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Altruism, Education Subsidy and Growth

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Abstract

An optimal education subsidy formula is derived using an overlapping generations model with parental altruism. The model predicts that public education subsidy is greater in economies with lesser parental altruism because a benevolent government has to compensate for the shortfall in private education spending of less altruistic parents with a finite life. On the other hand, growth is higher in economies with greater parental altruism. Cross-country regressions using the World Values Survey for altruism lend support to our model predictions. The model provides insights about the reasons for higher education subsidy in richer countries.

* This paper is an extension of Ch. 2 of Armellini's PhD thesis (2009). We benefitted from the useful comments and discussions from Thomas Renstrom, Peter Sinclair, Kunal Sen and Indraneel Dasgupta. The usual disclaimer applies.

1. Introduction

There is a growing literature on the social desirability of education subsidy. Should the government directly or indirectly subsidise education or should it be left in the realm of private decision-making? The literature in this regard can be broadly divided in two strands. The first strand advocates education subsidy as a redistributive policy in the presence of credit market imperfections. Such capital market imperfections pose barriers to poor individuals to finance schooling.[1] The second strand uses a growth-human capital framework to argue that education subsidy is needed because the private returns to human capital could fall short of the social returns. Human capital may have a positive spillover on productivity that may not be privately internalized (Lucas, 1988, Azariadis and Drazen, 1990 and Tamura, 1991). Education subsidy is needed to correct for this externality. Acemoglu and Angrist (1999), Bils and Klenov (2000) and Krueger and Lindahl (1999), however, question this positive externality argument.[2]

We approach the issue of education subsidy by striking a middle ground between these two strands of literature. First, in our model we have an extreme form of capital market imperfection as in Loury (1981) where education cannot be financed through the credit market. Second, we have endogenous growth via the accumulation of human capital. Human capital investment is driven by parental altruism which turns out to be a key determinant of public education subsidy. If parents are less altruistic towards their children, they will spend less on offspring's education. This happens because parents, due to their finite lives, do not internalise the full growth effects of education by maximizing the discounted stream of utilities of all future generations. This gives rise to a discrepancy between the private and social returns to education. A far sighted government needs to correct this externality by instituting an educational subsidy. The rate of education subsidy is higher in economies where parents are less altruistic because a far sighted government has to compensate for this shortfall in schooling investment by subsidising education. More altruistic societies

[1] See Saint-Paul and Verdier, 1993, Perotti, 1993 and Benabou, 1999. This view has been challenged by Cameron and Heckman (1998), Cameron and Tabler (2000), Keane and Wolpin (1999) and Shea (2000).

[2] The distinction between these two strands is not sharp. There are papers which combine growth and credit market imperfections. Glomm and Ravikumar (1992) argue that public education lowers income inequality but it may lower per capita income unless initial income inequality crosses a threshold. Bandyopadhyay and Basu (2005) make a case for redistributive tax-subsidy measure in the context of human capital and endogenous growth.

thus receive less public subsidy to education but grow faster which is the key testable hypothesis in this paper.[3]

We establish this key hypothesis by employing a simple overlapping generations model with limited altruism where parents care only about the immediate descendant's welfare. A closed-form formula for the optimal education subsidy is derived to show the explicit relation between parental altruism and the education subsidy. We test the key theoretical prediction of the model using cross-country data and some hitherto unexplored data for parental altruism based on the World Values Survey. Our cross-country regressions of education subsidy on parental altruism after controlling for various macroeconomic factors lend support to the key predictions of the model. Given that governments in rich countries spend systematically more on education than in poor countries, a new testable hypothesis emanates from our model whether parents in richer countries are less altruistic. Cross country data lend support to this hypothesis.

The paper is organized as follows. In the following section, we lay out the model. Section 3 provides some empirical justification of the model. Section 4 concludes.

2. The Model

At each date there is a continuum of identical agents in the unit interval who live for two periods. Each such adult agent is attached to a single offspring. During the first period (date *t-1*) of their life, agents do not consume; they go to school and transform the inherited human capital h_{t-1} into a flow income using a linear schooling technology, ah_{t-1}, where $a > 0$. The parameter a represents the return to schooling. In the second period t they allocate their resources between consumption (c_t) and child's education (b_t). This flow education spending is converted one-for-one into stock of knowledge (h_t) using a technology: $h_t = b_t$. As in Loury (1981), we assume that there is no credit market to finance education spending. The adult receives direct

[3] The relationship between public education subsidy and private altruism is a relatively unexplored area of research. To the best of our knowledge, Eckstein and Zilcha (1994) come close to the issue that we address. However, their focus is more on compulsory public education while we look at broader education subsidy.

altruistic utility from his immediate descendant's consumption which is positively related to the amount the adult spends on his kid's education. This parental altruism is formulated by inserting h_t in parent's utility function.[4]

The agent born at date *t*-1 thus has the following utility function:

(1) $W_t = \theta U(c_t) + (1-\theta)V(h_t)$

where W_t is the adult's welfare, c_t =consumption in period *t* and h_t = knowledge acquired by the individual's child. The degree of parental altruism is represented by $(1-\theta)$, as it shows the effect that the parent's spending on the child's education has on utility.

There is a government that imposes a lump-sum tax equal to T_t on all individuals, and subsidises education expenditure at a flat rate ω_t. An individual born at date *t-1* will thus face the following flow budget constraint:

(2) $ah_{t-1} - T_t = c_t + (1-\omega_t)h_t$

The left-hand side of (2) shows the total resources: initial wealth (ah_{t-1}) minus the lump sum tax. The right-hand side of (2) shows the use of the resources, which can be either spent on consumption or education. The fact that the expenditure on education is subsidised at a rate ω_t is reflected in the factor $(1-\omega_t)$. Individuals maximise (1) subject to (2).

