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Equity and efficiency effects of redistributive policies ☆

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Abstract

How do various forms of redistribution affect the distributions of earnings and consumption and their intergenerational mobility? Do redistributive policies enhance efficiency by mitigating market imperfections? Or do they create a trade-off between equity and efficiency? To address these issues, a dynamic general equilibrium model is constructed and solved numerically. The effects of the degrees of targeting of money transfers and educational transfers and the relative performance of the two types of transfers are examined.
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1. Introduction

Consider the following evidence regarding income inequality, and its persistence across generations in the United States.

1. The United States exhibits greater income inequality than most developed countries. Inequality has shown a secular increase, particularly from the mid-70s to the early 90s.[1]
2. There is a large degree of persistence in income and earnings across generations. Recent empirical work finds parent-son correlations of earnings of the order of 0.4–0.5.[2]

These facts indicate that there is considerable inequality within a generation, and persistence in economic status across generations. If these phenomena are being caused by unequal opportunities for acquiring human capital, then the economy is not using its resources efficiently. There is indirect evidence in support of this view. Tomes (1981) finds that for poor families, family income has an important effect on child's educational attainment. Shea (2000) finds that parental income is an important determinant of children's income for poor families even after controlling for genetic transmission of ability. If this view is correct, the high inequality and the low degree of mobility can be altered, not only to enhance equity, but also to raise efficiency through governmental intervention. However, if policies are not very effective, the costs of distorting people's working, investment and consumption choices could well exceed the benefits of easing such unequal opportunities. Thus, it seems important to examine how policies alter people's choices and affect economic outcomes. Modeling the various mechanisms through which such inequality is generated, and persists, is central to such an examination.

Income inequality is transmitted across generations through bequests and human capital. Asset levels persist across generations through bequests.[3] Human capital is transmitted through various channels—genes, nurture, education, family and neighborhood environments.[4] Market imperfections also affect the degree of inequality and its persistence. First, in the presence of intergenerational borrowing constraints, poor parents with able children would be unable to undertake efficient investments in their children. Loan markets for abilities at early ages rarely exist, as human capital is not a valid collateral. Second, there might be no insurance markets

[1]See Katz and Murphy (1992) and Levy and Murnane (1992).

[2]See Cooper et al. (1994), Solon (1992) and Zimmerman (1992).

[3]Inheritance is extremely important for persistence in economic status for the upper tail of the income distribution, but not that important for the majority of the population (Tomes, 1981).

[4]Ashenfelter and Rouse (2000), in their review of the literature on the return to education, find that education per se is important for human capital accumulation. Corcoran et al. (1991) find substantial disadvantages in economic status for black men and men from more welfare-dependent families or communities after controlling for family income. This suggests that family or neighborhood background is also important for human capital accumulation. Smith et al. (1997) demonstrate that mother's education has a statistically significant impact on her child's cognitive ability, even after controlling for family income.

in which parents can purchase insurance against their children's abilities. The lack of insurance markets creates an additional motive for investing in human and physical assets, since these could be used to self-insure against idiosyncratic shocks to ability.

Redistributive policies can reduce inequality and its persistence across generations by mitigating the impact of market imperfections. Two widespread policies are money transfers and educational transfers. Money transfers are mainly targeted at the poor and may be used by recipients to increase their consumption, leave additional bequests, or spend more on their children's education. These transfers might cause negative incentives for the recipients to work and invest in their children because their incomes are now less dependent on earnings. At the same time, they also allow parents to spend more time with their children, which is beneficial for their children's development. Educational transfers, on the other hand, specifically augment human capital.

The empirical literature on the effectiveness of redistributive policies suggests that while some policies are quite successful in improving the plight of poor families, others are not.[5] Although these results are suggestive about the effectiveness of the policies, the results cannot be directly compared to one another because they are not analyzed in a unified setting. Further, they remain silent on what would happen if these policies are altered. To complement such empirical work, it is important to investigate the relative performance of various policies using numerical simulations.

The primary objective of this paper is to quantify the relative efficiency and inter/intra-generational equity performances of two types of redistribution—money transfers and educational transfers—in a unified setting. A dynamic general equilibrium model with heterogenous agents is constructed. In doing so, the analysis draws upon the theoretical work by Becker and Tomes (1979), Loury (1981) and Laitner (1992). Individuals live for two periods—the first as a child and the second as an adult. They have an altruistic concern for the well-being of their progenies. In the first period they simply accumulate human capital. They begin the second period with the human capital acquired, bequests from parents, if any, and a child with random innate ability. The ability of the child is initially not known to them. They first decide how much time to devote to childcare. After this decision has been made, they get to know the abilities of their children. Now they choose how much to consume, invest in their children's education and leave for them in bequests. Parents cannot leave debts to their children nor purchase insurance against the random innate abilities of their children. The model includes integral elements in considering inequality—it has two types of accumulated assets, physical and human capital, and incorporates imperfections in intergenerational loan and credit markets.[6]

[5]Cooper (1998) finds that equalization of educational expenditures across school districts significantly reduces persistence in economic status for families in poor neighborhoods, but not in non-poor neighborhoods. Antel (1992) shows that a mother's welfare dependence appears to increase the welfare dependence of her daughters.

[6]Aiyagari et al. (2002) analyze the impact of these imperfections and find significant gains from completing these 'missing' markets.

This paper uses a calibrated general equilibrium model to quantify the effects of income and educational redistributive policies in an economy where intergenerational credit and insurance markets are missing. While there is now a considerable theoretical literature on this subject, careful quantitative assessments of these issues remain very scarce, so this is an important endeavor. Perhaps the most closely related paper is Benabou (2002), who studies tax and educational policies in a dynamic economy and concludes that the efficiency costs and benefits of redistribution are roughly of the same order of magnitude. Benabou (2000) develops a theory of inequality to explain how different countries can sustain different systems of redistributive policies. Fernandez and Rogerson (1998) analyze the effects of moving from a community-wide system of public education financing to a state-wide system and find that the move entails an increase in steady-state welfare and intergenerational mobility. Hanushek et al. (2003) find that wage subsidies dominate tuition subsidies in their general equilibrium set-up. This paper makes an important advance by incorporating the simultaneous accumulation of human and physical capital, whereas these previous papers considered only the former. Because this allows agents to engage in precautionary savings against transitory income or ability shocks, it potentially changes the welfare implications of the social insurance provided by redistributive policies. Another novel feature of this paper is to consider money and educational transfer policies jointly—as opposed to separately, or in contrast to one another.

The paper is organized as follows. Section 2 presents the set-up of the model, and Section 3 details the redistributive policies examined. Section 4 defines the competitive equilibrium. Section 5 presents the methodology and the measures used to compare different policies. Section 6 describes the procedure employed to calibrate the model to the U.S. economy. Section 7 presents the results of the numerical examination and Section 8 concludes.

2. Economic environment

The economy consists of a continuum of heterogeneous consumers, a representative firm and a government.

Consumers: A consumer lives for two periods, the first as a child and the second as an adult. In the first period of his life, he makes no decisions and simply accumulates human capital. His human capital is determined by his innate ability, his parent's human capital, the time spent by his parent on childcare, and his education.

He begins the second period of his life with the human capital acquired in the first period, bequests from his parent, if any, and a child with random innate ability. He cares about his own utility and the discounted present value of the utility of his progenies. He exhibits 'pure' altruism. In the beginning of the second period, he chooses how much time to devote to childcare and work. At this point in time, the ability of his child is not known to him. After this decision is made, the ability of his child is revealed. The parent now decides how much to consume, to spend on the education of his child and how much to leave for him in bequests. Generations go by in this fashion. The timing of the decision making is designed to capture the fact that early investment in a child is risky in nature since ability is not easily detectable early in life.[7]

Dynasty's problem: The maximization problem facing an adult in period 0 in a lineage starting with given values of human capital h_0 and assets a_0 is given by

$$\max_{n_0} E_0 \left\{ \begin{array}{l} \max_{c_0,e_0,a_1}[U(c_0) + \max_{n_1} E_1(\max_{c_1,e_1,a_2}\{\beta U(c_1) + \cdots \\ \quad +\max_{n_t} E_t[\max_{c_t,e_t,a_{t+1}}(\beta^t U(c_t) + \cdots)]\})] \end{array} \right\},$$

subject to the constraints (for $t \geqslant 0$)

$$c_t + e_t + a_{t+1} = (1 - \tau_{h,t})w_t h_t(1 - n_t) + [1 + r_t(1 - \tau_{k,t})]a_t + \mathbf{g}_t,$$

$$c_t, e_t, a_{t+1} \geqslant 0,$$

and

$$h_{t+1} = X(\theta_t, h_t, n_t, \widetilde{e}_t).$$

In the above formulation, E_t stands for the expectation conditional on the information available at the beginning of period t, $U(\cdot)$ is the momentary utility function, β is the rate at which a consumer discounts the utility of future generations, and $X(\cdot)$ denotes the production function for human capital. Here, $h_t, c_t, n_t, e_t, \widetilde{e}_t$ and a_{t+1} denote the human capital of an adult in period t, his consumption, the time he devotes to childcare, the educational expenditures he chooses for his child, the effective educational expenditures on his child (including subsidies and transfers from the government), and bequests, respectively. Further, w_t and r_t represent the wage rate per unit of human capital and the interest rate in period t. The government's policy variables $\tau_{h,t}, \tau_{k,t}$, and $\mathbf{g}_t$ stand for the tax rate on labor income, the tax rate on capital income, and governmental transfers, respectively. Assume that the utility function $U(\cdot)$ is strictly increasing, strictly concave and twice continuously differentiable. Furthermore, assume that $\lim_{c\to 0} U_1(c) = \infty$ so that consumption will always be maintained at a strictly positive level. A parent cannot leave a negative bequest to his child because loan markets to borrow against the child's income do not exist.

