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Abstract
Variation in income tax policies and health insurance costs are shown to be theoretically appropriate instruments to identify endogenous firm wage and benefit offers in a labor supply model. Empirical results show that firms are more likely to provide health insurance benefits in states with high marginal income tax rates and low hospitalization costs. The model implies that over the 1983-1995 period, large increases in health insurance costs and reductions in marginal income tax rates lowered the probability of receiving health insurance benefits from employers by 10 percentage points. This decrease in benefits lowered hours of labor supply by 4-7%.

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Benefits have become an increasingly large share of compensation packages offered by firms, representing nearly 30 percent of total compensation at large firms. Other than legally required employer contributions for social security, worker's compensation and unemployment insurance, health insurance represents the largest average benefit outlay, averaging $3,078 per full time employee or about 7 percent of total compensation. The relative cost of providing this benefit has risen substantially, more than doubling in real terms between 1983 and 1995. As the costs of providing the benefit rose, the proportion of employees covered by employer-provided health insurance fell by 10 percentage points and many firms cut back on the quality of insurance benefits offered.[1]

Given the importance of health insurance benefits to firm compensation, there has been surprisingly little research on the impact of health insurance on labor supply. The review by Currie and Madrian (1999) suggests that most of the studies of the impact of health insurance on labor supply have concentrated on transition to retirement or job turnover rather than hours worked. Studies of labor supply have tended to concentrate on the impacts of Medicaid or other government policies rather than employer compensation packages. The few studies that have examined responses to employer-provided health insurance have concentrated on the impact of husband's health insurance on wife's labor supply.

A notable exception is the study by Cutler and Madrian (1998) on the impact of health insurance costs on hours of work. They concluded that rising health insurance costs in the 1980s and 1990s caused firms to cut back on the number of workers employed and to increase average hours for those who were retained by 3 percent. This conclusion seems puzzling, however. If firms responded to rising insurance costs by cutting back or eliminating the benefit, then one

would have expected labor supply to fall. That is particularly true if access to benefits serves as a marginal inducement for some workers to work full-time rather than working part-time without benefits.

This study examines whether the conclusion of rising average hours worked in response to rising health insurance costs holds up under alternative samples and assumptions about firm behavior. Most importantly, we relax the assumption that health insurance benefits are exogenous to hours worked. There is at least a strong prima facie case that firms condition the receipt of benefits on an employee's work hours. Lettau and Buchmueller (1999) report that 86.4 percent of full-time workers but only 23.5 percent of part-time workers receive firm-provided health insurance benefits.[2]

An illustration of how endogenous benefits could bias the results can be found in Cutler and Madrian. The impact of health insurance on hours worked per week is measured by the difference in work hours between workers receiving benefits and those not receiving benefits. Over their sample period, the proportion of employees receiving health insurance benefits falls by about ten percentage points. If firms opting to discontinue health insurance benefits were those with a shorter work week before they dropped the health insurance benefit or are firms experiencing declining labor demand, then average hours in covered firms would rise while those in uncovered firms would fall. That is the pattern of results that Cutler and Madrian report--average weekly hours rose by 0.7 in covered firms and fell by 0.5 in uncovered firms. The increase in insurance costs would have no impact on hours worked in firms that never provided the benefit, so the drop in average hours in uncovered firms in consistent with a sorting of low average hours firms into the uncovered group.

A second reason why earlier studies may have underestimated the supply response to changes in health insurance costs is their concentration on hours worked by prime-aged males. However, estimated elasticities of labor supply for prime-age males are nearly zero, so that group may not reflect the supply response to changes in compensation for the labor force as a whole. In addition, prime age males are about one-third as likely to work part-time than similarly aged women (Rones, Ilg and Gardner,1997) and it is in the shift from full-time to part-time work that one might expect to see the biggest supply response to changes in employer-provided insurance benefits.[3]

This study adds to the existing research in several ways. It corrects for the potentially endogenous wage and health insurance benefit levels. The theory shows that variation in income tax rates and prices of health insurance across states and across time provide instruments for firm compensation strategies that are directly implied by the firm's optimization process. The sample includes both men and women and includes both full- and part-time workers, providing a more complete range of possible labor supply responses to rising insurance costs. By restricting the sample to single workers, the study avoids the complications caused by cross-effects of one spouse's compensation package on the other's labor supply. Finally, the study makes use of data on actual costs of health insurance rather than on firm expenditures, providing better information on the magnitude of the shock to the relative costs of offering benefits versus wages.

The empirical work demonstrates that the probability of receiving health insurance through one's employer is significantly affected by insurance costs and income tax rates. Hours of labor supply are strongly positively influenced by the probability of receiving benefits and by the level of those benefits. Because insurance costs rose and income tax rates fell over the period, there was a 10 percentage point reduction in the probability of receiving employer-

provided health insurance between 1983 and 1995. In our sample of single workers, this reduction in benefits led to a 4-7% reduction in average hours worked.

I. Stylized Facts Regarding Employer Contributions to Health Insurance

Insurance premiums rose rapidly in the 1980s and 1990s. As shown in Table 1, correcting for inflation, the average cost to community hospitals of a one-day stay plus services rose 124 % from 1983 to 1995. The most common type of privately provided health insurance in the United States is hospitalization coverage. Of those covered for hospitalization, 99% had coverage paying 80% or more of the average cost of a semi-private hospital room in the local area. As confirmed in conversations with people in the insurance industry, cross sectional variation in insurance rates are tied in part to the cross-sectional information on daily hospital costs.[4]

In apparent response to this dramatic increase in the cost of providing health insurance benefits, firms cut back on benefit provision. The proportion of single workers covered by employer-provided health insurance fell from 71% to 61%[5], nearly identical to the drop in coverage rates reported by Sheu for the labor market as a whole. Average real employer contributions only rose 24% over the period, so employer contributions fell considerably short of the 124% increase in premium costs. Looking only at employees who retained benefits over the period, employer contributions rose only 88%. The implication is that not only did many employers stop offering health insurance benefits, but that the quality of health insurance benefits offered also fell.

