PRELIMINARY DRAFT

TAXES AND WAGE GROWTH

William M. Gentry
Williams College and NBER

and

R. Glenn Hubbard
Columbia University and NBER

November 2003

We are grateful to Anne Jones, Manuel Lobato Osorio, and Wouter Vergote for excellent research assistance.

TAXES AND WAGE GROWTH

I. Introduction

A variety of models predict that nonlinear payoffs create incentives for labor market effort, including models of promotion, job search, and efficiency wages. Existing empirical work on these models often focuses on specific groups of individuals, such as corporate executives, rather than the general population. Differences across households in the nonlinearities in the tax system that they face provide a source of variation for measuring the responsiveness of labor market behavior to nonlinear payoffs using the general population. In this paper, we use data from the Panel Study on Income Dynamics to test whether nonlinearities in the income tax system affect wage growth, which we argue captures a broad spectrum of both observable and unobservable types of worker effort.

Because many models of how labor market payoffs affect effort emphasize unobservable components of effort, we examine the *ex post* growth in real wage income over three years as an indirect measure of *ex ante* effort.[1] To measure the relevant nonlinearities of the tax system for each individual, we construct measures of tax convexity using a methodology similar to what we introduced in our paper on entry into entrepreneurship (Gentry and Hubbard, 2003a). Our measure of tax convexity captures how the tax rate changes as income varies around an initial income level. We decompose tax convexity into the 'upside convexity' associated with how the tax rate changes with increases in income and the 'downside convexity' associated with how the tax rate changes with decreases in income. We also control for the level of the marginal tax rate

[1] An alternative research strategy, which we are pursuing in a separate paper on job turnover (Gentry and Hubbard, 2003b), is to examine whether observable types of effort, such as actively looking for a new job, respond to nonlinearities in payoffs created by the tax system. Focusing on observable effort inherently excludes a wide variety of behaviors that affect wage growth.

in the spirit of the research on the responsiveness of taxable income to tax rates (see, *e.g.*, Feldstein, 1995, Auten and Carroll, 1999, and Gruber and Saez, 2002).

We find that both the level of the tax rate and the convexity of the tax system have statistically significant negative effects on wage growth. For the level of the tax rate, we estimate that the elasticity of wage income with respect to the tax price is 0.81 which is smaller than Feldstein's (1995) estimates of the responsiveness of taxable income (which is a broader measure of income) and larger than many estimates from subsequent work. For the convexity of the tax system, we find that reducing upside convexity faced by individuals in our sample from its mean of 3.6 percentage points to 2.6 percentage points would increase average three-year real wage growth from 9.1 percent to 10.5 percent. While the estimate tax effects are sensitive to the functional control for earnings, in general, they are robust to a variety of sensitivity tests. The results have implications for both the responsiveness of labor market effort to nonlinear payoffs and the efficiency costs of nonlinear income tax systems.

The paper is organized as follows. In section II, we discuss previous literature on nonlinear payoffs and behavior and the responsiveness of taxable income to tax rates. In section III, as a guide to theoretical predictions about how the tax system affects effort, we briefly discuss how taxes affect human capital accumulation and other forms of labor market effort. Section IV presents our empirical strategy for measuring the effects of tax progressivity on wage growth, including a discussion of our data. Section V presents our basic results and sensitivity analysis. Section VI concludes.

II. Previous Literature

Our research is related to several areas of previous research. First, nonlinear payoffs are important in a wide range of contexts, including some models of wage growth. Second, the recent literature on the responsiveness of taxable income to tax rates focuses on the level of the marginal tax rate for behavior; however, behavior can also depend on other aspects of tax policy.

II.A. Nonlinear Payoffs and Behavior

Recent research has pointed out that convexities in tax and transfer programs can have strong (and sometimes unintended) behavioral effects. For example, using simulation models, Hubbard, Skinner, and Zeldes (1995) find that non-linearities introduced by asset-based, means-test social insurance programs help explain the low saving of low-income households. In the context of unemployment, Meyer (1990) finds that discontinuities in unemployment insurance benefits (*e.g.*, the expiration of benefits) have large effects on the duration of unemployment. Gruber and Yelowitz (1999) find strong empirical evidence of these affects using data on Medicaid eligibility. The link between these studies and our work is that they emphasize the behavioral consequences of policy when uncertain returns to investments face a convex tax schedule.[2]

Our emphasis on the interaction between behavior and nonlinear payoffs is common in the literature on incentive contracting (see, *e.g.*, Holmstrom and Milgrom, 1987; and the survey in Prendergast, 1999) that emphasizes the role of nonlinear compensation schedules in aligning

[2] Our model of the effects of nonlinearities in the tax system departs from the traditional approach to analyzing effects of taxes on labor supply (see Hausman, 1985) that emphasizes how workers choose the number of hours to work when facing a nonlinear budget constraint. In addition to these traditional labor supply effects, our point is that when the "wage rate" is uncertain, a nonlinear tax system can affect employment choices even for a given number of hours.

the incentives of principals and agents. One constraint in designing these contracts is that they often shift risk onto the risk-averse manager; from the perspective of the risk-averse manager, reducing the sensitivity of pay to performance offers insurance against these unforeseen bad outcomes. Thus, as with the incentives from the tax system for risk-taking, there can be countervailing incentive and insurance effects.

Despite the well-developed theory on incentive contracts, empirical tests of whether managerial actions respond to nonlinearities in payoffs has been limited (see, *e.g.*, Prendergast, 1999; and Himmelberg and Hubbard, 2000). For the most part, the empirical work has focused on relatively well-paid workers, such as corporate executives; one notable exception is Lazear (2000) who examines the effects of monetary incentives on the effort of automobile glass repairers; he finds that monetary incentives enhance worker productivity. By analogy, our empirical analysis can be viewed as using the tax system to identify variation in the nonlinear payoffs to engaging in a risky activity across workers throughout the income distribution.

II.B. The Responsiveness of Taxable Income to Tax Rates

Over the last decade, a growing public finance literature has examined the responsiveness of taxable income to tax rates (or, more precisely, to the tax price which is defined as one minus the marginal tax rate). The seminal contribution in the literature is Feldstein (1995) using data around the Tax Reform Act of 1986; for methodological refinements and extensions to other data, see, for example, Auten and Carroll (1999), Goolsbee (1999), and Gruber and Saez (2002). This literature focuses on the elasticity of taxable income to the tax price which provides a broader measure of how taxes affect behavior than focusing narrowly on the elasticity of labor supply (defined as hours worked) with respect to the after-tax wage. By focusing on taxable income instead of direct measures of labor supply, this elasticity captures two margins that are not part of the narrow measure of labor supply. First, as emphasized by Slemrod (1998) and Feldstein (1999), this measure allows individuals to shift income between fully-taxable and tax-favored sources in response to the tax rate. These changes can take the form of tax avoidance, defined as legal forms of tax planning, timing responses to transitional changes in tax rates, and tax evasion (defined as illegal forms of reducing taxable income). Income shifting responses to tax rates have implications for both the revenue consequences and efficiency costs of changing tax rates.

Second, the elasticity of taxable income combines behavioral responses far broader than just the decision of how many hours to work. These other margins include financial decisions but also include dimensions of labor supply outside the narrow confines of the number of hours worked. These dimensions include effort decisions and occupational choices. Of course, many of these decisions do not bear fruit for a long time, so studies that focus on the change in taxable income over short intervals are more likely to capture timing responses to tax changes and less likely to reflect long-term investments in skills.

Much of this literature has focused on tax reforms that change individuals' marginal tax rates as the source of econometric identification. One major reason for concentrating on tax reforms is that the level of the tax rate at a point in time is a non-linear function of income. However, as we discuss below, the convexity of the tax system is a more complicated function of income and may vary across individuals with similar earnings. Also, as pointed out by Gruber and Saez (2002), while major Federal tax reforms are an important source of econometric identification, state tax reforms and detailed features of the tax code (e.g., bracket creep) also provide some identification. Therefore, we use data both from years that span tax reforms and those that do not.

Given the focus of this literature on the elasticity of taxable income, studies have mainly used tax return data. Our interest in labor market behaviors leads us to use the PSID dynamics, which allows for a broader set of household characteristics than are available in the tax return data. One cost of using the PSID data is that we focus more narrowly on labor income, rather than a broad measure of taxable income. Similar to the taxable income, however, our measure of wage income excludes many nontaxable forms of compensation, ranging from health insurance to job perquisites. To the extent that the tax schedule affects the form of compensation rather than the level of effort, our estimates may reflect responses along the form of compensation (or job characteristic) margin rather than the margin of labor market effort. Nonetheless, the elasticity of taxable income literature argues that such broad elasticities are relevant for evaluating tax policy.

