Worker Sorting, Taxes and Health Insurance Coverage

Kevin Lang
Boston University and NBER & IZA
Dept. of Economics
Boston University
270 Bay State Road
Boston, MA 02215
lang@bu.edu

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Abstract

If firms hire heterogeneous workers but must offer all workers insurance benefits under similar terms, then 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. This pattern is consistent with trends in the U.S. economy following the creation of section 125 plans.
Introduction

In the United States, most adults and many dependent children receive their health insurance through an employer. Amidst growing concerns about the number of uninsured Americans, a wide range of reforms have been proposed. Many are intended to encourage employers to offer health insurance; others are intended to weaken the link between the labor market and health insurance.

Surprisingly, there are few papers that analyze the interaction between the labor market and health insurance. In this paper, I analyze labor market equilibrium when firms may choose to offer health insurance as part of their compensation package and, if so, may fully or partially subsidize the insurance they offer. I use the model to assess the effect on insurance coverage of making employees' share of health insurance premiums tax-deductible. I find that as the tax wedge between the workers' cost of employee premiums and their value to the firm declines, more firms require employee premium contributions and the premiums rise. Furthermore, because this reduces the cost of offering health insurance, more firms choose to do so. However, since fewer firms offer health insurance for free, the take-up rate declines. The overall effect on coverage may be positive or negative.

This is consistent with the U.S. experience since the introduction of section 125 of the Internal Revenue Service code under which firms may allow employees to contribute their portion of insurance premiums for employer-provided health insurance on a pre-tax basis. Between 1986 and 1997, the share of firms offering IRS Section 125 plans grew rapidly. One might have expected that by making it cheaper for workers to purchase health insurance through their employer, section 125 would increase insurance coverage. Yet over roughly the same period, there was a dramatic decline in the fraction of workers covered by employer-provided health insurance with health-insurance coverage in the private sector declining from 70.6% in May 1983 to 64.5% by February 1997 (Farber and Levy, 2000). As predicted by the model, there was a large increase in the proportion of workers obtaining employer-provided health insurance who contribute to the cost of their insurance premium (Gruber and McKnight, 2002). And, also as predicted, the number of workers in firms offering health insurance rose. However, perhaps because more firms are requiring employee premiums, the take-up rate has declined (Farber and Levy, 2000).

Although it is not the main focus of the paper, I demonstrate the broader use of the
model by applying it to analyze the effect of increasing the tax on employer-paid premiums. Here, too, the effects are complex and could result in an increase in coverage for some types of workers.

Even ignoring the effect on government revenues, the model predicts important distributional effects from policy changes. I find that reducing the tax wedge increases health insurance coverage among groups in which the coverage rate was initially high and decreases the coverage where it was low. Moreover, workers in groups that generally place a high value on health insurance benefit from the change if the individuals, themselves, value insurance highly, but are hurt if their individual valuation is low. The opposite is true in groups where health insurance is generally not highly valued. Therefore, if we assume that high-skilled workers generally value health insurance more, the model predicts a decline in insurance coverage among the low-skilled workers, a trend documented by Farber and Levy (2000). This varying impact of the tax wedge reduction across different skill groups may also help explain the large fall in health insurance coverage in the private sector and the rise in public sector coverage from 1979 to 1997.1

While the focus of the paper is on the effect of making employee-paid premiums tax-deductible, I view the contribution as broader. The labor market model of health insurance that I propose is relatively tractable, making it potentially valuable for assessing the impact on the labor market and health insurance coverage of other proposed health insurance related reforms. For example, there has been much public discussion of tax reforms that would reduce the tax advantage of employer-provided plans over plans in the individual market. Employees who purchase health insurance on the private market can deduct insurance premiums only to the extent that their total health costs exceed 7.5% of their adjusted gross income. Therefore, in practice, few employees would be able to deduct their premiums if they did not purchase insurance through their employer, and the tax law creates a strong incentive to link insurance to employment.2 Understanding the effects of

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1 The public sector tends to have more skilled workers than the private sector. Almost half of the workers in the public sector have at least a college degree while only 24.9 percent of workers in the private sector have at least a bachelor’s degree. (U.S. Bureau of Census, Current Population Survey (CPS), Annual Social and Economic Survey File, March 2006.)

2 Current U.S. tax law allows the self-employed to deduct their health insurance premiums up to their level of net profit.
reforms designed to weaken this link requires a tractable model linking wages and health insurance.

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 (2005) 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.

Dey and Flinn (2005) 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.

In the model, there is no labor market failure. Instead, 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. This imperfect sorting of workers is important, because firms are compelled to offer health insurance in a nondiscriminatory fashion. They cannot offer insurance to the types of workers they know place a high value on insurance and refuse to offer it to the types they know place a low value on it. Despite the tax advantages to offering health insurance for free, if the low-skill workers’ valuations are sufficiently low and high-skill workers’ evaluations sufficiently high, it is efficient (and

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3In the main model, I assume that high-skilled workers have greater willingness to pay for insurance, perhaps because of higher earnings or the absence of alternate government programs.
profitable) for the firm to charge for health insurance so as to only provide it to those workers with high valuations and not to those with low valuations.

In equilibrium, some firms choose to offer health insurance for free to all employees; others offer health insurance but require an employee contribution while the remaining do not offer health insurance at all. When firms require a contribution, some, but not all, workers choose to purchase health insurance. Workers who must pay a 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.

However, because the tax wedge is distortionary, some workers whose valuation of health insurance exceeds 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 the government’s objective is to increase the prevalence of health insurance, reducing the tax wedge may actually be harmful. Moreover, the tax wedge affects wages through its impact on compensating differentials. Reducing the wedge can lower the wages of the less skilled workers.

1.1 A Highly Stylized Example

I start with a simple example to highlight the basic intuition for the main model. Suppose that there are four workers of each type and that each firm requires exactly one worker of each type. For concreteness, we will assume that the full premium for insurance, $p$, is 6. Type 1 workers value the insurance at $b_1 = \{5, 7, 11, 12\}$ while type 2 workers value it at $b_2 = \{1, 2, 4, 7\}$.

