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Taxes and labor supply of high-income physicians

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Abstract

We use the 1983–1985 Physicians' Practice Costs and Income Survey, supplemented with federal and state tax rates, to estimate the effect of variation in marginal tax rates on work hours for high-income physicians. We find that self-employed physicians are much more sensitive to the marginal tax rate than would be suggested by previous labor-supply studies, while those who are employees have no discernible sensitivity to marginal tax rates. © 1997 Elsevier Science S.A.

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1. Introduction

Recently there has been an increased interest in the economic behavior of high-income (HI) individuals. Part of this stems from questions about behavioral responses to tax policy changes which have dramatically altered incentives for these individuals. For example, the Reagan administration substantially lowered the top marginal tax rates during the 1980s arguing that lowering the rates on HI individuals would spur savings, investment and entrepreneurial activity. In contrast, the Clinton administration raised the top marginal rates in 1994 with the intent of increasing the progressivity of the tax code, asserting that this would increase federal tax revenues.

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These policy fluctuations provide motivation for empirical studies of the size and magnitude of behavioral responses to changes in tax rates. Economic theory typically gives little guidance since in many models, the income and substitution effects move in opposite directions. Perhaps the most famous example of this theoretical ambiguity is the backward-bending supply curve. In its simplest form, a backward-bending supply implies that at sufficiently high wage levels labor supply will actually decrease with an increase in the wage, or equivalently, a decrease in the marginal tax rate.

Related to the general questions about behavioral responses of HI individuals, recent work by Feenberg and Poterba (1993); Feldstein (1995) suggests that the elasticity of federal tax receipts with respect to the marginal federal tax rate is essentially zero for the upper tail of the income distribution. Using tax return data, they are unable to determine whether this is due to changes in labor supply or in other forms of tax avoidance.

This paper explores the labor supply response to differences in marginal tax rates for a group of HI individuals using a unique data source, the 1983–1985 Physicians' Practice Cost and Income Survey (PPCIS). The PPCIS is a survey of approximately 5000 physicians randomly selected from the American Medical Association Masterfile of Physicians. Among the over 450 variables included, the data contain detailed information on physician income, labor hours and demographics. Supplementing these data with federal and state tax rates, we estimate the effect of marginal tax rates on work hours. The econometric identification of the tax effect comes from the state variation in marginal rates. Since physicians constitute a significant fraction of HI individuals (about 15% of the top 1/2% of the income distribution were physicians in 1983) the PPCIS also provides insights on HI individuals in general.

The results suggest that high-income, self-employed physicians are much more sensitive to the marginal tax rate than would be suggested by previous labor-supply studies, with labor elasticities with respect to the marginal tax rate of about −0.30 for self-employed HI physicians. We find that HI employee physicians (physicians who work for HMOs, clinics or hospitals) have no discernable sensitivity to marginal tax rates.

The paper proceeds as follows: first we discuss several issues in labor supply estimation and then we give a brief description of the data. In Section 4 we present and discuss the empirical results and we conclude with Section 5.

2. Labor-supply issues

Over the past 30 years there has been an enormous amount of research done on the labor supply of men and women with the majority of that work, especially for men, suggesting "... that the elasticities of hours of work with respect to wages are very small" (Pencavel, 1986, p. 94). Heckman (1993) has gone so far as to suggest modifying George Stigler's dictum "all elasticities are 1 in absolute value" to "elasticities are closer to zero than one for hours-of-work equations estimated *for those who are working*" (Heckman, 1993; italics in the original). This directly suggests that labor supply is not very sensitive to the marginal tax rate on labor income.

2.1. Focus on high-income labor supply

Much of the previous labor-supply research has been motivated by policy questions surrounding various welfare proposals and thus has focused primarily on low- and middle-income individuals and families. For example, the major income maintenance experiments of the 1970s such as the New Jersey Income Maintenance Experiment and the SIME/DIME were explicitly designed to learn more about the labor incentives of various welfare schemes.

In contrast to this focus on the low end of the income distribution, major changes in the tax codes of most industrialized countries since the early 1980s have dramatically altered the incentives for high-income individuals. For example, in the US, top federal tax rates have fallen from above 70% to as low as 28% and have recently begun climbing again. Much of the downward movement of the top tax rates had an explicit political motive of increasing work incentives. However, relatively little has been done to assess the empirical effects on labor supply largely because of the lack of reliable data on high-income individuals.[1]

Recent work by Feenberg and Poterba (1993); Feldstein (1995) suggests that high-income individuals are indeed responding to incentives, although the exact mechanisms of their response are unclear. Feenberg and Poterba report that the reported adjusted gross income (AGI) for the extreme tail of the income distribution (top one quarter of 1%) increased dramatically in 1987 and 1988 after the 1986 Tax Reform Act which lowered the highest federal marginal tax rates from 50% to 28%. Using panel data on individuals who paid federal taxes in 1985 and 1988, Feldstein also finds a large increase in reported income suggesting a high elasticity of reported income with respect to the marginal tax rate. Neither of these studies is able to distinguish to what extent the increase in reported AGI is due to changes in labor supply versus changes in a variety of other possible tax-avoidance responses.

In this study, we begin to fill part of the gap in the previous labor literature and answer some of the questions raised by the work on HI individuals using tax-return data. Specifically, we investigate the labor supply response of physicians

[1] Slemrod (1994a) is a notable exception to this generalization, but he admits the quality of his data limits the usefulness of his work. There is also work done by Break (1957) and Holland (1969), among others, using interviews of high-income individuals that find taxes having at most a secondary impact on labor-market decisions. The usefulness of such data is discussed in Atkinson and Stiglitz (1980) (pp. 48–50).

using the 1983–85 PPCIS. Physicians are a particularly interesting subset of the population for at least two reasons. First, physicians are among the highest paid professionals in the economy and a careful study of physicians' characteristics and work behavior may provide insights on HI individuals in general (or at least those whose incomes are derived primarily from earnings). Second, physicians tend to be self-employed and presumably have a greater degree of control over labor hours than non-self-employed workers. This will allow us to gain some understanding about the work behavior of self-employed individuals.[2]

2.2. The model and estimation issues

Our analysis is based on the neoclassical model of an optimizing agent who receives both wage and non-wage income and spends it on a composite commodity. Formally, the optimization problem is

$$\text{Max } U(c, l; v) \text{ subject to } wh + y = pc \tag{1}$$

where c is the composite commodity, l is hours in leisure activity, v is a parameter that measures characteristics of utility which are unobservable to the econometrician and has a continuous distribution given by the density function $f(v)$, w is the competitive wage rate, h is hours of work, y is non-wage income, and p is the price of the commodity. Utility is assumed to be quasi-concave in c and l. It is assumed that $l+h=L$, where L is a fixed amount of time that can be allocated between labor and leisure.