Human capital production: The human capital of an individual born in period t, h_{t+1}, is a function of his innate ability θ_t, the human capital of his parent h_t, the time spent by his parent on childcare, n_t, and the effective educational expenditures $\widetilde{e}_t$ including governmental support for education.[8] The evolution of human capital then reads

$$h_{t+1} = X(\theta_t, h_t, n_t, \widetilde{e}_t).$$

[7]For instance, Herrnstein and Murray (1994, p. 130) note that a mother's IQ when her child is 5 years old is a better predictor of her child's ability than is her child's IQ score at that age. Cognitive ability seems to set soon after that. Currie and Thomas (2001) find that test scores administered at the age of 7 are good predictors of future test scores and wages.

[8]To be more accurate, θ stands for the uninherited component of innate ability.

Assume that the function $X(\cdot)$ is continuous, strictly increasing in each of its arguments, twice continuously differentiable, strictly concave, satisfies $X_i(0) = \infty$ for $i = 2, 3, 4$ and possesses positive cross-derivatives. The initial distribution of human capital is given, while future distributions will be determined endogenously.

The introduction of parental human capital in the human capital production function may be interpreted in a few ways. First, if the human capital of the parent, and childcare time enter multiplicatively, then this formulation may be thought of as capturing 'quality time' in the sense that a parent with higher human capital would be better able to transmit learning to his child. A second interpretation is that a parent with higher human capital could provide better neighborhoods and surroundings which would augment his child's human capital. Another interpretation is that the parental human capital reflects an inherited component of innate ability. Let $\Theta : [\theta_{\min}, \theta_{\max}] \to [0, 1]$ represent the distribution function over the intrinsic ability. An individual's ability is drawn from this function each period and is uncorrelated across generations within a progeny. The random innate ability is the only source of individual uncertainty in this economy. There is no aggregate uncertainty.

Recursive formulation: This section poses the problem in a recursive fashion. The aggregate state Z represents the joint distribution function of a and h.[9] Let $J(a, h; Z)$ denote the welfare of an individual beginning his adulthood with bequests a and human capital h. His optimization problem can then be reformulated as

$$J(a, h; Z) = \max_n \left[\int V(a, h, \theta, n; Z)\, \mathrm{d}\Theta(\theta) \right], \tag{1}$$

where $V(a, h, \theta, n; Z)$ is the value function of the individual after he observes his child's ability θ and decides how much time to devote to childcare n. The function $V(\cdot)$ in turn, is given by the solution to the Bellman equation

$$V(a, h, \theta, n; Z) = \max_{c, e, a'} \{U(c) + \beta J(a', h'; Z')\}, \tag{2}$$

subject to the constraints

$$c + e + a' = (1 - \tau_h) wh(1 - n) + [1 + r(1 - \tau_k)]a + G(a, h; Z), \tag{3}$$

$$h' = X(\theta, h, n, \widetilde{e}), \tag{4}$$

$$c, e, a' \geqslant 0, \tag{5}$$

and

$$Z' = \mathbf{\Psi}(Z). \tag{6}$$

Here, $\mathbf{\Psi}(\cdot)$ describes the evolution of the aggregate state of the world Z, which denotes the joint distribution of human capital and assets. Further, $G(a, h; Z)$ denotes money transfers from the government. Observe that the transfers can be a function of the individual's states.

[9]Hereafter, period t variables will be expressed without any subscripts or superscripts, and period $t - 1$ variables and period $t + 1$ variables will be represented with subscript '-1' and superscript '$'$', respectively.

Firm: The firm rents physical capital and human capital from consumers to produce final goods using a constant-returns-to-scale production technology $\mathbf{y} = F(\mathbf{k}, \mathbf{h})$, where $\mathbf{y}$, $\mathbf{k}$ and $\mathbf{h}$ denote aggregate output, aggregate physical capital and aggregate human capital used for the production, respectively. The optimization problem facing the firm is then given by

$$\max_{\mathbf{k},\mathbf{h}}[F(\mathbf{k}, \mathbf{h}) - (r + \delta)\mathbf{k} - w\mathbf{h}],$$

where δ is the rate of depreciation of physical capital. The function $F(\mathbf{k}, \mathbf{h})$ is assumed to be strictly increasing and strictly concave. The first-order conditions associated with the above problem are $r = F_1(\mathbf{k}, \mathbf{h}) - \delta$ and $w = F_2(\mathbf{k}, \mathbf{h})$.

Government: The government administers proportional taxes on labor income τ_h, and capital income τ_k, and uses the proceeds $\tau_h w\mathbf{h} + \tau_k r\mathbf{k}$ to finance redistributive policies and other policies. The non-redistributive policies are governmental consumption of the final goods and they do not affect people's utilities. Denote the expenditures on these other policies by $\mathbf{c}_g$. The redistributive policies are detailed in Section 3.

3. Redistributive policies

This section describes the manner in which redistributive policies are implemented within the context of the model presented. Two types of redistributive policies are considered: money transfers and educational transfers. The former can be used by recipients for consumption, bequests or educational expenditures, while the latter exclusively augments human capital. Money transfers take the form of a negative income tax, while educational transfers can either be a lump-sum educational transfer or a subsidy to individual expenditures.

3.1. Money transfers

Money transfers are formulated as a negative income tax. The negative income tax (NIT) guarantees that every individual possesses a net income of at least g, but the transfer amount decreases as wealth increases, and above a certain level, it becomes zero. Denote the rate at which post-tax income is reduced by t. The net amount that each individual receives is then given by

$$\max(g - t\{(1 - \tau_h)wh(1 - n) + [1 + (1 - \tau_k)r]a\}, 0).$$

Given g and t, individuals with higher wealth receive less in transfers. Observe that as g increases or as t decreases, more individuals participate in the program. The 'break-even' individuals who just qualify for the NIT, are then characterized by

$$(a, h) : (1 - \tau_h)wh(1 - n) + [1 + (1 - \tau_k)r]a = \frac{g}{t}. \tag{7}$$

Individuals with net income below the break-even level qualify for the negative income tax. Finally, the government's budget constraint reads

$$\int_{\Im} (g - t\{(1-\tau_h)wh(1-n) + [1+(1-\tau_k)r]a\})\,\mathrm{d}Z(a,h) = s_{NIT}(\tau_h w\mathbf{h} + \tau_k r\mathbf{k}),$$

where $\Im = \{(a,h) : t\{(1-\tau_h)wh(1-n) + [1+(1-\tau_k)r]a\} \leqslant g\}$ denotes the set of qualified individuals and s_{NIT} is the share of the government's budget devoted to the negative income tax. The deduction rate t takes a value between 0 and 1. Lump sum transfers and income maintenance programs are special cases of the negative income tax when the deduction rate takes on the extreme values 0 and 1, respectively.

3.2. Educational transfers

Educational transfers can take the form of a lump-sum transfer $\bar{\mathbf{e}}$ or a tuition subsidy s^{T}. If a parent spends an amount e on his child's education, his child will effectively receive $\widetilde{e} = \bar{\mathbf{e}} + (1+s^{\mathrm{T}})e$ worth of education. The government's budget constraints are then given by

$$\bar{\mathbf{e}} = \xi s_e(\tau_h w\mathbf{h} + \tau_k r\mathbf{k}),$$

and

$$s^{\mathrm{T}}\mathbf{e} = (1-\xi)s_e(\tau_h w\mathbf{h} + \tau_k r\mathbf{k}),$$

where $\mathbf{e}$ represents aggregate expenditures on education by individuals, s_e is the share of the governmental expenditures on educational transfers, and ξ denotes the share of educational transfers devoted to the lump-sum transfer.

4. Competitive equilibrium

Definition 1. A recursive competitive equilibrium consists of a set of decision rules for individuals, N, C, A, E and H; a set of aggregate decision rules, $\mathbf{k}$, $\mathbf{h}$ and $\mathbf{e}$; a law of motion for the distributions of a and h (the aggregate state of the world), $\mathbf{\Psi}$; price functions R and W; government policies τ_h, τ_k, g, $t, \bar{\mathbf{e}}, s^{\mathrm{T}}$ and $\mathbf{c}_g$; and value functions J and V; such that

1. The function N solves (1) given V, with the maximized value function given by J.
2. The functions C, A, E and H solve (2) given the functions $\mathbf{\Psi}$, W, R, the value function J and the government policies, with the maximized value function given by V.
3. The pricing functions R and W satisfy the conditions:

$$R(\mathbf{k},\mathbf{h}) = F_1(\mathbf{k},\mathbf{h}) - \delta,$$

and

$$W(\mathbf{k},\mathbf{h}) = F_2(\mathbf{k},\mathbf{h}),$$

where

$$\mathbf{k} = \int_a \int_h a \, \mathrm{d}Z(a,h),$$

and

$$\mathbf{h} = \int_a \int_h h[1 - N(a,h;Z)] \, \mathrm{d}Z(a,h).$$

4. The government's budget constraint is satisfied, i.e.

$$\tau_h w\mathbf{h} + \tau_k r\mathbf{k} = \mathbf{tr} + \bar{\mathbf{e}} + s^{\mathrm{T}}\mathbf{e} + \mathbf{c_g},$$

where

$$\mathbf{tr} = \int_{\Im} (g - t\{(1-\tau_h)wh(1 - N(a,h;Z)) + [1 + (1-\tau_k)r]a\}) \, \mathrm{d}Z(a,h),$$

and

$$\Im = \{(a,h) : t\{(1-\tau_h)wh(1 - N(a,h;Z)) + [1 + (1-\tau_k)r]a\} \leqslant g\},$$

and

$$\mathbf{e} = \int_a \int_h \int_\theta E(a,h,\theta,N(a,h;Z);Z) \, \mathrm{d}\Theta(\theta) \, \mathrm{d}Z(a,h).$$

5. The aggregate state evolves according to the following equation, which defines $\mathbf{\Psi}$.

$$(Z)'(\widehat{a},\widehat{h}) = \int_{\widehat{a},\widehat{h}} \left\{ \int_a \int_h \int_\theta \Xi(a,h,\theta,Z) \, \mathrm{d}\Theta(\theta) \, \mathrm{d}Z(a,h) \right\} \mathrm{d}a' \, \mathrm{d}h',$$

where

$$\Xi(a,h,\theta,Z) = 1(a' = A(a,h,\theta,N(a,h;Z);Z), h' = H(a,h,\theta,N(a,h;Z);Z)),$$

$\forall(\widehat{a},\widehat{h},\widehat{\theta},\widehat{n}) \in \mathscr{B}$ (an appropriate family of subsets of $[0,a_{\max}] \times [h_{\min},h_{\max}] \times [\theta_{\min},\theta_{\max}] \times [0,1]$). Here, $1(\cdot)$ is an indicator function which takes on a value one if the statement is true and zero otherwise.