Previous studies had used the level of employer contributions to health insurance as a measure of insurance cost. A second implication from Table 1 is that the time path of employer

health insurance contributions understates the actual increase in costs of health insurance. In addition, the level of employer contributions may have been responding to factors other than rising insurance premiums. Income tax rates were also changing across states. Over the sample period, average state tax rates rose 44% while marginal tax rates fell by 25%. Because insurance benefits are untaxed, firms are more likely to provide benefits in states with high income tax rates. These changes in average and marginal tax rates would be expected to have conflicting effects on firm incentives to provide health insurance benefits. Nevertheless, to the extent that employer contributions were changing in response to tax incentives rather than premium costs, there is a further reason to believe that employer contributions to health insurance are a poor measure of insurance costs.

The results in Table 1 highlight why previous conclusions that health insurance costs led to increases in hours worked may be overstated. Firms appear to have changed the quality of benefits over the period, so a dummy variable indicating the presence or absence of the benefit will not capture the change in the quality of benefits over time. In addition, it seems apparent that the provision of benefits changes in response to economic incentives, indicating the need to treat the benefit as an endogenous choice.

II. Employer and Employee Incentives Regarding Health Insurance

A. The Employer's Tradeoff

Firms have several reasons why they may want to provide health insurance benefits to their employees. One is that firms almost certainly can obtain more favorable terms in acquiring health insurance than can their employees. Thus, by offering the benefit rather than a similar dollar amount of wages, the firm may be able to raise worker utility without adding compensation cost.

There are two main reasons why employers can access health insurance at a lower cost than can individual workers. First, employers can bundle many health insurance policies into one. This gives the employer some market power in bidding down the cost per covered member. Insurance companies are willing to cut the price of a pooled policy because of the lower cost of providing multiple clients the same menu of services.

Firms also face lower cost of procuring health insurance because of the favorable tax treatment given to benefits versus wages. A worker who buys an insurance policy must pay with after-tax earnings. Thus, if a worker earns $W in wages which he uses to purchase health insurance, he will only have $W(1-t) left to purchase the insurance policy, where $t < 1$ is the marginal income tax rate. If instead, the firm pays the same amount in compensation but in the form of a health insurance benefit, the worker receives $W of the insurance benefit.[6]

Our interest is to illustrate why firms may make different choices regarding the mix of wages and benefits to offer their employees. A likely candidate is variation in health insurance costs and income tax rates across states. However, it is also likely that workers supply of hours or effort will be influenced by the levels of wages and benefits. Consequently, the firm's profit maximizing compensation decisions will reflect the firm's beliefs about worker labor supply behavior.

For the firm to attract workers, it must offer a compensation package that at least meets a worker's opportunity wage at other firms, $\overline{U}(Z)$. Z is an index of skill such that $\overline{U}_2 > 0$. The firm's wage, W, health insurance benefit, B, and work hours, h, must satisfy

$\overline{U}(Z) \leqq U(W(1-t), B, h)$, where $U_W > 0$, $U_B > 0$, and $U_h < 0$, and where t is the tax rate.

This implies that for workers of a given skill level Z, and other attributes X, a firm will face a supply schedule of hours that their employers are willing to work. The supply schedule is given by

$$h = h((1-t)W, B; Z, X) \tag{1}$$

where $h_W > 0$, $h_{WW} < 0$, $h_B > 0$, $h_{BB} < 0$. Equation (1) implies that the firm can induce more hours from its workers of a given skill level by raising the after-tax wage rate, (1-t)W, or by raising health insurance benefits, B. However, it becomes more expensive to increase hours of work by raising compensation as the levels of W and B increases.[7]

Given (1), the firm is assumed to choose a level of employment and compensation mix so as to maximize profit. The firm's profit maximization problem, treating the output price as numeraire, can be written

$$\max_{N,W,B} \pi = f(Nh) - N(Wh + C^B B) \tag{2}$$

where C^B is the cost of obtaining a health insurance policy for an employee.

The firm chooses N directly but sets h implicitly by its choice of W and B. The firm's short-run production function $f(\bullet)$, depends on the total hours of labor employed. While we view $h(\bullet)$ as an hours of labor supply equation, the story can also be couched in terms of the effort exerted by workers.[8] The production function is assumed to be concave in the labor input.

Inserting (1) into (2) and taking the first order conditions, we obtain

$$\frac{\partial \pi}{\partial N} = hf' - (wh + C^B B) = 0 \tag{3A}$$

$$\frac{\partial \pi}{\partial W} = Nf'(1-t)h_W - Nh - NW(1-t)h_W = 0 \tag{3B}$$

$$\frac{\partial \pi}{\partial W} = Nf'h_B - NC^B - NWh_B = 0 \tag{3C}$$

Condition (3B) can be arranged as

$$(1-t)h_W f' = h + (1-t)Wh_W \tag{4}$$

This means that the firm will raise wages to the point where the revenue from the induced increase in hours supplied equals the cost of the increased hours plus the cost of raising the wage for the h hours the firm had already induced. Notice that for each dollar increase in wages, the employees only respond to $(1-t), their after-tax share.

In a similar manner, condition (3C) implies that

$$h_B f' = C^B + Wh_B \tag{5}$$

Here, the firm will raise benefit levels until the gain in revenue from induced increased labor is equal to the cost of raising the benefit. The latter includes both the direct cost of raising B plus the increased wage bill from the induced increase in hours worked.

Conditions (3B) and (3C) can be manipulated to generate the condition

$$\frac{h_W}{h_B} = \frac{h}{(1-t)C^B} \tag{6}$$

The firm's decision of how to divide compensation between wages versus health insurance benefits will depend on the relative cost of raising each form of compensation and their relative impacts on labor supply. As current hours increase or as the tax rate increases, it becomes more expensive to raise compensation through a wage increase rather than an increase in benefits. Conversely, higher insurance costs make it more attractive to increase compensation through a wage increase.

Equation (6) has two important implications. First, it illustrates why incentives to offer health insurance rise as hours worked increase, consistent with the large difference between full and part-time workers in the receipt of insurance benefits. Second, the firm's decision on the

level of wages or benefits will depend on relative costs of offering the two forms of compensation, suggesting that tax rates and insurance costs will be useful instruments to identify endogenous firm compensation decisions.