III. Taxes and Labor Market Effort

Several types of models motivate the link between the convexity of the tax schedule and labor market effort. First, models of human capital, or skills, accumulation suggest that the return to such investments depends on the tax rate at the level of income associated with the higher skill level. In general, acquiring human capital increases future wage income so it results in wage growth. Research on taxation and human capital formation (see, *e.g.*, Eaton and Rosen, 1980) emphasizes the importance of considering the tax treatment of both the returns to human capital investment and the costs of the investment. A standard result in this line of inquiry is that a proportional tax will not affect human capital investment when the returns to the investment are certain if the cost of investment is deductible from the tax base, as would be the case when the cost of the investment is foregone wage income at the time of the investment. With uncertain returns, as pointed out by Eaton and Rosen, the effects of a change in the marginal tax rate are ambiguous due to an insurance effect (an increase in the tax rate reduces the riskiness of human capital investment, increasing such investment) and an effect on risk tolerance (the income effect from the tax change can affect individuals' willingness to bear risk depending on the preferences of the individuals).

Progressivity – marginal tax rates increasing with income – complicates the analysis of human capital investment. With certain returns, the after-tax cost of the investment depends on the foregone after-tax earnings, which depend on the nonlinearities in the tax system and the returns depend on the increased earnings after accounting for the potential increases in marginal tax rates. Progressive tax rates typically reduce the government's share of the cost of the human capital investment and increase its share of the returns, suggesting that, relative to a constant marginal tax rate, progressive tax rates reduce the incentive for human capital investment. Uncertainty exacerbates the problem; while it may be relatively straightforward to calculate the after-tax cost of the investment, the after-tax return depends on the uncertain return on the investment.

Second, models of job search suggest that job search effort depends on the payoff to search, which depends on the distribution of future wage offers.[3] If the marginal tax rate increases with income, then the after-tax return to search is lower than if the marginal tax rate does not increase with income.

Third, efficiency wage models suggest that effort depends on the probability of losing one's job if caught shirking and the lost wage income from losing a job that pays more than the worker's marginal product. The after-tax lost wage income depends on how the tax rate changes between the income in the current job and the income earned in the job opportunity if caught shirking. If the marginal tax rate decreases as income falls, then the after-tax cost of getting caught shirking is higher than if the tax rate is constant. Thus, "downside" convexity (i.e., marginal tax rates that decrease as income decreases) may encourage work effort. Intuitively, convexity in the tax system increases the cost of negative wage growth. If human capital accumulation reduces the chance of negative wage growth, then downside convexity also encourages investments in skills accumulation.

IV. Empirical Specification and Data

To discriminate among potential effects of the tax system on labor market effort, one would ideally like to have household-level panel data, with information on employment, labor market effort – both observable and unobservable forms of effort, and sufficient information to

[3] See Kesselman's (1976) model of taxes and job search in which search effort is similar to human capital accumulation; this formulation is especially helpful for thinking about on-the-job search, which is most relevant for the wage growth impacts in which we are interested. In general, research on job search focuses on search by someone who does not have a job. Even in this framework, however, tax progressivity may dampen the incentives for job search; see, Manning (2001) who conjectures that increasing the marginal tax rate is "likely to have an adverse impact on search intensity as it reduces the reward from higher-wage jobs."

estimate measures of income tax convexity across households and time. For a household, the relevant convexity of the income tax depends upon provisions of the tax code and a description of the *ex ante* distribution of payoffs to effort. While households face a common tax code, they may have access to different labor market opportunities.

Many forms of labor market effort are inherently unobservable so we examine observed labor income growth as an *ex post* proxy for a broad spectrum of *ex ante* labor market effort. Because current effort may not lead to immediate increases in wage income, we focus on wage growth over a three-year period as the main dependent variable in our analysis. The PSID provides longitudinal data on employment, household income, and household characteristics which allows us to construct household-specific measures of wage growth and tax incentives.

We use data over the period from 1979-1993. While the PSID starts in 1968, we start in 1979 because the NBER TAXSIM model (our source for creating tax variables) includes state tax code information starting in the late 1970s. We end with 1993 because it is the last year for which final-release PSID data are available. We use both the representative national sample and the national sample of low-income families; our analysis uses sample weights to avoid overweighting the low-income households.

Our sample conditions on being a head of household between the ages of 23 and 58 who is in the workforce in both years for constructing wage growth and has positive labor income in both years. The age restrictions are aimed at reducing the influence of education and retirement decisions on measuring initial and final labor income. The sample pools single men and women (and single parents) and married heads of households (almost always men); in our sensitivity analysis, we examine whether this pooling matters. We exclude married women to avoid issues of the endogeneity of labor force participation. Because it is difficult to separate the labor and capital components of income from self employment, we exclude the self employed from our analysis.

Abstracting from tax considerations, we estimate ordinary least squares regressions for three-year wage growth, *WAGEGROWTH* by the head of household *i* at time *t*:

$$WAGEGROWTH_{i,t} = f(x_{it}, z_{it}, \gamma_t) \tag{1}$$

where x_{it} are job characteristics of the individual's current job, z_{it} are household characteristics, and γ_t are year effects common to all households. In estimating the effects of the tax code on wage growth, we use explanatory variables from year *t* to predict future wage growth of the head of household.

Controlling for job and family characteristics is important for two reasons. First, these variables may capture factors, such as job attachment or job opportunities, that affect the decision to exert effort that might affect wage growth. Second, as discussed below, our measure of the tax convexity that is relevant for the decision whether to exert effort depends on many factors, including household characteristics. Controlling for these characteristics reduces the probability that our estimated results are driven by a spurious correlation between household characteristics, tax convexity, and wage growth.

As job characteristics, we include dummy variables for the worker's occupation and industry (both at the two-digit classification level in the PSID) in year *t* and the level and square of the labor earnings of the head of household in year *t*. For z, we include the number of children in the household, the age and age-squared of the head of household, and dummy variables for whether the head is nonwhite, female, single, a homeowner, whether the household lives in a rural area (not resident in a Standard Metropolitan Statistical Area), and whether the head experienced a marital transition during the year (using separate variables for marriages, divorces, or the death of a spouse). We approximate educational status with indicator variables for "less than high school education," "some college," "college," and "some post-college education" (with the omitted category being a high school education). We control for the level and square of the spouse's labor earnings in year t, assigning values of zero to non-married households. We also include property income and dividend and interest income as proxies for wealth, which is not available on an annual basis in the PSID. Finally, we include Census-region-specific year dummy variables to capture trends in wage growth or the effects of macroeconomic conditions; that is, we allow the year effects, γ_t, to vary by Census region. Table 1 provides summary statistics for the control variables.

Starting from this econometric approach to estimating the effects of job and household demographics on wage growth, we face the more complicated task of adding empirical measures of the tax incentives for labor market effort. While the *level of the tax rate* facing a worker is a relatively easy concept to model, the *convexity* of the tax system that a worker faces is much harder to measure. The model above highlights the importance of the asymmetry in the variation of tax rates. Neither the average tax rate at various outcomes nor the variance in tax rates faced over the distribution of outcomes are useful measures of the asymmetry in tax rates faced by potential job changers. Instead, we require a measure of the spread in tax rates across the distribution of possible outcomes.

To characterize a reasonable range for potential wage growth over a three-year period, we examine the distribution of real earnings growth over a three-year period. We examine heads of households that were in the work force in year *t* and year *t+3* but were not self employed; calculating wage growth also conditions on household heads having labor income of at least $1,000 in the first year (to avoid unreasonably large growth rates) and positive labor income in year *t+3*, as well as being between the ages of 23 and 58 in the first year.

This observed distribution of wage growth guides our construction of measures of the tax incentives for potential effort. Overall, the median three-year growth in real wage income is 2.14 percent and mean three-year growth in real wage income is 8.19 percent. In calculating our benchmark tax rate (*i.e.*, the tax rate that will be relevant if the worker does not exert unusually low or high effort), we allow for five percent wage income growth.