Definition 2. A stationary recursive competitive equilibrium is a recursive competitive equilibrium in which $Z = \mathbf{\Psi}(Z)$ and the government's policies are time-invariant.

5. Criteria and methodology

Before proceeding to a discussion of the calibration and results, it is important to set out the precise manner in which comparisons across various redistributive policies are made and to spell out the criteria used in attempting such comparisons. This helps to clarify the scope of the present analysis.

First, it is important to note that the analysis focuses exclusively on steady-states. That is, comparisons are made across steady-states with different policies. The paper thus remains silent on transitions from one steady-state to another resulting from a policy change. An analysis of a transitional path is greatly complicated by the fact that the distributions of physical and human capital would be changing along a transition to the new steady-state and that the consumer would have to keep track of these distributions in order to predict prices and solve his optimization problem.

Different redistributive policies are contrasted in the following manner. First, within each of money transfers and educational transfers, the effects of equalization of transfers are examined. That is, comparisons are made among negative income taxes with different deduction rates and among educational transfers with different shares spent on the lump-sum transfer relative to the tuition subsidy. After the comparisons within each type of transfers are made, the relative desirability of educational transfers over money transfers is examined by changing the allocations of revenues to each transfer. In comparing policies, tax rates are held fixed. Hence, governmental revenues could be different depending on redistributive policies because the policies alter the distributions of human and physical capital and hence their aggregates. Since the analysis focuses on long-run effects, it appears more relevant to fix tax rates rather than tax revenues while making comparisons.

Finally, the criteria used to compare different policies are equity and efficiency measures explained below.

5.1. Equity

In assessing equitableness of a model economy, the analysis differentiates between inequality *within* a generation and economic mobility *across* generations. Two measures of inequality within a generation are considered: the Gini coefficient and the coefficient of variation. The measure used to compare economic mobility is the intergenerational correlation of the natural logarithm of a variable.

5.2. Efficiency

Three measures of efficiency are considered: aggregate output, average expected utility across agents, and average certainty-equivalents. The first measure is typically used for measuring efficiency, but it does not take into account how much redistributive policies alleviate market imperfections explicitly. The second criterion is given by

$$\int_a \int_h J(a,h;Z)\,\mathrm{d}Z(a,h),$$

where Z is the stationary distribution of individuals over states (a,h). Consider an individual who is yet to be born into a given economy. If he begins adulthood with assets a and human capital h, $J(a,h;Z)$ would represent his expected utility. Of course, he could be born into any family. Then the above measure represents his average expected utility over all possible combinations of a and h. This measure reflects the effects of policies on market imperfections through changes in the smoothness of consumption streams. However, this measure rises with greater equality even when policies do not alleviate market imperfections. Hence the analysis also presents average certainty-equivalents, which is the third measure employed. This measure is developed in Benabou (2002). It is obtained by computing the amount of certain (period-by-period) consumption that an individual will need in order to be as well off as in a given economy, and then aggregating across all individuals. That is, for each individual, find $\widetilde{c}$ such that

$$\frac{U(\widetilde{c})}{1-\beta} = J(a, h; Z).$$

Then the average certainty-equivalents is given by $\int_a \int_h \widetilde{c}\, \mathrm{d}Z$. The main advantage of this measure is that it helps to distinguish the ability of a particular policy to correct market imperfections from its ability to enhance equality.

6. Calibration

Calibration involves choosing functional forms and the parameter values. The parameters are pinned down based on existing empirical work, if available. Otherwise they are set so that relevant statistics of the model economy get close to the corresponding ones of the U.S. economy, when policy parameters of the model are determined based on actual policies.

6.1. Final goods production and preferences

Final goods production function: Assume that the function is given by

$$F(\mathbf{k}, \mathbf{h}) = \mathbf{k}^{\alpha}\mathbf{h}^{1-\alpha}.$$

The parameter α is set to equal 0.36, which is approximately the capital's share of income in the United States.

Depreciation rate for physical capital δ: The annual rate of depreciation is usually set between 0.08 and 0.10 in the business cycle literature. Choosing the midpoint of these estimates and assuming that each period in the model corresponds to 25 years in real life, the depreciation rate for numerical simulations is set to be $1-(0.91)^{25}$.

Utility function: Assume that the utility function is of the constant-relative-risk-aversion variety and given by

$$U(c) = \frac{c^{1-\sigma}-1}{1-\sigma}, \quad \sigma > 1.$$

The analysis initially sets the value of σ to 2.0. The sensitivity of the results is explored for $\sigma = 5.0$ and the results are presented in Appendix A.3.

Discount factor on descendants' utilities β: Huggett (1996) chooses an annual discount factor of 0.91. Many business cycle papers use a quarterly discount factor of 0.99, which corresponds to an annual discount factor of about 0.96. The discount factor used for computation is set $(0.93)^{25}$, the corresponding annual value roughly in the middle of these estimates.

6.2. Human capital production function

The human capital production function and the distribution of innate ability are specified as follows:

$$h' = X(\theta, h, n, \tilde{e}) = A\theta h^{\chi_1} n^{\chi_2} \tilde{e}^{\chi_3}, \quad \text{where } \ln(\theta) \sim N(0, \sigma_\theta^2).$$

There seems to be no empirical analysis directly estimating the above production function. Further, direct evidence is hard to obtain to set the parameters for the following reasons. Existing work examining the effects of childcare on child's development uses indirect measures such as mother's working hours and focuses on the effects on child's educational attainment (as proxied, for instance, by test scores), and not on future earnings. Second, the literature on the effects of education on earnings distinguishes 'quantity' (years of education) from 'quality' (per student expenditures at each level of education) and examines each of them separately, while $\tilde{e}$ encompasses both aspects.[10] Ideally, the parameters should be determined based on structural estimation such as the method of simulated moments. However, given the complexity of the general equilibrium model, this is computationally infeasible. Thus, the parameters of the function are calibrated to match relevant statistics of the U.S. economy. The statistics to be matched are described in Section 6.4.

6.3. Governmental policies

As detailed above, the parameters governing the human capital production function and innate ability are set so that certain features of the model economy mimic those of the U.S. economy. In order to proceed, governmental policy parameters need to be matched with actual U.S. policies. Recall that the government's budget constraints are given by

$$\int \max\{\mathbf{g} - t[(1-\tau_h)wh(1-n) + (1-\tau_k)ra], 0\}\, \mathrm{d}Z(a,h) = s_{NIT}[\tau_h w\mathbf{h} + \tau_k r\mathbf{k}], \tag{8}$$

$$\bar{\mathbf{e}} = \xi s_e(\tau_h w\mathbf{h} + \tau_k r\mathbf{k}), \tag{9}$$

$$s^{\mathrm{T}}\mathbf{e} = (1-\xi)s_e(\tau_h w\mathbf{h} + \tau_k r\mathbf{k}), \tag{10}$$

and

$$\mathbf{c}_g = (1 - s_{NIT} - s_e)[\tau_h w\mathbf{h} + \tau_k r\mathbf{k}], \tag{11}$$

[10] The quantity aspect is largely examined using Mincer-type regressions. The representative work examining the quality aspect includes Card and Krueger (1992) and Hanushek (1986).

where $\mathbf{g}$ and t stand for the maximum possible transfer and the deduction rate for the negative income tax, $\bar{\mathbf{e}}$ is the lump-sum educational transfer, s^{T} is the subsidy rate for individual educational expenditures, and $\mathbf{c}_g$ is the government's expenditure on all other policies. Further, s_{NIT} and s_e represent the shares of government revenue spent on money transfers and educational transfers, and ξ denotes the share of educational transfers devoted to the lump-sum transfer $\bar{\mathbf{e}}$. Note that Eqs. (8)–(11) pin down $\mathbf{g}$, $\bar{\mathbf{e}}$, s^{T}, and $\mathbf{c}_g$ for given values of t, s_{NIT}, s_e, and ξ. Hence these four parameters need to be matched to data on U.S. policies. The value of ξ is almost impossible to set based on data because it is difficult to disentangle actual educational transfers into the two types of transfers in the model. Consequently, the parameter is set to match the ratio of educational expenditures to GDP.