The first-order condition (3A) implies that the firm will hire workers until the revenue generated from the last worker equals the anticipated cost of total compensation. Additional insights can be obtained by inserting (3B) and (3C) into (3A) to generate

$$hf' = \left((1-t)Wh_W + Bh_B\right)(f' - W)$$

Dividing both sides of the equation by h, this converts to

$$\frac{f'}{(f' - W)} = (1-t)E_W^h + E_B^h \qquad (7)$$

where E_W^h is the elasticity of hours supplied with respect to wages and E_B^h is the elasticity of hours supplied with respect to the insurance benefit. The standard condition for a firm that takes wages as given exogenously is $f' = W$. As f' approaches W on the left-hand-side, the right-hand-side becomes infinitely large. This is consistent with a perfectly elastic labor supply curve at the market-determined wage, so that $E_W^h \to \infty$ as assumed for a firm in a perfectly competitive labor market. If the hours elasticities are of finite size, then the firm will set wages and benefits endogenously.

B. Full-time versus Part-time Contracts

If workers have diminishing marginal utility of leisure, it will become increasingly difficult to induce additional hours of labor supply through a wage increase. Because an individual faces rising disutility from hours of work as hours increase, a convex compensation mechanism would be more efficient at inducing additional hours of work. Equation (6) suggests that the firm will increase benefits as hours supplied become less sensitive to wage increases.

However, benefits may also be used to create the convex compensation mechanism needed to induce additional labor supply as h increases. This happens when firms offer health benefits only to their full-time workers but not to their part-time workers. As reported by Currie and Yelowitz (2000), this is a common practice. In 1994, 74% of establishments had minimum hours requirements to qualify for health insurance benefits.[9]

Figure 1 shows the budget constraint from the perspective of a firm offering part-time and full-time jobs to a worker. The worker could earn the wages W_{NB} if he receives no benefits. However, after H^* hours of work, the firm provides a benefits package that shifts the budget constraint upward. Because it is providing benefits, the firm can lower hourly wages and still meet the reservation utility condition, so the wage it pays with benefits satisfies $W_B < W_{NB}$.[10]

Workers facing the choice of how many hours to work look at the after-tax reward structure. These choices are illustrated in Figure 2. When an individual is faced with the compensation package that has no health benefit, he would opt for the part-time job and earn $H_0 W_{NB}(1-t)$. However, when the alternative contract is offered with health insurance benefits added after a minimum of H^* hours, the worker is induced to work full time at compensation level $H^* W_B(1-t) + B$.

For workers who would already be beyond H^* when faced with the wage only contract, say, at hours level H_1, the health benefit contract would induce a reduction in hours worked. For such workers, the health insurance benefit induces both an income and a substitution effect away from hours worked. Knowing this, firms will want to set the minimum hours necessary to obtain the health benefit at the upper-tail of the distribution of hours worked under the wage only contract, reinforcing the implication of equation (6) that firms will increasingly use benefits at higher levels of hours.[11]

III. Empirical Strategy

Our aim is to estimate labor supply equations of the form

$$h = h(W(1-t), B, V(1-t), P, \tau) \qquad (8)$$

where W, t and B are defined above, V is a nonlabor income, P is a price index and τ is an index for value of time in nonmarket activities. In principle, equations such as (8) can be estimated if wages and benefits are exogenous. However, it is virtually certain, given our discussion above, that the firm's level of wages and benefits will be chosen jointly with hours worked. Consequently, we need to be able to derive instruments for W and B.

Equation (6) suggests that plausible instruments for W and B can be derived from state income tax rates, t^S, and measures of the cost of offering benefits relative to wages. In addition to the direct cost of health insurance, C^B, local labor market conditions, L, will affect the relative cost of benefits. High earnings states will be exposed to higher federal marginal tax rates which may make untaxed nonwage compensation more attractive. Firms with more cyclical labor demand or high turnover may find it more expensive to provide benefits with significant fixed costs such as health insurance.[12] Similarly, unionized firms may face lower benefit costs because of lower turnover, shared administrative costs between the union and the firm, or shared costs of negotiating for better insurance premiums. Wage and benefit levels will also reflect the workers level of skill, Z.

The instrumenting equations will be of the form

$$\begin{aligned} W &= W(t^S, C^B, L, Z) \\ B &= (t^S, C^B, L, Z) \end{aligned} \qquad (9)$$

Our strategy is to use (9) to identify W and B in (2), yielding unbiased estimates of the supply responses to W and B.

There is another reason to opt for an instrumental variables strategy to identify health insurance benefits and wages, even if these forms of compensation could be considered exogenously determined. Berger, Black and Scott (1998) found that employees and employers disagree on the level and incidence of health insurance coverage provided by the employer. They found that when the CPS measure of health insurance is used as an explanatory variable, its coefficient is significantly biased toward zero. This suggests that earlier estimates of health insurance effects on hours of work may be too small. Blundell and MaCurdy (1999, pp.1622-1625) argue that instrumental variables can serve as a robust method to correct for both endogeneity and measurement error in the analysis of tax effects or other nonlinear budget constraints on labor supply. Consequently, the same mechanism used to correct for possible endogeneity in (9) can also serve as an instrumental variables mechanism to correct for measurement error in observed health insurance benefits.

IV. Data

The primary data set is based on the 1983, 1987, 1991, and 1995 editions of the March Current Population Surveys (CPS). The years were selected to span a period when the cost of health insurance was rising rapidly relative to the consumer price index. The specific years correspond to years when public use information on hospital costs by state were available. These data are used by insurance companies to set rates. The real cost of hospitalization more than doubled over the twelve year period. This measure has clear advantages over the expenditure data used previously to proxy for health insurance costs. Expenditures are themselves a function of the number and quality of health insurance policies that firms are offering their workers and are therefore endogenous.

The analysis concentrates on single workers aged 25 to 60. By concentrating on single workers, we are able to insure a one-to-one correspondence between health benefits offered and health benefits received. In the case of married couples, one spouse may opt to decline a firm's offered health benefits if the spouse's employer offers a dominant package. In addition Dranove, Spier and Baker (2000) argue that firms modify benefit packages to attempt to induce employees to opt for their spouse's benefit package. These problems are not an issue for single workers in the CPS because the observed variation in health insurance benefits received will also be the actual variation in compensation offered.[13]

Our sample is restricted to single civilians aged 25 to 60 who reside in the continental United States. Individuals who were classified as students, disabled or retired were excluded. The self-employed were excluded because of measurement problems in determining compensation terms for those who employ themselves and set their own hours. Finally, the unemployed were excluded because of the absence of information on hours, wages or benefits.[14] The final sample consists of 27,564 individuals spread over the four years.