To measure the relevant spread in tax rates faced by people who exert abnormal effort, we calculate tax rates that someone would face at various levels of future wage income. Based on the distribution of observed wage growth, we form a weighted average of these tax rates for "successful" and "unsuccessful" experiences. Our basic measure of tax convexity is the difference in the weighted average of the marginal tax rates in the various successful and unsuccessful states. That is, how does the marginal tax rate change between good outcomes and the bad outcomes? For someone facing a constant marginal tax rate over the range of possible outcomes, this measure of convexity is zero. If success changes the household's tax bracket, then the convexity measure is non-zero (and typically positive). Because many models of effort suggest differential effects of tax rate convexity above and below the current income level, in our regression analysis, we separate the convexity measure into "upside" and "downside" measures. The upside convexity measure is the difference between the weighted average tax rate in the successful outcomes and the benchmark tax rate; the downside convexity measure is the difference between the benchmark tax rate and the weighted average tax rate in the unsuccessful outcomes.

We use the observed wage growth experience of all workers in formulating the benchmark wage growth rate and a spread between successful and unsuccessful experiences. For successful experiences, we consider households with more than five percent real three-year wage growth (our benchmark growth rate). Among these households, the 25th percentile of wage growth is 12.0 percent, the median is 21.9 percent, the 75th percentile is 43.0 percent, the 90th percentile is 84.2 percent, and the 95th percentile is 128.5 percent. We consider five possible "successful" outcomes from job search; labor income increases by 10, 25, 50, 100, or 200 percent. The distribution of wage growth indicates that these outcomes are not equally likely so we assign probabilities of 0.3, 0.3, 0.25, 0.10, and 0.05, respectively, to the five cases. To simulate the tax rate faced at different levels of success, we compute tax rates after replacing the head's labor income with income that is a multiple of the head's current labor income.

Similarly, for unsuccessful experiences, we consider heads of household with growth below our five percent benchmark. Among these households, the 75th percentile of wage growth is -2.29 percent, the median is -10.9 percent, the 25th percentile is -26.5 percent, the 10th percentile is -53.6 percent, and the 5th percentile is -71.5 percent. Correspondingly, we consider five possible "unsuccessful" experiences with zero labor income growth or declines of 5 percent, 10 percent, 25 percent or 50 percent. We calculate tax rates associated with each of these outcomes and assign probabilities of 0.15, 0.20, 0.35, 0.25, and 0.05 to these five outcomes, respectively.

To construct tax variables, we use the TAXSIM model of the National Bureau of

Economic Research (see Feenberg and Coutts, 1993). From the PSID, we use household characteristics on family size, family structure, age, labor earnings, dividends, interest received, income from other sources (*e.g.*, rental income), and state for residence.[4] To construct the household's predicted future marginal tax rate, we use household characteristics in year t and project the tax rate using the year $t + 1$ tax code;[5] to capture the effects of future wages exceeding current wages, we allow earnings to grow by five percent in constructing our benchmark tax rate. The decision to exert effort depends on longer run consequences rather than just income over a short horizon. We use the near-term tax code for forming tax rates because households probably have a better idea of the near-term tax structure (either explicitly through knowledge of the tax system or implicitly through observing the after-tax living standards of households with differing levels of success) than of the actual future tax code when the steady-state outcome will be realized.

The TAXSIM model processes the PSID data by incrementing wage income by $100 to calculate federal and state income tax payments and marginal income tax rates; we also construct average tax rates using family income. Because the tax rate schedules can have notches, TAXSIM occasionally produces unrealistic marginal tax rates; we exclude observations for

---

[4] We restrict our analysis to PSID observations that have these data items. Actual tax returns incorporate variables that are not available from the PSID. For example, without interest payments and charitable contributions, we understate the number of households that itemize their deductions; similarly, we do not have information on contributions to tax-advantaged retirement savings. Lastly, we do not have data on realized capital gains; however, because many capital gains realizations are transitory phenomena, excluding realized capital gains probably better captures the incentives for labor market effort.

[5] By using the $t + 1$ tax code, we are assuming that households have information about future tax rates. As alternative measures of the tax-related incentives, we could assume households have either less or more foresight about future tax law by constructing the tax measures with either the year t or $t + 2$ tax code, respectively.

which TAXSIM produces marginal or average tax rates that are below -20 or above 75 percent. To compute our convexity measures, we repeat this process for alternative levels of income by replacing the head of household's labor income with some multiple of the original labor income (*e.g.,* 110, 125, 150, 200, and 300 percent of labor income for the five levels of being successful). Our convexity measure is the difference between the weighted average of the marginal tax rates for successful and unsuccessful outcomes.

Implicitly, we link the distribution of labor market outcomes to current income by expressing the opportunities as percentage increases in current wage income. The convexity measure assumes that each head of household with a given current labor earnings has the same potential distribution of outcomes. That is, other household characteristics do not affect the variance of the outcomes. The variability of the distribution of payoffs is constant in percentage terms across households. As an alternative, effort could affect wages by the same absolute dollar amount across households. Unfortunately, this alternative would lead to either very large percentage changes for low-income households or very small percentage changes for high-income households.[6] We also assume that other types of income and demographics do not change with the effort decision. For example, the wife's labor supply does not change when her husband's income changes.

Even focusing on income taxes, it is not obvious how to measure the convexity of the tax system. By using marginal tax rates at specific income levels, our measure focuses on the shape of the tax rate schedule over the relevant range of outcomes associated with wage growth; for

[6] A key part of our convexity measure is whether households change marginal tax rate brackets. In the early years of the sample, the tax code had many different tax brackets but the income range within a bracket increased with income. Thus using a constant percentage variance in outcomes makes the probability of changing marginal tax brackets similar across income groups.

example, if a household remains in the same marginal tax bracket regardless of wage growth, our measure of convexity will be zero. As an alternative measure of convexity, we replace our marginal tax rate measures with average tax rate measures. The level of the average tax rate replaces the level of the marginal tax rate; the spread between average tax rates for successful search and the benchmark income level replaces the marginal tax rate measure of convexity. This alternative measure of convexity incorporates features of the tax code that apply to very low incomes; for example, reducing every household's tax liability (irrespective of income or employment status) by $500 would affect average tax rates but not marginal tax rates.

Before presenting results on how convexity affects wage growth, some simple examples help illustrate our measure of overall convexity (i.e., the convexity measure is the sum of 'upside' and 'downside' convexity). These examples also help clarify the sources of econometric identification for the convexity effects. Consider a family with one child that lives in a state without a state income tax; the husband earns $25,000 and the wife earns $15,000 as employees. In the 1986 tax code, this family faced a marginal tax rate of 28 percent and our convexity measure based on marginal tax rates for this household is 10.09 percentage points; in 1992, this family's marginal tax rate was 15 percent and their convexity measure was 7.17 percentage points. Alternatively, consider a family in which the husband earns $90,000 and the wife earns $50,000. For the years 1986, 1988, 1992, and 1993, working as employees, this family would face marginal tax rates of 49, 33, 31, and 31 percent, respectively; however, the spread between successful and unsuccessful entry would be 3.06, -0.75, 2.00, and 7.24 percentage points, respectively.

These examples reveal that convexity need not be positively correlated with the level of the tax rate or with income. Table 1 includes the basic summary statistics on the tax rate and convexity measures. The mean of the marginal tax rate spread is 5.92 percentage points and the median is 6.05 percentage points. The tenth, 25th, 75th, and 90th percentiles of the distribution of this measure of convexity are 0.81, 3.03, 8.68, and 10.66, respectively.[7] Figure 1 provides a histogram of the median convexity measure by income deciles (computed on an annual basis). Middle-income households face the most convexity; for example, the sixth income decile has a median convexity measure of 7.12 percent. While the figure indicates that convexity varies with income, convexity also varies within each income decile. Overall, the convexity depends on tax provisions that vary across households within a state, across similar households in different states, across time, and the distribution of income within the family.

Figure 2 illustrates the relationship between wage growth and convexity; it is a histogram of mean (in Figure 2A) and median (in Figure 2B) wage growth by the marginal tax rate measure of convexity. The numbers along the x-axis are the percentage of the distribution of households that is in each range of the convexity measure. The numbers at the top of each bar are the mean (or median) wage growth of heads of households in the range of convexity. For example, of the 18.0 percent of the sample that had a convexity measure of greater than or equal to 4 percent but less than 6 percent, the mean three-year real wage growth is 10.63 percent and the median is 4.57 percent. In contrast, among the 18.9 percent of the sample with a convexity measure of greater than or equal to 8 percentage points but less than 10 percentage points, mean wage growth is 4.62 percent and median wage growth is 3.11 percent. In general, the univariate comparison

[7] The average tax rate measure of convexity has a mean of 2.91 percentage points and a median of 2.89 percentage points. The distribution of this measure of convexity is much tighter, with a fifth to 95th percentile range of 1.31 to 4.63 percentage points.

suggests that wage growth is lower for heads of households that face more convexity in the tax code. However, it is important to control for other factors that may affect wage growth, which we do in the multivariate analysis in the next section. For example, Figure 3 indicates that wage growth is higher for low-income households than for high-income households, consistent with transitory income shocks affecting the level of wage income.

