The Optimal Taxation of Height: A Case Study of Utilitarian Income Redistribution*

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Abstract

Should the income tax system include a tax credit for short taxpayers and a tax surcharge for tall ones? This paper shows that the standard Utilitarian framework for tax policy analysis answers this question in the affirmative. Moreover, based on the empirical distribution of height and wages, the optimal height tax is substantial: a tall person earning \$50,000 should pay about \$4,500 more in taxes than a short person earning the same income. This result has two possible interpretations. One interpretation is that individual attributes correlated with wages, such as height, should be considered more widely for determining tax liabilities. Alternatively, if policies such as a tax on height are rejected, then the standard Utilitarian framework must in some way fail to capture our intuitive notions of distributive justice.

Introduction

This paper can be interpreted in one of two ways. Some readers can take it as a small, quirky contribution aimed to clarify the literature on optimal income taxation. Others can take it as a broader effort to challenge that entire literature. In particular, our results can be seen as raising a fundamental question about the framework for optimal taxation for which William Vickrey and James Mirrlees won the Nobel Prize and which remains a centerpiece of modern public finance.

More than a century ago, Edgeworth (1897) pointed out that a Utilitarian social planner with full information will be completely egalitarian. More specifically, the planner will equalize the marginal utility of all members of society; if everyone has the same separable preferences, equalizing marginal utility requires equalizing after-tax incomes as well. Those endowed with greater than average productivity are fully taxed on the excess, and those endowed with lower than average productivity get subsides to bring them up to average.

Vickrey (1945) and Mirrlees (1971) emphasized a key practical difficulty with Edgeworth's solution: The government does not observe innate productivity. Instead, it observes income, which is a function of productivity and effort. The social planner with such imperfect information has to limit his Utilitarian desire for the egalitarian outcome, recognizing that too much redistribution will blunt incentives to supply effort. The Vickrey-Mirrlees approach to optimal nonlinear taxation is now standard; for some recent examples of

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its application, see Saez (2002), Golosov, Kocherlakota, and Tsyvinski (2003), Albanesi and Sleet (2006), and Kocherlakota (2006), and for an overview of this growing literature, see Golosov, Tsyvinski, and Werning (2006).

Although Vickrey and Mirrlees assumed that income was the only piece of data the government could observe about an individual, that assumption is far from true. In practice, a person's income tax liability is a function of many variables beyond income, such as mortgage interest payments, charitable contributions, health expenditures, number of children, and so on. Following Akerlof (1978), these variables can be considered "tags" that identify individuals whom society deems worthy of special support. This support is usually called a "categorical transfer" in the substantial literature on optimal tagging (e.g., Mirrlees 1986, Kanbur et al. 1994, Immonen et al. 1998, Viard 2001, Kaplow 2007). In this paper, we use the Vickrey-Mirrlees framework to explore the potential role of another variable: the taxpayer's height.

The inquiry is supported by two legs—one theoretical and one empirical. The theoretical leg is that, according to the theory of optimal taxation, any exogenous variable correlated with productivity should be a useful indicator for the government to use in determining the optimal tax liability (e.g., Saez 2001, Kaplow 2007).[1] The empirical leg is that a person's height is strongly correlated with his or her income. Judge and Cable (2004) report that "an individual who is 72 in. tall could be expected to earn $5,525 [in 2002 dollars] more per year than someone who is 65 in. tall, even after controlling for gender, weight, and age." Persico, Postlewaite, and Silverman (2004) find similar results and report that "among adult white men in the United States, every additional inch of height as an adult is associated with a 1.8 percent increase in wages." Case and Paxson (2006) write that "For both men and women...an additional inch of height [is] associated with a one to two percent increase in earnings." This fact, together with the canonical approach to optimal taxation, suggests that a person's tax liability should be a function of his height. That is, a tall person of a given income should pay more in taxes than a short person of the same income. The policy simulation presented below confirms this implication and establishes that the optimal tax on height is substantial.

Many readers will find the idea of a height tax absurd, whereas some will find it merely highly unconventional. The purpose of this paper is to ask why the idea of taxing height elicits such a response even though it follows ineluctably from a well-documented empirical regularity and the dominant modern approach to optimal income taxation. If the policy is viewed as absurd, defenders of this approach are bound to offer an explanation that leaves their framework intact; otherwise economists ought to reconsider this standard approach to policy design.

Before proceeding, a note about our own (the authors') interpretation of the results. One of us takes from this *reductio ad absurdum* the lesson that the modern approach to optimal taxation, such as the Vickrey-Mirrlees model, poorly matches people's intuitive notions of fairness in taxation and should be reconsidered or replaced. The other sees it as clarifying the scope of the framework, which nevertheless remains valuable for the most important questions it was originally designed to address. The paper presents both interpretations and invites readers to make their own judgments.

The remainder of the paper proceeds as follows. In Section I we review the Vickrey-Mirrlees approach to optimal income taxation and focus it on the issue at hand—optimal taxation when earnings vary by height. In Section II we examine the empirical relationship between height and earnings, and we combine theory and data to reach a first-pass judgment about what an optimal height tax would look like for white males in the United States. We also discuss how the case for a height tax extends beyond the Vickrey-Mirrlees model

[1] Such a correlation is sufficient but not necessary: even if the average level of productivity is not affected by the variable, effects on the distribution of productivity can influence the optimal tax schedule for each tagged subgroup.

to a broader set of tax policy frameworks. In Section III we consider some of the reasons that economists might be squeamish about advocating such a tax. Section IV concludes.

1 The Model

We begin by introducing a general theoretical framework, keeping in mind that our goal is to implement the framework using empirical wage distributions.

1.1 A General Framework

We divide the population into H height groups indexed by h, with population proportions p_h. Individuals within each group are differentiated by their exogenous wages, which in all height groups can take one of I possible values. The distribution of wages in each height group is given by $\pi_h = \{\pi_{h,i}\}_{i=1}^{I}$, where $\sum_i \pi_{h,i} = 1$ for all h, so that the proportion $\pi_{h,i}$ of each height group h has wage w_i. Individual income $y_{h,i}$ is the product of the wage and labor effort $l_{h,i}$:

$$y_{h,i} = w_i l_{h,i}.$$

An individual's wage and labor effort are both private information; only income and height are observable by the government.

Individual utility is a function of consumption $c_{h,i}$ and labor effort:

$$U_{h,i} = u\left(c_{h,i}, l_{h,i}\right),$$

and utility is assumed to be increasing and concave in consumption and decreasing and convex in labor effort. Consumption is equal to after-tax income, where taxes can be a function of income and height. Note that we are assuming preferences are not a function of height.

The social planner's objective is to choose consumption and income bundles to maximize a Utilitarian[2] social welfare function which is uniform and linear in individual utilities. The planner is constrained in its maximization by feasibility–taxes are purely redistributive[3]–and by the unobservability of wages and labor effort. Following the standard approach, the unobservability of wages and effort leads to an application of the Revelation Principle, by which the planner's optimal policy will be to design the set of bundles that induce each individual to reveal his true wage and effort level when choosing his optimal bundle. This requirement can be incorporated into the formal problem with incentive compatibility constraints.

The formal statement of the planner's problem is:

$$\max_{c,y} \sum_{h}^{H} p_h \sum_{i}^{I} \pi_{h,i} u\left(c_{h,i}, \frac{y_{h,i}}{w_i}\right), \tag{1}$$

[2] Throughout the paper, we focus our discussion on the Utilitarian social welfare function because of its prominence in the optimal tax literature. The Vickrey-Mirrlees framework allows one to consider any Pareto-efficient policy, but nearly all implementations of this framework have used Utilitarian or more egalitarian social welfare weights. See Werning (2007) for an exception. Our analysis would easily generalize to any social welfare function that is concave in individual utilities. That is, a height tax would naturally arise as optimal with a broader class of "welfarist" social welfare functions.

[3] We have performed simulations in which taxes also fund an exogenous level of government expenditure. The welfare gain from conditioning taxes on height increases.

subject to the feasibility constraint that total tax revenue is non-negative:

$$\sum_{h}^{H} p_h \sum_{i}^{I} \pi_{h,i} \left(y_{h,i} - c_{h,i} \right) \geq 0, \tag{2}$$

and individuals' incentive compatibility constraints:

$$u\left(c_{h,i}, \frac{y_{h,i}}{w_i} \right) \geq u\left(c_{h,j}, \frac{y_{h,j}}{w_i} \right) \tag{3}$$

for all j for each individual of height h with wage w_i, where $c_{h,j}$ and $y_{h,j}$ are the allocations the planner intends to be chosen by an individual of height h with wage w_j.

As shown by Immonen et al. (1998), Viard (2001a, 2001b), and others, we can decompose the planner's problem in (1) through (3) into two separate problems: setting optimal taxes within types and setting optimal aggregate transfers between types. Denote the transfer paid by each group h with $\{R_h\}_{h=1}^{H}$. Then, we can restate the planner's problem as:

$$\max_{\{c,y,R\}} \sum_{h}^{H} p_h \sum_{i}^{I} \pi_{h,i} u\left(c_{h,i}, \frac{y_{h,i}}{w_i} \right), \tag{4}$$

subject to H height-specific feasibility constraints:

$$\sum_{i}^{I} \pi_{h,i} \left(y_{h,i} - c_{h,i} \right) \geq R_h; \tag{5}$$

an aggregate budget constraint that the sum of transfers is non-negative:

$$\sum_{h}^{H} R_h \geq 0; \tag{6}$$

and a full set of incentive compatibility constraints from (3). Let the multipliers on the H conditions in (5) be $\{\lambda_h\}_{h=1}^{H}$.

