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Worker Sorting, Taxes and Health Insurance Coverage

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Abstract

We develop a model in which firms hire heterogeneous workers but must offer all workers insurance benefits under similar terms. In equilibrium, some firms offer free health insurance, some require an employee premium payment and some do not offer insurance. Making the employee contribution pre-tax lowers the cost to workers of a given employee premium and encourages more firms to charge. This increases the offer rate, lowers the take-up rate, increases (decreases) coverage among high (low) demand groups, with an indeterminate overall effect. We test the model using the expansion of section 125 plans between 1987 and 1996. The results are generally supportive.

Introduction

Between 1986 and 1997 the use of section 125 plans, which allow employee contributions to insurance premiums to be paid on a pre-tax basis, grew rapidly. Yet over roughly the same period, there was a dramatic decline in the fraction of workers who were covered by employer-provided health insurance (Farber and Levy, 2000). On first thought, most of us would expect that by subsidizing health insurance through the tax system, section 125 plans would have increased health insurance coverage.

We argue that this intuition is incomplete. Section 125 plans reduce the tax on employee-paid health insurance premiums. This makes it less expensive for firms to charge workers for their health insurance. This should have two effects. The first is that more firms should charge for health insurance. In fact, there was a dramatic increase in the proportion of those obtaining health insurance through their employer who contribute to the cost of the premium (Gruber and McKnight, 2002). Second, more firms should offer health insurance. Over this period, the number of workers in firms providing health insurance has grown. However, perhaps because more firms are requiring employee premiums, the take-up rate has declined (Farber and Levy, 2000).

We develop a simple model that predicts precisely these outcomes. As the tax wedge between the cost to workers of employee premiums and their value to the firm declines, more firms require employee premiums and the premium rises. Because this reduces the cost of offering health insurance, more firms choose to do so. However, because fewer firms offer health insurance for free, the take-up rate declines. The effect on coverage may be positive or negative.

Even ignoring the effect on government revenues, reducing the tax wedge has important distributional effects. Health insurance coverage rises among groups in which the coverage rate is high and falls where the coverage rate is low. Workers in groups that generally place a high value on health insurance benefit from the change if they, themselves, value insurance highly and are hurt if they do not. The opposite is true in groups where health insurance is generally not highly valued.

We test the hypothesis that the distribution of health insurance across skill levels became more unequal over this period. We present evidence not only that inequality increased but that the increase is greater than can be explained by rising earnings inequality. Our model also has implications for the evolution of compensating differentials. None of the predictions is contradicted by the data although in some cases the data are inadequate to reject alternative views.

1 The Intuitive Argument

To understand the existence of employee premium payments, we must recognize that firms have only a limited ability to discriminate among workers with respect to the plans that they offer and that sorting of workers across firms is imperfect (Pauly, 1986). Otherwise, firms would tailor policies to individual workers or would have a homogeneous set of workers desiring the same policy. Levy (1998), Dranove, Baker and Spier (2000), Gruber and McKnight and (implicitly) Bernard and Selden (2002) examine the consequence of imperfect sorting for firms' decisions regarding insurance provision. However, they do not endogenize the allocation of workers to firms. Miller (2004) looks at the optimal decision for a monopoly hiring a fixed number of workers but treats the workers' outside options both in the labor and insurance markets as exogenous.[1]

In our model, mismatching arises because firms are compelled to offer health insurance in a nondiscriminatory fashion. Production requires two different types of workers (low and high skill) with different distributions of willingness to pay for health insurance. Some high skill workers with high valuations of health insurance must be matched with low skill workers with low valuations. Despite the tax advantages to offering health insurance for free, if the low skill workers' valuations are sufficiently low, it is efficient (and profitable) for the firm to charge for health insurance.

In equilibrium, some firms choose to offer health insurance for free to all employees; others offer health insurance but require an employee contribution while yet others do not offer health insurance at all. When firms require a contribution, some, but not all, workers

[1] Dey and Flinn (2002) is closest in spirit to this paper in that it describes equilibrium behavior. However, their model cannot be used to examine employee contributions. Moreover, their assumptions ensure that the provision of health insurance is always efficient conditional on where the worker is employed. The mismatching is a result of labor market imperfections not of imperfections directly related to the insurance problem.

choose to purchase health insurance. Workers who must pay part of the premium receive a compensating differential for this cost, as do workers without health insurance. Thus workers implicitly pay for the health insurance that they nominally receive for free, as is standard in models of compensating differentials.

Because there is a distortionary tax wedge, some workers who value health insurance at more than its cost do not get insurance. Others who value it at less than its cost nevertheless receive free health insurance from their employer. Yet reducing the tax wedge is not unambiguously good. It has an ambiguous effect on the proportion of workers receiving health insurance through their employer. The proportion of workers receiving health insurance for free declines while the proportion of workers in firms offering health insurance rises and the take-up rate declines. If our objective is to increase the prevalence of health insurance, reducing the tax wedge may be harmful. Moreover, the tax wedge affects wages. Reducing the wedge can lower the wages of the less skilled workers.

Somewhat more formally, suppose that there is only one type of health insurance and that it costs firms p per insured worker to provide the insurance. Firms offer workers a wage and may also offer the opportunity to purchase insurance at a an employee premium, c, chosen by the firm. The cost to the worker of purchasing the insurance is γc where $\gamma > 1$ because, for example, the worker pays for the insurance in after-tax dollars. Alternatively, a payment of γc might reduce the firm's cost by only c because of adverse selection. We expect that the results would be similar if, because of adverse selection, γ were greater than one even in the absence of a tax wedge. However, we do not formally model adverse selection.

For purposes of simplifying the intuition, suppose that each firm requires exactly one type 1 and one type 2 worker (e.g. skilled and unskilled, white collar and blue collar). Before we address how workers are matched with firms, let us first consider the case of a single firm with two workers. The firm wants to minimize its compensation costs

$$C = w_1 + w_2 + (p - c)(H_1 + H_2) \tag{1}$$

where 1 and 2 refer to the two workers, $p - c$ is the employer's share of the health insurance premium and H_i equals 1 if worker i takes health insurance and 0 otherwise. Note that there is only one type of health insurance available in the market.

The firm minimizes C subject to the constraint that it must provide each worker with a fixed level of utility

$$u_i^* = w_i + (b_i - \gamma c)H_i \tag{2}$$

where b_i can be interpreted as the worker's willingness to pay for insurance. We discuss in somewhat greater detail below why willingness to pay varies among workers. For the moment, the important point is that it is independent of expected medical costs and that therefore there is no adverse selection in the model. In addition, because there is only a single health insurance plan, there is no consideration of choosing a health insurance plan to reduce moral hazard. We assume that the firm knows b_i and, without loss of generality, that $b_1 > b_2$. Note that the worker's demand for health insurance is given by

$$\begin{aligned} H_i &= 1 \; if \; \gamma c < b_i \\ H_i &= 0 \; otherwise. \end{aligned} \tag{3}$$

We rewrite the firm's objective function as

$$\min_c u_1^* + u_2^* - (b_1 - p - (\gamma - 1)c)H_1(c) - (b_2 - p - (\gamma - 1)c)H_2(c). \tag{4}$$

This consists of three segments: one with $\gamma c < b_2$ in which both H_1 and H_2 equal 1 (both workers get health insurance), one with $b_2 \leq \gamma c < b_1$ in which only H_1 equals 1, and one with $b_1 \leq \gamma c$ in which H_1 and H_2 both equal 0 (neither worker gets insurance).

Since within segments, $dC/dc = (\gamma - 1)(H_1 + H_2)$, conditional on $\gamma c < b_2$, the optimum is $c = 0$. Conditional on $b_2 \leq \gamma c < b_1$, $\gamma c = b_2$ is optimal and conditional on $\gamma c \geq b_1$, the compensation cost is independent of c since no worker purchases insurance in any event. We will refer to the three possible minima as offering insurance for free, requiring an employee premium and not offering insurance.

The total costs of the three possible minima are

$$C_{f(ree)} = u_1^* + u_2^* + 2p - b_1 - b_2 \tag{5}$$

$$C_{e(mployee\_premium)} = u_1^* + u_2^* + p - b_1 + \frac{(\gamma - 1)b_2}{\gamma} \tag{6}$$

$$C_{n(o\_hi)} = u_1^* + u_2^* \tag{7}$$

Providing health insurance for free will be optimal if

$$p - b_2 < \frac{(\gamma - 1)b_2}{\gamma} \tag{8}$$

or

$$p < \frac{(2\gamma - 1)b_2}{\gamma} \tag{9}$$

and

$$2p < b_1 + b_2. \tag{10}$$

These conditions will always be satisfied if both workers value health insurance at more than its full premium.

