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ESSAYS ON THE POLITICAL ECONOMICS OF EDUCATION AND SOCIAL SECURITY

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To my parents

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Chapter 1

Introduction

Education and social security are not only among the largest items in most governments' budgets, but their strong distributional impact makes them also particularly interesting from a social welfare perspective. In this work, we investigate the political economy of these two policies, and study the economic and political forces shaping the extent and character of the respective policies chosen by the government of a given society.

We start our analysis with higher education as the most exclusive, and also the most relevant part of education from a labor market perspective. In Chapter 2, we develop a formal model to explain why governments subsidize higher education despite its regressive character, and why the empirical relevance of loan programs is rather minor. We show that subsidies to higher education are mostly demanded by those agents who have the necessary talent, but not the necessary skill to enroll into tertiary education. Nevertheless, positive degrees of higher education subsidies always emerge in the political equilibrium, since such subsidies lower redistributive pressures for the rich elite, and generate positive externalities for the lowly skilled. The larger the group of agents credit constrained in their educational decision, the larger the subsidies, but also the redistributive transfers emerging in the political equilibrium.

The higher education policies emerging from the political sphere directly determine enrollment rates, and critically shape the structure of the higher education sector. While most higher education sectors are traditionally dominated by public providers, private higher education plays an increasingly important role across countries. This private provision of higher education is the focus of Chapter 3. Using a dynamic model of signaling we argue that the differences in the structure of higher education sectors across countries can be derived from three principal factors: the aggregate returns to skilled labor, the degree of governmental subsidization of higher education in general, and the relative subsidy provided to public providers in particular. Higher returns to skilled labor imply higher enrollment rates, and thus a lower average talent of those enrolling in higher education. The lower the signaling value of public education, the easier it is for private providers to enter the higher education market by selling a costly elite signal. Higher degrees of generic subsidization accelerate the growth in enrollment, and therefore foster also the emergence and growth of private elite institutions. The smaller the difference between the subsidies provided to private and public institutions, respectively, the earlier and the more numerous private providers will emerge.

In Chapter 4, we switch our focus from higher to basic education, and concentrate our analysis on the interaction between public education and social security. Basic or elementary, as opposed to higher education is accessed by all socioeconomic classes of a given population, so that government expenditure on this type of education has redistributive rather than regressive character. As long as the median voter has labor income below the mean, positive levels of public education expenditure always arise from the political equilibrium independent of the level of economic development. The same is not true for PAYGO social security systems. PAYGO systems are costly for young agents in a dynamically efficient economy, and are thus strictly opposed by the majority of the young as long as the young do not receive additional incentives to support such a system. We show that intergenerational transfers or bequests between parents and their descendants can generate such incentives. As long as agents are poor, the transfers to the retired population implicit in the PAYGO pension system are completely absorbed by the parental generation. This changes over time, as agents accumulate private wealth and parents share an increasing part of their wealth with their children. Once a sufficient number of young agents is linked to the old generation via bequest, the introduction and continuation of pension systems always receive majority support. Public education increases economic growth, and thus also the political support for pension systems by lowering the inherent economic cost for the young. PAYGO pension systems in return increase the incentives to invest into human capital, and thus raise the political support for public education expenditure. Therefore, public education and pension systems always mutually complement and enforce each other in the political domain.

Throughout our analysis, we make an effort to support the main assumptions and implications of the theoretical models presented with empirical evidence. We use panel data from the World Bank and the OECD to demonstrate the positive relation between credit constraints and higher education subsidies outlined in Chapter 2, provide some descriptive statistics and calibration results in support of the signaling model presented in Chapter 3, and show some cross-sectional results for the basic relation between educational and social security expenditure in Chapter 4. Finally, we dedicate the last chapter of this work to the empirical evaluation of one of the models' main building blocks: agents' intentional choice to share a part of their wealth with their descendants. Theoretically, agents may decide to leave a part of their wealth to their posterity because they directly care about the welfare of their descendants, because they enjoy the act of giving or because they want to lure their descendants into providing attention to their parents. In Chapter 5, we use data from the Health and Retirement Study (HRS) to determine the overall relevance of intentional bequests within the elderly US population, and to identify the main motivation underlying such bequests. Overall, the data strongly underline the empirical importance of intentional bequests. A large majority of respondents in the sample indicates positive probabilities to leave some financial bequest to their descendants. However, we find little evidence for agents directly caring about the welfare of their children. Neither children's education nor family size appear to matter in agents' bequest decision. On the other hand, we find that parents appear more likely to leave positive bequests if at least one adult child lives at their home and if their children are relatively wealthy. These findings are highly inconsistent with altruistic models of bequests, and indicate strategic motivations to be the principal driver for end of life transfers within the US population featured in the HRS sample.

We conclude our analysis with a brief summary and a few final remarks in Chapter 6.

Chapter 2

The Political Economics of Higher Education

2.1 Introduction

The international degree of higher education subsidization is remarkable. In 2000, the US government spent more than US$ 6,900 for each student enrolled in higher education, still lagging well behind members of the European Union, who spent on average close to US$ 10,000 for the same purpose. Relative subsidies to higher education appear even larger in developing countries with an average subsidy of more than 100% of GDP per capita per student; the average levels of government expenditure per student in higher education, enrollment rates and national incomes are summarized in Table 1 below. From a political perspective, the wide diffusion and dimension of higher education subsidies are quite surprising. As shown in Table 1, access to tertiary education is mostly reserved to a rather small fraction of the population. Since the minority enrolling in higher education can generally be assumed to be relatively wealthy, subsidies to higher education constitute highly regressive transfers, inconsistent with standard median voter based models.

Table 1: GDP, Enrollment and Subsidies to Higher Education[1]

	GDP Per Capita[1)]			Tertiary Enrollment[2)]			Subsidy Per Student[3)]		
Quintile	*min*	*mean*	*max*	*min*	*mean*	*max*	*min*	*mean*	*max*
I	511	1,009	1,499	0.6	3.2	16.7	40.0	317.5	1,180.1
II	1,503	2,453	3,604	1.2	11.0	30.5	11.3	132.2	849.8
III	3,662	5,009	6,691	4.8	21.6	44.4	9.0	65.2	312.4
IV	6,701	9,802	15,816	5.5	26.5	51.8	5.6	47.1	149.3
V	16,402	21,821	33,740	8.5	46.1	84.0	14.9	37.0	54.7
Overall	**511**	**8,152**	**33,740**	**0.6**	**21.9**	**84.0**	**5.6**	**109.7**	**1,180.1**

1) Constant 1995 US$ PPP. 2) Gross enrollment in tertiary education (WDI Definition).
3) Annual government expenditure per student enrolled in tertiary education as percentage of GDP per capita.

Although partial explanations have emerged over the last years, the puzzle regarding the close to uniform existence of publicly financed higher education and the dominant position of public subsidies relative to loan programs has remained largely unresolved[2].

In this chapter, we develop a formal model with heterogeneous agents and a multi-dimensional policy space to provide a complete analysis of the political forces driving higher education policy. We allow for heterogeneity in wealth and ability, and assume that private credit market access is restricted. Higher education enrollment is associated with financial costs and individual effort, so that the decision to enroll hinges upon individual talent and the skill premium endogenously determined in the labor market.

In the political domain, agents determine higher education policy as well as the degree of general redistribution. Since access to private credit markets is restricted, governments can either set up public loan schemes, or directly subsidize higher education. Redistribution is achieved by generic lump sum transfers. Transfers

[1]Source: World Bank Development Indicators (WDI) 2002. All numbers indicated are averages for the period 1990 to 1999.

[2]Loan programs play no or only a very minor role in most countries. Graph 2 in the Appendix summarizes the data on relative budget allocation between loans and subsidies to higher education.

and subsidies to higher education have to be financed by taxing either wealth or labor income.

Policy outcomes are shaped in a process of legislative bargaining, where legislators act on behalf of their respective constituencies. Since government loan programs minimize the net skill premium earned in the labor market, any agent directly interested in higher education strictly prefers subsidies to government loans. Subsidies to higher education increase enrollment, but still allow positive returns to higher education and, at the same time, lower the aggregate demand for redistributive policies. As a consequence, positive subsidies to higher education always emerge in the bargaining process. The larger the group of credit constrained agents, the larger the degree of subsidization in equilibrium.

Higher levels of private wealth imply a smaller fraction of agents credit constrained and, correspondingly, a lower degree of subsidization demanded by agents not directly interested in higher education. Thus, the wealthier or more developed a country, the smaller is the subsidy to higher education emerging from the political equilibrium. The same is not necessarily true for redistributive transfers. Although a larger share of agents not credit constrained implies lower tax rates, the comparative statics for redistributive transfers are uncertain, since smaller tax rates can be more than compensated by increases in the taxable wealth stock.

In the second part of the chapter, we use data from the OECD and the World Bank to test the empirical validity of our model. The main implications of the theory presented appear well supported in the data. The wealthier a country, and the smaller the group of agents credit constrained, the smaller the level of government expenditure per student observed. Redistributive transfers weakly increase with national income levels, and decrease with the share of the population relatively wealthy.

The model we present follows a series of papers linking the political economy of education to general redistributive policies, pioneered by Perotti (1993). Perotti uses a setup where human capital generates a positive externality for all agents, but the access to education depends on the post-tax income of agents. As a consequence, redistribution leads to more educational investment in relatively rich countries, and to less investment in relatively poor ones. Along the same lines, Glomm/Ravikumar (1998) and Epple/Romano (1995) stress the redistributive character of public education, while Fernandez and Rogerson (1995) demonstrate that public subsidies for education may be the regressive outcome of a coalition between rich and middle income agents. Acemoglu and Robinson (1996) and Bourguignon and Verdier (2000) stress the political and economic externalities associated with education, and demonstrate that the extension of education access may well be in the interest of a ruling elite.

Easterly and Rebelo (1993), James (1993) and Sylwester (2000) empirically study the determinants of total public expenditure on education, and find a positive and highly significant relation between income inequality and public education expenditure. Although our study exclusively focuses on expenditure on tertiary education, our results are highly consistent with these previous studies, and the theory presented here is likely to provide at least partial explanation for the overall patterns observed in public education expenditure.

As to the general trade-off between redistribution and other policy dimensions, the basic argument laid out in this paper follows recent work by Austen-Smith and Wallerstein (2003), who show that the conflict among the poor along the dimensions of redistribution and affirmative action may cause the low degrees of income redistribution empirically observed. The same mechanism is applied by Levy (2005), who shows that the political coexistence of an in-kind-transfer such as public education with plain redistributive transfers leads to relatively modest degrees of redistribution in the political equilibrium.

The rest of the chapter proceeds as follows: we present the basic setup in the following section, and then discuss the political outcomes in section 3 of the chapter. We provide empirical evidence in support of our theoretical model in section 4, and use section 5 to summarize and conclude the chapter.

2.2 The Model

2.2.1 General Setup

We consider a single period model and a continuum of heterogeneous agents of size 1. Agents are heterogeneous along the dimensions of wealth and talent. Private wealth b^i is uniformly distributed in the interval $[b^{\min}, b^{\max}]$. Agents are either endowed with high (θ^h) or with low (θ^l) talent. The likelihood of any agent to be of the high talent type is denoted by p, and is assumed to be independent from the private wealth endowment[3]. Given her type (b^i, θ^i), each agent i maximizes a generic utility function u^i given by

$$u^i = u(c^i) - \phi(\theta^i) \tag{2.1}$$

where c^i is the consumption of agent i, $u(.)$ is a standard concave utility function, and $\phi(\theta_t^i)$ is the talent dependent effort cost of enrolling into higher education.

Before entering the labor market, agents decide whether or not to enroll into higher education. Higher education is associated with a pecuniary cost C, a talent dependent effort cost $\phi(\theta^i)$, and a premium π earned by providing high skilled labor to the production sector. For simplicity we assume that the effort cost is zero for highly talented agents and infinitely high for agents with low talent, so that the latter type of agents never enrolls into higher education[4]. Access to the

[3]It should be noted that the model generates a strong and positive correlation of incomes across generation despite this assumption. We will discuss the implications of a positive correlation between wealth and talent in the empirical part of this paper.

[4]Another way to interpret this assumption is that agents marked with θ^h have a positive return

credit market is restricted, so that agents cannot borrow from the private sector to finance higher education. An agent i decides to enroll into higher education if and only if the following three conditions are satisfied:

$$\begin{aligned} C - S &\leq b^i(1-\tau^b). && \text{(credit constraint)} \\ \theta^i &= \theta^h && \\ \pi(1-\tau^I) &\geq C - S, && \text{(incentive compatibility constraints)} \end{aligned} \tag{2.2}$$

where C is the cost of higher education, S is the public subsidy provided to each student enrolling into higher education, and τ^b, τ^I are the tax rates levied on labor income and private wealth, respectively.

We assume that $0 < b^{\min} < C < b^{\max}$, so that some, but not all agents can afford to enroll into higher education without any public subsidization. We refer to agents with private wealth $b^i \geq C$ as rich, and, correspondingly, to agents with wealth below this level as poor.

Abstracting from physical capital[5], we assume that high and low skilled labor are the only inputs for production, so that total output Y is given by:

$$Y = H^{\alpha}L^{1-\alpha}. \tag{2.3}$$

H and L are the total stock of high and low skilled labor, respectively, and $\alpha \in (0.5, 1)$ measures the relative productivity of the highly skilled. The production sector is perfectly competitive and wages equal the marginal products of labor. Wages for the skilled w^s and unskilled w^u are given by

$$w^s = \alpha\left(\frac{L}{H}\right)^{1-\alpha} \tag{2.4}$$

to higher education, while all other agents face negative returns on human capital investment.