One advantage of using this two-part approach is that, when we take first-order conditions with respect to the transfers R_h we obtain

$$\lambda_h = \lambda_{h'}$$

for all height groups h, h'. This condition states that the marginal social cost of increased tax revenue (i.e., income less consumption) is equated across types. Note that this equalization is possible only because height is observable to the planner.

Throughout the paper, we will also consider a "benchmark" model for comparison with this optimal model. In the benchmark model, the planner fails to use the information on height in designing taxes. Formally, this can be captured by rewriting the set of incentive constraints in (3) to be

$$u\left(c_{h,i}, \frac{y_{h,i}}{w_i} \right) \geq u\left(c_{g,j}, \frac{y_{g,j}}{w_i} \right) \tag{7}$$

for all g and all j for each individual of height h with wage w_i. Constraints (7) require that each individual prefer his intended bundle to not merely the bundles of other individuals in his height group but to the bundles of all other individuals in the population. Given that (7) is a more restrictive condition than (3), the planner solving the optimal problem could always choose the tax policy chosen by the benchmark planner, but it may also improve on the benchmark solution. To measure the gains from taking height into account, we will use a standard technique in the literature and calculate the windfall that the benchmark planner would have to receive in order to be able to achieve the same aggregate welfare as the optimal planner.

The models outlined above yield results on the optimal allocations of consumption and income from the planner's perspective, and these allocations may differ from what individuals would choose in a private equilibrium. After deriving the optimal allocations, we next consider how a social planner could implement these allocations. That is, following standard practice in the optimal taxation literature, we use these results to infer the tax system that would distort individuals' private choices so as to make them coincide with the planner's choice. When we refer to "marginal taxes" or "average taxes" below, we are describing that inferred tax system.

1.2 Analytical Results for a Simple Example

To provide some intuitive analytical results, we consider a version of the model above in which utility is additively separable between consumption and labor, exhibits constant relative risk aversion in consumption, and is isoelastic in labor:

$$u(c_{h,i}, \frac{y_{h,i}}{w_i}) = \frac{(c_{h,i})^{1-\gamma} - 1}{1-\gamma} - \frac{\alpha}{\sigma}\left(\frac{y_{h,i}}{w_i}\right)^{\sigma}.$$

The parameter γ determines the concavity of utility from consumption, α sets the relative weight of consumption and leisure in the utility function, and σ determines the elasticity of labor supply. In particular, the compensated (constant-consumption) labor supply elasticity is $\frac{1}{\sigma-1}$.

The planner's problem, using the two-part approach from above, can be written:

$$\max_{\{c,y,R\}} \sum_{h=1}^{H} p_h \sum_{i}^{I} \pi_{h,i} \left[\frac{(c_{h,i})^{1-\gamma} - 1}{1-\gamma} - \frac{\alpha}{\sigma}\left(\frac{y_{h,i}}{w_i}\right)^{\sigma}\right], \tag{8}$$

subject to H feasibility constraints

$$\sum_{i}^{I} \pi_{h,i} \left(y_{h,i} - c_{h,i}\right) \geq R_h; \tag{9}$$

an aggregate budget constraint that the sum of transfers is zero:

$$\sum_{h=1}^{H} R_h = 0; \tag{10}$$

and incentive constraints for each individual:

$$\frac{(c_{h,i})^{1-\gamma} - 1}{1-\gamma} - \frac{\alpha}{\sigma}\left(\frac{y_{h,i}}{w_i}\right)^{\sigma} \geq \frac{(c_{h,j})^{1-\gamma} - 1}{1-\gamma} - \frac{\alpha}{\sigma}\left(\frac{y_{h,j}}{w_i}\right)^{\sigma}. \tag{11}$$

We can learn a few key characteristics of an optimal height tax from this simplified example.

First, the first-order conditions for consumption and income imply that the classic result from Mirrlees (1971) of no marginal taxation on the top earner holds for the top earners in all height groups. Specifically, the optimal allocations satisfy:

$$(c_{h,I})^{-\gamma} = \frac{\alpha}{w_I}\left(\frac{y_{h,I}}{w_I}\right)^{\sigma-1} \tag{12}$$

for the highest wage earner I in each height group h.

Condition (12) states that the optimal allocations equate the marginal utility of consumption to the marginal disutility of producing income for all highest-skilled individuals, regardless of height. Individuals' private choices would also satisfy (12), so optimal taxes do not distort the choices of the highest-skilled. As we will see below, the highest-skilled individuals of different heights will earn different incomes under optimal policy. Nonetheless, they all will face zero marginal tax rates. This extension of the classic "no marginal tax at the top" result is due to the observability of height, which prevents individuals from being able to claim allocations meant for shorter height groups. Therefore, the planner need not manipulate incentives by distorting shorter highest-skilled individuals' private decisions, as it would if it were not allowed to condition allocations on height.[4]

Second, the average cost of increasing social welfare is equalized across height groups:

$$\sum_i^I \pi_{h,i}\,(c_{h,i})^{\gamma} = \sum_i^I \pi_{g,i}\,(c_{g,i})^{\gamma} \tag{13}$$

for all height groups g, h. The term $(c_{h,i})^{\gamma}$ is the cost, in units of consumption, of a marginal increase in the utility of individual h,i. The planner's allocations satisfy condition (13) because, if the average cost of increasing welfare were not equal across height groups, the planner could raise social welfare by transferring resources to the height group for which this cost was relatively low. Note that in the special case of logarithmic utility, where $\gamma = 1$, condition (13) implies that average consumption is equalized across height groups.

Readers familiar with recent research in dynamic optimal taxation (e.g., Golosov, Kocherlakota, and Tsyvinski, 2003) may recognize that (13) is a static analogue to that literature's so-called Inverse Euler Equation, a condition originally derived by Rogerson (1985) in his study of repeated moral hazard. What is the connection between these results? In a dynamic optimal tax model, the incentive problem stems from individuals receiving shocks to their wages between one period and the next that are not observable by the planner, who allocates resources across individuals and periods to maximize social welfare. If the planner could observe shocks, it would allocate resources to an individual over time just as the individual would choose on his own, thus satisfying the traditional Euler equation that relates an individual's marginal utilities across periods (e.g., Atkinson and Stiglitz, 1976). Because the planner cannot observe shocks, however, an attempt to satisfy the traditional Euler equation for each individual will tempt those who receive a high wage shock to feign a low shock in order to receive smoothed consumption with less labor effort. In that situation, the best a planner can do is to equalize across periods the expected cost (across shock values) of raising an individual's utility. The resulting allocation is described by the Inverse Euler Equation, which relates an individual's expected inverse of marginal utilities across periods.

Height groups play a role in our static setting similar to that played by time periods in the dynamic setting. Across height groups, just as across periods, the planner may have information on the distribution of wages. However, within height groups, just as within periods, the planner cannot observe individuals' abilities. As in the dynamic model, the planner must settle for equalizing across groups the cost of raising utility. This implies equalizing across height groups the expected inverse of marginal utility, or condition

[4] This result does not depend on the highest wage w_I being the same across groups.

(13).

In the next section, we continue this example with numerical simulations to learn more about the optimal tax policy taking height into account.

2 Calculations Based on the Empirical Distribution

In this section, we use data from the National Longitudinal Survey of Youth and the methods described above to calculate the optimal tax schedule for the United States, taking height into account. The data are the same as that used in Persico, Postlewaite, and Silverman (2004), and we thank those authors for making their data available for our use.

2.1 The Data

The main empirical task is to construct wage distributions by height group. For simplicity, we focus only on adult white males. This allows us to abstract from potential interactions between height and race or gender in determining wages. Though interesting, such interactions are not the focus of this paper. We also limit the sample to men between the ages of 32 and 39 in 1996. This limits the extent to which, if height were trending over time, height might be acting as an indicator of age. The latest date for which we have height is 1985, when the individuals were between 21 and 28 years of age. After these screens, we are left with 1,738 observations.[5]

Table 1 shows the distribution by height of our sample of white males in the United States. Median height is 71 inches, and there is a clear concentration of heights around the median. We split the population into three groups: "short" for less than 70 inches, "medium" for between 70 and 72 inches, and "tall" for more than 72 inches. In principle, one could divide the population into any number of distinct height groups, but a small number makes the analysis more intuitive and simpler to calculate and summarize. Moreover, to obtain reliable estimates with a finer division would require more observations.

We calculate wages[6] by dividing reported 1996 wage and salary income by reported work hours for 1996.[7] We consider only full-time workers, which we define (following Persico, Postlewaite, and Silverman 2004) as those working at least 1,000 hours. Table 2 gives summary statistics on the distribution of wages and hours across our sample. We group wages into 18 wage bins, as shown in the first three columns of Table 3, and use the average wage across all workers within a wage bin as the wage for all individuals who fall within that bin's wage range.