Not providing health insurance will be optimal if

$$2p > b_1 + b_2 \tag{11}$$

and

$$p > b_1 - \frac{(\gamma - 1)b_2}{\gamma}. \tag{12}$$

These conditions will be satisfied if neither worker values health insurance at more than its full premium.

Finally, requiring an employee premium will be optimal if inequalities (9) and (12) are both reversed. We know that a necessary condition for this to arise is that $b_1 > p > b_2$. However, this is not sufficient. In fact, for fixed b_1 and b_2, for sufficiently large γ, we require that $b_1 - b_2 > p > 2b_2$. Put differently, when γ is high, unless the two workers have very different valuations, a firm with one worker who values health insurance at more than its cost and another who values it at less than its cost, will choose either to provide health insurance for free or not at all. For γ sufficiently low, it will offer health insurance but require an employee premium.

This makes one of the key points of the paper. When the tax wedge declines, the offer rate goes up because some firms which would not have offered health insurance now offer it. However, the take-up rate declines, because some firms that were offering it for free, now require an employee premium which causes some workers who would have accepted free insurance to reject it. In the one firm case, the coverage rate could decline or increase depending on whether the firm went from not providing insurance to providing it with an employee premium or from providing it for free.

Even as a source of intuition, the argument so far is incomplete because we have not discussed how workers are allocated among firms. Suppose that there are three workers of each type. Two type 1 workers value health insurance at more than its cost and one at less than its cost. In contrast, only one type 2 worker values insurance at more than its cost. How will the market allocate workers to firms.

By the usual arguments, the economy will organize itself so that it is constrained efficient. This can always be achieved by matching the workers so that the type 1 worker who values insurance most highly is matched with the type 2 worker who values it the most, and so on. Other matches can also achieve full efficiency and will imply the same compensation packages in equilibrium. However, the case where the workers are matched in this way is easiest to understand, and so we will use it for the intuitive argument.

The firm attracting the workers with the highest evaluations provides insurance for free while the firm attracting those with the lowest evaluations does not offer insurance at all. The middle firm is in essentially the same situation as the single firm described above. Therefore when γ is high, we will have either two firms offering insurance for free or two firms not offering insurance. In the former case two-thirds of workers are covered while in the former only one-third are covered. In either case, the take-up rate is 1. When γ is sufficiently close to 1, the middle firm requires an employee premium. The take-up rate falls below 1 because the type 2 worker at the middle firm turns down coverage. The offer rate is two-thirds. The coverage rate is one-half. Thus the coverage rate can rise or fall. In this example, the offer rate either rises or stays the same. However, as we show formally below, with a continuum of types, the offer rate always rises.

The model also has implications for the relation between compensating differentials and the tax wedge. These cannot be addressed with the simple example used in this section. We therefore turn to a more formal model.

2 The Basic Model

There are two types of workers 1 and 2 distinguished by the type of work they do, each with measure m_i. It may be helpful to think of these as high and low skill workers or as white-collar and blue-collar workers. Worker type is exogenous. Within each type, there is a distribution $F_i(b)$ of willingness to pay for health insurance with $0 < F_i(p) < 1$ where p is the cost to employers of providing health insurance to an employee. F_i is continuous, with no mass points and with $F_i' > 0$ everywhere in the support.

Further assume that

$$F_1(b) \leq F_2(b),$$

with strict inequality for $0 < F_i(b) < 1$.

We treat willingness to pay as exogenous to expected health costs. All workers have the same expected health costs. There is variation in b because some workers are more risk averse or because the variance of their health costs is higher. We do not formally model a relation between earnings potential and willingness to pay. However implicitly we think of type 1's as having a greater willingness to pay because their earnings are higher. This is consistent with the work of Starr-McCluer (1996) who finds a strong positive relation between wealth and insurance. It is plausible that workers with lower earnings and wealth are more likely to be eligible for government-provided healthcare in the event of a catastrophic illness and therefore place a lower valuation on insurance. We present an example later in which willingness to pay depends on earnings. Still, it is important to recognize that our formulation assumes away problems of adverse selection.

We note that willingness to pay might depend on availability of health insurance through some other source such as a spouse or association membership provided that the availability of this health insurance is exogenous. Thus a worker who can get health insurance through his or her spouse would be willing to pay no more than the premium for that insurance. However, to model this properly would require modelling the joint employment decision.

There is a single type of health insurance. Firms pay p for each worker for whom they provide health insurance. Since there is no variation in the type of health insurance available, we abstract from issues of moral hazard associated with varying generosity of health plans.

The employee compensation package consists of a wage that may be conditioned on worker type and the price (employee premium), c, at which workers may purchase health insurance from the firm. The employee premium may not be conditioned on worker type. The amount received by the firm from each worker who purchases insurance is c. The cost to the worker is γc, $\gamma > 1$. We model γ as arising from differential tax treatment of firm and worker health insurance premiums.

Utility is given by

$$u_i = w_i + (b_i - \gamma c)H_i.$$

Workers decide to purchase insurance from the firm if $\gamma c < b$. The wage may not be conditioned on the worker's decision whether or not to purchase insurance from the firm. Note that setting $c > \overline{b}/\gamma$ where $\overline{b}$ is the highest willingness to pay is equivalent to not offering health insurance. We will treat c as infinite in the case where insurance is not available at the firm.

The firm's profit is given by

$$\pi = q(L_1, L_2) - w_1 L_1 - w_2 L_2 - \sum_{j=1}^{2} \sum_{i \in L_j} [p - c] H_i$$

where H_i equals 1 if the worker takes health insurance and 0 otherwise.

Output is produced according to a production function that is homogeneous of degree one, that is

$$q(L_1, L_2) = L_2 q(\frac{L_1}{L_2}, 1) \equiv L_2 q(\theta).$$

2.1 Equilibrium

We model a market rather than a game. Therefore we define equilibrium in terms of prices and the allocation of workers to firms rather than in terms of worker and firm strategies.

Definition 1 *An equilibrium is a profile of compensation packages* $\{(w_1^A, w_2^A, c^A), (w_1^B, w_2^B, c^B), ...(w_1^K, w_2^K, c^K)\}$ *and an allocation of workers and firms such that*

1. All firms make zero-profit

2. No worker prefers to be employed at a firm with a different compensation package

3. All workers are employed

4. All workers have their preferred insurance status given the employee health insurance premium

5. θ maximizes profit at the firm given the compensation package and health insurance status of workers at the firm
6. There is no other compensation package that would simultaneously attract both type 1 and type 2 workers and make positive profit.

Note that because production is constant returns to scale, the size of individual firms is indeterminate.

The proof of the equilibrium, which is relegated to the appendix, proceeds as follows. We show first that all workers of a given type at a firm either purchase or do not purchase insurance and that if all workers take insurance the firm must provide it for free. It follows immediately that there are no more than four equilibrium compensation packages and that these may be summarized by the set of types receiving insurance at firms with that package. We then show that a there cannot be two compensation packages such that only type 1 workers get health insurance with one and only type 2 workers get health insurance with the other. The proofs in the appendix address the case of N types of worker. We show that there are at most $N+1$ equilibrium compensation packages. However, without strong restrictions on tastes and technology, we are not able to reduce the set of potential equilibria to one. Therefore in the text and in the remainder of the paper, we limit ourselves to the case of two types, relegating the three worker-type case to an example in a later section.

Proposition 1 *In equilibrium, there are at most three compensation packages. These take the form $(w_1^A, w_2^A, 0)$, (w_1^B, w_2^B, c^*), and (w_1^C, w_2^C, ∞). If all three packages are present in equilibrium,*

$$w_1^B = w_1^A + \gamma c \tag{13}$$

$$w_2^B = w_2^A + \gamma c \tag{14}$$

$$w_2^C = w_2^B \tag{15}$$

$$w_1^C = w_1^A + p + (\gamma - 1)c \tag{16}$$

$$b_1^* = p + (\gamma - 1)c \tag{17}$$

$$b_2^* = \gamma c \tag{18}$$

where b_i^* represents the individual of type i with the highest valuation of health insurance *among those not obtaining insurance.*

Proof. see appendix ■

Equation (13) reflects the compensating differential that type 1 workers require in order to be indifferent between getting insurance for free and paying c. Since charging for insurance is costly, c is set so it is just sufficient to deter a type 2 worker from accepting the job and purchasing insurance. Therefore the highest willingness to pay of any type 2 worker in a B or C firm must be γc which is also the compensating differential this worker requires to be indifferent between A firms and B and C firms, which gives (14) and (18). Workers who do not get health insurance do not care whether it is offered and how much the firm charges for it which explains (15). Since $w_2^B = w_2^C$, the cost of employing type 1 workers must be the same at B and C firms which gives (16), and this wage differential must leave the marginal type 1 worker indifferent between employment in an A or B firm or in a C firm which gives (17).

