Progressive Taxation in a Dynastic Model of Human Capital

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Abstract

We develop a quantitative theory of economic inequality in which parental investments in human and physical capital play a key role in the intergenerational transmission of earnings, income, and wealth inequality. Our calibrated model economy reproduces a set of key statistics characterizing the earnings and wealth inequality in the U.S.: the variance of the life-time earnings, the intergenerational correlation of life-time earnings, the wealth inequality as characterized by the Gini coefficient, and the high concentration of wealth by individuals at the top of the wealth distribution. We use our theory of inequality to investigate the effects of replacing the current U.S. progressive income tax system with a proportional income tax system. We find that the steady state level of output increases by 12.6%, capital by 21.8%, and consumption by 13.2%. These effects are less than half if human capital evolves exogenously. Moreover, the elimination of progressive taxation increases the Gini coefficients of earnings by .016, income by .034, and wealth by .062 (all changes are expressed in percentage points). Given the lack of conclusive micro-evidence for parameterizing the human capital technology, we emphasize the importance of using the cross-sectional implications of our theory in order to accurately assess the effects of tax policy on the human capital accumulation.

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1 Introduction

Despite the fact that in the U.S. income is taxed progressively, most quantitative analysis of U.S. income taxation focus on proportional income taxation. Scholars in public finance are thus faced with the following question: does the progressivity of the tax code matters for assessing the aggregate and distributive effects of U.S. income taxation? In this paper, we develop a quantitative theory of economic inequality in order to evaluate the effects of replacing the progressive income tax system in the U.S. economy with a proportional income tax system. Building a theory of inequality is a necessary first step for assessing the consequences of progressive income taxation: Since marginal tax rates increase with income under a progressive tax system, income taxation has a differential effect on individuals across the income distribution and, therefore, the distribution of income matters for the impact of taxation on the economy. We argue that building a theory of economic inequality is also important for evaluating the effects of income taxation on human capital accumulation.

While economists consider human capital as a crucial component of aggregate wealth, they have conflicting views about how human capital accumulation is affected by taxation. While King and Rebelo (1990) and Rebelo (1991) have found large negative effects of taxation on human capital accumulation, other studies have found negligible effects; see, for instance, Heckman (1976), Boskin (1977), Davies and Whalley (1989), Lord (1989), Perroni (1995). In an influential paper, Trostel (1993) showed that the consequences of income taxation hinge crucially on the specification of the human capital production technology. When time is the only input in the education technology, the reduction of the net wage due to an increase in the income tax affects equally the benefits and costs of human capital investment so that income taxation does not affect human capital accumulation. When goods are an input in the human capital technology, however, income taxation has important effects on human capital because the costs of these goods is not reduced by income taxation. The conflict in the views about the impact of taxation on human capital accumulation has remained due to the lack of conclusive micro-evidence on the parameters of the human capital technology.

In the light of these difficulties, our paper provides a novel approach to studying the impact of income taxation on human capital accumulation. By building a model with heterogeneous individuals, we can use the cross-sectional implications of our theory in order to parameterize the human capital technology. Motivated by the empirical studies of Neal and Johnson (1996) and Keane and Wolpin (1997), we focus on investments that take place 'early' in the life of an individual and formulate a model of parental investments in the human capital of their children. We assume that individuals' labor productivity is jointly determined by their education and an uninsurable market luck shock (which is drawn from an *iid* distribution over time and individuals). The main novelty of our model relative to the previous work in the area is the inclusion of a production technology for human capital which takes market goods and (quality-adjusted) parental time as inputs. In our theory, the relative importance of these inputs determines the intergenerational correlation of earnings. We then use observations on the persistence of earnings in order to pin down the shares of time and expenditure inputs in the human capital production function, which is a crucial step toward evaluating the quantitative impact of taxation.

We find that modeling parental investments in human capital increases substantially the aggregate effects of replacing progressive income taxation with proportional income taxation. In our benchmark economy, the change in tax policy increases the steady state levels of output by 12.6%, capital by 21.8%, and consumption by 13.2%, while the increase in the same variables for an economy with no investments in human capital is less than a half. Two main channels explain why progressive taxation has a much bigger impact in an economy with parental investments. First, the share of expenditures in the human capital production technology in our calibrated economy is large, which implies that income taxation does not affect proportionally the benefits and costs of human capital accumulation. Second, a progressive tax system treats asymmetrically the costs and benefits of time inputs in human capital accumulation. When the marginal tax rate depends on income, the tax rate applied to the cost of time inputs is not, in general, equal to the tax rate applied to the return on human capital investments. Under a progressive tax schedule the marginal tax rate increases with income, creating another asymmetry. When parents increase the time spent in educating their children, the tax rate at which time inputs are deducted *decreases* due to lower parental earnings. At the same time, the tax rate at which their children are taxed *increases* due to higher human capital of their children. The different marginal tax rates at which costs are deducted and benefits are taxed (imperfect tax-deductibility of time inputs) creates disincentives for human capital accumulation. This effect was not examined by Trostel (1993) because he studied a flat income tax system in a representative agent environment.

The elimination of progressive income taxation leads to an important increase in economic inequality: the Gini coefficients of earnings increase by .016, income by .034, and wealth by .062 (all changes are expressed in percentage points). When we consider a version of our model with exogenous labor productivity, the inequality effects are less pronounced: The Gini coefficients increase by .0 for earnings, by .052 for income, and by .048 for wealth (all in percentage points). We thus conclude that inequality increases more in the economy with endogenous human capital, though not by much.

We find that the effects of progressive taxation on economic mobility, as measured by the intergenerational correlation of earnings, depend crucially on the specification of the human capital technology, a result that is novel in the literature. In particular, progressive taxation can increase or decrease economic mobility depending on the importance of time and expenditure inputs in the accumulation of human capital. In the presence of time inputs and progressive taxation, parents with high market luck have strong incentives to invest in the human capital of their children. Because parents with above-average market luck expect their children to have lower market luck, they expect their children to face a lower marginal tax rate than themselves. They thus face strong incentives to spend time educating their children, which leads to a higher intergenerational correlation of earnings under progressive than under proportional income taxation. On the other hand, a progressive tax system can enhance economic mobility in the presence of expenditure inputs. The non tax deductibility of expenditures implies that income taxation discourages investments in human capital accumulation. When income taxes are progressive, this effect is more important among parents with high earnings because they face a high marginal tax rate on their investments. To sum up, the imperfect deductibility of time inputs and the non-deductibitility of expenditures associated with a progressive tax system have opposite effects on earnings mobility. In our experiments, we find that the second effect is more important so that the elimination of progressive taxation leads to lower economic mobility.

Castañeda et. al. (1999), Conesa and Krueger (2002), Meh (2002) and Ventura (1999) evaluate the effects of progressive taxation in an economy with exogenous labor productivity. Heckman et. al. (1998) evaluate the effects of progressive taxation on human capital but their analysis focuses on a life-cycle framework with no intergenerational transfers. The distinguishing feature of our paper is to study the impact of progressive taxation on the *initial* inequality among young individuals, an aspect that recent empirical studies point to be crucial for understanding inequality (see Neal and Johnson (1996) and Keane and Wolpin (1997)).

Our paper relates to a recent literature on the U.S. economic inequality (see Quadrini and Ríos Rull (1997) for a review). In a recent contribution, Castañeda et. al. (2003) argue that the social security system plays a crucial role for understanding why poor households hold little wealth. Our paper offers an alternative (but complimentary) explanation. In our framework, as in Knowles (1999), poor households accumulate little physical capital because they prefer to accumulate human capital. Our explanation relies on the fact that poor households face a higher return in accumulating human than physical capital. We follow Krusell and Smith (1997, 1998) in modeling a stochastic discount factor to generate plausible levels of wealth holdings by the richest individuals in the economy. In order to evaluate the role of human capital investments in shaping the wealth distribution in our benchmark economy, we consider an experiment where human capital investments are fixed. The wealth Gini in this experiment is about 10% points lower than in the benchmark economy and the concentration of wealth by the top 5% of households drops from 54% to 40%. We conclude that human capital investments play an important role in concentrating the wealth distribution in our benchmark economy.