The distribution of wages for tall people yields a higher mean wage than does the distribution for short people. This can be seen in the final three columns of Table 3, which shows the distribution of wages by height group. Figure 1 plots the data shown in Table 3. As the figure illustrates, the distributions are similar around the most common wages but are noticeably different toward the tails. Many more tall white males have wages toward the top of the distribution and many fewer have wages toward the bottom than

[5]It is unclear whether a broader sample would increase or decrease the gains from the height tax. For example, adding women to the sample is likely to increase the value of a height tax, as men are systematically taller than women and, as the large literature on the gender pay gap documents, earn more on average. In this case, a height tax would serve as a proxy for gender-based taxes (see Alesina and Ichino, 2007). Our use of a limited sample focuses attention on height itself as a key variable.

[6]Note that since we observe hours, we can calculate wages even though the social planner cannot. An alternative approach is to use the distribution of income and the existing tax system to infer a wage distribution, as in Saez (2001).

[7]There is top-coding of income in the NLSY for confidentiality protection. This should have little effect on our results, as most of these workers are in our top wage bin and thus are already assigned the average wage among their wage group.

short white males. This causes the mean wage for the tall to be $17.28 compared to $16.74 for the medium and $14.84 for the short. The tall therefore have an average wage 16 percent higher than the short in our data. Given that the mean height among the tall is 74 inches compared with 67 inches among the short, this suggests that each inch of height adds just over two percent to wages (if the effect is linear)–quite close to Persico et al.'s estimate of 1.8 percent.

2.2 What Explains the Height Premium?

We have just seen that each inch of height adds about two percent to a young man's income in the United States, on average. Two recent papers have provided quite different explanations for this fact.

Persico, Postlewaite, and Silverman (2005) attribute the height premium to the effect of adolescent height on individuals' development of characteristics later rewarded by the labor market, such as self-esteem. They write: "We can think of this characteristic as a form of human capital, a set of skills that is accumulated at earlier stages of development." By exploiting the same data used in this paper, they find that "the preponderance of the disadvantage experienced by shorter adults in the labor market can be explained by the fact that, on average, these adults were also shorter at age 16." They control for family socioeconomic characteristics and height at younger ages and find that the effect of adolescent height remains strong. Finally, using evidence on adolescents' height and participation in activities, they conclude that "social effects during adolescence, rather than contemporaneous labor market discrimination or correlation with productive attributes, may be at the root of the disparity in wages across heights."

In direct contrast, Case and Paxson (2006) argue that the evidence points to a "correlation with productive attributes," namely cognitive ability, as the explanation for the adult height premium. They show that height as early as three years old is correlated with measures of cognitive ability, and that once these measures are included in wage regressions the height premium substantially declines. Moreover, adolescent heights are no more predictive of their wages than adult heights, contradicting Persico et al.'s proposed explanation. Case and Paxson argue that both height and cognitive ability are affected by prenatal, in utero, and early childhood nutrition and care, and that the resulting positive correlation between the two explains the height premium among adults.

Thus, the two most recent, careful econometric studies of the adult height premium reach very different conclusions about its source. How would a resolution to this debate affect the conclusions of this paper? Is the optimal height tax dependent upon the root cause of the height premium?

Fortunately, we can be agnostic as to the source of the height premium when discussing optimal height taxes. What matters for optimal height taxation is the consistent statistical relationship between height and income, not the reason for that relationship. Of course, if taxes could be targeted at the source of the height premium, then a height tax would be redundant, no matter the source. Depending on the true explanation for the height premium, taxing the source of it may be appropriate: for example, Case and Paxson's analysis would suggest early childhood investment by the state in order to offset poor conditions for some children. To the extent that these policies reduced the height premium, the optimal height tax would be reduced as well. However, so long as a height premium exists, the case for an optimal height tax remains.

2.3 Baseline Results

To simulate the optimal tax schedule, we need to specify functional forms and parameters. We will use the same utility function that we analyzed in Section 1.2:

$$u(c_{h,i}, l_{h,i}) = \frac{(c_{h,i})^{1-\gamma} - 1}{1-\gamma} - \frac{\alpha}{\sigma}\left(\frac{y_{h,i}}{w_i}\right)^{\sigma},$$

where γ determines the curvature of the utility from consumption, α is a taste parameter, and σ makes the compensated (constant-consumption) elasticity of labor supply equal to $\frac{1}{\sigma-1}$. Our baseline values for these parameters are $\gamma = 1.5$, $\alpha = 2.55$, and $\sigma = 3$. We vary γ and σ below to explore their effects on the optimal policy, while an appropriate value for α is calibrated from the data. We determined the baseline choices of σ and α as follows.

Economists differ widely in their preferred value for the elasticity of labor supply. A survey by Fuchs, Krueger, and Poterba (1998) found that the median labor economist believes the traditional compensated elasticity of labor supply is 0.18 for men and 0.43 for women. By contrast, macroeconomists working in the real business cycle literature often choose parameterizations that imply larger values: for example, Prescott (2004) estimates a (constant-consumption) compensated elasticity of labor supply around 3. Kimball and Shapiro (2003) give an extensive discussion of labor supply elasticities, and they show that the constant-consumption elasticity is generally larger than the traditional compensated elasticity. Taking all of this into account, we use $\frac{1}{\sigma-1} = 0.5$ in our baseline estimates to be conservative. In the sensitivity results shown below, we see that the size of the optimal height tax is positively related to the elasticity of labor supply.

In our sample, the mean hours worked in 1996 was 2,435.5 hours per full-time worker. This is approximately 42 percent of total feasible work hours, where we assume eight hours per day of sleeping, eating, etc., and five days of illness per year. We choose α so that the population-weighted average of work hours divided by feasible hours in the benchmark (no height tax) allocation is approximately 42 percent: this yields $\alpha = 2.55$. The results on the optimal height tax are not sensitive to the choice of α.

With the wage distributions from Table 3 and the specification of the model just described, we can solve the planner's problem to obtain the optimal tax policy. For comparison, we also calculate optimal taxes under the benchmark model in which the planner ignores height when setting taxes. Figure 2 plots the average tax rate schedules for short, medium, and tall individuals in the optimal model as well as the average tax rate schedule in the benchmark model (the two lowest wage groups are not shown because their average tax rates are large and negative, making the rest of the graph hard to see). Figure 3 plots the marginal tax rate schedules. We calculate marginal rates as the implicit wedge that the optimal allocation inserts into the individual's private equilibrium consumption-leisure tradeoff. Using our assumed functional forms, the first order conditions for consumption and leisure imply that the marginal tax rate can be calculated as:

$$T'\left(y_{h,i}, h\right) = 1 + \frac{u_y\left(c_{h,i}, \frac{y_{h,i}}{w_i}\right)}{w_i u_c\left(c_{h,i}, \frac{y_{h,i}}{w_i}\right)} = 1 - \frac{\alpha\left(\frac{y_{h,i}}{w_i}\right)^{\sigma-1}}{w_i\left(c_{h,i}\right)^{-\gamma}}$$

where $T'\left(y_{h,i}, h\right)$ is the height-specific marginal tax rate at the income level $y_{h,i}$. Table 4 lists the corresponding income, consumption, labor, and utility levels as well as tax payments, average tax rates, and marginal tax rates at each wage level for the height groups in the optimal model. Table 5 shows these same variables for the benchmark model (with no height tax).

The graphical tax schedules provide several useful insights about the optimal solution. First, notice the relative positions of the average tax schedules in Figure 2. The average tax rate for tall individuals is always above that for short individuals, and usually above that for the medium group, with the gap due to the lump-sum transfers between groups. The benchmark model's average tax schedule lies in between the optimal tall and short schedules and near the optimal medium schedule. Other than their levels, however, the tax schedules are quite similar and fit with the conclusions of previous simulations (see Saez, 2001 and Tuomala, 1990) that optimal average tax rates rise quickly at low income levels and then level off as income gets large. Finally, in Figure 3, we can see an approximately flat marginal tax rate for most incomes and then a sharp drop to zero marginal rates for the highest wage earners in each group. The drop at the top of the income distribution reflects the extension of the classic zero top marginal rate result to a model with observable height.

Turning to the data in Tables 4, 5 and 6, we can learn more detail about the optimal policy. Table 4 shows that the average tax on the tall is about 7.1 percent of the average tall income, while the average tax on the medium is about 3.8 percent of average medium income. These taxes pay for an average transfer to the short of more than 13 percent of average short income. Note that Table 5 shows that the planner also transfers resources to the short population in the benchmark Mirrlees model. Importantly, this is not an explicit transfer. Rather, it reflects the differences in the distributions of the height groups across wages. Due to the progressive taxes of the benchmark model, the tall and medium end up paying more tax on average than the short even when taxes are not conditioned on height. The resulting implicit transfers are in the same direction as the average transfers in Table 4, though substantially smaller.