Income taxation changes the analysis only slightly. The budget constraint is modified to

$$wh + y - T(wh, y) = pc \tag{2}$$

where $T(.,.)$ is the total amount of taxes paid. The function T allows for nonlinearities in the tax system such as are commonly found in industrialized countries and it also allows for different rates of taxation for labor and non-labor income. Building on the suggestion in MaCurdy et al. (1990) we will assume that T is twice differentiable in both its arguments.[3] The marginal tax rate on labor income, t, is then defined as the partial derivative of T with respect to labor income, wh.

From this point, most recent labor studies use the local equivalence of this maximization problem with a convex budget constraint to one with a linear budget constraint constructed with the after-tax marginal wage and 'virtual income'[4] to

[2] A recent paper by Rizzo and Blumenthal (1994) also looks at physician labor supply; however their focus and methodology is quite different from ours.

[3] MaCurdy et al. (1990) suggest using a differentiable approximation to the typical non-differentiable budget constraints induced by most tax systems.

[4] Virtual income ≡ (after-tax income) − $(1-t)wh$ where w is the marginal wage, t is the marginal tax rate and h is hours worked.

derive a labor supply equation as a function of the marginal (real) wage, $(1-t)w$, virtual income, VI, and the index parameter, v.

$$h = h\{(1 - t)w, VI, v\} \tag{3}$$

Typically, the unit of observation is an hourly wage-earning individual and the marginal wage is easily measured. If the hourly wage is not given, it is inferred by dividing reported labor income by reported hours worked which tends to give a reasonable estimate of the marginal wage. Although the PPCIS is a rich source of information, it poses some serious measurement problems that are likely to be shared by most data on the self-employed.

For example, physicians do not report an hourly wage. We do have a good measure of hours worked, but yearly income is reported for a different year than that of labor hours and is reported in brackets ranging in size from \$10 000 up to \$40 000 with the highest bracket only reporting that income is above \$200 000.[5] This makes computing a reasonable measure of the average or marginal wage problematic.

Further, for an established practice, reported income for an individual can be greater or less than the actual amount earned from hours worked in a given year. For example, suppose the owner of a practice earns \$100 000 in a given year, but only takes \$60 000 in compensation and reinvests the remaining \$40 000 in the practice. The firm is now worth an additional \$40 000 which presumably will be withdrawn at some point in the future as deferred income.

Aside from income-measurement issues, it is also customary practice among physicians to set prices by procedure rather than by an hourly rate. This implies that the actual hourly wage is stochastic, depending on the time it takes a physician to perform a particular procedure for a particular patient. This time will vary based on many factors, such as the difficulty of the particular procedure being performed. Therefore, any measure of a marginal wage that we could infer from the available data would be subject to problems of interpretation.

For these reasons, we approach the econometric estimation somewhat differently than most labor studies. Beginning with a standard hours specification, we assume that the labor hour equation has the form

$$\log(h) = \beta_0 + \beta_1 \log\{(1 - t)w\} + \beta_2 I + X\delta + v \tag{4}$$

where t is the marginal tax rate, w is the marginal wage, I is a measure of non-labor income, X is a set of demographic characteristics and v is the stochastic error term. This can be re-written as

[5] For example, the first two income brackets are (1) income less than \$30 000, and (2) income between \$30 000 and \$40 000. The actual income question describes income as a physician's 'own net income from ALL your medical practices after practice deductions, but before taxes... includ[ing] bonuses, deferred income and other forms of compensation.' Physicians in the top bracket (over \$200 000) are then asked the amount of income in excess of \$200 000, with 174 out of 186 responding.

$$\log(h) = \beta_0 + \beta_1 \log(1-t) + \beta_1 \log(w) + \beta_2 I + X\delta + v \tag{5}$$

where β_1 has the interpretation of being the elasticity of hours with respect to the net wage.

Next we incorporate the stochastic wage by assuming that wages are given by the following specification:

$$\log(w) = Z_1\theta_1 + \xi_1 \tag{6}$$

where Z_1 is a set of observable characteristics (which might have some elements in common with X from Eq. (4)), θ_1 is the coefficient vector and ξ_1 is the stochastic error term. This form of the wage equation has been widely used in empirical work.[6]

Suppose that income has a form similar to Eq. (6):

$$I = Z_2\theta_2 + \xi_2 \tag{7}$$

where Z_2 is also a set of observable characteristics, and ξ_2 is the stochastic error term.

Combining Eqs. (5)–(7) we get

$$\log(h) = \beta_0 + \beta_1 \log(1-t) + Z\Gamma + \epsilon \tag{8}$$

where Z is the union of X, Z_1 and Z_2 and ϵ is a combination of v, ξ_1 and ξ_2. With the assumption that the stochastic terms are independent of Z and t, this specification can be used to estimate β_1 which, as stated previously, is a measure of the uncompensated wage elasticity. The most obvious disadvantage of this formulation is that the income effect is unobservable since Γ captures both the wage and income effects. However this formulation is useful in providing a tractable estimation equation for our problem.

With the given assumptions, β_1 could be estimated with Ordinary Least Squares, however, with a nonlinear tax code, the marginal tax rate on labor is a function of labor hours, hence t is endogenous. We account for this by estimating Eq. (8) with an instrumental variables technique where the instrument for the tax rate is the maximum state tax rate in the state of residence of the individual, t_{max}, specifically, $\log(1-t_{max})$.

[6] Berndt (1991) (Chapter 5) gives an excellent exposition of the empirical use of wage and earnings functions.

3. Data description

The primary data for this study is the 1983–85 Physicians' Practice Costs and Income Survey (PPCIS) conducted by the National Opinion Research Center under contract to the Health Care Financing Administration. This cross-sectional survey was conducted from October 1984 through June 1985 and includes responses from 4729 physicians (out of 6847 eligible) drawn from a stratified random sample of physicians from the American Medical Association's 1984 Physician Master File. The surveyers asked the physicians (or their representatives) detailed questions regarding pricing policies, reimbursement rates and practice characteristics. The data set also contains variables concerning the physicians' personal characteristics (age, sex, specialty, etc.) obtained from the AMA Physician Masterfile.