2 A Model of Parental Investments

We develop a model of economic inequality in which parental investments in human and physical capital play a key role in the intergenerational transmission of earnings, income, and wealth inequality. The economy is populated by three-period-lived individuals who are altruistic towards their descendents. We refer to individuals in the first period of their lives (age-0) as children. Children do not take any economic decisions. They receive an education investment which is chosen by their parents. At age 1 children become young adults who work, consume, accumulate capital, and produce and educate their own children. At age 2 individuals become old and they work (part of their time), consume, and transfer resources to their children.

In our model, parental investments are not the sole determinant of an individual's earnings. At age 1, individuals draw an uninsurable and idiosyncratic labor market shock that, together with the human capital they supply to the market, determines their labor market earnings. Labor market luck is drawn from a fixed *iid* distribution F. As a result, the intergenerational transmission of earnings inequality in the model economy is due to parental investments in education and not to the exogenous *iid* shock to earnings.

Goods are produced by combining capital and labor inputs according to a neoclassical production function. There is a government that taxes income and administers a pay-as-you-go social security system. Because we only study steady state equilibria, the notation below does not use time subscripts.

2.1 Human Capital

The paper studies the role of human capital investments in explaining economic inequality and its transmission across generations. Since our goal is to understand the heterogeneity in human capital investments, we abstract from public education and focus exclusively on private investments in human capital. Furthermore, we consider investments that take place 'early' in the life of an individual. This approach is motivated by the following empirical studies of the determinants of earnings inequality. Keane and Wolpin (1997) find that 90% of the variance in lifetime utility is accounted by heterogeneity in the skills of individuals at age 16, i.e. prior to labor market entry. Similarly, Neal and Johnson (1996) observe that nearly three quarters of the black-white wage differential is explained by a measure of skill levels at age 16-18. Moreover, these authors find that parental capacity (as measured by parents' education and professional status) to provide for the human capital of their children is essential for explaining differences in skill attainments of their children. These findings also motivate us to take a broad view of human capital investment. It includes not only formal education but also pre-natal care, child rearing, health care, and time spent in helping children do things, teaching them new skills, reading and talking to them, providing information and stimulation.

The literature on human capital formation (see the seminal work of Becker and Tomes (1979)) typically considers the following inputs in human capital accumulation: time (which include parental time and labor services purchased in the market) and market goods (books, medicine, housing). Our formulation of the human capital technology is given by

$$h' = \left[(uh)^{\eta} m^{1-\eta}\right]^{\xi} \ , 0 < \eta,\ \xi < 1.$$

where u denotes parental time, h is the parental human capital, m is human capital services purchased in the market, and h' is the human capital of the child. Notice that parental time is multiplied by the parent's human capital. This will be important in generating persistence in earnings inequality. As we shall later see, by modeling expenditures as purchases of human capital services, our model of parental decisions will be less responsive to changes in taxation than a model were expenditures consists of goods purchases.

2.2 The Individual's decision problem

We start by considering the decision problem of young (age-1) individuals. They divide their resources among consumption, accumulation of physical capital, and investment in the human capital of their offsprings. The labor income of the young is determined by their education, market luck, and the fraction of time devoted to market activities. Young individuals also receive a non-negative financial transfer from their parents, which they take as given. Their decision problem is stochastic because they face uncertainty about the market luck and patience of their children. Following the work of Krusell and Smith (1997, 1998), we introduce preference shocks so that the model is capable of matching the high concentration of wealth in the data. Optimal behaviour at age-1 requires individuals to forecast their decisions at age-2. We assume that individuals take decisions at age-2 *after* observing the realization of the shocks to market luck and the discount factor of their children. Decisions at age-2 are thus contingent on the realization of the stochastic shocks to earnings and preferences.

The state of a young individual is given by a four-tuple (h, q, z, β) representing human capital, transfer of goods from parents, market luck, and discount factor. The problem of the young is written as follows:

$$
\begin{aligned}
v(h,q,z,\beta) &= \max_{\substack{c^y,u,m,a \\ c^o,q(z',\beta')}} \{\log(c^y)+\beta\sum_{\beta',z'}[\log(c^o)+v(h',q',z',\beta')]\,\pi_z\pi_{\beta\beta'}\} && (1)\\
s.t. \quad c^y+a+wm &= \omega^y+q-\Theta(\omega^y), && (2)\\
c^o(z',\beta')+q(z',\beta') &= \omega^o-\Theta(\omega^o-.5b), && (3)\\
h' &= \left[(uh)^\eta m^{1-\eta}\right]^\xi, && (4)\\
\omega^y &= w(1+z)h(1-u) && (5)\\
\omega^o &= w(1+z)h\,t^o+b+a(1+r) && (6)\\
a',q(z',\beta') &\geq 0, && (7)\\
u &\in [0,1],
\end{aligned}
$$

where ω^y and ω^o denote the incomes when young and old, respectively, and b is a social security benefit received when old that depends on the individual average lifetime earnings, $\Theta(\cdot)$ is a progressive tax function with $\Theta',\Theta''>0$.

An age-1 individual with human capital h, market luck z spends a fraction u of his time on market activities and obtains a before-tax labor income equal to $w(1+z)h(1-u)$. Young individuals can save in order to finance retirement, human capital investments, and transfers of goods to their children. The decisions of individuals at the young age will determine the resources available to them at the old age. These resources are the sum of labor income, gross returns on physical capital and social security benefits, minus tax liabilities (income taxes). We assume that individuals can only work a fraction t_o of their time endowment when old. We model a social security system because it is likely to have important consequences for economic inequality. By taxing parents when they are investing in their children's human capital, social security may negatively affect human capital investments of credit constrained parents. Credit-constrained young individuals would like to borrow against their future pension claims in order to finance human capital investments. Because pension benefits cannot be used as collateral in the credit market, young parents are more likely to be liquidity constrained in the presence of social security. Liquidity constraints, in turn, negatively affect human capital investments and have consequences for inequality and intergenerational mobility.

To illustrate the role of the liquidity constraints, let's assume that individuals face no uncertainty so that there is no risk in human capital accumulation. Because of decreasing returns to scale in human capital accumulation ($\xi < 1$), individuals face a decreasing rate of return to human capital investment. Therefore, if individuals are not borrowing constrained, they will make investments in human capital up to the point where its marginal return equals the interest rate on capital. In this case, parental investments in education will be determined by the level of human capital h, the fixed values of β and z, and will be independent of the intergenerational transfer q (recall that we are assuming that there is no uncertainty). On the other hand, among families that are borrowing constrained, parental investment in education depends on q. Thus, there will be earnings inequality between the children of families whose parents receive different amount of intergenerational transfer q and are borrowing constrained.

When young individuals make consumption and investment decisions, they face uncertainty over the market luck and discount rate of their children. Parental investments in human capital are thus risky. In our model, individuals self-insure future generations via accumulation of a safe asset - savings. Hence, a wealth transfer q received by a young agent plays an insurance role, with a higher transfer encouraging a larger investment in the human capital of their children.

The state of an old individual is given by the amount of resources available and his offspring's human capital, market luck, and discount rate. Because the transfer q is altruistically motivated, old individuals take into account the triple (h', z', β') in order to forecast the decisions of their offsprings and, in particular, their human capital investments. Because transfers are done after z' is known, they play an insurance role within the family.

