DEATH AND TAXES:

THE IMPACT OF PROGRESSIVE TAXATION ON HEALTH

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Abstract

More progressive taxes, holding tax liability constant, generate disincentives for health investment by decreasing benefits for additional working time and, thus, decreasing returns to health. On the other hand, progressive taxation may induce individuals to invest more in health for the purpose of extending their working life, because lifetime maximization could imply less work per period but more working years. I identify the effect of progressivity through differences in labor income tax rates among states. I find that the former effect dominates, more progressive taxes are negatively correlated with health, and argue that neither selection effects nor reverse causality can explain this result.

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1. INTRODUCTION

Understanding the factors that determine individuals' investment in their health is important in crafting effective health policies. In this paper I investigate the relationship between fiscal policy and health investment and conclude that both the average labor income tax rate and the progressivity of labor income tax have a significant impact on health.

Grossman's [1972] health investment model postulates that an increase in wages encourages investment in health by raising the reward for this investment, thus, suggesting that taxes negatively impact health. However, the issue of progressive taxation has not been explored in the context of health yet. I argue that since one important return to health investment is more time to earn wages, a higher marginal tax rate on labor income reduces the incentives to invest in health. At the same time, however, a more progressive tax system generates incentives to inter-temporally substitute toward a longer working life [Ippolito, 1985], thus encouraging health investment. Tax progressivity also alters the input mix used in health production by lowering the cost of the time input, introducing inefficiency in health production.

Empirically, I identify the effect of a tax system from differences in the tax rates on labor income in the state of residence. In each of the three different surveys used, the National Longitudinal Survey of Youth 1979 (NLSY79), the Current Population Survey (CPS) 2002, and the Behavioral Risk Factor Surveillance System dataset (BRFSS) 2002, I measure the impact of increased progressivity through changes in the ratio between the maximum tax rate and the average tax rate on labor income in the state of residence, while keeping constant the average tax rate. I find a negative impact on health from both the average level and the progressivity of the labor income tax rates in the state of residence. Specifically, my estimates obtained from NLSY79 indicate that a 1 percentage point increase in the average rate of taxation is associated with a cumulative decline in health of 0.28 standard deviations by the age 40, and a 1 percentage point increase in the maximum rate of taxation, keeping the average tax rate constant, thus increasing progressivity, is associated with a cumulative decrease in health of approximately 0.36 standard deviations by age 40. I argue that neither selection effects nor reverse causality can explain these effects.

These findings contribute not only to our understanding of the incentives that determine health investment, but also of the mechanics of the tax structure impact on economic performance. Progressivity

affects growth through its influence on labor incentives, on investment in education and thus labor productivity and perhaps health production efficiency, and on health investment incentives.

The remainder of the paper is organized as follows: Section 2 discuses the issue of health production; Section 3 develops a model of income taxation and health; Section 4 describes the empirical strategy; Section 5 presents and discusses the findings, and Section 6 concludes.

2. HEALTH PRODUCTION

Grossman [1972] was the first to develop a model of health capital and demand for health that motivated subsequent empirical work in health economics. This study identifies some of the factors that can influence health such as education, the cost of medical care, health depreciation rate (if it changes over time), and the price of time. Empirically he finds that an increase in the hourly wage rate improves health, but it should be recognized that hourly wage rate could be a function of health under the hypothesis that health increases productivity or changes the number of hours worked.

Several of the factors identified by Grossman were subsequently studied in an attempt to explain health outcomes and offer policy recommendations. Lakdawalla and Phillipson [2002], for instance, suggest that the technological innovations that lowered the price of food by shifting food production from the household to the market may be an explanatory factor for the increase in the intake of calories and obesity - based health problems. Others look at technological innovations like fast food for an explanation. Since fast food does not require a long preparation time it has a low cost per calorie consumed, leading to increased caloric intake and obesity [Cutler, Glaeser, and Shapiro, 2003].

The pervasiveness of fast food as well as the amount of time spent exercising, another health determinant, can be explained by the economic theory of time allocation. Becker [1965] proposes that the higher the reward for work, the higher the incentive to spend more time working and to consume less time-intensive commodities. In this case, people will prefer to eat out instead of preparing food at home; will prefer types of food they do not have to wait for, i.e. fast food; and in general will avoid time-intensive activities such as exercise. Readily available statistics (OECD Productivity Database) indicate that Americans tend to work longer hours than most of their counterparts in other countries and, thus, according to the theory of time allocation should tend to use fast-food more often. This tendency implies a higher

incidence of diseases, situation supported by Banks et al. [2006] study. They provide evidence that a higher proportion of the United States population age 55-64 reports having various health problems than the similar segment of the population in England (Appendix 1, Table A3).

This theory also offers an explanation for the increase in medical expenditures observed in the United States. As the value of time increases, people try to substitute their own time with medical care in producing health. The implication is that we should observe a higher incidence of disease due to less home prevention in the United States, but perhaps a higher rate of cure due to more medical care. Thus the relevant measure of health is not the incidence of disease, but rather the number of unimpaired, productive days during lifetime. It is not obvious that the impact of increased value of time on health as expressed by life expectancy or number of productive days should be negative. This hypothesis is consistent with the observed relatively small difference in life expectancy between the countries postulated to have significant differences in disease incidence (Life expectancy at birth in 2005 is 77.7 years for U.S. and 78.4 years for UK; Source: Census Bureau, International Database). The hypothesis of a higher incidence of diseases when the reward for work increases is also consistent with observed counter-cyclical variations in health [Ruhm, 2000]. He finds that smoking and obesity increase while physical activity and healthy diet habits reduce during booms.

If the explanation for higher incidence of disease is that individuals change the input mix used for health production, it is no longer obvious that spending more time enhancing health will necessarily improve health, as expressed by life expectancy or number of unimpaired days, or promote growth. People already are making rational decisions, maximizing their lifetime income. Forcing them to use more of their own time in health production rather than medical care, which is less time intensive but requires higher financial expenditures, is a constraint that cannot lead to higher income. Even though health improvements that reduce medical spending provide significant scope for growth [Murphy and Topel, 2005] it is not obvious that these should come from allocating more time to health production. The loss of a lower lifetime income may offset any gains from decreased health expenditures.

Consequently, if increased reward for work leads to a higher incidence of diseases and higher medical expenditures, a plausible implication is that the United States is only the first country to experience this trend because it has the highest labor productivity. In the future as countries develop, the same trend

will be observed elsewhere[1]. Once it is acknowledged that this trend is the rational implication of a desirable increase in labor productivity and, thus, in the reward for work, it should also be acknowledged that the solution for health problems may not lie in making people spend more of their own time in health production. Rather it may be found in either the increase in the reward for health coming from an increase in the retirement age, or in the decrease in the cost of health production through medical innovations that reduce the price of medical care.

This postulated significant effect of the value of time on health behavior represents the motivation for this study. The way to test the effect of changes in the value of time on health is to look at the effect of exogenous factors that change the value of time. Differences among state tax systems provide a plausible exogenous variation among the value of time of otherwise identical individuals. Specifically, this paper explores the effect of the progressivity of the system of taxation on health in a time allocation setting. Progressive taxation, which affects health choices by changing the relative gain from investment, is most relevant in health context because it is one of the policy tools that generate an inter-temporal distortion.

In regard to the issue of taxation, the relevant question is the effect of increasing progressivity while keeping the average tax rate or the tax revenue constant. Sandmo [1983] addressed this problem with respect to labor supply. For the representative consumer, progressive taxation reduces labor supply compared with a flat tax that brings the same revenues. Overall, through increased progression, the average tax rate falls for low income people but rises for high income individuals, indicating that there is a negative income effect for part of the population, a positive income effect for the other, and a negative substitution effect for everybody. The overall effect on the total labor supply is a function of the relative sizes of these effects. Empirical studies like the one conducted by Atkinson and Stiglitz [1980] suggest that these effects offset one another in the case of aggregate labor supply.