Using data on governmental expenditures on policies that correspond to those in the model economy for the years 1970, 1980 and 1990 and taking averages over the three years, the values of the remaining three parameters are given by $s_{NIT} = 0.071$, $s_e = 0.154$, and $t = 0.67$. The exact procedure used to set these parameters is detailed in Appendix A.2. Further, following Lucas (1990), the tax rates on capital income τ_k and labor income τ_h are set to 0.36 and 0.40, respectively.

6.4. Pinning down the parameter values

As mentioned earlier, the parameters governing the human capital production function A, χ_1, χ_2, and χ_3; the standard deviation of the natural logarithm of the innate ability σ_θ; and the proportion of educational transfers spent on the lump-sum transfer ξ are set so that relevant statistics of the model economy are reasonably close to the corresponding ones of the U.S. economy. The statistics to be matched are the Gini coefficient, coefficient of variation, skewness, and the mean/median ratio of lifetime earnings, all of which are taken from Knowles (1999); the intergenerational correlation of the natural logarithm of lifetime earnings, which is obtained from Solon (1992) and Zimmerman (1992); the percentage of the population leaving no bequests from McGarry (2000);[11] the ratio of total educational expenditures to GDP (from Snyder et al., 1997);[12] and the proportion of time (childcare time plus working time) spent on childcare, which is calculated using data from Hill and Stafford (1985) and McGrattan and Rogerson (1998).[13]

The values of the parameters used in simulations are presented in Table 1. The coefficient on educational expenditures in the human capital production function, χ_3, is set to 0.24. This is an important parameter and it is worthwhile examining how reasonable this value is. A Mincer regression (using data from the National

[11]The average reported probability of leaving a bequest among respondents with at least one non-coresident adult child in the Assets and Health Dynamics Study (AHEAD) is 0.55.

[12]Total educational expenditures are total expenditures spent by all educational institutions. The value is computed as the average of the ratios in 1970, 1980, and 1990.

[13]Using the data from McGrattan and Rogerson (1998), the average working time spent by males and females between the ages of 25 and 64 for the years 1970, 1980, and 1990 is 55.5 h a week. Estimates from Hill and Stafford (1985) suggest that the average time spent on childcare is 10 h a week. Assuming that childcare for the first 6 years of life affects human capital development, $E[n] = \frac{6\times 10}{6\times 10+40\times 55.5} = 2.63$ (%).

Table 1
Parameters

Parameter	Description	Value
α	Coeff. on physical capital of production function	0.36
δ	Depreciation rate of physical capital	$1-(0.91)^{25}$
σ	Coeff. of relative risk aversion	2.0
β	Discount factor on descendants' utilities	$(0.93)^{25}$
A	Constant of human capital (HC) production function	1.51
χ_1	Coeff. on parental human capital of HC function	0.33
χ_2	Coeff. on childcare time of HC function	0.12
χ_3	Coeff. on educational expenditures of HC function	0.24
σ_θ	Standard deviation of the natural log of innate ability	0.45
s_e	Share of government's budget devoted to education	0.154
s_{NIT}	Share of government's budget devoted to NIT	0.071
ξ	Fraction of educational transfers spent on lump-sums	0.33
τ_h	Tax rate on human capital	0.4
τ_k	Tax rate on physical capital	0.36

Longitudinal Survey of Youth 1979) that controls for the effects of innate ability, parental human capital, and childcare yields a return to an additional year of education of 0.07. Transformation of the return to the elasticity of earnings with respect to educational expenditures, χ_3, using national average expenditures at each level of education, yields 0.37.[14] This over-estimates the 'true' elasticity since variations in expenditures across schools at each level of education are not captured. For instance, Heckman (2000) reports that the elasticity of earnings with respect to per pupil expenditures in mandatory education is about 0.1. The value 0.24 used in the simulations is the midpoint of the implied estimate from the Mincer regression, 0.37, and the elasticity with respect to per-pupil expenditures reported by Heckman, 0.1. Since the model captures both quantity (years of education) and quality (per pupil educational expenditures at a given level of education) aspects of education with one variable $\widetilde{e}$, the value of the coefficient seems reasonable.

Another parameter that plays an important role is ξ, the fraction of educational transfers spent on lump-sums. The value is set at 0.33 in the baseline economy and deserves special mention. Is this value reasonable? An obvious counterpart in the data is the distribution of life-time educational expenditures. One could vary ξ and choose the value that results in the best fit. Unfortunately, the distribution of life-time educational expenditures (primary, secondary, and higher education combined) is a difficult object to compute from the data. So, we look at other moments. As ξ

[14]Using the human capital production function of the model, the return to education for an individual with s years of education is computed as $\chi_3(\ln \widetilde{e}_{s+1} - \ln \widetilde{e}_s)$, where $\widetilde{e}_s$ is the total educational expenditures spent on him and $\widetilde{e}_{s+1}$ is the total expenditure if he takes additional one year of education. Since there are no data on actual educational expenditures for individuals in the NLSY data, national average expenditures for each level of education is used for $\widetilde{e}_s$. The implied value for χ_3, 0.37, is obtained by equating the average return to education based on the above expression to the estimated return to education from the Mincer regression, 0.07.

rises, holding other parameters fixed, the ratio of educational expenditures to GDP rises considerably. For instance, when ξ rises to 0.5, the ratio of educational expenditures to GDP rises to 8%, which is much higher than the U.S. economy. Further, the intergenerational correlation in earnings decreases considerably when ξ rises. With the chosen value of 0.33, both statistics get closer to the corresponding values for the U.S. economy.[15]

7. Results

We now proceed to the results of the numerical simulations. The effects of changes in (i) the degree of targeting of money transfers, (ii) the degree of targeting of educational transfers, and (iii) the allocation of the government's budget between money transfers and educational transfers are examined.

Baseline economy: First, the statistics of the baseline economy calibrated to match data on the U.S. economy are presented in Table 2.[16] The match between the baseline economy and the U.S. data seems reasonable in terms of the presented statistics with the notable exception of the skewness in earnings, which is much lower in the model economy. The distribution of assets exhibits the greatest dispersion, followed by the distribution of earnings, and finally the distribution of consumption (see Table 3). This is in accord with the data. The intergenerational correlation of consumption is higher than that of earnings (again, see Table 3). This is a direct result of intergenerational consumption smoothing and is also supported empirically. Before turning to an examination of the effects of various policies, it is instructive to compare the baseline economy to an economy without any redistributive policies to see how effective current redistributive policies are.

Economy without redistributive policies: Now, some care needs to be exercised in attempting such a comparison. Since the baseline economy contains non-redistributive policies, it would make little sense to compare the baseline economy

[15]One might think that a value of $\xi = 0.33$ implies an education finance policy that is quite regressive. This would be true if one were to take the view that the lump-sum transfer corresponds to public expenditures on mandatory education and the tuition subsidy corresponds to expenditures on higher education. However, as stressed earlier, the educational expenditures in the model encompass both 'quantity' and 'quality' aspects of educational expenditures of real economy, hence the tuition subsidy reflects regressive parts of public expenditures on mandatory education (e.g. differences in expenditures across school districts) as well as public expenditures on higher education. Unfortunately we do not have data of the U.S. economy that can check the appropriateness of our choice of ξ directly. Of course we certainly cannot rule out the possibility that there may exist some combination of parameters with a higher value of ξ that may result in a better match between the model and the data, although we could not find such ξ.

[16]The value for the tuition subsidy rate s^{T} is 3.79. According to the Digest of Education Statistics, proportions of tuition and fees in current-fund revenues of degree-granting institutions for years 1980–1995 are in the range between 0.21 and 0.279, the corresponding values for s^{T} between 2.58 and 3.76. Since the tuition subsidy in the model includes regressive part of expenditures on mandatory education (such as differences in expenditures across school districts) as well, the true value for the U.S. economy should be higher, hence the value of 3.79 seems reasonable.

Table 2
Match of the model economy with the U.S. economy

	Model	U.S. Data (Source)
Distribution of earnings		
Gini	0.3408	0.32 (Knowles, 1999)
Coefficient of variation	0.6678	0.69 (Knowles, 1999)
Mean/Median	1.2427	1.13 (Knowles, 1999)
Skewness	1.8720	3.49 (Knowles, 1999)
Corr($\ln X, \ln X_{-1}$)	0.3966	0.4 (Solon, 1992; Zimmerman, 1992)
Other statistics		
People without bequests (%)	46.33	45 (McGarry, 2000)
Educational exp./GDP (%)	6.71	7.02 (Digest of Ed. Stat., 1997)
$E\left[\frac{\text{childcare time}}{\text{childcare time+work time}}\right]$(%)	2.50	2.63 (Hill and Stafford, 1985)

Table 3
Economy without redistributive policies

	No redistributions	Baseline
Distribution of earnings		
Gini	0.3198	0.3408
C.V.	0.6146	0.6678
Corr.	0.3297	0.3966
Distribution of assets		
Gini	0.5548	0.6643
C.V.	1.0938	1.3477
Zero bequests (%)	28.58	46.33
Distribution of consumption		
Gini	0.2259	0.2699
C.V.	0.4228	0.5062
Corr.	0.9062	0.9160
Measures of efficiency		
Aggregate output	56.41	100
Average welfare	2	1
Certainty equivalent	63.36	100

to an economy without any intervention whatsoever. Hence, the analysis proceeds as follows: imagine that individuals continue to pay taxes on capital and labor but that these tax rates are reduced by the proportion of governmental revenues spent on redistributive policies in the baseline case.[17] Consequently, tax rates are lower, but individuals receive no transfers from the government. The results are depicted in

[17]The resulting tax rates on capital and labor are $\tau_k = 0.279$ and $\tau_h = 0.31$.

Table 3. For average welfare in Table 3, only the ranking is presented, with 1 denoting the case associated with the highest average welfare. Aggregate output and certainty equivalents in the baseline economy are normalized to 100.