If the distribution of willingness to pay for health insurance is sufficiently similar for the two groups and if the inefficiency associated with charging for health insurance is sufficiently high (γ is sufficiently greater than 1), the equilibrium reduces to one in which each firm either offers health insurance for free or does not offer it. We find this case uninteresting and for the remainder of the paper restrict ourselves to the case where all three packages exist in equilibrium.

We now have all of the elements to fully characterize the equilibrium. This is summarized in the proposition below:

Proposition 2 *In equilibrium*

$$q(\theta_A) - (w_1 + p)\theta_A - (w_2 + p) = 0 \tag{19}$$

$$q(\theta_B) - (w_1 + p + (\gamma - 1)c)\theta_B - w_2 - \gamma c = 0 \tag{20}$$

$$q(\theta_C) - (w_1 + b_1^*)\theta_C - w_2 - \gamma c = 0 \tag{21}$$

$$L_C\theta_c/m_1 = F_1(b_1^*) \tag{22}$$

$$L_A/m_2 = 1 - F_2(\gamma c) \tag{23}$$

$$q'_A = (w_1 + p) \tag{24}$$

$$q'_B = (w_1 + p + (\gamma - 1)c) \tag{25}$$

$$q'_C = (w_1 + b_1^*) \tag{26}$$

where θ_i is the ratio of type 1 to type 2 workers employed in firms with compensation package i.

Proof. see appendix. ■

Equations (19)-(21) are the zero-profit conditions. Equations (22) and (23) require that the number of workers in each type of firm conform to the number with the appropriateness willingness to pay. Equations (24)-(26) are the usual first-order conditions. Note that there is only one per type of firm because of the constant returns to scale assumption.

Note that from Proposition 1 $b_1^* = p + (\gamma - 1)c$ and therefore $q'_B = q'_C$ and $\theta_B = \theta_C$.

While our main focus in this paper is on the comparative statics of the model, it is worth noting that the model has a number of interesting implications:

Corollary 1 $\gamma c < p$.

Proof. If not, the compensation cost of type 2 workers is at least as great at B firms as at A firms and the compensation cost of type 1 workers is strictly greater at A than at B firms. ■

This means that some type 2 workers who get health insurance for free value the health insurance at less than its cost to the firm. Moreover since $b_1^* = p + (\gamma - 1)c$, among type 1 workers, the compensating differential for not having health insurance exceeds the cost of health insurance to the firm. Therefore some type 1 workers who value health insurance at more than its cost to the firm do not get health insurance. Relative to the efficient solution, too many type 2 workers and too few type 1 workers get health insurance.

Finally we note that the compensating differential for not having health insurance is larger in the group with the higher demand for health insurance.

3 The Effect of Changing the Tax Wedge

In this section we examine the effect of changing the tax wedge on wages in each type of job, the employee premium for health insurance in firms that require an employee contribution and the proportion of each type of worker employed in each of the three types of firms. Proofs of all propositions in this section are relegated to the appendix.

Our first result is quite intuitive. Increasing the tax wedge, increases the inefficiency associated with having employees contribute to the cost of their health insurance premiums. As a consequence, the employee contribution falls in type B firms. This is stated formally in the following proposition.

Proposition 3 $\frac{dc}{d\gamma} < 0$.

How beneficial to workers is this decrease in the employee contribution? On the one hand, when the tax wedge goes up, the employee contribution goes down. On the other hand, the cost of any fixed contribution goes up. Which effect dominates? The next proposition establishes that the total cost of employee contribution ($c\gamma$) goes down as γ goes up.

Proposition 4 $d(c\gamma)/d\gamma < 0$.

Since we have already established that $c\gamma$ is equal to the cutoff willingness to pay for health insurance (b_2) below which type 2 workers do not get health insurance, we have the following corollary:

Corollary 2 *Increasing the tax wedge raises the fraction of type 2 workers getting health insurance.*

And since $c\gamma$ is also equal to the compensating differential received by type 2 workers, we have

Corollary 3 *Increasing the tax wedge lowers the compensating differential received by type 2 workers who do not get health insurance.*

To find how the tax wedge affects the number of type 1 workers getting health insurance, we must look at how it affects the compensating differential received by type 1 workers who do not get health insurance. The following theorem establishes that when the tax wedge goes up, the compensating differential between type 1 workers receiving health insurance for free and those not receiving health insurance goes up.

Proposition 5 $d(p + (\gamma - 1)c)/d\gamma > 0$

Corollary 4 *Increasing the tax wedge lowers the fraction of type 1 workers getting health insurance.*

We have established that when the tax wedge goes up, there are fewer type 2 workers without health insurance and thus more in type A firms and that there are fewer type 1 workers with health insurance and thus more in type C firms. It is therefore not too surprising to find that there are fewer of both types of worker in type B firms when the tax wedge increases. We state this formally in the next theorem.

Proposition 6 $dL_B/d\gamma < 0$, $d(\theta_B L_B)/d\gamma < 0$.

When the tax wedge increases, the number of type B workers with health insurance increases while the number of type A workers with health insurance falls. What then is the overall effect of an increase in the tax wedge on health insurance coverage? Given that the two effects work in opposite directions, it is perhaps not surprising that the effect is unsigned. An increase in the tax wedge, lowers the number of workers with health insurance if, in a sense made precise in the proposition below, at the margin between receiving and not receiving health insurance, the density of type 1 workers is sufficiently large relative to the density of type 2 workers.

Proposition 7 *The proportion of workers with health insurance coverage falls when the tax wedge rises if and only if*

$$(27)\quad m_1 f_1[(L_B+L_C)q_A''+q_B''(L_A-m_2f_2q_A''(\theta_A-\theta_B)^2)] < m_2f_2[(L_B+L_C)q_A''\theta_A+L_Aq_B''\theta_B].$$

A sufficient condition for (27) is that $m_1f_1/m_2f_2>\theta_A$ where f_1 is the density of type 1 workers evaluated at b_1 and f_2 is the density of type 2 workers evaluated at b_2. Since θ_A must be greater than m_1/m_2, this condition will frequently be violated so that there is no reason to expect that reducing the tax wedge will increase coverage.

We have seen that, when the tax wedge increases, the wages of type 1 workers in type C firms increase relative to those in type A firms and that the wages of type 2 workers in B and C firms fall relative to those in type A firms. What happens to the relative wages of type 1 and type 2 workers? Our intuition suggests that increasing γ makes providing health insurance more expensive and should reduce demand for the group that most values it. However, our intuition is incorrect. The following proposition provides an uninformative condition under which the wages of type 1 workers in type A firms rise and wages of type 2 workers in these firms fall.

Proposition 8 $dw_1/d\gamma < 0$ *and* $dw_2/d\gamma > 0$ *if and only if*

$$(28)\qquad L_B + L_C + m_2f_2q_B''(\theta_A-\theta_B)\theta_B > 0.$$

Recall that the compensating differential for being in a type B firm is the same for the two types of workers and that the compensating differential for being in a type C firm rises for type 1 workers and falls for type 2 workers when γ rises. Therefore (28) is a necessary and sufficient condition for the wages of all type 1 workers to rise relative to type 2 workers in the same firm.

We can, however, draw a more definitive conclusion about wages in firms where type 1 workers do not receive health insurance. As summarized in the proposition below, in such firms, the wages of type 1 workers rise which, in turn, implies that the wages of type 2 workers without health insurance go down when the tax wedge increases.