2.3 Goods

The production of goods combines capital and labor inputs according to a Cobb-Douglas production function $Y = K^{\alpha}L_g^{1-\alpha}$, where K denotes the capital input and L_g the aggregate amount of human capital used in the goods sector. We assume that there is a large number of firms that rent physical and human capital services in competitive markets. Note that human capital is used in the education and goods sectors and competitive markets ensure that agents are indifferent between working in either sector.

2.4 Government

The government implements a self-financed pay-as-you-go social security system, and it uses income tax revenues to finance a fixed level of government expenditures. The social security scheme involves taxation of the working population at the flat rate τ_{ss} and redistribution of the proceeds to the current retired proportionally to their average life-time incomes at the replacement rate ρ. Although Social Security statutory benefit in the U.S. is progressive, the effective benefit is not progressive when a longevity-income relationship is taken into account (Fuster et al., 2000). The benchmark economy incorporates a progressive income tax schedule. Since in our model the young start with no assets, earnings is their only taxable income. The taxable income of the old, includes labor earnings before retirement, interest income on capital, and half of social security benefits.

3 Calibration

We calibrate the model economy to the U.S. economy. We set the model period to 30 years. Since we assume that an individual becomes economically active at age 20 and retires at age 65, the time endowment when old t^o is set to .5. The parameter values for the benchmark economy are summarized in Tables 1 and 2. Table 2 also indicates corresponding targets used for calibration. Because individuals in the model economy only live 3 periods, special care is needed in selecting the distributional statistics that our model will be asked to reproduce. In order for these targets to be truly comparable to the statistics generated by our model, we put special care in using data that have the minimum possible amount of heterogeneity driven by life-cycle behavior.

3.1 Progressive Taxation

The progressive tax schedule in the model is based on a relationship between individual effective federal income tax rates and income for the U.S. tax return over 1979-89, estimated by Gouveia and Strauss (1994):

$$\Theta(\omega) = a_0(\omega - (\omega^{-a_1} + a_2)^{-1/a_1}) \tag{8}$$

where y is a taxable income of an individual, and $\Theta(\omega)$ is a corresponding tax bill, $a_0 = .258, a_1 = .768, a_2 = .031$. The authors use the following concept of income: labor income, interest, dividends, capital gains, rents, royalties, pensions, sole proprietorship income and farm income net of Social Security obligations. Since tax deductions are incorporated in the tax returns, the effective tax schedule lies below the statutory tax schedule and is less progressive. Thus, the effects of progressive taxation reported in the next section are of a conservative nature. Since the relationship (8) was estimated for incomes in 1990 U.S. dollars and it is not unit free, we normalize the tax formula so as to equalize the average tax rates in the U.S. economy and in the model. The normalization amounts to an appropriate choice of parameter a_2 :

$$a_2^{\text{model}} = a_2 \left(\frac{AHI_{\text{model}}}{AHI_{\text{U.S. 1990}}} \right)^{-a_1}$$

where AHI is the average household income (about \$50 thousand for the U.S.). Under the benchmark calibration of the progressive tax formula, average tax rate, computed as total income tax revenues divided by total income, amount to 11.8%. Figure 1 shows the distribution of marginal income tax rates across wage percentiles. A median young individual faces a tax rate of 15%. In our economy, the tax rate tops out at 25%, but the tax progressivity matters all throughout the wage distribution.

3.2 Goods Production Technology

Given the above definition of a taxable income, we adopt a narrow definition of physical capital that excludes consumer durables and owner-occupied residential structures. We use 1986 asset-GNP ratios reported in Díaz-Giménez et. al. (1992) to compute a capital-output ratio as household tangible assets less consumer durables plus corporate tangible assets, and adjust the ratio for imputed rents from the owner-occupied housing. The resulting capital-output ratio of 2.17 is used as a target for the capital share α. An annual capital depreciation rate δ of 8% is computed using the investment-output ratio from National Income and Product Accounts as of 1986.

3.3 Stochastic Discount Rate

In order to restrict the number of free parameters, we assume that the discount factor β takes on 3 symmetrically distributed values, $\beta \in \{\beta_L, 2\beta_L, 3\beta_L\}$, and that the stochastic process for β is described by the following transition matrix

$$\begin{bmatrix} \pi_{LL} & 1-\pi_{LL} & 0 \\ \frac{1-\pi_{MM}}{2} & \pi_{MM} & \frac{1-\pi_{MM}}{2} \\ 0 & 1-\pi_{LL} & \pi_{LL} \end{bmatrix} \tag{9}$$

The matrix in (9) implies a symmetric distribution of agents across states of nature and no possibility of going from the low state to the high without passing through the middle. β_L is chosen so that the model's interest rate matches that of the U.S. According to Poterba (1997), the return to capital after property and corporate level taxes averaged 5.3% over 1981-95. The transition probabilities π_{LL} and π_{MM} are calibrated to match the U.S. wealth

Gini and the percentage of wealth held by the top 5% of the population. Although we do not have estimates of these statistics for the average life-time wealth, we take the values reported by Quadrini and Rios-Rull (1997) – .78 for the Gini and 55% for the concentration in 1992 – relying on the fact that the wealth Gini for any age group (above 50 years old in our case) is similar to the wealth Gini of the population as a whole (Projector and Weiss, 1966, and Greenwood, 1987). The values of the parameters reported in Table 2 imply the following distribution of agents across patience groups: $\{9.4\%, 81.2\%, 9.4\%\}$, with an average duration in low/high and middle states 1.4 and 26 periods. Note that the high average duration in the middle state and the low fraction of the population in the tails of the distribution are required in order to achieve high inequality as well as high concentration of wealth.

3.4 Earnings and Human Capital Technology

We assume that the market-luck shock is drawn from a log-normal distribution, characterized by one parameter σ_z: $\log z \sim N(0, \sigma_z)$. Two parameters specifying the education technology are also important for the behavior of earnings in our benchmark economy: the time share, η, and the returns to scale, ξ. To date, the literature on human capital formation provides no conclusive micro-evidence on the parameters of the human capital production function. Unlike previous studies, we do not assume values for the time share and the degree of scale in education, but instead we use three observations on individual earnings inequality in the U.S. economy to jointly calibrate the three parameters. The effects of progressive taxation will depend crucially on the parametrization of the earnings process.

Our study focuses on the inequality and intergenerational persistence of the permanent component of household earnings. We adopt the variance of log-earnings and the correlation of log-earnings between individuals from two adjacent generations as the measures of earnings inequality and persistence in our model economy. Because of the lack of earnings data spanning a whole life-time, most empirical studies proxy permanent earnings of an individual with a four- or five-year average or instrument it with other data less sensitive to life-cycle fluctuations (for example, occupation). The literature provides a range of estimates for the variance and correlation of log-earnings. For example, Gottschalk and Moffitt (1994) report the variance of log-earnings of .31 for white males aged 40-49 observed over the time period 1979-87 in PSID. Using NLS data for a sample of males with mean age of 34 over the period 1970-80, Zimmerman (1992) estimates the variance of life-time earnings to be .26 and an intergenerational correlation of earnings of .4. Solon (1992) obtains the same correlation of .4, and .53 when earnings are instrumented. The values we choose for the two targets are based on the empirical study of earnings of fathers and sons by Mulligan (1997, 1999). He uses PSID data on annual money wages and salaries with observations covering 1967-72 for fathers (mean age about 40) and 1984-89 for sons (mean age just above 30). Modifying the methods of Solon and Zimmerman to account for unemployment spells, Mulligan finds the variance of log-earnings of about .36 and the corresponding correlation of about .5. The latter implies that the difference between the earnings of two individuals will on average be half of the earnings gap between their parents. In our model, the aforementioned statistics will largely depend on the values of σ_z and η. The higher the variance of the market luck shock σ_z, the larger is the variance of earnings. The time share η controls the earnings correlation across generations. In particular, a larger time share makes parents with low opportunity cost of time (due to low market luck realization) allocate more time in the education of their offspring, which leads to a lower correlation of earnings. Hence the above pair of statistics is used as targets for calibrating σ_z and η.