We augment the PPCIS data by constructing tax code variables. First we estimate the combined federal and state marginal income tax rate faced by each physician. In the simplest case where a state does not allow a deduction for the federal tax liability, the formula for the marginal tax rate is $t = MTR = fmtr + smtr - (fmtr \times smtr)$ where *fmtr* is the federal marginal tax rate and *smtr* is the state marginal tax rate.

The state tax rates were collected for various years from the State Tax Handbook. Most state tax rate schedules are relatively simple and the highest marginal tax rate is typically applicable to taxable income over $10 000. From the PPCIS data we can determine the state of residence for each physician. Using two different methods we attach an estimate of t to each observation based on reported income and state. Both methods produce roughly the same results, and we report results using the one that results in the largest sample size. A detailed discussion of the construction of marginal tax rates and the matching procedures is included in Appendix A.

We also include several additional variables that capture geography-specific effects. These include the state unemployment rate for the year the survey was conducted and the following variables for the county of residence for the physician: physicians per 1000 (population), hospitals per 1000, hospital beds per 1000, percent (of county population) living in urban areas, percent age 65 or over, percent age 14 or under, percent nonwhite, median income, percent of those age 25 or older who completed at least 12 years of education, percent of families with income less than the poverty line and per capita local government expenditures.

The sampling frame of the PPCIS is practicing physicians working at least 20 hours per week on average. We initially restrict our sample to high-income (income of at least $80 000 in 1983) male physicians age 60 or less, working 20–90 hours in the week prior to the survey and who are either self-employed or employed by an HMO or hospital. The age restriction is included to avoid retirement issues. The hours restriction is imposed to reduce the influence of some extreme outliers, although dropping this restriction does not materially change any of the estimation results. The high-income level was chosen to reflect approximately the top 5% of the US income distribution (acknowledging that the income in the PPCIS is more broadly defined than is typical with most income distribution statistics gathered from sources such as the CPS).[7] Modest changes in the high-income cutoff level do not substantially affect our estimation results.

Table 1 gives some descriptive statistics of our data. The initial sample has 1689 observations. The first variable is hours worked in the week prior to the survey[8] which is our primary measure of labor hours. Our motivation for using weekly hours is that this variable seems to have been collected with considerable care; several detailed follow-up questions were asked of the physician to verify the accuracy of the number.[9] The surveyers also asked the number of vacation weeks taken during 1983, allowing us to estimate yearly hours worked. Variables 2 and 3 are the estimated tax rate variables. Variables 4–18 are dummy variables giving the specialty of the physician. Variables 19–25 give other demographic characteristics of the physician and variables 26–37 give demographic characteristics of the county and state of the physician's residence. A more detailed description of the variables and their sources is included in Appendix A.

4. Empirical results

We begin this section by examining the correlation between marginal tax rates and work hours. Since this is cross-sectional data and most physicians are at or near the top of the federal tax schedule, most of the variation in marginal tax rates is from variation in state marginal tax rates. If marginal tax rates do affect the labor supply of physicians, we ought to be able to observe some difference in hours worked by state. We perform a couple of simple tests of this implication.

First, we rank states by their top marginal tax rate in 1985. We can define this maximum rate either by taking the top statutory rate in a state's tax schedule or, more appropriately, by computing a maximum effective tax rate which adjusts the top statutory rate to account for interaction with the federal tax code.[10] Table 2 gives an abbreviated ranking of the highest tax states using these two measures.

[7] We also estimated our models using state-specific high-income cutoff levels to account for possibly differing price levels across states. Specifically, we computed the income distribution for each state and chose the income level that represented the *n*th percentile of the distribution each state. The results were very similar to those reported in the paper.

[8] Or the hours worked in the last full week of work if they survey was done after a holiday period.

[9] More specifically, the physicians were asked two general questions: how many hours did they spend on medical activities and how many hours did they spend on administrative activities. Then they were asked several follow-up questions on hours spent on specific activities (such as hours spent on hospital visits).

[10] For example, allowing filers to deduct part of their federal tax liability lowers the effective state marginal tax rate.

Table 1
Statistics for sample of self-employed and employees of hospitals, HMOs or clinics

Sample Size: 1689	Mean (1)	Std. Dev. (2)	Min (3)	Max (4)
(1) Hours Worked (week)	57.60	12.77	20	90
Tax Variables				
(2) Total MTR	0.48	0.04	0.42	0.57
(3) Maximum State Marginal Tax Rate	0.06	0.04	0	0.15
Individual Demographic Characteristics				
(4) General Practice	0.02	0.15	0	1
(5) Family Practice	0.06	0.24	0	1
(6) Internal Medicine	0.10	0.30	0	1
(7) Cardiovascular	0.03	0.18	0	1
(8) Pediatrics	0.03	0.17	0	1
(9) Other Medical	0.08	0.27	0	1
(10) General Surgery	0.07	0.25	0	1
(11) Orthopedic Surgery	0.05	0.22	0	1
(12) Opthalmology	0.05	0.21	0	1
(13) Urological Surgery	0.05	0.21	0	1
(14) Ob/Gyn	0.07	0.25	0	1
(15) Other Surgery	0.06	0.23	0	1
(16) Other Specialty	0.07	0.25	0	1
(17) Psychiatry	0.04	0.19	0	1
(18) Hospital-based Specialty	0.23	0.42	0	1
(19) Age	45	7.68	29	60
(20) White	0.83	0.37	0	1
(21) Black	0.01	0.11	0	1
(22) Asian	0.12	0.32	0	1
(23) Other	0.04	0.19	0	1
(24) Board Certified	0.75	0.43	0	1
(25) Foreign Medical School Graduate	0.22	0.42	0	1
County and State Demographics				
(26) Physicians per 1000	1.918	1.132	0.07	13.55
(27) Hospitals per 1000	0.029	0.020	0	0.37
(28) Hospital beds per 1000	6.543	3.767	0	44.89
(29) Percent Urban Population	79.8	22.5	0.0	100.0
(30) Percent Unemployed in State	7.3	1.7	3.9	15.0
(31) Percent Age 65 and Over	11.3	3.7	0.0	32.7
(32) Percent Age 14 and Under	20.8	4.3	0.0	35.3
(33) Percent Minority Population	16.7	17.7	0.2	100.0
(34) Median Income	19 625	4238	9622	33 711
(35) Percent of Adults with High School Education	68.5	9.2	32.2	89.9
(36) Percent Under Poverty Line	9.0	4.2	2.3	34.4
(37) Per Capita Local Government Expenditures	1153	521	0	7028

Sources and Notes: variables 1,4–28 come from the PPCIS including information from the American Medical Association and the American Hospital Association; variables 2–3 come from the State Tax Handbook; variable 30 is from the 1986 Statistical Abstract of the United States; variables 31–37 come from the 1986 City and County Data Book. Variables 26–37 (with the exception of 30) are based on the county of residence of the physician.