Proposition 9 $dw_1^C/d\gamma > 0$ $dw_2^C/d\gamma < 0.$

As discussed in the introduction, over the last twenty-five years, the expansion of section 125 plans has effectively reduced the tax wedge between employer and employee payments for health insurance premiums. The results in this section reveal that this reduction should have increased the number of workers being offered health insurance, increased the number for whom insurance is available but for which they must make a contribution to the premium, reduced the number who receive health insurance for free and had an ambiguous effect on the number of workers receiving health insurance through their employer. The reduction in the tax wedge should also have had effects on the wage structure. While the effect on the wages of workers with free health insurance is ambiguous, the compensating differential for not having health insurance should have increased for groups in which health insurance is relatively uncommon and decreased in groups in which it is relatively common.

We examine the some of these implications empirically in section 5. Before we do so, we consider some extensions to the model.

4 Extensions

Some of the assumptions of the model are restrictive. However, relaxing these assumptions makes the model very complex. As a consequence, we rely on simple intuitive arguments and numerical examples to address the generality of our results.

4.1 Different Tax Rates

We think of type 1 workers as being more willing to pay for health insurance because they have higher earnings. It may therefore also be reasonable to think of type 1 workers as facing a higher tax rate and thus having a higher γ than do type 2 workers. This does not substantially change the model. Firms that require an employee premium will have to pay a compensating differential of $\gamma_1 c$ to type 1 workers. Type 2 workers will get a compensating differential of $\gamma_2 c$ in firms where they do not get health insurance.

In this case, we must consider the comparative statics of changes in the two tax rates separately. Increasing the tax rate on type 1 workers is similar to increasing the overall tax rate in the base model. It makes it more expensive to require an employee contribution.

This lowers the optimal premium and reduces the prevalence of type B firms. Thus the tax increase lowers the offer rate, increases the take-up rate, lowers the coverage rate for type 1 workers and increases it for type 2 workers and has an indeterminate effect on the overall coverage rate, just as in the base model.

Increasing the tax rate on the type 2 workers has the opposite effect. It makes it cheaper to deter type 2 workers from purchasing insurance in type B firms. As we raise the tax rate for type 2 workers (holding the tax rate for type 1 workers constant), we can get the same deterrent effect from a smaller employee premium. This reduces the compensating differential that type B firms must pay type 1 workers. Therefore type B firms expand and the effects are the opposite from those obtained when the unitary tax rate for all workers goes up.[2]

Therefore if tax rates changed differently for different types of workers, we would have to examine the details of the change carefully in order to assess its anticipated effects.

4.2 Multiple types of workers

Our example assumes a CES production function of the form

$$q = .5(L_1^{.5} + L_2^{.5} + L_3^{.5})^2. \tag{29}$$

The price of insurance is .2. Willingness to pay for insurance is uniformly distributed between 0 and an upper value of 1, .5 and 1/3 for the three types. We find the equilibrium for γ equal to 1.1 and to 1.2. In both cases, there are four types of compensation packages in equilibrium: one in which all three types get insurance for free, one in which the first two types pay for insurance and the third chooses not to purchase it, one in which only the first type chooses to purchase insurance and one in which insurance is not offered.

As in the base model, at the lower γ, the employee premium is higher at each type of firm and more firms charge for health insurance. However, the overall increase in the average employee premium, conditional on the employee premium being positive, is small because there is a much bigger increase in the proportion of employees paying the lower premium (at the firms where both type 1's and type 2's purchase insurance). In the

[2] The proofs that $dc/d\gamma_1 < 0$ and $dc/d\gamma_2 > 0$ are available from the authors on request.

example, both type 1's and type 2's have higher coverage rates at the lower γ, but overall coverage declines because of a sharp decline in the coverage of type 3's.

4.3 Endogenous insurance demand based on earnings

In this example, we assume that willingness to pay is composed of a nonstochastic term equal to $.02 + .01w$ and a stochastic term distributed uniform on the unit interval. The wage is measured as the wage net of the employee cost of health insurance. The production function is given by

$$q = .5(4L_1^{.5} + L_2^{.5})^2. \tag{30}$$

The price of health insurance is .25. We set γ equal to 1.4 and 1.2.

In both equilibria, w_1 is about 7.5 higher than w_2 which is sufficient to ensure that all three compensation packages exist in equilibrium. Consistent with the exogenous willingness to pay model, lowering γ increases c and γc, increases the number of type B firms and reduces the number of type A and type C firms.

4.4 Adverse selection

Because we focus on the effects of tax treatment of insurance premiums, we have abstracted from the issue of adverse selection. Just as in a standard insurance market, it is possible that adverse selection causes the equilibrium to unravel so that employers do not provide health insurance. However, as the example in this section shows, the presence of adverse selection need not change the essential features of the model. Adverse selection makes the model numerically more complex. The example is correspondingly simple.

We assume that $m_1 = m_2$ and that production requires exactly one worker of each type (or, equivalently, equal numbers). Given these assumptions only the sum of wages and not their allocation between types is determined. We assume that $w_1 = 2w_2$ (perhaps because there is technology that allows workers to transform themselves into type 1 workers at some cost in foregone earnings). We further assume that, for each type, the expected cost of medical care is distributed uniformly on the interval (0,.5). Type 1 workers willingness to pay for insurance is twice their expected cost while type 2 workers are only willing to pay their expected cost.

Before we turn to the equilibrium in the labor market, it is worth noting that in the private insurance market, the equilibrium price of insurance would be .37 and coverage would be 45% if insurers could not discriminate on the basis of occupation. With separate prices for type 1 and type 2 workers, the market for health insurance for type 2 workers would unravel while the price for type 1 workers would be .33, and 67% of type 1 workers would be covered.[3]

With γ sufficiently low but greater than 1, the equilibrium in this example retains the features of our base model. For $\gamma = 1.2$, the offer rate is 58%, the takeup rate is 71% and the coverage rate is 42%. When γ falls to 1.1, the offer rate rises to 62%, the takeup rate falls to 62% and the coverage rate falls to 38%. When γ falls to 1, the equilibrium mimics the private insurance equilibrium in that the implicit price to type 2 workers is .5 while the implicit price to type 1 workers is .33. Two-thirds of workers are in firms that offer insurance but only the type 1's take the insurance.

5 Evidence

The major prediction of the model is that as the tax wedge falls, health insurance coverage should rise in those occupations in which individuals tend to have a high willingness to pay and fall in occupations in which individuals have a relatively low willingness to pay for health insurance. This will be the main focus of our empirical analysis. During the period that we study, inequality and the skill premium were also rising. It would not be surprising if the forces that caused increasing earnings inequality also caused health insurance to be more unequally distributed. Therefore we will ask a more stringent question: did health insurance inequality rise more rapidly than would be predicted on the basis of the rise in earnings inequality? Of course, it is always possible that these forces affected health insurance coverage more forcefully than they did earnings. To address this possibility, we will turn to other predictions of the model.

The model also predicts that as the tax wedge falls, the compensating differential for having an employee premium should rise and that the compensating differential for not having health insurance should rise among groups with a low incidence of coverage and

[3] These calculations implicitly assume that private premiums would receive favorable tax treatment.

should fall among those with a high incidence of coverage. We will provide some evidence on changes in compensating differentials. However, perhaps because it is difficult to control fully for productivity differences, it is difficult to measure compensating differentials (see for example, Brown, 1980). One must be cautious when interpreting changes in differentials when the levels do not have the right sign.

Our strategy is to look for a period when the tax wedge between employee and employer premiums changed. We will argue below that the use of section 125 plans expanded rapidly during a period beginning around 1987 and ending around 1996. Therefore, we will look for our predicted changes over this period. Of course, any changes we observe over this period may have been part of a long-term trend unrelated to the growth of the section 125 plans. We therefore extend much of the analysis through 2001, a period when we do not expect tax code changes to significantly affect the tax wedge. We do not extend the analysis to an earlier period because there were complex changes to the tax code during that time. It is difficult to predict the effects of these changes.

5.0.1 The Rise of Section 125 Plans

Although section 125 plans were first included in the tax code in 1978, their use initially grew slowly. In 1986 only five percent of workers in establishments with at least one hundred workers were eligible for flexible benefits or reimbursement accounts (Committee on Ways and Means, 1994). By 1988 this had grown to 13% (Dranove et al, 2000) and by 1991 to 36% (Committee on Ways and Means, 1994). In 1997 the figure stood at 46% (Foster, 2000). The results of the 1999 Employee Benefits Survey suggest that coverage eligibility decreased between 1997 and 1999 but the revision of the survey suggests circumspection in drawing this conclusion. Smaller establishments show a similar pattern of growth albeit at a much lower level. Presumably the figure in 1986 was no higher than the 5% for larger establishments. In 1992 it reached 14% (Committee on Ways and Means) and in 1996, 18% (Foster) before apparently falling in the 1999 survey. This sparseness of this information makes the exact timing of the increase imprecise. It suggests a start date in the mid-to late 1980s and an end date in the mid 1990s.