Empirical studies of the life-cycle earnings find that a large part of individual and household earnings is predetermined by an unobserved endowment heterogeneity, or fixed effects, early in life, prior to the labor market entry (Keane and Wolpin 1999, Storesletten et al. 2000). Using PSID data on household earnings, Storesletten et al. (2000) estimate the variance of the fixed effects at the age of 23 to be .24 (in logs), which together with Mulligan's estimate of the earnings variance above implies that two-thirds of individual earnings variation occurs due to the variance in the early-acquired skills (fixed effects). Zimmerman (1992) arrives to the same conclusion when decomposing variance of life-time earnings into two components: two-thirds of the variance is due to fixed effects and one-third due to transitory shocks experienced during a life-time.

In the model, old agents' earnings are given by the market value of their human capital $w(1+z)ht^o$. The variance of log-earnings can be decomposed into the sum of variances of two independent components (in logs): the exogenous market-luck shock $(1+z)$ and the endogenous human capital h. The variance of human capital depends to a large extent on the curvature of the human capital production function: the smaller the value of ξ, the more curved the production function, and the faster the marginal product of investment in human capital declines with an increase in either input, leading to less heterogeneity in individual investment decisions. Since human capital is determined during the childhood stage of an agent's life, we can view it as a fixed effect, and use the above estimate of the fraction of log-earnings variance due to fixed effects $(\frac{2}{3})$ to calibrate the degree of scale of the human capital production technology.

Interestingly, the value of .75 that we obtain for the degree of scale in the benchmark economy lies in the range of values typically considered in the literature (see Trostel 1993 for a survey). Our model also requires a time share lower than the expenditure share in order to deliver the high correlation of earnings across generations. The last observation is important because the aggregate and distributional effects of taxation on the investment in human capital are determined, to a large extent, by the share of expenditures in the education technology.

4 Discussion

The calibration strategy outlined in the previous section requires searching for parameter values so that the model economy reproduces US data on earnings inequality, intergenerational correlation of earnings, wealth inequality, and wealth concentration. Table 3 shows that the calibrated economy matches these data quite closely. Building a theory of economic inequality and endogenous human capital that is quantitatively consistent with the aforementioned observations is an important contribution of our paper. In this section we examine how the model economy is able to account for some salient features of US economic inequality and we relate our findings to other quantitative studies of the income distribution and wealth.

Inequality of Earnings The benchmark economy reproduces the variance of log earnings in the US economy. Our calibration procedure ensures that two thirds of the variance of log-earnings are explained by differences in parental investments in human capital (the other third is explained by market luck). Parental investments vary substantially not only because some families are constrained in their educational expenditures but because the "efficient" amount of parental investments differs across families. By efficient investment, we mean the parental investment in human capital that would result in the absence of borrowing constraints.

Since human capital investments are subject to decreasing returns, unconstrained parents invest in the education of their children up to the point where the expected marginal return to human capital equals the return on capital (apart from a risk premium due to risky education). Parents differ in their ability to educate children because parental human capital is an input in the education technology. As a result, time investments are more productive the higher is parental human capital. Figure 2 shows that, in the benchmark economy, effective time investments uh increase with parental wages over low wage levels and stays relatively constant over the rest of the wage distribution. However, the average parental time input decreases with parental wages, except for the lowest 5% of the wage distribution. This observation is due to the fact that the opportunity cost of time is increasing in parental human capital (for a fixed market luck). As higher-wage parents substitute expenditures on market human capital m for the effective time input uh, expenditures on education increase over the entire support of the wage distribution (see Figure 3).

The amount of aggregate resources devoted to human capital accumulation in our benchmark economy constitute 7.2% of output.[1] This amount is not far from the estimates obtained by Haveman and Wolfe (1995). These authors report that parental expenses, including foregone earnings but excluding college expenses, account for about 10% of GDP.

Persistence of Inequality The correlation between parental and children's log earnings in the benchmark economy is equal to our calibration target of .5. We emphasize that this correlation is entirely due to parental investment decisions. In our economy, human capital can be correlated across generations even among parents who do not face binding borrowing constraints. Efficient (or unconstrained) investments in human capital depend on parental characteristics such as human capital, the discount factor, and market luck. A higher parental human capital has two opposite effects on human capital investments: On the one hand, it increases the ability of parents to educate their children, and while on the other hand, it increases the opportunity cost of these investments. Patient parents (those with a high discount factor) will want to invest more in their childrens' education than impatient parents (those with a low discount factor). Since the discount factor is correlated across generations, it reinforces persistence of earnings inequality. High market luck increases the opportunity cost of parental time without affecting the ability to educate children since market luck is not an input in the production of human capital. Thus, if we consider parents

[1] Private expenditures on education amount to 3.8% of output. In addition, agents spend, on average, 8% of their young-age time endowment educating their offsprings.

who are not credit-constrained and that only differ in their market luck, those with high market luck have higher earnings and choose to spend less time in the education of their children and to transfer more goods instead.

Human capital is also correlated across generations because of the presence of borrowing constraints. When parental earnings are low, expenditures on education are likely to be limited by parental resources. As a result, differences in resources among borrowing constrained parents are likely to be transmitted to their children. Figure 4 shows that the fraction of households facing binding borrowing constraints decreases with parental earnings and that credit constraints are quite likely to bind among low earnings households. In fact, about half of the households in the bottom 5% of the earnings distribution face binding liquidity constraints in the benchmark economy. Given the importance of borrowing constraints for the persistence of inequality in our model, it is worth noting that these constraints are quite "soft" since they are imposed over a 30 year period!

Time Share in Human Capital Technology We use the cross-sectional restrictions of our theory in order to pin down the time share (η) in the education technology. In our model economy, both inequality and its persistence across generations are jointly determined by the specification of preferences, technologies, and stochastic process for earnings. We find, however, that the share of time input in the human capital technology plays an important role in determining persistence of earnings. Intuitively, when time is an input in the human capital technology ($\eta > 0$), parents with high market luck face a high cost of educating their children and, thus, a lower return on human capital investments. As a result, parents with high wages invest less in their children, which translates into a lower intergenerational correlation of earnings. The strength of this effect is positively associated with the time share (η) in the education technology. In order to illustrate the quantitative importance of this finding we consider two economies that only differ with our benchmark economy in the human capital technology. In the first economy, which we denote as "time-only economy", human capital accumulation requires only time inputs ($\eta = 1$). In the second economy, which we denote as "expenditures-only economy", human capital is a function of expenditures and there is no time input ($\eta = 0$). In both economies, returns to scale in human capital accumulation (ξ) and all other parameters are mantained as in our benchmark economy. Table 5 shows that the intergenerational correlation of earnings is almost three times higher in the expenditures-only economy: The intergenerational correlation of earnings is .25 when time is the sole input in the human capital technology ($\eta = 1$) and it is .71 when human capital is only a function of expenditures ($\eta = 0$). Our calibration target of .5 for the persistence of earnings inequality is well within this range of values, and $\eta = 0.4$ matches this target.