There is a planner whose goal is to maximize the sum of the excess of workers’ valuations over the insurance premium ($\Sigma(b_i - p)$) for those workers receiving insurance. The planner can allocate workers to firms and can require any individual firm to provide insurance to all its workers or not to provide insurance to any of its workers.
In the main part of this paper, a firm can deter workers who are offered health insurance from taking up that insurance by requiring an employee premium. There I formally model the tax wedge as the difference between the amount a worker must earn to pay an employee premium and the amount of that employee premium received by the firm. In that model, the cost of deterring take-up is determined by the exogenous tax wedge and the endogenously chosen employee premium.

In this highly stylized example, I capture the intuition behind that model by assuming that at an additional cost, the planner can deter individual workers who have been offered insurance from taking it. While this cost is exogenous in the example, the reader should remember that it is endogenized in the main part of the paper.

What should the planner do? It is fairly obvious that he should make sure that the type 1 worker and type 2 worker with the highest valuations get insurance and that the ones with the lowest valuations do not. He can achieve this by allocating the former pair to the same firm and having that firm provide insurance to both workers. Similarly he can allocate the latter pair to the same firm and have that firm not provide insurance. He is then left over with type 1 workers with valuations 11 and 7 and type 2 workers with valuations 4 and 2. How should he allocate these remaining workers?

Suppose first that it is very costly to deter workers who are offered insurance from taking it. Given the insurance cost of 6, the optimum is to take the worker with the higher valuation in each pair and put them together in a firm where they both receive insurance and to take the worker with the lower valuation in each pair and place them together in a firm with no insurance. Thus, in equilibrium, half of the workers are in firms that offer insurance, and all of the workers in these firms choose to take-up the insurance. The offer rate is .5, the take-up rate 1, and the coverage rate .5.

Suppose now that there is little or no cost to deterring workers offered insurance from taking it. Then the planner should assign the four intermediate workers to firms offering insurance but then pay the cost of deterring the two type 2 workers from taking the insurance. Therefore, when the cost is low, three-quarters of workers will be in firms that offer insurance, but only two-thirds of these workers will take the insurance and the

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4It does not matter how these workers are matched.
coverage rate will then be .5. Thus, in this very stylized example, lowering the cost of deterring workers from taking up the insurance (lowering the tax wedge) increases the offer rate, lowers the take-up rate and leaves the coverage rate unchanged.

Of course, I have examined a planning problem rather than a competitive equilibrium. However, in this case, the two are the same.\textsuperscript{5} The real problem is that in the highly stylized example the cost of deterring a worker from taking up insurance is included in an ad hoc manner. In the model below, this cost arises because firms that want to deter some workers from taking the offered insurance must charge an employee premium. This premium is costly, because it means that workers who do take the insurance do not get the full tax advantage of employer-provided insurance.

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. Note that the critical assumption is that within each group of workers, some workers value insurance at more than its cost while others value it at less than its cost.

We will also need the distributions of willingness to pay to differ for the two groups. If not, it would be possible to create firms in which all workers shared the same willingness to pay for insurance. It is convenient to assume that one distribution stochastically dominates the other, and without loss of generality, I assume that type 1 workers tend to be willing to pay more for health insurance

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

with strict inequality for $0 < F_1(b) < 1$.

\textsuperscript{5}There are multiple efficient allocations and competitive equilibria, but all are equivalent for our purposes.
I 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. Because there is no variation in expected health costs, there is also no adverse selection in the main formulation. However, in Section 4, I provide an example with adverse selection and show that the main predictions of the model still hold.

I do not formally model a relation between earnings potential and willingness to pay. However, implicitly, we can 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. Later, I provide an example in which willingness to pay depends on earnings, and the results continue to apply.

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, modeling this properly would require modelling the joint employment decision, and I abstract from this complication.

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, I abstract from issues of moral hazard associated with varying generosity of health plans.

The employee compensation package consists of a wage, $w$, 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.\footnote{In addition to prohibiting most forms of direct discrimination, the tax code prevents employers from structuring their rules in such a way as to effectively restrict benefits to certain key employees defined by their role in the company and by their earnings. In our model, some firms will use employee premiums to exclude one group of workers from health insurance while providing it to a second group. If the latter is interpreted as the group of key employees, this would clearly be illegal. However, we think of both groups}
The amount received by the firm from each worker who purchases insurance is $c$. The cost to the worker is $\gamma c$, where $\gamma > 1$. I model $\gamma$ as arising from differential tax treatment of firm and worker health insurance premiums.

Utility for worker $i$ given by

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

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

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 $c > \bar{b}/\gamma$ where $\bar{b}$ is the highest willingness to pay is equivalent to the firm not offering health insurance. Therefore, I will treat $c$ as infinite in the case where insurance is not available at the firm.

The firm’s profit is given by

$$\pi = q(L_1, L_2) - w_1L_1 - w_2L_2 - \sum_{j=1}^{2} \sum_{i \in L_j} (p - c)H_i.$$  

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

$$q(L_1, L_2) = L_2q(L_1 L_2^{-1} 1) \equiv L_2q(\theta)$$  

where $\theta$ is the ratio of type 1 to type 2 workers employed in the firm. I make the usual assumption that $dq/dL_i > 0$ and $d^2q/dL_i^2 < 0.$

2.1 Equilibrium

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

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7It is also important to note that the model treats the scope of the firm as fixed. Therefore, firms cannot sub-contract the unskilled work to another firm although for some types of work this is an important strategy firms use to get around the nondiscrimination rules governing health insurance and pensions. Such sub-contracting is not costless but it is also not impossible. I abstract from this possibility.
Definition 1 An equilibrium is a profile of compensation packages 
\{ (w_A^1, w_A^2, c^A), (w_B^1, w_B^2, c^B), \ldots (w_K^1, w_K^2, 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. \( \theta \) 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. I 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. I then show that 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. I 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. Furthermore, as I discuss in Section 4, the comparative statics as predicted by the main model continue to hold with multiple types of workers. Therefore in the text and in the remainder of the paper, I limit the analysis to the case of two types.

Proposition 1 In equilibrium, there are at most three compensation packages. These take the form \( (w_A^1, w_A^2, 0), (w_B^1, w_B^2, c^*), \) and \( (w_C^1, w_C^2, \infty) \). If all three packages are present in
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 (1) 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 $\gamma c$ which is also the compensating differential this worker requires to be indifferent between $A$ firms and $B$ and $C$ firms, which gives (2) and (6).

Workers who do not get health insurance do not care whether it is offered and how much the firm charges for it which explains (3). Since $w_2^B = w_2^C$, the cost of employing type 1 workers must be the same at $B$ and $C$ firms which leads to (4), 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 (5).