Therefore we will look for the trends predicted by the model to begin around 1987 and to end around 1996 or 1997. When we look at changes between end dates, we will look for changes between these two dates.

5.0.2 Other Tax Code Changes

Our formal model assumes that all workers face the same tax rate. In reality, of course, tax rates vary by income and other factors. We do not believe that this is important provided that all tax rates change similarly as they do when firms adopt section 125 plans. However, when different workers face very different tax changes, it is difficult to predict the effects under our model because changes in the tax wedge for type 1 and type 2 workers have different effects.

The 1986 tax reform dramatically change the tax structure. The marginal income tax rate for a family with four for with median income fell to 15% in 1987 and remained at this level throughout the period under consideration.[4] Because the model suggests that coverage should adjust differently to changes in the tax rate at different income levels, our model is largely silent about the predicted effects of the tax changes that occurred in the Reagan years. Both a stronger and a weaker relation between wages and coverage would be consistent with our model. We therefore restrict our analysis to the period beginning in 1987. A case could be made for delaying our start date until 1988 because the marginal tax rate for a family of four with twice the median income fell from 35% to 28% in 1988 and remained there until 1998 when it rose again.

The growth of section 125 plans stopped somewhere in the mid-1990's and taxes on high income families increased in 1998. This suggests that the changes we anticipate should have ended some time between 1995 and 1998.

Finally, we note that in the early 1990s, because of the phaseout of the earned income tax credit which had become increasingly generous, the marginal tax rate on low-income families increased dramatically. According to our model, this would increase the inequality of health insurance coverage across occupations and thus reinforces our main prediction for this period.

[4] Data on historical tax rates are from Tax Policy Center (2002).

5.1 Data

We use data on earnings and health insurance coverage from the March Current Population Surveys. Responses from the surveys refer to the previous year so that when, for example we compare 1987 and 1996, we use the 1988 and 1997 surveys. In addition to obtaining information on previous year's earnings, the surveys ask whether the worker has health insurance coverage through his or her employer and whether the employer covers all or part of the cost. We use data from the 1988(b) through the 2002 surveys. We present results from both 2001 surveys. The results are similar.

Unfortunately, the change in the CPS education code in 1992 makes conducting this exercise somewhat difficult. We develop a set of imperfectly concordant codes for the two variables and use this in our estimation.[5] Any breaks in trend between 1990 and 1991 (the 1991 and 1992 surveys) using education data should be treated with suspicion.

5.2 Methods

One way to ask whether the health insurance/skill relation has become steeper would be to estimate the relation between having employer-provided health insurance and the wage for each year during our time period. We would then ask whether this relation became steeper between 1987 and roughly 1996 and ceased to increase or increased less afterwards.

There is an important problem with this approach. It is well established that the earnings/skill relation became much steeper between 1987 and 1996 and then levelled off. It would not be surprising if the health insurance/skill relation mirrored the earnings/skill relation. In fact, if health insurance is a normal good, we would expect it to do so (as it does).

Therefore we would like to ask if the insurance/skill relation became steeper by more than would be predicted on the basis of the increase in the slope of the wage/skill relation.

[5] For surveys prior to 1992, we recode highest grade completed as follows: 1 to 4 becomes 2.5; 5 or 6 becomes 5.5; 7 or 8 becomes 7.5; 9 through 12 are not changed; 13 to 15 becomes 14; 16 is not changed 16; greater than 16 is set to 17.5. In samples beginning with 1992, we recode as follows: 32 is replaced with 2.5; 33 is set to 5.5; 34 is set to 7.5; 35 to 37 are coded as 9, 10 and 11; 38 and 39 are set to 12; 40 and 42 are set to 14; 43 is set to 16; codes 43 and above are set to 17.5;

The simplest approach would be to regress health insurance status on the wage and ask if the slope of this relation increased when our model predicts that it should have. However, our model implies that the wage depends on health insurance and that this relation changes over time as the tax wedge changes. Therefore we cannot treat the wage as exogenous to health insurance status.

There are two numerically equivalent ways to address this problem. The first is to view

$$HI_{it} = a_t + b_t \ln w_{it} + X_{it} B_t + e_{it}$$

as the structural equation that we wish to estimate. We wish to determine whether b_t is rising over time. Since workers, at least according to the theory, receive a compensating differential for not receiving employer-provided health insurance, the wage and error term are correlated. We must find some instrumental variable that affects the wage but does not directly affect health insurance coverage.

One candidate instrument is schooling which is widely used as a proxy for skill. Schooling does not meet modern "natural experiment" standards for an instrument because it is not difficult to make arguments that people with more education should want more or less health insurance than workers with the same wage but less education. However the instrumental variables estimator has a second interpretation.

The two-stage least squares estimator is numerically equal to the ratio of the OLS coefficients from regressions of health insurance and log wage on schooling. Therefore asking whether the 2SLS estimate of b is rising over time is equivalent to asking whether the relation between health insurance and education is rising faster over time than the relation between the log wage and education. We recognize that this is a weak test of the model. If we confirm that the 2SLS estimate of b is rising over the predicted time period, it will not be difficult to develop alternative explanations that do not rely on our model.

The necessity of dealing with the change in the CPS education question makes the use of schooling as an instrument somewhat suspect. Therefore we conduct a similar exercise using occupation differences. While occupation codes did change over this period, it is relatively straightforward to align the two coding schemes.[6] The difficulty in this case is

[6] Most of the recoding involves collapsing codes to make them compatible. Details are available from the authors on request.

that occupations do not have a natural ordering in the same way that education does.

We proceed in the following manner. We combine the 1988 to 2002 March CPS and regress the log wage on three-digit occupation dummies and year dummies.[7] This generates a standardized wage for each occupation. We use this standardized wage as an instrument in the regression of health insurance on the log wage. Similarly to the estimates using education as an instrument, this approach can be interpreted as asking whether the inequality of health insurance provision across occupations rose more rapidly than inequality of wages.

5.3 Did Health Insurance Provision Become More Unequal?

The results are presented visually in figure 1. Using either instrument, the coefficient on the ln wage in the health insurance coverage equation increased between the late 1980's and the mid- to late 1990's before remaining constant or falling.[8] Equivalently, over this period the effect of schooling on health insurance grew more rapidly than the return to schooling and the effect of occupation on health insurance rose more rapidly than its effect on earnings.

More formally, we estimate the 2SLS coefficient in each of the fifteen years (sixteen observations because there are two for 2000) and regress it on a time trend, a dummy for the post-1997 period and a post-1997 trend. The results are shown in table 1. In both cases, the trend through 1997 is positive and statistically significant. The trend after 1997 (obtained by adding the coefficients on trend and trend post 1997) is negative but not statistically distinguishable from zero. In the case where we use education as an instrument, the post-1997 trend is significantly less positive that the trend before that time. Using the occupation wage as an instrument, we cannot reject that the trend is constant although the point estimates are consistent with our predictions. In neither case is the post-1997 dummy remotely significant. Dropping the post 1997 dummy increases the efficiency of the remaining parameter estimates without changing the substance of the results. Using

[7] We adjust the weights so that the observations in each year have the same total weight. However, the results are nearly identical whether we use this weighting scheme, the reported weights or no weighting.

[8] Note that we provide two sets of estimates for 2000 corresponding to the revised and unrevised 2001 March CPS.