Observe, rather interestingly, that current redistributive policies *enhance* efficiency but *reduce* equity along all dimensions. Notice that while redistribution raises steady-state output by 77.3%, the Gini coefficient of consumption rises by 19.5%. Redistribution enhances efficiency by completing, in part, missing loan and insurance markets. The increase in earnings inequality transpires primarily because money transfers lower incentives to accumulate human capital by the poor and tuition subsidies benefit the rich more than the poor. This increased earnings dispersion translates into higher asset and consumption inequality. Taken together, the results of the simulations suggest that, while current U.S. redistributive policies enhance efficiency greatly, this comes at a cost of higher inequality both within and across generations. The increased inequality is sensitive to the value of ξ. For instance, if the value of ξ were as high as 0.75, then the Gini coefficient of earnings *decreases* from 0.3198 to 0.2975. However, as mentioned above, this value of ξ does not yield realistic values for the ratio of educational expenditures to GDP and the intergenerational correlation of earnings.

The result that current redistributive policies increase efficiency but reduce equity is the exact reverse of the usual "equity-efficiency" trade-off traditionally thought to characterize redistributive policies. It is also different from what occurs in the more recent class of models that feature credit market imperfections where redistributive policies often improve *both* equity and efficiency. The result that really stands out is the very large (77.4%) increase in steady-state output that is achieved by going from zero to current redistributive policies. As a comparison, in Benabou (2002), even when one turns off both labor supply and savings distortions, the gain in steady-state output relative to laissez-faire is only 15–20% at most, with either money or educational transfers. In Fernandez and Rogerson (1998), which allows for neither type of distortion, complete equalization of education expenditures yields only a gain of 3–4% in steady-state GDP. Why is there a much larger effect in the current environment? The main difference is the inclusion of intergenerational transfer of assets. In Section 7.4, the corresponding economy where there is no possibility for intertemporal trade in assets is presented and the exact same experiment conducted. It transpires that the welfare gain is much smaller than that reported here. Redistributive policies can be much more effective if individuals have greater flexibility in transferring resources from one generation to the next. Further, by raising human capital accumulation, redistributive policies also raise the return to complementary physical capital. The resulting effect in the economy is so profound that the magnitudes of the increase in steady-state output are much larger than what the above papers report.[18]

[18] There is one additional difference. The comparison here is not with a laissez faire economy but with one in which individuals continue to pay taxes so as to finance 'other' governmental policies. This further results in a bigger welfare gain than reported in these papers, since the comparison is with an economy in which, in addition to capital market distortions, there are distortionary taxes as well. If the baseline economy that includes other government policies is compared with a pure laissez faire economy, the increase in output is only about 18.1%, which is more in line with Benabou (2002). To summarize, the

The analysis suggests that a failure to incorporate intertemporal trade in assets can lead one to undervalue the efficiency enhancing effects of redistributive policies.[19] Having described the features of the baseline economy, the analysis now shifts toward an examination of the effects of policy changes.

7.1. Targeting money transfers

The first examination looks at the effects of changes in the deduction rate on money transfers t, holding fixed the shares of government revenues allocated to each of money transfers, educational transfers, and non-redistributive policies at the U.S. level.[20] Given budget allocations, an increase in the deduction rate lowers the number of people who qualify for the transfer program but increases the amount of money received by each qualified person. Recipients have more money to invest in their children as well as to consume for themselves. But, at the same time, the policy change lowers their incentives to work, since 'the tax' imposed on working now rises: the more they work, the less they receive from the government. It also might lower their educational expenditures since (after-transfer) income is less dependent on human capital. Do they invest more in their children? And, as a result, does the government succeed in decreasing inequality and increasing efficiency through such a policy change? Table 4 presents the effects on the distributions of earnings, assets, and consumption and efficiency. The case $t^{NIT} = 0.67$ corresponds to the actual U.S. economy and is depicted with a '$*$'.[21]

(*footnote continued*)
efficiency gains from redistribution are (much) larger in the presence of non-redistributive policies than in its absence. One might wonder why this is so. To see why note that most of the government's budget (77.5%) goes towards non-redistributive policies. Hence, the increase in tax rates needed to finance redistributive policies is small indeed. Consequently, while the additional distortions (due to the slightly higher tax rates) are small, the benefits from redistributions are large. Also note that the non-redistributive policies do not provide any utility whatsoever. In a sense, the baseline economy is "pretty" distorted to begin with. To get a more concrete picture, it is instructive to look at physical and human capital. In the baseline economy, human capital increases by 93% relative to the no redistributions case while physical capital increases by 52%. Likewise, in the baseline economy, human capital increases by 46% relative to the laissez faire economy while physical capital *decreases* by 24%. This decrease in physical capital can explain why output increases by only 18.1% in the baseline economy in comparison to the laissez faire. What is going on? The negative effect of a tax on human capital is smaller than that of a tax on physical capital, since the human capital production function exhibits diminishing returns in educational expenditures.

[19]The absence of raw labor/effort in the model also might come into play in generating sizeable output gains. This is because with labor in the production function, the weights of human and physical capital will be reduced. Further, some of the policy changes which in the current model induce people to work less would not translate, one for one, into greater time spent educating children at home.

[20]Since the shares are fixed, the maximum amount of transfers, g changes accordingly.

[21]When $t^{NIT} = 1.0$, those individuals who are a part of the welfare program devote all their time to childcare and no time to market work. Since their earnings are zero, the correlation of the logarithm of earnings across generations is undefined and marked with 'na'.

Table 4
Targeting of money transfers

t^{NIT}	0.0	0.33	0.5	0.67*	1.0
Distribution of earnings					
Gini	0.3197	0.3319	0.3377	0.3408	0.3720
C.V.	0.6159	0.6586	0.6667	0.6678	0.6957
Corr.	0.3285	0.3947	0.4069	0.3966	na
% on welfare	100	40.33	29.44	26.62	10.31
Distribution of assets					
Gini	0.5428	0.6742	0.6662	0.6643	0.5933
C.V.	1.0585	1.3714	1.3494	1.3477	1.1509
Zero bequests (%)	23.99	46.84	46.51	46.33	35.8
Distribution of consumption					
Gini	0.2080	0.2803	0.2722	0.2699	0.2191
C.V.	0.3939	0.5186	0.5083	0.5062	0.4103
Corr.	0.9078	0.9229	0.9218	0.9160	0.8371
Measures of efficiency					
Aggregate output	106.03	99.39	99.87	100	105.18
Average welfare	1	5	4	3	2
Certainty equivalent	106.07	99.22	99.91	100	105.40

The results show that increasing the rate leads to a more unequal distribution of earnings, both in terms of static inequality and intergenerational mobility. However, the changes are very small when the degree of targeting is intermediate. The distribution of human capital traces that of earnings until $t^{NIT} = 0.67$, then moves in the opposite direction. For example, when $t^{NIT} = 1.0$, the Gini coefficient of the distribution of human capital is 0.3197. In contrast, the inequality measures for assets and consumption increase and then decrease when t^{NIT} rises. The case $t^{NIT} = 0.0$ is best in terms of equality of earnings, assets, and consumption. Table 4 also shows the efficiency measures. Efficiency decreases and then increases as the deduction rate increases, and the changes in efficiency measures are very small at intermediate rates. In sum, targeting at the poor completely or giving equally to one and all, dominate all other choices, in terms of both efficiency and equality. Policy effects are minor when the deduction rate lies in an intermediate range.

How can these results be explained? In the short run, when the distributions of human capital and assets remain unchanged, income inequality declines when the government allocates more transfers to the poor by increasing the deduction rate. To gain more insight, imagine that prices are fixed at the levels that obtain when $t^{NIT} = 0.67$ (the baseline case). Now consider varying t^{NIT}. The Gini coefficient of after-tax, after-transfer income decreases monotonically from 0.3228 to 0.2868 as t^{NIT} rises from 0 to 1. Of course, this is the partial equilibrium or the short-run effect since prices are held fixed. The short run results do not hold in the long run because the change in t^{NIT} affects the steady-state distributions through its impact on investment decisions.

The policy change affects investments in children mainly through the following effects. (i) The direct effect of transfers: when the deduction rate is raised, the poor increase and the rich decrease their investments in education, in response to changes in received transfers. (ii) The effect on the return from work: a higher t^{NIT} lowers the return from work for the poor and raises the return for the rich, resulting in more time spent in childcare by the poor and less by the rich. (iii) The effect on the return to investment in education: a higher t^{NIT} implies a higher return to investment by the rich and a lower return for the poor, since the incomes of the rich will be more dependent on their human capital while those of the poor become less dependent. As a result, educational expenditures by the former group go up and expenditures by the latter group fall. (iv) The effect on credit constraints: targeting more at the poor alleviates credit constraints of the recipients of the transfers but worsens the constraints of individuals who formerly qualified (but not currently) for the program. Hence, the current recipients increase investments, while those who formerly qualified reduce investments. (v) The insurance effect: receiving more transfers implies more insurance against the random ability shock, so recipients' investments would decrease.

The results on the earnings and human capital distributions suggest that, when the transfers are distributed relatively evenly, the third and the fifth effect dominate the other effects; when the deduction rate is in the intermediate range, the opposing effects nearly cancel out; and when the transfers are targeted at the very poor, the third and the last effect are dominated by the other effects, especially by the effect on the return from work. The results also suggest that the distribution of assets and consumption are largely determined by the distribution of earnings when the degree of targeting is low, while they are more affected by the distribution of money transfers when targeted to the extreme poor.