Table 4 also shows that the optimal tax policy usually gives lower utility to taller individuals of a given wage than to shorter individuals of the same wage. This translates into lower expected utility for the tall population as a whole than for shorter populations, as shown at the bottom of Table 4. Intuitively, this is because the planner wants to equalize the marginal utility of consumption and the marginal disutility of income across all individuals, not their levels of utility. To see why this results in lower expected utility for the tall, suppose that wages were perfectly correlated with height, so that the planner had complete information. Then, the planner would equalize consumption across height groups, but it would not equalize labor effort across height groups. Starting from equal levels of labor effort, the marginal disutility of income will be lower for taller populations because they are higher-skilled. Thus, the planner will require more labor effort from taller individuals, lowering their utility. Another way to think of this is that a lump-sum tax on taller individuals doesn't affect their optimal consumption-labor tradeoff but lowers their consumption for a given level of labor effort. Thus, they work more to satisfy their optimal tradeoff and obtain a lower level of utility.

We make the optimal tax policy more concrete by using the results from Table 4 to generate a tax schedule that resembles those used by U.S. taxpayers each year–this schedule is shown as Table 6. Whereas a typical U.S. tax schedule has the taxpayer look across the columns to find his or her family status (single, married, etc.), our optimal schedule has height groups across the columns. As the numbers show, taller individuals pay substantially more taxes than shorter individuals for most income levels. For example, a tall person with income of $50,000 pays about $4,500 more in taxes than a short person of the same income.

Finally, we can use the results of the benchmark model to calculate a money-metric welfare gain from the height tax by finding the windfall revenue that would allow the benchmark planner to reach the same level of social welfare as the planner that uses a height tax. Table 5 shows that the windfall required is about 0.19 percent of aggregate income in our baseline parameter case. In 2007, when the national income of the

U.S. economy is about \$12 trillion, a height tax would yield an annual welfare gain worth about \$23 billion.

2.4 Sensitivity to Parameters

Here, we explore the effects on optimal taxes of varying our assumed parameters. In particular, we consider a range of values for risk aversion and the elasticity of labor supply. To summarize the effects of each parameter, we focus on two statistics: the average transfer to the short as a percent of average short income and the windfall required by the benchmark planner to achieve the aggregate welfare obtained by the optimal planner. Table 7 shows these two statistics when we vary the risk aversion parameter γ, and Table 8 shows them when we vary the elasticity of labor supply $\frac{1}{\sigma-1}$. In both cases, when either γ or σ is changed, the parameter α must also be adjusted so as retain an empirically plausible level of hours worked. We adjust α to match the empirical evidence as in the baseline analysis.

Increased risk aversion (higher γ) increases the average transfer to the short and the gain to aggregate welfare obtained by conditioning taxes on height. For example, raising risk γ from 1.50 to 3.50 increases the average transfer to the short from 13.38 percent to 13.97 percent of average short income and increases the windfall equivalent to the welfare gain from 0.19 percent of aggregate income to 0.28 percent. Intuitively, more concave utility makes the Utilitarian planner more eager to redistribute income and smooth consumption across types. The transfer across height groups is a blunt redistributive tool, as it taxes some low-skilled tall to give to some high-skilled short, but it is on balance a redistributive tool because the tall have higher incomes than the short on average. Thus, as risk aversion rises, the average transfer to the short increases in size and in its power to increase aggregate welfare.

Increased elasticity of labor supply (lower σ) has a more dramatic effect on the optimal height tax. For example, raising the constant-consumption elasticity of labor supply from 0.5 to 3.0 increases the average transfer to the short from 13.38 percent to 31.73 percent of average short income and increases the windfall equivalent to the welfare gain from 0.19 percent of aggregate income to 0.49 percent. Intuitively, a higher elasticity of labor supply makes redistributing within height groups more distortionary, so the planner relies on the transfer across height groups for more of its redistribution toward the short, low-skilled. As with increased risk aversion, increased elasticity of labor supply makes the average taxes and transfers across height groups larger and gives the height tax more power to increase welfare.

2.5 The Taxation of Height in Other Approaches to Optimal Taxation

The analysis above has focused on the Vickrey-Mirrlees framework for optimal taxation, both because it is the dominant and least restrictive modern approach and because its focus on individual-specific lump-sum taxation directly invites the use of height as a tag. The case for a height tax extends well beyond that specific framework, however. In fact, any Utilitarian model of income redistribution will recommend conditioning taxes on an inelastic characteristic correlated with an individual's ability to earn income.

Ramsey model For example, consider the model of optimal linear taxation based on the work of Frank Ramsey (1928). In the Ramsey approach, lump-sum taxes are prohibited by assumption, and the goal of taxation is to fund government expenditure using distortionary linear taxes with the minimum welfare cost to a representative household. Just as in the model above, when the Ramsey model's planner sets taxes as a function of an endogenous variable (namely, income), the elastic response of taxpayers has efficiency costs. Conditioning taxes on any exogenous variable correlated with income, such as height, makes it possible for the Ramsey planner to maintain a higher level of social welfare while funding government expenditure.[8]

Pareto efficiency Some readers have asked whether this paper's analysis is a critique of Pareto efficiency. The answer depends on how one chooses to apply the Pareto criterion.

One approach is to consider the set of tax policies that place the economy on the Pareto frontier–that is, the frontier on which it is impossible to increase the welfare of one person without decreasing the welfare of another. This set of policies can be derived within the Mirrless approach by changing the weights attached to the different individuals in the economy.[9] (By contrast, throughout the paper, we use a Utilitarian social welfare function with equal weight on each person's utility.) Nearly every specification of these social welfare weights, except perhaps a knife-edge case, has taxes conditioned on height. Thus, most Pareto efficient allocations include height-dependent taxes.

A related, but slightly different, question is whether height-dependent taxes are a Pareto improvement starting from a position without such taxes. In principle, they can be. Consider the extreme case in which height is perfectly correlated with ability. Then, income taxes could be replaced with lump-sum height taxes specific to each individual's height. By removing marginal distortions without raising tax burdens, the lump-sum taxes make all individuals better off.[10] In general, the tighter the connection between height and wages and the greater the distortionary effects of marginal income taxes, the larger is the Pareto improvement provided by a height tax.

In practice, however, such Pareto improvements are so small as to be uninteresting. We have calculated the height tax that provides a Pareto improvement to the height-independent benchmark tax system derived above. We solve an augmented planner's problem that adds to the set of equations (1) through (3) new constraints guaranteeing that no individual's utility falls below what it received in the benchmark allocation, i.e., the solution to the problem described by equations (1), (2), and (7). Given the data and our benchmark parameter assumptions described above, it turns out that only an extremely small Pareto-improving height tax is available to the planner. The planner seeking a Pareto-improving height tax levies a very small (approximately \$4.15 annual) lump-sum tax on the middle height group to fund lump-sum subsidies to the short (\$2.90) and tall (\$2.37) groups. Not surprisingly, in light of how small the Pareto-improving height tax is, the changes in utility from the policy are trivial in size.

Nevertheless, if a nontrivial Pareto-improving height tax were possible, and if people both understood and were convinced of that possibility, it is our sense that most people would be comfortable with such a policy. In contrast, we believe most people would be uncomfortable with the Utilitarian-optimal height tax that we derived above. The difference is that the Utilitarian-optimal height tax implies substantial costs to some and gains for others relative to a height-independent policy designed according to the same welfare weights. Therefore, this paper's critique concerns the intuitive discomfort people feel toward height taxes that sacrifice the utility of the tall for the short, not Pareto improvements that come through unconventional means such as a tax on height.

[8] We have simulated a Ramsey model with two types of individuals, short and tall, who differ only in their wage. For a wide variety of parameterizations, the optimal Ramsey policy sets a higher tax rate on the (higher-wage) tall than on the short.

[9] Ivan Werning (2007) uses this approach to study the conditions under which taxes are Pareto efficient, including in the context of observable traits.

[10] Louis Kaplow suggested this example.

3 Perspectives from Political Philosophy

So far, this paper has made the case for the optimal taxation of height using the dominant modern approach to Utilitarian policy design, namely the Vickrey-Mirrlees framework, and has calculated the details of this optimal height tax using the empirical earnings distribution for thirty-something white males in the United States. Nothing in the preceding analysis is unconventional for the optimal tax literature, except for the focus on height rather than on an unobserved characteristic, such as "ability," that affects individuals' wages.

There are various ways to react to the idea of a height tax. One option is to accept a height tax once the preceding logic and evidence have been presented. While a height tax may seem unnatural at first, one purpose of economic analysis is to produce results that are not obvious. Perhaps it is our intuition that needs to change, not the analysis.

Most of our readers, we suspect, are both accustomed to thinking about optimal taxation from a Utilitarian perspective and instinctively uncomfortable with a tax on height. What explains this cognitive dissonance, and how can it to be resolved? If one does not accept a height tax, then is that because of something particular to height or have we stumbled onto a more fundamental problem with the modern framework for optimal taxation? Here we consider three notable responses in increasing order of the extent to which they question the fundamental approach.

3.1 Political Economy Constraints

This response acknowledges that a height tax would be optimal in a first-best political system but argues that political constraints make a height tax undesirable or infeasible in practice.