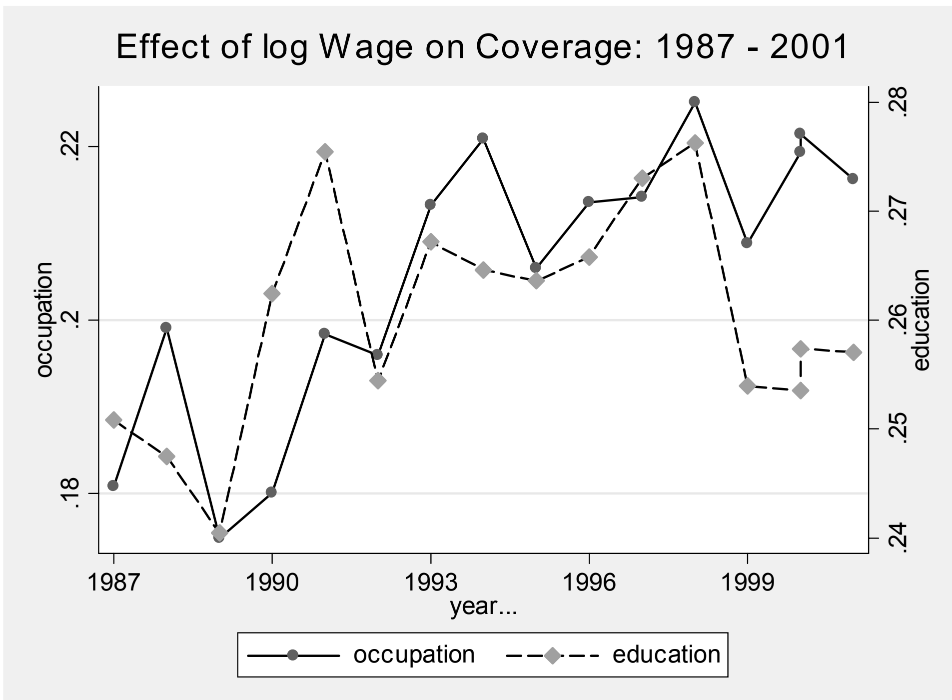
Effect of log Wage on Coverage: 1987 - 2001
occupation
.18
.2
.22
education
.24
.25
.26
.27
.28
1987
1990
1993
1996
1999
year...
occupation
education

Figure 1:

TABLE 1 TIME-SERIES PATTERN OF COEFFICIENTS ON LN WAGE IN LINEAR PROBABILITY MODEL OF HEALTH INSURANCE COVERAGE USING EDUCATION AND OCCUPATION WAGE AS INSTRUMENTS				
	Education		**Occupation**	
Trend	0.23 (0.08)	0.24 (0.07)	0.38 (0.09)	0.38 (0.08)
Trend Post 1997	-0.81 (0.37)	-0.74 (0.23)	-0.50 (0.42)	-0.43 (0.26)
Post 1997	0.29 (1.10)	-	0.29 (1.25)	-
All coefficients and standard errors are multiplied by 100.				

Figure 2:

education as an instrument, the post-1997 trend is now significantly negative. Using the occupation wage as an instrument, the change in the trend after 1997 is now statistically significant at the .1 level using a one-tailed test.

5.4 Compensating Differentials

The model implies that the compensating differential for having to pay for health insurance should have gone up. Over this period, the increase in price of health insurance exceeded the growth in the CPI. Therefore, even a naive model in which the employee premium was a fixed percentage of the overall premium would predict a rising compensating differential for having an employee premium. Thus we do not think that this test has much power for distinguishing our model from others. Nevertheless, we examine this prediction for completeness. Note that the model predicts a rise in the absolute compensating differential not the compensating differential relative to wages. Nevertheless, we calculate the compensating differential in logs in order to provide a more rigorous test of the prediction.

The results are presented in figure 3.[9] As is common in estimates of compensating

[9] The March 1995 survey did not ask whether the employee paid for part of the premium. Therefore, there is no observation for 1994.


Compensating Differential for Paying Employee Premium
compensating differential
-.03
-.035
-.04
-.045
-.05
-.055
1987
1991
1996
2001
year
cd = -3.47 + 0.0017 year - 0.0037 post 1997
(0.0005) (0.0018)

Figure 3:

differentials (see for example Brown, 1980), the compensating differential has the wrong sign. There are at least two explanations for the failure of this prediction (and for the common failure of empirical research to find compensating differentials). The first is that the market-clearing model of the labor market is wrong. The second is that workers with higher earnings potential take some of their compensation in the form of better working conditions and fringe benefits. In particular, to the extent that the tax system is progressive, higher earners should be more likely to work in firms that offer health insurance for free.

If we are willing to treat the bias as constant, then we can still interpret the trend as measuring the increase in the compensating differential. As predicted by the model, the compensating differential for having an employee premium increased between 1987 and 1997. over this period. The trend is significant at the .05-level using a two-tailed test. The trend after 1997 is statistically indistinguishable from zero and significantly lower at the .06 level than the earlier trend. While the slope and significance of the trend through 1997 are greatly reduced if we drop 1987 from the sample, it remains significant at the .06 level.

5.4.1 Differentials between those with and without health insurance

The model implies that within each type, workers without health insurance will earn more than workers who have health insurance. In fact, even among workers in the same occupation, workers with health insurance generally earn more than workers without health insurance. Again this may reflect the failure of the theory or that within each occupation, more productive workers both earn more than other workers and are more likely to select jobs offering health insurance.

The model also has implications for the comparative statics of compensating differentials. We have already noted that the compensating differential for type 2 workers is $c\gamma$ which increases when γ falls. Thus the compensating differential for type 2 workers should increase when the tax wedge declines. In contrast, the increase in $c\gamma$ and the increase in the fraction of workers of type 1 workers who, conditional on getting insurance, pay an employee premium, both raise the average wage of type 1 workers with health insurance while $(\gamma - 1)c + p$, the difference in wages between type 1 workers in C and A firms falls. Therefore the compensating differential for not having health insurance should fall for type

1 workers.

We test this implication empirically in the following manner. We calculate the wage differential between workers with and without health insurance in each three-digit occupation for 1987 and for 1996. We then calculate the change in the real wage differential between these years (adjusting by the change in the CPI between 1987 and 1996). We then regress the change in the compensating differential on the average coverage rate for the two years (weighting by the average number of observations over the two years).

The resulting parameter estimate is -2421 which represents a large change in the relation between the wage differential and the coverage rate in the occupation. However, the standard error is 2844 so that the estimate is far from being statistically significant.

6 Conclusion

In this paper we have explored the equilibrium pricing and provision of employer-provided health insurance in the context of a model of labor market equilibrium. The model generates a number of nontrivial predictions. The predictions regarding equilibrium compensating differentials are inconsistent with the data, as is common in models of compensating differentials. The predictions regarding comparative statics are all at least consistent with the data and in some cases confirmed. We interpret this as weak empirical support for the model.

Based on the model, we make two points which we believe to be important. The first is methodological. If we want to measure the underlying demand for health insurance, we must simultaneously model the distribution of health insurance provision, employee premiums and wages. The cost to a worker of employer-provided health insurance is not only his or her share of the premium but the effect on the wage. Given the difficulties in estimating compensating differentials, this is perhaps a hopeless task. In any event, recognizing the endogeneity of matching limits the availability of instruments because, in contrast with standard supply and demand models, factors that affect supply are not appropriate instruments in the demand equation and vice versa (Kahn and Lang, 1988).

Perhaps more significantly it means that we must use great caution in interpreting "natural experiments" at the firm level. If adjustment is slow so that during the course of the "experiment" the stock of workers at the firm is constant, then eliminating the tax wedge as in Gruber and Washington (2003) must increase the take-up and coverage rates. However, we have seen that this need not be the case when equilibrium is restored.

The second point is substantive. The effect of tax policy on employer provision of health insurance is complex. Not only can reducing the tax wedge raise or lower the coverage rate, but it also changes the distribution of the recipients of health insurance. Lowering the tax wedge increases efficiency (ignoring the effect on the government budget constraint), but it also lowers coverage among low-demand (and therefore presumably lower income) groups. Policy analysts must exercise considerable caution when basing conclusions on simple homogeneous worker models and models that ignore the interaction between the labor market and the market for health insurance.

7 References

Brown, Charles, "Equalizing Differences in the Labor Market," *Quarterly Journal of Economics*, 94 (February 1980): 113-134.

Bureau of Labor Statistics, *National Compensation Survey: Employee Benefits in Private Industry in the United States, 1999, Supplementary Tables*, http://www.bls.gov/ncs/sp/ebtb0001.pdf.

Committee on Ways and Means, United States House of Representatives, *1994 Green Book*, section 16, 1994.

Cooper, Philip S. and Schone, Barbara S., "More Offers, Fewer Takers for Job-Based Health Insurance: 1987 and 1996," *Health Affairs*, 16 (1997): 142-9.

Dey, Matthew S. and Flinn, Christopher J., "An Equilibrium Model of Health Insurance Provision and Wage Determination," New York University, mimeo, 2002.