We have not formally discussed the option of purchasing an individual insurance plan. Not surprisingly, in the model, no one would choose to do so. The cost of the individual insurance plan is $\gamma p$ and therefore exceeds the wage differential between firms offering insurance for free and those not offering insurance.

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 ($\gamma$ 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. This case is uninteresting. The
remainder of the paper considers only the case where all three packages exist in equilibrium.

I note that the equilibrium has some of the features of Levy (1998) but, in contrast with that paper, the composition of the labor force within each firm is endogenous. Heterogeneity in demand for health insurance does not cause the firm to require an employee premium, and charging a premium does not cause the firm to have a work force with heterogeneous tastes for health insurance. Instead these are equilibrium outcomes. Neither can be said to be causally prior. Nevertheless, many of the predictions in Levy’s work apply equally to this model: firms with a high proportion of workers with high demand for health insurance will provide health insurance for free (or, equivalently, firms that provide health insurance for free will have a high proportion of workers with high demand for health insurance). Firms with a labor force with heterogeneous demand for health insurance will charge workers for insurance. In this sense the motivation for charging is identical to that in Levy.

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

**Proposition 2 In equilibrium**

\begin{align*}
q(\theta_A) - (w_1 + p)\theta_A - (w_2 + p) &= 0 \\
q(\theta_B) - (w_1 + p + (\gamma - 1)c)\theta_B - w_2 - \gamma c &= 0 \\
q(\theta_C) - (w_1 + b_1^*)\theta_C - w_2 - \gamma c &= 0 \\
L_C\theta_c/m_1 &= F_1(b_1^*) \\
L_A/m_2 &= 1 - F_2(\gamma c) \\
qu_A &= (w_1 + p) \\
qu_B &= (w_1 + p + (\gamma - 1)c) \\
qu_C &= (w_1 + b_1^*) \\
\theta_AL_A + \theta_BL_B + L_C &= m_1 \\
L_A + L_B + L_C &= m_2
\end{align*}

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

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Proof. see appendix. ■

Equations (7)-(9) are the zero-profit conditions. Equations (10) and (11) require that the number of workers in each type of firm conforms to the number with the appropriate willingness to pay. Equations (12)-(14) are the usual first-order conditions. Note that there is only one per type of firm because of the constant returns to scale assumption. Further note that from Proposition 1 \( b_1^* = p + (\gamma - 1)c \) and therefore \( q_B' = q_C' \) and \( \theta_B = \theta_C \).

While my 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 B than at A 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 I 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

To assess the impact of a rise in the use of Section 125 plans, I examine the effect of changing the tax wedge on wages in each type of job, the employee premium for health insurance in firms requiring 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.

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

**Proposition 3**  \( \frac{dc}{d\gamma} < 0 \).

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

**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** *Decreasing the tax wedge lowers 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 for not having health insurance, we have

**Corollary 3** *Decreasing the tax wedge raises 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 down, the compensating differential between type 1 workers receiving health insurance for free and those not receiving health insurance goes down.
Proposition 5 \(d(p + (\gamma - 1)c)/d\gamma > 0\)

Corollary 4 Decreasing the tax wedge raises the fraction of type 1 workers getting health insurance.

We have established that when the tax wedge goes down, there are more type 2 workers without health insurance and thus fewer in type A firms and that there are more type 1 workers with health insurance and thus fewer in type C firms. It is therefore not too surprising to find that there are more of both types of worker in type B firms when the tax wedge decreases. I 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 decreases, the number of type 2 workers with health insurance decreases while the number of type 1 workers with health insurance rises. What then is the overall effect of an decrease 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. A decrease in the tax wedge, raises 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 rises when the tax wedge falls if and only if

\[
(17) \quad m_1 f_1 [(L_B + L_C)q''_A + q''_B(L_A - m_2 f_2 q''_A (\theta_A - \theta_B)^2)] < m_2 f_2 [(L_B + L_C)q''_A \theta_A + L_A q''_B \theta_B].
\]

A sufficient condition for (17) is that \(m_1 f_1 / m_2 f_2 > \theta_A\) 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 \(\theta_A\) 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 decreases, the wages of type 1 workers in type C firms decrease relative to those in type A and B firms and that the wages of type 2
workers in B and C firms rise relative to those in type A firms. What happens to the relative wages of type 1 and type 2 workers? Our intuition suggests that decreasing $\gamma$ makes providing health insurance cheaper and should increase the 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 fall and wages of type 2 workers in these firms rise.

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

\[
L_B + L_C + m_2 f_2 q_2^B (\theta_A - \theta_B) \theta_B > 0.
\]

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 falls for type 1 workers and rises for type 2 workers when $\gamma$ falls. Therefore (18) is a necessary and sufficient condition for the wages of all type 1 workers to fall 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 fall which, in turn, implies that the wages of type 2 workers without health insurance go up when the tax wedge decreases.

**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.

4 Extensions and Examples

I begin with a simple example. The production function is given by

\[ Q = (2^\theta A^5 + 1)^2. \]

The measure of each type of worker is 1. The cost of insurance is .25. Among type 1s, willingness to pay for insurance is distributed uniformly on the unit interval while it is distributed uniformly on the interval \((0, .5)\) among type 2s. Table 1 shows the key parameters when the tax wedge is 1.5 and when the wedge is 1.4. If we interpret \(\gamma\) as reflecting the case where the employee premium is paid post-tax, these values of \(\gamma\) correspond to tax rates of 33% and 29%.

The results of the example are shown in the first two columns of Table 1. As I showed analytically, reducing the tax wedge lowers the proportion of workers in firms offering insurance for free and in firms not offering insurance. In the example, the proportion of workers in firms receiving free insurance falls by about 1.4 percentage points while the proportion in firms not offering insurance falls by about .8 percentage points. Consistent with our intuition that wages rise for type 1s who get insurance and fall for type 2s who get insurance, in firms offering insurance for free, wages received by type 1 workers rise slightly while those received by type 2 workers decline slightly. Wages rise slightly for both types of worker in firms that charge for insurance. In firms that do not offer insurance, wages for type 1 workers fall slightly while those of type 2 workers rise slightly. Again, this confirms the analytic results. Overall, the offer rate increases by .8 percentage points but coverage falls by .4 percentage points.
4.1 Taxing Employer Premiums

In this sub-section I analyze the effect of taxing employer premiums as part of worker compensation. Until now, it has been convenient to work with pre-tax wages rather than explicitly model taxes, but to show the relation between taxation of employer premiums and deductibility of employee premiums, it is helpful to be explicit about taxes.