The government balances the budget and faces the following budget constraint:

(3) $T_t = \omega_t h_t$

The adult chooses his consumption and schooling spending on his offspring treating the taxes (T_t) educational subsidy rate (ω_t) as given.

The first order condition for the adult's problem equates the marginal utility cost of educational investment (net of education subsidy) to the marginal altruistic utility gain:

[4] The altruism in our model is *limited* in the sense that the adult cares only about the immediate descendant's welfare. The modelling of parental altruism follows Glomm and Ravikumar (1992) and Bräuninger and Vidal (2000).

(4) $$(1-\omega_t)U'(c_t)=\frac{1-\theta}{\theta}V'(h_t)$$

Using (2) and the government budget constraint (3), (4) can be rewritten as:

(5) $$(1-\omega_t)U'(ah_{t-1}-h_t)=\frac{1-\theta}{\theta}V'(h_t)$$

The comparative statics effect of a change in education subsidy on schooling and consumption spending of the adult is thus given by:

(6) $$\frac{\partial h_t}{\partial \omega_t}=\frac{-U'(ah_{t-1}-h_t)}{[(1-\omega_t)U''(c_t)+\frac{1-\theta}{\theta}V''(h_t)]}>0$$

and

(7) $$\frac{\partial c_t}{\partial \omega_t}=-\frac{\partial h_t}{\partial \omega_t}<0$$

The total expenditure on education (h_t) is positively related to the rate of subsidy while the adult's consumption is negatively related to the subsidy.

Private Desirability of Education Subsidy

Is a higher education subsidy beneficial for private welfare? To investigate this differentiate the private welfare (1) with respect to ω_t, use (7) and set the partial equal to zero to obtain the first order condition for optimal education subsidy.

(8) $$[-\theta U'(c_t)+(1-\theta)V'(h_t)].\frac{\partial h_t}{\partial \omega_t}=0$$

Since $\frac{\partial h_t}{\partial \omega_t}$ is positive as shown in (6), the necessary condition for privately optimal education subsidy must satisfy

(9) $$U'(c_t)=\frac{1-\theta}{\theta}.V'(h_t)$$

Comparison with (5) immediately reveals that the optimal education subsidy must be zero. We thus have the following proposition.

Proposition 1: *The privately optimal education subsidy (ω_t) is zero for all t.*

Education subsidy is thus not privately desirable. The result follows from the basic principles of uniform commodity taxation. Since consumption is not taxed or subsidised, the optimal subsidy to education must be zero. The adult is thus worse off with an education subsidy. To see this more clearly, take a parametric example. Assume that the adult's utility function (1) is logarithmic. In other words,

(10) $W_t = \theta \ln c_t + (1-\theta) \ln h_t$

which implies the following consumption and education policies for the adult:

(11) $c_t = \theta.[ah_{t-1} - T_t]$

(12) $h_t = \frac{1-\theta}{1-\omega}[ah_{t-1} - T_t]$

Plugging the government budget constraint (3) into (11) and (12) one obtains the following equilibrium policy rules:

(13) $h_t = \frac{a.(1-\theta)}{1-\omega_t\theta}.h_{t-1}$

(14) $c_t = \frac{a.\theta(1-\omega_t)}{1-\omega_t\theta}.h_{t-1}$

which upon substitution in (10) and differentiation with respect to ω_t yields:

(15) $\frac{\partial W_t}{\partial \omega_t} = -\frac{\theta}{1-\omega_t} + \frac{\theta}{1-\theta\omega_t}$

The two terms on the right hand side of expression (15) represent the private marginal cost and benefit (respectively) of increasing subsidies: more subsidies decrease parent's consumption $\left(\frac{\partial c_t}{\partial \omega_t} < 0\right)$, which is a cost in terms of utility. At the same time, more subsidies increase expenditure on education $\left(\frac{\partial h_t}{\partial \omega_t} > 0\right)$ and thus give greater utility to parents. As long as $0 < \theta < 1$, the marginal costs are greater than the marginal benefits. Parents are thus worse off with a higher education subsidy. Even though higher education subsidy promotes growth, altruistic parents do not internalize this growth effect of an education subsidy.

Socially Optimal Education Subsidy

We now turn our attention to designing an optimal education subsidy when the government is far sighted and benevolent in the sense that it takes into account the welfare of finitely lived future generations. The government takes the private sector behaviour as given and commits to a sequence of education subsidy $\{\omega_t\}$ that maximizes the discounted stream of indirect utilities of all generations. Doing so, the government arrives at a socially optimal education subsidy.

We solve the socially optimal education subsidy in two steps. First, we solve the far sighted government's problem setting up a fictitious social planning problem. The planner solves the intertemporal allocation of consumption (c_t) and human capital (h_t) taking into account the welfare of the future generations. From the social planner's problem, we work out the social intergenerational marginal rate of substitution in consumption. In the next step, from the adult's private optimization problem we work out the education subsidy which reproduces the social marginal rate of substitution in consumption.

The social planning problem is given by:

$$\text{(P)} \qquad \text{Max} \quad \sum_{t=0}^{\infty} \beta^t [\theta U(c_t) + (1-\theta) V(h_t)]$$

$$\text{s.t.} \quad c_t + h_t = a h_{t-1}$$

The first order condition for the social planning problem (P) is given by:

$$U'(c_t) = \frac{1-\theta}{\theta} V'(h_t) + \beta a U'(c_{t+1}) \tag{16}$$

The social planner equates the marginal utility cost of education spending to the instantaneous marginal utility benefit of education spending plus the discounted future marginal utility of consumption of the future generation. The private agent fails to internalize the growth effect of education spending and that is why the term $\beta a U'(c_{t+1})$ does not appear in adult's first order condition (4). This difference between the social and private benefits of education spending is an externality that the government needs to correct by formulating the right education subsidy.