[5]Assuming a small and open economy with exogenously given interest rates leads to identical results.

$$w^u = (1-\alpha)(\frac{H}{L})^\alpha, \tag{2.5}$$

so that the wage premium π equals

$$\pi = w^s - w^u. \tag{2.6}$$

Noting that by assumption $L = 1 - H$, the premium for higher education can be expressed as

$$\pi = \alpha(\frac{1-H}{H})^{1-\alpha} + (\alpha - 1)(\frac{H}{1-H})^\alpha, \tag{2.7}$$

which simplifies to

$$\pi = \frac{\alpha - H}{H^{1-\alpha}(1-H)^\alpha}. \tag{2.8}$$

We restrict the share of talented agents p to be smaller than the relative productivity of high skilled labor α, so that the premium to higher education π is strictly positive and decreasing in H.

2.2.2 Policy Space and Timing

In each period, agents decide on higher education policy as well as on the degree of general redistribution. Higher education policy aims at easing the private credit constraints for agents striving to enroll in tertiary education. To reach this policy objective, governments can either subsidize enrollment by transferring an amount S to each student, or, alternatively, create a governmental loan program for higher education. Within the loan program we assume that students can not default and that interest rates are zero, so that the loan program has no effective cost for the government[6].

In addition to higher education policies, agents can use a generic per capita transfer R to redistribute incomes. Redistributive transfers, as well as any subsidy

[6]This is clearly the assumption most favorable for the loan program; as we will show later, loans are always dominated by the subsidies in the political decision process despite this setup.

for higher education S have to be financed by taxes on wealth (τ^b) or income (τ^I). The government's budget constraint is given by

$$R + HS = \tau^b \overline{b} + \tau^I \overline{w}, \tag{2.9}$$

where $\overline{b}$ and $\overline{w} = w^u + H\pi$ are the mean levels of private wealth and labor income, respectively, and H is the share of agents enrolling into higher education. To exclude the case of full expropriation, we assume that agents can hide their wealth at some given cost ξ; the maximum feasible tax rate on wealth $\tau^b_{\max}$ thus equals $\xi < 1$.

The decision sequence is the following:

1. Agents are born and endowed with talent θ^i and private wealth b^i.
2. Legislature sets the policies S, R, τ^I, τ^b.
3. Agents take their enrollment decision. Wages are determined in the labor market and workers get paid. Agents pay income taxes and receive the redistributive transfer R.

2.2.3 The Social Planner Solution

To get a normative benchmark for the political outcomes derived in the following section, we begin our analysis by determining the optimal policies for a social planner exclusively interested in aggregate output[7]. Since output is a function of human capital investment the social planner maximizes

$$Max_H \; H^\alpha (1 - H)^{1-\alpha} - HC. \tag{2.10}$$

[7] We focus on output since we are mostly interested in the optimal education policies. The utilitarian optimum is highly similar to the solution outlined here, but would also encompass the maximum feasible degree of wealth redistribution.

The first order condition implies

$$\alpha(\frac{1-H}{H})^{1-\alpha} - (1-\alpha)(\frac{H}{1-H})^{\alpha} - C = 0, \tag{2.11}$$

which, by (2.7), equals

$$\pi(H^*) = C, \tag{2.12}$$

where H^* is the efficient amount of human capital. The result is intuitive; the social planner wants agents to enroll until the market premium for high skilled workers is just equal to the full (unsubsidized) cost of higher education. Clearly, this condition is always satisfied under the loan program. If access to higher education is unrestricted and the pool of talented agents is sufficiently large[8], agents will enroll exactly until the return to higher education equals the cost, so that the efficient level of enrollment will always be achieved.

Nevertheless, the efficient level of human capital can also be reached by a combination of subsidies and income taxes. Let us order agents along the dimension of wealth and denote by b^{i*} the wealth of the poorest agent who should enroll into higher education in the social optimum, such that

$$p\int_{b^{i*}}^{\infty} f(b^i)di = H^*. \tag{2.13}$$

where $f(b^i) = \frac{1}{b^{\max} - b^{\min}}$ is the density function of private wealth, and p is the fraction of highly talented agents as defined before. Then, the socially optimal enrollment rate H^* can be reached by setting the subsidy S to

$$S^* = C - b^{i*}. \tag{2.14}$$

To see why this is the case, note that S^* satisfies the credit and the talent constraint exactly for a share H^* of the total population. Since an enrollment rate of H^*

[8]Technically, we need $p > H^*$, which we assume to be satisfied throughout our analysis.

implies a premium ($\pi = C$) larger than the net cost ($C - S^*$) of higher education, all agents with high talent who can afford to enroll into higher education will do so, so that the enrollment rate will be exactly H^*.

The maximum feasible income tax rate at the socially optimal level of human capital follows directly from the previous exhibition. Plugging (2.12) into the incentive constraint (2.2) at $\pi(H^*) = C$, we get $C(1-\tau^I) = C - S^*$, which implies a maximum feasible income tax of

$$\tau^I_{\max} = \frac{S^*}{C} = \frac{C - b^{i*}}{C}. \tag{2.15}$$

Lemma 1 *The income distribution under the government loan program for higher education is identical to the income distribution with the socially optimal level of subsidies S^* and the highest feasible tax $\tau^I_{\max}$ given S^*.*

Proof. Assume any S^* such that $\pi(H) = C$ and a corresponding maximum tax rate $\tau^I_{\max}(S^*)$. The income tax contribution of each skilled agent amounts to $\tau^I_{\max} w^s$. Since $w^s = w^u + C$ at H^*, the amount a skilled agent contributes equals $\tau^I_{\max}\pi + \tau^I_{\max} w^u$. The first part of this term $\tau^I_{\max}\pi = \tau^I_{\max} C$, which, by (2.15) is exactly identical to the subsidy received S^*, and thus exactly repays the subsidy received. The second part $\tau^I_{\max} w^u$ equals the tax contribution of unskilled agents. Since $\tau^I_{\max} C = S$, the budget constraint (2.9) implies that $R = \tau^I_{\max} w^u$. Therefore, the income after tuition fees, income tax payments and redistribution for all agents equals exactly w^u, which is exactly the income all agents get under a loan scheme net of tuition payments. ■

The basic mechanism underlying Lemma 1 is simple: Since the social planner has discretion over income tax rates, she will choose a tax rate that sets net premiums to higher education to zero. As a result, beneficiaries fully repay the subsidy received through income taxation, rather than repaying it directly to the government under a loan scheme.

2.2.4 Policy Preferences I: The Rich and Talented

We classify agents as rich and talented if $\theta^i = \theta^h$ and $b^i \geq C$, so that all rich and talented can and will enroll into higher education in the absence of government intervention. Disposing of high labor income and wealth, rich and talented agents clearly oppose general redistribution. The same is true for governmental loan programs, which significantly lower the premium earned by skilled labor, and thus strictly decrease the life time income of any rich and talented agent.

Subsidies to higher education constitute a net transfer from the general budget which comes at the cost of lowering the labor market premium earned with higher education, and has to be financed by some form of taxation. The rich and talented differ in their wealth endowment, and may thus have diverging preferences with respect to taxation. We focus our analysis on the median of this group, and assume that the median strictly prefers income to wealth taxation[9]. Under this assumption, the life time income maximization for the median of the rich and talented can be expressed as

$$\max_S w^s(S)(1-\tau^I(S)) + S. \tag{2.16}$$

Noting that the total budgetary cost of the subsidy equals HS, and that, by the Cobb-Douglas production function, skilled labor always pays a share α of the total budget, the tax cost of S for each skilled agent exactly equals αS, so that we can rewrite (2.16) as

$$\max w^s(S) + S(1-\alpha). \tag{2.17}$$

The first order condition implies

$$-\frac{\partial w^s}{\partial H}\frac{\partial H}{\partial S} = 1 - \alpha. \tag{2.18}$$

[9]This requires $\frac{b^{max}+C}{2b} > \frac{w^s}{w^u}$ for the mean rich and talented agent and is not very restrictive, since in equilibrium net wage premiums are always low.

The partial derivative of the skilled wage with respect to high skill labor $\frac{\partial w^s}{\partial H} = \frac{\alpha^2-\alpha}{H^2\left(\frac{1}{H}(1-H)\right)^\alpha}$ is strictly negative and convex ($w' < 0, w" > 0$). $\frac{\partial H}{\partial S}$ is the constant density of the wealth distribution function $f(b)$. With constant marginal benefits and decreasing marginal cost the optimal level of subsidization for a rich and talented agent must always coincide with a corner solution, that is $S \in \{0, C\}$. The rich will strictly prefer a subsidy of zero to any other policy bundle as long as the unsubsidized skilled wage is larger than the high skill wage under full subsidization plus the net transfer generated by the higher education subsidy, that is

$$\alpha(\frac{1-\gamma^{RT}}{\gamma^{RT}})^{1-\alpha} > \alpha(\frac{1-p}{p})^{1-\alpha} + C(1-\alpha), \tag{2.19}$$

where $\gamma^{RT} = pf(b)(b^{\max} - C)$ is the group size of the rich and talented. Rearranging this expression we get

$$\gamma^{RT} < \frac{1}{\chi + 1}, \tag{2.20}$$

where χ is a constant given by $[(\frac{1-p}{p})^{1-\alpha} + C\frac{(1-\alpha)}{\alpha}]^{\frac{1}{1-\alpha}}$.

The larger the group of the poor and talented, the more the rich and talented lose by subsidization in general. The median of the rich and talented will support full subsidization only if there are few poor and talented agents so that the negative wage effects are small. To choose the most conservative assumption towards educational subsidies, we exclude this and focus on the more interesting case where the fraction of the poor and talented agents is relatively large, so that the median of the rich and talented always strictly prefer zero to full subsidization, and therefore opposes any government policy.

2.2.5 Policy Preferences II: The Poor and Talented

The poor and talented are those agents characterized by $\theta^i = \theta^h$ and $b^i < C$. This group thus comprises those agents who have the necessary talent to enroll into higher education but insufficient wealth to do so. Each poor and talented agent

i needs at least a subsidy $S^i_{\min} = C - b^i$ to access higher education. Any further increase in the subsidy implies - similar to the case of the rich and talented - a marginal cost of $\frac{\partial w^s}{\partial H}\frac{\partial H}{\partial S}$, which decreases in S, and a constant marginal benefit. As a consequence, the optimal subsidy will again be a corner solution: each agent will either choose the minimum level of subsidization allowing herself to access higher education ($S^i_{\min}$), or opt for full subsidization $S^{\max} = C$. Denoting the share of talented agents with wealth at least as large as b^i by $H^i = pf(b)[b^{\max} - b^i]$ any poor and talented agent's optimal level will be given by $S^{\max} = C$ as long as

$$\alpha(\frac{1-H^i}{H^i})^{1-\alpha} - \alpha(\frac{1-p}{p})^{1-\alpha} < (C - S^i_{\min})(1-\alpha) = b^i(1-\alpha), \qquad (2.21)$$

and by $S^i_{\min}$ otherwise[10]. Since the left hand side of inequality (2.21) goes to zero and $b^{\min} > 0$, there are at least some agents that strictly prefer full subsidization. We assume that (2.21) is not necessarily satisfied for all agents, but that it always holds for the median member of this group.

Since full subsidization implies sizeable direct transfers to the poor and talented, the median of the poor and talented generally strongly prefers government subsidies to the loan program. Loan programs are only interesting for the poor and talented if the premium under full enrollment becomes very small relative to the full cost of education[11]. Since this case is rather unlikely, we assume throughout the following analysis that the median of the poor and talented strictly prefers full subsidization to the loan program.

Since the poor and talented are characterized by $b^i < C$, the private wealth of the median voter must always be strictly smaller than the average private wealth

[10] $1-\alpha$ is the the lower bound for the net benefit, that is, the case where the subsidy has to be financed by income taxation. If the subsidy can be financed with wealth taxation, the net benefit is higher than this, and given by $1 - H\frac{b^i}{\bar{b}}$.

[11] Technically, this requires $C > \frac{w^s(H^{\max}) - w^u(H^*)}{\alpha}$ if the subsidies are financed with income taxes, $w^s(H^{\max}) - \xi b^i > w^u(H^*)$ otherwise.

in the economy. Therefore, the median agent of the poor and talented always demands the maximum feasible degree of wealth taxation. The optimal policies for the median of the poor and talented are thus given by $S = C$, $\tau^b = \xi$, and the lowest level of income taxation $\tau^I \geq 0$ necessary to satisfy the government budget constraint (2.9) given full subsidization of higher education and the maximum feasible rate of wealth taxation.

2.2.6 Policy Preferences III: The Untalented

Untalented agents are those characterized by θ^l and thus never enroll into higher education independent of the degree of subsidization. One may interpret members of this group as agents with relatively modest innate abilities or, alternatively, as agents not directly interested in higher education (in which case θ^l would mark preferences towards higher education rather than talent). The policy preferences of agents of this group follow directly from the life time income maximization, which is given by:

$$Max_{\tau^b,\tau^I,S}\ b^i(1-\tau^b) + w^u(1-\tau^I) + R \tag{2.22}$$

subject to constraints (2.2) and (2.9).

Lemma 2 *Under a higher education loan scheme, the optimal level of income taxation for untalented agents is zero.*

Proof. Optimizing (2.22) with respect the income tax, unskilled agents maximize $w^u(1-\tau^I) + \tau^I(Hw^s + (1-H)w^u)$. Since $w^s = w^u + \pi$, the maximization term corresponds to $w^u + \tau^I H\pi$. Given that there are no binding restrictions to higher education access, $\pi(1-\tau^I) = C$, so that $\tau^I = \frac{\pi - C}{\pi}$. Using this expression, unskilled agents maximize $w^u + H(\pi - C)$, which by by (2.4) and (2.5), is nothing else but $Y - HC$. The maximization of this term[12] yields $\pi_t = C_t$ as solution, which directly

[12]Note that this is exactly the term maximized by the social planner.

implies a tax rate of zero. ■

The intuition of Lemma 2 is straightforward: since the loan program eliminates the credit constraint, the incentive compatibility constraints (2.2) are always exactly satisfied, so that all agents have the same labor income net of taxes and tuition payments[13]. As a consequence, young agents strive to maximize the average income in the economy. Given that any income taxation strictly lowers total human capital and output under the loan scheme, the optimal income tax rate must be zero.