Perhaps a height tax would act as a "gateway" tax for a government, making taxes based on demographic characteristics seem natural and dangerously expanding the scope for government information collection and policy personalization. For instance, much the same analysis as we performed above could, in principle, be applied to characteristics such as skin color, gender, and physical attractiveness, each of which is a (relatively) inelastic characteristic that has been shown to affect economic outcomes. Even those who are comfortable with a height tax would likely be uncomfortable with a system of taxes tailored to so many personal characteristics. No matter how compelling the theory, the administrative burden and invasiveness of such a system may be too great. Moreover, democratic societies may have an interest in avoiding the taxation of specific groups as a matter of course to counter the majority's temptation to tax minority groups.[11]

A counterargument to this concern is that modern tax systems already condition on a great deal of personal information, such as number of children, marital status, and personal disabilities, without conditioning on many others. To argue that a height tax would lead to an over-reaching tax policy while these conditional taxes do not, one would have to believe that a height tax would trigger a descent down a slippery slope for tax policy. It seems more natural to think that a height tax could be endorsed on its own merits while taxes based on gender, for instance, could be resisted for the reasons currently applicable.

3.2 Costs Missing from the Conventional Model

The next set of concerns sets aside political economy, but argues that a height tax is objectionable because it would have costs that are not reflected in the conventional optimal tax model.

[11] Ed Glaeser suggested this point.

One prominent example is stigma. Perhaps government transfers to the short, based on evidence that the short are less skilled on average, would lower short persons' self-respect, an unmodeled component of welfare. Amartya Sen (1995) discusses this cost, among others, of transfers based on observable characteristics. Sen writes: "there are also direct costs and losses involved in feeling–and being–stigmatized. Since this kind of issue is often taken to be of rather marginal interest (a matter, allegedly, of fine detail), I would take the liberty of referring to John Rawls's argument that self-respect is 'perhaps the most important primary good' on which a theory of justice as fairness has to concentrate..."

This cost may be particularly relevant for height, given that one explanation for the height wage premium relies upon the advantage it gives individuals in developing self-esteem (see Persico et al. 2005). Moreover, if height is a characteristic engendering discrimination, a height tax risks "institutionalizing" differential treatment based on height and thus perpetuating costly stigma. In fact, a colleague of ours who is shorter than average remarked that he would not want to receive a height transfer *because* it would be degrading.

The interesting question raised by this critique–that a transfer to short individuals would lower their self-esteem–is whether the same problem arises with transfers based on unobserved "ability." In fact, when Sen (1995) writes that "Any system of subsidy...that is seen as a special benefaction for those who cannot fend for themselves would tend to have some effects on their self-respect ...," it seems likely that a transfer designed for those who are low in general ability to "fend for themselves" would be particularly damaging to a recipient's self-respect, perhaps even more so than a transfer based on a relatively narrow physical characteristic such as height. While stigma has been analyzed for some transfer programs such as the United States' welfare program for poor families, it is rare to encounter an argument that taxpayers toward the bottom of the schedule of tax rates feel stigmatized by the implicit subsidy they receive from those at the top.

3.3 Critiques of the Basic Framework

Finally, we turn to the response that a height tax is not desirable because Utilitarianism is the wrong philosophical framework for determining optimal tax policy.

Utilitarianism is "the paradigm case of consequentialism," in that it relies solely on the consequences of an action–or a policy–to determine its desirability (Sinnott-Armstrong, 2006). For example, the means by which a policy achieves its ends or the motives of policymakers are irrelevant to the desirability of a policy. Moreover, it is also the most prominent case of the "welfarist" subset of consequentialist philosophies, in that it is "motivated by the idea that what is of primary moral importance is the level of welfare of people" rather than, for instance, equality or liberty (Lamont, 2007). In this subsection, we discuss two critiques of a height tax that can also be understood as critiques of the welfarist-Utilitarian framework in general: the Libertarian critique and the horizontal equity critique.

Libertarianism Libertarians emphasize individual liberty and rights as the sole determinants of whether a policy is justified. In particular, any transfer of resources by policies that infringe upon individuals' rights is deemed unjust from a Libertarian perspective. Hausman and McPherson (1996) discuss the views of Robert Nozick, a prominent Libertarian, by writing: "According to Nozick's entitlement theory of justice, an outcome is just if it arises from just acquisition of what was unowned or by voluntary transfer of what was justly owned...Only remedying or preventing injustices justifies redistribution..." If the existing distribution of resources was generated by voluntary transfers between individuals, a Libertarian views that distribution as just and, therefore, any redistributive taxation as unjust.

Libertarians are skeptical of the redistribution of income or wealth because they believe that individuals are entitled to the returns on their justly-acquired endowments. Is height a "justly-acquired endowment?" On the one hand, height may seem to be an ideal example, given that it is assigned by nature. Thus, if individuals are entitled to the returns to their endowments, a height premium is a just source of inequality and the government ought not try to offset it with redistribution. It might be argued, however, that height is acquired in a more complicated way that is less obviously just. The mating decisions and health of past generations affects modern individuals' heights, so if one's ancestors unjustly acquired the resources that generated one's height today, height taxation could potentially be justified even within a Libertarian framework.

Whether one agrees with the Libertarian critique is of fundamental importance for tax policy. Unlike critiques that accept Utilitarianism, which are essentially quarrels with details about the height tax as a policy, the Libertarian critique questions the very basis of the dominant modern model of optimal taxation. It argues that differences in ability are not appropriate targets for redistribution so long as they are generated in a just manner. Even though these differences may mean suffering for some, the Libertarian critique argues that it is no other individual's responsibility to remedy that suffering unless it has been generated by the violation of someone's rights. These differences in ability are, in contrast, the basis of tax policy in the Utilitarian framework. While Utilitarian policy would recommend steeply progressive taxes if ability were observable, a Libertarian policy would not. For example, the prominent Libertarian Milton Friedman (1962) writes: "I find it hard, as a liberal, to see any justification for graduated taxation solely to redistribute income. This seems a clear case of using coercion to take from some in order to give to others..."

At the root of the difference between the Libertarian and welfarist-Utilitarian conception of optimal tax policy is the relationship of the individual to the state. The welfarist-Utilitarian model sees the state as an entity outside the individuals who compose it, in that the government puts in place policies that are optimal according to its own social welfare function. This function is dependent upon the individuals' welfare, but by combining them in a particular way the state assumes an authority to force individuals to act in ways with which they may disagree. In contrast, a Libertarian model sees the state as merely a collection of individuals who agree to cooperate only insofar as it serves their individual interests. Thus, all contributions by individuals to the state's activities must be voluntary, and the state has authority over individuals only insomuch as they wish to grant it. Once framed in these terms, it becomes clear why legal scholars (e.g., Hasen, 2006) have identified much the same tension between classically liberal theories of society and modern optimal tax theory as we have in this paper.

Though these perspectives seem to have little philosophical connection, one way that economists often frame them is to follow Harsanyi (1953, 1955) in thinking of the Utilitarian model as an *ex ante* model in which individuals set up society's rules prior to knowing their position in society (in this case, their height) while the Libertarian model is an *ex post* model in which existing individuals cooperate to form a society with full knowledge of their endowments. Given this distinction, it is not surprising that these models yield starkly different recommendations.

Horizontal Equity A second critique of the Utilitarian approach to taxation that has particular relevance for a height tax is based on the principle of horizontal equity. Traditionally, horizontal equity requires that people with a similar ability to pay taxes should pay similar taxes. Feldstein (1976) suggests a slightly different variant: "If two individuals would be equally well off (have the same utility level) in the absence of taxation, they should also be equally well off if there is a tax." Using either definition, the violation of horizontal equity by a height tax is glaring. In particular, return to the simulation from the previous section and consider the taxes shown in Table 4. For any given wage, the amount of tax and the average tax rates rise substantially with height.

The conflict between horizontal equity and maximization of a Utilitarian social welfare function is not unique to a height tax. When ability is unobservable, as in the Vickrey-Mirrlees model, respecting horizontal equity means neglecting information on how any exogenous personal characteristic is related to ability. This information can make redistribution more efficient, as we have seen in the analysis above. In other words, as Kaplow (2001) points out, horizontal equity gives priority to a dimension of heterogeneity across individuals–ability–and focuses on equal treatment within the groups defined by that heterogeneity. He argues that it is difficult to think of a reason why that approach, rather than one which aims to maximize the well-being of individuals across all groups, is an appealing one. Why would society sacrifice potentially large gains for its members in order to preserve equal treatment of individuals within an arbitrarily-defined group?

Nevertheless, it is likely that concerns about horizontal equity limit the political viability of a height tax. As Auerbach and Hassett (1999) write, "...there is virtual unanimity that horizontal equity – the extent to which equals are treated equally – is a worthy goal of any tax system." For instance, it may be difficult to explain to a tall person that he has to pay more in taxes than a short person with the same earnings capacity because, as a tall person, he had a better chance of earning more.

4 Conclusion

The problem addressed in this paper is a classic one: the optimal redistribution of income. A Utilitarian social planner would like to transfer resources from high-ability individuals to low-ability individuals, but he is constrained by the fact that he cannot directly observe ability. In conventional analysis, the planner observes only income, which depends on ability and effort, and is deterred from the fully egalitarian outcome because taxing income discourages effort. If the planner's problem is made more realistic by allowing him to observe other variables correlated with ability, such as height, he should use those other variables in addition to income for setting optimal policy. Our calculations show that a Utilitarian social planner should levy a sizeable tax on height. A tall person making $50,000 should pay about $4,500 more in taxes than a short person making the same income.