Table 2
The ten states with the highest marginal tax rates

Unadjusted statutory marginal income tax rate (1)		Statutory marginal income tax rates adjusted to account for state-specific laws (2)	
	Maximum state marginal tax rate (1985)		Maximum state marginal tax rate (1985)
(1) Oklahoma	17.00	(1) West Virginia	14.56
(2) Minnesota	16.00	(2) New York	14.00
(3) West Virginia	14.56	(3) Delaware	13.50
(4) New York	14.00	(4) Minnesota	11.32
(5) Delaware	13.50	(5) California, D.C., Hawaii	11.00
(6) Iowa	13.00	(8) Rhode Island	10.19
(7) Rhode Island	11.34	(9) Oklahoma	10.12
(8) Vermont	11.13	(10) Vermont	10.02
(9) California, D.C., Hawaii, Montana	11.00		

(1) States with no income tax: Alaska, Connecticut, Florida, Nevada, New Hampshire, South Dakota, Texas, Washington and Wyoming.

We then divide states into four groups: (1) no personal income tax, (2) a top effective marginal tax rate greater than zero but less than or equal to 5%, (3) a top effective marginal tax rate of between 5 and 10%, and (4) a top effective marginal tax rate of over 10%.[11] Finally, we compute mean weekly labor hours for all male physicians in each group of states.[12] The results are given as follows:

Top State Marginal Tax Rate	N	Mean hours
0	770	58.1
0.01–0.05	1070	57.2
0.05–0.10	1368	57.7
0.10–0.15	976	55.5

While not a monotonic relationship, this rough calculation showing a decline of 2.6 hours from the zero tax group to the highest taxed group does give some support to the hypothesis of a negative relationship between marginal tax rates and labor hours.

Next we run a regression of individual labor hours on the maximum effective state rate, t_{max}. The estimated coefficient for the tax variable is -15.65 with a

[11] Group 1: AK, CT, FL, NH, NV, SD, TN, TX, WA, WY. Group 2: AL, AZ, CO, IL, IN, KY, LA, MO, ND, NJ, PA, UT. Group 3: AR, GA, IA, ID, KS, MA, MD, ME, MI, MN, MS, MT, NC, NE, NM, OH, OK, OR, SC, VA, WI. Group 4: CA, DC, DE, HI, NY, RI, VT, WV.

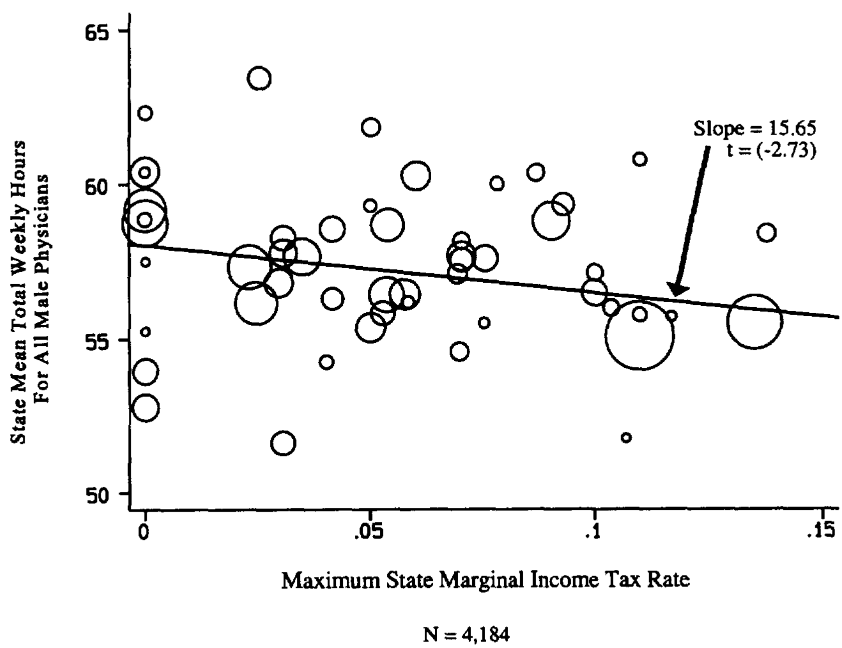
[12] Ranking states by statutory rate gives very similar results.

t-statistic of -2.73 and a sample size of 4184. The mean number of hours is 57.1 and the mean tax rate is 0.06. This reflects about a 9 minute decrease in weekly work hours for every percentage point increase in the maximum tax rate. Fig. 1 plots the fitted regression line along with mean total hours worked by state. The size of the circles is scaled to represent the number of physicians in the sample from each state. Again, although the magnitude is not large, these results are consistent with a negative relationship between marginal tax rates and labor hours.

Such statistics, while useful since they require so little individual-specific information, are obviously very crude measures of the relationship between marginal taxes and labor hours and alone probably would not be very valuable or informative. In the following sections we refine the analysis and find a substantially larger tax effect than is suggested by these results.

4.1. Instrumental variables estimates

Next, we estimate Eq. (8) instrumenting for the endogenous full marginal tax rate, t, with the maximum state tax rate, t_{max}, and the variables described in



The circles are scaled to reflect the number of physicians in each state. The regression line is from a regression of each physician's weekly work hours on the maximum marginal tax rate for their state of residence.

Fig. 1. Physicians' Work Hours and Maximum State Income Tax Rates.

Section 3 as controls.[13] We initially restrict our sample to high-income physicians aged 60 or less and working between 20 and 90 hours. The results for the combined sample of self-employed and employee physicians are reported in Table 3, column 1. The estimated coefficient is 0.33 with an asymptotic t-statistic of 2.36[14] and an adjusted R-square of 0.05. Line 6 gives the expected weekly work hours, 57.84, for a representative physician[15] facing a marginal tax rate of 0.48. With a tax rate of 0.49 expected hours decrease by 0.36 hours or 21.6 min per week. This implies a semi-elasticity of labor hours with respect to the marginal tax rate of −0.30 where semi-elasticity is defined as the arc elasticity of labor hours with respect to a 0.01 unit increase in the marginal tax rate. These are much larger labor supply effects than are typically found in studies of working age males in the US.