The effect on efficiency is more complicated. When the deduction rate is low, the negative incentive effect caused by less dependence of recipients' income on investments in education dominates and efficiency decreases. The increase in efficiency when the deduction rate is large suggests that the transfers enhance investment in children by the poor greatly in this range. Although their income is less dependent on earnings, which tends to reduce their educational expenditures, they allocate more time to childcare instead of market work. The net effect on human capital accumulation of their children is positive and increases intergenerational mobility.[22] When the deduction rate lies in the middle, the opposing effects cancel each other, resulting in relatively smaller changes in efficiency.

Note that the result for $t^{NIT} = 1.0$ would change significantly if individuals are allowed to allocate their time for leisure as well as for childcare and work. In the current set-up, the income of those in the welfare program is independent of their human capital and work. Consequently, they do not work and spend all their time on childcare. If they are allowed to choose leisure, they would increase time spent on

[22] In fact, the intergenerational correlation of human capital is lowest when $t^{NIT} = 1.0$.

leisure as well. This will result in a smaller increase in childcare time. Hence the human capital investment of the poor would not rise as much as the model predicts, and upward mobility of their children would become more difficult. This suggests that the inclusion of leisure will strengthen the superiority of lump-sum money transfers ($t^{NIT} = 0.0$) over targeted money transfers.

7.2. Targeting educational transfers

The second experiment investigates the effects of changes in the share of educational transfers allocated to lump-sum transfers relative to tuition subsidies. Recall that total educational expenditures on a child are given by

$$\widetilde{e} = \bar{\mathbf{e}} + (1 + s^{\mathrm{T}})e,$$

where $\bar{\mathbf{e}}$ is a lump-sum educational transfer, while s^{T} represents the subsidy rate on the individual educational expenditures chosen by his parent, e. Consider what happens when the government devotes a greater fraction of its educational spending to the lump-sum transfer.[23] Now, educational transfers become more equally distributed, that is, the transfers are targeted less at the rich, who spend more on education and hence receive larger tuition subsidies, $s^{\mathrm{T}}e$. Given budget allocations, the equalization of the transfers raises the educational expenditures on poor children, whose private expenditures are small. At the same time, it lowers expenditures by the rich who now receive less in subsidies. As a result, the distribution of earnings would be more equalized. The effects on the distributions of assets and consumption and on efficiency, however, are not that apparent. As in the previous experiment, the shares of government revenues allocated to the three types of policies, that is, money transfers, educational transfers, and non-redistributive policies, are fixed at the U.S. level. Table 5 depicts the results. In the tables below, '% Equalization' refers to the fraction of the government's educational transfers devoted to the lump-sum transfer, $\bar{\mathbf{e}}$. The case with 33% equalization corresponds to the actual U.S. economy and is marked with '*'.

The results show that, as educational transfers are equalized to a greater degree, the distribution of earnings becomes more equal both in terms of static inequality and intergenerational mobility. In contrast, the distribution of assets becomes *more* dispersed when the degree of equalization is small. At higher levels of equalization, the effect goes in the opposite direction. For instance, the Gini coefficient for assets increases from 0.6340 to 0.6643 and the percentage of the population leaving no bequests increases from 43.57% to 46.33%, when the degree of equalization increases from 0% to 33%; and the Gini coefficient decreases from 0.6643 to 0.6146 and the ratio of the population leaving no bequests decreases from 46.33% to 43.22%, when the degree of equalization changes from 33% to 100%. The distribution of consumption and efficiency measures show the same pattern as the distribution of assets. For example, aggregate output decreases by 3.0% when the

[23] It is worth pointing out that this is different from the rate of equalization of expenditures, which is what previous papers focus on.

Table 5
Targeting of educational transfers

% Equalization	0	25	33*	50	75	100
Distribution of earnings						
Gini	0.3576	0.3477	0.3408	0.3264	0.2975	0.2758
C.V.	0.6894	0.6735	0.6678	0.6297	0.5838	0.5308
Corr.	0.4617	0.4174	0.3966	0.3417	0.2685	0.2378
% on welfare	22.83	24.17	26.62	24.88	27.58	25.89
Distribution of assets						
Gini	0.6340	0.6489	0.6643	0.6376	0.6278	0.6146
C.V.	1.2544	1.2996	1.3477	1.2489	1.2183	1.1900
Zero bequests (%)	43.57	45.12	46.33	45.02	44.51	43.22
Distribution of consumption						
Gini	0.2610	0.2632	0.2699	0.2468	0.2245	0.2186
C.V.	0.4793	0.4887	0.5062	0.4493	0.4070	0.4002
Corr.	0.9152	0.9113	0.9160	0.8925	0.8483	0.8126
Measures of efficiency						
Aggregate output	102.98	102.41	100	101.62	101.88	105.87
Average welfare	4	5	6	3	2	1
Certainty equivalent	102.17	102.02	100	101.86	101.97	104.94

degree of equalization increases from 0% to 33%, and it increases by 5.9% when the degree of equalization changes from 33% to 100%. The change in efficiency is small when the degree of equalization lies in the intermediate range. Overall, the government can maximize both efficiency and equality when the government attempts a *complete* equalization of educational transfers.

Since lump-sum educational transfers directly affect human capital formation, equalizing transfers increases educational expenditures on poor children. It also decreases human capital investment by the rich because tuition subsidies are reduced. This is why the distribution of earnings becomes more equal. The distribution of assets is largely determined by the distribution of earnings and the return to investing in physical capital relative to human capital. As the government allocates more of its budget to the lump-sum educational transfers, the relative return to assets for the rich rises while the return to the poor falls, and assets inequality tends to increase. When the degree of equalization is low, this effect dominates and the inequality increases. The results on the efficiency measures suggest that the negative effect on investment by the rich dominates the positive effect on investment by the poor when the degree of equalization is small, and vice-versa when it is high.

7.3. Money transfers versus educational transfers

The final experiment examines the relative performance of money transfers over educational transfers in achieving equity and efficiency. This is performed by

Table 6
Money versus educational transfers

% Edu	0	25	50	68*	75	100
Distribution of earnings						
Gini	0.3710	0.3683	0.3499	0.3408	0.3382	0.3205
C.V.	0.7347	0.7244	0.6873	0.6678	0.6528	0.6108
Corr.	0.4897	0.4642	0.4146	0.3966	0.3743	0.3243
% on welfare	49.27	44.01	35.16	26.62	20.59	0
Distribution of assets						
Gini	0.7973	0.7247	0.6976	0.6643	0.6295	0.5209
C.V.	2.6252	1.5355	1.4383	1.3477	1.2413	1.0034
Zero bequests (%)	64.35	59.84	53.66	46.33	41.95	22.65
Distribution of consumption						
Gini	0.3055	0.2763	0.2705	0.2699	0.2519	0.2009
C.V.	0.8426	0.5173	0.5025	0.5062	0.4629	0.3823
Corr.	0.9139	0.9125	0.8996	0.9160	0.9074	0.9045
Measures of welfare						
Aggregate output	38.52	62.68	85.91	100	105.81	127.30
Average welfare	6	5	4	3	2	1
Certainty equivalent	43.91	69.40	89.83	100	104.50	120.08

changing budget allocations between money transfers and educational transfers, holding fixed the proportions of revenues spent on redistributive and non-redistributive policies. Since money transfers are targeted more at the poor than are educational transfers (recall that tuition subsidies benefit the rich, who spend more on education than the poor), increasing money transfers relative to educational transfers would increase equality if people's decisions are not affected by the policy change. However the policy change does affect their decisions: poor people can spend more time on childcare, but their incentives to invest in education decrease because their incomes become less dependent on human capital. Consequently, the long-run effects on equality are not obvious, nor are the effects on efficiency. Throughout this experiment, the deduction rate on the negative income tax and the share of educational transfers devoted to the lump-sum variety are fixed at their U.S. levels.[24] Table 6 presents the effects on the distributions of earnings, assets, consumption and efficiency. The case where the government allocates 68% of its spending on redistributive policies to educational transfers corresponds to the actual U.S. economy, and is marked with '$*$'.

The results suggest that as a greater fraction of the government's budget is devoted to educational transfers relative to money transfers, almost all measures of equality and efficiency *increase*. Spending completely on educational transfers can maximize both efficiency and equality. The magnitudes of changes in efficiency and equality

[24]As the share devoted to money transfers varies, so does the maximum amount of the transfer, **g**.

are much larger when the share spent on educational transfers is very small or very large. The changes are modest in the intermediate range.

Increasing educational transfers relative to money transfers affects human capital investment mainly through three effects. The first one is a direct effect: since educational transfers are targeted more at the rich compared to money transfers, increasing the share spent on educational transfers increases investment by the rich and decreases investment by the poor. The second effect is on the return to work: since after-transfer net income becomes more dependent on earnings, people spend less time on childcare and more on working. And the last effect is on the return to investment in education: because net income is more dependent on human capital, they increase spending on education. The last two effects would especially affect poor people, who are the beneficiaries of money transfers.

The increased efficiency from the policy change indicates that the effect on the return to human capital investment dominates the effect on the return to work. The decrease in earnings inequality suggests the effect on the return to human capital investment dominates the other two effects.

The change in efficiency may be too high to be considered realistic. There are at least a few reasons why this transpires. First, the coefficient of risk aversion might affect the results. The higher the risk aversion, the more consumers try to smooth their consumption through intergenerational transfers. For this reason, money transfers would be preferable to educational transfers especially for the rich. To check the robustness of the results, the same experiment is performed when the coefficient of risk aversion is equal to 5.0. The qualitative results remain the same.[25] Second, the coefficient on educational expenditures in the human capital production function equals 0.24, a large effect of educational expenditures on human capital. When the coefficient is set as low as 0.1,[26] the magnitudes of changes in efficiency become a lot smaller, but the basic results nevertheless go through. Third, the money transfer considered here is a negative income tax with a deduction rate of 0.67. This has associated with it, as we have seen before, large negative incentive effects. To see how the results change, the experiment is repeated assuming a deduction rate of 0.0, the case in which money transfers have no marginal negative incentive effects on human capital accumulation and work.