Let us assume next that there is no loan program. In the absence of a loan program, unskilled agents choose an optimal combination of higher education subsidies and income taxation maximizing

$$Max_{\tau^b,\tau^I,S}\ b^i(1-\tau^b)+\tau^b\bar{b}+w^u(S)+H(S)(\tau^I\pi(S)-S). \qquad (2.23)$$

Lemma 3 *The optimal level of subsidies for higher education for any unskilled agent is such that the socially efficient level of enrollment H_t^* is reached.*

Proof. Unskilled agents always set an income tax rate such that the talented are just indifferent between enrolling and not enrolling into higher education. Thus, $\tau^I = \frac{\pi - C + S}{\pi}$ for all S. Plugging this expression into the maximization problem and substituting π with $w^s - w^u$, the unskilled maximize $w^u + H(w^s - w^u - C)$. Rearranging the terms we get $(1-H)w^u + Hw^s - HC$, which, by (2.4) and (2.5), corresponds to $Y(H) - HC$. The solution of the maximization implies $\pi(H^*) = C$, the efficient level of enrollment. Thus, unskilled agents will set a subsidy just large enough to allow the wealthiest H^* agents to enroll into higher education. ■

The intuition for Lemma 3 is very similar to the once underlying Lemma 2. Since the untalented can use redistributive taxation to equalize net labor incomes

[13]This hold due to our assumption that effort costs are zero for talented agents.

across groups, they select the subsidy that maximizes the average income net of educational costs, and thus mimic the behavior of the social planner.

As shown in Lemma 1, the socially optimal subsidy S^* leads to a distribution of incomes equal to the distribution under the loan program if and only if the maximum feasible tax rate $\tau^I_{\max}$ can be imposed. Since the untalented are strictly worse off under any other tax rate, any untalented agents weakly prefers loans to government subsidies for higher education. Just like for the social planner, the slightest inefficiency in taxation would be sufficient to make untalented agents strictly prefer loan programs to the optimal tax-subsidy combination.

The income maximization for unskilled agents with respect to the wealth tax τ^b has no effect on enrollment[14] and can thus be treated independently of the other policy dimensions. Any agent with $b^i < \overline{b}$ wants the highest feasible wealth tax rate $\tau^b_{\max}$, while any agent with $b^i > \overline{b}$ strictly opposes such taxation. Given that the distributions of talent and wealth are independent, the median unskilled agent has a private wealth of $\overline{b}$, and is indifferent with respect to redistribution based on wealth taxation.

2.3 The Political Process - A Model of Legislative Bargaining

2.3.1 Basic Setup

Following recent work by Austen-Smith and Wallerstein (2003) we assume that policy outcomes are shaped in a process of legislative bargaining. Representing the respective groups in our model, we assume that there are three types of legislators:

[14] As demonstrated before, the optimal level of subsidy S^* can always be financed with income taxes; therefore redistribution of wealth does not affect the human capital investment reached in the economy.

representatives of the untalented, representatives of the poor and talented, and representatives of the talented and rich. Legislators are organized in parties, and each party maximizes the utility of the median voter of its constituency[15].

To avoid a trivial solution, we assume that no single party, but any coalition of two parties forms a majority. As it is usually the case in a multidimensional policy space, the majority core is empty in our setup. To see why this is the case start by considering the lower bound, the policy preferred by the rich and talented (RT). The RT want no loan program, zero subsidies and no taxation. Since the coalition of the poor and talented (PT) and the untalented (U) strictly favors any policy with $S > 0$ to this policy, any policy bundle with $S = 0$ can never be the core. The same is true for any policy with $0 < S < S^*$. The optimal subsidy/tax combination of U $(S^*, \tau^I_{\max})$ cannot be in the core either, since the coalition of the RT and PT will favor any feasible bundle with lower income tax rates to the one proposed by PT. The same is true for government loan programs, which is strictly opposed by a coalition of RT and PT. Any combination of S^* with $\tau^b > 0$ cannot be in the core either, since a coalition of RT and U would prefer a similar bundle with lower wealth and higher income taxes. Similarly, no combination of S^*, $\tau^b = 0$, and $\tau^I_{\min} < \tau^I < \tau^I_{\max}$ can be in the core, since a coalition of U and PT would strictly prefer any policy with $\tau^b_{\max}$ and $\tau^I + \epsilon$ to such a bundle. The same logic applies to all policies with $S > S^*$, so that no feasible bundle is in the majority core.

Given this, we follow Austen-Smith and Wallerstein (2003) and previous work by Baron/Ferejohn (1989) and Banks/Duggan (2000) in assuming that legislators engage in an infinite horizon bargaining process. In each period a randomly selected legislator can make a policy proposal. If the proposal gets the support of any other party, the game ends and the policy is implemented, otherwise a new

[15]Following Austen-Smith and Wallerstein, we abstract from the electoral stage in our setup, and assume the distribution of legislators to be exogenously given.

proposer is randomly selected. The solution concept in this setup is a no delay stationary subgame perfect Nash equilibrium, which consists of a probability distribution over the strategy set and an acceptance set for each of the parties involved.

Let us denote the respective sizes of the three groups by γ_i with $i \in \{PT, RT, U\}$. To capture the relative political influence of each group, we assume that the probability to be selected as proposal maker is proportional to the relative group size. Thus, in each round, party i is selected as proposer with probability γ_i and makes a proposal $(S_i, \tau_i^b, \tau_i^I)$. If the proposal is accepted, the policy bundle is imposed, otherwise a new round begins and a new policy proposer is randomly drawn. In a stationary (history independent) subgame perfect equilibrium, each party will accept a proposal of the other party if and only if the utility of such a proposal is equal to the continuation value of the bargaining game. That is, a non-proposing party $j \neq i$ will accept the proposal $(S_i, \tau_i^b, \tau_i^I)$ of party i if and only if

$$u_j(S_i, \tau_i^b, \tau_i^I) \geq v_j, \tag{2.24}$$

where v_j is the continuation value of party j and given by

$$v_j = \delta[\gamma_i u_j(S_i, \tau_i^b, \tau_i^I) + \gamma_j u_j(S_j, \tau_j^b, \tau_j^I) + \gamma_k u_j(S_k, \tau_k^b, \tau_k^I)]. \tag{2.25}$$

$\delta \in (0, 1)$ is the common discount factor between bargaining periods, and i, j, k denote the three respective parties. We denote the set of all proposals satisfying inequality (2.24) for party j as acceptance set A_j, and assume A_j to be non-empty for all parties.

If a party i gets to propose, it chooses the utility maximizing policy bundle out of the two other acceptance sets. Therefore, the policy bundle proposed by legislator i is given by

$$(S_i, \tau_i^b, \tau_i^I) = \arg\max u_i(S, \tau^b, \tau^I) \text{ subject to } (S, \tau^b, \tau^I) \in A_j \cup A_k. \tag{2.26}$$

Treating the policy proposals of the other two players as exogenous, we can derive acceptance sets and best response function for each of the three parties. Solving the system of best response functions with respect to the tax rate and subsidy proposals, we get the set of optimal proposal given by

$$\{(\tau_U^I, \tau_U^b, S_U), (\tau_{PT}^I, \tau_{PT}^b, S_{PT}), (\tau_{RT}^I, \tau_{RT}^b, S_{RT})\}. \tag{2.27}$$

The levels of subsidization $\widehat{S}$ and taxation $\widehat{\tau}$ emerging in the bargaining equilibrium correspond to a probability distribution over the individually optimal proposals, and are given by

$$\widehat{S} = \gamma_U S_U + \gamma_{PT} S_{PT} + \gamma_{RT} S_{RT}, \tag{2.28}$$

and

$$\widehat{\tau}^I = \gamma_U \tau_U^I + \gamma_{PT} \tau_{PT}^I + \gamma_{RT} \tau_{RT}^I, \tag{2.29}$$

$$\widehat{\tau}^b = \gamma_U \tau_U^b + \gamma_{PT} \tau_{PT}^b + \gamma_{RT} \tau_{RT}^b, \tag{2.30}$$

Analogously, the rate of redistribution $\widehat{R}$ emerging in the political equilibrium is given by

$$\widehat{R} = \widehat{\tau}^b \overline{b} + \widehat{\tau}^I \overline{w}(\widehat{S}) - H(\widehat{S})\widehat{S}. \tag{2.31}$$

2.3.2 Characterization of the Bargaining Equilibrium

In the bargaining process legislators choose policies to maximize the average utility of their constituency[16], subject to at least one other party accepting the proposal. The RT try to minimize subsidies and redistribution, while the U are indifferent with respect to wealth taxation, but try to achieve the socially optimal education policy. The PT, on the other hand, try to maximize subsidies and the level of wealth taxation, but aim at keeping income taxation as low as possible.

Since we work with infinite horizons and variable group sizes, the number of possible equilibria is large. In order to be able to derive general and testable predictions, we restrict our analysis to the set of group size distributions $(\gamma^U, \gamma^{PT}, \gamma^{RT})$ implying stable coalitions. That is, we assume that the initial distribution of group sizes is such that a marginal change in the respective sizes does not change the coalition formed in equilibrium. Technically, we assume that γ^U, γ^{PT} and γ^{RT} are such that for every party i either $A_j \prec_i A_k$ or $A_j \succ_i A_k$ for $i, j, k \in \{U, PT, RT\}$ and $j \neq k \neq l$. If this is satisfied, marginal changes in group sizes always affect the relative bargaining power, but never the composition of equilibrium coalitions. Under this assumption, we can state the following result:

Proposition 1: *The policies emerging from the bargaining equilibrium can be characterized as follows:*

(i) There is no loan program for higher education.
(ii) $\widehat{S} > 0, \frac{\partial \widehat{S}}{\partial \gamma_{PT}} > 0, \frac{\partial \widehat{S}}{\partial \gamma_{RT}} < 0, \frac{\partial \widehat{S}}{\partial b} < 0.$
(iii) $\widehat{R} \geq 0, \frac{\partial \widehat{R}}{\partial \gamma_{PT}} > 0, \frac{\partial \widehat{R}}{\partial \gamma_{RT}} < 0, \frac{\partial \widehat{R}}{\partial b} > 0.$

The first part of Proposition 1 follows immediately from the preferences of the three parties. Since both potential coalition partners of the U strictly prefer tax/subsidy combinations to the loan program, a loan proposal will be accepted

[16] In our setup, the policies maximizing the mean welfare are identical to the ones preferred by the median.

by neither the RT nor the PT, who of course will never propose a loan program themselves. Part (ii) follows directly from the composition of possible coalitions. Since both the U and the PT want subsidies strictly larger than zero, and the RT prefer subsidies to any other policy choice, any possible equilibrium coalition must feature levels of higher education subsidies strictly larger than zero. The more likely the rich and talented agents are to propose, the higher their relative bargaining power, and the lower the expected level of higher education subsidies. A higher stock of private wealth implies that the marginal agent enrolling in the social optimum requires less subsidies, so that the optimal subsidy S^* for U declines. Since the optimal points for the two other groups do not change, it must always hold that $\frac{\partial \widehat{S}}{\partial \overline{b}} < 0$.

The analysis for redistributive transfers follows analogously. The more likely the coalition between the U and the PT, the higher the expected degree of redistribution. Thus, the smaller γ_{RT} and the larger γ_{PT} the higher the expected degree of redistribution $\widehat{R}$. More accumulated wealth $(\overline{b})$ implies a larger tax base, so that the redistributive transfer observed in equilibrium is larger keeping everything else constant.

2.3.3 Discussion

The main implications of Proposition 1 are straightforward. The larger the group of agents credit constrained, the larger the degree of higher education subsidization, and the larger also the degree of redistribution emerging in equilibrium. This result is intuitive, and may appear somewhat similar to the social planner solution. Yet, there are two important differences between the model predictions and the social planner's optimal choices. First, as it has been pointed out before, the social planner will choose to subsidize higher education only if there is no cost associated with income taxation. In the more likely case that taxation causes at least some marginal cost, the social planner will always impose the loan program and never opt for the subsidy-tax combination emerging from the political equilibrium.

The second difference between the model and the social planner solution is more subtle. The model presented in the previous section implies that subsidies to higher education are driven by two distinct channels; one is the socially optimal level demanded by the untalented; the second one is the relative group size of the poor and talented. From a comparative statics perspective, both channels work in the same direction. The larger the group size of the poor and talented relative to the size of those talented and unconstrained, the higher the equilibrium outcome relative to the social optimum. Thus, our model predicts excessively high rates of subsidization in very poor countries, and a more rapid decline in subsidies than implied by the socially optimal subsidization path. The distinction between wealth and group size channels is clearly not trivial from an empirical perspective, and shall be discussed in further detail in the empirical section below.

2.4 Empirical Findings

2.4.1 Interpretation and Testability

In the previous sections, we have presented a relatively complex economic framework to track the forces driving the political support for higher education subsidies and redistribution. We have demonstrated that higher education subsidies are in the interest of a majority of the population, even though they limit the scope of redistribution, and even though they are partially consumed by the wealthiest group of agents. It is the group of the poor and talented who mostly profits from and demands higher education subsidies and wealth redistribution, and the group of the rich and talented strongly opposing both of these policies.