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[1] International Obesity Task Force, EU Platform on Diet, Physical Activity and Health, March 15, 2005: "A marked trend towards increasing levels of adult overweight and obesity can be found throughout Europe, although there are variations in prevalence." available at http://www.publico.clix.pt/docs/pesoemedida/EU_Platform_Diet_PA_Health_2005.pdf

Ippolito [1985] argues that higher progression creates incentives for inter-temporal substitution. Workers may prefer to work less before the usual retirement age but continue working after retirement age, an effect found to be statistically significant in the empirical analysis conducted on Social Security Newly Entitled Beneficiaries Survey data. Another effect of progressivity is identified by Gentry and Hubbard [2002], who argue that an increase in the degree of progression will decrease job search as it decreases the rewards from the search. Their estimates from the Panel Study of Income Dynamics support this theory.

Similar to Ippolito's [1985] paper, I argue that increased progressivity could induce individuals to invest more in health for the purpose of extending their active life because lifetime maximization, when the duration of life can be chosen through health investment, may be associated with fewer labor hours per period but more working periods. In other words since health investment extends the duration of life, it can also provide a way of avoiding high marginal tax rates by smoothing taxes over a longer period of time. However, there is an opposite effect: if progressivity discourages work and decreases utility, it also generates disincentives for health investment. In addition, it leads to inefficient health production by distorting the input mix because it changes the price of the time input. Consequently, I expect that the degree of tax progressivity has a significant impact on health investment in addition to the effect of tax level identified by Grossman [1972].

This paper uses individual level data to investigate the impact of progressive taxation on health by first developing a health-investment type of model and then testing empirically the effects of tax system progressivity on the flow of health. I identify the effect of tax progressivity through differences in labor income taxes among states. The empirical results indicate that controlling for the level of the tax more progressive income taxes are associated with declining health.

3. THE THEORETICAL MODEL

The investment model of health proposes that individuals use their time as well as medical care to produce a stock of health, which, in turn, determines the duration of life. This paper investigates the impact of progressive taxation on health in the setting of an health investment model.

Let the individual's utility be increasing at a decreasing rate in consumption (c) and leisure (l):

$$U_t = \alpha_1 \log(c_t) + \alpha_2 \log(l_t)\text{ , where } \alpha_1, \alpha_2, (\alpha_1 + \alpha_2) < 1 \quad (1)$$

Investments in health determine the amount of time available to be divided among health production, market production, and leisure. Health is produced using time (x) and medical care (m). The Cobb-Douglas in logs production function of health is defined as:

$$Q_t = A + \beta_1 \log(x_t) + \beta_2 \log(m_t) \quad (2)$$

where Q_t denotes output, m_t is medical care, $\beta_1 + \beta_2 < 1$, and A is a parameter dependent on human capital (S).

Total human capital is considered exogenous in the sense that the accumulation period has already ended. Health depreciates at a rate (δ), which increases with time, so the dynamics of the health stock (D_t) are described by:

$$\dot{D}_t = A + \beta_1 \log(x_t) + \beta_2 \log(m_t) - \delta D_t \quad (3)$$

The cost of investment is measured by the time spent producing health that could have been used for other purposes (x_t) and by the cost of medical care. In this model the gain from investing in health comes from a longer life, allowing for more periods in which the individual can earn wages or enjoy leisure. The period is counted as a standard measure of healthy time; thus, the total time available each period is normalized to 1, and the number of periods available is a function of the stock of health. Therefore, the time spent working each period is ($1-x_t-l_t$), and the pre-tax total income (I_t) each period is calculated as earned wage, which is a function of human capital (S), multiplied by the amount of time spent working:

$$I_t = (1 - x_t - l_t)w \quad (4)$$

The amount of money available for utility enhancing consumption is determined by the income earned, and by the amount of tax liability and of medical expenditures.

$$c_t = w(1 - x_t - l_t) - T(w(1 - x_t - l_t)) - p_m m_t \quad (5)$$

where $T(w(1-x_t-l_t))$ is the tax function and p_m is the price of medical care.

This model suggests a trade-off between using time for market production versus health production similar to the one that occurs in any specialization decision in which gains from trade provide incentives toward production specialization. However, in reality the specialization decision with respect to health versus market production bears some particularities.

First, specialization can occur only if trade takes place: when people choose to specialize in producing a specific product or service, there is an underlying assumption that the goods and services they no longer produce can be acquired on the market. Health cannot be bought, nor is it obvious that health can be produced using the only input that can be bought, medical care. Even if it could be, the quality of medical services is hard to evaluate without having specific knowledge. Obtaining specific knowledge requires a time investment, bringing us back to the point that all persons are in charge of producing their own health and that health production technology is always going to involve time use.

The second particularity refers to the way health production is affected by taxes. Wages earned in different occupations are taxed similarly under the income tax. On the other hand, the output of health production is not taxed directly: taxation affects only the product, healthy time, used for market production. In the case of market production, the worker receives the value of his output in the form of wages that are immediately taxed. In the case of health production, the increase in the stock of health is not taxed in the period of occurrence but will be taxed when the healthy time produced is used for work. It can be said that taxes corresponding to the health output produced this period are paid in the future with the extended active life. Because of this delay between obtaining the output and the moment when taxes are due, taxation generates an inter-temporal substitution effect that represents an incentive to produce health. This effect should moderate the direct effect of the decreased incentives to invest in health associated with the decrease in wages by taxation noted by Grossman [1972].

A more interesting case is that of progressive taxation. Progressive taxation exacerbates the issue just described because the marginal tax increases with wages and, thus, with time spent working each period. As a result, for the representative individual, a progressive tax decreases the incentives to invest in health compared with a proportional tax bringing the same revenue. But since health production can be used to shift resources between periods, lifetime maximization could be associated with earning a smaller wage per period but working more periods, i.e. living longer. This second effect acts as an incentive to invest in health. Thus, the overall effect of increased progressivity is a function of the relative magnitude of these two effects.

Under progressive taxation the amount of tax increases with income at an increasing rate, such that the marginal rate of taxation is always higher than the average rate of taxation. Accordingly, $T(w(1-x_t-l_t))$, the tax liability in this model, indicates that the amount of tax is a function of income. For the rest of this paper, $\pi = dT/d(w(1-x_t-l_t))$ will denote the marginal rate of taxation and $\tau = T/(w(1-x_t-l_t))$ the average rate of taxation.

The dynamics of this model are described by the current value Hamiltonian (*Hc*) below. The length of lifetime is chosen by the individual through the choice of stock of health. When the stock of health drops below *Dmin*, the individual dies.

$$Hc = \alpha_1 \log(w(1-x_t-l_t) - T(w(1-x_t-l_t)) - p_m m_t) + \alpha_2 \log(l_t) + \\ + \lambda_t (A + \beta_1 \log(x_t) + \beta_2 \log(m_t) - \delta D_t) \tag{6}$$

The system of equations representing the first order conditions necessary for the maximization is presented below:

FOC:

$$\frac{\alpha_1 w(1-\pi)}{w(1-x_t-l_t)(1-\tau)-p_m m_t}=\frac{\lambda_t \beta_1}{x_t} \tag{7}$$

$$\frac{\alpha_1 w(1-\pi)}{w(1-x_t-l_t)(1-\tau)-p_m m_t}=\frac{\alpha_2}{l_t} \tag{8}$$

$$\frac{\alpha_1 p_m}{w(1-x_t-l_t)(1-\tau)-p_m m_t}=\frac{\lambda_t \beta_2}{m_t} \tag{9}$$

$$\dot{D}_t = A+\beta_1 \log(x_t)+\beta_2 \log(m_t)-\delta D_t \tag{10}$$

$$\dot{\lambda}_t = (\delta+\rho)\lambda_t \tag{11}$$

$$D_{1^{st}\ period} = D_o \tag{12}$$

$$\lambda_{1^{st}\ period} = \lambda_0(D_o) \tag{13}$$

In this problem, ρ is the discount rate, and λ_t is the Lagrange multiplier representing the shadow value of health. The above system of equations completely characterizes the time path of the stock and the shadow value of health.