Comparing (4) with (16), it immediately follows that the socially optimal education subsidy is:

(17) $\omega_t = \beta a \dfrac{U'(c_{t+1})}{U'(c_t)}$

The socially optimal education subsidy is thus positive while in contrast the privately optimal education subsidy is zero. The education subsidy is proportional to the marginal product of human capital (a) and the social intertemporal marginal rate of substitution in consumption.

For a logarithmic utility function as in (10), a closed form expression for the socially optimal education subsidy exists. We have the following proposition:

Proposition 2: If $W_t = \theta \ln c_t + (1-\theta)\ln h_t$ *, a far sighted government sets the optimal education subsidy at a constant level given by:*

(18) $\omega = \dfrac{\beta}{1-\theta.(1-\beta)}$

and the socially optimal balanced growth rate is given by:

(19) $\dfrac{h_t}{h_{t-1}} = a[1-\theta(1-\beta)]$

Proof: Appendix.

The optimal education subsidy is negatively related to the degree of parental altruism. In other words, ω decreases with $1-\theta$. This means that in countries with greater parental altruism, education subsidy will be lower. Intuitively, when parents are altruistic enough to naturally spend on their children's education, there is less need for a government subsidy. The government has to compensate for the lack of parents' altruism via subsidies. For example, as evident from (18) in a non-altruistic society ($\theta \to 1$), the rate of subsidy will tend to 100% ($\omega \to 1$).

Second, the optimal education subsidy is positively related to β. A forward-looking government that looks after the future generations has to care about growth. The parameter β represents the degree of benevolence or foresightedness of the government. At one extreme, if the government values the future generations as much as the present ($\beta \to 1$), then (18) means that $\omega \to 1$, which is the maximum level of subsidy (100% subsidy). At the other extreme, a completely short-sighted government (β=0) will set $\omega = 0$. Greater foresight of the government means higher subsidy to education.

Finally, the optimal growth rate (19) is higher in economies with a greater altruism (lesser θ) and greater foresight of the government (larger β). Comparison with (13) immediately reveals that the socially optimal growth rate is higher than the privately optimal growth rate, $a(1-\theta)$ which is obtained by plugging ω equal to zero in (13). The difference between social and private growth rates is $a\theta\beta$ which represents the degree of externality. This term basically consists of an interaction between returns to education (a), the lack of private altruism (θ) and government benevolence or foresight (β). This clearly demonstrates the role of a benevolent government who cares for growth while designing an optimal education subsidy.

The two key testable hypotheses thus originate from the model which can be summarized by the following proposition.

Proposition 2 *(i) The optimal education subsidy is higher if the degree of private altruism (θ) is lower, and the social rate of discount is lower ($1/\beta$).*

(ii) The growth rate is higher in economies with greater private altruism and lower social rate of discount.

In the next section, we look for empirical support for these two hypotheses using cross country data.

3. Cross-Country Relation between Altruism, Education Subsidy and Growth

Data

Measuring Education Subsidy

There is no internationally comparable indicator for the level of subsidies to education, which comes closest to the model ω. We construct a proxy for this by computing the ratio of public expenditure on education to the total expenditure on education. The total expenditure on education is the sum of private and public spending on education. For example, if an individual spends h on education, a rate of subsidy ω means that the individual receives a subsidy of $\omega.h$ units. This means that out of total expenditure on education h, only $\omega.h$ units are public subsidy to education. Thus,

$$\frac{\text{Public expenditure on education}}{\text{Total expenditure on education}} = \frac{\omega.h_t}{\omega.h_t + (1-\omega).h_t} = \omega$$

The appendix details the data sources for public and private spending on education.

In the regression reported later, we label this measure as *Subsidies*. Figure 1 plots this for all the countries in our sample. *Subsidies* range from about 45% to 99% which shows a substantial variation. Figure 2 plots *Subsidies* against log of GDP per capita. Rich countries subsidise education more than poor countries.

<Figures 1 and 2 come here>

Proxy for Altruism

Our proxy for altruism comes from the question A026 of the World Values Survey[5], reproduced here:

"*Which of the following statements best describes your views about parents' responsibilities to their children?: A- Parents' duty is to do their best for their children even at the expense of their own well-being; B- Parents have a life of their own and should not be asked to sacrifice their own well-being for the sake of their children*".

The proxy for altruism is the percentage of people choosing answer *A* from the previous question in each country. The survey is carried out in different years in different countries, and most countries have only one available observation for the period 1994-2004 (where there are two available observations for a country we take the average of these two). We call this proxy *Altruism*. [6] While arguably this could be an imperfect measure of parental altruism, to the best of our knowledge this is the first time this World Values Survey is used to identify altruism as a possible determinant of public education subsidy.[7]

[5] European and World Value Survey four-wave integrated data file, 1981-2004, v.20060423, 2006. The European Values Study Foundation and World Values Survey Association. Aggregate File Producers: ASEP/JDS, Madrid, Spain/Tilburg University, Tilburg, The Netherlands. Aggregate File Distributors: ASEP/JDS and ZA, Cologne, Germany.

[6] Previous research has used monetary transfers made by individuals as a proxy for altruism. For example, Bouhga-Hagbe (2006) looks at the remittances of migrant workers as an expression of their altruism. Andreoni (2006) compares altruism across countries by looking at the percentage of cash revenues of the non-profit sector that are received from philanthropy. Castillo and Carter (2002) run behavioural experiments in South African communities, and derive their measure of altruism from the amount of money that the individuals are willing to transfer in their 'dictator game'. However, these are not real proxies for altruism but rather some of its consequences. Furthermore, those measures tend to be aggregated and not standardised, whereas the measure presented here focuses particularly on preference based altruism from parents to children, which comes closest to the utility function developed in our theoretical model.

[7] Alesina et al. (2010) use the world value survey to get a measure of family ties. However, their focus is on the regulation of labour market while we address the issue of education subsidy.