In contrast with samples of prime-aged males used in previous analyses of the impact of health insurance provision on work hours, this sample of singles more closely mimics the range of hours worked and health insurance benefits received in the labor force as a whole. The distributions of benefits received and hours worked are reported in Table 2. The proportion of single workers receiving employer-provided benefits is virtually identical to the proportion of all workers aged 25-64 receiving own employer provided benefits reported by Currie and Yelowitz (2000). Their estimates for 1987, 1991 and 1995 were 68%, 61% and 62%, compared to our corresponding estimates for single workers of 68%, 62% and 61% for the same respective years.

As indicated above (footnote 3), sample of prime-age males used in earlier studies had benefit rates that were much higher than the labor market average.

The hours distribution for singles matches nearly exactly the distribution of work hours reported by Rones, Ilg and Gardner (1997). Whereas 25.7% of single workers work part-time, the corresponding proportion in the overall labor force is 24%. The proportion of prime-age males working part-time is typically below 10%. Single workers were somewhat more likely to work 35-39 hours per week and somewhat less likely to work over 41 hours, but the differences are slight. Nevertheless, the sample of single workers includes broad variation in hours and health insurance benefits that are more indicative of the range of hours and benefits observed in the labor market as a whole than are the hours and benefits observed for prime-age males. Consequently, the sample of singles workers should yield labor supply responses that better reflect the range of hours responses for the labor market as a whole.

A. Endogenous Variables

Summary information on the variables and their empirical definitions are included in Table 3. The main variable of interest is hours worked per year. This is measured by multiplying weeks worked last year by usual hours worked per week in the CPS. The other endogenous variables are wages and health benefits. Wages are measured by weeks worked last year times average weekly earnings, divided by annual hours of wage work.

Two measures of employer provided health insurance are available. The first is a continuous measure of the dollar amount of the employer's contribution to health insurance. The alternative measure is a dummy variable indicating whether the employer contributes to health insurance. The value of the dichotomous measure as opposed to the dollar amount of the benefit

is that it may be the existence of the discontinuity as opposed to changes in the marginal value of the benefit that affect labor supply.

B. Exogenous Variables

The key identifying variables in the wage and benefit equations include measures of the firm's cost of acquiring health insurance, state tax rates, and local labor market conditions. The cost of health insurance is based on the average daily cost per patient in community hospitals, reported by state in the *Source Book of Health Insurance Data*. This data was supplemented by estimates of the ratio of metropolitan to nonmetropolitan health care costs by state in 1995 which was provided to us by a national insurance company. The latter data allow us to introduce variation in health insurance costs across metropolitan and nonmetropolitan areas within a state.

Let C^B be the average cost of hospital beds in the state and let $r = C^B_m/C^B_n$ be the ratio of metropolitan to nonmetropolitan health insurance cost in the state. Let α_m be the share of the state's population that resides in a metropolitan area. Then

$$\begin{aligned} C^B &= \alpha_m r C^B_n + (1-\alpha_m) C^B_n \\ &= C^B_n(\alpha_m r + 1 - \alpha_m) \end{aligned}$$

The metropolitan and nonmetropolitan health insurance costs can be derived from information on C^B, r and α_m using

$$\begin{aligned} C^B_m &= r C^B_n \\ C^B_n &= C^B/(\alpha_m r + 1 - \alpha_m) \end{aligned} \qquad (10)$$

under the assumption that r does not vary over time. Increases in heath insurance costs should lower incentives for firms to provide health benefits and raise wage share of total compensation.

Increases in a state's income tax rate should increase incentives for firms to provide health insurance because benefits are untaxed. The effect on wages should also be positive

because employers need to offer a competitive after-tax rate to attract and retain workers. We make use of two measures of the state's income tax level. The first is the average state income tax rate. The second is the summed average of the federal and state marginal income tax rates. Information on average state tax income rates and the marginal federal and state income tax rates have been appended to the CPS data by Unicon Research Corporation.

The variables used to describe local labor market conditions include the employment growth rate, the unemployment rate, the average non-supervisory manufacturing wage and union coverage. Tight labor market conditions, resulting from a strong economy, should have a positive effect on labor demand. On the other hand, firms in unstable labor markets with high probability of unemployment may want to avoid compensation packages with high fixed costs.

The log of the state average non-manufacturing wage is used as an indicator of local wage competition that should have a positive effect on both forms of competition. In addition, states with high average incomes will have higher tax rates on average, which may give an added reason for firms to offer benefits. Numerous studies have shown that unionized workers receive higher wages and benefits (Freeman and Medoff, 1984).

The remainder of the variables includes measures of skill, living costs and geographic variables. Measures of skill include linear and quadratic terms in experience and education.[15] The effects of these variables should be similar, whether compensation is measured in wages or benefits. Following Mincer (1974) these measures of human capital are expected to have a positive but diminishing marginal effect on wages. Changes in the cost of living over time are captured by changes in the consumer price index. Cross-sectional variation in living costs is controlled by measures of land prices in the state and a series of dummy variables indicating

region of the country and metropolitan residence. The rest of the variables in the wage and benefit equations include dummy variables indicating gender and race.

Following the specification suggested by equation (8), the independent variables used in the labor supply equation include the instrumented measures of employer-provided health insurance and hourly wage rates less taxes. Nonlabor income is measured by taxable income minus earned income. This was multiplied by one minus the average tax rate to generate household non-wage income less taxes.

Controls for the value of nonmarket time, τ, in equation (8) include measures of skill and individual and household demographics. In addition to those used in the compensation equations, we include measures of the number of persons in the household and the number of children under six.

The remaining geographic and price variables are the same as those in the compensation equations. These measures are included to correct for changes in the purchasing power of wages and income over time and across areas of the country.

V. Estimation

The theory suggests that equations (8) and (9) can be approximated by a system of equations of the form

$$\ln h = \beta_w \ln W(1-t) + \beta_B g(B) + \beta_v \ln V(1-t) + P\beta_P + \tau\beta_\tau + e_h \qquad (11a)$$

$$\ln W = \gamma_t \ln t^S + \gamma_C \ln C^B + L\gamma_L + Z\gamma_Z + e_W \qquad (11b)$$

$$g(B) = S_t \ln t^S + \delta_C \ln C^B + L\delta_L + Z\delta_Z + e_Z \qquad (11c)$$

where P is a vector of cost of living measures, τ is a vector of indicators of the value of nonmarket time, L is a vector of local labor market variables, and Z is a vector of skills. Where

possible, variables are transformed into logarithmic form so that their associated coefficients can be interpreted as elasticities.