Dougherty, C. R. S., "Estimates of Labor Aggregation Functions," *Journal of Political Economy*, 80 (Nov.-Dec. 1972): 1101-19.

Dranove, David; Spier, Kathryn E., and Baker, Laurence, "'Competition' Among Employers Offering Health Insurance," *Journal of Health Economics*, 19 (2000): 121–140.

Farber, Henry S., and Levy, Helen, "Recent Trends in Employer-Sponsored Health Insurance Coverage: Are Bad Jobs Getting Worse?," *Journal of Health Economics*, 19 (2000): 93-119.

Foster, Ann C., "Private Sector Employee Benefits, 1996-97," *Compensation and Working Conditions*, (Summer 2000): 17-22.

Gruber, Jonathan and McKnight, Robin, "Why Did Employee Health Insurance Contributions Rise?," NBER Working Paper 8878, 2002.

Gruber, Jonathan and Washington, Ebonya, "Subsidies to Employee Health Insurance Premiums," NBER Working Paper 9567, 2003.

Kahn, Shulamit and Lang, Kevin, "Efficient Estimation of Structural Hedonic Systems," *International Economic Review*, 29 (February 1988), 157-66.

Levy, Helen, "Who Pays for Health Insurance?" Princeton Industrial Relations Section Working Paper 398, 1998.

Miller, Nolan H., "Health Benefits and Wages: Minimizing Total Compensation Cost," Harvard University, unpublished, 2004.

Pauly, Mark V., "Taxation, Health Insurance, and Market Failure in the Medical Economy," Journal of Economic Literature, 24 (June 1986): 629-75.

Starr-McCluer, Martha, "Health Insurance and Precautionary Savings," American Economic Review, 86 (March 1996): 285-95.

Tax Policy Center, "Historical Federal Income Tax Rates for Family of Four," 2002, http://www.taxpolicycenter.org/TaxFacts/TFDB/TFTemplate.cfm?Docid=226.

A Appendix

A.1 General results

Lemma 1 *There cannot be an equilibrium compensation vector with $c > 0$ and in which all workers in firms with that compensation vector purchase health insurance.*

Proof. Suppose there is an equilibrium compensation vector $\{w_1, w_2, ..., w_N, c\}$ with $c > 0$ and all workers allocated to firms with that vector take health insurance. Workers would be indifferent between the original compensation vector and compensation vector $(w_1 - \gamma c, w_2 - \gamma c, ..., w_N - \gamma c, 0)$ which would be profitable. ■

Corollary 5 *All firms in which all workers receive insurance must have the same wages.*

Lemma 2 *At all firms at which $c^* \neq 0$, workers of a given type at that firm either all take or all refuse health insurance.*[10]

Proof. Suppose some workers of type i pay c^* and receive insurance and some do not pay and do not receive insurance. Workers of type $j \neq i$ either all pay c^* or all do not pay c^*. If $c^* < p$, then setting $c = c^* + \Delta > c^*$, $w_j = w_j^* + \gamma\Delta$ for all types purchasing insurance, and $w_j = w_j^*$ for all types not purchasing health insurance and $w_i = w_i^* + \varepsilon$, $\gamma\Delta > \varepsilon > 0$, would attract all of the workers of type $j \neq i$ that the original firm attracted (and possibly additional workers) but only workers of type i who do not purchase insurance. For Δ and ε sufficiently small, this must be profitable. For $c \geq p$ lowering c and lowering wages by γc for groups in which at least some workers purchase health insurance will yield more profit. The argument applies equally if more than one type has some workers who purchase and some who do not purchase insurance. ■

Lemma 3 *Let A represent a compensation vector for which a set M_A pay c_A for health insurance and B represent an offer for which a set M_B pay c_B for insurance with $c_B > c_A$. $M_B \subset M_C$.*

Proof. For types in M_B lowering c_B towards c_A and raising the wage by $\gamma\Delta c$ reduces the employment cost. Types in neither M_A nor M_B will not switch to purchasing insurance since they can already purchase it at c_A and choose not to. Types in M_A but not M_B, employed in A firms value insurance at no more than γc_A and would not switch to the B firm and purchase insurance. ■

A.2 Results for 2 types

Lemma 4 *Offers in which both types of worker receive health insurance for free and offers in which neither type receives health insurance must exist in equilibrium.*

Proof. Suppose not. Then either there are workers of both types who value health insurance at more than its cost and are not receiving it or there are workers of one type who value health insurance at more than its cost and workers of the other type are paying for their health insurance. A compensation vector which gives workers of types not getting health insurance a wage of $w_i - p - \varepsilon$ and workers of the type paying c, $w_j - \gamma c$ and provides health insurance for free will be profitable. The proof of the second part parallels the first. ■

Lemma 5 *In equilibrium there cannot be an offer for which type $1's$ purchase insurance and type $2's$ do not.*

[10] Ignoring sets of measure zero.

Proof. Suppose such an offer exists. To attract type 2 workers, it must pay $w_2 + \gamma c$ where w_2 is the wage paid to type 2 workers at firms offering health insurance for free and c is the price it charge for health insurance. The firm must attract type 1 workers who value health insurance at less than γc. Therefore it need pay a compensating differential of no more than γc to type 1 workers. Suppose it paid less than γc. Then the highest valuation of health insurance among type 1 workers would be less than γc and the firm could reduce c and the wage it paid type 2 workers and increase its profit. Therefore, the firm pays type 1 workers $w_1 + \gamma c$ where w_1 is the wage paid to type 1 workers by firms offering health insurance for free. For this to be an equilibrium both firms offering health insurance for free and those charging for health insurance must make zero profit

$$\pi_A = f(\theta_A) - (w_1 + p)\theta_A - (w_2 + p) = 0 \tag{31}$$
$$\pi_B = f(\theta_B) - (w_1 + \gamma c)\theta_B - (w_2 + p + (\gamma - 1)c) = 0 \tag{32}$$

which establishes that

$$\gamma c < p \tag{33}$$
$$\theta_B > \frac{m_1}{m_2} > \theta_A \tag{34}$$

where m_i is the measure of type i. Now

$$F_2(p + (\gamma - 1)c) > F_1(p + (\gamma - 1)c) \tag{35}$$
$$F_2(\gamma c) > F_1(\gamma c) \tag{36}$$

and

$$\theta_A L_A = m_1(1 - F_1(\gamma c)) \tag{37}$$
$$L_c = m_2 F_2(p + (\gamma - 1)c) \tag{38}$$

and therefore

$$\frac{m_1}{m_2} L_A > m_1(1 - F_1(\gamma c)) \tag{39}$$

or

$$L_A > m_2(1 - F_1(\gamma c)) > m_2(1 - F_2(\gamma c)) \tag{40}$$

which implies that

$$L_A + L_c > m_2(1 - F_2(\gamma c) + F_2(p + (\gamma - 1)c)) > m_2 \tag{41}$$

which is a contradiction. ■

Proof. of Proposition (1)
>From the various lemmas, we know that there are only four candidates for equilibrium offers, one in which both types receive insurance for free (denoted A), one in which neither type receives insurance (denoted C) and two in which one type but not the other purchases insurance from the employer (denoted B if type 1's buy insurance and D if type 2's purchase insurance). B and D offers cannot both exist in equilibrium.

must exist in equilibrium. If not, a firm could offer

Suppose that all four offers exist in equilibrium. Then for type 1's to be indifferent between A and B firms, we must have (13)

$$w_1^B = w_1^A + \gamma c^A$$

and

$$(42) \qquad v_1^A = w_1^A + p$$
$$(43) \qquad v_1^B = w_1^A + (\gamma - 1)c^A + p > v_1^A.$$

where v_i^j is the compensation cost of a type i worker for a type j firm. In order for type 1's to be indifferent between C and D firms, we must have

$$(44) \qquad v_1^C = w_1^C = w_1^D = v_1^D.$$

Similarly, we have

$$(45) \qquad w_2^D = w_2^A + \gamma c^D$$
$$(46) \qquad v_2^A = w_2^A + p$$
$$(47) \qquad v_2^D = w_2^A + (\gamma - 1)c^D + p > v_2^A$$
$$(48) \qquad v_2^B = w_2^B = w_2^C = v_2^C.$$

The middle equality is (15). Since, if $v_1^B > v_1^A$ and $v_2^B > v_2^A$, offer A and offer B cannot both make zero profit, we have

$$(49) \qquad w_2^B < w_2^A + p,$$

and since $v_1^C = v_1^D$, we must have $v_2^D = v_2^C$ or

$$(50) \qquad w_2^A + (\gamma - 1)c^D + p = w_2^C = w_2^B$$

which implies

$$(51) \qquad w_2^B > w_2^A + p$$

and contradicts (49). Therefore only three offers exist in equilibrium.