Let \( w_N \) denote the earnings of a worker not receiving insurance and \( w_I \) denote the wage of that same worker receiving insurance paid for entirely by the firm. Then for the worker to be indifferent between the two compensation packages requires that

\[
\gamma w_N = \gamma w_I
\]
\( (1 - t)w_N = (1 - t)w_I + b^a - \delta tp \)

where \( t \) is the tax rate on earned income, \( b^a \) is the valuation of insurance in after-tax earnings and \( \delta \) is the proportion of the employer premium on which the worker pays taxes. Rearranging terms gives

\[
\begin{align*}
\text{(21)} & \quad w_N = w_I + \frac{b^a}{1 - t} - \frac{\delta t}{1 - t} p \\
\text{(22)} & \quad = w_I + b - \tau p
\end{align*}
\]

where \( b \) is, as before, the value of insurance in pre-tax earnings, and \( \tau \equiv \delta t/(1 - t) \). A sufficient condition for \( \tau < 1 \) is that the tax rate by less than .5.

Similarly, let \( w_P \) denote the earnings of the worker if she pays part or all of the premium for her employer-provided insurance. Then for the worker to be indifferent between paying part of the premium and not paying any of it requires that

\[
(1 - t)w_P - (1 - \lambda t)c + b^a - \delta t(p - c) = (1 - t)w_I + b^a - \delta tp
\]

where \( \lambda \) is the proportion of the employee premium that is tax deductible. Rearranging terms gives

\[
\begin{align*}
\text{(23)} & \quad w_P = w_I + \frac{1}{1 - t} (1 - \lambda t - \delta t) c \\
\text{(24)} & \quad = w_I + (\gamma - \tau)c
\end{align*}
\]

where \( \gamma \equiv (1 - \lambda t)/(1 - t) \geq 1 \).

It is worth noting that if \( \delta = 1 \) (employer premiums are fully taxable) and \( \lambda = 0 \) (employee premiums are not deductible) or \( \delta = 0 \) and \( \lambda = 1 \), \( \gamma - \tau \) reduces to 1. Note also that if employee-paid premiums were deductible and employer-paid premiums were taxable, workers would prefer to pay the premium. I assume throughout that \( \delta + \lambda < 1 \) or equivalently that \( \gamma - \tau - 1 > 0 \).

A worker at a firm offering insurance will be indifferent between purchasing and not purchasing insurance if

\[
(1 - t)w + t\lambda c + b^a - c - \delta t(p - c) = (1 - t)w.
\]
Dividing by $1 - t$ and rearranging terms gives

$$b = \tau p + (\gamma - \tau) c.$$  

Putting (22) and (25) together, reveals that a worker with $b = (\gamma - \tau)c$ will be indifferent between being in a firm charging for insurance and one providing it for free and will be indifferent between purchasing and not purchasing the insurance if

$$w_P = w_N = w_I + (\gamma - \tau) c - \tau p$$

We can now insert (22) and (24) into (7)-(16) to get

$$q(\theta_A) - (w_1 + p)\theta_A - (w_2 + p) = 0$$

$$q(\theta_B) - (w_1 + p + (\gamma - \tau - 1)c)\theta_B - (w_2 + (\gamma - \tau)c) = 0$$

$$q(\theta_C) - (w_1 + b_1^* - \tau p)\theta_C - (w_2 + (\gamma - \tau)c) = 0$$

$$\frac{Lc\theta_B}{m_1} = F_1((1 + \tau)p + (\gamma - \tau - 1)c)$$

$$\frac{L_A}{m_2} = 1 - F_2(\tau p + (\gamma - \tau)c)$$

$$q'_A = w_1 + p$$

$$q'_B = w_1 + p + (\gamma - \tau - 1)c$$

$$q'_C = w_1 + b_1^* - \tau p$$

$$\theta_A L_A + \theta_B (L_B + L_C) = m_1$$

$$L_A + L_B + L_C = m_2.$$  

What are the effects of raising $\tau$, that is increasing the proportion of the employer premium that is taxable? Intuitively, since raising $\tau$ makes it more expensive for employers to provide insurance or, equivalently, makes its provision more costly to employees, we would expect firms to be less likely to offer insurance.

To some extent, this intuition turns out to be correct. We can prove that raising $\tau$ makes type 2 workers less likely to obtain health insurance. This is stated formally as:

**Proposition 10** $dL_A/d\tau < 0$. 

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Proof. see appendix ■

However, it is not true that increasing the taxation of employer-paid premiums must lower insurance coverage for all types of workers. It is possible to construct examples in which raising \( \tau \) increases coverage of type 1 workers. The intuition is similar to that for reducing taxation of employee-paid premiums. Doing so makes charging workers for their health insurance attractive and making charging for insurance more attractive can increase its availability. However, in contrast with reducing the tax on employee-paid premiums, raising the tax on employer-paid premiums does not always increase coverage of type 1 workers. Indeed, the proposition below suggests that the opposite is more common.

**Proposition 11** If \( \theta_B < 1 \), then \( d\theta_B L_C/d\tau > 0 \).

Proof. see appendix ■

Only if the ratio of type 1 workers to type 2 workers in jobs not offering insurance for free exceeds 1 can increasing the tax on employer-paid premiums increase coverage of type 1 workers. Note than since \( \theta_B < \theta_A \), we can only get \( \theta_B < 1 \) if the ratio of type 1 workers to type 2 workers exceeds 1 and by continuity, we would expect coverage of type 1 workers to fall even when \( \theta_B \) is somewhat greater than 1. So, while we can construct counterexamples, the basic intuition that making health insurance more expensive will reduce coverage is largely correct.

### 4.2 Different Tax Rates

I 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 \( \gamma \) 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.

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.

4.3 Multiple types of workers

Extending the model to the case of many types of workers is difficult primarily because of the need to specify conditions under which different combinations of workers can be matched. However, the basic structure of the model goes through. Assuming the appropriate parameters to permit the existence of all types of firms, there will be firms that offer insurance for free, firms that charge a low employee premium and all of whose employees except one type purchase the insurance, firms that charge a somewhat higher premium and all of whose employees purchase insurance except the two types that are least willing to pay, and so on through firms that do not offer insurance.