It is common practice in labor studies to exclude self-employed individuals. For comparability, columns 2 and 3 split the sample into self-employed and employee

Table 3
Instrumental variables regression results

Dependent Variable: Log (h)	SE and employee (1)	SE only (2)	Employee only (3)	Solo, sole proprietor (4)	Yearly hours (5)
Regression Results					
(1) Total Marginal Tax Rate	0.33	0.33	0.10	0.61	0.31
(2) (Std. Error)	(0.14)	(0.16)	(0.31)	(0.46)	(0.16)
(3) Sample Size	1689	1392	297	185	1357
(4) R-square	0.07	0.06	0.22	0.22	0.07
(5) Adjusted R-square	0.05	0.04	0.12	0.04	0.05
Elasticity Computations					
(6) Expected Hours (t=0.48)	57.84	59.11	53.27	60.93	2861.00
(7) Expected Hours (t=0.49)	57.48	58.74	53.17	60.21	2844.00
(8) Difference (h)	−0.36	−0.37	−0.10	−0.72	17.00
(9) Difference (min)	−21.6	−22.2	−6.0	−43.2	–
(10) Semi-elasticity	−0.30	−0.30	−0.09	−0.57	−0.28
(11) (Std. Error)	(0.13)	(0.15)	(0.28)	(0.43)	(0.15)

(1) All regressions include controls for specialty, age, physician characteristics and local demographic characteristics.
(2) Instrument is log(1 − maximum state marginal tax rate).
(3) Heteroskedasticity-robust standard errors are in parentheses.

[13] We also experiment using lagged tax rates as instruments and found no significant differences in the estimation results.

[14] All standard errors are robust to general forms of heteroskedasticity.

[15] The representative physician is a family practice physician, white, age 45, board certified, US medical school graduate and lives in a county represented by the means of the county and state variables.

components. In column 2 (self-employed physicians) the estimated coefficient is the same as in the combined sample at 0.33 with a slightly lower t-statistic of 2.06; but with the employee physicians in column 3, the estimated coefficient is much smaller at 0.10 and is statistically insignificant. We find it very interesting that the estimate for the employee physicians is roughly equivalent to what has been found in previous labor studies that almost universally use employees, while the results for the self-employed suggest a much greater sensitivity to the tax rate.

As an additional experiment we constructed a sample that on a priori grounds we would expect to be very sensitive to the marginal tax rate. Column 4 gives the estimation results for a sample of 185 high-income solo practice physicians in sole proprietorships. This group of physicians conceivably has the greatest flexibility in setting labor hours, when contrasted with employee physicians and self-employed physicians working with other physicians. Since sole proprietors only face the personal income tax rate, we are more accurately capturing the true marginal tax rate for this group as opposed to the larger, but more heterogenous group of physicians who more realistically face some complex combination of the personal and corporate tax rates.

As seen in column 4, the tax effect for this group is nearly twice as large as for the full group of self-employed physicians with an estimated coefficient of 0.61; but, not surprisingly, given the relatively small sample size, it is statistically insignificant with a t-statistic of 1.33. Line 9 reports the estimated decrease in work hours, which is over 43 min per week. Although these results are intriguing, a note of caution is in order since it is possible that selection into this group of physicians is also a function of tax rates. A more complete model of the choice of business and work structure (sole proprietorship versus incorporation, solo practice versus multiple physician practice) is beyond the scope of this paper but is an important topic for future research.

Column 5 gives the results using an estimate of yearly hours worked. Yearly hours is estimated as the hours worked in the week prior to the survey multiplied by the reported weeks of work in 1983 with the additional constraint that vacation weeks not exceed 13. The sample size is slightly smaller at 1357 observations as compared to the 1392 using weekly work hours (column 2). The estimation results are very similar to those using weekly hours. The estimated tax coefficient is 0.31 with a t-statistic of 1.94. As seen in line 8, there is an estimated 17 hour reduction in yearly work hours for the representative physician due to a 1% increase in the marginal tax rate.

4.2. Wage/VI specifications

An additional test is to use the more common wage/virtual income form of a labor-supply regression. As mentioned in Section 2, constructing a wage or a measure of 'virtual' income using this data (or likely any data on self-employed) is very difficult. Two key empirical problems hinder these efforts: First, no wage information is included and annual income is only measured in categories, so constructing wage information from the data is problematic. Second, we only have very limited information on the direct source of the income; we cannot separate practice-related income into labor and non-labor components.

Nonetheless, because the wage/*VI* methodology is a standard approach we experiment with it extensively using a wide range of instruments and subsets of our data. The results are generally inconclusive, but highly suggestive of severe measurement problems that cannot be corrected using the best available instruments. As an example, Table 4 gives some representative estimation results for a group of high-income solo-practice self-employed physicians. This sample represents the most likely opportunity to accurately measure the after-tax wage: presumably, all income comes from the efforts of the single physician so dividing income[16] by hours worked should yield a good measure of the average wage; we are also reasonably confident that we have a credible measure of the marginal tax rate for these individuals. We limit the sample to individuals with under \$10 000 of non-medical income—including individuals with substantial amounts of non-labor income would likely bias the results since the estimation will not adequately control for that income.[17]

Table 4
Standard wage/virtual income model IV regression results

Dependent Variable: Log (Yearly Hours)	OLS (1)	IV (2)	IV (3)
(1) Log Net Wage: $\log[(1-t)w]$	−0.86	−0.84	–
	(0.021)	(0.21)	
(2) Income (×10 000)	0.20	−0.0010	–
	(0.0078)	(0.0710)	
(3) $\text{Log}(1-t)$	–	–	0.33
			(0.33)
Sample size	1133	1133	1133
R-square	0.87	0.67	0.15
Adjusted R-square	0.86	0.63	0.05

(1) All regressions include controls for specialty, age, physician demographic characteristics and local demographic characteristics.
(2) Instruments include: log(1 − maximum state marginal tax rate), Medicaid Reimbursements for Office and Hospital Visits and the standard fees for office and hospital visits, except in column 2 where only the maximum state marginal tax rate is used.
(3) Heteroskedasticity-robust standard errors are in parentheses.

[16] We estimate the level of income for each bracket using techniques described in Appendix A (see Section A.3).

[17] There was a question in the survey which asked if the physician had income in addition to medical income of over \$10 000, including income from a spouse. A little over a third of the sample responded affirmatively.

Column 1 gives the results of an OLS regression where the dependent variable is the log of yearly hours worked (using the same estimate of yearly hours as described previously) and explanatory variables of the log of the after-tax wage, virtual income and all the control variables used in the previous regressions. The estimated coefficient for the net wage is -0.86 with a t-statistic of -43; for virtual income the coefficient is 0.000020 with a t-statistic of approximately 0. The strong negative correlation is indicative of construction bias: since w is estimated as income divided by hours, if there is any measurement error associated with income, by construction w will be negatively correlated with the dependent variable of yearly hours which is rather apparent.