V. Estimated Effects of Tax Rate Convexity on Wage Growth

V.A. Base Case Results

Table 2 presents the results for our base specifications on the determinants of wage growth. The first two columns have results for specifications that include all households; these specifications pool single men or women and married men as heads of households. The third and fourth columns report results restricting the sample to married men. Focusing on married men removes the possibility that tax convexity differs between married and single households because they face different tax schedules; this difference could create spurious results if these differences in convexity are correlated with different wage growth patterns for single and married people. For each sample, we present results that use the convexity measure based on marginal tax rates and the convexity measure based on average tax rates.

The first column of Table 2 presents results using the marginal tax rate measures of the tax variables. The estimated coefficient on the level of the tax rate is -0.0115 and statistically different than zero at the 99 percent confidence level. A one percentage point decrease in the marginal tax rate increases wage growth by 1.15 percentage points. To compare this result with the literature on the responsiveness of taxable income to changes in tax rate, we calculate the elasticity of wage income (which is a narrower definition of income than typically studied in the previous literature) with respect to the tax price of consumption (which is equal to one minus the tax rate expressed as a fraction). Evaluated at the mean marginal tax rate in the sample, the estimated coefficient on the level of the tax rate in the first column of Table 2 implies an elasticity of wage income with respect to the tax price of 0.81. This estimate is slightly higher than the estimates in Auten and Carroll (1999), which is the most comparable study in the previous literature because it controls for occupation.

The estimated coefficient on the convexity of the tax system is −0.0142 and is statistically different from zero at the 99 percent confidence level. In terms of economic significance, this estimate suggests that a one percentage point decrease in convexity would increase the rate of wage income growth by 1.42 percentage points. Evaluated at the mean wage growth rate, a one percentage point decrease in convexity would increase average three-year wage income growth from 9.07 to 10.49 percent. Expressed as an elasticity and evaluated that the mean convexity, this result suggests that the elasticity of wage income with respect to our measure of convexity is −0.084. This estimate is consistent with increasing marginal tax rates discouraging investments that increase wage growth.

The estimated coefficient on downside convexity is 0.00440 and statistically different from zero at the 99 percent confidence level. This positive coefficient estimate on downside convexity suggests that individuals respond to lower marginal tax rates below the benchmark wage growth level by exerting effort that reduces the chance of lower wages. That is, consistent with the efficiency wage effect, workers exert more effort when the after-tax cost of a reduction in wage income is higher.

The second column of Table 2 presents the results using the average tax rate measures of the tax variables for all households. In terms of signs and statistical significance, using the average tax rate yields similar conclusions with respect to the level of the tax rate and upside convexity to the specifications that use the marginal tax rate versions of the tax variables. However, this specification suggests a larger economic impact from lower income tax rates and less convexity. The estimated effect of downside convexity is positive but not statistically different from zero at conventional confidence levels.

The results from focusing on married men (reported in the third and fourth columns of Table 2) are broadly similar to those reported for the overall sample. Two differences emerge. First, the estimated effect of the level of the tax rate is somewhat smaller in magnitude. Second, the estimated effect of downside convexity is indistinguishable from zero in the marginal tax rate specification and positive and statistically significant at the 99 percent confidence level in the average tax rate specification (the opposite of the pattern found using the sample with all households).

In terms of the other variables, the head of household's income is highly statistically significant. Over most incomes in our sample, an increase in the initial level of wage income (holding other household characteristics constant) reduces future wage income growth, which is consistent with transitory shocks to wage income leading to mean reversion in wage income. For the first column, the positive coefficient on the quadratic term does not outweigh the negative coefficient on the linear term until $218,000 of labor income. The estimated coefficients on the dummy variables for minority status, female-headed households, home ownership, and rural residence are negative and statistically significant. Education beyond high school is positively correlated with wage income growth, consistent with the notion that the returns to education increased during the 1980s.

V.B. Sensitivity Analysis

A number of statistical issues merit further investigation. Our sensitivity analysis serves two important functions. First, sensitivity analysis helps gauge whether the results are driven by spurious correlations between the tax variables and other plausible determinants of wage growth. Second, the sensitivity analysis provides some guidance on which sources of variation in the convexity measures are important for econometric identification.

V.B.1. Alternative Functional Forms for Earnings Controls

As illustrated by Figure 3, wage income growth depends critically on the initial level of wage income with workers starting at lower levels of wage income having higher growth rates. For the estimating the effects of the level of the tax rate on income growth, this correlation between income and wage growth could affect the estimates because the level of the tax rate is a nonlinear function of income with higher income being associated with higher marginal income tax rates. This correlation is a standard problem for estimating the effects of tax rates on behavior. As illustrated by Figure 1, the relationship between tax convexity and income is more complicated than the relationship between the level of the tax rate and income. Nonetheless, a correlation between the convexity measure and income could make the estimates sensitive to the functional form with which we control for income.

In Table 3, we present results from specifications that use several alternative controls for earnings.[8] The first column reports results that only include linear controls for labor income. The estimated tax effects are similar to those reported in Table 2 with the estimated effect of the level of the tax rate being somewhat larger in magnitude than it is in the specification that allows for a quadratic function of labor earnings. The second column reports results from including a cubic function of labor earnings. With the higher order polynomial controlling for earnings, the estimated tax effects are about one-third smaller than in our base case but they are still statistically different than zero at the 99 percent confidence level.

Replacing the quadratic function of labor earnings with the logarithm of labor earnings (see the third column of Table 3), changes the results substantially. The estimated effects of neither the level nor the convexity of the tax system are statistically different from zero. This result suggests that the estimates are sensitive to the form of the earnings control. The most puzzling aspect of these results is that neither the level nor the convexity of the tax schedule has a statistically significant effect on wage growth. In the fourth column of Table 4, we include a set of dummy variables for the decile of the income distribution for each household (the income distribution is constructed separately for each year) and allow for a quadratic function of labor earnings. The estimated effects are somewhat smaller in magnitude than in our base specification but they are statistically different than zero at the 99 percent confidence level. Overall, the estimated effects are somewhat sensitive with respect to the functional form of the earnings control.

---

[8] Table 3 reports results using the marginal tax rate measure of convexity and the sample of all households. We obtain a similar pattern of results if we use the average tax rate measures of convexity or the sample of married men.

V.B.3 Variation across Income, Education, and Age Groups

The estimated response to nonlinearities in payoffs could vary across groups within the population. In the previous section, we discussed alternative functional forms for controlling for earnings. An alternative strategy for dealing with the possibility that the relationship between income and the tax variables creates spurious results is to estimate the tax effects within income groups. To allow the estimated tax effects to vary across income groups, we interact the tax variables with each household's income quintile (formed on an annual basis); this specification also includes dummy variables for each income quintile.

The first panel of Table 4 reports the estimated coefficients on the tax variables interacted with income quintiles. For the level of the tax rate, the estimated coefficients decline with income and are statistically different from zero at the 95 percent confidence level for all income groups. For the estimated effect of upside convexity, the estimated coefficient is negative and statistically different from zero at the 95 percent confidence level for all income quintiles. The estimated negative effect of upside convexity is stronger for the lower income groups but persists for all income groups. In contrast, the estimated positive effect of downside convexity is concentrated among the bottom income quintile. Thus, the negative effects of both the level of the tax rate and upside convexity appear throughout the income distribution. Statistically, these results suggest that the measured effects can be identified by variation in tax incentives within income quintiles, which reduces the possibility that the results are driven by a spurious correlation between the tax parameters, the level of income and wage income growth.

The effects of the tax system may vary with education level because education is correlated with ability to understand incentives or because the types of labor market effort that might be affected by nonlinear payoffs may be correlated with education. For example, on the one hand, if individuals with low education are in jobs that are monitored heavily by managers, then individuals with these jobs will have fewer opportunities to invest in unobservable effort that might lead to job growth; on the other hand, for low skill workers, a small investment in skills acquisition may translate into a large relative increase in skills.