Money transfers without targeting: Aside from the deduction rate, the parameters are set as before. Table 7 presents the effects on the distributions of earnings, assets, consumption and efficiency.

Now the effects of policy changes on the distributions are quantitatively different. Increasing the share on educational transfers relative to money transfers has a very small impact on the distribution of earnings. The distributions of assets and consumption are relatively more affected, although the changes in the distributions are much smaller than the case where the deduction rate is 0.67. Since money transfers are distributed equally to all, marginal negative incentives to invest in

[25]The results are presented in Appendix A.3.

[26]Recall that this value is equal to the estimated elasticity of earnings with respect to per-pupil educational expenditures in mandatory education as reported in Heckman (2000).

Table 7
Money versus educational transfers ($t = 0$)

% Edu	0	25	50	68	75	100
Distribution of earnings						
Gini	0.3257	0.3243	0.3211	0.3197	0.3237	0.3205
C.V.	0.6229	0.6225	0.6161	0.6159	0.6189	0.6108
Corr.	0.3312	0.3274	0.3251	0.3285	0.3280	0.3243
% on welfare	100	100	100	100	100	0
Distribution of assets						
Gini	0.5571	0.5604	0.5318	0.5428	0.5346	0.5209
C.V.	1.0884	1.0973	1.0341	1.0585	1.0350	1.0034
Zero bequests (%)	32.10	27.16	24.47	23.99	23.34	22.65
Distribution of consumption						
Gini	0.2046	0.2065	0.1987	0.2080	0.2072	0.2009
C.V.	0.3736	0.3857	0.3740	0.3939	0.3905	0.3823
Corr.	0.8978	0.9078	0.9105	0.9078	0.9108	0.9045
Measures of efficiency						
Aggregate output	45.24	66.46	88.18	100	104.79	120.06
Average welfare	6	5	4	3	2	1
Certainty equivalent	51.82	72.66	91.25	100	103.18	113.20

human capital and work do not arise. The effect on efficiency is also smaller than in the previous experiment, but the magnitude of the changes is still very large. Again, increasing educational transfers relative to money transfers improves efficiency greatly. This result is quite strong since it suggests that educational transfers are better than money transfers even when money transfers have no marginal negative incentive effects on human capital investment and work.

7.4. Experiment without bequests

In the model economy presented, individuals are allowed to invest in both human capital and physical capital. This is one of the features of the current analysis that distinguishes itself from most recent work.[27] How will the results change if parents could invest only in human capital? In this subsection, the corresponding model without bequests is constructed, and the desirability of educational transfers over money transfers re-examined.

The model employed here is the same as the original one except that there is no physical capital and aggregate output is assumed to equal aggregate human capital. The parameters governing the human capital production function and the stochastic innate ability, and the tax rate on human capital are set so that the new model resembles the U.S. economy in terms of the statistics used to set the parameters of

[27]See, for instance, Benabou (2002) and Fernandez and Rogerson (1998).

the original model. The values of these parameters are presented in Table 8. The other policy parameters are exactly the same as before. Table 9 presents the match between the model economy and the U.S. economy.

The model matches, reasonably well, the U.S. economy in terms of most statistics presented. The notable exception is the skewness of earnings as before. One significant difference from the original economy with bequests is that now the intergenerational correlation of consumption is much lower (see the case with a '$*$' in Table 10). While bequests can be used to smooth income streams against random innate ability shocks in the original economy, human capital investment, the return to which is affected by the random shock, is now the only way to transfer resources across generations. This makes it more difficult to smooth income streams.

Economy without redistributive policies: Now, imagine conducting the very same experiment that was carried out at the beginning of the section and documented in Table 3. The purpose is to shed some light on the source of the enormous increase in welfare that results with redistributive policies. As before, taxes are reduced by the proportion of governmental revenues spent on redistributive policies in the baseline

Table 8
Parameters: experiment without bequests

Parameter	Description	Value
β	Discount factor on descendants' utilities	$(0.9245)^{25}$
A	Constant of HC production function	0.785
χ_1	Coeff. on parental human capital	0.26
χ_2	Coeff. on childcare	0.13
χ_3	Coeff. on educational expenditures	0.16
σ_θ	SD of the natural log of innate ability	0.526
τ_h	Tax rate on human capital	0.3867

Table 9
Baseline case: experiment without bequests

	Economy	U.S. Data
Distribution of earnings		
Gini	0.3241	0.32
Coefficient of variation	0.6292	0.69
Mean/Median	1.1412	1.13
Skewness	1.9158	3.49
Corr($\ln X, \ln X_{-1}$)	0.3873	0.4
Other statistics		
Educational exp./GDP (%)	7.04	7.02
$E\left[\frac{\text{childcare time}}{\text{childcare time+work time}}\right]$(%)	2.57	2.63

Table 10
Money versus educational transfers: experiment without bequests

% Edu	0	25	50	68*	75	100
Distribution of earnings						
Gini	0.3541	0.3397	0.3270	0.3241	0.3201	0.3098
C.V.	0.6838	0.6583	0.6351	0.6292	0.6234	0.6139
Corr.	0.4033	0.3823	0.3779	0.3873	0.3907	0.4829
% on welfare	53.80	50.25	40.63	29.61	24.93	0
Distribution of consumption						
Gini	0.2262	0.2366	0.2535	0.2680	0.2772	0.3058
C.V.	0.4856	0.5009	0.5213	0.5446	0.5532	0.5994
Corr.	0.4332	0.4329	0.4240	0.4306	0.4344	0.4972
Measures of efficiency						
Aggregate output	58.21	77.69	92.22	100	100.93	106.57
Average welfare	6	5	3	1	2	4
Certainty equivalent	78.95	91.52	97.78	100	99.56	98.45

economy. Output now rises by 48.2%, much less than the 77.4% rise in the economy with physical assets. There are two important effects at play when physical capital is included in the analysis: first, it serves as an additional means of insurance against random shocks and second, redistributive policies that increase the return to human capital also increase the return to the complementary physical capital. This leads to a large welfare increase with redistribution. The analysis thus reveals that a failure to incorporate physical capital could lead to an underestimation of the welfare consequences of redistributive policies.

Money transfers versus educational transfers: How well do money transfers perform relative to educational transfers in an economy without bequests? Table 10 presents the distributions of earnings, consumption and efficiency, respectively, for various shares of educational transfers relative to money transfers. The case where the government allocates 68% of its spending on redistributive policies to educational transfers corresponds to the actual U.S. economy, and is marked with '$*$'.

As in the original economy, greater reliance on educational transfers over money transfers reduces earnings inequality in most cases, but the correlation of earnings goes up when the share on educational transfers is high. The noticeable difference from the original economy lies in the distribution of consumption: now larger educational transfers result in *higher* values for the Gini coefficient and the coefficient of variation, a slightly lower intergenerational correlation when the share on educational transfers is low, and a higher correlation when the share is high. Aggregate output increases when the relative spending on educational transfers is raised, but average welfare and the certainty equivalent measure increase initially and then *decrease* slightly. This decline is a result of the increased inequality in consumption. The changes in the efficiency measures are much smaller than the corresponding economy with bequests.

In the economy with bequests, an increase in educational transfers relative to money transfers decreases asset inequality much more than earnings inequality. The reason is that such a policy change reduces the return to physical capital relative to human capital, and consequently adversely affects asset accumulation of the rich. (Remember that the distribution of assets is affected by the relative return as well as the distribution of earnings.) This large improvement in the distribution of assets, together with the lower earnings inequality dominates the direct negative effect of the policy change, resulting in reduced consumption inequality. On the other hand, in the current economy without bequests, (before-transfer) income inequality changes in the same magnitude as earnings inequality, so the direct effect of the transfers dominate and consumption inequality worsens.

In sum, the important implication from these results is that ignoring bequests would undervalue the loss in efficiency and equality that is associated with a greater reliance on money transfers over educational transfers.

8. Conclusion

This paper presents a dynamic general equilibrium model in order to compare the effects of different types of redistributive policies—money transfers and educational transfers—in terms of both efficiency and equity. Altruistic individuals, who differ in their human capital, assets and their children's innate abilities, undertake decisions on consumption, work effort, and investment in children to maximize their expected utilities. The model includes key elements in considering the problem—it has two types of accumulated assets, physical and human capital, and includes market imperfections as well as imperfect information about childrens' abilities. This makes investment in human capital and assets inefficient in a laissez faire economy. Redistributions can mitigate the adverse consequences of market imperfections while simultaneously improving the equity properties of the economy. The extent to which redistributions affect the long-run equity and efficiency properties of the economy is investigated numerically.

The main results of the analysis are that (i) compared to laissez faire, current redistributive policies result in very large gains in aggregate output and efficiency, but at the same time increase long-run inequality and reduce social mobility. Furthermore, the magnitudes of the increase in steady-state output is much larger than reported by previous papers that do not allow intertemporal trade of assets. (ii) For both money and educational transfers, the degree of targeting of these transfers has U-shaped effects on most measures of equity and efficiency. The opposing effects on behaviors of different classes of agents induced by variations in the policies play an important role in these results. (iii) Within the class of policies considered, both equity and efficiency are highest with "universal" non-targeted, lump-sum transfers. (iv) Educational transfers are superior to money transfers, in the sense that reallocating the government's budget from the latter to the former (keeping the degree of targeting, as well as the tax rates that generate revenue, fixed), raises aggregate output and efficiency, while at the same time promoting equity. (v) Omitting the role of physical capital would lead one to underestimate the degree to which educational transfers dominate money transfers.