Efficient estimation would suggest estimating (11a-c) jointly, imposing the restrictions implied by wage and benefit equations on the hours equation. The nature of the benefits data complicates that strategy. Because 35 percent of the employees in the sample receive no firm provided health benefits, B could be measured as a dummy variable. This suggests a two-stage estimation procedure in which the first stage involves estimating (11c) using a probit procedure and (11b) is estimated using least-squares. Predicted values from the first-stage are inserted into (11a) in the second stage. While this would yield consistent estimates of the parameters, the standard errors would be biased. To generate correct standard errors, we use a bootstrap procedure in which we replicated the estimation over 100 (random) samples with replacement of the full data set.

The second strategy we employed used the level rather than the presence or absence of employer contributions to health insurance. It is convenient to transform the benefits measure into natural logarithms, so we added $1 to every observed benefit to eliminate the problem of taking logs of zero values. We then estimated equations (11a-c) as a system of equations. We discuss the results of each of these estimation strategies in turn.

VI. Results

The estimates in which benefits are measured as a dichotomous variable indicating whether the firm pays for health insurance are reported in Table 4. The first two columns report the compensation equations. Both wages and benefits rise with skill. At sample means, wages rise 14 percent per year of experience and 12.3 percent per added level of educational attainment.[16] The corresponding impacts on the probability of getting employer-provided health

insurance are 0.7 percent per year of experience and 5.5 percent per added education level. Both wages and benefits are higher for whites, union members, and those who live in metropolitan areas. Single women face an 8 percent lower wage on average than comparably skilled men but are 4.7 percent more likely to receive health insurance benefits. Workers in the Midwest are more likely to receive health insurance but face lower wages than do comparably skilled workers elsewhere. Measures of local labor market conditions have little impact on wages, but areas with higher average earnings and rising employment are significantly more likely to receive employer provided health insurance. This suggests that benefits more than wages are used to attract or retain workers as labor markets tighten.

Our primary interest is to assess whether variation in state taxes and insurance costs can be used to identify firm wage and benefit offers. The answer appears to be yes. Firms in states and metropolitan areas facing higher insurance costs were significantly less likely to offer benefits. The implied elasticity is -0.07, so a ten percent increase in health insurance cost lowers the probability of receiving benefits by 0.7 percent. In addition, both higher state average and marginal income tax rates led to a higher probability of firms offering health insurance benefits.

Evaluated at sample means, the elasticities of the probability of receiving benefits with respect to state income tax rates were 0.01 with respect to average rates and 0.34 with respect to marginal income tax rates. This implies that marginal tax rates are more important than average tax rates in affecting the decision of whether to offer health insurance benefits. Unlike most studies, an increase in insurance costs did raise wages as would be expected if firms trade off wages and benefits as implied by the reservation utility condition, but the estimate is very small and imprecise. Higher tax levels did raise the wages that firms had to pay, also consistent with

the reservation utility hypothesis. The positive impact of income taxes on wages suggests that some of the incidence of the income tax is shifted from workers to firms.

The third column contains estimates of the labor supply equation. Labor supply responds negatively to the presence of young children and other members of the household. Nonlabor income also lowers hours worked. Exogenous shifts in after tax wages have a significant positive impact on hours worked with an elasticity of 0.11. Employer provided benefits have an even stronger positive effect on hours worked. The implied elasticity of work hours with respect to an increase in the probability of receiving benefits is 0.43. Because most firms condition receipt of the insurance benefit on the number of hours worked, we can interpret the increase in probability of receiving benefits as an increased probability of a convex kink in the budget constraint. These results suggest that the kink in the budget constraint created by the provision of health insurance benefits strongly increases the hours worked by single workers.

The real cost of health insurance rose 124% over the sample period, implying an 8.4% decrease in the probability of receiving benefits. This in turn would imply a 3.4% decrease in hours of labor supply. At the same time, average state income taxes rose 44% while marginal income tax rates fell 25%. The combined impact of these tax changes was to lower the probability of receiving benefits by 8% and to lower hours worked by 3.4%. Taken as a whole, the model's estimates imply that changes in tax rates and health insurance costs lowered the probability of receiving benefits by 10 percentage points between 1983 and 1995, equal to the observed reduction in the proportion of workers receiving employer-provided health insurance benefits over the period. The decrease in provision of benefits would have led to a 7% reduction in average hours worked.

Table 5 presents the results from the simultaneous estimation of equations (11a-c). The null hypothesis that the three equations are independent was easily rejected. The correlation matrix of the residuals indicates that unobserved attributes that raise wages also raise benefits.[17] Residuals from the benefit and hours equations are also positively correlated. The wage and hours residuals are nearly uncorrelated.

Despite the difference in estimation methods used in Tables 4 and 5, the stories that emerge are quite similar. Outcomes regarding how benefits and wages respond to measured skill, gender, minority status, residency status, business cycle, and union coverage are virtually identical across the tables.

The impacts of health insurance costs and taxes are also much as in Table 4. The effects on wages are virtually identical. As before, firms do not appear to raise wages much, if at all, in response to an increase in health insurance premiums. Wage responses to increases in tax rates are much larger, particularly with respect to the marginal income tax rate.

A ten percent increase in health insurance costs lowers the employer's contribution to health insurance by 3.5 percent. The impact is five times larger than the effect on the probability of receiving benefits, so firms are more apt to decrease the level of health insurance benfits than to eliminate the benefit altogether. The elasticities of employer contributions with respect to tax levels are also larger than in Table 4. The elasticity of benefit level with respect to the average income tax rate is 0.09, while the implied elasticity with respect to marginal income tax rates is 2.16. Raising the marginal tax rate by one percentage point increases employer contributions to health insurance by 12.8 percent.

Turning to the labor supply effects, the elasticity of hours worked with respect to employer health insurance contributions is 0.04, one-tenth the size of the response to the

probability of receiving benefits reported in Table 4. Apparently, the kink in the budget constraint caused by the benefit is more important in influencing labor supply decisions than is a change in the level of the employer's contribution. A percentage change in the wage has an impact on hours worked roughly four times larger than that of a percentage change in the employer's health insurance contribution.