Panel B of Table 4 reports the results of interacting the tax variables with our five education groups. The estimated effect of the level of the tax rate is negative and statistically significant at the 99 percent confidence level for all education groups. The estimated effect of upside convexity is also negative and statistically significant at the 99 percent confidence level for all education groups. The estimated effect is slightly smaller for the lower education groups. In contrast, the estimated positive effects of downside convexity are concentrated among the bottom two education groups.

Panel C of Table 4 allows the effects of the tax variables to vary across three age groups in the population. In terms of responsiveness to both the level and convexity of tax rates, the wage growth of younger individuals is more responsive than the wage growth of older individuals.

V.B.3. Interstate and Intertemporal Variation in Tax Incentives

The variation in tax rates and tax convexity arises from a variety of sources. In part, the variation arises from differences in tax policy over time and across locations. The variation also comes from differences across households in their location on the tax schedule at a given point in time. This variation arises due to nonlinearities in the tax schedule and differences across families in their sources of income and the level of income.

As one way to examine the relative importance of different sources of variation in providing for econometric identification, we estimate alternative specifications that control for some sources of variation or seek to isolate specific sources of variation. For example, including state fixed effects removes the average time-invariant state-specific component to the labor market environment (but still allows intertemporal differences in state tax policy and cross-sectional intrastate variation in tax incentives to affect the estimated coefficients on the tax variables). Including state fixed effects to the specifications reported in Table 2 increases the magnitude (and associated statistical significance) of the estimated tax coefficients relative to the results without state fixed effects. The estimated effects of the level of the tax rate are roughly 30 to 50 percent larger and the estimated effects of convexity are 4 to 60 percent larger than the results reported in Table 2. In addition, we include state-year specific fixed effects to eliminate the cross-sectional differences across states within each year. With these additional controls, the results are quite similar to the results with just state fixed effects. Overall, these results imply that the results in Table 2 are not driven by a spurious relationship between state tax policy and wage growth.

Our sample period includes two substantial reforms of the rate structure of personal income taxes in 1981 and 1986. These reforms help identify differences in convexity across households with otherwise similar characteristics. To investigate the role of this time-series variation in tax incentives, we estimate the marginal tax rate specification for all households in Table 2 but allow for the earnings and tax variables to have year-specific coefficients. For the level of the tax rate, all twelve of the year-specific estimated coefficients are negative and nine of these are statistically different from zero at the 95 percent confidence level. Thus, for the effects of the level of the tax rate, the econometric identification does not seem to be driven by years in which the tax law changes. For the upside convexity of the tax schedule, ten of twelve annual coefficient estimates are negative and seven of the twelve estimates are statistically different from zero at the 99 percent confidence level. The largest negative effects of upside tax convexity on wage growth are for wage growth between 1984-1987 and 1986-1989, which suggests that the flattening of the tax rates associated with the Tax Reform Act of 1986 plays an important role in econometrically identifying the overall parameter. The year-specific results for downside convexity are less clear cut. Eleven of the twelve year-specific coefficient estimates are positive but only three of these are statistically different from zero at the 95 percent confidence level.

IV. Conclusions and Directions for Future Research

In this paper, we attempt to use variation in tax rates and tax rate convexity to estimate whether labor market effort responds to nonlinearities in payoffs. We use *ex post* wage growth as a proxy for *ex ante* labor market effort in hopes of capturing a broad spectrum of labor market behaviors. At this preliminary stage, the results suggest that growth in wage income is sensitive to both the level and the convexity of tax incentives. These preliminary results echo our results using a similar methodology to examine how the probability of moving to a better job, as an example of one specific observable component of labor market effort, responds to tax rates and convexity (see Gentry and Hubbard, 2003b). The estimated effects of convexity are also consistent with the estimated effects of tax convexity on the decision to enter self employment (see Gentry and Hubbard, 2003a).

A number of issues remain to be addressed. First, further sensitivity analysis is warranted, especially on the importance of the functional form of earnings controls and the sources of econometric identification, before we can draw definitive conclusions. Second, using a narrow measure of income, such as annual wage income, raises the issue of whether the observed behavior is driven by "real" behavior – such as effort, training, or job search – or some form of timing response or shift in the form of compensation (see Feldstein, 1999, and Slemrod, 1998, for further discussion). Third, the results suggest that behavior responds to the shape of the tax schedule instead of just the marginal tax rate around an individual's current income. The responsiveness to a wider range of tax rates poses problems for estimating the effects of tax reform. Instead of only estimating the effects of marginal tax rate changes, the results suggest that policy analysis should include the behavioral effects of changes in progressivity. Changing the tax rate at a point in the income distribution has two different effects. First, the change affects some behavior by changing the level of the tax rate. Second, the change alters the convexity of the tax schedule for other individuals.

References

Anderson, Patricia M., and Bruce D. Meyer. "Unemployment Insurance Takeup Rates and the After-tax Value of Benefits." *Quarterly Journal of Economics*, 112:3, 1997, pp. 913-937.

Auten, Gerald and Robert Carroll. "The Effect of Income Taxes on Household Income." *Review of Economics and Statistics*, 1999, 81:4, pp. 681-693.

Blau, David M. and Philip K. Robins. "Job Search Outcomes for the Employed and Unemployed." *Journal of Political Economy*, 1990, 98, pp. 637-655.

Domar, Evsey, and Richard Musgrave. "Effects of Proportional Taxes on Risk-Taking." *Quarterly Journal of Economics,* 59, 1944.

Feenberg, Daniel, and Elisabeth Coutts. "An Introduction to the TAXSIM Model." *Journal of Policy Analysis and Management ,* 12, 1993, pp.189-194.

Feldstein, Martin. "The Effect of Marginal Tax Rates on Taxable Income: A Panel Study of the 1986 Tax Reform Act." *Journal of Political Economy,* 103(3), June 1995b, pp. 551-572.

Feldstein, Martin S. "Tax Avoidance and the Deadweight Loss of the Income Tax." *Review of Economics and Statistics*, 1999.

Gentry, William M., and R. Glenn Hubbard. "Tax Policy and Entry into Entrepreneurship." Mimeograph, Columbia University, 2003a.

Gentry, William M., and R. Glenn Hubbard. "The Effects of Progressive Income Taxation on Job Turnover." *Journal of Public Economics*, forthcoming, 2003b.

Goolsbee, Austan. "Evidence on the High-income Laffer Curve from Six Decades of Tax Reform." *Brookings Papers on Economic Activity*, September 1999.

Gruber, Jonathan, and Emmanuel Saez. "The Elasticity of Taxable Income: Evidence and Implications." *Journal of Public Economics*, 84(1), April 2002, pp. 1-32.

Gruber, Jonathan, and Aaron Yelowitz. "Public Health Insurance and Private Savings." *Journal of Political Economy*, 107(6), Part 1 December 1999, pp. 1249-1274.

Hausman, Jerry A. "Taxes and Labor Supply." In Alan J. Auerbach and Martin Feldstein, eds., *The Handbook of Public Economics*, New York: North Holland, 1985.

Himmelberg, Charles P., and R. Glenn Hubbard. "Incentive Pay and the Market for CEOs:

An Analysis of Pay-Performance Sensitivity." Mimeograph, Columbia University, 2000.

Hofler, Richard A. and Kevin J. Murphy. "Underpaid and Overworked: Measuring the Effect of Imperfect Information on Wages." *Economic Inquiry*, 30, July 1992, pp. 511-529.

Homstrom, Bengt, and Paul Milgrom. "Aggregation and Linearity in the Provision of Intertemporal Incentives." *Econometrica*, 55, March 1987, 303-328.

Hubbard, R. Glenn, Jonathan Skinner, and Stephen P. Zeldes. "Precautionary Saving and Social Insurance." *Journal of Political Economy*, 103:2, April 1995, pp. 360-399.

Kesselman, Jonathan R. "Tax Effects on Job Search, Training, and Work Effort." *Journal of Public Economics*, 1976, 6, pp. 255-272.

Lazear, Edward P. "Performance Pay and Productivity." *American Economic Review*, 90:5, 2000, pp. 1346-1361.

Manning, Alan. "Labour Supply, Search and Taxes." *Journal of Public Economics*, 2001, 80:3, pp. 409-434.

Meyer, Bruce D. "Unemployment Insurance and Unemployment Spells." *Econometrica*, 58:4, pp. 757-782.

Mortensen, Dale T. "Job Search and Labor Market Analysis." In Orley Ashenfelter and Richard Layard, eds., *The Handbook of Labor Economics*, vol. 2, New York: North Holland, 1986.