Inequality of Wealth The benchmark economy matches our targets of .78 for the Gini coefficient on wealth and 55% of wealth concentrated among the richest 5% of the population. In this economy, poor individuals save very little capital and a small subset of individuals own most of aggregate capital holdings. Poor households are likely to face high marginal returns to education investment because of decreasing returns to human capital accumulation. As a result, they allocate most of their savings to human capital investment and accumulate very little physical capital (see Figure 5). Since the rate at which individuals discount the future is stochastic, and since shocks to the discount factor are quite persistent, wealthy individuals tend to be more patient than the average individual in the economy. They thus hold a big fraction of the economy's capital stock.

Relation to Other Quantitative Studies of US Economic Inequality In a review of recent contributions, Quadrini and Ríos-Rull (1997) identified two problems typically faced by models attempting to explain the US wealth distribution. First, poor households tend to hold too much wealth relative to the data. Second, rich households tend to hold too little wealth relative to the data.

In one of the first quantitative studies of the U.S. income distribution, Castañeda et al. (1998) find that low income households have strong incentives to save when they face a high probability of becoming unemployed, which leads to a counterfactual wealth distribution. In a recent paper, Castañeda et al. (2003) argue that the social security system plays a crucial role for understanding why poor households hold little wealth. In their framework, social security transfers are independent of past labor earnings. Under such a progressive social security system, low income individuals save very little since they expect their retirement income to be high. Our paper emphasizes an alternative (but complementary) explanation. In our framework, as in Knowles (1999), poor people accumulate little physical capital because they prefer to accumulate human capital. Our explanation relies on poor people facing a higher return in accumulating human than physical capital.

The high wealth concentration by individuals at the top of the wealth distribution in the US economy, has proven quite difficult to match, as the work of Huggett (1996) and Castañeda et al. (1998) have shown (also see Díaz-Giménez et al., 1997). In order to account for the high wealth concentration by the richest individuals, Quadrini (2000) formulates a model with entrepreneurial projects where rich individuals face high returns to capital accumulation. A different approach is taken by Castañeda et al. (2003). They consider an economy where individuals face uncertainty in their labor productivity. The stochastic process is such that individuals face the chance, though with low probability, of obtaining a productivity shock that is more than 1000 times their median income in the economy. They showed that the desire to smooth consumption could lead to high wealth concentration. In our paper, we follow Krusell and Smith (1997, 1998) in considering a stochastic discount factor in order to generate plausible levels of wealth holdings by the richest individuals in the economy.

With the exception of Knowles (1999), the papers just cited abstract from human capital accumulation so that earnings inequality is mostly exogenous. In order to evaluate the role of human capital investments in shaping the distribution of wealth in our benchmark economy, we consider an experiment where parental decisions' regarding human capital accumulation are fixed. To this end, we assume that expenditures are a fixed parameter in the human capital technology and that parents spent an (exogenous) fixed amount of time educating their children. Expenditures and time inputs are fixed at the mean values in the benchmark economy, so that there is no heterogeneity in human capital across households. We find that the economy with fixed human capital has much lower values of wealth concentration than the benchmark economy. The wealth Gini is now about 10 percentage points lower than in the benchmark economy and the concentration of wealth by the top 5 % drops from 54% to 40%. We conclude that human capital investments play an important role in concentrating the distribution of wealth in our benchmark economy.

Knowles (1999) considers a model where parents make fertility choices and decide education and bequests to their children. His aim is to match the fertility-earnings relation present in the data. Knowles argues that the quality-quantity trade-off, advocated by Becker and Tomes (1976), leads to substantial economic inequality. We view this argument as complementary to our research. In our paper, we abstract from fertility decisions but, unlike Knowles (1999), we consider a human capital technology with both time and expenditure inputs. As emphasized by Trostel (1993), the implications of tax policy depend crucially on the share of time and expenditure inputs in the human capital technology. Since it is hard to obtain convincing direct evidence on this parameter, we propose using the cross sectional restricitions of theory in order to parameterize the human capital technology. We can then evaluate tax policy in our benchmark economy and examine the sensitivity of the results to alternative specifications of the human capital technology.

5 Eliminating Progressive Income Taxation

We consider the effects of replacing progressive income taxation with proportional income taxation. To this end, we compute the steady state of an economy that is identical in terms of preferences and technology to the benchmark economy but has proportional income taxation instead of progressive income taxation. The proportional tax on income is chosen so that the government tax revenue is equal to that in the benchmark economy. In order to isolate how the imperfect tax-deductibility of time inputs and non-deductibility of expenditures contributes to the impact of progressive taxation, we conduct two experiments. In the first experiment, we evaluate progressive taxation in an economy where human capital accumulation only requires time inputs. In this case, imperfect deductibility of time inputs is the crucial margin affecting human capital accumulation. In a second experiment, we focus on the non-deductibility of expenditures by considering an economy with only expenditure inputs in the human capital technology.

Our main findings are that progressive income taxation has large negative effects on the aggregate stocks of physical and human capital and that it leads to a slight reduction in inequality. The magnitude of these effects depend on the specification of the human capital technology. In our benchmark economy, the share of expenditures is sufficiently large so that the non-deductibility of expenditures is a crucial factor in assessing the impact of progressive taxation. We also find that the imperfect deductibility of time inputs arising in a progressive tax system matters: Aggregate effects on human capital are large when human capital accumulation only depends on time inputs. Interestingly, the impact of progressive taxation on economic mobility depends crucially on how human capital is parameterized, a result that is novel in the literature.

5.1 Progressive Taxation and Households' Decisions.

Before proceeding to the numerical results, we present a brief discussion on how key margins on the households' decision problems are affected by progressive income taxation. With progressive taxes the marginal rate of return on savings is high for poor individuals and low for rich individuals. The elimination of progressive taxation differentially affects individuals across the income distribution: While high income individuals face a decrease in their marginal tax rate, low income individuals face an increase in the marginal tax rate. Moreover, because of the high concentration of income and wealth in the benchmark economy, the individuals that account for most of the savings in the economy face a reduction on their marginal tax rates. As a result the aggregate capital stock will be higher and the distribution of wealth more concentrated under proportional income taxation.

In examining the consequences of progressive taxation for human capital accumulation, it is convenient to first consider a proportional income tax. By reducing the net wage, a proportional income tax reduces the return and the cost of time inputs in human capital investments. When time is the only input in human capital accumulation, taxation reduces proportionally the benefits and costs of human capital investments. In this case, taxation does not affect the rate of return on human capital investments and, thus, human capital accumulation. When expenditure is also an input in the human capital technology, however, taxation only reduces *part* of the costs of human capital investments. In this case, the total cost is reduced less than the return with income taxation. Human capital accumulation is thus discouraged by taxation when education requires expenditures, a point emphasized by Trostel (1993). When income taxes are progressive, the tax rate on income increases with parental investments, an effect that further discourages parental investments in human capital.

Unlike a flat income tax, a progressive income tax discourages human capital accumulation even when the education technology does not depend on expenditures (that is, human capital is accumulated only with time inputs). A progressive tax system treats assymmetrically the costs and benefits of time inputs in human capital accumulation. To put it differently, the tax deductibility of time inputs under a progressive tax system is imperfect: The tax rate applied to the cost of time inputs is not, in general, equal to the tax rate applied to the return on human capital investments. When parents increase the time spent in educating their children, the tax rate at which time inputs are deducted *decreases* due to lower parental earnings. At the same time, the tax rate at which their children are taxed *increases* due to higher expected income of their children. The different marginal tax rates at which costs are deducted and benefits are taxed creates desincentives for human capital accumulation. This effect is not examined by Trostel (1993) because he only studies a flat income tax system.