In all of the examples I have constructed, the comparative statics continue to hold: reducing the tax wedge increases the number of workers who are in firms that charge an employee premium and increases the premium charged by each type of firm with an indeterminate effect on total coverage However, in some examples, the overall increase in the average employee premium, conditional on the employee premium being positive, is small because there is sometimes a much bigger increase in the proportion of employees paying any premium than there is in the distribution of the rest of the workforce.
4.4 Endogenous insurance demand based on earnings

When I presented the basic model, I noted that I was assuming that type 1 workers had a greater willingness to pay than type 2 workers do because I think of type 1 workers as skilled and thus higher pay. I did not formally model demand for health insurance as depending on earnings because this complicates the comparative statics; I would have to take account of the effect of the tax change on the wage distribution and the effect of the change in the wage distribution on willingness to pay.

In this example, I endogenize willingness to pay. I continue to use the parameters of the simple example above. However, I assume that the cost of health care in the event of illness is 6.0. Given the wages in the simple example, this suggests (verified below) that workers without health insurance will either go bankrupt or be unable to pay for health care. I assume that the utility associated with this state is 0. To produce a health insurance price of .25, I assume that the probability of illness, $q$, is 1/24. Workers who are not ill, either because they did not get sick or because their insurance covered the cost of care and allowed them to recover have utility

$$u = C^a$$

where $C$ is consumption. Therefore for those without insurance, utility is given by

$$u_u = (1 - q)w^a$$

while for those with insurance, it equals

$$u_i = (w - c\gamma)^a.$$  

Willingness to pay for insurance is given by

$$(1 - q)w^a = (w - b)^a$$

or

$$b = (1 - (1 - q)^{1/a})w.$$  

I note that, in this example, willingness to pay is proportional to income. I also note that I continue to ignore taxes and focus only on the tax wedge. A major advantage of
the assumption about the utility function is that a proportional tax drops out of all the equilibrium conditions. All that matters is the wedge. Thus if no portion of the employee premium is paid pre-tax, we can interpret $\gamma$ as $1/(1-t)$ and changes in $\gamma$ as reflecting changes in the tax rate. Alternatively, we can interpret different values of $\gamma$ as reflecting differences in the portion of the premium that can be paid pre-tax, holding the tax rate constant.

We cannot exactly replicate the simple example above with exogenous willingness to pay, but we can come close. I assume that $a$ is distributed uniformly between .2 and 1. This turns out to imply that type 1 workers have a willingness to pay of between .24 and 1.1 and that type 2 workers have a willingness to pay between .12 and .55.

Column 3 of Table 1 gives the equilibrium values for the baseline case where $\gamma$ equals 1.5. Wages, the employee premium and the coverage rate are similar to the values obtained in the case where willingness to pay is exogenously determined. However, the example also results in more type B firms and therefore a higher offer rate.

The last column of Table 1 shows the effect of reducing the tax wedge to 1.4. The effects on many of the equilibrium values are similar to those obtained with an exogenous willingness to pay for health insurance. We see a similar increase in the employee premium and similar small changes in the wages paid by different types of firms. The decline in the coverage rate between the third and fourth columns is also similar to that between the first two columns. However, the rise in the offer rate is noticeably larger because the shift towards type B firms is noticeably more marked in the example with endogenous willingness to pay than it is in the example with exogenous willingness to pay.

Still, the most important point is that the broad predictions of the base model are maintained.

### 4.5 Adverse selection

Because I focus on the effects of tax treatment of insurance premiums, I have abstracted from the issue of adverse selection. Just as in a standard insurance market, it is possible

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8 If we explicitly account for taxes, equation (39) becomes $(1-q)((1-t)w)^a = ((1-t)(w-b))^a$ and the $(1-t)$ terms cancel. Wages should be viewed as pre-tax.
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.

I maintain the example in the previous sub-section. However, instead of assuming that all workers have the same expected insurance costs but vary in their degree of risk aversion, I fix $a$ at .5 for all workers and allow $q$, the probability of illness, to be uniformly distributed between 0 and .05. The average probability of illness is therefore somewhat lower than in the previous examples, but it will turn out that in equilibrium, the average probability of illness among those receiving insurance will be close to that in the earlier examples.

I assume, as before, that any firm that requires an employee premium must set the same premium for all workers. However, the implicit price given by the difference between the wages of those without insurance and those who receive it for free may differ between the two types of workers. I also assume that the insurance premium paid by the employer is equal to the expected health costs of its insured workers. Therefore, an employee with a high risk of illness is implicitly more costly to insure than is one with a low-risk of illness.

The first column of Table 2 shows the baseline equilibrium with a tax wedge of 1.5. In equilibrium the proportion of workers receiving health insurance is lower than in the two examples without adverse selection even though the equilibrium price of insurance is lower. Note that there are different implicit prices of insurance for the two types of workers. Because type 2 workers are more adversely selected than are type 1 workers, among those with health insurance, their expected health costs are higher. Since employers are charged the expected health costs of their employees, there is implicitly a higher insurance cost for type 2 than for type 1 employees.
<table>
<thead>
<tr>
<th>TABLE 2</th>
<th>MODEL WITH ADVERSE SELECTION</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$\gamma=1.5$ Tax Rate=.33</td>
</tr>
<tr>
<td><strong>Free insurance firms (Type A)</strong></td>
<td></td>
</tr>
<tr>
<td>Type 1 Employees</td>
<td>39.3</td>
</tr>
<tr>
<td>Type 2 Employees</td>
<td>37.9</td>
</tr>
<tr>
<td>Type 1 Wage</td>
<td>5.742</td>
</tr>
<tr>
<td>Type 2 Wage</td>
<td>2.795</td>
</tr>
<tr>
<td><strong>Employee premium firms (Type B)</strong></td>
<td></td>
</tr>
<tr>
<td>Type 1 Employees</td>
<td>13.4</td>
</tr>
<tr>
<td>Type 2 Employees</td>
<td>13.7</td>
</tr>
<tr>
<td>Type 1 Wage</td>
<td>5.924</td>
</tr>
<tr>
<td>Type 2 Wage</td>
<td>2.977</td>
</tr>
<tr>
<td>Employee Premium</td>
<td>0.121</td>
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<tr>
<td><strong>No insurance firms (Type C)</strong></td>
<td></td>
</tr>
<tr>
<td>Type 1 Employees</td>
<td>47.3</td>
</tr>
<tr>
<td>Type 2 Employees</td>
<td>48.4</td>
</tr>
<tr>
<td>Type 1 Wage</td>
<td>6.024</td>
</tr>
<tr>
<td>Type 2 Wage</td>
<td>2.977</td>
</tr>
<tr>
<td><strong>Coverage rate</strong></td>
<td>45.3</td>
</tr>
<tr>
<td><strong>Offer rate</strong></td>
<td>52.1</td>
</tr>
</tbody>
</table>