Mortensen, Dale T. and Christopher A. Pissarides. "New Developments in Models of Search in the Labor Market." In Orley Ashenfelter and David Card, eds., *The Handbook of Labor Economics*, vol. 3, New York:; North Holland, 1999.

Pissarides, Christopher A. and Jonathan Wadsworth. "On-the-job Search: Some Empirical Evidence from Britain." *European Economic Review*, 1994, 38, pp. 385-401.

Poterba, James M. "Taxation, Risk-taking, and Household Portfolio Behavior." Working Paper No. 8340, National Bureau of Economic Research, June 2001.

Prendergast, Canice. "The Provision of Incentives in Firms." *Journal of Economic Literature*, 37, March 1999, 7-63.

Slemrod, Joel. "Methodological Issues in Measuring and Interpreting Taxable Income Elasticities." *National Tax Journal* 51(4), December 1998, 773-788.

Topel, Robert H. and Michael P. Ward. "Job Mobility and the Careers of Young Men."

Quarterly Journal of Economics, 107:2, pp. 439-479.

Table 1: Summary Statistics				
	Mean	Standard Deviation	Min	Max
Wage income growth	0.0907	0.390	-0.890	3.00
Marginal tax rate	29.61	9.62	-16.80	60.00
Marginal tax rate upside convexity	3.55	3.14	-14.78	23.32
Marginal tax rate downside convexity	2.48	3.10	-12.74	29.83
Average tax rate	16.03	7.64	-18.15	55.91
Average tax rate upside convexity	3.20	1.05	-8.31	9.39
Average tax rate downside convexity	2.12	0.923	-25.11	16.96
Head’s labor earnings	25,257	17,118	50	545,000
Spouse’s labor earnings	5,532	8,864	0	140,000
Dividend and interest income	657.82	2,272.86	0	70,000
Other property income	437.81	3,018.17	-95,000	116,457
Age	37.54	10.07	23	58
Minority (non-white = 1)	0.147	0.353	0	1
Female head	0.200	0.400	0	1
Married (single = 1)	0.362	0.481	0	1
Number of kids	1.00	1.17	0	9
Homeowner	0.632	0.482	0	1
Rural	0.390	0.489	0	1
Less than high school	0.155	0.362	0	1
High school	0.383	0.480	0	1
Some college	0.199	0.399	0	1
College	0.182	0.386	0	1
Some post-college education	0.081	0.273	0	1

Source: Authors' calculations based on data from the PSID. Our sample pools data from 1979 to 1990. The number of observations is 27,315. The sample includes households for which the head works for someone else in year t and is not out of the labor force in $t + 1$. We include only those households whose age is between 23 and 58 and whose labor income is positive in t. We drop all observations with average or marginal tax rates larger than 75 percent or smaller than -20 percent. We also drop observations with average or marginal tax rates for the successful or the unsuccessful case larger than 75 percent or smaller than –20 percent. The sample is weighted to reflect oversampling of low-income households.

Table 2: Determinants of Wage Growth				
	All Households		Married Men	
	(1): Marginal tax rate measure of convexity	(2): Average tax rate measure of convexity	(3): Marginal tax rate measure of convexity	(4): Average tax rate measure of convexity
Tax rate on employment	-0.0115 (0.00111)	-0.0162 (0.00137)	-0.00740 (0.00134)	-0.0120 (0.00174)
Upside tax rate convexity	-0.0142 (0.00144)	-0.0480 (0.00650)	-0.0148 (0.00179)	-0.0567 (0.00836)
Downside tax rate convexity	0.00440 (0.00131)	0.00388 (0.00540)	-0.000492 (0.00145)	0.0180 (0.00661)
Head's labor earnings	-52.7 (11.7)	-26.9 (11.3)	-57.3 (13.0)	-34.4 (13.0)
Head's labor earnings squared	12.1 (4.33)	7.18 (3.68)	12.0 (3.78)	7.60 (3.41)
Spouse's labor earnings	31.5 (8.26)	18.3 (7.85)	12.7 (9.60)	11.5 (9.14)
Spouse's labor earnings squared	-16.3 (17.2)	0.532 (15.8)	0.643 (19.6)	4.55 (17.2)
Dividend and interest income	4.87 (1.62)	4.13 (1.55)	4.46 (1.51)	4.54 (1.44)
Other property income	1.08 (0.952)	0.426 (1.10)	0.293 (0.974)	0.126 (1.18)
Minority	-0.0217 (0.00994)	-0.0271 (0.00988)	-0.00810 (0.0113)	-0.0111 (0.0113)
Female head	-0.0538 (0.0163)	-0.0620 (0.0164)		
Single (single = 1)	0.00661 (0.0151)	0.0262 (0.0153)		
Number of kids	-0.0143 (0.00338)	-0.0243 (0.00377)	-0.0110 (0.00351)	-0.0170 (0.00391)
Less than high school	-0.0596 (0.0109)	-0.0632 (0.0109)	-0.0610 (0.0113)	-0.0653 (0.0115)
Some college	0.0263 (0.00987)	0.0256 (0.00992)	0.0219 (0.0100)	0.0213 (0.0101)
College	0.115 (0.0135)	0.116 (0.0133)	0.0926 (0.0135)	0.0953 (0.0135)
Some post-college education	0.152 (0.0174)	0.149 (0.0173)	0.137 (0.0181)	0.134 (0.0180)
Number of obs.	27,315	27,315	18,321	18,321
Adjusted-R^2	0.148	0.156	0.146	0.152

Source: Authors' calculations, as described in the text. Estimated models also include year effects, age and age-squared of the head of household, and dummy variables for home ownership, residing in a rural area, industry, occupation, and marital transitions. The sample pools data from 1978 to 1990. We drop observations with average or marginal tax rates l;rger than 75 percent or smaller than -20 percent. The estimated coefficients and standard errors for labor earnings are multiplied by 10^7 and for labor earnings squared are multiplied by 10^{12}. The estimated coefficients and standard errors for capital income and property income are multiplied by 10^6. Robust standard errors are in parentheses. The regressions are weighted by sample weights.

Table 3: Sensitivity to Controlling for Earnings				
	(1): Linear earnings controls	(2): Cubic earnings controls	(3): Log earnings controls	(4): Include income decile controls
Tax rate on employment	-0.0137 (0.00112)	-0.00758 (0.00102)	0.000201 (0.000992)	-0.00957 (0.00104)
Upside tax rate convexity	-0.0158 (0.00140)	-0.00983 (0.00145)	-0.00137 (0.00151)	-0.00987 (0.00143)
Downside tax rate convexity	0.00532 (0.00132)	0.00347 (0.00129)	-0.000450 (0.00120)	0.00359 (0.00131)
Head's labor earnings	-24.1 (9.71	-134.0 (14.2)		-62.2 (14.9)
Head's labor earnings squared		93.2 (13.4)		13.8 (4.90)
Head's labor earnings cubed		-135.0 (21.9)		
Log (Head's labor earnings)			-0.317 (0.0201)	
Spouse's labor earnings	31.3 (4.74)	13.0 (11.5)		17.8 (11.8)
Spouse's labor earnings squared		21.2 (43.2)		-17.5 (21.1)
Spouse's labor earnings cubed		-271.0 (281.0)		
Log (Spouse's labor earnings)			-0.00122 (0.000967)	
Dividend and interest income				
Other property income				
Dummy variables for family income deciles	No	No	No	Yes
Number of obs.	27,315	27,315	27,315	27,315
Adjusted-R^2	0.143	0.159	0.186	0.161

Source: Authors' calculations as described in the text. See also the notes for Table 2. We multiplied the estimated coefficients and standard errors for labor earnings by 10^7; we multiplied those for labor earnings squared by 10^{12}; and we multiplied those for labor earnings cubed by 10^{18}. For dividend and interest income and for age squared, we multiplied the estimated coefficients and standard errors by 10^6. Robust standard errors are in parentheses. The regressions are weighted by sample weights.