Altruism may not be necessarily represented by a continuous variable in the context of cross-country regressions because its effect may show up across countries once a threshold is reached. In other words, two countries may differ in *Altruism* by a few percents and this may not make much difference to the measure of education subsidy or growth. To take this possibility into account, three dummies are constructed classifying countries as follows. The first dummy for altruism takes the value 1 when a country has a value of *Altruism* on the top 50% of the values of the sample (median), and 0 otherwise. A second associated dummy for altruism takes the value 1 when a country has a value of *Altruism* on the top 33% of the values of the sample, and 0 otherwise. A third associated dummy for altruism takes the value 1 when a country has a value of *Altruism* on the top 20% of the values of the sample, and 0 otherwise. We call these proxies *Altruism Dummy 50%, Altruism Dummy 33%* and *Altruism Dummy 20%* respectively. These various dummies are constructed to check for robustness of the results.

Social Discount Rate

For the social discount rate we use the average real interest rate for 1992-2002 (World Bank, World Development Indicators (WDI) April 2008, ESDS International, (Mimas) University of Manchester) as a proxy.

Common Sample Correlations

Table 1 presents the simple correlations between subsidy, GDP growth rate, altruism and the interest rate. These correlations are consistent with the model predictions in Proposition 1. There is a weak negative correlation between education subsidy and growth, which might be due to the conflicting responses of growth and subsidy to altruism.

<Table 1 comes here>

Cross-Country Regressions

Although these correlations are broadly consistent with the model, they do not necessarily validate the model because these correlations may reflect the influences of third factors, which are not accounted in our model. In the next step, we report some cross-country regression results in a similar vein as in Barro and Lee (1997). Table 2

presents the results of cross-country regressions, where variables are averaged for the period 1992-2002. These regressions capture the effects of altruism and social discount rate on subsidies after controlling for a number of macroeconomic variables such as investment/GDP ratio, per capita GDP, financial deepening, openness and others. Note that the number of observations varies in each specification due to the availability of data: when more controls are used, fewer observations are available. The list of countries included in each specification of Table 2 is presented in Appendix B, together with some descriptive statistics. Appendix C presents the sources of the data used.

<Table 2 comes here>

In all seven specifications the proxies for altruism and social discount rate enter with a negative sign, suggesting that more altruistic and short-sighted countries tend to subsidise education less. This is in line with the predictions of our model.

Altruism appears statistically insignificant when it is measured as a continuous variable. When it is measured as a discrete dummy, in three out of five cases it appears statistically significant. This suggests that altruism has a nonlinear effect on education subsidy. The effect appears piecewise nonlinear because it picks up after a certain threshold.

Regarding the economic significance of the altruism coefficients, specification (7) of table 2 shows that if a country changes from 'no altruistic' to 'altruistic' (as defined by the 33% dummy), the subsidy rate is expected to decrease by almost 14 percentage points (see coefficient of Altruism Dummy 33% in specification (7)). Considering that the average subsidy of the sample used in that regression is 0.80 (80%), the estimated effect of altruism on subsidies is economically relevant, as it represents a drop of more than 17% of the average value of subsidies.[8]

Similar cross-country growth regressions are reported in Table 3. In all these specifications the sign of the coefficients of altruism and the social discount rate are

[8] For robustness, all the specifications of Table 2 were tested with a variation of the dependent variable, where instead of considering the expenditure of households, we include all the private expenditure. This alternative was computed as [(Public expenditure on education / (Public + Total private expenditure on education) where 'total private expenditure on education' includes the expenditure of households but also the expenditure of private institutions (firms). The results did not change substantially. These results are not reported for brevity and are available upon request.

consistent with the model predictions. The statistical insignificance of these coefficients is not surprising in view of the fact that there is such a tremendous variation in cross country growth rates which could be attributable to a host of economic and non-economic factors (Barro and Lee, 1997).

<Table 3 comes here>

Are parents in rich countries less altruistic?

We reported earlier (Figure 2) that there is a strong cross-country positive relationship between education subsidy and the per capita GDP. Rich countries tend to subsidise education more than poor countries. Does our model provide any insight about this stylized fact? Given our key theoretical result that optimal education subsidy is less in countries with greater parental altruism, a natural question arises whether the high education subsidy in rich countries is a possible fallout due to lower altruistic nature of parents in rich countries, one effect of which could be less parental spending on their children's education. Since parents spend less on their children's education, the government substitutes this by subsiding education more.

We investigate this implication of the model by correlating altruism with two broad development indicators, (i) the level of per capita GDP, (ii) the degree of financial deepening proxied by the ratio of M2 to GDP. Figure 3 shows the plots of altruism against log per capita GDP while Figure 4 shows the plot of altruism against M2/GDP.[9] The relationship between altruism and both development indicators is robustly negative. The regression of altruism on each of these measures of development reported in Table 4 show that this relationship is statistically significant.

<Figure 3 here>

<Table 4 comes here>

The relationship between altruism and the level of economic development is controversial. Rapoport and Vidal (2007) draw a useful distinction between two components of altruism: (i) "natural altruism" which is simply unconditional parental love for their offspring, (ii) "endogenous altruism" which is driven by cost-benefit analysis of adults. In less developed countries where infrastructural facility is poor

[9] The common sample for which altruism and M2/GDP series are available for only 24 countries.

and private insurance markets are lacking, one may argue that "natural altruism" may prevail as a survival mechanism. On the other hand, in advanced economies where basic necessities are already met and insurance markets exist to cover old age contingencies, parents will choose altruistic behaviour based more on cost-benefit considerations. This means that "endogenous altruism" might become more predominant in rich countries. It is difficult to ascertain from the World Values Survey question A026 whether this parental value represents "natural altruism" or "endogenous altruism." However, since the altruism parameter $1-\theta$ in our model is preference driven, it is deemed to be "natural altruism." Thus the negative relation between altruism and the level of development reported here basically alludes to the possibility that natural altruism is less in rich countries. While the issue whether rich parents are less altruistic decidedly warrants more research, the two stylized facts, (i) education subsidy in rich countries is greater in rich countries, and (ii) altruism indicator is lower in rich countries, lend support to our key theoretical result that government in rich countries may subsidise education more to offset the lack of parental natural altruism.