5.2 Aggregate Effects

Elimination of progressivity in the income tax schedule results in large aggregate effects in our benchmark economy. In order to get a sense of how modeling human capital amplifies the aggregate impact of taxation, we also study taxation in an economy with exogenous human capital calibrated to the targets used in formulating our benchmark economy. Table 6 shows that eliminating progressive income taxation leads to a 22% increase in the aggregate physical capital stock in the economy with human capital accumulation. When labor productivity is exogenous, eliminating progressive income taxation leads to a roughly 12% increase in the physical capital stock which, though sizable, is about a half of the effect found in the economy with endogenous human capital. Similarly, the response of output to the elimination of progressive income taxes is much larger in the economy with human capital accumulation than in the economy with exogenous labor productivity. The key to these results is the response of the labor input. Since in the economy with exogenous human capital the labor supply cannot respond to tax incentives, an increase in the capital stock directly translates into an increase in the capital-labor ratio and, thus, a decrease in the interest rate. This last effect slows down capital accumulation. On the other hand, when human capital is endogenous, the aggregate labor supply turns out to be quite responsive to the elimination of progressive income taxation. Since the aggregate labor supply increases by 8.3%, the return to capital does not decrease as much with capital accumulation which leads to a larger increase in the capital stock when human capital is endogenous.

We have emphasized that progressive taxation affects human capital through two channels: imperfect tax-deductibility of time inputs and non-deductibility of expenditures. It is interesting to evaluate the role played by these two channels in generating our results. To this end, we report in Table 7 the effects of eliminating progressive taxation for economies with different time-shares in the human capital technology. Our findings parallel previous results in the literature: the impact of taxation varies widely across economies depending on how the human capital production function is parameterized. The elimination of progressive taxation leads to an increase in human capital between 4% and 19%, depending on whether the share of expenditures in the human capital technology, η, is 0 or 1. When expenditures are the only input in the technology for human capital ($\eta = 0$), taxation has the largest impact since the costs incured in accumulating human capital are not tax-deductible, a finding that is consistent with Trostel (1993). We emphasize, however, that even in the "time-only economy", taxation has distortionary effects on human capital due to imperfect time deductibility. In fact, when the share of time inputs, η, is equal to 1, eliminating progressive taxation leads to a 4% increase in human capital, about half the effect obtained in our benchmark economy. We conclude that imperfect time deductibility matters.

It is worth noting that by modeling expenditures as purchases of human capital services our benchmark model economy is less responsive to changes in taxation than a model were expenditures consists of goods purchases. In our model economy, the elimination of progressive taxation leads to an increase in capital accumulation and, as a result, to an increase in the wage rate. A higher wage rate in turn translates into a higher cost of human capital purchases, which negatively affects human capital invesments. Had we model expenditures as purchases of goods, the increase in the wage rate would have no impact on the cost of human capital accumulation so that changes in taxation would have larger effects.

5.3 Distributional Effects

The elimination of progressive income taxation leads to an important increase in economic inequality (see Table 8): The Gini coefficients of earnings, after-tax income, and wealth increase by .016, .062 and .062 percentage points, respectively. When labor producitivity is exogenous, the Gini coefficients of earnings, after-tax income, and wealth increase by .0, .052 , and .048 percentage points. We thus conclude that inequality increases more in the economy with endogenous human capital, though not by much.

The effect of taxes on the persistence of earnings inequality is far from trivial, however. We find that progressive taxation can increase or decrease earnings mobility, depending on the parameterization of the human capital technology. As Table 9 indicates, in the "time-only economy" the intergenerational correlation of earnings is *reduced* by .078 points with the elimination of progressive taxation. In the "expenditures-only economy", however, the elimination of progressive taxation leads to an *increase* in earnings persistence of .057 percentage points.

Our findings indicate that the imperfect tax-deductibility of time inputs associated with a progressive tax system leads to lower economic mobility. In providing some intuition for this finding it is convenient to consider parents that differ (only) in their market luck. Since parents with above average realizations of their market luck shocks expect their children to have lower market luck, they expect their children to face lower marginal tax rates. As a result, parents with high market luck can deduct the cost of human capital investments (market value of parental time) from their current tax liabilities at a higher rate than the rate they expect their children's earnings to be taxed . It follows that, in the presence of imperfect time deductibility, parents with high market luck have strong tax incentives to invest in the human capital of their children. These incentives lead to a higher intergenerational correlation of earnings under progressive than under proportional income taxation.

In the "expenditures-only economy", investment in human capital is not tax-deductible, and as a result taxes have a stronger distortionary effect on the human capital accumulation. Under a progressive tax system, this effect is more important among parents with high earnings because they face a higher marginal tax rate on their investments. Moreover, due to borrowing constraints, the elimination of progressive taxation does not increase investments in human capital of low earnings parents by much. Since individuals with low earnings are likely to be borrowing constrained, their investments are likely to be limited by their lack of resources but not by taxation. This effect is particularly important under a flat income tax because individuals with low earnings are more likely to face binding borrowing constraints with a proportional income tax. We conclude that the non-deductibility of expenditures enhances the intergernerational persistence of earnings inequality *more* under a progressive than under a proportional tax on income.

Our benchmark economy features both imperfect deductibility of time inputs and no deductibility in expenditures. Since these two features of a progressive tax code have opposite effects on earnings mobility, it is not clear a priori which effect is likely to dominate. We find that the elimination of progressive taxation leads to lower economic mobility.

We also find that the number of people who are credit constrained is significantly smaller when taxes are progressive rather than proportional. The key to this finding is that low income individuals face a low tax rate when taxes are progressive. As a result, they face a relatively high after-tax interest rate, which encourages them to save and makes them less likely to face a binding borrowing constraint. When tax progressivity is eliminated, the number of people who are borrowing constrained increases by a factor of three: from 8.1%

of the population to 25.1% (see Table 8). When parents can invest in the education of their children, the number of credit constrained individuals is quite sensitive to tax incentives for two reasons. First, the elimination of progressive income taxation substantially increases the returns to investment in education and, thus, the need to finance educational expenditures. Second, the costs of educational expenditures are relatively high under proportional taxation because the wage rate is in this case 4.2% higher than in the economy with progressive taxation.

6 Conclusion

In this paper, we took an intergenerational approach to evaluating the effects of progressive income taxation on capital accumulation and inequality. We first built a quantitative theory of parental investments in human and physical capital that is consistent with a set of observations about economic inequality in the U.S. economy. To this end, we devoted special attention to the persistence of life-time inequality, as measured by the intergenerational correlation of life-time earnings. Rather than assuming an exogenous transmission of human capital across generations, we considered parental investments of time and expenditure on education as inputs into the human capital production of an offspring.

Recognizing that the effects of income taxation depend crucially on the specification of the production technology for human capital, as emphasized by Trostel (1993), and given the lack of conclusive micro evidence on the determinants of human capital formation, we introduced a novel approach to parameterizing the human capital technology. In particular, we used the cross-sectional restrictions of theory – such as the intergenerational correlation of life-time earnings, the variance of life-time earnings and its decomposition into endogenous and exogenous components – to jointly pin down the parameters of the human capital technology and the variance of a shock to the earnings process.

We then evaluated the effects on economic aggregates and inequality of replacing the progressive income tax system in the U.S. economy with a proportional income tax system. We found that the elimination of progressive taxation has large effects on macroeconomic variables and leads to an important increase in inequality. Parental investments in human capital amplify the aggregate effects, but not the distributive effects, of progressive taxation. We find that the non-deductibility of expenditures and the imperfect deductibility of time inputs under progressive income taxation have, in isolation, important effects on earnings mobility. Because these effects work in opposite directions, earnings mobility only decreases by a modest amount with the elimination of progressive taxation.

We have not modeled a labor-leisure choice. Introducing this feature into our framework will increase the aggregate impact of progressive taxation since labor supply distortions will further discourage human capital accumulation. This is a non-trivial extension that we leave for future research.