Table 4: Tax Variables Interacted with Family Characteristics			
	Marginal tax rate	Upside convexity	Downside convexity
Panel A: Income quintiles			
Lowest quintile	-0.0233 (.00237)	-0.0203 (0.00345)	0.0133 (0.00282)
2nd quintile	-0.0109 (0.00204)	-0.0129 (0.00258)	0.00362 (0.00299)
3rd quintile	-0.00607 (0.00140)	-0.0114 (0.00252)	-0.000202 (0.00259)
4th quintile	-0.00486 (0.00123)	-0.00799 (0.00204)	-0.00207 (0.00183)
Top quintile	-0.00300 (0.00118)	-0.00674 (0.00282)	-0.00168 (0.00246)
Panel B: Educational attainment			
Less than high school	-0.0117 (0.00155)	-0.00961 (0.00268)	0.00725 (0.00267)
High school graduate	-0.0131 (0.00138)	-0.0136 (0.00195)	0.00786 (0.00202)
Some college experience	-0.00950 (0.00161)	-0.0178 (0.00284)	0.00192 (0.00287)
College graduate	-0.00901 (0.00164)	-0.0148 (0.00304)	-0.00409 (0.00314)
Post-college experience	-0.00908 (0.00238)	-0.0176 (0.00508)	-0.00366 (0.00313)
Panel C: Age of head of household			
Less than 35	-0.0144 (0.00124)	-0.0178 (0.00192)	0.00687 (0.00208)
$35 \leq$ age ≤ 50	-0.00904 (0.00123)	-0.0108 (0.00189)	0.00270 (0.00153)
Greater than 50	-0.00832 (0.00161)	-0.00781 (0.00336)	0.00206 (0.00324)

Source: Authors' calculations, as described in the text. Each panel is a separate regression. The models also include the other covariates from the specifications in Table 2. The coefficients are marginal effects from probit estimated. Robust standard errors are in parentheses. The regressions are weighted by sample weights. See also the notes for Table 2.