**Implicit Full Price of Insurance**

|         | $\gamma=1.5$ Tax Rate=.33 | $\gamma=1.4$ Tax Rate=.29 | $\gamma=1.97$ Tax Rate=.49 | $\gamma=1.148$ Tax Rate=.129 |
|---------|-----------------------------|
| Type 1 Employees | 0.221 | 0.219 | 0.226 | 0.211 |
| Type 2 Employees | 0.243 | 0.249 | 0.229 | 0.274 |

Assumes that probability of illness is $U(0, .5)$. The cost to the insurer of an illness is 6. Uninsured illness reduces consumption to 0. Utility is given by the square root of consumption.

The second column repeats the exercise of reducing the tax wedge to 1.4. We see a sharp drop in both the fraction of workers in firms offering insurance for free and those not providing insurance. The result is an increase in the offer rate and a decrease in the coverage rate, as in the earlier examples. Also consistent with the earlier examples and
analysis with exogenous willingness to pay, wages rise for type 1 workers with insurance and fall for those without insurance while the opposite is true of type 2 workers.

Columns 3 and 4 show the tax wedges that are just sufficient to eliminate any firms charging for insurance \((\gamma = 1.97)\) and to push firms charging for insurance to set the premium at one hundred percent of their own insurance cost \((\gamma = 1.148)\). For even lower tax wedges, the firm would want to set a premium above the cost of offering insurance (to type 1 workers) in order to deter type 2 workers from purchasing insurance, something which would probably be illegal.\(^9\)

Comparing the last two columns with the first two, we observe that the pattern persists. Coverage rates are higher and the offer rate lower when the tax wedge is greater. A greater tax wedge is also associated with lower wages for type 1 workers who receive insurance and type 2 workers who do not and with higher wages for type 1 workers without insurance and type 2 workers with insurance.

### 4.6 Couples

Although I have suggested casually that willingness to pay for health insurance might be affected by ability to obtain insurance through one’s spouse, in contrast with Dranove, Speir and Baker (2000), I have abstracted from the family in the formal model. DSB assume that all workers are part of a couple and that couples value health insurance at more than its cost and focus on the symmetric equilibrium where homogeneous firms all offer the same compensation package (although in an extension heterogeneous firms may offer different packages). In the model in this paper, the equilibrium is straightforward. Assuming that workers differ only with respect to the price at which they can obtain insurance from their spouse’s employer, we have only one type of worker and no need to match different types of workers. Therefore, as long as there is a tax wedge, there would be two types of firms. One type, like the type A firms, would offer health insurance for free. The other, like the type C firms, would not offer it at all but would pay a compensating differential equal to the price of health insurance. If both members of a couple worked, one would accept employment at a firm with free insurance from which both members would get their insurance, and

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\(^9\)If we impose that the employee premium cannot exceed the average cost of insurance to the employer, in equilibrium for sufficiently low \(\gamma\), some type 2 workers purchase insurance at type B firms.

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the other would choose to work at a high-wage firm with no insurance. If only one spouse worked, she would work at a low-wage firm offering health insurance. Type B firms would not exist.

We can imagine a more complicated setting in which men and women tend to work in different jobs. For example, suppose all wives manage restaurants and all husbands are chefs. Each restaurant requires one manager and one chef. All men work in the labor market but only half of women do. In equilibrium one-third of women and two-thirds of men should work in restaurants offering health insurance for free while their spouses, if in the labor force, should work at restaurants that do not offer insurance. While I do not claim to offer a formal proof, it appears likely that under the DSB assumption that all couples value health insurance at more than its price, the market can always sort workers perfectly so that only one spouse works at a firm offering insurance, and no firm need require an employee premium. Of course, the assumption that the labor market is perfect is a strong one. I do not wish to suggest that there is no insight from assuming that matching is imperfect and considering the potential for firms to attempt to shift premiums to the firms employing their employees’ spouses.

4.7 Multiple insurance plans

Levy (1998) notes that firms may offer several plans and provide a fixed subsidy so that workers must cover the extra cost associated with the more expensive plans. Extending the model to the case where firms may provide more than one insurance plan is complicated, and I have attempted to address it in a companion paper (Kang and Lang, 2004). The basic logic of the simple model goes through when firms can choose to offer two plans of differing quality. Some firms will offer only the more expensive plan for free and will attract high demand workers. Others will not offer any insurance and attract workers with low willingness to pay for insurance. Depending on the parameters of the model, some firms may offer both plans and charge only for the more expensive plan. These firms attract type 1 workers with a high willingness to pay for health insurance and type 2 workers with an intermediate willingness to pay. It is not, however, the case that the net cost of the two plans to the firm must be the same.
5 Conclusion

In this paper, I have explored the impact of a reduction in the tax wedge on 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 regarding the prevalence of employee premium contributions and the divergence in coverage across workers groups with different health insurance valuations. These predictions are in line with the historical trends in employee contributions, offer, and coverage rates as documented in the literature. The predictions regarding equilibrium compensating differentials are surely inconsistent with the data, as is common in models of compensating differentials, since high-wage jobs tend to provide health insurance. This may reflect our limited ability to control for differences in skills in empirical work or a failure of the market-clearing model of compensating differentials that underlies the approach in this paper (Lang and Majumdar, 2004).

Based on the model, I make two points which I 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 (2005) 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 or eliminating the deductibility of employer premiums 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.

Moreover, this message is not limited to a single example. Instead, my point is that consideration of any reforms intended to increase health insurance coverage by making employers more willing to provide or workers more willing to purchase insurance must be analyzed in the context of the labor market. In this period in which health insurance reform is at the forefront of political agenda, 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.