Due to this bias, OLS likely is not the best technique to use. Column 2 gives the instrumental variables estimate where the instruments are the log of 1 minus the maximum state tax rate, the medicaid reimbursement rate for an office visit, the medicaid reimbursement rate for a hospital visit with an established patient, the standard fee charged by the physician for an office visit and the standard fee charged by the physician for a hospital visit. Unreported results using a variety of other instruments are very similar. The first stage results suggest that the chosen instruments work reasonably well with at least one instrument in each first stage regression having a t-statistic over 2 (in absolute value).[18] The second stage results are very similar to those using OLS; an estimated coefficient on the net wage of -0.84 with a t-statistic of -4.0 and again the coefficient for virtual income is statistically insignificant. Both the adjusted and unadjusted R-square measures are also very high at 0.63 and 0.67, respectively.

For comparison, in column 3 we give the estimation results for the sample using the tax-only format we used previously. The estimated coefficient is 0.33 with a t-statistic of 1. Our view of these results is that the negative coefficients in the wage/*VI* specification can be explained on the basis of a poor measure of the marginal wage; the statistically significant negative coefficient is an artifact of the construction of the wage rather than revealing fundamental insights about labor-supply behavior.

On a related topic, Triest (1992) argues that in a tax system which allows for the full or partial deduction of some, but not all, consumption goods (e.g. housing, medical expenses), the standard optimization framework of Section 2 which treats all consumption as a Hicksian composite commodity is incorrect since the tax rate will affect the relative prices of the elements of the composite good. This is potentially important since high-income and hence highly taxed individuals would presumably have a strong incentive to rearrange their compensation to consume relatively more tax-deductible goods. This would directly affect the interpretation of the tax coefficient we have estimated: although the coefficient would still be interpreted as a tax elasticity, it would no longer have a wage elasticity interpretation since it would also be accounting for differences in the relative

[18] Full regression results are available from the authors upon request.

prices of taxable and nontaxable consumption. Unfortunately, the required data and estimation methodology to account for this effect is closely related to, but even more demanding than, the wage/*VI* specification. We therefore conclude that our results are subject to this difference in interpretation and note that this is an important topic for future research.

4.3. Physician mobility and location decisions

Another possible concern with this study is that it does not address the issue of tax arbitrage due to physician mobility. Rather than adjusting labor hours when a state changes its tax rate, a physician has the option of moving to another state. This would tend to dampen the sensitivity of labor hours to state tax rate changes which would imply that our estimates understate the true effect. As a check on physician mobility we use the 5% Public Use Micro Sample of the 1990 Census to compare HI physician mobility with the mobility of other HI professionals:

% of HI Professionals (Ages 40–65) Living in a Different State in 1990 than in 1985

Physicians	Other professionals	Difference
(1)	(2)	(*t*-stat)
5.66	10.23	−14.38
(*N*=7382)	(N=32 121)	

This suggests that physicians are about half as likely to have moved in the years 1985–1990 as other professionals (5.66% versus 10.23%).[19] Moreover, summary statistics from the Practice Patterns of Young Physicians Survey of 1987 show that when asked the most important reasons for moving to their present location, physicians cite other factors more often than those related to financial concerns or state taxation.[20] It seems unlikely given this information and the likely direction of the bias that this selection problem seriously undermines our results.

Two additional sources of selection bias are important to consider. It may be possible that even if physicians make infrequent location decisions, those who have a higher mean preference for work hours,[21] ceteris paribus, are more likely to seek the advantages of living in lower tax states. If this is true, then our results would tend to overstate the true elasticities. Similarly, if physicians are heterogeneous with respect to their elasticities of labor supply and physicians with more elastic supplies locate in lower tax states, then the interpretation of these results is

[19] Physicians (occupation code 084) and other professionals (occupation codes 003–199, except 084). To avoid biases related to timing issues and to keep to a sample somewhat analogous to the PPCIS data, we focus on respondents ages 40–65, with earnings over $100 000.

[20] The most commonly cited reasons for decision to locate in current job are: (1) Like this location (29%), (2) Family here/hometown (18%), (3) Good professional opportunity (17%), (4) Spouse's job (5%).

[21] Traditionally modelled as a lower marginal utility of leisure for a given level of work effort.

somewhat problematic. This is a problem inherent to cross-sectional analysis. Studies using panel data would provide useful information about the impact of this potential selection problem.

In the absence of a more complete model of physician location choice, it is difficult to estimate the likely size of these effects on the interpretation of our results. To the extent that mobility is low and tax rates are variable over time, these effects are likely to be small. Although current evidence on location choice is sketchy at best, it seems likely that given the preliminary evidence mentioned above, these selection effects could not largely explain the results of this study. As longitudinal data on labor supply and location decisions becomes available, more careful estimates of these parameters could be made.

4.4. *Tax rates and reported incomes*

As previously noted, our work was motivated in part by the finding of a negative correlation between marginal tax rates and reported income in the papers of Feenberg and Poterba (1993); Feldstein (1995). While our paper has focused on the effect of marginal tax rates on labor supply, it is also of some interest to see if the negative correlation between marginal tax rates and reported income occurs with the PPCIS data.

However, we are at a disadvantage for investigating this particular question relative to previous papers due to the nature of our income data. The major practical problem, as discussed earlier, is that the income measure in the PPCIS is reported in brackets as opposed to some continuous measure. Furthermore, the income question includes only income from medical practice(s) so we do not have a measure of total income. Also, the PPCIS data is cross-sectional and variations in costs of living are not accounted for. For example, one might expect that states with higher taxes have higher nominal costs of living, possibly inducing a positive correlation between tax rates and reported incomes. One last concern is that unlike previous papers that rely on government tax data, our data is based on self-reported income information. It is unlikely that the incentives for under or over-reporting income are the same for these data sources.

While it is not possible to overcome these problems, we have done some exploratory analysis in order to make some comparisons with previous work. We fit a log-normal distribution to the reported income data, estimate the conditional mean for each of the thirteen income brackets and use these conditional means as the measure of income for each individual.[22] Then we did two simple tests. First, we split the data into 4 groups based on the maximum value of the marginal tax rate in the physician's state of residence and compute average incomes for each of the four groups. The results are given in the following table:

[22] Additional information on these tests can be obtained from the authors upon request.