How should one interpret these groups from a socioeconomic and political perspective? The rich and talented somewhat fit the general idea of members of the upper class - agents wealthy enough to privately afford tuition payments, and strictly opposing any kind of government policy. The group of the poor and talented are those with low wealth and high potential income, the group whose upward social mobility crucially depends on the policies selected by the government. One may think about this group as the "Bourgeois", the middle class or the new rich. The group of the unskilled is the remainder of the population, and contains all those agents who for reasons of taste or talent are not directly interested in enrolling into higher education. One should not necessarily think of this group as working class - it simply contains descendants from all classes not willing to invest time or effort to become highly educated.

Despite the broad alignment of our basic groups with socioeconomic classes, we do not find it particularly fruitful to interpret the three groups defined in our model as political parties. While one may be tempted to denominate the rich and talented as members of a conservative party, such a classification turns out more problematic for the remaining two groups. The PT can neither be placed left nor right, since they oppose income taxation but favor high wealth taxes and subsidies. The unskilled cannot be the left party either since they are indifferent with respect to wealth taxation and want only moderate degrees of redistribution.

Rather than mapping the model groups directly into the domain of political parties, we find it more appropriate to interpret the three types of agents as basic interest groups in the overall population, represented in all constituencies of a given legislature. Correspondingly, the bargaining process should not be interpreted as the process of government formation. We assume governments to be exogenously given. The legislative bargaining captures the process of policy formation, where the politicians of some given government try to maximize the welfare of a constituency divided along the dimensions of wealth and talent.

Empirically, this implies that we do not attempt to measure the strength or impact of certain political parties or coalitions. Rather, we try to gauge how the three main interest groups in some given population shape the equilibrium outcome for redistribution and higher education subsidies. As described in Proposition 1, the policy outcomes shaped in the bargaining process is directly linked to the underlying distribution of wealth $F(b^i)$. The distribution of wealth does not only define the respective sizes of the the three groups, but also directly imposes the policy preferences of each legislator. The higher wealth on average, the larger ceteris paribus the group of the RT, the higher the upper limit for redistribution, and the lower the socially efficient point of higher education subsidies S^*. Similarly, the more unequal wealth is distributed, the smaller is the group size of the RT, and the larger the optimal level of S^* demanded by the U holding everything else constant.

2.4.2 The Data

We use three different data sets in our empirical specifications. The data used in the cross-sectional and panel regressions on higher education expenditure mostly stem from the World Bank's Development Indicators (WDI). Data on educational attainment have been added from the Barro and Lee data set[17]; data on redistribution derive from the OECD's Social Expenditure Database (SOCX, www.oecd.org/els/social/expenditure).

Table 2 below summarizes the key variables of our empirical specifications. Detailed summary statistics of all data sets used and a list of countries included in the respective specifications are available in the Appendix.

[17]Data can be publicly accessed under:
http://post.economics.harvard.edu/faculty/barro/data.html

Table 2: Descriptive Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
GDP per Capita	99	9.26	7.97	0.78	33.74
Fertility (Births per woman)	106	2.71	1.28	1.13	5.95
Tertiary Education Expenditure (% of GDP per capita)	106	63.49	56.67	5.61	285.60
Tertiary Education Expenditure (1995 US$)	99	4082	3266	299	13041
Registry Coverage (per 1000 population)	86	287.90	360.63	0.00	1021.00
Gini Index	75	39.12	10.34	24.70	74.33
Barro Lee Share	74	7.54	4.80	0.33	28.57
Total Social Expenditure (% of GDP)	25[a]	7.9	4.0	0.7	17.2

Notes:
a. The panel data set contains 118 observations for the 25 countries in the sample.

2.4.3 Empirical Specification

Identification of Model Variables

The main challenge in the empirical identification of our theoretical model lies in the determination of the empirical counterparts to the main variables used in the model: the average levels of private wealth holdings on one side, and the sizes of the three respective model groups on the other. The first task is relatively easy; although we do not have international data on private wealth distribution, national per capita income lends itself quite naturally as alternative proxy for the average wealth of an economy.

The most important from a theoretical, and at the same time the most difficult variables to identify from an empirical perspective are the respective sizes of the three groups in our model. In the model, the main division of the population follows along the lines of wealth and income. Defining q^{cc} as the fraction of agents credit constrained in the total population, we can express the model group sizes as $\gamma^U = 1 - p$, $\gamma^{RT} = p(1 - q^{cc})$ and $\gamma^{PT} = pq^{cc}$, where p is the fraction of agents with the necessary talent to enroll into higher education as before. Using these definitions, we can state the relative group size of the poor and rich talented as

$$\frac{\gamma^{PT}}{\gamma^{RT}} = \frac{pq^{cc}}{p(1-q^{cc})} = \frac{q^{cc}}{1-q^{cc}}. \tag{2.32}$$

This formulation is useful for two reasons. First, it implies that the relative size and political power of the RT and PT is nothing else than a function of the aggregate fraction of the population credit constrained. Second, it implies that the relative political power of the two talented groups is independent of p, the total share of agents potentially enrolling into higher education. This is important from an empirical viewpoint, since it means that we can use credit constraint measures to directly test the effect of the relative political power of the RT and PT on observed outcomes, without having to worry about the total pool of talented agents in an economy.

We apply three different proxies for the overall relevance of credit constraints in our empirical specifications. The first variable we use is the share of the population covered in public credit rating systems. This variable stems from the World Bank's Business Environment Data Base[18], and indicates the percentage of the population with a credit record. The variable should work well as a proxy for the overall development of credit markets. The only problem with this variable is its potential endogeneity. If higher education loans are a major part of total credit demand, (historical) degrees of higher education subsidization will have a direct effect on the number of people asking for loans, and the size of the credit registry thus no longer be exogenous.

We use two alternative measures for the overall relevance of credit constraints: the Gini Index of income inequality and educational attainment data. The Gini Index measures the distribution of parental incomes corresponding to agents' endowments in our model. The more unequal the distribution of incomes, the more

[18]Source: http://www.doingbusiness.org/.

concentrated is income in the top deciles, and the larger the fraction of agents credit constrained is likely to be keeping everything else constant.

The same logic applies to educational attainment, our third credit constraint proxy. The data we use stem from the Barro-Lee data set. Our main variable of interest is the share of the adult population with completed tertiary education. The main assumption for using this variable is that parents with completed education have sufficient income to support their descendants' higher education. If this is the case, the Barro-Lee variable should work well as proxy for the size of the population not credit constrained. The higher the fraction of the population with completed higher education, the less relevant credit constraints should be on average.

Higher Education Subsidies

We start our analysis with the first part of Proposition 1. The main predictions we want to test are the following: $\frac{\partial \widehat{S}}{\partial \gamma_{PT}} > 0$, $\frac{\partial \widehat{S}}{\partial \gamma_{RT}} < 0$, and $\frac{\partial \widehat{S}}{\partial \bar{b}} \leq 0$. Our main dependent variable is governmental expenditure per student in higher education. The variable includes wages, but does generally not include specifically denominated research grants, and should thus work reasonably well as proxy for the governmental subsidy per student in higher education[19].

We start with a cross-sectional analysis, and use the proxies defined before to estimate the following reduced form:

$$S_i = \alpha_0 + \alpha_1 CC_i + \alpha_2 GDP_i + \alpha_3 \mathbf{X}_i + \varepsilon_i. \tag{2.33}$$

S_i is governmental expenditure per student in higher education, **CC** represents our proxies for q^{cc}, the fraction of the population credit constrained, GDP is our proxy for average wealth $\bar{b}$ in the economy, and X is a matrix of additional control

[19] One major concern from the perspective of our model is the allocation of the budget. Our model implies that all students receive the same subsidy, which is the case if governments publicly provide education, but not the case if government specifically target groups of the population.

variables. The most important controls in our setup are fertility as an important determinant of family's capability to support children's education, and regional fixed effects to control for other unobservable geographical or cultural differences.

Since our credit constraint variables are supposed to control for the relative group sizes of the PT and RT, the average wealth variable included in the regressions should directly pick up the socially optimal level of higher education subsidies, and thus the optimal policy choice for the untalented. Higher level of wealth imply lower degree of subsidies, so that we would expect $\alpha_2 < 0$.

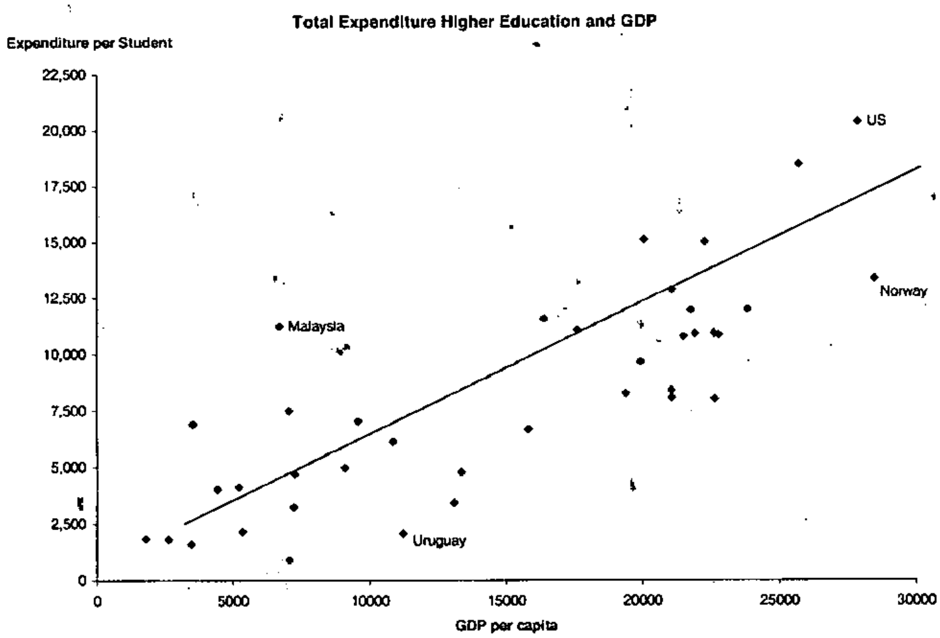
This, however, would only be the case if the true cost of education was either constant across countries or directly observable. Unfortunately, only limited information is available on the total cost of providing higher education. In the only noteworthy cross-national study on higher education expenditure[20], the OECD finds the ratio of total expenditure per student[21] to national incomes per capita to be remarkably stable across countries, and, more importantly for the scope of this study, mostly independent of the level of economic development. Regressing total expenditure per student on GDP per capita explains about two thirds of the total variation in expenditure[22]. The estimated coefficient of 0.5 implies that the average cost of one year of higher education corresponds very closely to fifty percent of national per capita income. Graph 1 below summarizes the OECD data.

[20] "Education at a Glance 2005"; relevant data are from 2002.

[21] Totale expenditure is the sum of government expenditure per student and average private tuition payment.

[22] The correlation coefficient is 0.82.

Graph 1: Total Expenditure for Higher Education and GDP



For the scope of our study, we build on the results of this study and assume the cost of education to be a constant fraction of GDP per capita. Correspondingly, our GDP per capita variable does not only pick up the wealth effects described before, but also the true cost of education. Given this, and taking the OECD's point estimate of 0.5 as our main reference for the cost of higher education, we can thus re-state the empirical predictions of Proposition 1 in terms of our reduced form estimates as $\alpha_1 < 0, \alpha_2 < 0.5$.

The results from our cross-sectional analysis are summarized in Table 3 below. In columns 1 to column 3 of Table 3 we test each of our three credit constraint proxies together with national per capita income. The results strongly confirm our priors. The less developed credit markets, the higher inequality and the smaller the share of the adult population with completed higher education, the higher the subsidy observed across countries.

Table 3: Cross-Section: OLS Results

Dependent Variable	Government Expenditure per Student in Tertiary Education (1990 avg., % of GDP per capita)					
	1	2	3	4	5	6
GDP per capita	0.27***	0.29***	0.36***	0.41***	0.48***	0.43***
(1995 '000 US$)	(0.04)	(0.03)	(0.04)	(0.04)	(0.05)	(0.06)
Public Registry Coverage	-5.32***			-5.24***	-3.97***	-3.80***
(number registered per 1000)	(0.89)			(1.73)	(1.48)	(1.67)
Gini Coefficient		87.27**		71.52	58.41	88.52
		(38.04)		(44.26)	(43.39)	(56.94)
Share of population with higher education			-305.32***	-277.63***	-246.15***	-198.12***
(% of population 30-64)			(61.16)	(59.01)	(60.63)	(69.65)
Fertility					694.21**	474.49
(Number of Births per woman)					(278.85)	(419.84)
Other controls	const	const	const	const	const	const, regions
Restrictions	none	none	none	none	none	GDP[a]
Stata-Method	OLS	OLS	OLS	OLS	OLS	OLS
Option	robust	robust	robust	robust	robust	robust
# of Obs.	94	83	81	60	60	54
R squared	0.42	0.42	0.46	0.58	0.60	0.69

Robust standard errors in brackets. *,**, *** imply significance at 90, 95 and 99% confidence interval.

a) Poorest 10% of sample excluded. GDP threshold is 1200 US$ (PPP).

The estimated coefficient on GDP per capita ranges between 0.29 and 0.36, and is significantly below 0.5 as predicted by our model. In column 4, we test all three credit constraint proxies at the same time. The estimated coefficients on our credit constraint measures become slightly smaller, but remain highly significant for the credit registry and parental educational attainment. In columns 5 and 6 we add fertility to our specification. Fertility has a positive effect as expected[23], but loses significance when we add regional dummies and exclude the poorest 10% of the countries in the sample to verify the robustness of our results in column 6.

Overall, the cross-sectional results strongly confirm the main predictions of our model. All credit measures have the predicted sign across specifications, with the registry and the Barro-Lee measures always being significant at the 99% level. Also, the point estimates on the GDP variable are strictly below 0.5 as predicted, even though the difference is not significant in all cases.