6 References


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 \( w_i = w_i^* + \epsilon, \gamma \Delta > \epsilon > 0 \), 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 \( \Delta \) and \( \epsilon \) sufficiently small, this must be profitable. For \( c \geq p \) lowering \( c \) and lowering wages by \( \gamma c \) 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 \( c_B > c_A \). \( M_B \subset M_A \).

**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 \( \gamma c_A \) and would not switch to the \( B \) firm and purchase insurance. ■

A.2 Results for 2 types

I use superscripts \( A \) to denote offers where both types receive insurance for free, \( B \) to denote offers where one type but not the other purchases insurance and \( C \) to denote offers with no health insurance.

\(^{10}\) Ignoring sets of measure zero.
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 Suppose that an offer exists in which one type purchases insurance and the other does not, then

$$w^B_i = w_i + \gamma c$$

where $w$ denotes the wage in firms offering insurance for free.

Proof. We require those purchasing insurance to be indifferent between working where they must purchase insurance and working where they receives it for free and therefore $w^B_i = w_i + \gamma c$ for those purchasing insurance. The highest valuation among those not buying health insurance must be $\gamma c$. If it were higher, then such individuals would purchase the insurance. If it were less, it would be possible to reduce $c$ without attracting additional purchases of insurance, and reducing $c$ would therefore be profitable. The highest valuation equals the difference between the wage with and without insurance and therefore $w^B_i = w_i + \gamma c$ for those not purchasing insurance. ■

Lemma 6 Suppose that an offer exists in which one type purchases insurance and the other does not, then in firms not offering insurance

$$w^C_i = w_i + \gamma c$$

for types not purchasing health insurance when employed at type B firms and

$$w^C_i = w_i + p + (\gamma - 1)c$$

for types purchasing health insurance when employed at type B firms.

Proof. Types not purchasing health insurance do not care whether it is offered. Therefore, their compensation must be the same at B and C firms. Zero-profit at both B and C firms therefore requires that the firms compensation cost, $w_i + p + (\gamma - 1)c$, be the same at both types of firms. ■

Corollary 6 $\theta_A = \theta_B$.

Lemma 7 In equilibrium there cannot be an offer for which type 2’s purchase insurance and type 1’s do not.

Proof. Suppose such an offer exists. Then from the previous two lemmas and the zero-profit condition

\begin{align*}
\pi_A &= f(\theta_A) - (w_1 + p)\theta_A - (w_2 + p) = 0 \\
\pi_B &= f(\theta_B) - (w_1 + \gamma c)\theta_B - (w_2 + p + (\gamma - 1)c) = 0
\end{align*}
which establishes that

\[ (43) \quad \gamma c < p \]
\[ (44) \quad \theta_B > \frac{m_1}{m_2} > \theta_A \]

where \( m_i \) is the measure of type \( i \). Now

\[ (45) \quad F_2(\gamma c) > F_1(\gamma c) \]

and

\[ (46) \quad \theta_A L_A = m_1(1 - F_1(\gamma c)) \]
\[ (47) \quad L_c = m_2 F_2(p + (\gamma - 1)c) \]

and therefore

\[ (48) \quad \frac{m_1}{m_2} L_A > m_1(1 - F_1(\gamma c)) \]

or

\[ (49) \quad L_A > m_2(1 - F_1(\gamma c)) > m_2(1 - F_2(\gamma c)) \]

which implies that

\[ (50) \quad L_A + L_c > m_2(1 - F_2(\gamma c) + F_2(p + (\gamma - 1)c)) > m_2 \]

which is a contradiction.

**Proof.** of Proposition (1)

The first four equations are established in the preceding lemmas. Let \( b_2^* \) represent the highest \( b \) of any type 2 at type B firms. Then \( b_2^* = \gamma c \) which is equation (6). Similarly \( b_1^* = p + (\gamma - 1)c \) which is (5).

**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. The last three conditions require that the firm hire workers until their marginal product equals their cost of 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)

\[ ^{11} \text{Without loss of generality given the constant returns to scale assumption, we have treated each offer as being made by a single firm.} \]
Substitute (5), (12) and (13) into (7)-(14), use \( \theta_B = \theta_C \), add the two labor market clearing conditions and eliminate the two redundant equations to get

\[
q(\theta_A, 1) - (w_1 + p)\theta_A - (w_2 + p) = 0
\]

\[
q(\theta_B, 1) - (w_1 + p + (\gamma - 1)c)\theta_B - (w_2 + \gamma c) = 0
\]

\[
\frac{L_C \theta_B}{m_1} = F_1(p + (\gamma - 1)c)
\]

\[
\frac{L_A}{m_2} = 1 - F_2(\gamma c)
\]

\[
q_A = (w_1 + p)
\]

\[
q_B = (w_1 + p + (\gamma - 1)c)
\]

\[
L_A + L_B + L_C = m_1
\]

\[
L_A \theta_A + L_B \theta_B + L_C \theta_B = m_2
\]

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

\[
\theta_A dw_1 + dw_2 = 0
\]

\[
\theta_B dw_1 + dw_2 + ((\gamma - 1)\theta_B + \gamma)dc + c(1 + \theta_B)d\gamma = 0
\]

\[
m_1 f_1((\gamma - 1)dc + c d\gamma) = L_C d\theta_B + \theta_B dL_C
\]

\[
-m_2 f_2(\gamma dc + c d\gamma) = dL_A
\]

\[
dw_1 + (\gamma - 1)dc + c d\gamma = q''_B d\theta_B
\]

\[
dL_A + dL_B + dL_C = 0
\]

\[
L_A d\theta_A + (L_B + L_C) d\theta_B + \theta_A dL_A + \theta_B (dL_B + dL_C) = 0
\]

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

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

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 \( \frac{dc}{d\gamma} < 0 \).