Height is, of course, only one of many possible personal characteristics that are correlated with a person's opportunities to produce income. In this paper, we have avoided these other variables, such as race and gender, because they are intertwined with a long history of discrimination. In light of this history, any discussion of using these variables in tax policy would raise various political and philosophical issues that go beyond the scope of this paper. But if a height tax is deemed acceptable, tax analysts should entertain the possibility of using other such "tags" as well.

Many readers, however, will not so quickly embrace the idea of levying higher taxes on tall taxpayers. Indeed, when first hearing the proposal, most people recoil from it or are amused by it. And that reaction is precisely what makes the policy so intriguing. A tax on height follows inexorably from a well-established empirical regularity and the standard approach to the optimal design of tax policy. If the conclusion is rejected, the assumptions must be reconsidered.

Our results, therefore, leave readers with a menu of conclusions. You must either advocate a tax on height, or you must reject, or at least significantly amend, the conventional Utilitarian approach to optimal taxation. The choice is yours, but the choice cannot be avoided.

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Table 1: Height distribution of adult white males in the U.S.

Height in inches	Percent of population	Cumulative percent of population
60	0.1%	0.1%
61	0.1%	0.2%
62	0.3%	0.6%
63	0.5%	1.1%
64	1.0%	2.1%
65	2.0%	4.1%
66	3.2%	7.2%
67	4.8%	12.1%
68	8.5%	20.5%
69	10.1%	30.7%
70	14.8%	45.5%
71	12.9%	58.4%
72	17.0%	75.4%
73	9.8%	85.3%
74	8.3%	93.6%
75	3.0%	96.5%
76	2.6%	99.1%
77	0.5%	99.6%
78	0.2%	99.8%
79	0.1%	99.9%
80	0.1%	100.0%

Source: National Longitudinal Survey of Youth, Authors' calculations

Table 2: Wage and hours distribution of adult white males in the U.S.

Wages

Summary statistics		Percentiles	Wage
Mean	16.29	1%	2.40
Std. Dev.	10.85	5%	5.05
Observations	1,738	10%	6.41
Min	0.12	25%	9.62
Max	90.01	50%	13.74
		75%	19.87
		90%	27.13
		95%	38.58
		99%	60.01

Hours

Summary statistics		Percentiles	Hours
Mean	2,436	1%	1,125
Std. Dev.	665	5%	1,540
Observations	1,738	10%	1,820
Min	1,000	25%	2,080
Max	6,680	50%	2,313
		75%	2,704
		90%	3,200
		95%	3,640
		99%	4,680

Source: National Longitudinal Survey of Youth, Authors' calculations

Table 3: Wage distribution of adult white males in the U.S. by height

Bin	Min wage in bin	Max wage in bin	Average wage in bin	Number of observations in each height group			Proportion of each height group in each wage range		
			Pop. Avg	Short	Medium	Tall	Short	Medium	Tall
1	-	4.50	2.88	23	29	13	0.043	0.037	0.030
2	4.50	6.25	5.51	40	33	22	0.075	0.042	0.052
3	6.25	8.25	7.24	57	63	29	0.107	0.081	0.068
4	8.25	10.00	9.17	58	67	39	0.109	0.086	0.091
5	10	12	10.91	67	94	48	0.126	0.121	0.112
6	12	14	12.98	60	102	53	0.113	0.131	0.124
7	14	16	14.98	56	68	44	0.105	0.087	0.103
8	16	18	16.91	38	57	33	0.071	0.073	0.077
9	18	20	18.95	32	54	28	0.060	0.069	0.066
10	20	22	20.91	24	46	25	0.045	0.059	0.059
11	22	24	22.83	22	38	21	0.041	0.049	0.049
12	24	27	25.26	15	50	15	0.028	0.064	0.035
13	27	33	29.55	14	24	25	0.026	0.031	0.059
14	33	43	37.18	9	19	12	0.017	0.024	0.028
15	43	54	47.19	9	19	7	0.017	0.024	0.016
16	54	60	54.55	5	7	7	0.009	0.009	0.016
17	60	73	63.53	4	6	4	0.008	0.008	0.009
18	73	n/a	81.52	0	2	2	-	0.003	0.005
				Total observations			*Average wage by height group, using average wage in bin*		
				533	778	427	14.84	16.74	17.28

Source: National Longitudinal Survey of Youth, Authors' calculations

Table 4: Optimal Allocations in the Baseline Case

Alpha= 2.55	**Average transfer paid(+) or received(-) as percent of per capita income:**	*Short*	*Med*	*Tall*
Sigma= 3		-13.38%	3.78%	7.13%
Gamma= 1.5				
	Maximum work hours per year 5,760			

		Optimal Model																				
Wage bin	**Wage**	**Annual income**			**Annual consumption**			**Fraction of time working**			**Utility**			**Annual tax (income-consumption)**			**Average Tax Rate**			**Marginal Tax Rate**		
	Pop. Avg	*Short*	*Med*	*Tall*	*Short*	*Med*	*Tall*	*Short*	*Med*	*Tall*	*Short*	*Med*	*Tall*	*Short*	*Med*	*Tall*	*Short*	*Med*	*Tall*	*Short*	*Med*	*Tall*
1	2.88	4,086	4,104	4,107	27,434	25,332	24,913	0.25	0.25	0.25	1.07	1.03	1.03	-23,349	-21,228	-20,806	-5.71	-5.17	-5.07	0.44	0.50	0.51
2	5.51	10,588	10,181	10,629	29,306	26,784	26,548	0.33	0.32	0.33	1.08	1.04	1.04	-18,718	-16,603	-15,919	-1.77	-1.63	-1.50	0.41	0.52	0.49
3	7.24	15,174	15,386	15,004	31,178	28,624	28,064	0.36	0.37	0.36	1.10	1.06	1.05	-16,004	-13,239	-13,060	-1.05	-0.86	-0.87	0.41	0.47	0.51
4	9.17	20,652	20,924	21,309	33,528	30,771	30,459	0.39	0.40	0.40	1.12	1.08	1.07	-12,876	-9,847	-9,150	-0.62	-0.47	-0.43	0.40	0.46	0.45
5	10.91	25,730	26,616	26,442	35,926	33,273	32,686	0.41	0.42	0.42	1.14	1.10	1.10	-10,196	-6,657	-6,244	-0.40	-0.25	-0.24	0.39	0.42	0.44
6	12.98	31,852	33,492	33,415	38,887	36,541	35,886	0.43	0.45	0.45	1.16	1.13	1.12	-7,036	-3,049	-2,471	-0.22	-0.09	-0.07	0.37	0.37	0.39
7	14.98	38,305	37,846	39,042	42,292	38,657	38,672	0.44	0.44	0.45	1.19	1.16	1.15	-3,988	-811	370	-0.10	-0.02	0.01	0.33	0.43	0.39
8	16.91	42,444	42,890	43,350	44,512	41,035	40,778	0.44	0.44	0.45	1.21	1.18	1.17	-2,068	1,854	2,572	-0.05	0.04	0.06	0.38	0.44	0.44
9	18.95	48,882	50,102	49,636	47,962	44,607	43,834	0.45	0.46	0.45	1.23	1.20	1.20	920	5,495	5,802	0.02	0.11	0.12	0.35	0.39	0.42
10	20.91	54,136	56,189	56,068	50,909	47,896	47,189	0.45	0.47	0.47	1.25	1.22	1.22	3,227	8,293	8,878	0.06	0.15	0.16	0.35	0.36	0.38
11	22.83	59,266	60,036	59,702	53,832	49,975	49,091	0.45	0.46	0.45	1.27	1.24	1.24	5,435	10,061	10,611	0.09	0.17	0.18	0.35	0.40	0.43
12	25.26	60,068	68,522	59,702	54,223	54,547	49,091	0.41	0.47	0.41	1.29	1.26	1.26	5,845	13,974	10,611	0.10	0.20	0.18	0.50	0.35	0.58
13	29.55	70,412	70,338	79,398	58,229	55,315	57,056	0.41	0.41	0.47	1.31	1.29	1.28	12,183	15,023	22,341	0.17	0.21	0.28	0.53	0.56	0.41
14	37.18	88,591	93,054	94,415	64,200	62,789	62,752	0.41	0.43	0.44	1.34	1.32	1.32	24,391	30,265	31,663	0.28	0.33	0.34	0.56	0.53	0.52
15	47.19	134,292	138,770	127,681	83,286	83,042	75,221	0.49	0.51	0.47	1.37	1.36	1.36	51,005	55,727	52,460	0.38	0.40	0.41	0.27	0.23	0.44
16	54.55	154,128	151,130	157,447	95,184	90,211	90,875	0.49	0.48	0.50	1.41	1.40	1.39	58,944	60,918	66,572	0.38	0.40	0.42	0.24	0.33	0.26
17	63.53	188,292	182,230	179,611	119,168	108,755	103,984	0.51	0.50	0.49	1.44	1.43	1.43	69,124	73,476	75,627	0.37	0.40	0.42	0.00	0.18	0.26
18	81.52		237,496	240,765		144,014	141,369		0.51	0.51		1.49	1.48		93,482	99,396		0.39	0.41		0.00	0.00
Expected Values		36,693	43,032	44,489	41,603	41,407	41,319	0.41	0.42	0.43	1.175	1.161	1.158	(4,911)	1,625	3,170	-0.62	-0.34	-0.28	0.39	0.42	0.43