[23] A larger number of children per family implies more binding credit constraints.

Clearly, none of our right hand side variables is completely free of endogeneity concerns, and more reliable IV estimates would be desirable. Unfortunately, the supply of good instruments in our setup is scarce. To provide further, and more robust evidence, we choose an alternative approach, and test the model's predictions in a dynamic panel context.

Introducing the time dimension to our data set does not only allow us to control for country specific factors, but also expands the set of possible instruments used in the estimation. Data on higher education expenditure are available for the period from 1975 to 2000. While GDP data is readily available, data on our measures of credit constraints are scarce. The only measure available for the full period and a large fraction of countries is the Barro-Lee share of agents with completed higher education, which we use together with GDP per capita as main explanatory variable in our panel estimation. Table 4 below summarizes the results.

Table 4: Panel Evidence: Higher Education Subsidies

Dependent Variable	*Government Expenditure per Student in Tertiary Education (1995 US$)*			
	1	2	3	4
Lagged Dependent			0.64***	0.65***
			(0.03)	*(0.03)*
GDP per capita (1995 US$)	*418.44**** *(106.24)*	*399.7**** *(34.00)*	*209.9**** *(62.40)*	*213.35**** *(58.44)*
Share of population with higher education (% of population 25-64, Barro Lee)	-89.60** *(41.01)*	-75.73*** *(24.58)*	-57.17** *(28.13)*	-52.19** *(25.24)*
Birth per woman	105.72** *(50.14)*	84.78*** *(15.48)*	40.76 *(37.87)*	35.37 *(35.58)*
Stata-Method	xtpcse	xtgls	xtabond2	xtabond2
Option	corr(ar1)	corr(ar1) p(h)	robust	twostep robust
# of Obs.	345	345	276	276
Other Statistics	R-sq: 0.26 rho =0.69	AR(1)=0.75	p(Hansen)=0.64	p(Hansen)=0.64

Robust standard errors in brackets.
*,**, *** imply significance at 90, 95 and 99% confidence interval.

Given that the Wooldridge statistic rejects the null of no autocorrelation of order one at the 99% level, we apply a series of estimators allowing for such correlation. Column 1 shows the result of a simple OLS regression with panel corrected standard errors and a common AR(1) term. In column 2, we loosen the restriction on the AR(1) term and show feasible generalized least squares (FGLS) estimates, which allow for different (panel specific) degrees of autocorrelation across countries. In columns 3 and 4 we perform the system GMM estimators developed by Arellano and Bond (1991), which allows to instrument predetermined or endogenous variables with lagged values or first differences. We treat the Barro-Lee share as exogenous in column 3 and as predetermined in column 4. Both the Arellano-Bond for AR(2) in first differences and the Hansen test of overidentification indicate a correct specification.

All results strongly confirm the findings of the cross-sectional analysis as well as the main implications of our model. An increase in GDP per capita of US$ 1000 implies an increase in government expenditure per student in the range of US$ 200-400. The estimated coefficient is a bit smaller than the corresponding estimates in the cross-section, but well in the predicted range of the model.

The results appear particularly robust with respect to the Barro-Lee variable. The higher the fraction or rich (unconstrained) agents, the lower is the degree of subsidization empirically observed. Our estimates imply that this effect is highly significant and also relevant in size. A 10 percent increase in the adult population with completed higher education decreases governmental expenditure per student by US$ 500-800, or roughly 12-20% of the average subsidy provided.

Redistribution

As a last step, we test the implications of our model with respect to redistributive transfers. Since data on the respective revenues from income and wealth taxation are not available, we focus our analysis on the expenditure side. Data on redistributive expenditure are limited and stem from the OECD's Social Expenditure Database (2004), which covers 25 OECD countries and the period from 1980 to 2000. We take total social expenditure excluding health and pension payments as percentage of GDP as our dependent variable[24], and run a similar set of regressions as in the previous panel averaging all data over 5 year periods. As before, we take GDP per capita as proxy for wealth and the Barro-Lee share as proxy for the relative size of the rich and talented. We estimate the following reduced form:

$$R_{it} = \beta_0 + \rho R_{it-1} + \beta_1 BL_{it} + \beta_2 GDP_{it} + \varepsilon_{it}. \tag{2.34}$$

R_{it} is the size of total redistribution in country i and period t, ρ is the coefficient of autocorrelation, BL is the Barro Lee share of the adult population with completed higher education and GDP is defined as before. The main implications from Proposition 1 are that redistribution increases with the size of the tax base and the relative size of those credit constrained. In terms of our reduced form, this implies $\beta_1 < 0 < \beta_2$. Table 5 below summarizes the results from our panel regressions on redistributive expenditure.

Table 5: OECD Panel - Redistributive Transfers

Dependent Variable	*Total Social Expenditure (% of GDP, OECD 2004, excluding Health and Pension Systems)*			
	1	2	3	4
GDP per capita (1995 US$)	0.28*** *(0.10)*	0.30*** *(0.04)*	0.09 *(0.07)*	0.10 *(0.09)*
Share of adults with higher education (Barro Lee)	-0.06* *(0.03)*	-0.06*** *(0.02)*	-0.05* *(0.03)*	-0.085** *(0.03)*
Lagged Dependent	(rho=0.69)		0.73*** *(0.09)*	0.89*** *(0.15)*
Other controls	const	const	const	const
Sample	OECD	OECD	OECD	OECD
Stata-Method	xtpcse	xtgls	xtabond2	xtabond2
Option	corr(ar1) pairwise	corr(ar1) p(h)	robust	robust
# of Obs.	113	112	89	89
Other Stats	R sq = 0.17		AR(1) present; AR(2), OID ok.	

Robust standard errors in brackets.
*,**, *** imply significance at 90, 95 and 99% confidence interval.

Given the high degree of serial correlation (the null of zero correlation is rejected

[24] We test alternative specification where we include health expenditure in the dependent variable - the results do not change.

at the 99% level) we use the same specifications as in the panel for higher education subsidies. Once again, columns 1 and 2 show the OLS and FGLS estimates, while columns 3 and 4 reports the results for Arellano and Bond's system GMM estimator.

Overall, the empirical results strongly confirm our priors. The larger the share of agents with completed higher education, the smaller the degree of redistribution observed in equilibrium. This effect is significant, and highly robust across specifications. The result with respect to average wealth are a bit weaker. The estimated coefficient on GDP per capita is always positive as expected, but not always significant.

2.4.4 Discussion of Empirical Results

The evidence presented in the previous sections nicely confirms some of the main implications of the theoretical model presented in the earlier part of this chapter. As predicted by our model, higher education subsidies seem to be negatively correlated with national income, and to increase with the overall relevance of credit constraints in an economy. Similarly, wealthier countries and more binding credit constraints seem to be associated with a higher degree of redistribution.

Still, one may wonder about the degree to which our empirical results are driven by the assumptions underlying our reduced form estimates. The first major assumption follows directly from the theoretical model, and is the orthogonality between private endowment and talent. While the importance of the genetic transmission of talent in educational attainment is still disputed, some positive correlation between endowment and talent seems the most likely assumption from an empirical perspective[25]. Assuming that the correlation of talent across generations across countries is roughly the same (or at least not correlated with any

[25] See, e.g., Hansen, Heckman and Mullen (2003) and Plug and Vijverberg (2003).

other explanatory variable), this issue should be rather minor from an empirical perspective. A positive degree of talent correlation implies that our measures of the share of agents credit constrained overstate the real fraction of the population dependent on government subsidies in a constant way. As a result, the estimated coefficients should be correct in their direction, but too small in their size. That is, the higher the correlation of incomes across generations, the more likely we are to underestimate the actual coefficient on the group of agents credit constrained.

More problematic is the assumption regarding the overall fraction of untalented agents in the population. In our empirical specification, GDP per capita is supposed to capture both the cost of higher education and the ideal policy point of the untalented. This, however, can only be the case if the untalented have the same political power across countries; in terms of our model, this requires p to be constant across countries. Given that we define p as the fraction of the population that can profitably enroll into higher education, this assumption is unlikely to hold empirically. Considering the empirical evidence on the historical evolution of labor market premiums[26], it seems more reasonable to assume p to be increasing over time and to be positively correlated with national income levels.

Since the relative size of the unconstrained does not depend on the overall group size of the untalented, we should still be able to estimate the coefficient on the relative size of RT and PT correctly under this alternative assumption. However, the interpretation on the GDP variable becomes still more complicated. If the group of the untalented is of minor importance in richer countries, higher levels of GDP are not only associated with lower preferred policy point of the untalented, but also with less bargaining power for the group of the untalented. As a consequence, the interpretation of the estimated coefficient on the wealth variable becomes rather difficult, which may provide at least partial explanations for the mixed results obtained in our panel regressions on redistributive outcomes.

[26] See, e.g. Goldin and Katz (1999) for a detailed discussion of the historical evolution of wage premiums in the US.

Despite these empirical issues we judge the overall picture emerging from the data quite supportive for the model presented. While the results on the average wealth variable are somewhat difficult to interpret, the results on the main driver of the models results - the political struggle between the group striving upwards and a relatively independent elite - appear highly robust not only with respect to specification, but also with respect to the underlying identification assumptions.

2.5 Summary

In this chapter we present a positive theory on the political economy of higher education. We demonstrate that higher education subsidies will always emerge together with moderate degrees of redistribution in a legislative bargaining setup. The larger the stock of private wealth in a given economy and the more developed credit markets, the lower the subsidy to higher education chosen in the political equilibrium.

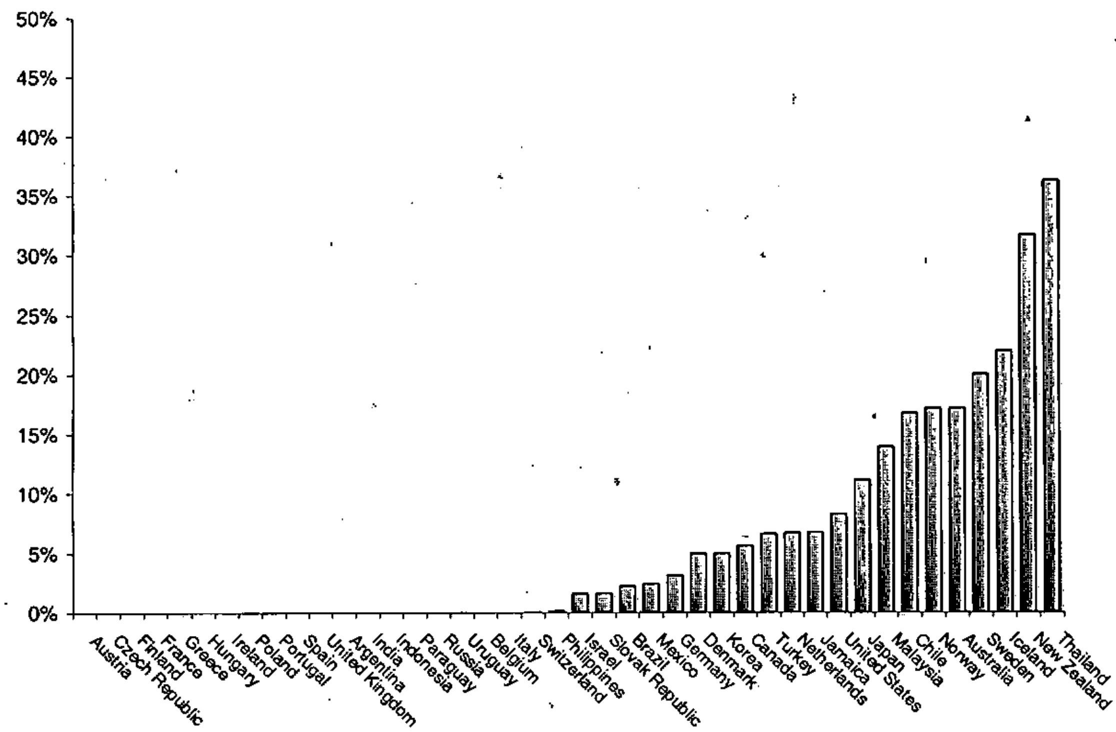
We use data from the OECD and the World Bank to test our theory and find strong support for the main predictions of our model. The larger the fraction of the population that can afford to enroll into higher education independent of governmental support, the lower the degrees of higher education subsidization and redistribution observed.

Over the last years, a growing number of countries have started to reform the university sector and to cut government expenditure on higher education. If our analysis is correct, the reform process has just begun.

2.6 Appendix

2.6.1 Additional Graphs

Graph 2: Relative Size of Loan Programs*



Source: UOE, 2000.

* The expenditure for loans is based on their respective face value.

2.6.2 Data Description

Cross Section Higher Education Expenditure

Descriptive Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
GDP per Capita	99	9.26	7.97	0.78	33.74
Fertility	106	2.71	1.28	1.13	5.95
Tertiary Education Expenditure (% of GDP/cap)	106	63.49	56.67	5.61	285.60
Tertiary Education Expenditure (1995 US$)	99	4082	3266	299	13041
Registry Coverage (per 1000 population)	86	287.90	360.63	0.00	1021.00
Gini Index	75	39.12	10.34	24.70	74.33
Barro Lee Share	74	7.54	4.80	0.33	28.57
Africa	106	0.104	0.306	0	1
Asia	106	0.274	0.448	0	1
Eastern Europe & FSU	106	0.151	0.360	0	1
Latin America	106	0.170	0.377	0	1
OECD	106	0.245	0.432	0	1

Country list:

Australia, Austria, Bangladesh, Belgium, Botswana, Canada, Central African Republic, Chile, Colombia, Costa Rica, Denmark, Ecuador, Egypt, Arab Rep., El Salvador, Finland, France, Germany, Greece, Guatemala, Honduras, Hong Kong, India, Ireland, Israel, Italy, Jamaica, Japan, Jordan, Kenya, Korea, Rep., Lesotho, Malawi, Malaysia, Mali, Mauritania, Mexico, Nepal, Netherlands, New Zealand, Norway, Pakistan, Panama, Peru, Philippines, Portugal, Senegal, Singapore, South Africa, Spain, Sri Lanka, Sweden, Switzerland, Thailand, Tunisia, Turkey, United Kingdom, United States, Uruguay, Zambia, Zimbabwe.