This system implies that the amount of time spent investing in health is:

$$x_t = \frac{\lambda_t \beta_1 \dfrac{(1-\tau)}{(1-\pi)}}{(\alpha_1+\lambda_t\beta_2)+(\alpha_2+\lambda_t\beta_1)\dfrac{(1-\tau)}{(1-\pi)}} \tag{14}$$

where $\lambda_t=\lambda o + exp((\delta+\rho)t)$.

As a result, the fraction above can be interpreted as the share of the total time available each period being used for health production. In the case of a proportional income tax, the marginal rate of taxation is equal to

the average rate of taxation: $\pi = \tau$; thus, the fraction of healthy time spent for health production becomes: $\frac{\lambda_t \beta_1}{(\alpha_1 + \alpha_2) + \lambda_t(\beta_1 + \beta_2)}$. But the higher the difference between the marginal rate of taxation and the average rate, i.e., the more progressive the tax system, the higher will be the share of time spent on health investment.

On the other hand, the more progressive the tax system, the lower the amount of medical care purchased:

$$m_t = w\frac{1}{p_m}\frac{\lambda_t \beta_2 (1-\tau)}{(\alpha_1 + \lambda_t \beta_2) + (\alpha_2 + \lambda_t \beta_1)\frac{(1-\tau)}{(1-\pi)}} \tag{15}$$

This relationship also indicates that the amount of medical care decreases with an increase in the level of the tax rate.

Given the results above, total investment in health is given by:

$$INV_t = G_t + \beta_2 \log(1-\tau) + \beta_1 \log\frac{(1-\tau)}{(1-\pi)} - (\beta_1 + \beta_2)\log[(\alpha_1 + \lambda_t \beta_2) + (\alpha_2 + \lambda_t \beta_1)\frac{(1-\tau)}{(1-\pi)}]$$

where $G_t = A + \beta_1 \log(\lambda_t \beta_1) + \beta_2 \log(\lambda_t \beta_2 w / p_m)$

Therefore, the model predicts that higher tax levels decrease health investment, but does not offer a clear prediction of the impact of progressivity:

$$\frac{dINV_t}{d\frac{(1-\tau)}{(1-\pi)}} = \frac{\beta_1(\alpha_1 + \lambda_t \beta_2) - \beta_2(\alpha_2 + \lambda_t \beta_1)\frac{(1-\tau)}{(1-\pi)}}{\frac{(1-\tau)}{(1-\pi)}[(\alpha_1 + \lambda_t \beta_2) + (\alpha_2 + \lambda_t \beta_1)\frac{(1-\tau)}{(1-\pi)}]} \tag{16}$$

The sign of this expression, given by the sign of the numerator, is uncertain. The actual direction of change of health investment, and thus of health, is ultimately an empirical question. The investment determines the stock of health; thus, controlling for the original level of health, the effect of taxation on health stock is completely determined by its effect on health investment.

An implication of this model is that the share of healthy time spent for investment tends toward a constant as the shadow value of health increases. Since the shadow value of health increases with age, $\lambda_t=\lambda o + exp((\delta+\rho)t)$, the share of time invested in health also increases with age, leveling off at a constant. The same happens with medical care spending. However, since the depreciation rate of health also increases with time, at some point the stock of health drops below a minimum value, and the individual dies. At high values of the shadow value of health, it is more likely that the effect of progressivity on health investment is negative.

4. EMPIRICAL STRATEGY

The theoretical model suggests that the stock of health is determined by:

$$D_t=D_t\,(D_0, \pi, \tau, X, \Omega),$$

where D_0 is the initial stock of health; X is a vector of controls among which is the price of medical care, Ω is a vector of parameters specific to each individual: α_1, α_2, β_1, β_2, ρ, δ, A, and S education. Thus health is a function not only of the tax level but also of the tax progressivity.

4.1. Measuring progressivity

As the theoretical model suggests, the impact of a progressive system of taxation is captured by the ratio of the marginal tax rate and the average tax rate while controlling for the average tax level in the state of residence. We observe the wage earned by the individual; thus, the average and marginal rate of tax can be calculated for each person, but these measures are endogenous as they are functions of the time spent working, which is endogenous in the model. Also, hourly wage, sometimes used to construct measures of the marginal tax faced by each person, is endogenous if wage is a function of the number of daily hours of work. A solution to this problem would be to use an exogenous measure of the tax level and the degree of progressivity of the tax system constraining individuals. Such a measure is the state level ratio of the marginal tax rate for a maximum level of income and the average tax rate. This ratio measures the

growth of the tax rate with income. For instance, between two states having the same maximum rate of taxation, the state with a higher average rate has a less progressive system because it means that low income people are taxed at a higher rate in this state compared with the other. In other words, for states having the same maximum rate but a higher average rate, the marginal tax rate increases at a slower rate with income. Similarly, between two states with the same average tax rate, the one with a higher maximum tax rate has a more progressive system as it means that low income individuals are taxed at a lower rate, i.e. the tax rate increases faster with income.

The caveat of measuring progressivity by this ratio is that it assumes a smooth tax schedule, ignoring the possible kinks generated by constant marginal tax rates within the brackets. Using this ratio it would be impossible to measure accurately the effects of an income tax reform on health just as it can not be done for labor supply [Hausman 1981]. Moreover, all the issues generated by a negative income tax [Burtless and Hausman 1978] or by any kind of tax system generating non-convexities in the after-tax income schedule are also relevant for health choices. As previous surveys [Hausman, 1985; Pencavel, 1986] indicate, using piecewise linear constraints delivers different results in the case of labor supply and, thus, has the same effect in the case of health. Nevertheless, the ratio between the marginal and the average tax rate at an exogenous level of income alone is sufficient for investigating the main point of the paper, the existence of a significant effect of the tax progressivity on health, and offers the advantage of simplicity. Given that studies incorporating piecewise-linear constraints indicate larger labor supply responses, my approach will at most underestimate the negative effect of progressivity on health.

4.2. Empirical specification

The empirical analysis uses individual level data to test the effect of tax progressivity on health. Considering only taxes would not account for the entire picture of the effect of government on health choices. It may be the case that people with health problems move where the health care system is better. If the quality of health care is correlated with state expenditures for hospitals, then where taxes are higher and the state spends more on health care, there are also more people with health problems. To account for this possibility, the regression analysis controls for the level of health and hospital expenditures in the state of residence.

Another issue arises from the fact that health production uses two inputs: time and medical care, so there may be substitution in production. The empirical analysis acknowledges that changes in the price of medical care influences health outcomes by controlling for the differences in the median hourly wages of the medical personnel in the state of residence.

Given these considerations, testing the effect of progressive taxation uses the following model specification:

Model 1: OLS on NLSY79 and BRFSS data/ Ordered probit on CPS

$$Health_i = a_0 + a_1(Tax\ progressivity)_i + a_2(Tax\ level)_i + a_3(Price\ of\ medical\ care)_i + a_4(State\ health\ expenditures)_i + a_5(I)_i + a_6(R) + e_i$$

where I is a vector individual characteristics variables and R is a vector of state demographics.