Some limitations associated of the analysis conducted will now be discussed. First, the analyses focused exclusively on steady-states and remained silent on transitions from one steady-state to another. Since the transition to a new steady-state can take time and the effects of policies along the transition can be different from their long-run effects, analyzing transitions would be important when assessing policy changes from one steady-state to another. Second, the parameters of the model were set based on calibration. Even though the sensitivity of some of the key parameters were analyzed, it would be desirable to structurally estimate them based on, for example, the method of simulated moments. Both modifications are computationally harder and are left for future work.

Appendix A

A.1. Computational details

This section describes the algorithm used to compute the solution to the consumer's dynamic programming problem.

The Algorithm

Step 1: Enter the ith iteration with a guess for the interest and wage rates, r^i and w^i, and the policy parameters $(\mathbf{g}^{NIT})^i$, $\bar{\mathbf{e}}^i$ and $(s^{\mathrm{T}})^i$.

Step 2: Solve the agent's dynamic programming problem using discrete state space dynamic programming (see below for details).

Step 3: Based on the decision rules computed in Step 2, perform a Monte-Carlo simulation by drawing random innate abilities from the log-normal distribution and compute aggregate physical capital $\mathbf{k}^i = \int a\,\mathrm{d}Z^i(a,h)$, aggregate effective human capital $\mathbf{h}^i = \int h(1-n)\,\mathrm{d}Z^i(a,h)$, and aggregate educational expenditures $\mathbf{e}^i = \int e\,\mathrm{d}Z^i(a,h)$. Note that the population is normalized to be 1. (See below for details.)

Step 4: Using the aggregate variables and the distributions of the state variables obtained in Step 3, revise the guess for the interest rate, wage rate and policy parameters.

$$r^{i+1} = F_1(\mathbf{k}^i, \mathbf{h}^i) - \delta,$$

$$w^{i+1} = F_2(\mathbf{k}^i, \mathbf{h}^i),$$

$$(\mathbf{g})^{i+1} = \frac{1}{\int_{\Im^i} \mathrm{d}Z^i(a,h)} \times (s_{NIT}(\tau_h w^i \mathbf{h}^i + \tau_k r^i \mathbf{k}^i) + t \int_{\Im^i} \{(1-\tau_h) w^i h(1-n) + [1 + (1-\tau_k) r^i] a\}\,\mathrm{d}Z^i(a,h)),$$

where

$$\mathfrak{I}^i = \{(a,h) : t[(1-\tau_h)w^i h(1-n) + [1+(1-\tau_k)r^i]a] \leqslant (\mathbf{g})^i\},$$

$$\bar{\mathbf{e}}^{i+1} = \xi s_e[\tau_h w^i \mathbf{h}^i + \tau_k r^i \mathbf{k}^i],$$

and

$$(s^{\mathrm{T}})^{i+1} = \frac{(1-\xi)s_e[\tau_h w^i \mathbf{h}^i + \tau_k r^i \mathbf{k}^i]}{\mathbf{e}^i}.$$

Step 5: Stop when the prices and the policy variables converge. Otherwise, repeat Steps 1–5.

Discrete state-space dynamic programming

Create grid points for the variables a, h, θ, and n. Let $a \in \{a_1, a_2, \ldots, a_m\}, h \in \{h_1, h_2, \ldots, h_n\}$, $\theta \in \{\theta_1, \theta_2, \ldots, \theta_k\}$, and $n \in \{n_1, n_2, \ldots, n_l\}$.

Step 1: Enter the jth iteration with a guess for the value function $J^j(a,h)$, which is a $m \times n$ matrix. Here, $a \in \{a_1, a_2, \ldots, a_m\}, h \in \{h_1, h_2, \ldots, h_n\}$.

Step 2: Construct

$$U((1-\tau_h)wh(1-n) + [1+r(1-\tau_k)]a + G(a,h) - a' - e) + \beta J^j(a', h'), \tag{12}$$

where

$$h' = X(\theta, h, n, \bar{\mathbf{e}} + (1+s^{\mathrm{T}})e),$$

$$G(a,h) = \max(g - t\{(1-\tau_h)wh(1-n) + [1+(1-\tau_k)r]a\}, 0),$$

and $a, a' \in \{a_1, a_2, \ldots, a_m\}$, $h, h' \in \{h_1, h_2, \ldots, h_n\}$, $\theta \in \{\theta_1, \theta_2, \ldots, \theta_k\}$, and $n \in \{n_1, n_2, \ldots, n_l\}$. Then obtain the decision rules for a', h' by choosing the a' and h' that maximize equation (12). The decision rule for e is obtained using the decision rule for h' and the human capital production function $X(\cdot)$.

Step 3: Now construct V^j, which is a $m \times n \times k \times l$ matrix.

Step 4: Then construct $J^{j+1}(a,h) = \max_n[\sum_{i=1}^{l} V^j(a,h,\theta_i,n)Pr(\theta_i)]$ and find the associated policy rule for childcare time n.

Step 5: Repeat Steps 1–5 until the value functions converge.

Monte-Carlo simulation

Step 1: Discretize the distribution of innate ability θ, using the procedure developed by Tauchen (1986).

Step 2: Obtain 100,000 random draws from a uniform distribution [0, 1] and assign an innate ability θ to each draw by choosing θ at which the distribution function of the ability assumes the value of the random draw.

Step 3: Starting with some initial state (a_0, h_0), find n_0 using the decision rule computed above. The individual now realizes his child's ability, θ_0. His state is now $(a_0, h_0, \theta_0, n_0)$. Find a_1, h_1 and e_0, using the decision rules computed above.

Step 4: Now the individual's state is (a_1, h_1). Repeat step 3 for the 100,000 draws. Discarding the first 1000 draws, construct the distributions of the state variables using the rest of the draws and compute aggregate physical and human capital, and aggregate educational expenditures.

A.2. Setting the parameters governing governmental policies

This section details the procedure used to set the parameters of the government's policies when the model is calibrated to match certain features of the U.S. economy.

(1) s_{NIT}: Negative income tax in the model is a non-educational transfer *within* a generation whose recipients are solely determined by income levels. The corresponding policies in the United States are public aid excluding supplemental security income (mainly Medicaid; Temporary Assistance to Needy Families, TANF, from July 1, 1997; Aid to Families with Dependent Children, AFDC, until July 1, 1997; and food stamps), and housing assistance in social welfare programs. Intergenerational transfers such as social security (OASDI) or health insurance (Medicare), unemployment insurance, transfers to special groups of people such as health and medical programs or veteran's programs are excluded, because these transfer programs do not match the nature of the negative income tax in the model. Thus, the share of governmental expenditures spent on negative income tax, s_{NIT}, is set to be equal to the proportion of government expenditures spent on public aid (excluding supplemental security income) and housing assistance. The data on the transfers are taken from Social Security Programs in the United States, 1997 (Appendix A). The governmental expenditures are the total current expenditures and are taken from the Economic Report of the President, 1998.

(2) s_e: The share is set to equal the proportion of governmental expenditures spent on education. The data sources are the same as those of s_{NIT}. Using the data on governmental expenditures on these policies for the years 1970, 1980 and 1990 and taking averages over the three years, the values of the parameters are computed to be $s_{NIT} = 0.071$ and $s_e = 0.154$.

(3) t: Finally, the deduction rate of negative income tax needs to be pinned down. Actual policies interpreted as negative income tax in the above calculation have different criteria for eligibility, but the vast majority of the expenditures on such policies is spent on Medicaid and AFDC. Further, the eligibility for Medicaid is almost entirely based on AFDC receipt (Moffitt, 1992, p. 5). Hence, the deduction rate for AFDC would approximate the combined deduction rate for these policies. The deduction rate for AFDC has changed twice. It was equal to 0.67 in 1968–1981 and 1.0 before 1967 and after 1982. So the deduction rate for negative income tax is set to be one of the two values, i.e. $t^{NIT} = 0.67$.

A.3. Money transfers versus educational transfers when $\sigma = 5.0$

This section presents the results of the experiment that examines the relative performance of money transfers over educational transfers, when the coefficient of relative risk aversion σ is equal to 5.0, as opposed to the value of 2.0 considered in the baseline calibration. The other parameters are the same as before. As is clear from Table 11, the qualitative results in the main text continue to hold in this experiment too.

Table 11
Money versus educational transfers ($\sigma = 5.0$)

% Edu	0	25	50	75	100
Distribution of earnings					
Gini	0.3512	0.3499	0.3359	0.3222	0.3055
C.V.	0.6938	0.6743	0.6446	0.6077	0.5681
Corr	0.5211	0.4654	0.4339	0.3670	0.3119
% on welfare	49.51	40.72	33.08	20.14	0
Distribution of assets					
Gini	0.7972	0.6904	0.6585	0.6081	0.4989
C.V.	2.9732	1.4305	1.3235	1.1873	0.9526
Zero bequests (%)	62.69	53.14	47.06	37.31	22.20
Distribution of consumption					
Gini	0.2881	0.2498	0.2453	0.2271	0.1828
C.V.	0.9358	0.4714	0.4544	0.4186	0.3433
Corr	0.9666	0.9596	0.9560	0.9509	0.9425
Measures of efficiency					
Aggregate output	37.17	61.16	82.08	100.00	121.53
Average welfare	5	4	3	2	1
Certainty equivalent	40.78	65.33	84.79	100.00	116.82

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