Conclusion

In this paper we present a new hypothesis that parental altruism could be an important factor determining the education subsidy. This hypothesis helps us understand the reasons for the enormous cross-country variation in public education spending and particularly why in rich countries government spends so much on public education compared to poor countries. In countries where parents are less altruistic to their offspring, a benevolent forward-looking government has to compensate for this private shortfall in education spending by subsidising public education. The socially optimal growth rate thus depends positively on private altruism and the government benevolence. These theoretical predictions are tested against the cross-country data which lend support to our model predictions. Our model and cross country regressions also provide insights why governments in rich countries subsidise education more than in poor countries.

Appendix A: Proof of Proposition 1

The social planner's maximization problem is:

$$\text{Max} \quad \sum_{t=0}^{\infty} \beta^t [\theta \ln c_t + (1-\theta) \ln h_t]$$

$$\text{s.t.} \quad c_t + h_t = a h_{t-1}$$

The first order condition for this problem is:

$$\text{(A.1)} \quad \left[\frac{1-\theta}{h_t} - \frac{\theta}{a h_{t-1} - h_t} \right] + \beta \left[\frac{\theta a}{a h_t - h_{t+1}} \right] = 0$$

which is a nonlinear second order difference equation in h_t. Conjecture a solution as follows:

$$\text{(A.2)} \qquad h_t = \lambda h_{t-1}$$

We use the method of undetermined coefficient to solve for λ. Plug (A.2) into (A.1) to get:

$$\text{(A.3)} \quad \left[\frac{1-\theta}{\lambda h_{t-1}} - \frac{\theta}{(a-\lambda) h_{t-1}} \right] + \beta \left[\frac{\theta a}{(a-\lambda) h_t} \right] = 0$$

which means

$$\text{(A.4)} \quad \frac{h_t}{h_{t-1}} = \frac{a \lambda \beta \theta}{[\theta \lambda - (1-\theta)(a-\lambda)}$$

Given our conjecture (A.2), it must be true from (A.4) that

$$\text{(A.5)} \quad \lambda = \frac{a \lambda \beta \theta}{[\theta \lambda - (1-\theta)(a-\lambda)}$$

which uniquely solves λ as follows

$$\text{(A.6)} \quad \lambda = a\left[1 - \theta(1-\beta)\right]$$

This also characterizes the socially optimal growth rate.

Recall from (13) that for a given ω the privately optimal growth rate is:

$$\text{(A.7)} \quad \frac{h_t}{h_{t-1}} = \frac{a(1-\theta)}{1 - \omega_t \theta}$$

Equating (A.6) to (A.7) it is straightforward to solve the socially optimal education subsidy ω_t that equates the private and social growth rates. This completes the proof.

Appendix B

Countries common to all the specifications of table 2:
Argentina, Australia, Canada, Chile, China, Czech Republic, Denmark, India, Indonesia, Japan, Jordan, Mexico, New Zealand, Norway, Peru, Philippines, Poland, Slovak Republic, Sweden, Switzerland, United States.

Countries added for specifications 1, 3, 4, 5: Austria, Belgium, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Netherlands, Portugal, Spain, United Kingdom.

The statistics provided below are calculated for the whole pool of 34 countries included in specifications 1, 3, 4, 5.

	Observations available	Mean	Std. Dev.	Min	Max
Altruism	34	71.3	10.8	41.6	90.3
Subsidies	34	0.8	0.1	0.5	1.0
Democracy	33	0.9	0.2	0.2	1.0
ln of GDP per capita, PPP	34	9.5	0.8	7.7	10.3
Public expenditure/GDP, PPP	34	20.1	7.8	8.6	50.7
Invesmtnet/GDP, PPP	34	20.9	4.0	11.3	30.6
M2/GDP	22	60.5	29.5	23.4	128.7
Trade/GDP, PPP	34	68.6	34.7	18.0	151.5
Real Interest Rate	34	6.9	4.4	1.6	27.4

Values for variables averaged 1992-2002

Appendix C: Data

Altruism and Subsidies are explained in the text.

GDP per capita, PPP: Penn World Table. Source: Alan Heston, Robert Summers and Bettina Aten, Penn World Table Version 6.2, Center for International Comparisons of Production, Income and Prices at the University of Pennsylvania, September 2006.

Public and Private Spending on Education: The private spending on education series is proxied by household expenditure on education. The difference between 'household' and 'private' is not major (the latter includes expenditure by firms and other private but non-household units). For our model 'household' was the right choice, considering that we are looking at how individuals spent on their offspring's education. The data for household and government spending on education came from the Organisation for Economic Development and Cooperation, Education Statistics, Volume 2006, Issue 01, ESDS International, (Mimas) University of Manchester.

Investment/GDP, PPP: World Penn Table. Source: Alan Heston, Robert Summers and Bettina Aten, Penn World Table Version 6.2, Center for International Comparisons of Production, Income and Prices at the University of Pennsylvania, September 2006. Expressed in percentage points (1% instead of 0.01).

Degree of democracy: Measures the degree of institutionalised democracy from 0 to 1 (where higher numbers mean more democracy). This variable is a linear transformation of the variable 'Polity' from the Polity IV database, which ranges from -10 to 10. Source: Monty G.

Marshall and Keith Jaggers. 2004. Polity IV Data Set. [Computer file; version p4v2004] College Park, MD: Center for International Development and Conflict Management, University of Maryland.