Over the sample period, the implied impact of the changes in health insurance costs and income tax rates on employer contributions to health insurance are -43% and -50%, respectively. The corresponding implied changes in hours worked are -1.9% and -2.2%, respectively. In total, the model projects that reductions in employer health insurance contributions induced by changes in insurance premiums and tax rates led to a 4.1% decrease in hours worked.

VII. Conclusions

This study shows that variation in the cost of health insurance and in state tax rates can identify the levels of wages and health insurance benefits offered by firms. This allows us to estimate the impact of employer contributions to health insurance on hours worked. We test the empirical strategy on a sample of single workers included in the Current Population Survey for various years between 1983 and 1996. The analysis led to several important conclusions:

1) Increases in income tax rates, particularly at the margin, raise wage levels for firms, presumably because of the need to compete for workers by offering competitive after-tax compensation packages. As a result, some of the incidence of income taxes is shifted to firms.

2) Both average and marginal tax rates raise the incidence and level of firm provided health insurance. The impact of marginal tax rates is nearly four times larger than that of average tax rates.

3) There are some sharp differences in the probability of receiving health insurance benefits between workers. Workers who are white, covered by collective bargaining and residing in metropolitan areas are significantly more likely to receive benefits. Interestingly, women are more likely to receive benefits, even though women are more likely to receive lower wages on average.

4) Employer provision of health insurance benefits has a large and significant impact of labor supply. A 10 percent increase in the probability of receiving the benefit raises hours worked by 4.3 percent. Marginal increases in the dollar amount of the benefit have much smaller effects, suggesting that the kink in the budget constraint may be more important than the benefit level in influencing labor supply.

5) In contrast to results reported for samples of prime-age males, reductions in health insurance benefits induced by rising health premiums and falling marginal tax rates led to a 4-7% reduction in average hours worked by single workers over the period. Such a result could explain an apparent increase in hours worked by those retaining benefits because those in the uncovered group would include workers who would have reduced work hours because they lost employer-provided health insurance coverage.

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Figure 1: Alternative compensation packages with and without health insurance benefits: firm's perspective.

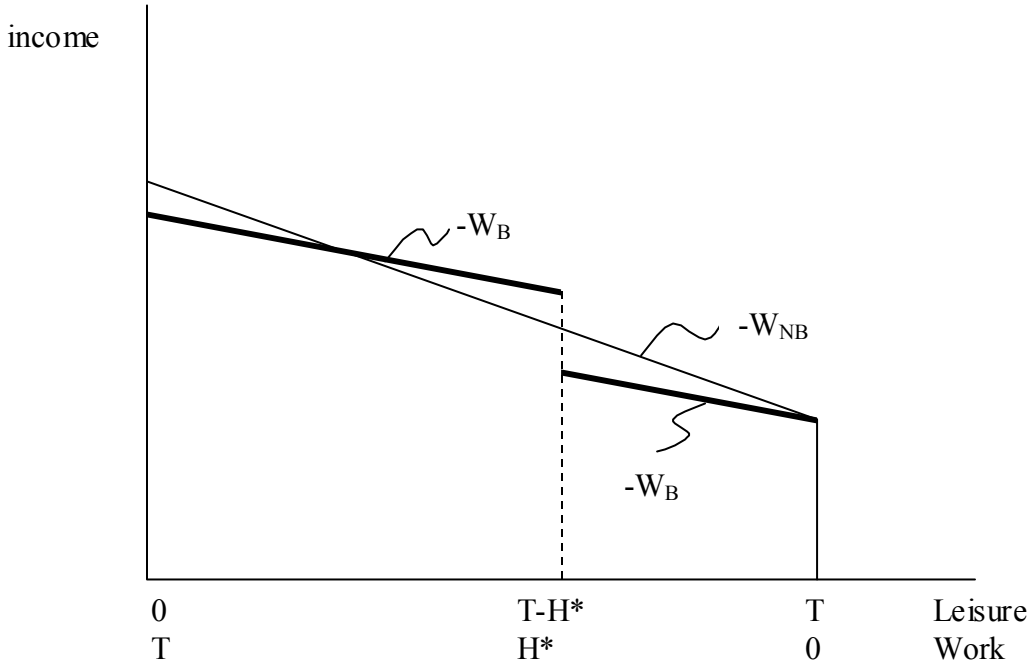

Figure 2: Alternative compensation packages with and without health insurance: worker's perspective.

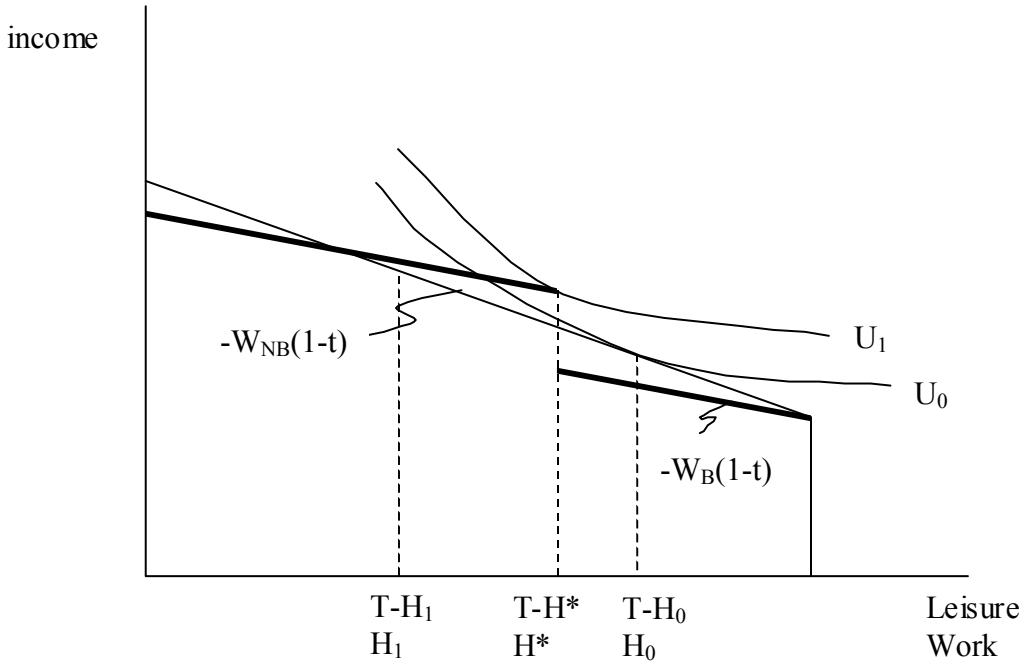

Table 1: Average Real Health Insurance Costs, Tax Rates, and Benefit Levels, 1983-1995