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7 Appendix

Table 1. Model Parameters

Parameter	Notation	Value
Capital Depreciation Rate (ann.)	δ	.08
Working Time Before Retiring	t^o	.5
Income Tax Parameters	a_0	.258
	a_1	.768
	a_2^{model}	2.37
Social Security Replacement Rate	ρ	.44

Table 2. Calibrated Model Parameters

Target	Parameter		**Time&Expenditure**	Exogenous
Capital/Output	Capital Share	α	.35	.338
Interest Rate	Discount Factor	$\beta_L^{\frac{1}{30}}$	.9282	.9252
Wealth Gini	Trans. Prob.	π_{LL}	.74	.835
Wealth Top 5%		π_{MM}	.94	.97
Fixed Eff. Var.	Prod. Shock Var.	σ_z	.74	.943
Earnings Var.	Degree of Scale	ξ	.75	-
Earnings Corr.	Time Share	η	.4	-
Earnings Corr.	Prod. Shock Corr.	ϱ	(0)	.5

Notation Used in the Tables Below

Earnings are measured by the market value of human capital $w(1+z)h$. Income includes the wage and interest income of the old before taxes and after social security transfers. Wealth is computed as the holdings of assets by the old (a). The number of borrowing constrained individuals is computed as the fraction of old parents with zero assets $(a = 0)$. Statistic 'no wealth transfer' reffers to a fraction of old parents that make zero transfers of capital to their off-springs $(q = 0)$. Intergenerational correlations of (log) earnings, income, and wealth are computed using observations of two consecutive old individuals of the same dynasty. Because log wealth is not well defined for zero wealth, we compute (log) wealth correlations using observations in which both parents and children have positive wealth when old. This procedure is similar to the one used by Mulligan (1997, page 191)

Table 3. Benchmark Calibration Results

Targets	U.S.	Time&Expenditure
Capital/Output	2.17	2.17
Interest Rate	5.4%	5.3%
Wealth Gini	.78	.78
Wealth: top 5%	55%	54%
$Var[Log(Earnings)]$	.36	.34
$\frac{Var(\log(1+z))}{Var[Log(Earnings)]}$	.33	.33
Earnings Corr.	.5	.5

Table 4. Other Statistics for the Benchmark

Ave Time Investment	.079
Total Educ.Expend.	3.8% $of\ GNP$
Total Cost of Inv. in Educ.	7.2% $of\ GNP$
Borrowing Constrained	8%
Average Tax Rate	11.8%

Table 5. Inequality under Alternative Human Capital Production Technology Specifications

Human Capital Technology	Time Only	**Time&Expenditure**	Expenditure
Time Share η	1.0	**.4**	.0
Earnings Gini	0.352	.289	0.280
Income Gini	0.515	.484	0.499
Wealth Gini	0.763	.781	0.812
Var of Log-Earnings	0.479	.343	0.377
Var of Log-Income	0.770	.696	0.717
Earnings Corr.	0.253	.505	0.710
Income Corr.	0.871	.858	0.920
Borrowing Constrained	7.9%	8.1%	8.5%

Table 6. Proportinal Tax Experiments: Aggregate Effects
in the Benchmark and Exogenous Earnings Economies

Change in	**Time&Expenditure**	Exogenous
Output	12.6%	3.8%
Capital	21.8%	11.8%
Labor	8.3%	0
Consumption	13.2%	3.8%
Capital/Output	7.8%	7.8%
Interest Rate	$-.27$	$-.25$
Wage Rate	4.2%	3.9%
Ave Time Inv.	.002	.0
New Tax Rate	12.3%	13.1%

Table 7. Proportional Tax Experiments: Aggregate Effects
under Alternative Human Capital Production Technology Specifications

Change in	Time	**Time&Expenditure**	Expenditure
Output	9.5%	12.6%	24%
Capital	20%	21.8%	35%
Labor	4%	8.3%	19%

Table 8. Proportional Tax Experiment: Inequality and Mobility Effects in the Benchmark and Exogenous Earnings Economies

	Time&Expenditure		Exogenous	
Statistics	**Initial Value**	**Change**	Initial Value	Change
Earnings Gini	.289	+.016	.359	0
Income Gini	.484	+.034	.501	+.024
After-tax Income Gini	.457	+.062	.472	+.052
Wealth Gini	.781	+.062	.782	+.048
Var of Log-Earnings	.343	+.044	.341	0
Var of Log-Income	.696	+.098	.635	+.066
Earnings Corr.	.505	+.023	.505	0
Income Corr.	.858	+.000	.841	−.005
$\frac{Var(\log(1+z))}{Var[Log(Earnings)]}$	.329	−.036	1	0
borrowing constrained	8.1%	+17.7%	7%	+8.5%

Table 9. Proportional Tax Experiments: Aggregate Effects under Alternative Human Capital Production Technology Specifications

Statistics	Time	**Time&Exp**	Expenditure
Earnings Gini	+.014	+.016	+.021
Income Gini	+.033	+.034	+.038
Wealth Gini	+.054	+.062	+.062
Var of Log-Earnings	+.037	+.044	+.072
Var of Log-Income	+.067	+.098	+.136
Earnings Corr.	−.078	+.023	+.057
Income Corr.	−.015	+.000	+.004
borr. constrained	+22.9%	+17.7%	+18%