Panel Higher Education Expenditure

Descriptive Statistics

Variable		Mean	Std. Dev.	Min	Max	Observations		
Fertility	overall	26.1	12.5	8.0	56.1	N	=	400
(Births per woman)	between		12.0	10.3	51.2	n	=	80
	within		3.5	14.9	36.5	T	=	5
GDP per capita	overall	8.7	7.7	0.5	41.8	N	=	395
(1995 US$)	between		7.5	0.5	26.6	n	=	79
	within		2.0	-0.9	23.9	T	=	5
Expenditure per Student	overall	5159.7	4125.2	139.0	32470.5	N	=	395
('000 1995 US$)	between		3572.2	370.6	16780.7	n	=	79
	within		2094.2	-4432.7	20849.5	T	=	5
Barro Lee Share	overall	6.2	4.9	0.2	30.3	N	=	345
(% Completed Tertiary Education)	between		4.5	0.3	24.8	n	=	69
	within		1.9	-0.6	13.3	T	=	5

Country List

Argentina, Australia, Austria, Bangladesh, Barbados, Belgium, Botswana, Bulgaria, Burkina Faso, Canada, Central African Republic, Chile, China, Colombia, Costa Rica, Cote d'Ivoire, Cyprus, Denmark, Dominican Republic, Ecuador, Egypt, Arab Rep., El Salvador, Ethiopia, Finland, France, Greece, Haiti, Honduras, Hungary, India, Iran, Islamic Rep., Ireland, Israel, Italy, Jamaica, Japan, Jordan, Kenya, Korea, Rep., Kuwait, Latvia, Lesotho, Luxembourg, Madagascar, Malawi, Malaysia, Mali, Malta, Mauritius, Mexico, Mongolia, Morocco, Nepal, Netherlands, New Zealand, Norway, Panama, Paraguay, Peru, Philippines, Portugal, Rwanda, Saudi Arabia, Senegal, Singapore, Spain, Swaziland, Sweden, Switzerland, Syrian Arab Republic, Thailand, Togo, Trinidad and Tobago, Tunisia, Turkey, Ukraine, United Kingdom, United States, Uruguay, Zimbabwe.

Panel Redistribution

Descriptive Statistics

Variable		Mean	Std. Dev.	Min	Max	Observations
Fertility	overall	14.2	4.7	9.2	32.0	N = 118
	between		4.7	9.8	30.3	n = 25
	within		1.6	8.7	19.3	T-bar = 4.72
GDP per capita (1995 US$)	overall	17.8	6.2	3.8	41.8	N = 118
	between		5.7	4.7	26.6	n = 25
	within		3.1	8.3	33.0	T-bar = 4.72
Expenditure per Student ('000 1995 US$)	overall	6.6	3.3	0.4	15.7	N = 118
	between		3.1	0.7	12.4	n = 25
	within		1.6	3.3	11.6	T-bar = 4.72
Total Social Expenditure (% of GDP) (excl. pension & health)	overall	7.9	4.0	0.7	17.2	N = 118
	between		3.9	1.0	14.1	n = 25
	within		1.3	4.3	13.1	T-bar = 4.72
Total Social Expenditure (% of GDP) (excluding pension only)	overall	13.1	5.2	1.6	24.4	N = 118
	between		5.2	2.8	21.9	n = 25
	within		1.6	8.9	19.1	T-bar = 4.72
Barro Lee Share (completed tertiary education)	overall	9.5	5.1	1.7	30.3	N = 118
	between		4.6	3.1	24.8	n = 25
	within		2.2	2.6	14.9	T-bar = 4.72

Country List

Australia, Austria, Belgium, Canada, Denmark, Finland, France, Greece, Hungary, Ireland, Italy, Japan, Korea, Rep., Luxembourg, Mexico, Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, Turkey, United Kingdom, United States.

Chapter 3

The Provision of Higher Education

(Joint with Andreas Bergh[1])

3.1 Introduction

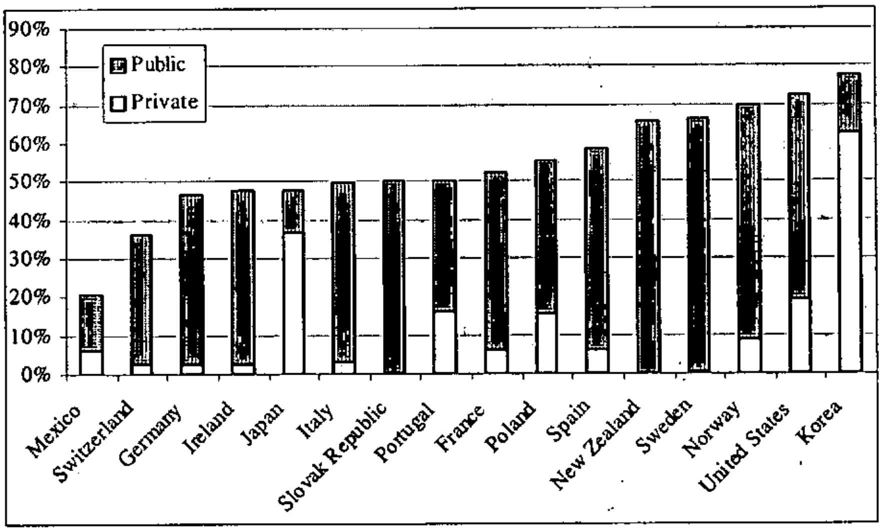
The degree to which higher education is provided by private rather than publicly financed universities varies substantially across countries. While total enrollment in higher education can largely be explained by wealth and income levels[2], there is no established theory in the literature that explains why private providers have taken substantial market shares in some countries but remain marginal in others. In 2002, the share of private providers in the higher education sector was 32 percent in Portugal and 26 percent in the United States, but only 1 percent in Sweden and

[1] Lund University and Ratio, Stockholm, Sweden.

[2] See, for example, Aghion et.al. (2004) who show that enrollment and returns to higher education increase as economies move towards the technology frontier and the production shifts from imitation to innovation.

0.1 percent in New Zealand[3].

Figure 1. Enrollment in Private and Public Universities



More surprisingly, as can be seen in Figure 1, both the absolute and the relative size of private higher education display only very modest degrees of correlation with the total size of the higher education sector - countries like New Zealand, Sweden, Norway and the US are very similar with respect to total enrollment, but show completely different patterns in the provision of higher education.

To shed light on the emergence and consequences of private versus public providers of higher education, we develop a model where higher education serves as a signal of unobservable talent (Spence, 1973), but may also have a positive effect on workers' productivity. In the model, each individual receives a wage which is based on the average talent of all individuals with the same type of education. The model predicts that the entry of private providers depends on the shape of the

[3]Data on total enrollment rates comes from the Worldbank's world development indicators (WDI), and data on the relative size of the privates university sector is from the UIS / OECD / EUROSTAT 2002 Data Collection on Education Statistics (UOE). As private institutions we count only those defined by the UOE as private and independent.

talent distribution, the degree of subsidization within public education and on the fixed cost of entering the higher education market. When the talent distribution is more compressed, less can be gained from enrolling the most highly talented into private institutions. Similarly, the higher the fixed costs of entering, the later private universities will emerge and the slower the private sector will grow. The effect of subsidies on public education, on the other hand, is theoretically more ambiguous. Higher subsidies increase the relative price of the services offered by private institutions, and thus make it harder to compete for potential new entrants. On the other hand, higher subsidies have a positive effect on overall enrollment. Since public subsidies increase the overall enrollment rate but decrease the relative size of the private sector, the effect of public subsidies on total enrollment in private institutions of higher education is uncertain.

Last, we show that the emergence of private institutions itself has a significant impact on the structure of the higher education sector. The entry of private providers significantly increases the premium for the most talented, but, by the same means, lowers the premium for public education, which then attracts a lower number of students. As a consequence, average educational premiums increase, but total enrollment in higher education decreases as private institutions emerge.

The theory presented here builds on Spence's (1973) seminal work on signaling and applies the basic mechanism developed therein to a dynamic framework with multiple potential education providers. Our model is related to recent work by Hendel et al. (2001), who demonstrate that the easing of credit constraints will eliminate the pool of highly talented among the uneducated, and thus increase wage inequality over time. While this finding is in line with our model, we do not model group specific credit constraints explicitly, but rather focus on the organizational structure of higher education and its implications. As to the emergence of private providers of higher education, to our knowledge, the research closest to this model are the simulations conducted by Ortmann et al. (2002). Applying various types of matching models, Ortmann et al. take a simulation approach to explain the recent emergence of low cost private education providers in the US. Although we also calibrate our model to US data in some of the simulations, we are more interested in the high than in the low end of the market, and have a more international perspective in mind. Last, Futagami and Ishiguro (2004) use an overlapping generations model to show that there are two steady states when agents use education to signal ability. In one steady state, only high ability agents obtain education ("Elites steady state") and in the other, everybody obtains education ("Mass higher education" steady state). Futagami and Ishiguro use a closed economy model with no exogenous productivity growth, so that the initial level of capital stock determines the steady state reached. Our model is set in an open economy, uses a dynamic framework, and leads to a unique steady state in the long run.

As for the rest of the chapter, the usual road map applies: In the next section, we discuss the background of our theoretic model and discuss the intuition underlying the assumptions made. In section 3 we develop the formal model, and in section 4 we present some numerical simulations and some basic empirical evidence. Section 5 summarizes the findings and concludes the chapter.

3.2 Background

Higher education has a long history. Although no exact record is available, the first two Indian universities (Nalanda and Takshashila) supposedly date back more than 3000 years. In the Western world, Bologna became the first official university in 1088, while Harvard became the first university in the United States in 1636. Originally mostly associated with the clerus and specific professions, universities grew significantly in size and scope throughout the 19th, and even more so in the 20th century.

Given its long history, higher education should be considered a sector particularly hard to enter from an economic perspective. Traditional institutions (the incumbents) are not only protected by the human and physical capital accumulated over the last centuries, but also profit from their reputation and often highly developed ties to the government sector. Most traditional institutions are not profit oriented, and charge a price much below the actual cost of education. For this reason, we shall loosely refer to these historic and non-profit oriented institutions as public or philanthropic, while we shall simply denote all profit oriented enterprises as private in the rest of this chapter.

Private providers can only enter the higher education market if such an entry is profitable. Profits can be generated by offering services not delivered by the public sector. In practice, such services may be provided along many dimensions[4]. For the purpose of our study we concentrate on the simplest and most generally applicable strategy for entry: the creation of an elite signal. We assume that private and public institutions have the screening technology[5] required for such a selection, but that only private institutions apply it to generate profits. Since there is free entry and all entrants share the same technology, the private sector is perfectly competitive, so that all private providers operate at the optimal size[6] and generate zero profits in equilibrium. Given this, any private providers can and will enter precisely when it becomes profitable for a sufficient large pool of students to switch from public to private institutions.

Because the philanthropic provider is cheaper from the individual's perspective and initially offers the same signal, private entry will not occur up to a certain enrollment threshold. As long as only a few are enrolled with the philanthropic

[4] One may think of highly specialized or more applied study programs such MBA's, but also about other fringe benefits not provided by the public sector.

[5] The screening technologies applied by most private schools can be considered as complex as cost intensive, and range from basic standardized tests to personalized interviews.

[6] We assume some generic U-shaped cost function based on high initial fixed cost and increasing marginal costs caused by general capacity constraints.

provider, there is no market for private providers. As incomes rise, enrollment with the philanthropic provider increases, and the signaling value of completing philanthropically provided higher education falls. This makes it possible for private providers to offer a signaling premium large enough to enroll the required number of students to break even.

The model we present in this chapter is agnostic with respect to what extent signaling and human capital explain the demand for higher education in general[7]. Human capital augmenting technology in higher education (which is optional but not necessary in our setup) simply increases the aggregate demand for higher education, but does not affect the qualitative results of our model.

Further, throughout the chapter we assume that private and public providers dispose of the same production technologies. By this, we abstract both from arguments related to the relative performances of private and public sectors, and from normative arguments based on educational content[8]. Second, we assume that the access to the public sector is unrestricted for all agents. In reality, the set of possible constraints in the public sector is large, ranging from highly selective high school system and placement exams to enrollment ceilings currently enacted in a large range of countries. While these "institutional" factors are crucial to understand the variation in enrollment rates across countries, they add little value to the aspect taken into consideration in this chapter. Last, the model implicitly assumes that all agents enrolled in one university earn the same premium, which is clearly a simplification of reality[9], but allows us to abstract from strategic enrollment

[7]The signaling approach to modeling education itself is not undisputed. While some studies raise doubts regarding its validity (for example Kroch and Sjoblom 1994), others have empirically confirmed the signaling hypothesis (for example Lang and Kropp 1986 and Bedard 2001) For a comparison of the human capital models and the signaling models, see Weiss (1995).

[8]Concerns regarding the ideological independence of educational institutions have without any doubt been one of the major motivations for public expenditure on higher education, especially in countries traditionally subject to strong clerical institutions.

[9]See Krueger and Dale (1999), who show that market premiums depend primarily on agent's talent and not necessarily on their strategic school choice.

choices and thus to keep our model tractable.