	1983	1987	1991	1995
Insurance Cost Index[a,b]	1.0	1.23	1.43	2.24
Benefit Level Index[a]	1.0	1.05	1.30	1.24
Coverage Rate[c]	0.71	0.68	0.62	0.61
Benefit Level Index for Covered Employees[a,d]	1.0	1.10	1.50	1.88
Average Tax Rate	0.025	0.029	0.033	0.036
Marginal Tax Rate	0.20	0.19	0.16	0.15

Source: Authors' compilations of average values for single employees in the Current Population Surveys, various years.
[a] In constant 1983 dollars.
[b] Based on daily cost of hospitalization reported for the respondent's state and residential population.
[c] Proportion of employees receiving firm provided health insurance benefits.
[d] Excludes all employees who are not receiving employer -provided health insurance benefits.

Table 2: Employer-provided Health Insurance and Hours Worked Per Week

	Hours Per Week, 1983-1995					
	1-14	15-24	25-34	35-39	40	41+
Benefit > 0	0.18	0.33	0.48	0.67	0.76	0.78
Observations	1982	2337	2790	2935	11546	5972
Share (%)	7.1	8.5	10.1	10.6	41.9	21.7

Source: Authors' calculations based on sample of single workers from the CPS in 1983, 1987, 1991 and 1995.

Table 3: Sample Statistics and Definitions.

Variable	Mean	Standard Deviation	Definition
B>0	.65	.48	Dummy variable indicating employer provides health insurance contribution
ln B	3.69	4.47	Log of one plus the employer health insurance contribution
ln W	2.10	.70	Log of hourly wage last year
ln (h)	7.46	.59	Log of hours of work last year
EXP	18.6	8.5	Age—years of education—6
EDUC	8.3	2.3	Index of education level (from 0:none to 12:beyond Master's degree)
FEMALE	.43	.50	Female
BLACK	.13	.34	Black
OTH MINORITY	.04	.20	Other minority groups
ln (JOB GRO)	.01	.03	Log of state annual employment growth
ln (AVG EARN)	2.37	.17	Log of state average manufacturing earnings
UNEMP	6.97	2.34	State unemployment rate
UNION	.01	.07	Covered by collective bargaining
ln (CPI)	4.83	.16	Log of the consumer price index
ln (PLAND)	7.17	.75	Log of state average farmland value
METRO	.84	.37	Metropolitan residence
NEAST	.30	.46	Northeastern residence
WEST	.22	.41	Western residence
SOUTH	.26	.44	Southern residence
ln (C^B)	6.5	.41	Log of daily hospital in the state, by metro or nonmetro residence
$\bar{t}^S$	.03	.02	Average state income tax rate
t^S	.17	.02	Average marginal tax rate in the state
CHILD < 6	.05	.25	Number of children under 6 in the home
NUMBER	1.87	1.3	Number of persons in the home
ln (V(1-t))	9.7	.31	Log of non-wage income after taxes

Table 4: Bootstrap Estimation of the Compensation and Labor Supply Equations

Variable	ln W	B > 0[a]	ln (h)
EXP	.041**	.056**	.007**
	(.004)	(.008)	(.003)
EXP^2	-.0005**	-.0005**	-.0002**
	(.0001)	(.0001)	(.0001)
EDUC	.191**	.317**	-.017**
	(.016)	(.031)	(.007)
$EDUC^2$	-.003**	-.008**	
	(.001)	(.001)	
EDUC x EXP	-.001**	-.002**	
	(.0003)	(.0005)	
FEMALE	-.084**	.129**	-.011
	(.009)	(.017)	(.01)
BLACK	-.091**	-.170**	-.030**
	(.011)	(.026)	(.013)
OTH MINORITY	-.047**	-.132**	-.041*
	(.021)	(.038)	(.022)
ln (JOB GRO)	-.093	.751*	
	(.182)	(.413)	
ln (AVE EARN)	.052	.246**	
	(.054)	(.097)	
UNEMP	.006*	.001	
	(.003)	(.006)	
UNION	.089**	.395**	
	(.04)	(.145)	
ln (CPI)	1.32**	-.336	.169**
	(.119)	(.22)	(.062)
ln (PLAND)	.018**	.006	-.007
	(.007)	(.014)	(.006)
METRO	.186**	.215**	-.013
	(.015)	(.031)	(.019)
NEAST	.054**	.009	-.011
	(.013)	(.027)	(.012)
WEST	.049**	-.133**	-.013
	(.015)	(.033)	(.015)
SOUTH	.033**	-.047	.037**
	(.016)	(.03)	(.012)
ln (C^B)	.006	-.121*	
	(.034)	(.065)	
$\bar{t}^S$	.267	.741*	
	(.216)	(.406)	
t^S	4.17**	3.57**	
	(.354)	(.750)	
CHILD < 6			-.015
			(.017)
NUMBER			-.047**
			(.003)

ln V(1-t)			-.022*
			(.12)
E[B > 0]			.651**
			(.11)
E[ln(W(1-t)]			.109**
			(.047)
Constant	-7.20**	-1.11	6.48**
	(.42)	(.89)	(.34)
N	27564	27564	27564
R^2	.21	.07[b]	.04
Log likelihood		-16724	

Bootstrap Standard errors in parentheses.
*indicates significance at the .01 level. **indicates significance at the .05 level.
[a]Dummy variable indicating that the firm is providing a health insurance benefit.
[b]Pseudo-R-square.