Trade/GDP, PPP: Sum of exports and imports of goods and services measured as a share of gross domestic product. Source: World Penn Table. Source: Alan Heston, Robert Summers and Bettina Aten, Penn World Table Version 6.2, Center for International Comparisons of Production, Income and Prices at the University of Pennsylvania, September 2006. Expressed in percentage points (1% instead of 0.01).

M2/GDP: Ratio of Money and quasi money (M2) as a share of GDP. Source: World Bank, World Development Indicators (WDI) April 2008, ESDS International, (Mimas) University of Manchester. Expressed in percentage points (1% instead of 0.01).

Figure 1

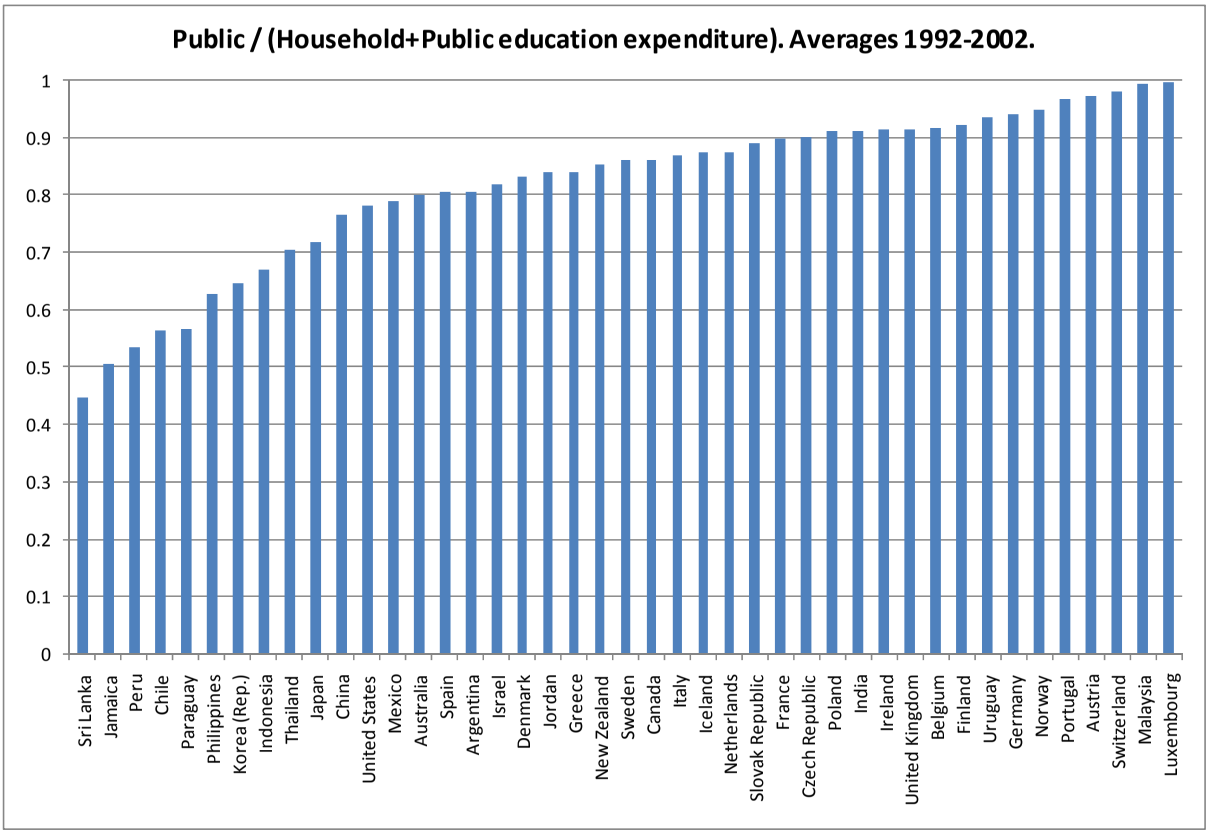

Figure 2

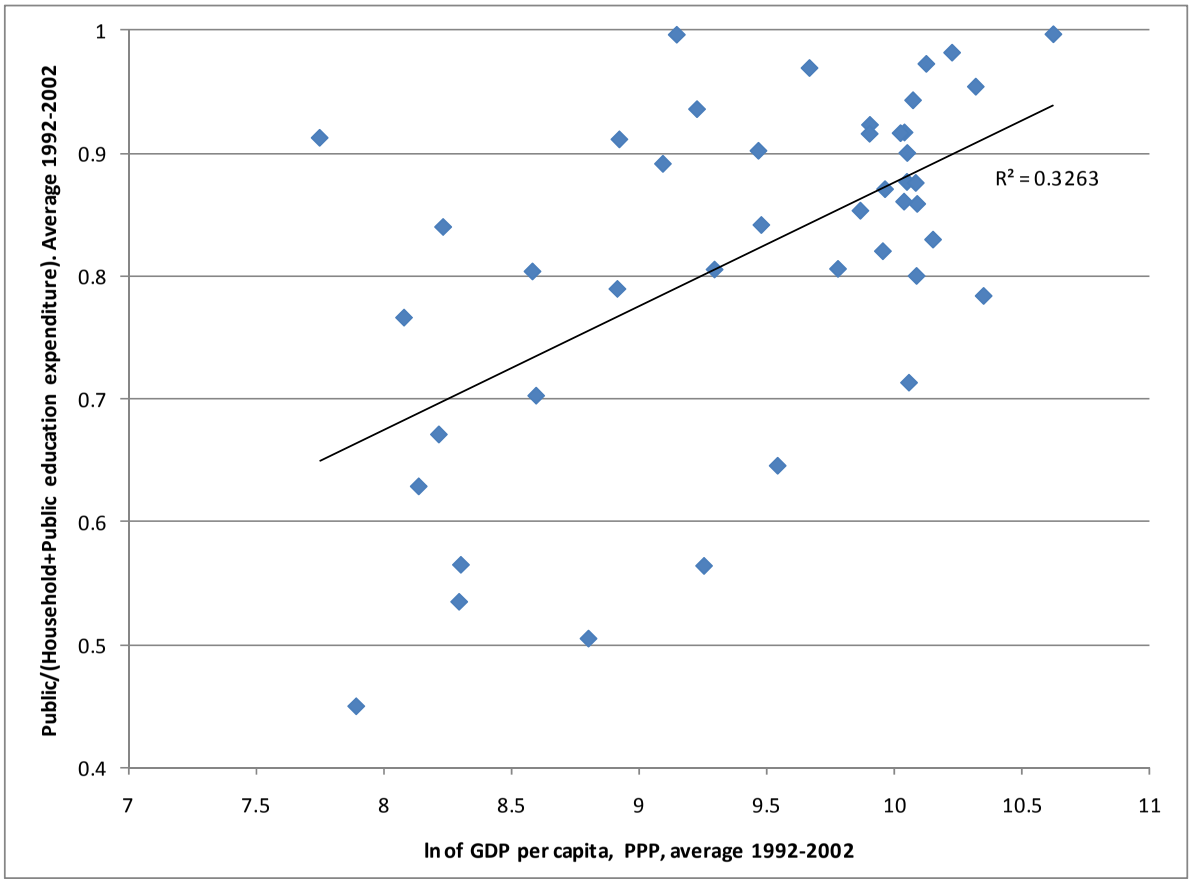

Figure 3

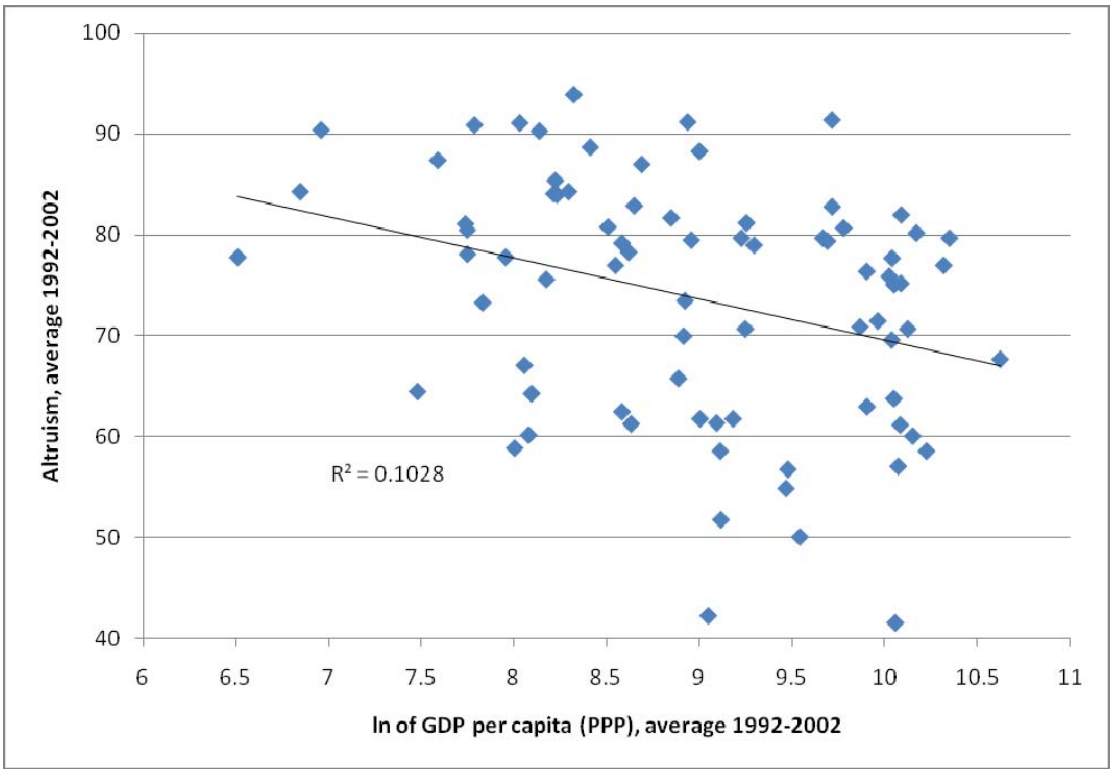

Figure 4

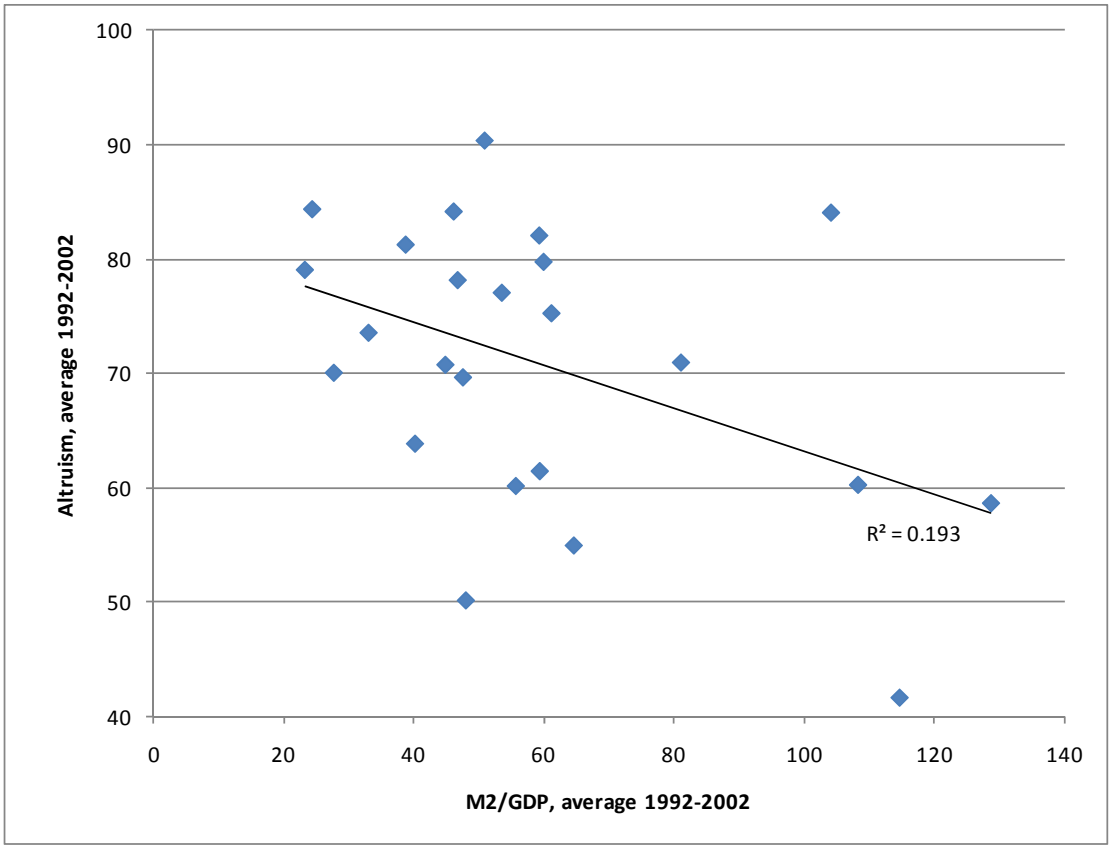

Table 1

Pairwise Correlations

	Subsidy	Growth, GDP per capita (PPP)	Altruism	Interest rate
Subsidy	1	-0.05917	-0.29747	-0.4914
Growth, GDP per capita (PPP)		1	0.079564	-0.2419
Altruism			1	0.287229
Interest rate				1

Note: variables represent averages for 1992-2002

Table 2

Dependent variable: Subsidies	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**
Altruism	-0.002	-0.002					
	(-1.06)	(-0.78)					
Altruism Dummy 50%			-0.043			-0.074	
			(-1.27)			(-1.34)	
