>$1 - v_H$</td>
<td>0.6409 0.5759</td>
</tr>
<tr>
<td>$\frac{(s_e + s_u)}{m}$</td>
<td>0.0142 0.0150</td>
</tr>
<tr>
<td>$\frac{s_e}{m}$</td>
<td>0.0102 0.0110</td>
</tr>
<tr>
<td>$\frac{u}{m}$</td>
<td>0.173905 0.173945</td>
</tr>
</tbody>
</table>

where Benchmark is given by the NLSY calibration before the increase in health costs. As we can see, an increase in premium reduces the measure of workers with health coverage in 11.3%, while increasing the fraction of worker sick in steady state by 5.634%.

Now, let’s consider the changes in the probabilities of getting sick and the probability of recovering once sick:
Now, let’s consider the exercise of governmental investment on health developments on preventive or curative medicine, as presented in section 4. Then, we obtain:

<table>
<thead>
<tr>
<th>Benchmark</th>
<th>Preventive</th>
<th>Curative</th>
</tr>
</thead>
<tbody>
<tr>
<td>$1 - \gamma_H$</td>
<td>0.4170</td>
<td>0.4344</td>
</tr>
<tr>
<td>$1 - v_H$</td>
<td>0.6409</td>
<td>0.6573</td>
</tr>
<tr>
<td>$\frac{(s_x + s_u)}{m}$</td>
<td>0.0142</td>
<td>0.0136</td>
</tr>
<tr>
<td>$\frac{u}{m}$</td>
<td>0.173905</td>
<td>0.1738756</td>
</tr>
</tbody>
</table>

Similarly as before, the investment in Preventive medicine generates a higher health coverage and lower fraction of sick workers in steady state.