A source of concern with the estimates obtained from this specification is that individuals self-select themselves with respect to their state of residence. For instance, people who are more efficient at producing wages may prefer to live in states with less progressive systems of taxation. If health also increases labor productivity, then healthier people may choose to locate in states with less progressive income taxes, introducing a bias toward a more negative estimator of the effect of progressivity on health. On the other hand, people who value health more may be also very risk adverse toward getting sick even when readily available treatments exist and, thus, may prefer to spend a lot of time exercising at the cost of less working time. In that case they may choose a state with more progressive taxes in order to benefit from the lower tax rates applied to the lowest income brackets. In this case health is positively correlated with progressivity and the coefficients obtained would be biased toward a more positive estimate. The instrumental variable technique is used to correct for this possibility, the proposed instruments being the property crime rate in the state, the ratio of Democrats to Republicans in the state House, and the same ratio in the Senate, severance tax revenues per capita and the state population.

A high crime rate is the result insufficient law enforcement, indicative of poor police financing. This suggests that the property crime rate is correlated with state expenditures, which are financed by higher taxes and, thus, is also correlated with the tax level. The property crime rate in a state is expected to be correlated with health production efficiency, so it has the potential of being a good instrument for the tax

level. If political beliefs influence the way people vote for taxes, the ratio of Democrats to Republicans is a good indicator of both tax levels and progressivity too. Moreover, since it is not obvious that political preferences are in any way correlated with health, the ratios of Democrats to Republicans in the state House or Senate are good instruments for the tax system. Severance tax revenues are postulated to be correlated with labor income taxes because they represent a good substitute for labor income taxes. Since their base of taxation, natural resources, is fixed severance taxes are very hard to avoid, making severance taxes a good alternative for labor income taxes. At the same time there is no reason to believe they are correlated with health. Hansen and Kessler [2001] argue that state population is an important determinant in the emergence of tax heavens because under sorting smaller states have a more homogenous population lowering political conflict and creating the conditions for the creations of "tax heavens". Thus the tax system should be correlated with state population. At the same time if the analysis controls for population density in the region of residence there is no reason to believe that state population has an influence on an individual's health.

I also acknowledge that there may be selection into states based on state health expenditures and instrument for this variable. The proposed instrument is state government employment- full time equivalent. Higher government employment is measured as the number of full-time equivalent government employees as a share of population. Since a significant share of government employment is occupied in health related fields, higher government employment is expected to be strongly positively correlated with state health and hospital expenditures. With these instruments, the following model specification is estimated.

Model 2: 2SLS model

First stage:

$$Tax\ progressivity_i = b_0 + b_1(Property\ crime\ rate)_i + b_2(Dem/Rep\ ratio\ House)_i + b_3(Dem/Rep\ ratio\ Senate)_i + b_4(Severance\ Tax)_i + b_5(Government\ Employment)_i + b_6(Population)_i + b_7(E)_i + u_i$$

$$Tax\ level_i = c_0 + c_1(Property\ crime\ rate)_i + c_2(Dem/Rep\ ratio\ House)_i + c_3(Dem/Rep\ ratio\ Senate)_i + c_4(Severance\ Tax)_i + c_5(Government\ Employment)_i + c_6(Population)_i + c_7(E)_i + u_i$$

$$State\ health\ expenditures_i = d_0 + d_1(Property\ crime\ rate)_i + d_2(Dem/Rep\ ratio\ House)_i + d_3(Dem/Rep\ ratio\ Senate)_i + d_4(Severance\ Tax)_i + d_5(Government\ Employment)_i + d_6(Population)_i + d_7(E)_i + u_i$$

(where E is the vector of exogenous variables from the health regression)

Second stage:

$$Health_i = a_0 + a_1(Tax\ progressivity)_i + a_2(Tax\ level)_i + a_3(Price\ of\ medical\ care)_i + a_4(State\ health\ expenditures)_i + a_5(I)_i + + a_6(R)_i + e_i$$

5. DATA AND ESTIMATION RESULTS

The empirical analysis uses a measure of health from the National Longitudinal Survey of Youths 1979 (NLSY79), the physical score determined based on the SF12 survey (higher score means healthier) administered to individuals turning 40 in 1998, 2000, and 2002 for a cross-section analysis. The SF-12 survey, the 12 question survey (Appendix 2) designed by John Ware of the New England Medical Center Hospital, was meant to give a health assessment not conditioned by the individual propensity to use medical services. This survey is considered reliable when samples are sufficiently large and the objective is to monitor overall physical and mental health outcomes. As the objective of this paper is exactly to measure the overall level of health, these scores provide a good measure for this purpose. But it should be recognized that this physical score suffers from measurement error as it is based on survey data [Baker, Stabile and Deri, 2001]. I acknowledge this potential problem and check the robustness of the results on two additional datasets that provide other measures of health. First, the Behavioral Risk Factor Surveillance System dataset (BRFSS) provides a measure of the number of days of poor physical health in the month prior to the interview, and second, the Current Population Survey (CPS) has a measure of self-reported health ranking from excellent to poor.

In all datasets I use the 2002 state level marginal tax rate at a maximum level of income and the average tax rate on labor income calculated by Daniel Feenberg using the TAXSIM model (Table 1) for constructing the tax variables. The maximum tax rate represents "the maximum tax rate for an additional $1000 of income on an initial $500,000 of wage income (split evenly between husband and wife) given that the taxpayer is assumed to be married and filing jointly. This rate allows for a mortgage interest deduction of $50,000 and the calculated state income tax as personal deductions" [Feenberg and Coutts, 1993]. The average marginal income tax rate was calculated using a nationally representative sample of individuals, isolating the effect of the tax system from the impact of the state characteristics.

Table 1: Tax Rates on Labor Income by State

STATE	Maximum Tax Rate[1] Wages 2002	Average Tax Rate[1, 2] Wages 2002	Tax Progressivity[3]
Alabama	41.64	27.52	151.308
Alaska	39.76	24.43	162.751
Arizona	42.78	27.29	156.761
Arkansas	44.18	28.64	154.260
California	45.81	29.85	153.467
Colorado	42.69	28.07	152.084
Connecticut	42.52	28.41	149.666
Delaware	43.52	28.00	155.429
Florida	39.76	24.43	162.751
Georgia	43.34	29.04	149.242
Hawaii	44.7	30.26	147.720
Idaho	44.6	30.21	147.633
Illinois	41.6	26.8	155.224
Indiana	41.85	27.12	154.314
Iowa	44.9	29.27	153.399
Kansas	43.75	29.22	149.726
Kentucky	43.55	28.40	153.345
Louisiana	42.02	27.09	155.113
Maine	45.13	30.54	147.773
Maryland	42.72	27.96	152.790
Massachusetts	43.01	28.59	150.437
Michigan	42.28	27.68	152.746
Minnesota	44.72	29.9	149.565
Mississippi	42.78	27.98	152.895
Missouri	43.38	28.29	153.340
Montana	44.22	28.79	153.595
Nebraska	44.39	29.27	151.657
Nevada	39.76	24.43	162.751
New Hampshire	39.76	24.43	162.751
New Jersey	43.67	27.43	159.205
New Mexico	44.55	29.39	151.582
New York	43.96	29.68	148.113
North Carolina	44.98	30.15	149.187
North Dakota	43.08	27.15	158.674
Ohio	44.36	28.64	154.888
Oklahoma	43.26	29.40	147.143
Oregon	45.34	31.22	145.227
Pennsylvania	41.48	26.59	155.999
Rhode Island	45.45	28.86	157.484
South Carolina	44.11	29.66	148.719

Continued on the next page

Table 1.1: Tax rates on labor income by state (Continued)