Altruism Dummy 33%				-0.089 **			-0.136 **
				(-2.53)			(-2.99)
Altruism Dummy 20%					-0.150 ***		
					(-4.32)		
Interest Rate	-0.011 ***	-0.008	-0.011 ***	-0.009 **	-0.008 **	-0.008	-0.005
	(-2.76)	(-1.43)	(-2.94)	(-2.38)	(-2.47)	(-1.42)	(-1.23)
ln GDP per capita (PPP)		0.084				0.087	0.083 *
		(1.45)				(1.58)	(1.9)
Public expenditure/GDP (PPP)		0.003				0.003	0.001
		(0.76)				(0.89)	(0.36)
Investment/GDP (PPP)		-0.016				-0.018	-0.017 *
		(-1.27)				(-1.55)	(-1.96)
Trade/GDP (PPP)		0.000				0.000	0.000
		(-0.33)				(-0.58)	(0.34)
Degree of Democracy		0.015				0.014	-0.046
		(0.09)				(0.09)	(-0.34)
M2/GDP		0.001				0.001	0.001
		(0.81)				(1.05)	(1.39)
Constant	1.039 ***	0.456	0.939 ***	0.931 ***	0.926 ***	0.314	0.365
	(0.922)	(0.96)	(28.43)	(32.23)	(37.09)	(0.86)	(1.24)
Obs	34	21	34	34	34	21	21
R-squared	0.268	0.554	0.279	0.371	0.527	0.592	0.732
Adj R-squared	0.221	0.256	0.232	0.331	0.496	0.321	0.553

*Notes: t-values in parenthesis, *** stands for significant at 1% level, * stands for significant at 10%. All the variables represent average values for each country for the period 1992-2002.*

Table 3

Dependent variable: GDP per capita Growth, PPP

	(1)		**(2)**		**(3)**	
Altruism	0.001	+	0.001	*	0.001	**
	(1.72)		(2.09)		(2.13)	
Interest Rate	-0.002	**	-0.002	**	-0.001	+
	(-2.24)		(-2.35)		(-1.74)	