Top state marginal tax rate	N	Mean income
0	652	108 717
0.01–0.05	894	101 326
0.05–0.10	1176	100 443
0.10–0.15	835	100 859

As is the case with weekly hours, there is a negative correlation (although the relationship is not monotonic) between tax rates and reported income with the highest income appearing in the states with no income tax. Other groupings of the states (e.g. adjusting the tax rate groupings to have less disparity in the number of observations in each group) exhibit similar patterns.

We also ran a regression of log(income) on the maximum state tax rate, a set of specialty dummies, age and age squared. The regression included 3557 observations and had an adjusted R^2 of 0.18. The estimated coefficient for the tax rate was -0.36 with a t-statistic of -1.9 implying that lower taxes are associated with higher reported income. For the reasons noted above, these results should be interpreted with caution. It is interesting that despite the data problems that would likely work against finding any significant relationship between tax rates and reported income, there appears to be an effect that is consistent with previous work.

4.5. The incidence of the income tax

Another issue that impacts the interpretation of these results, is the incidence (or burden) of the income tax on the self-employed. Even if the market for health-care services were perfectly competitive, a tax on self-employed labor may still increase prices for physicians' services. Thurston (1995) results suggest that in fact physicians do pass on substantial amounts of fixed costs and factor taxes, especially to patients with less elastic demand. To the extent that some of the income tax on high-income physicians is passed on in the form of higher prices, our results are actually understatements of the true underlying labor-supply effect.

5. Summary

We have estimated the labor supply elasticity with respect to 1 minus the marginal tax rate for a group of high-income physicians. Under the assumptions of our model this supply elasticity is the same as the labor-supply elasticity with respect to the unobserved wage. We use state variation in income tax rates to identify the tax effect and find that the elasticities are much larger for this group of physicians than is typically found for working age males. Using a combined sample of self-employed physicians and physicians who work for HMOs and hospitals, we get an estimated elasticity of 0.33. Splitting the sample into self-employed and employee, the estimated elasticity of the self-employed is also 0.33 and statistically significant, but for the employee physicians it is 0.10 and statistically insignificant. Looking at a small group of solo practice sole proprietors for whom we might expect to find a higher labor supply elasticity, we get an elasticity estimate of 0.61 with a t-statistic of 1.33.

Part of the motivation for this paper is the observation that the elasticity of federal tax revenues with respect to the marginal tax rate at the top end of the income distribution appears to be close to zero, suggesting a significant behavioral response on the part of high-income taxpayers. Our study suggests that a nontrivial fraction of that response is possibly due to changes in labor supply, in contrast to the conventional wisdom that the labor-supply elasticity for males is essentially zero. As noted in our discussion of the results, some interpretational problems arise from the use of cross-sectional variation, suggesting that additional evidence from other data sources would be useful. That work is underway and preliminary analysis suggests that the results from this cross-sectional work hold up reasonably well when extended to examine changes over time. Showalter (1996) uses pairs of cross-sectional data (the 1983 and 1988 PPCIS data sets and the 1980 and 1990 Public Use Micro Samples of the US census surveys) to examine labor hour responses to the changes in the federal tax code during the 1980s. That work results in elasticity estimates that are slightly smaller than those found in this cross-sectional study, but they are still substantially larger than are found in more traditional studies of male labor supply. Preliminary results using panel data from Thurston (1997) show that control of one's work schedule is an important factor in the response of physician work hours to changes in marginal tax rates.

The results from this paper also suggest other avenues of research worth exploring. Due to the lack of data, we intentionally avoid the issue of the 'extensive margin' of labor supply—the decision to participate in the labor force. Given that we have found the self-employed to be more sensitive to marginal tax rates than their employee counterparts, it would be interesting if similar differences could be found concerning the retirement decision. It would also be interesting to investigate further the interaction between work environment and labor force participation. We have documented a difference between employees and the self-employed, but why there should be this difference is not obvious and merits further consideration.

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Appendix A

Data appendix

Details of the construction of state marginal income tax rates

The Commerce Clearing House publishes several serials (Commerce Clearing House, 1982–5) intended to aid tax practitioners in dealing with state tax statutes. We use this information to re-construct marginal tax rates that can be matched to the PPCIS's 13 brackets of reported income. Most states have graduated income tax systems where successively higher statutory rates are applied to increasing 'brackets' of taxable income. We refer to the maximum and minimum values in each of these brackets as the 'cutoff' levels of income for the corresponding statutory tax rate. Income between the cutoff levels is taxed at that bracket's statutory rate.

First, we construct a table that relates each state statutory tax rate to the applicable cutoff levels of income, adjusted for state allowances for personal exemptions and deductions. In comparing this table to the PPCIS income bracketing scheme, we learn that 32 states have statutory rates which are constant over all of the PPCIS income ranges making this task trivial. For the other states, we can easily infer the appropriate marginal income tax rate for any PPCIS bracket that is entirely contained or 'nested' within a state's statutory bracket. Of the 650 state-brackets (13 brackets times 50 states) for each year, less than ten are not nested within a statutory bracket.

In these cases, PPCIS income may be affected by two or more state statutory rates. Since the PPCIS brackets are somewhat narrowly defined, we assume that income is uniformly distributed within these brackets. There are two natural methods for imputing the appropriate expected rate for a physician, conditional on being in a particular bracket: (A) the appropriate rate is the probability weighted average of rates across the brackets, and (B) the appropriate rate is the rate which affects the largest portion of the bracket (the mode).

Method A has the advantage that mismatching errors balance themselves out within each bracket. Method B has the following advantages: (a) it maximizes the number of correct matches (which are minimized under Method A), (b) across the entire sample of physicians, mismatching errors may balance out, (c) the computational complexity of the integration involved for Method A is much greater than the objective binary decisions required to implement Method B. Comparing both methods demonstrates that the results are so similar as to make this choice inconsequential. Reported results use Method B.

Next we develop correspondences of state statutory rates to the PPCIS brackets for both single taxpayers and married-filing jointly for the years 1982–1985. During the process we have to make some decisions about the open-ended bottom and top PPCIS brackets. The first PPCIS bracket is for income less than \$30 000. Although it is apparent that we do not use these observations in our study, we do construct a marginal state income tax rate for this bracket equal to the marginal rate associated with \$29 999 of taxable income. For the top bracket (income greater than \$200 000), in some years there were a couple of states whose brackets continue to increase slightly beyond this point. For these states, we designate the rate associated with \$200 001 of taxable income as the corresponding rate for the top bracket. However, we stress that these cases are very rare, and the changes in the marginal rates are negligible. Although we could theoretically calculate an exact match based on the detailed incomes for the top bracket, the computational complexity of doing so far outweighs the benefits.