STATE	Maximum Tax Rate[1] Wages 2002	Average Tax Rate[1, 2] Wages 2002	Tax Progressivity[3]
South Dakota	39.76	24.43	162.751
Tennessee	39.76	24.43	162.751
Texas	39.76	24.43	162.751
Utah	43.31	29.21	148.271
Vermont	44.98	29.1	154.570
Virginia	43.34	28.79	150.538
Washington	39.76	24.43	162.751
West Virginia	43.75	28.9	151.384
Wisconsin	43.9	29.75	147.563
Wyoming	39.76	24.43	162.751

[1] Tax rate = Federal tax rate + State tax rate
[2] The average marginal income tax rate was calculated using a nationally representative sample of individuals.
[3] Tax Progressivity=100*Maximum Tax Rate/Average Tax Rate
Source: Feenberg, Daniel Richard, and Elizabeth Coutts, "An Introduction to the TAXSIM Model", Journal of Policy Analysis and Management; 12(1), Winter 1993 : 189-194

Such measures taken from a single year are valid only under the assumption that the structure of the tax system in a state relative to all other states is constant over time such that measures of the average rate of taxation and of progressivity from the chosen year are representative for the state system of taxation. This appears to be the case given that the correlation between average or maximum tax rate in any consecutive years between 1987 and 2002 ranges from 96.94% to 99.99%, with an average over these years of 99.19% for the maximum tax level and of 99.99% for the average tax level. These numbers indicate that the relative tax systems are stable over this period.

The regression analysis on all datasets controls for the cost of medical care measured by the median wage by state for individuals included in the "Healthcare practitioners and technical occupation" group as defined by The Bureau of Labor Statistics, for state health and hospital expenditures, for education, and for such other individual characteristics as: gender, race, age, marital status, and urban residence. In addition, the NLSY79 regression controls for ability as measured by ASVAB test scores, and for parents' health and family structure as a measure of the initial stock of health. If the parents experienced health problems, the probability is that the children inherited some of these genes, meaning that their initial stock of health is lower. Family structure measured by a variable indicating if the individual lived with both

parents until he was 18 years old controls for health accumulation in childhood. Children living with both parents have access to more resources and potentially more parental care and, thus, have better health outcomes [Case and Paxon, 2001].[2] Summary Statistics for all variables are available in Appendix 1, Table A1.

Given the availability of these measures of initial stock of health and of ability as well as the availability of detailed data regarding past states of residence, I choose the NLSY79 dataset for the main analysis. In the main analysis using the NLSY79 data, the questions serving as the basis for computing the dependent variable were asked in 1998-2002 when the individuals turned 40 years old. Given the age of the individuals in the sample, probability is that the current state of residence is the relevant one for testing. But I also check the results by restricting the sample to individuals who did not move between 1987 when they were 24-30 years old and 2002.

For easier interpretation, the analysis performed on NLSY79 dataset uses the standardized physical score as dependent variable. The OLS empirical results, reported in Table 2, Column 1, support the idea that the more progressive the income tax, controlling for the tax level, the lower the amount of health chosen by the representative individual. The higher the tax level, the poorer the health score is. The results obtained using the sample restricted to individuals who did not move between 1987 and 2002 (Table 2, Column 2) fully support the previous results, but are of a larger magnitude, suggesting that perhaps there is self-selection into the states of residence.

[2] In some unreported regressions I also control for having health insurance or not, family size, and spouse wage income as a measure for non-labor income. The estimates on the tax variables are not sensitive to the inclusion of these variables. The choice of not including them in the specifications reported is explained by the desire for parsimony in the case of family size and health insurance coverage, neither being significant in regressions. The exclusion of spouse wage as a measure of non-labor income is due to concerns raised by the decrease in sample size and by the correlation between spouses wage levels. This correlation would mean that the spouse wage picks up some of the variation in the time worked by the respondent which is endogenous and, thus, should not be included in the regression.

Other variables show the expected sign: the higher the level of education, the healthier people are, and the higher the ASVAB test scores the higher the physical health score. Married people are healthier, but this is only a simple correlation; it could be the case that healthier people have a better chance of getting married. Women seem to be less healthy than males, seemingly contradicting the observation that females have a longer life expectancy. This result could reflect the fact that these scores are computed on the basis of a survey and was recorded by previous literature [Strauss, Gertler, Rahman, and Fox, 1993]. Maybe women are more aware of their health or perhaps women systematically overestimate and/or men underestimate their health. Parental health is a very important predictor of children's health, indicating that parental health is a good proxy for the initial stock of health. In addition, individuals who lived with both of their parents until age 18 are healthier as expected since they had access to more resources.

A source of concern is that other types of taxes may be correlated at the same time with labor income taxes and with health. In Column 3 of Table 2 I control for general sales and gross receipts tax (percent) and I find that sales taxes do not affect the estimates. In conclusion, the exclusion of this variable does not raise problems with the estimation.

A possible source of bias in my estimates is that state demographics may be correlated with various characteristics of the tax system. Two such possible sources of confound in our estimates are state age structure and income structure. Age structure may determine the type of health care services offered in a state, influencing the access to and the price of medical care, and, thus, affecting individuals' health. If age structure is correlated with the level and/or progressivity of the income tax, then we might be observing a spurious correlation between tax level and/or progressivity and health. In addition, if some states have a higher proportion of high-income individuals there may be the case these states provide a larger selection of medical services, thus influencing health. If state income structure is positively correlated with health, and if high-income individuals vote for less progressive taxes, our estimates would be biased. In order to correct the potential bias arising from omitted demographic correlates of the tax variables I augment the specification by including in Column 4 of Table 2 the proportion of population between 50 an 65 and the proportion of population 65 years and older, and in Column 5 Table 2 both state income and age structure. In all these specifications the estimators are negative and significant with only small variations in the order of magnitude.

Table 2 The Effect of Labor Income Taxation on Health, NLSY79

	All sample	Restricted sample [a]			
	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.
	[t]	[t]	[t]	[t]	[t]
Tax Progressivity	-0.019	-0.030	-0.029	-0.028	-0.036
	[-2.13]**	[-2.47]**	[-2.73]***	[-2.76]***	[-2.54]**
Tax Level	-0.063	-0.082	-0.082	-0.078	-0.104
	[-2.94]***	[-2.71]***	[-2.86]***	[-3.03]***	[-3.07]***
Sales Tax			-0.001		
			[-0.05]		
Medical Care Cost	0.009	0.014	0.014	0.017	0.010
	[0.96]	[1.42]	[1.3]	[1.8]	[0.54]
State Health and	0.000	0.000	0.000	0.000	0.000
Hospital Expenditures	[0.6]	[0.38]	[0.38]	[0.23]	[0.45]
Education	0.036	0.040	0.040	0.040	0.041
	[3.55]***	[3.89]***	[3.86]***	[3.88]***	[3.85]***
ASVAB	0.003	0.002	0.002	0.002	0.002
	[3.61]***	[2.45]**	[2.45]**	[2.38]**	[2.41]**
Female	-0.131	-0.113	-0.113	-0.114	-0.112
	[-4.19]***	[-3.07]***	[-3.07]***	[-3.12]***	[-3.1]***
Black	0.086	-0.004	-0.004	0.002	0.007
	[1.65]	[-0.06]	[-0.07]	[0.03]	[0.1]
Hispanic	0.037	0.053	0.054	0.070	0.082
	[0.58]	[0.67]	[0.66]	[0.79]	[0.89]
If Married	0.127	0.112	0.113	0.111	0.112
	[2.96]***	[2.21]**	[2.21]**	[2.17]**	[2.16]**
Father Health	-0.207	-0.190	-0.190	-0.189	-0.197
Problem	[-7.41]***	[-4.77]***	[-4.79]***	[-4.72]***	[-4.87]***
Mother Health	-0.207	-0.211	-0.211	-0.212	-0.210
Problem	[-4.87]***	[-4.88]***	[-4.91]***	[-4.91]***	[-4.84]***
Both Parents until 18	0.137	0.162	0.162	0.160	0.160
	[4.01]***	[3.89]***	[3.9]***	[3.83]***	[3.86]***
Urban	0.022	0.045	0.045	0.048	0.048
	[0.54]	[0.97]	[0.97]	[1.03]	[1.03]
Interview year dummies	yes	yes	yes	yes	yes
State Age Structure	no	no	no	yes	yes
State Salaries Structure	no	no	no	no	yes
No. Obs.	4304	2802	2802	2802	2802
No. Clusters	50	47	47	47	47
R Squared	0.080	0.082	0.082	0.083	0.084