Although some of our assumptions may appear restrictive, they allow us to focus our analysis on a very specific aspect of higher education, that is the dynamic evolution of its provision. As Trow (1984) notes, "the growth of enrollment has markedly increased the size of universities, bringing into them students of lower social origins, reducing the value of their degrees, often diluting the quality of their facilities and reducing the quality of their instructional staff" (p. 147). It is exactly this aspect we focus in the model presented here, demonstrating its causal influence on the emergence and continued growth in the size and importance of private education providers.

3.3 The Model Structure

We use a non-overlapping generations model where in every period $t \in [1, \infty]$ a continuum of heterogeneous agents of size 1 is born and lives for one period. Agents differ with respect to talent. All agents receive primary and secondary education, and decide whether or not to invest in tertiary education. The decision depends on their own talent, the cost of tertiary education and the expected returns to such an investment as shown in further detail below.

3.3.1 The Production Sector

The economy is characterized by a standard neoclassical, constant-returns-to-scale production technology. Abstracting from capital stock effects, we analyze a small, open economy, where capital and labor produce a single homogeneous good. Output is uniquely determined by the amounts of physical and human capital employed in the economy. While the access to capital for firms is unrestricted, the human capital stock disposable for production is endogenously determined by the domestic investment in higher education. The total output Y at time t is given by

$$Y(A_t, K_t, H_t) = A_t H_t^{1-\alpha} K_t^{\alpha}; \qquad \alpha \in (0,1) \tag{3.1}$$

where K_t and H_t are the total stocks of physical and human capital[10] at time t, and A_t captures the technology employed in the economy. The production sector is perfectly competitive. Producers choose a profit maximizing level of production for a given wage rate w_t per efficiency unit of labor and an exogenously determined interest rate r for capital. Thus, the levels of human and physical capital in any period of time are determined by

$$\{K_t, H_t\} = \arg\max_{K_t, H_t} [Y(A_t, K_t, H_t) - w_t H_t - r_t K_t]. \tag{3.2}$$

The inverse demands for human and physical capital are given by

$$r_t = Y_K'(A_t, K_t, H_t) = \alpha A_t (\frac{H_t}{K_t})^{1-\alpha}, \tag{3.3}$$

$$w_t = Y_H'(A_t, K_t, H_t) = (1-\alpha) A_t (\frac{K_t}{H_t})^{\alpha}. \tag{3.4}$$

Since we assume the interest rate r to be constant and productivity A_t to rise over time, equation (3.3) implies that the ratio $\frac{H}{K}$ will decrease over time. Plugging the optimal human to physical capital ratio into (3.4), the wage rate w per efficiency unit of labor in each period t is given by

$$w_t = (1-\alpha) A_t \frac{(\alpha A_t)^{\frac{\alpha}{1-\alpha}}}{r_t^{\frac{\alpha}{1-\alpha}}} = (1-\alpha) A_t^{\frac{1}{1-\alpha}} \left(\frac{\alpha}{r_t}\right)^{\frac{\alpha}{1-\alpha}}. \tag{3.5}$$

which implies that the wage increases over time as A_t goes up. Firms operate in a perfectly competitive market. They know the overall distribution of talent

[10] We denote individual characteristics by small letters, while capital letters are used for aggregate measures.

and observe the aggregate enrollment decision, but cannot observe the talent of an individual agent.

3.3.2 The Formation of Human Capital and the Enrollment Decision

The human capital of an agent i in period t is determined by her talent θ_t^i and the investment in her own (higher) education. Each agent's talent is a random draw from some distribution $F(\mu, \sigma^2)$ with probability density function $f(\theta)$. If an agent decides to not enroll into higher education, her human capital h_t^i equals her talent. If she enrolls, human capital will be $\delta\theta_t^i$. $\delta \geq 1$ measures the effective productivity increase generated by higher education; if $\delta = 1$, higher education has only signaling value, otherwise additional human capital is generated. Thus, total human capital is given by $H_t = \sum_i h_t^i$.

Following Spence (1973), we assume that higher education is costly, and that the effort cost of completing tertiary education is decreasing in the talent of each agent[11]. More specifically, we assume that higher education is associated with some constant pecuniary cost and an agent specific cost $c\left(\theta^i\right)$, such that $c' < 0$.

Since firms can not observe talent, wages reflect the average talent of agents with different degrees of education. Tertiary education works as signal because the average talent of the educated will be higher than the average talent of the uneducated. The expected benefit of completing tertiary education depends on the overall wage rate which is a function of technology, and the relative wages paid by firms for educated and uneducated workers. The sequence of decisions is the following: In each period agents observe the technology level A_t, their talent θ_t^i and the overall distribution of talent $F(\theta)$. Based on these parameters, agents calculate

[11] Lower cost for the talented does not only model less effort required within universities, but also higher chances of getting scholarships, or higher chances to finish degrees faster.

their expected premiums π_t of higher education, and then decide whether or not to enroll. Once enrollment decisions are made, firms observe the labor market, and determine the new relative wages based on the average talent of each group.

Let $\widehat{\theta}_t^u$ denote the expected talent for uneducated agents, and let $\widehat{\theta}_t^j$, $j \in \{pu, pr\}$ denote the expected talent for uneducated agents, agents with publicly and privately provided education respectively, where $pr \in \{p_1, p_2, .., p_k\}$ denotes the k private schools in the higher education market.

Then, defining $\underline{\theta}_t^j$ as the talent level of the most unskilled agent of group j, the expected talent for each group can be determined as follows:

$$\widehat{\theta}_t^u = \int_0^{\underline{\theta}_t^{pu}} \theta_i f(\theta) d\theta, \tag{3.6}$$

$$\widehat{\theta}_t^{pu} = \int_{\underline{\theta}_t^{pu}}^{\underline{\theta}_t^{p_k}} \theta_i f(\theta) d\theta, \tag{3.7}$$

$$\widehat{\theta}_t^{p_n} = \int_{\underline{\theta}_t^{p_n}}^{\underline{\theta}_t^{p_{n-1}}} \theta_i f(\theta) d\theta \text{ for } n = 2..k, \tag{3.8}$$

$$\widehat{\theta}_t^{p_1} = \int_{\underline{\theta}_t^{p_1}}^{\infty} \theta_i f(\theta) d\theta. \tag{3.9}$$

Agents who enroll into higher education augment their human capital by δ, so that the market premiums π_t paid in the labor market is

$$\pi_t^j = (\delta\widehat{\theta}_t^j - \widehat{\theta}_t^u) w_t \tag{3.10}$$

where $j \in \{pu, pr\}$ as before.

Denoting the tuition fee charged by institution j by T^j, an agent i will enroll into publicly provided higher education if

$$\pi_t^{pu} = (\delta\widehat{\theta}_t^{pu} - \widehat{\theta}_t^u) w_t \geq T^{pu} + c(\theta_t^i) \tag{3.11}$$

and will want to enroll in any private institution that satisfies:

$$\pi^{pr} - \pi_t^{pu} = (\widehat{\theta}_t^{pr} - \widehat{\theta}_t^{pu})\delta w_t \geq T^{pr} - T^{pu} \tag{3.12}$$

where, as before, $pr \in \{p_1, p_2, \ldots, p_k\}$ represents all private institutions. Since we assume the tuition cost of higher education to be constant in real terms and wages to rise over time, (3.11) becomes less binding and overall enrollment increases over time as aggregate productivity A increases.

3.3.3 The University Sector

At $t = 0$, the higher education sector consists of a public or philanthropic provider only. The provision of higher education is associated with a fixed cost X and a marginal cost $m(e_t)$, where e_t is the number of students enrolled. We assume that the philanthropic provider covers most of its costs from sources that are not related to enrollment and charges a fixed tuition fee T^{pu} to its students, which is significantly below the true cost of providing this service.

Private education providers can enter the tertiary education sector in each period. Private providers are non-philanthropic, and try to operate a profitable business. As enrollment with the philanthropic provider increases, the average talent of those enrolled decreases, and so does the premium generated by public education. This generates demand for a more exclusive signal, and private education providers enter the market to satisfy this demand.

New entrants face fixed and marginal costs like the incumbent, but have no outside resources to cover their costs, so that the tuition fee T^{pr} charged by any private provider must cover the full economic cost. Since this tuition cost is higher than the subsidized cost charged by the incumbent, entry can only be successful if the institution can offer additional premiums to its students. Abstracting from other diversification strategies[12], private universities compete with the cheaper philanthropic institutions by offering higher wage premiums. Since wage premiums are determined in the labor market based on each cohort's talent, private institutions can generate and offer wage premiums only by restricting their access to the most talented. The higher the average talent of their students relative to the average talent of the students in the philanthropic institution, the higher will be the premium associated with private enrollment. On the other hand, the fewer students the entrant admits, the higher the cost it needs to charge.

As indicated before, private providers operate in a perfectly competitive environment, and can therefore only charge a tuition which exactly covers their cost at the cost minimizing level of production. Denoting this cost minimizing level of enrollment by e^{pr}, the tuition charged by each private institution is given by:

$$T^{pr} \geq m(e^{pr}) + \frac{X}{e^{pr}} \tag{3.13}$$

where as before m is the marginal cost and X is the fixed cost of providing higher education. These are the same for all private institutions.

Since effort costs and the productivity effect δ are the same for private and public providers of higher education, the wage premium generated by the difference in the talent pool must at least offset the difference in the tuition charged. At any point in time t potential students observe the state of technology and their own as well as the talent of the others, and then decide whether or not to enroll[13]. Once the enrollment decision is taken by the students, private firms decide whether or not they will enter the education market. From a dynamic perspective, it follows

[12] In reality universities can offer a whole variety of benefits to attract students, ranging from nicer campuses and better school teams to more targeted programs and more highly renowned teaching staff.

[13] We hace reduced the dynamics of the model to the private firms. Explicit modeling of the interactions between private and public institutions drastically reduces the dynamic tractability of the system without adding significant value to the analysis.

directly from the setup outlined above that the first private institution will emerge as soon as

$$\delta \left[\int_{\theta_t^{p_1}}^{\infty} \theta_i f(\theta) d\theta - \int_{\underline{\theta}_t^{pu}}^{\underline{\theta}_t^{p_1}} \theta_i f(\theta) d\theta \right] w_t > T^{p_1} - T^{pu}. \tag{3.14}$$

The analysis for the subsequent entries follows analogously. The timing of each entry depends mostly on the talent distribution; the more evenly talent is distributed, the harder it is for the new entrant to recruit a distinct pool of students and generate high rents. On the other hand, the larger the enrollment in the philanthropic sector, the weaker will be the signal of philanthropic education, and the easier it is for new education providers to enter. Thus, the more developed an economy, and the more uneven the talent is distributed, the earlier and the more numerous is the entry of private education providers.

3.3.4 The Equilibrium of the Economy

For any distribution of talent $F(\theta)$ and for any initial level of technology A_t an equilibrium of the economy can be described by a sequence of sets $\{A_t, w_t, \pi_t, e_t\}_{t=0}^{\infty}$ such that

(i) The overall wage rate per efficiency unit of labor w_t in each period t is uniquely determined by the exogenously given level of technology A_t.

(ii) The enrollment decision by each agent i in period t is individually and optimally determined given A_t and $F(\theta)$ such that inequalities (3.11) and (3.12) are satisfied.

(iii) The number of private universities operating in the educational sector in each period t is uniquely determined by the overall distribution of talent $F(\theta)$, the wage level w_t, the optimal size of private institutions e^{pr} and the tuition T^{pu} charged by the public provider.

(iv) The relative wages and premiums π_t for agents not enrolled (w_t^u), enrolled in public education (w_t^{pu}) and those enrolled in private institutions (w_t^{pr}) are given by the period specific wage per efficiency unit of labor w_t times the average talent of the corresponding group as determined by equations (3.6) to (3.9), and the human capital augmenting factor δ.

3.4 Simulation and Empirics

We run a simulation with 1000 agents drawn from a lognormal talent distribution parametrized to fit the current US income distribution[14]. The effort cost of education is given by $c(\theta) = \frac{1}{\theta}$. We assume that wages grow 2% per period relative to the private costs of enrolling. Higher (lower) relative wage growth rates simply leads to a faster (slower) increase in enrollment over time. For the simulations we use $\delta = 1$ as baseline. Other specifications do not significantly alter the results, other than simply accelerating the overall enrollment process.

In our first simulation (shown in Figure 2), we abstract from the private sector, to show how enrollment increases over time as the cost of education decreases relative to average income levels. While the increase in enrollment over time is mainly driven by income growth, the exact shape of the enrollment curve is determined by the shape of the talent distribution. A more compressed talent distribution means a lower signaling value of higher education, and thus lower enrollment rates at any point in time. We take the parameters from the US income distribution as our standard assumption in the remainder of this section and now add private providers to the model. We assume the optimal size for private providers to be 2% of the market, and that initially there is insufficient demand for the private institution. As enrollment increases, so does the demand for private providers, and the private institutions will emerge one by one, as shown in Figure 3 below.

[14]The ratios of incomes 90/10 and 50/10 are 14 and 3.6 in our simulated sample, which corresponds exactly to the 2002 US census data.