Table 5: Simultaneous Estimation of the Compensation and Labor Supply Equations

Variable	ln W	ln (B)	ln (h)
EXP	.041**	.237**	.008**
	(.004)	(.025)	(.002)
EXP^2	-.0005**	-.002**	-.0002**
	(.0000)	(.0003)	(.00004)
EDUC	.192**	1.22**	-.004
	(.013)	(.084)	(.005)
$EDUC^2$	-.003**	-.034**	
	(.0005)	(.004)	
EDUC x EXP	-.001**	-.009**	
	(.0002)	(.001)	
FEMALE	-.084**	.375**	
	(.008)	(.053)	
BLACK	-.091**	-.477**	-.055**
	(.012)	(.08)	(.011)
OTH MINORITY	-.047**	-.369**	-.063**
	(.019)	(.129)	(.017)
ln (JOB GRO)	-.076	3.82**	
	(.19)	(1.24)	
ln (AVE EARN)	.060	.882**	
	(.049)	(.323)	
UNEMP	.007**	.047**	
	(.003)	(.02)	
UNION	.086	.790**	
	(.054)	(.358)	
ln (CPI)	1.32**	.954	-.077
	(.107)	(.705)	(.07)
ln (PLAND)	.018**	.062	-.013**
	(.007)	(.046)	(.006)
METRO	.186**	.958**	-.012
	(.014)	(.096)	(.014)
NEAST	.055**	-.026	-.009
	(.013)	(.09)	(.01)
WEST	.049**	-.581**	-.022
	(.015)	(.101)	(.015)
SOUTH	.034**	-.632**	.050**
	(.014)	(.097)	(.016)
ln (C^B)	.005	-.348	
	(.033)	(.214)	
$\bar{t}^S$	.280	3.10**	
	(.185)	(1.25)	
t^S	4.13**	12.75**	
	(.363)	(2.42)	
CHILD < 6			-.033**
			(.015)
NUMBER			-.023**
			(.004)
ln (V(1-t))			-.117**
			(.024)

E[(ln (B))]			.044**
			(.012)
E[ln(W(1-t))]			.159**
			(.053)
Constant	-7.21**	-13.7**	
	(.42)	(2.80)	
N	27564	27564	27564
R^2	.21	.08	.09

Bootstrap Standard errors in parentheses.
*indicates significance at the .01 level. **indicates significance at the .05 level.

Correlation Matrix of Residuals

	ln(W)	ln(B)	ln(h)
ln(W)	1.0		
ln(B)	0.34	1.0	
ln(h)	0.07	0.32	1.0

Endnotes

[1] Factual data based on Lettau and Buchmueller (1999), Sheu (2001), and the U.S. Chamber of Commerce (1996).

[2] A similar argument is that prior studies have used firm expenditures on health insurance as a measure of firm cost. As Cutler and Madrian point out, expenditures are a product of exogenous costs and endogenous benefit levels, and so their inclusion as a regressor would lead to bias in the estimated hours response to rising insurance costs.

[3] While their sample is not restricted to full-time workers, the Cutler and Madrian sample generates sample means that are consistent with those reported for full-time workers. Average work hours in their sample is 43.5 per week. Comparable statistics for full-time workers in that age group reported by Rones, Ilg and Gardner (1997) were 44.9 for males and 43.3 overall. The proportion of their sample receiving employer-provided health insurance was 84%, identical to the proportion of full-time workers receiving that benefit (Lattau and Buchmueller,1999).

[4] The consumer price index hospital and related services over the same period implies a 163% increase, even larger than the 124 % increase in the data used in this study. For broader health insurance plans that cover physician services as well as hospitalization, the broader index for medical care services suggests a 128% increase over the time period. Finally, the broadest price index for medical care rose 124% over the period, the same as our cost data from the Health Insurance Association of America. Copnsequently, it appears that our measure which allows cross-sectional variation in cost of providing health insurance also does a good job of tracking the time series variation in the cost of providing health insurance.

[5] The statistics reported in Table 1 are based on a sample of single workers in the Current Population Survey. Concentration on single workers allows us to avoid confusion caused by the potential joint decision on acceptance of employer-provided health insurance in two-earner households. Nevertheless, the time paths of health insurance coverage and average employer contributions are similar to those reported in Cutler and Madrian (1998) or Sheu (2001).

[6] Several studies have concluded that rising marginal tax rates in the post World War II period have had a large impact on the provision of benefits. See Currie and Madrian (1999) for a review.

[7] Eventually, the hours supply schedule may bend backward in wages or benefits, but it would never pay for the firm to raise compensation to that level.

[8] Montgomery and Shaw (1997) use such an efficiency wage formulation to derive firm tradeoffs between wages and pensions.

[9] Some have argued that the difference in firm provision of benefits between full- and part-time workers is due to fixed costs of providing benefits. While this may explain part of the difference, Lettau and Buchmueller (1999) report large differences between full- and part-time workers in firm provision of many types of benefits, even when there are no apparent fixed costs to benefit provision. The strategic use of benefits to create convex compensation packages is a likely explanation.

[10] Currie and Madrian report that most empirical studies have failed to find an inverse empirical relationship between wages and health insurance benefits, presumably because of the difficulty of controlling fully for differences in worker ability. As equations (4-5) suggest, unobserved factors that shift f' upward would tend to raise both wages and benefits. Researchers have been able to find inverse relationships between wages and other benefits, however. For examples, Montgomery and Shaw (1997) find an inverse relationship between pensions and wages and Gruber (1994) finds an inverse relationship between maternity benefits and wages.

[11] Extending health insurance benefits to part-time workers would shift the budget constraint upward between 0 and H^* hours worked. The wage would fall via the reservation utility condition. Consequently, there would be both income and substitution effects toward leisure for part-time workers.

[12] Lettau and Buchmueller (1999) estimated that health insurance benefits averaged $3,078 per full-time worker.

[13]Cutler and Madrian (1998) and Sheu (2001) concentrate on males on the presumption that men are less likely than women to have to coordinate benefits decisions. However, it is not clear why this presumption would be accurate. In theory, the choice of which compensation package to accept would be jointly determined between married couples, so the bias would exist for both married males and married females. The rising popularity of cafeteria plans makes it even easier for married partners to tailor their individual compensation mix to meet joint objectives.

[14] The selection problem is not likely to be serious, as 94 percent of singles in this age range held a job in the previous year.

[15] The measure of education is an index indicating education level rather than years of education completed. The average of 8.3 corresponds to between 13 and 14 years of completed schooling.

[16] For column 2, the marginal effects of variables are computed by $\frac{\partial F(\bullet)}{\partial x} = \beta f(\bullet)$ where $f(\bullet)$ is the cumulative distribution function and $f(\bullet)$ is the density function evaluated at sample means.

[17] Currie and Madrian (1999) found that most studies fail to find that wages and health insurance benefits are inversely related as one would expect from the theory of compensating differentials. The common explanation that unobserved ability raises both

wages and benefits is consistent with our finding that the errors in the wage and benefits equations are positively correlated.