Health is measured by standardized SF12 physical score. Robust standard errors are corrected for clustering by state. All calculations are weighted. [a] Restricted sample refers to individuals who did not move between 1987 and 2002. *** significant at 1% significance level; ** significant at 5% significance level; * significant at 10% significance level

In the light of our assumption of stable relative state tax systems, I test the sensitivity of the estimates to changes in the date of the tax information. Table 3 reports the results when using tax data from the years following the Tax Reform Act of 1993. The estimators are not significantly different from the results obtained using the 2002 tax data. For the years preceding the 1993 tax reform, the results are of the same sign and significance but somewhat different in magnitude, suggesting some non-linearity.[3]

Table 3 Sensitivity Test of the Tax Impact Estimators to the Source of the Tax Information, NLSY79

[t statistic in brackets], (t statistic Ho: $a_i = a_i^{2002}$ in parentheses)

Tax Data Source	2002	2000	1998	1996	1994
Tax Progressivity	-0.036	-0.044	-0.039	-0.028	-0.031
	[-2.54]**	[-2.84]***	[-2.64]**	[-2.96]***	[-3.5]***
		(-0.52)	(-0.19)	(0.79)	(0.52)
Tax Level	-0.104	-0.110	-0.104	-0.091	-0.098
	[-3.07]***	[-3.42]***	[-3.26]***	[-3.37]***	[-3.88]***
		(-0.19)	(-0.01)	(0.50)	(0.23)

Health is measured by standardized SF12 physical score. Although the coefficients for covariates are not reported, all regressions control for Medical Care Cost, State Health and Hospital Expenditures, Education, ASVAB, Female, Black, Hispanic, If Married, Father Health Problem, Mother Health Problem, Both Parents until 18, Urban, Interview year dummies, State Age Structure; and State Salaries Structure. Robust standard errors are corrected for clustering by state. All calculations are weighted. The sample is restricted sample to individuals who did not move between 1987 and 2002.
*** significant at 1% significance level; ** significant at 5% significance level; * significant at 10% significance level

Another potential source of concern is that progressive taxation may encourage specialization within household [Hunt, DeLorme, and Hill, 1981]. Progressive taxation may distort time allocation decisions because marginal tax rates vary with family structure [Feldstein and Feenberg, 1996], and, in fact, the labor force participation of secondary earners which have higher labor supply elasticity [Killingsworth, 1983; Killingsworth and Heckman, 1986] has been shown to be sensitive to taxes [Triest, 1990]. In a couple one of the spouses may prefer to concentrate on household production, which could involve more health specific knowledge, thus influencing the health of at least one if not both of the spouses. The

[3] Log-linear specification does not change the results, nor does it seem to improve the fit.

inclusion of interaction terms (Table 4) indicates no differential effect on married people or on women. While some studies indicate different effects of tax provisions on men and women in a couple [Eissa and Hoynes, 2004], separate regressions for men and women (not reported) do not indicate any differential effect on marriage either. This result suggests that the estimated effect of progressivity on health is not driven by the influence of tax progressivity on the specialization within the household.

Table 4. The Effect of Labor Income Taxation on Health Differentiated for Married Individuals and for Women, NLSY79

	Restricted sample [a]	
	Coeff.	Coeff.
	[t]	[t]
Tax Progressivity	-0.037	-0.039
	[-2.18]**	[-2.91]***
Tax Level	-0.104	-0.103
	[-3.07]***	[-3.02]***
(Tax Progressivity)*(If Married)	0.003	
	[0.25]	
(Tax Progressivity)*(Female)		0.007
		[0.96]

Health is measured by standardized SF12 physical score. Although the coefficients for covariates are not reported, both regressions control for Medical Care Cost, State Health and Hospital Expenditures, Education, ASVAB, Female, Black, Hispanic, If Married, Father Health Problem, Mother Health Problem, Both Parents until 18, Urban, Interview year dummies, State Age Structure; and State Salaries Structure. Robust standard errors are corrected for clustering by state. All calculations are weighted. [a] Restricted sample refers to individuals who did not move between 1987 and 2002. *** significant at 1% significance level; ** significant at 5% significance level; * significant at 10% significance level

As already mentioned, an alternative explanation for our results is that there is self-selection with respect to the state of residence. In table 5, I correct for endogenous sorting into states of residence by instrumenting the tax variables and state health expenditures variable with the property crime rate in the state, the ratio of Democrats to Republicans in the state House, and the same ratio in the Senate, severance taxes per capita, full-time equivalent government employment, and the state population. The negative relation between both the level and the progressivity of the tax and the health index remains strong and statistically significant in this specification. The estimators obtained from the 2SLS estimation are larger than the estimators obtained from our main specifications but the Hausman exogeneity tests can only reject

the hypothesis that the questioned variables are exogenous at 8% significance level. The F statistics in the first stage regressions, as reported in Table 5, indicate that the proposed instruments are strongly correlated with the suspected variables. Overidentification tests (Table 1.5) indicate that all variables used to instrument the tax measures do not belong in the main equation and, thus, are legitimate in their use as instruments.

Table 5 The Effect of Labor Income Taxation on Health: 2SLS Estimation on NLSY79

	All sample	Restricted sample [a]
Instrumented Variables	Coeff. [t]	Coeff. [t]
Tax Progressivity [b]	-0.098 [-2.67]***	-0.102 [-3.03]***
Tax Level [b]	-0.294 [-2.65]**	-0.278 [-2.72]**
State Health and Hospital Expenditures[b]	0.000 [0.1]	0.000 [-0.07]
No. Obs.	4298	2800
No. Clusters	49	46
R squared	0.072	0.075
First stage F for Tax Progressivity	139.04	108.66
First stage F for Tax level	147.87	112.48
First stage F for Expenditures	195.74	136.06
Test for Overidentifying Restrictions [c]	0.860	6.440

Health is measured by standardized SF12 physical score. Although the coefficients for covariates are not reported, both regressions control for Medical Care Cost, State Health and Hospital Expenditures, Education, ASVAB, Female, Black, Hispanic, If Married, Father Health Problem, Mother Health Problem, Both Parents until 18, Urban, Interview year dummies, State Age Structure, and State Salaries Structure. [a] Restricted sample refers to individuals who did not move between 1987 and 2002. [b] Tax variables are instrumented using variables Property Crime, Dem./Rep. Ratio House, Dem./Rep. Ratio Senate, Severance Tax, Population, and Gov. Employment. Robust standard errors are corrected for clustering by state. All calculations are weighted. [c] 95% critical value is 7.81 *** significant at 1% significance level; ** significant at 5% significance level; * significant at 10% significance level

5.1. The magnitude of the effect

The coefficient on our measure of progressivity indicates that, keeping the average tax level constant, a 1 percentage point increase in the maximum rate of taxation, thus increasing progressivity, is associated with a cumulative decrease in health of approximately 0.36 standard deviations by the age of 40

(Table 6). But an exact interpretation of the magnitude of the effect is not possible as it is impossible to say exactly what this change means in terms of life expectancy.