Let b_2^* represent the highest b of any type 2 at type B firms. If $b_2^* > \gamma c$ some type 2's would choose to purchase health insurance from the firm which is a contradiction. Suppose that $b_2^* < \gamma c$, then lowering both c and w_1^B would be profitable. So $b_2^* = \gamma c$ which is equation (18). But since A jobs offer free health insurance and type 2's do not get insurance at B jobs, the worker type who is indifferent between the two jobs values health insurance at exactly the wage differential or

$$w_2^B - w_2^A = b_2^*.$$

Substituting γc for b_2^* and rearranging terms gives (14).

By a similar argument the wage differential for type 1 workers between working in type A firms and type C firms is b_1^* which is equation (16). ■

Proof. of proposition (2)

The first three conditions follow from combining the zero-profit conditions with the results of the previous proposition. The fourth and fifth conditions ensure that the number of workers employed in firms where they do not receive health insurance equals the correct number of workers of each type.[11] The last three conditions require that the firm hire workers until their marginal product equals their cost of

[11] Without loss of generality given the constant returns to scale assumption, we have treated each offer as being made by a single firm.

compensation. Because of the constant returns to scale assumption, there is only one condition for each type of firm even though each firm hires two types of worker. ■

Proof. of proposition (3)

Substitute (17), (24) and (25) into (19)-(26), use $\theta_B = \theta_C$, add the two labor market clearing conditions and eliminate the two redundant equations to get

$$q(\theta_A, 1) - (w_1 + p)\theta_A - (w_2 + p) = 0 \tag{52}$$

$$q(\theta_B, 1) - (w_1 + p + (\gamma - 1)c)\theta_B - (w_2 + \gamma c) = 0 \tag{53}$$

$$\frac{L_C \theta_B}{m_1} = F_1(p + (\gamma - 1)c) \tag{54}$$

$$\frac{L_A}{m_2} = 1 - F_2(\gamma c) \tag{55}$$

$$q'_A = (w_1 + p) \tag{56}$$

$$q'_B = (w_1 + p + (\gamma - 1)c) \tag{57}$$

$$L_A + L_B + L_C = m_1 \tag{58}$$

$$L_A\theta_A + L_B\theta_B + L_C\theta_B = m_2 \tag{59}$$

Then fully differentiate with respect to the endogenous variables $w_1, w_2, L_A, L_B, L_c, \theta_A, \theta_B, c$ to get

$$\theta_A dw_1 + dw_2 = 0 \tag{60}$$

$$\theta_B dw_1 + dw_2 + ((\gamma - 1)\theta_B + \gamma)dc + c(1 + \theta_B)d\gamma = 0 \tag{61}$$

$$m_1 f_1((\gamma - 1)dc + cd\gamma) = L_C d\theta_B + \theta_B dL_C \tag{62}$$

$$-m_2 f_2(\gamma dc + cd\gamma) = dL_A \tag{63}$$

$$dw_1 = q''_A d\theta_A \tag{64}$$

$$dw_1 + (\gamma - 1)dc + cd\gamma = q''_B d\theta_B \tag{65}$$

$$dL_A + dL_B + dL_C = 0 \tag{66}$$

$$L_A d\theta_A + (L_B + L_C)d\theta_B + \theta_A dL_A + \theta_B(dL_B + dL_C) = 0 \tag{67}$$

Solving for $d\gamma$ as a function of dc alone gives

$$dc = -cd\gamma \frac{(L_B + L_C)q''_A(1 + \theta_A) + q''_B(-m_2 f_2 q''_A(\theta_A - \theta_B)^2 + L_A(1 + \theta_B))}{A} \tag{68}$$

where $A = ((L_B + L_C)q''_A(\gamma + (\gamma - 1)\theta_A) - q''_B(\gamma m_2 f_2 q''_A(\theta_A - \theta_B)^2 - L_A(\gamma + (\gamma - 1)\theta_B))$

Since $q''_A < 0$, $q''_B < 0$, $\gamma > 1$, $f_2 > 0$,the numerator is negative and A is negative,thus the fraction is positive. The fraction is multiplied by $-c$, so that $\frac{d_c}{d_\gamma} < 0$. ■

Proof. of proposition (4)

$$d(\gamma c) = cd\gamma + \gamma dc. \tag{69}$$

Substituting for dc gives

$$d(\gamma c) = -cd\gamma * \frac{(L_B + L_C)q''_A\theta_A + q''_B L_A\theta_B}{A} < 0. \tag{70}$$

■

Proof. Proof of proposition (5)

$$db_1 = d(p + (\gamma - 1)c) = cd\gamma + (\gamma - 1)dc. \quad (71)$$

Substituting for dc gives

$$db_1 = cd\gamma\{1 - (\gamma - 1)\frac{(L_B + L_C)q_A''(1 + \theta_A) - q_B''(m_2 f_2 q_A''(\theta_A - \theta_B)^2 - L_A(1 + \theta_B))}{A}\} \quad (72)$$

$$= cd\gamma\frac{(L_B + L_C)q_A'' + q_B''(L_A - m_2 f_2 q_A''(\theta_A - \theta_B)^2)}{A} > 0. \quad (73)$$

■

Proof. of proposition (6)

(74) $d(L_B) =$

$$-cd\gamma\frac{q_A''[\theta_A m_2 f_2(\theta_B L_B + \theta_A L_C) + m_1 f_1(L_B + L_C - m_2 f_2 q_B''(\theta_A - \theta_B)^2)] + L_A[-L_C + q_B''(m_1 f_1 + m_2 f_2 \theta_B^2)]}{\theta_B A} < 0$$

(75) $d(\theta_B L_B) = \theta_B dL_B + L_B d\theta_B$

$$= -cd\gamma * \frac{q_A''(\theta_A^2 m_2 f_2(L_B + L_C) + m_1 f_1(L_B + L_C - m_2 f_2 q_B''(\theta_A - \theta_B)^2)) - L_A(L_B + L_C - q_B''(m_1 f_1 + m_2 f_2 \theta_B^2))}{A}$$

$$< 0$$

■

Lemma 6 $\theta_A > \theta_B$

Proof.

$$v_B^1 = w_1 + p + (\gamma - 1)c > w_1 + p = v_A^1$$

and therefore

$$v_B^2 < v_A^2$$

which together implies the lemma. ■

Proof. of proposition (7).

$$d[(1 - F_1(b_1))m_1 + (1 - F_2(b_2))m_2]$$
$$= -cd\gamma\frac{\{m_1 f_1[(L_B + L_C)q_A'' + q_B''(L_A - m_2 f_2 q_A''(\theta_A - \theta_B)^2)] - m_2 f_2[(L_B + L_C)q_A''\theta_A + L_A q_B''\theta_B]\}}{A}$$

The right hand side has the same sign as the numerator which proves the necessary and sufficient condition.

If $m_1 f_1 > m_2 f_2 * \theta_A$, then $f m_1 f_1 > m_2 f_2 * \theta_B$ since $\theta_A > \theta_B$. Then

$$m_1 f_1[(L_B + L_C)q_A'' - m_2 f_2[(L_B + L_C)q_A''\theta_A < 0$$
$$m_1 f_1 q_B''(L_A - m_2 f_2 q_A''(\theta_A - \theta_B)^2)] - m_2 f_2 L_A q_B''\theta_B < 0$$

and the numerator is negative which proves sufficiency. ∎

Proof. of proposition (8).

>From the solution of fully differential equations:

$$dw_1 = -cd\gamma \frac{q_A''(L_B + L_C + m_2 f_2 q_B''(\theta_A - \theta_B)\theta_B)}{A}$$

$dw_1/d\gamma < 0$ if and only if $L_B + L_C + m_2 f_2 q_B''(\theta_A - \theta_B)\theta_B > 0$.

$dw_2 = -\theta_A * dw_1$ which proves the second part of the proposition. ∎

Proof. of proposition (9).

Add dw_1 and db_1 to get

$$dw_1^C = -cd\gamma \frac{q_B''(q_A'' f_2(\theta_A - \theta_B)\theta_A - L_A)}{A} > 0.$$

∎