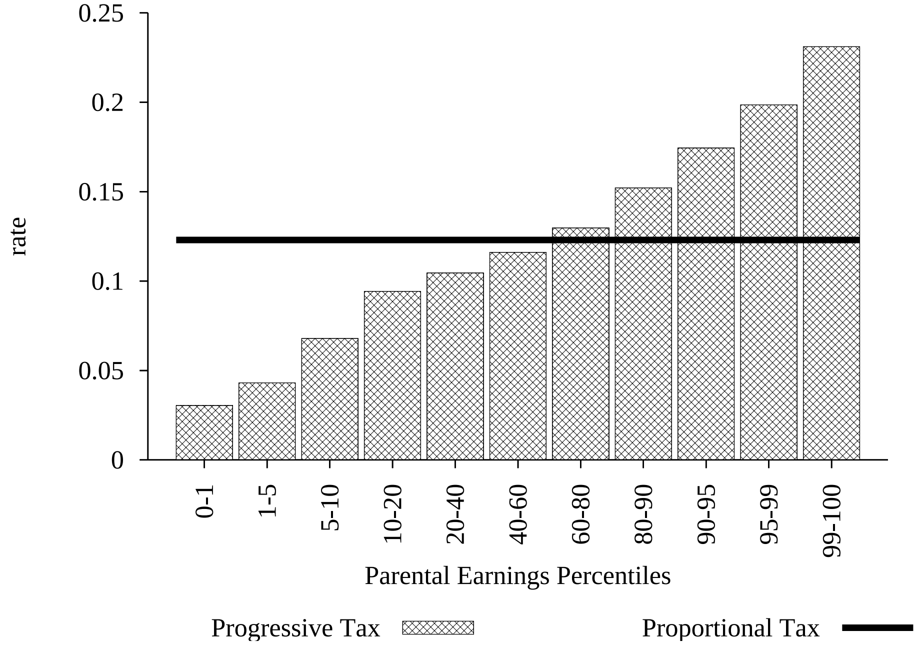

Figure 1: Marginal Tax Rates

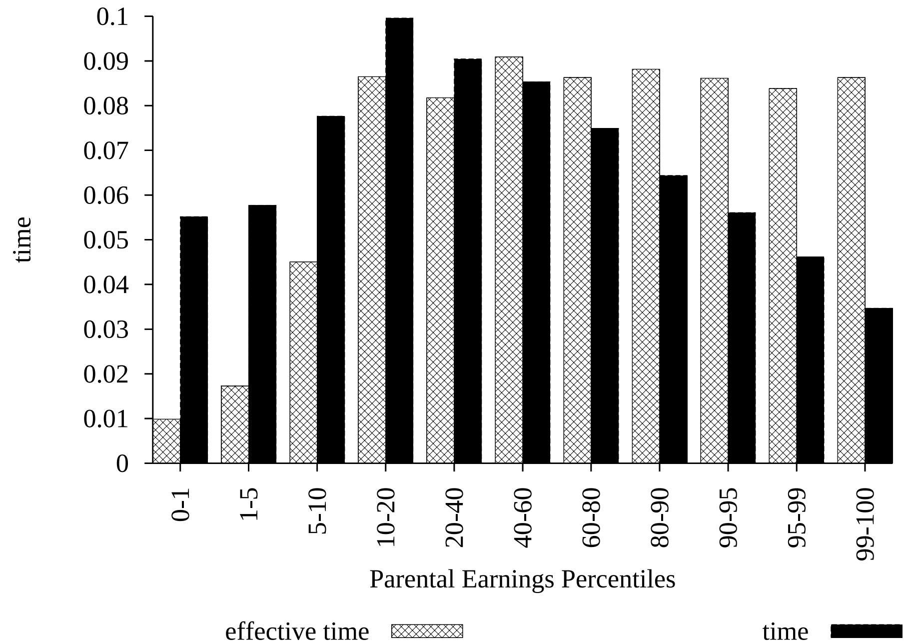

Figure 2: Parental Time Investment

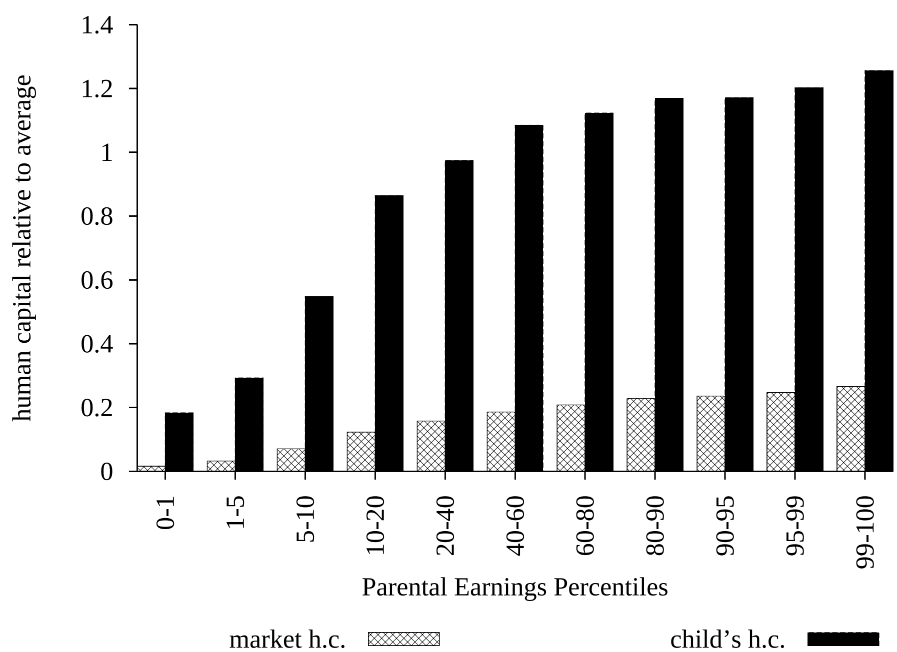

Figure 3: Market-purchased and Produced Human Capital

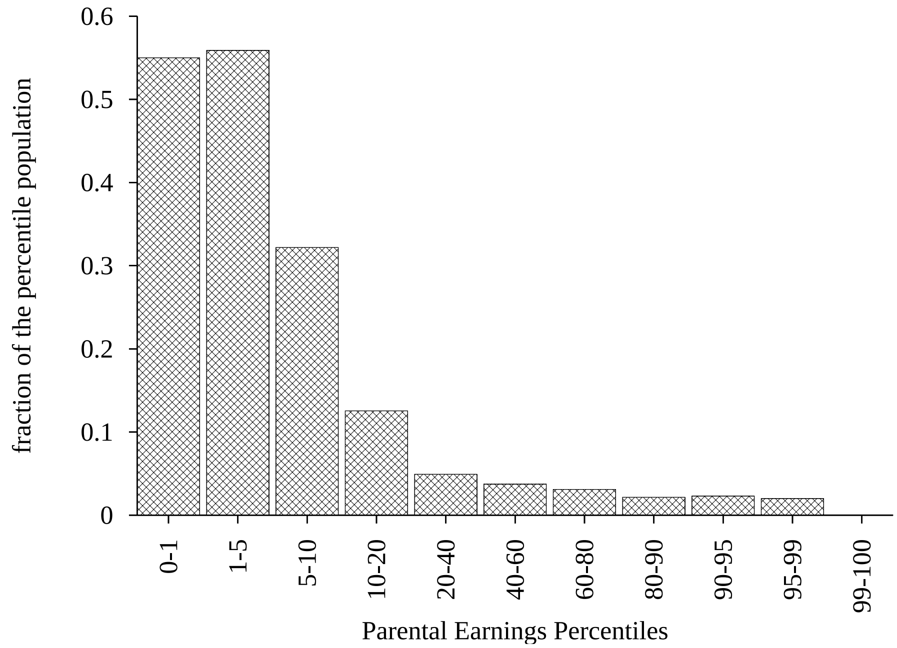

Figure 4: Borrowing Constrained Agents

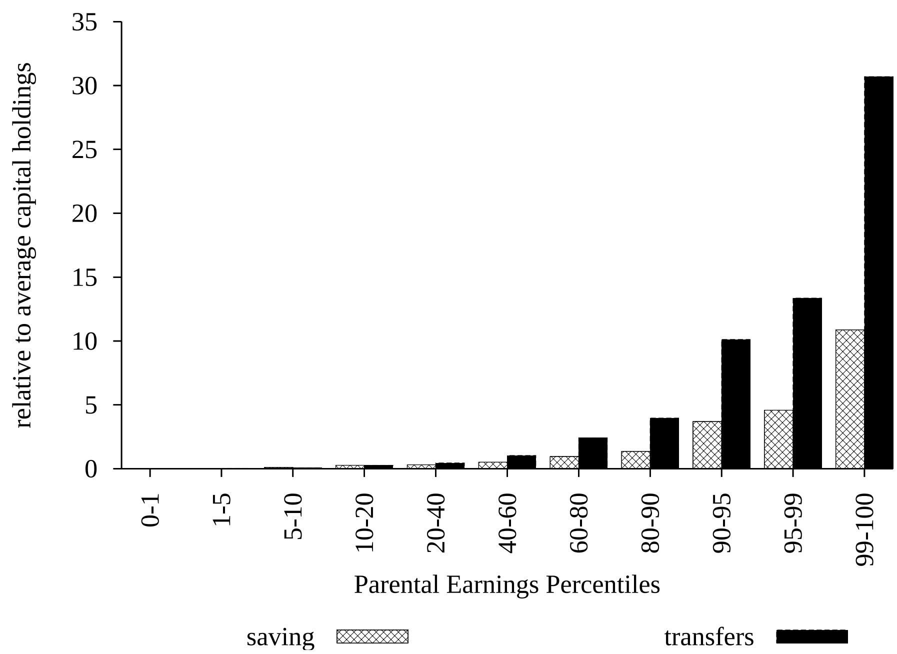

Figure 5: Wealth: Saving and Transfers