**Proof.** of proposition (4)

\[
d(\gamma c) = cd\gamma + \gamma dc.
\]

Substituting for \( dc \) gives

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

**Proof.** Proof of proposition (5)
(70) \[ db_1 = d(p + (\gamma - 1)c) = cd\gamma + (\gamma - 1)dc. \]
Substituting for \( dc \) gives

(71) \[ db_1 = cd\gamma \{1 - (\gamma - 1)\left[(L_B + L_C)q_A'(1 + \theta_A) - q_B'(m_2f_2q_A'(\theta_A - \theta_B)^2 - L_A(1 + \theta_B))\right]\} \]

(72) \[ = cd\gamma \frac{(L_B + L_C)q_A' + q_B'(L_A - m_2f_2q_A'(\theta_A - \theta_B)^2)}{A} > 0. \]

\[ \blacksquare \]

**Proof.** of proposition (6)

(73) \[ d(L_B) = -cd\gamma \frac{q_A'[\theta_A m_2f_2(\theta_B L_B + \theta_A L_C) + m_1f_1(L_B + L_C - m_2f_2q_B'(\theta_A - \theta_B)^2)] + L_A[-L_C + q_B'(m_1f_1 + m_2f_2\theta_B^2)]}{\theta_B A} < 0 \]

(74) \[ d(\theta_B L_B) = \theta_B dL_B + L_B d\theta_B \]
\[ = -cd\gamma \frac{q_A'[\theta_A m_2f_2(L_B + L_C) + m_1f_1(L_B + L_C - m_2f_2q_B'(\theta_A - \theta_B)^2)) - L_A(L_B + L_C - q_B'(m_1f_1 + m_2f_2\theta_B^2))}{A} \]
\[ < 0 \]

\[ \blacksquare \]

**Lemma 8** \( \theta_A > \theta_B \)

**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. \( \blacksquare \)

**Proof.** of proposition (7).

\[ d[(1 - F_1(b_1))m_1 + (1 - F_2(b_2))m_2] \]
\[ = -cd\gamma \frac{m_1f_1[(L_B + L_C)q_A' + q_B'(L_A - m_2f_2q_A'(\theta_A - \theta_B)^2)] - m_2f_2[(L_B + L_C)q_A'\theta_A + LAq_B'\theta_B]}{A} \]
The right hand side has the same sign as the numerator which proves the necessary and sufficient condition.

If \( m_1f_1 > m_2f_2 * \theta_A \), then \( fm_1f_1 > m_2f_2 * \theta_B \) since \( \theta_A > \theta_B \). Then

\[ m_1f_1[(L_B + L_C)q_A' - m_2f_2[(L_B + L_C)q_A'\theta_A < 0 \]

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and the numerator is negative which proves sufficiency. ■

Proof. of proposition (8).

> From the solution of fully differential equations:

\[
\frac{dw_1}{d\gamma} = -cd_\gamma q'_A (L_B + L_C + m_2 f_2 q''_B (\theta_A - \theta_B) \theta_B) \]

\( \frac{dw_1}{d\gamma} < 0 \) if and only if \( L_B + L_C + m_2 f_2 q''_B (\theta_A - \theta_B) \theta_B > 0 \).

\( dw_2 = -\theta_A \ast dw_1 \) which proves the second part of the proposition. ■

Proof. of proposition (9).

Add \( dw_1 \) and \( db_1 \) to get

\[
\frac{dw_1^C}{d\gamma} = -cd_\gamma q'_A (q''_B f_2 (\theta_A - \theta_B) \theta_B - L_A > 0.
\]

Proof. of proposition (10)

Fully differentiate to get

(75) \(-\theta_A dw_1 - dw_2 = 0\)

(76) \(-\theta_B (dw_1 - cd\tau + (\gamma - \tau - 1)dc) - dw_2 - (\gamma - \tau)dc + cd\tau = 0\)

(77) \(\frac{\theta_B dL_C + L_C d\theta_B}{m_1} = f_1 ((p - c)dr + (\gamma - \tau - 1)dc)\)

(78) \(\frac{dL_A}{m_2} = -f_2 ((p - c)dr + (\gamma - \tau)dc)\)

(79) \(q''_A d\theta_A = dw_1\)

(80) \(q''_B d\theta_B = dw_1 + (\gamma - \tau - 1)dc - cd\tau\)

(81) \(\theta_A dL_A + L_A d\theta_A + \theta_B (dL_B + dL_C) + (L_B + L_C) d\theta_B = 0\)

(82) \(dL_A + dL_B + dL_C = 0\)

Solving gives

\[
\frac{dL_A}{d\tau} = \frac{f_2 m_2 (-p (\gamma - \tau) (q''_B L_A + L_B q''_A + L_C q''_A) - (p (\gamma - \tau - 1) + c) (L_B q''_A \theta_A + L_A q''_B \theta_B + L_C q''_A \theta_A))}{(\gamma - \tau) (q''_B L_A + L_B q''_A + L_C q''_A) + (\gamma - \tau - 1) (L_B q''_A \theta_A + L_A q''_B \theta_B + L_C q''_A \theta_A) - q''_A m_2 f_2 (\theta_A - \theta_B)^2 (\gamma - \tau)} < 0
\]

where \( q''_i \equiv d^2 q(\theta_i)/d\theta_i^2 \). ■

Proof. of proposition (11)

Solving (75)-(82) gives

\[
\frac{d\theta_B L_C}{d\tau} = \]

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\[
\frac{\theta_B \left( f_1 m_1 (m_2 f_2 q_B^0 q_A^0 (\theta_B - \theta_A)^2 (p - c) - p(LCq_A^0 \theta_A + LAq_B^0 \theta_B + LBq_A^0 \theta_A)(\gamma - \tau - 1) - (p(\gamma - \tau) - c)(LAq_B^0 + LBq_A^0 + LCq_A^0))
\right)}{(\gamma - \tau)(q_B^0 LA + LBq_A^0 + LCq_A^0) + (\gamma - \tau - 1)(LBq_B^0 \theta_A + LAq_B^0 \theta_B + LCq_A^0 \theta_A) - q_A^0 q_B^0 m_2 f_2 (\theta_A - \theta_B)^2 (\gamma - \tau)}
+ \frac{(1 - \theta_B)LC (La_c + m_2 f_2 q_A (\theta_B - \theta_A)(\theta_A (p(\gamma - \tau - 1) + c) + p(\gamma - \tau)))}{(\gamma - \tau)(q_B^0 LA + LBq_A^0 + LCq_A^0) + (\gamma - \tau - 1)(LBq_B^0 \theta_A + LAq_B^0 \theta_B + LCq_A^0 \theta_A) - q_A^0 q_B^0 m_2 f_2 (\theta_A - \theta_B)^2 (\gamma - \tau)}.
\]

The first fraction is always negative. The second fraction is negative iff. \(1 - \theta_B \geq 0\). Taking the negatives of the two fractions proves the theorem. ■