Figure 1: Tax Spread vs. Income Decile

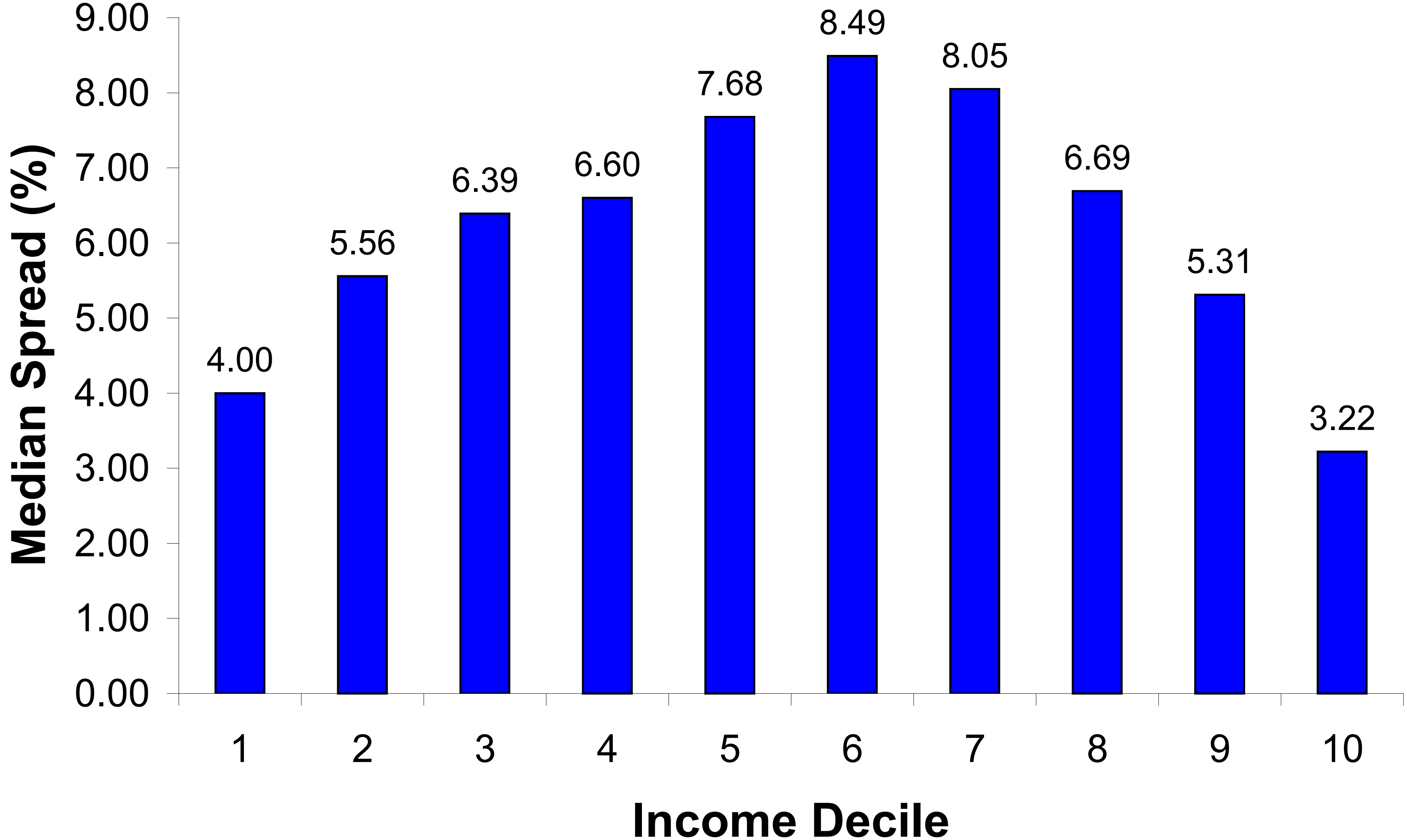

Figure 2A: Mean Wage Growth vs. Tax Spread

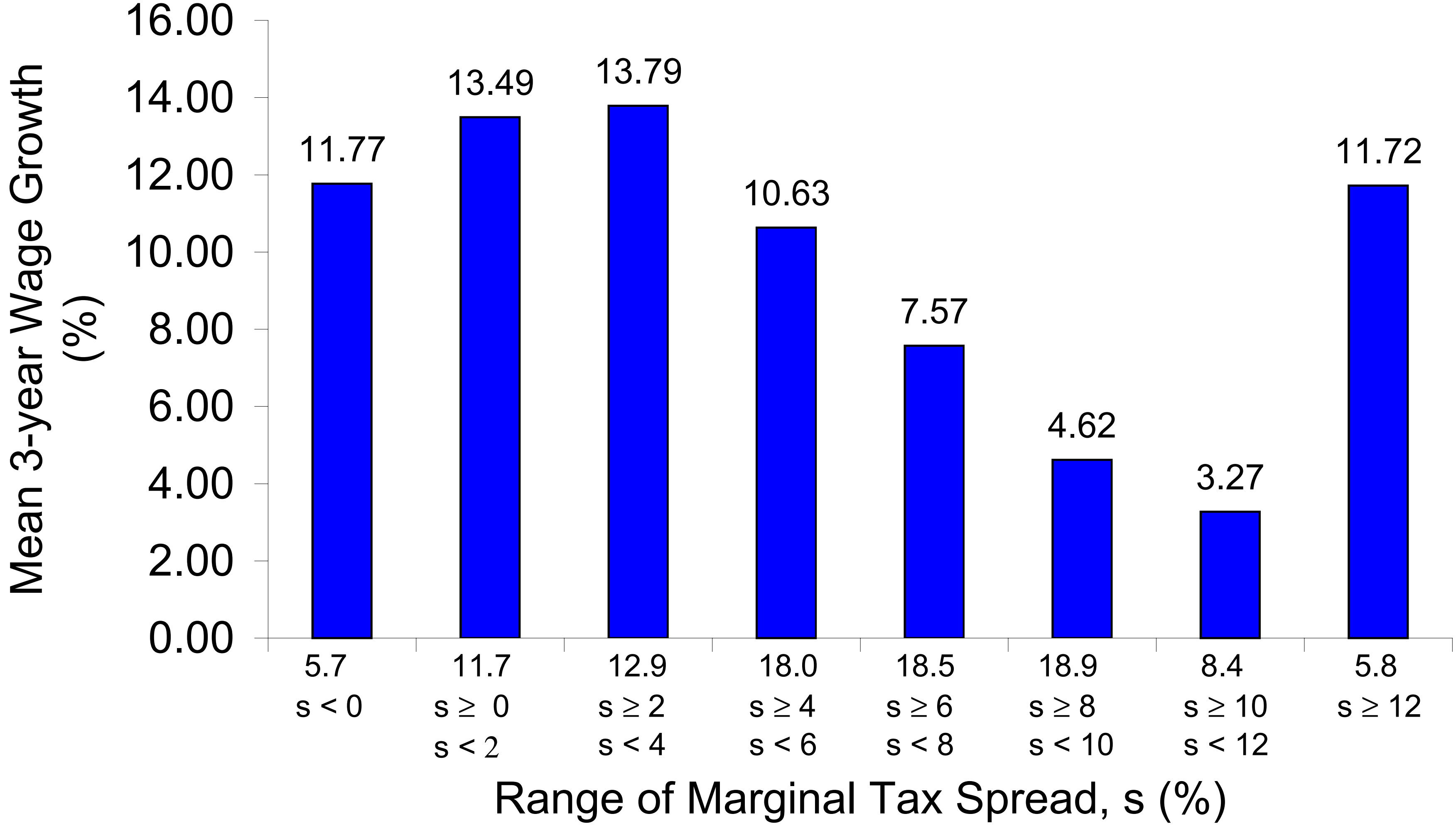

Figure 2B: Median Wage Growth vs. Tax Spread

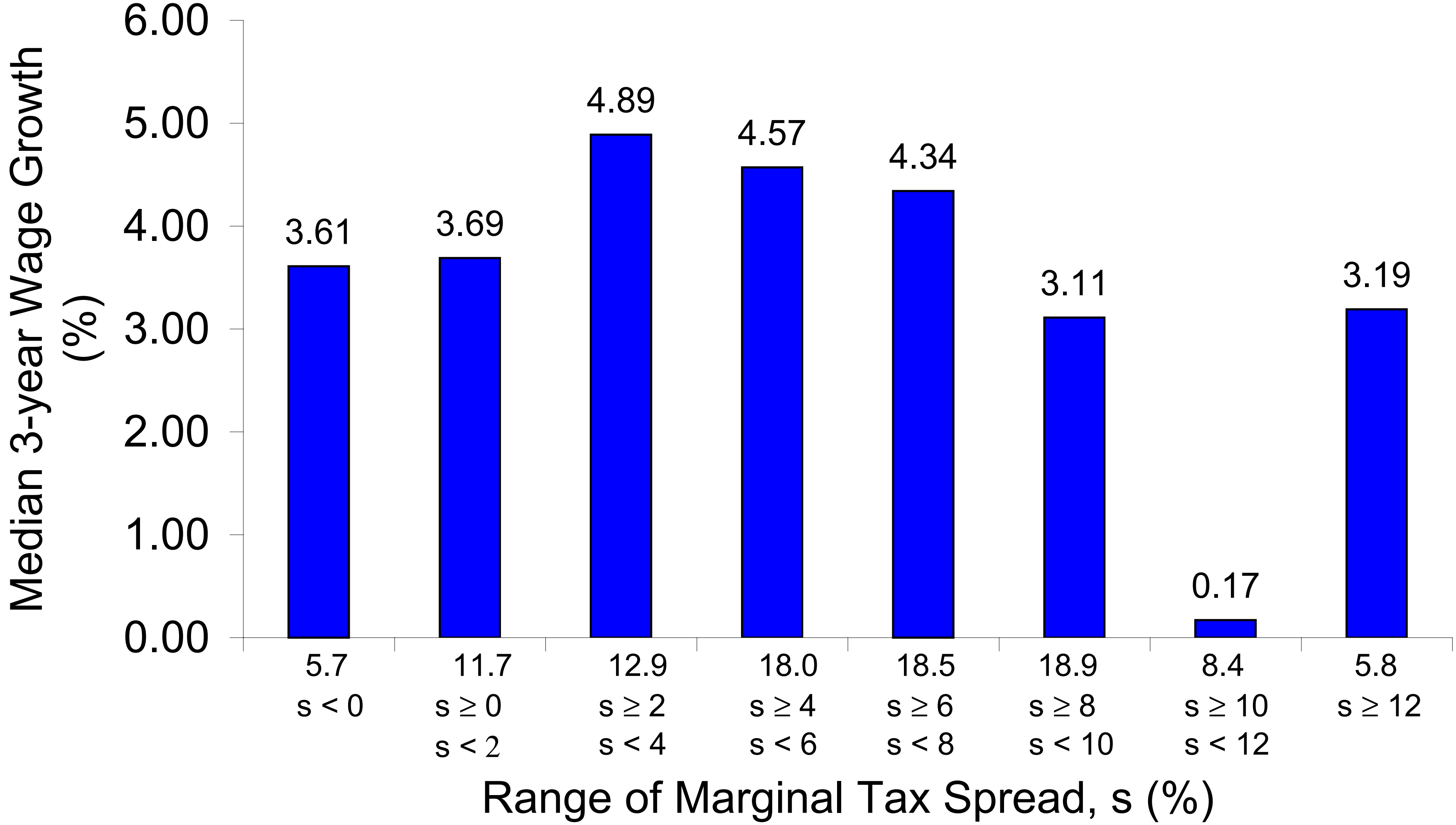

Figure 3A: Mean Wage Growth vs. Income Decile

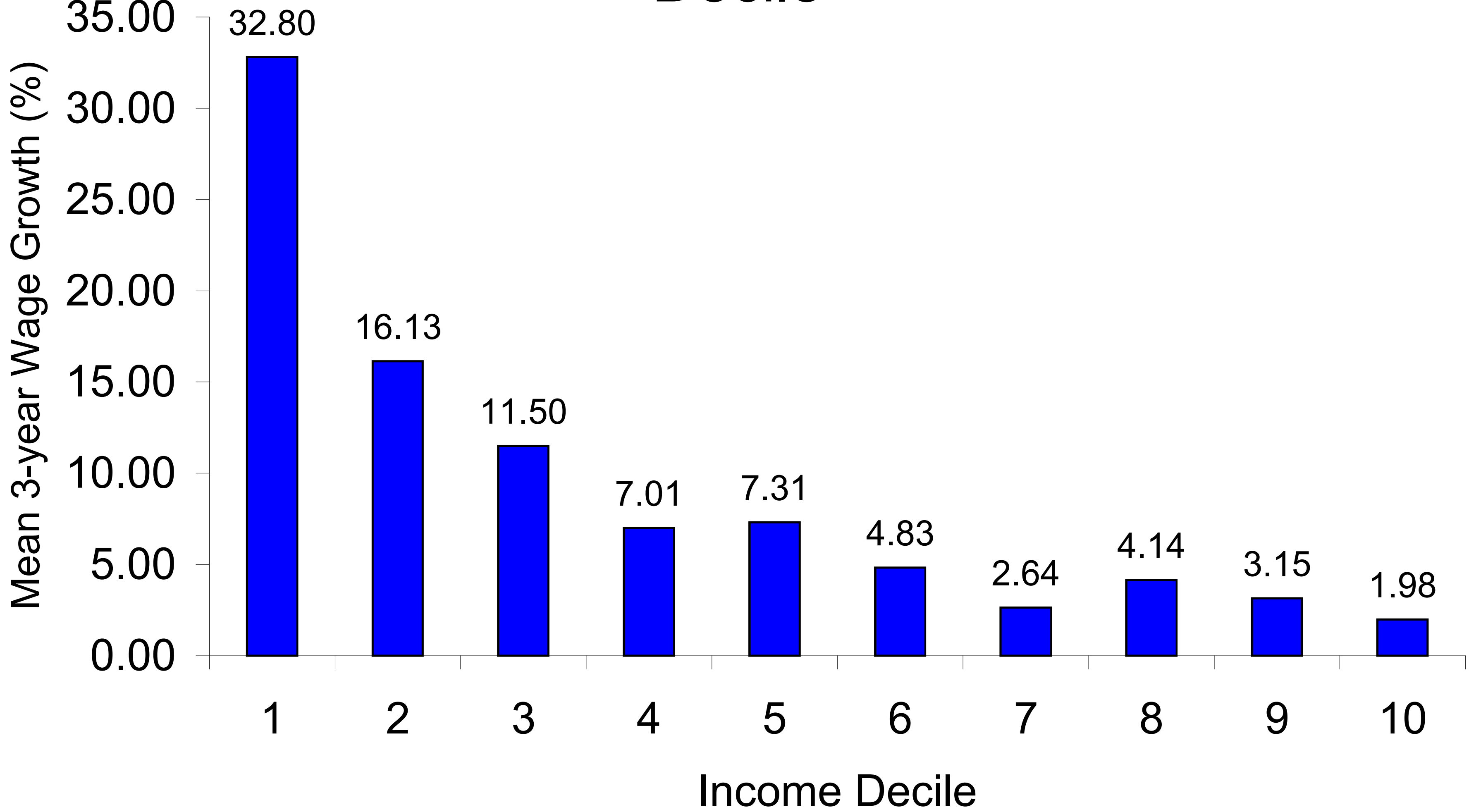

Figure 3B: Median Wage Growth vs. Income Decile