Source: National Longitudinal Survey of Youth, Authors' calculations

Table 5: Benchmark Case

Alpha=	2.55	**Average transfer paid(+) or received(-) as**			*Short*	*Medium*	*Tall*	
Sigma=	3	**percent of per capita income:**			-5.71%	1.59%	3.23%	
Gamma=	1.5							
		Maximum work hours per year				5,760		
		Windfall for benchmark to obtain optimal, as pct of aggregate income:					0.19%	
		Benchmark Model						
Wage bin	**Wage**	**Annual income**	**Annual consumption**	**Fraction of time working**	**Utility**	**Annual tax (inc.-cons.)**	**Average Tax Rate**	**Marginal Tax Rate**
1	2.88	4,106	25,799	0.25	1.04	-21,693	-5.28	0.49
2	5.51	10,479	27,443	0.33	1.05	-16,964	-1.62	0.48
3	7.24	15,251	29,206	0.37	1.07	-13,955	-0.91	0.46
4	9.17	20,926	31,461	0.40	1.09	-10,535	-0.50	0.44
5	10.91	26,281	33,850	0.42	1.11	-7,569	-0.29	0.42
6	12.98	32,962	37,004	0.44	1.14	-4,041	-0.12	0.38
7	14.98	38,327	39,686	0.44	1.16	-1,359	-0.04	0.39
8	16.91	42,837	41,913	0.44	1.19	924	0.02	0.43
9	18.95	49,585	45,305	0.45	1.21	4,280	0.09	0.39
10	20.91	55,518	48,507	0.46	1.23	7,012	0.13	0.37
11	22.83	59,718	50,787	0.45	1.25	8,931	0.15	0.40
12	25.26	64,720	53,296	0.44	1.27	11,424	0.18	0.44
13	29.55	73,290	56,895	0.43	1.30	16,394	0.22	0.50
14	37.18	92,058	63,385	0.43	1.33	28,673	0.31	0.54
15	47.19	135,042	81,508	0.50	1.36	53,535	0.40	0.29
16	54.55	153,574	92,198	0.49	1.40	61,376	0.40	0.28
17	63.53	182,763	110,400	0.50	1.44	72,363	0.40	0.16
18	81.52	236,347	145,040	0.50	1.49	91,307	0.39	0.00
Expected Values		41,345	41,345	0.42	1.164	0	-0.40	0.42

Source: National Longitudinal Survey of Youth, Authors' calculations

Table 6: Example Tax Table

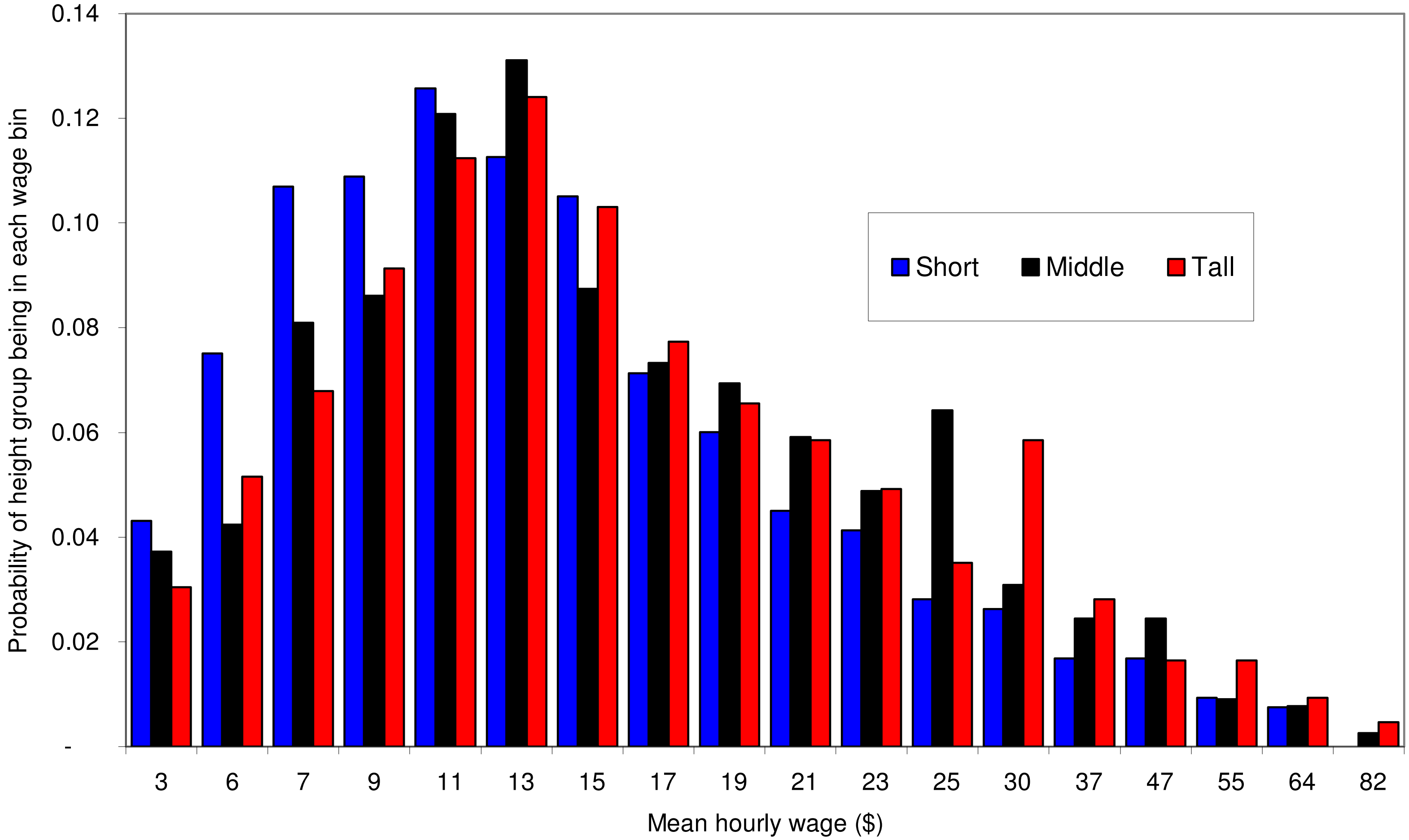
If your taxable income is closest to…	And you are --			If your taxable income is closest to…	And you are --		
	Short	*Medium*	*Tall*		*Short*	*Medium*	*Tall*
	69 inches or less	70-72 inches	73 inches or more		69 inches or less	70-72 inches	73 inches or more
	Your tax is --				**Your tax is --**		
5,000	-22,697	-20,546	-20,137	105,000	33,947	36,919	38,280
10,000	-19,136	-16,741	-16,391	110,000	36,859	39,704	41,406
15,000	-16,107	-13,488	-13,062	115,000	39,771	42,488	44,532
20,000	-13,248	-10,413	-9,962	120,000	42,682	45,273	47,658
25,000	-10,581	-7,563	-7,061	125,000	45,594	48,058	50,784
30,000	-7,992	-4,882	-4,319	130,000	48,506	50,843	53,559
35,000	-5,549	-2,274	-1,671	135,000	51,289	53,628	55,930
40,000	-3,201	327	860	140,000	53,290	56,244	58,300
45,000	-882	2,920	3,420	145,000	55,291	58,344	60,671
50,000	1,411	5,444	5,976	150,000	57,292	60,444	63,041
55,000	3,599	7,746	8,368	155,000	59,204	62,481	65,412
60,000	5,810	10,044	10,788	160,000	60,694	64,500	67,615
65,000	8,867	12,350	13,766	165,000	62,184	66,519	69,658
70,000	11,931	14,828	16,744	170,000	63,674	68,538	71,701
75,000	15,264	18,151	19,722	175,000	65,163	70,556	73,743
80,000	18,622	21,506	22,715	180,000	66,653	72,575	75,778
85,000	21,979	24,861	25,819	185,000	68,143	74,594	77,722
90,000	25,211	28,216	28,922	190,000	n/a	76,613	79,665
95,000	28,123	31,349	32,028	195,000	n/a	78,632	81,609
100,000	31,035	34,134	35,154	200,000	n/a	80,651	83,552

Note: Taxes calculated by interpolating between the 18 optimal tax levels calculated for each height group.