Nevertheless, the magnitude of the progressivity coefficient relative to the coefficient on the tax level provides an indication of the importance of the impact of progressivity on health choices (Table 6). The estimates suggest that progressivity may have a more important effect on health choices than the tax level. A 1 percentage point increase in the average rate of taxation is associated with a cumulative decline in health of 0.28 standard deviations by the age 40, while a 1 percentage point increase in the maximum rate of taxation, keeping the average tax rate constant, thus increasing progressivity, is associated with a cumulative decrease in health of approximately 0.36 standard deviations by 40 years of age.

Table 6 The Predicted Effect of Labor Income Taxes on Health: Interpretation

	All sample	Restricted sample
	Standard Deviations Change in SF12 Physical Score	
1 percentage point increase in maximum tax rate holding average tax rate constant	-0.351	-0.363
1 percentage point increase in the average tax rate holding tax progressivity constant	-0.294	-0.278

[a] Restricted sample refers to individuals who did not move between 1987 and 2002. Both regressions control for Medical Care Cost, State Health and Hospital Expenditures, ASVAB, Female, Black, Hispanic, If Married, Father Health Problem, Mother Health Problem, Both Parents until 18, Urban, Interview year dummies, State Age Structure, and State Salaries Structure.

5.2 Robustness check

I check the robustness of our results on two additional datasets, the Current Population Survey (CPS) 2002, and the Behavioral Risk Factor Surveillance System dataset (BRFSS) 2002. The sample retained for estimation includes individuals 40 to 65 years old, such that there is a reasonable probability that they resided in the observed state for a significant period. While these two datasets do not offer the same opportunities to control for various factors that may bias our results as NLSY79, they do provide different measures of health. When using BRFSS, the dependent variable is expressed as the number of

days of good physical health in the month prior to the interview, and in CPS the dependent variable is a self-reported health measure taking 5 values with a higher value representing better health.

Given that 66% of the individuals in BRFFS reported having good physical health for the entire month, the sample retained for estimation (Table 7, Column1) includes only individuals who had some health issues at least one day out of the 30 possible. The estimates obtained using this sample support our previous results. The model specification used on the CPS data (Table 7, Column 2) is an Ordered Probit, and again, the results are consistent with our previous results.

Table 1.7 Robustness Check

	BRFFS OLS	CPS All sample Ordered Probit	CPS Restricted sample [c] Ordered Probit
Dependent variable	Number days good physical health/month [a]	Health Status [b]	Health Status [b]
	Coeff. [t]	Coeff. [z]	Coeff. [z]
Tax Progressivity	-0.150	-0.013	-0.006
	[-1.73]*	[-2.22]**	[-0.38]
Tax Level	-0.433	-0.031	-0.005
	[-1.8]*	[-2.14]**	[-0.13]
Medical Care Cost	0.249	0.028	0.043
	[1.9]*	[4.87]***	[3.61]***
State Health and	-0.002	0.000	0.000
Hospital Expenditures	[-0.7]	[-3.12]***	[0.45]
High-School	4.020	0.419	0.308
	[9.5]***	[17.06]***	[5.14]***
Some College	4.687	0.555	0.386
	[11.32]***	[19.78]***	[6.43]***
College Degree (or >	8.251	0.864	0.556
for BRFFS dataset)	[18.26]***	[28.09]***	[7.13]***
> College		0.971	0.780
		[27.95]***	[4.78]***
Female	-0.311	-0.014	0.043
	[-1.87]*	[-2.04]**	[1.03]
Black	0.060	-0.261	-0.203
	[0.14]	[-12.62]***	[-2.82]***
Hispanic	0.243	-0.110	-0.017
	[0.42]	[-6.12]***	[-0.17]
Age	-0.172	-0.025	-0.002
	[-12.93]***	[-33.37]***	[-0.78]
If Married	1.705	0.253	0.113
	[2.86]***	[16.4]***	[2.23]**
Metropolitan		0.053	-0.012
		[6.18]***	[-0.55]
Intercept	52.665		
	[3.06]***		
No. Obs.	15124	65042	3466
(Pseudo) R squared	0.088	0.049	0.021

[a] Sample of individuals who experienced less than 30 days of good health in the previous month. [b] Health status takes values from 1 to 5, where higher value translates to better health. [c] Restricted sample refers to individuals who quit job or retired for health reasons.

Robust standard errors are corrected for clustering by state. All calculations are weighted. *** significant at 1% significance level; ** significant at 5% significance level; * significant at 10% significance level

Sample: individuals 40 to 65 years old

In addition, CPS provides us with a way to construct a falsification test. I estimate the same model specification on a sample of individuals that quit their job or retired for health reasons. If they are prevented from working, their health investment should not be affected by income tax progressivity. The results obtained from this restricted sample (Table 7, Column 3) suggest that this is in fact the case: the estimates are much smaller and not statistically significant.

Introducing interaction terms of progressivity variable with age group dummies: a 40 to 65 age group and a over 65 group in regressions on a CPS sample of individuals over 25 years old suggest a smaller but still negative impact of progressivity for younger people (Table 8). The larger negative estimated effect of progressivity for older individuals has two sources. One is the difference in the per period investment in health determined by changes in the shadow value of health over time indicated by the theoretical model, and the second is the cumulative effect over the years coming from each period investment.

Table 8: The Impact of Progressivity on Health by Age Groups, CPS

CPS			
Dependent variable: Health status[a]			
	Tax Progressivity	Tax Progressivity interacted with dummy for 39<age<66	Tax Progressivity interacted with dummy for age>65
Coeff.	-0.010	-0.005	-0.007
[z]	[-1.74]*	[-1.99]**	[-1.77]*

[a]Health status takes values from 1 to 5, where higher value translates to better health. Although the coefficients for covariates are not reported, the regression controls for Tax Level, Dummies for age groups 40-65 and over 65, Medical Care Cost, State Health and Hospital Expenditures, High-School, Some College, College Degree, >College, Age, Female, Black, Hispanic, If Married, and Metropolitan. Robust standard errors are corrected for clustering by state. All calculations are weighted. *** significant at 1% significance level; ** significant at 5% significance level; * significant at 10% significance level
Sample: individuals older that 25 (129799 observations)

However, the results from BRFSS and CPS are not reliable for measuring the magnitude of the effect because these regressions do not control for the initial stock of health. As an offset, it may be the case that the impact of the initial stock of health is picked up by other variables included in the regression.

As initial stock of health determines the life expectancy, it also influences investment in education because life expectancy limits the returns to human capital investment [Case, Lubotsky, and Paxson, 2002]. Thus, if the initial stock of health is positively correlated with education, then the estimated coefficients of education will pick up some of the influence of the initial stock of health.

6. CONCLUSION

This paper proposes that progressive taxation distorts health choices. Using plausibly exogenous variation in state labor income tax structure, I find that individuals who live in states with less progressive labor income taxes tend to report healthier outcomes. While this analysis can provide only a rough approximation of its importance, income tax progressivity appears to have a significant effect on people's health choices even when compared with the estimated effect of the tax level. A 1 percentage point increase in the average rate of taxation is associated with a cumulative decline in health of 0.28 standard deviations by the age 40, while a 1 percentage point increase in the maximum rate of taxation, keeping the average tax rate constant, thus increasing progressivity, is associated with a cumulative decrease in health of approximately 0.36 standard deviations by the age of 40.

More important than the identification of this influence are the implications of this result. One issue is that the distortions generated by progressive taxation are not limited to labor choices. Part of the observed health and health expenditures differences among people may be explained by the tax structure. Another aspect is that the estimated negative effect of progressivity is probably exacerbated by low employment opportunities after retirement age limiting the possibility of smoothing taxes over time. Increased labor opportunities for individuals past the legal retirement age promote health by increasing the reward for health investment.