ln GDP per capita (PPP)	-0.009		-0.011	**		
	(-1.49)		(-2.79)			
Public expenditure/GDP (PPP)	0.001	*	0.001	**	0.001	***
	(2.07)		(2.36)		(3.09)	
Investment/GDP (PPP)	0.003	***	0.003	***	0.003	***
	(3.23)		(4.12)		(3.22)	
Trade/GDP (PPP)	-1.96E-04	*	-1.97E-04	*	-2.32E-04	*
	(-1.86)		(-2)		(-2.00)	
Degree of Democracy	-0.008					
	(-0.4)					
M2/GDP	-2.33E-04	+	-2.21E-04	*	-2.19E-04	
	(-1.74)		(-1.87)		(-1.56)	
Constant	0.025	***	0.025		-0.091	*
	(0.41)		(0.43)		(-1.95)	
Obs	23		24		24	
R-squared	0.656		0.656		0.488	
Adj R-squared	0.460		0.505		0.307	

*Notes: t-values in parenthesis, *** stands for significant at 1% level, * stands for significant at 10%, + stands for significant at 11%. All the variables represent average values for each country for the period 1992-2002.*

Table 4

Dependent variable:	Altruism		Altruism	
	(1)		**(2)**	
Constant	115.985	***	82.057	***
	(5.141)		*(16.614)*	
ln GDP per capita (PPP)	-4.754	*		
	(-1.991)			
M2/GDP			-0.189	***
			(-2.861)	
R squared	0.1013		0.1920	
Adjusted R squared	0.0749		0.1560	
Countries	36		24	

Notes: t-values in parenthesis, *** stands for significant at 1% level,
** stands for significant at 5%, * stands for significant at 10%.
All the variables represent average values for each country for the period 1992-2002.

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