We follow this procedure separately for married and single taxpayers to get correspondences of state statutory tax rates to the PPCIS bracketing scheme for all fifty states in the years 1982–1985. We employ two different methods (described below) to determine the exact procedure for matching our sample data to these brackets.

Methods of matching marginal tax rates

Method 1: EAGI

The first method of matching involves a three-step process to estimate the taxable income of the physician from the survey. Step 1: We use data for total income (including non-taxable fringe benefits), and the dollar values of fringe benefits to estimate adjusted gross income (AGI). This procedure is described more thoroughly in Section A.3 below. Step 2: We use IRS tax tables to derive estimates of deductions and exemptions by AGI level and compute an estimate of taxable income. Step 3: Using this taxable income we determine the corresponding state and federal marginal tax rates and the combined federal and state marginal tax rate variable (see Section A.4 below). We refer to this derived marginal tax rate as the EAGI (Estimated AGI) estimate. As a practical matter since the highest tax rate in most states becomes effective at relatively low income levels, most physicians end up facing the highest marginal tax rate in their state tax code.

Method 2: SIMPLE

The second method, which we refer to as the SIMPLE method, is much more ad hoc but performs quite well. As described in the text (see Footnote 5) and below, the PPCIS brackets total incomes into 13 categories: under $30 000, $30 000–$40 000, etc. Instead of estimating deductions and exemptions, we simply account for the non-taxed portion of income by lowering the reported total income bracket two categories. For example, reported total income in the income category 8 ($90 000–$100 000) is assumed to be associated with taxable income in the range of the 6th income category ($70 000–$80 000). For bracket 13 (over $200 000) exact incomes are reported. We assume that 30% of total income is non-taxable: we lower total income to bracket 11 if the exact reported income is less than $230 000, to bracket 12 if it is greater than $230 000 but less than $285 000 and leave the income in bracket 13 if it is greater than $285 000. Using other schemes for estimating taxable income in the top bracket results in no noticeable change in the qualitative or quantitative results. Overall, the assumption is that 20–40% of total income is non-taxable; and it creates little deviation in the matched tax rates from the EAGI method.

The primary motivation for using this method is the limitation of the first method. The EAGI method requires much more information to compute the marginal tax rate than the SIMPLE method; specifically, EAGI requires the dollar amount of each of the fringe benefits. The response rate on these peripheral questions was much lower than for the simple income number, and, thus, the first method typically resulted in substantially fewer observations than this ad hoc method.

Construction of estimates of adjusted gross income (EAGI)

The income question on the 1983 PPCIS is phrased 'In 1983, what was your own net income from all your medical practices after practice deductions, but before taxes? Please include bonuses, deferred income and other forms of compensation.' The response was solicited as an element of one of 13 categories. First, we construct an estimate of unadjusted gross income that we can use as a basis for estimating deductions and exemptions. Here we give our imputed estimate of gross income in each reported bracket:

Reported categories	Estimated AGI
Below $30 000	$25 000
30 000–40 000	35 000
40 000–50 000	45 000
50 000–60 000	55 000
60 000–70 000	65 000
70 000–80 000	75 000

80 000–90 000	85 000
90 000–100 000	95 000
100 000–120 000	110 000
120 000–140 000	130 000
140 000–160 000	150 000
160 000–200 000	175 000
200 000+	Exact reported income

(Those respondents with over \$200 000 of reported income were asked a follow-up question: 'About how much was that?' referring to total income rather than the excess above \$200 000.) We also estimated the income distribution using a lognormal distribution and computed conditional means for each of the income categories. Generally, the conditional means were within a few hundred dollars of the figures listed in the table.

The questionnaire also asked for dollar amounts of premiums on health and life insurance, payments to pension plans (including IRA or Keogh), deferred compensation plans, and other fringe benefits. These reported amounts are deducted from the estimated gross income to obtain adjusted gross income (AGI).

We estimate deductions and exemptions using data from an Internal Revenue Service publication (Internal Revenue Service, 1985). We estimate deductions from the tax tables using OLS:

$$\text{deductions} = -2992 + 0.21 \times (\text{AGI}) - (8.3E-9) \times (\text{AGI}^2) \text{ for AGI less than \$200000.}$$

(For over \$200 000 we use a flat percentage, 0.21, which gives more plausible estimates.)Exemptions for married individuals are estimated to be \$3546; for singles, \$1476.

Taxable income is calculated by subtracting the estimated deductions and exemptions from the estimated AGI. This taxable income figure is then applied to the various tax schedules to determine marginal and average tax rates.

Construction of the combined federal and state marginal tax rate

To compute the appropriate effective tax rates we adjust for the federal deductibility of state income taxes (which reduces the marginal tax rate) and also for peculiarities in state tax codes. Twenty-two states have their own tax schedule and do not allow for deducting any portion of the federal tax liability, fourteen states allow for deducting all or part of the federal tax liability, and four states tax the federal liability at a flat rate. For simplicity, we do not make any adjustments for the alternative minimum tax. In summary:

No deductibility $f+s-(s\times f)$

Deductible federal taxes	$\{f+s-(2\times s\times f)\}/\{1-(s\times f)\}$
Kansas (1/2 of fed. taxes deductible)	$\{f+s-(1.5\times s\times f)\}/\{1-(0.5\times s\times f)\}$
Flat rate	$\{f+(s\times f)\}/\{1+(s\times f)\}$

where f is the federal marginal tax rate, and s is the state marginal tax rate.

Notes on specific variables

This section describes in more detail the county and state variables used in the regressions. Physicians per 1000 is the number of physician in the county in 1981 divided by the 1980 county population (in thousands). Hospitals per 1000 and Hospital beds per 1000 were similarly constructed. Percent Urban Population is the percentage of the county population residing in an urban area. These four variables are included in the expanded version of the PPCIS.

Percent Unemployed is the state unemployment rate during the year of the survey (1984 or 1985) in the state of residence of the physician. This was obtained from the Statistical Abstract of the United States, 1990 (for 1995) and 1986 (for 1984).

The remainder of the demographic variables come from the City and County Data Book, 1986 and all are for the county of residence of the physician. Percent Age 65 and Over, Percent Age 14 and Under, Percent Minority Population are estimates from 1984. Median Income and Percent Under Povery Line are for 1979. Percent of Adults with 12 or more years of education is for 1980. Per Capita Local Government Expenditures is for 1981–1982.

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