Under a progressive tax system, the marginal tax on income increases not only with hours of work but also with hourly wage, so tax progressivity also affects the incentives to invest in education. Since education has been proven to be strongly correlated with health, future research should concentrate on identifying the impact of progressivity on health mediated through education. This aspect is also very important in terms of growth because overall, progressivity affects growth through several channels: it

affects labor incentives, labor productivity through education, incentives to invest in health, and perhaps the efficiency of health production through the education channel.

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Appendix 1

Table A1: Descriptive Statistics NLSY79[1]

Variable	Description	Mean	Std. Dev.	Source
Physical Score	SF12 physical score (standardized)	0.010	0.988	NLSY79
Medical Care Cost	Median hourly wage of Healthcare practitioners and technical occupations	21.170	2.436	BLS
State Health and Hospital Expenditures		303.291	105.470	Census
Sales Tax	percent	5.287	1.327	B.o.S
Education	Years of education at interview	13.570	2.485	NLSY79
ASVAB	Overall Armed Forces Vocational Aptitude Test score (AFQT score) (percentile)	51.273	28.792	NLSY79
Female	dummy=1 if female	0.502	0.500	NLSY79
Black	dummy=1 if Black or African-American	0.131	0.337	NLSY79
Hispanic	dummy=1 if Hispanic	0.059	0.236	NLSY79
If Married	dummy=1 if married	0.653	0.476	NLSY79
Father Health Problem	dummy=1 if father had health problems	0.491	0.500	NLSY79
Mother Health Problem	dummy=1 if mother had health problems	0.436	0.496	NLSY79
Both Parents until 18	dummy=1 if lived with both parents till 18	0.714	0.452	NLSY79
Urban	dummy=1 if lives in urban area	0.665	0.472	NLSY79
Interview 1998	dummy=1 if interviewed in 1998	0.257	0.437	NLSY79
Interview 2000	dummy=1 if interviewed in 2000	0.386	0.487	NLSY79
State Age Structure	% of population between 50 and 65	0.159	0.009	Census
	% of population over 65 (2002)	0.125	0.018	Census
State Salaries Structure	% of population with salary income of 20000-30000	0.146	0.013	IRS
	30000-50000	0.197	0.009	IRS
	50000-75000	0.146	0.014	IRS
	75000-100000	0.077	0.012	IRS
	100000-200000	0.068	0.020	IRS
	>200000	0.019	0.007	IRS
Property Crime	Property Crime per 100,000 population	3589.004	774.777	Census
Severance Tax		13.855	62.870	Census
Gov. Employment	Full-time equivalent Gov. Empl. per capita	0.015	0.004	Census
Population	in thousands	11200	8870	Census
Dem./Rep Ratio House		1.190	0.824	B.o.S.
Dem./Rep Ratio Senate		1.097	0.794	B.o.S.

NLSY79: National Longitudinal Survey of Youth 1979; Census: www.census.org or from The Statistical Abstract of the United States 2003; IRS: Internal Revenue Service, United States Department of Treasury; B.o.S.: The Book of the States, Lexington KY., Council of State Governments, 2002

[1] Weighted statistics; Number of observations: 4304

Table A2: Descriptive Statistics: CPS and BRFFS[1]

	CPS[2]		BRFFS[3]	
Variable	Mean	Std. Dev.	Mean	Std. Dev.
Health Status	3.612	1.118		
Number days good physical health/month			19.545	10.707
Medical Care Cost	21.360	2.539	22.324	2.583
State Health and Hospital Expenditures	306.419	105.207	336.965	93.397
High-School	0.327	0.469	0.273	0.446
Some College	0.263	0.440	0.292	0.455
College Degree (or more for BRFFS)	0.175	0.380	0.294	0.456
> College	0.107	0.309		
Female	0.514	0.500	0.569	0.495
Black	0.109	0.312	0.093	0.291
Hispanic	0.110	0.313	0.148	0.355
Age	50.633	7.165	50.555	7.200
If Married	0.693	0.461	0.680	0.466
Metropolitan	2.529	0.964		

[1] Weighted statistics
[2] Number of observations: 65042
[3] Number of observations: 15124

Table A3: Self-reported Health in England and the United States, Ages 55-64 years

	England	USA
Unweighted sample size	3681	4386
Diabetes	6.1	12.5***
Hypertension	33.8	42.4***
All heart disease	9.6	15.1***
Myocardial infarction	4	5.4***
Stroke	2.3	3.8***
Lung disease	6.3	8.1***
Cancer	5.5	9.5***

English data are from the first wave of English Longitudinal Survey of Aging, and US data are from the 2002 wave of the Health and Retirement Survey. All data are weighted. *** significant at 1%, ** significant at 5% significance level.
Source: Oldfield, Zoe, and James P. Smith, "Disease and Disadvantage in the United States and England," *Journal of American Medical Association*, 295(17), May 3, 2006: 2037-2045.

Appendix 2: SF12 questionaire

The SF-12 (short-form 12-question questionnaire) measures self-reported mental and physical health. The questionnaire was administered to respondents who had turned 40 since their last interview in 1998, 2000, and 2002. Based on these 12 questions, 2 summary scores were created (by the Center for Human Resources Research, CHRR), the physical and the mental score. This research uses only the physical score.

SF12 questionaire

1) ASSESSMENT OF RESPONDENT'S GENERAL HEALTH: In general, would you say your health is ....

2) DOES RESPONDENT'S HEALTH LIMIT MODERATE ACTIVITIES? The following items are activities you might do during a typical day. Does your health limit you in these activities?... Moderate activities, such as moving a table, pushing a vacuum cleaner, bowling or playing golf?

3) DOES RESPONDENT'S HEALTH LIMIT CLIMBING STAIRS?.... Climbing several flights of stairs?

4) HAS RESPONDENT ACCOMPLISHED LESS THAN WOULD LIKE IN PAST 4 WEEKS? During the past 4 weeks, have you had any of the following problems with your work or other regular daily activities as a result of your physical health? ..... Accomplished less than you would like?

5) HEALTH LIMIT KIND OF WORK OR OTHER ACTIVITIES? .... Were limited in the kind of work or other activities?

6) HAVE EMOTIONAL PROBLEMS CAUSED RESPONDENT TO ACCOMPLISH LESS IN PAST 4 WEEKS? During the past 4 weeks, have you had any of the following problems with your work or other regular daily activities as a result of any emotional problems (such as feeling depressed or anxious)? (Please answer YES or NO for each question.).... Accomplished less than you would like?

7) HAVE EMOTIONAL PROBLEMS MADE RESPONDENT LESS CAREFUL IN PAST 4 WEEKS? .... Didn't do work or other activities as carefully as usual?

8) PAIN INTERFERED WITH NORMAL WORK IN PAST 4 WEEKS? During the past 4 weeks, how much did pain interfere with your normal work (including both work outside of the home and housework)?

9) HOW OFTEN RESPONDENT FELT CALM AND PEACEFUL IN PAST 4 WEEKS The next questions are about how you feel and how things have been with you during the past 4 weeks. for each question, please give the one answer that comes closest to the way you have been feeling. How often during the past 4 weeks..... have you felt calm and peaceful?

10) HOW OFTEN RESPONDENT HAD A LOT OF ENERGY IN PAST 4 WEEKS .... Did you have a lot of energy?

11) HOW OFTEN RESPONDENT FELT DOWN-HEARTED AND BLUE IN PAST 4 WEEKS .... Have you felt down-hearted and blue?

12) RS PHYSICAL/EMOTIONAL PROBLEMS INTERFER WITH SOCIAL ACIVITIES IN PAST 4 WEEKS During the past 4 weeks, how much of the time has your physical health or emotional problems interfered with your social activities (like visiting with friends, relatives, etc.)?