Table 7: Varying risk aversion					
	Risk aversion parameter gamma (γ)				
	0.75	1.00: u(c)=ln(c)	1.50	2.50	3.50
Average transfer to short group, as percent of per capita short income:	12.81%	13.05%	13.38%	13.75%	13.97%
Windfall needed for benchmark planner to obtain optimal planner's social welfare, as percent of aggregate income	0.119%	0.146%	0.187%	0.242%	0.275%
Gamma=1.50 is the baseline level assumed throughout paper					
Note: Maintains σ=3.00 as in the baseline; adjusts α to approx. match evidence on hours worked:					
α	12.50	7.50	2.55	0.30	0.04
α/σ	4.17	2.50	0.85	0.10	0.01
Source: National Longitudinal Survey of Youth, Authors' calculations					

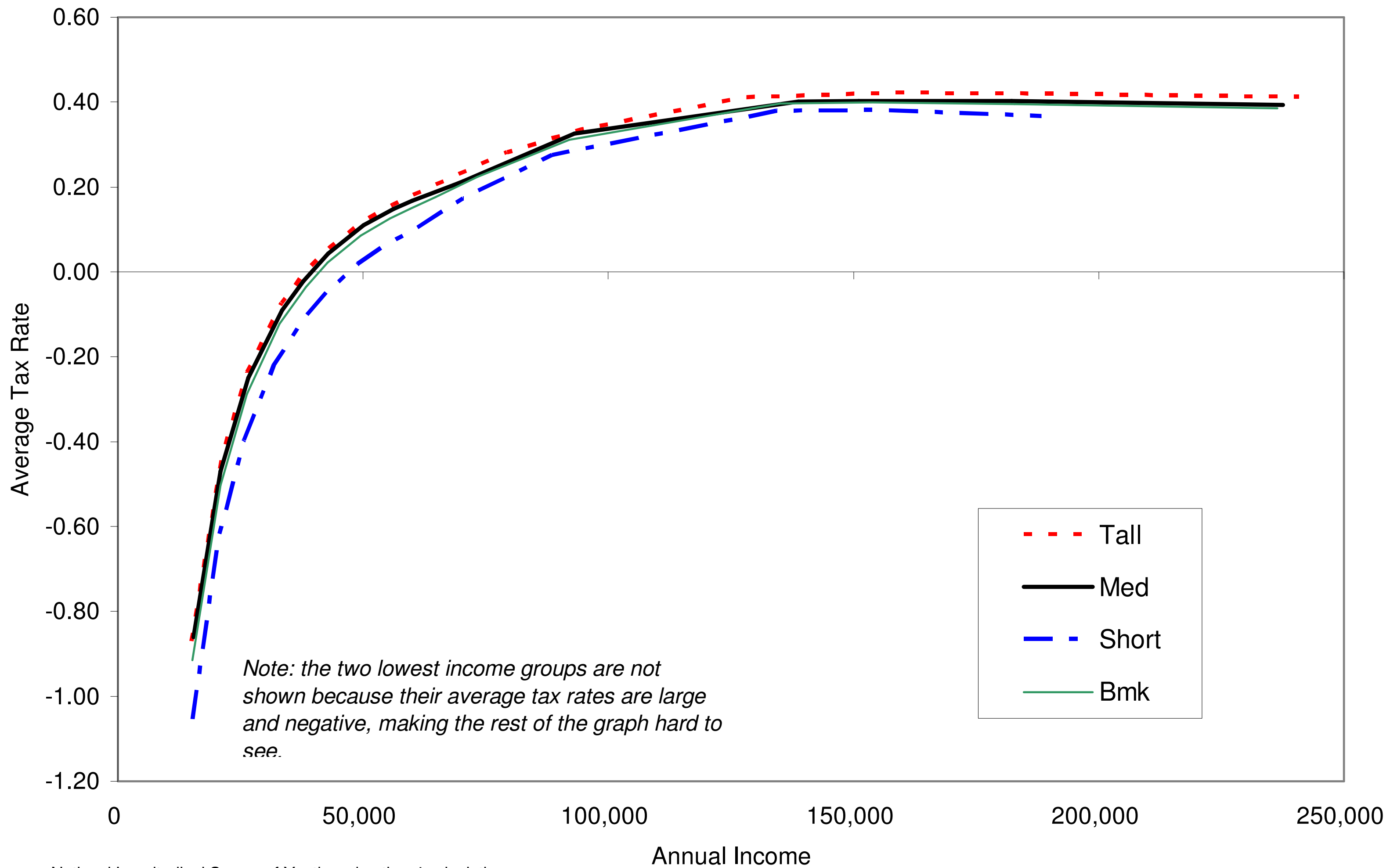
Table 8: Varying labor supply elasticity					
	Constant-consumption elasticity of labor supply				
	0.20	0.30	0.50	1.00	3.00
Value for parameter sigma (σ)	6.00	4.33	3.00	2.00	1.33
Average transfer to short group, as percent of per capita short income:	11.21%	11.93%	13.38%	17.06%	31.73%
Windfall needed for benchmark planner to obtain optimal planner's social welfare, as percent of aggregate income	0.097%	0.134%	0.187%	0.274%	0.493%
Sigma=3.00 is the baseline level assumed throughout paper					
Note: Maintains γ=1.50 as in the baseline; adjusts α to approx. match evidence on hours worked:					
α	30.00	8.00	2.55	1.15	0.65
α/σ	5.00	1.85	0.85	0.58	0.49
Source: National Longitudinal Survey of Youth, Authors' calculations					

Figure 1: Wage distribution of adult white males in the U.S. by height



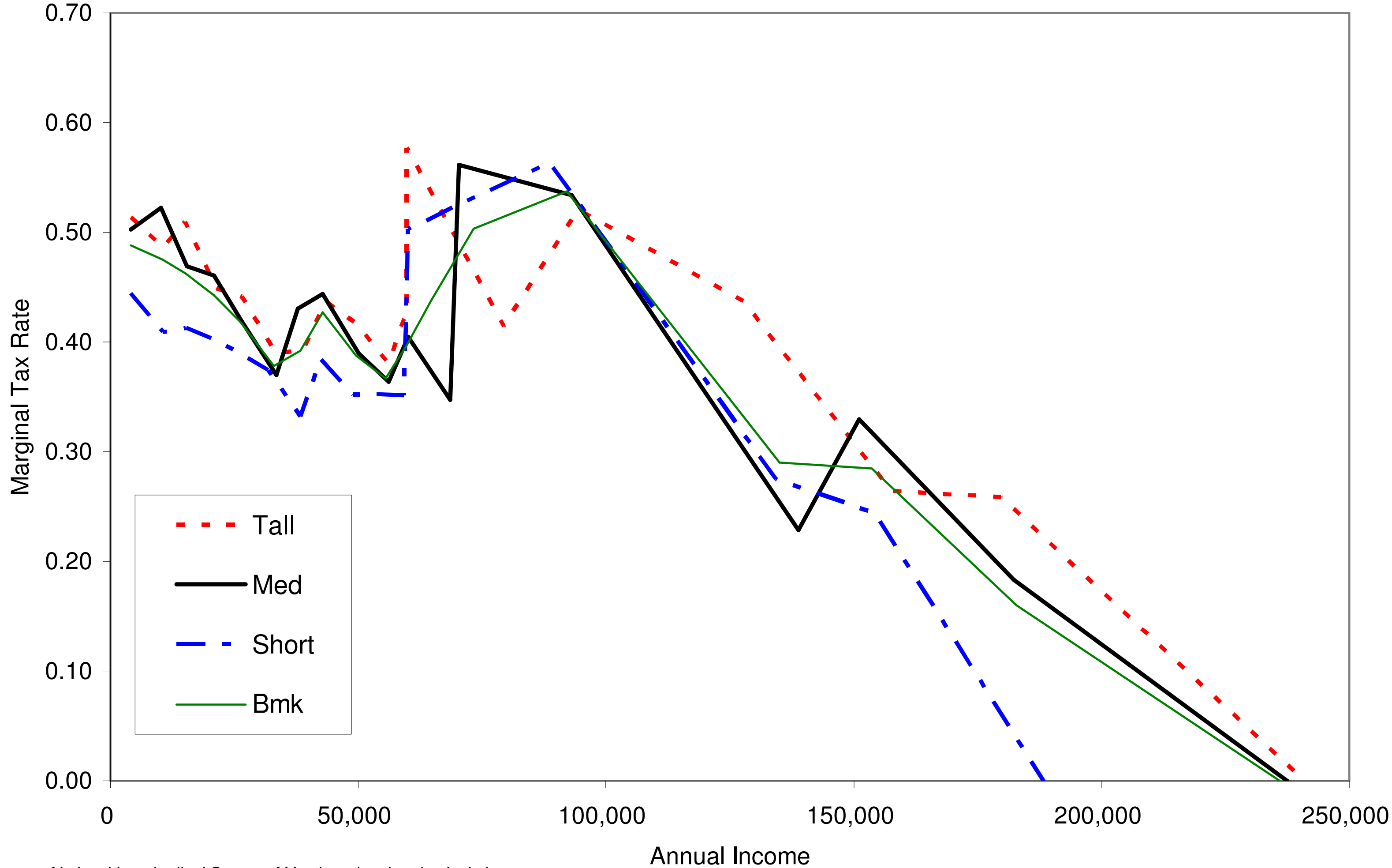
Source: National Longitudinal Survey of Youth and authors' calculations

Figure 2: Average Tax Rates



Source: National Longitudinal Survey of Youth and authors' calculations

Figure 3: Marginal Tax Rates



Source: National Longitudinal Survey of Youth and authors' calculations