Figure 2. Talent Distribution and Higher Education Enrollment over Time

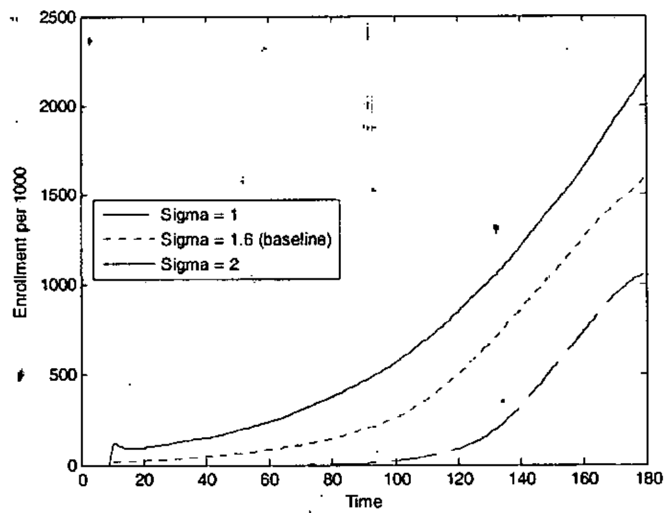
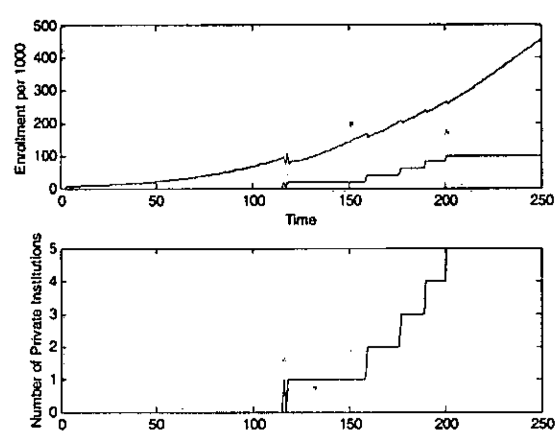
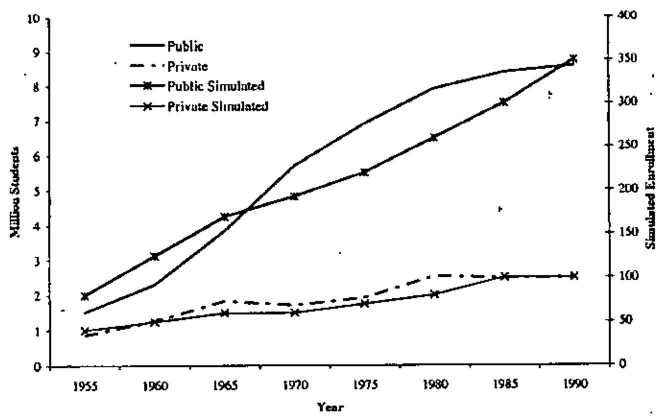


Figure 3. Enrollment with public and private education providers



The simulation results nicely illustrate our theoretical findings. Private institutions can only enter the market for higher education once the relative signaling value is sufficiently high. In our baseline simulation, the first private firm enters after public enrollment passes the 10 percent threshold and the second one at roughly 20 percent. The remaining entrants follow faster. As Figure 4 below shows, the model parameters selected fit well with the actual US enrollment data from 1955 to 1990[15].

Figure 4. Actual and Simulated Enrollment



The actual number of students are displayed on the left axis of Figure 4, while the simulation results are displayed on the right hand side. The overall fit of the model is quite good, and it does particularly well in predicting the relative sizes of the private and the public sector over time.

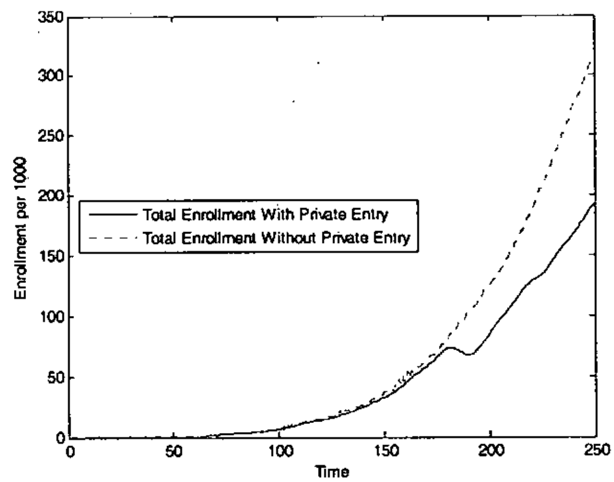
Let us now turn to the aggregate levels of enrollment. Figure 5 shows the result from running the same simulation with and without the entry of private providers. This method generates a counterfactual scenario with which the outcome resulting from private entry can be compared.

Clearly, the emergence of private providers significantly reduces total enrollment rates over time. The intuition for this result is that as private providers enter the higher education market, the most highly talented students leave the public institutions. Since the premium from public education is directly determined by

[15]Source: US Cencus bureau, Historical School enrollment report.

the average talent of the students with publicly provided education, increasing enrollment in private institutions reduces the return to public education. Therefore, total enrollment in a pluralistic system with both private and public providers will be lower than under a purely public higher education system, where all highly talent agents are pooled.

Figure 5. Total enrollment with and without private providers



In a next step, we simulate the effects of public subsidies to higher education. If the subsidies are paid equally to both private and public institutions (for example in the form of publicly available student loans), there is no big change in the result: Both private and public education can be afforded more easily and enrollment is accelerated. More interesting, and also empirically more relevant, is the case when the public providers are subsidized whereas private providers are not. In this case subsidies increase the relative and absolute price differentials between private and public education. Figure 6 below summarizes the simulation results for various levels of subsidies.

The first section of the table shows the enrollment effects of public subsidies in the absence of private education institutions. Subsidies are assumed to be proportional, that is the government covers some fraction of the total (private) cost of enrollment excluding the effort cost. As the table shows, the effect on enrollment of such subsidies is big in early stages of development where the cost of education is high relative to wages, while the net effect of subsidies levels off significantly in later stages of development. Switching from a subsidy of only 10% to a zero cost (100% subsidization) policy doubles enrollment after 150 simulated periods (from 8.6% to 17.1%), but has a much smaller relative effect on enrollment at the end of the simulated time period when total enrollment approaches 50 percent.

Figure 6. Enrollment under different degrees of subsidies to public education

Public Sector Only

Degree of Subsidization	Time Period: 25	50	75	100	125	150	175	200	225	250
100	10	20	38	66	110	171	252	351	462	576
70	3	9	21	44	84	143	224	327	442	562
40	0	0	23	26	63	117	199	303	422	546
10	0	0	0	0	75	86	179	280	402	532

Public and Private Institutions

Degree of Subsidization	Time Period: 25	50	75	100	125	150	175	200	225	250
100	10	20	38	66	86	140	198	260	347	452
70	3	9	21	44	57	110	155	218	322	433
40	0	0	23	26	63	117	125	191	298	413
10	0	0	0	0	20	50	122	165	274	394

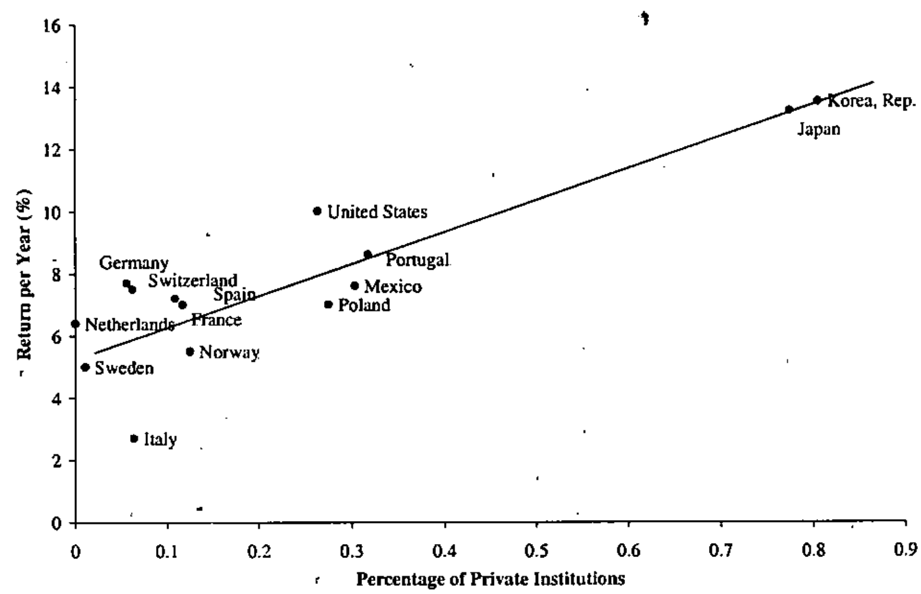
Entry Timing of Private Institutions

	Degree of Subsidization: 10	40	70	100
First Private Institution (Entry-Period)	75	93	107	116
Last Private Institution (Entry-Period)	110	188	194	202

This finding suggests that subsidizing higher education is a policy that will have a big effect on enrollment when higher education is limited to a small part of the population, but less so in a situation of mass higher education. To put it differently: The positive effect on enrollment of public subsidies is small relative to the effect caused by general wage growth.

The second and third sections of the table display the effects of public subsidies when private institutions are allowed to enter the education sector. The results regarding the declining effect of subsidies over time remains. The effect of subsidies on the size of private institutions is clearly negative, implying that higher public subsidies make it significantly harder for private institutions to enter the education sector. This finding indicates that the effect of subsidies on relative prices outweighs the increased signaling value generated by higher enrollment. Thus, in rich societies subsidizing higher education will have only a small effect on total enrollment, but may have a big effect on the relative size of the private higher education sector.,

Figure 7. Percentage of Private Institutions and the Returns to Higher Education[16]

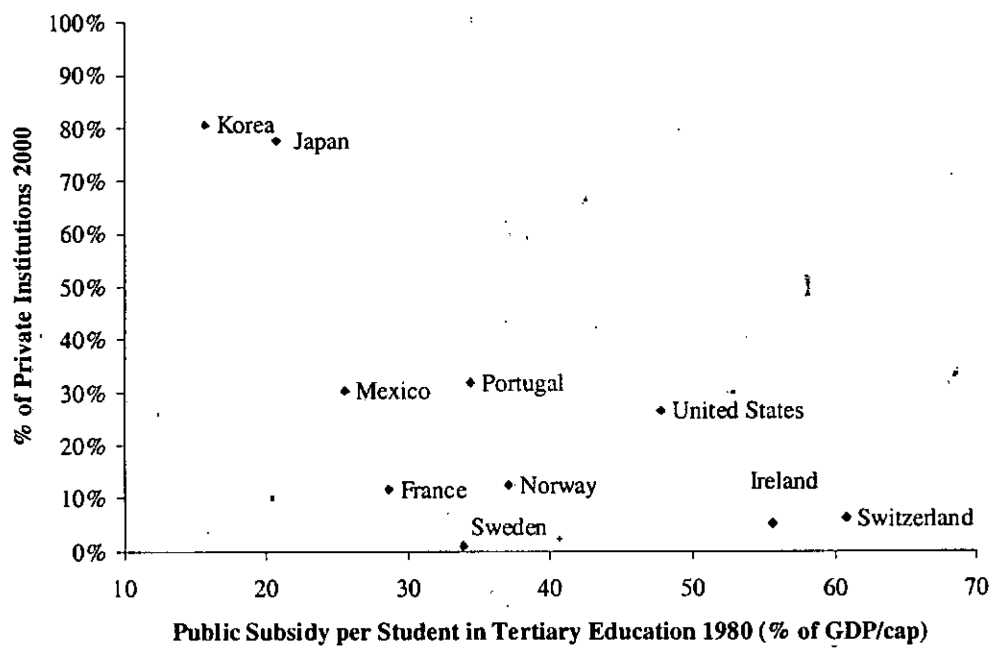


Another important result of our simulations is that private education leads to

[16]Source: OECD.

higher average returns to higher education over time, even if the level of subsidies for the public institutions is held constant. The intuition behind this result is straightforward. First, the most talented agents earn very high rents in the presence of the private sector, and second, the size of the public sector shrinks, as some of the lower talent agents will no longer enroll. This result fits well with the empirically observed correlation between the size of the private sector and education premium as summarized in Figure 7. The negative correlation between the degree of public subsidization and the relative size of the private sector predicted by the theoretical model and the simulation results is also confirmed empirically, as can be seen in Figure 8 which compares current shares of private institutions to the degree of government expenditure on higher education in 1980.

Figure 8. Percentage of Private Institutions 2000 versus Historical Degrees of Public Expenditure on Higher Education[17]



[17]Source: Institutional data: OECD, Expenditure data: WDI.

3.5 Summary and Discussion

We have presented a dynamic non-overlapping generations model to explain and simulate the general development of enrollment in higher education in general, and the evolution of private education institutions in particular. We have shown that subsidies for public universities have the expected positive effect on enrollment rates, but impede at the same time the emergence and growth of private institutions. The model presented does not only fit well with the historical development of the private and the public sectors in the US, but also offers an explanation for the empirically observed correlation between the relative size of the private sector and the average returns to higher education.

From a growth perspective, the effects of subsidized public education are unclear, as they depend on the relative performances of private and public institutions in the formation of human capital. If public institutions are as good as private ones in generating human capital, publicly subsidized institutions will generate higher economic growth via higher enrollment. If, on the other hand, private institutions are more efficient producers of human capital, high public subsidies will hinder the emergence of private universities and are thus likely to harm growth in the long run.

Finally, the model presented makes it very clear that higher education policy choices have important distributive implications. The higher the subsidies to public institutions, the larger are enrollment rates and the smaller is the importance of private institutions. Subsidizing public higher education implies reducing the wage gap between educated and uneducated labor not only by increasing enrollment, but also by preventing the formation of privately educated elites.

Chapter 4

Education and Social Security

4.1 Introduction

Over the last century, pay-as-you-go social security systems have emerged in a large majority of industrialized countries. Initially small and targeted, social security has witnessed rapid growth in the post war period, becoming one of the largest budgetary items in most developed countries. Concurrently, a long period of relatively stable economic growth has lead to sizeable increases in incomes and private wealth, fostering private investment in human capital as well as the flow of intergenerational wealth transfers. In the period from 1970 to 2000, gross enrollment in tertiary education increased from 47% to 73% in the US, from 19% to 54% in France, and from 17% to 50% in Italy[1].

Even though data on bequests are less available and harder to compare across countries, their increasing importance can hardly be doubted. While low incomes, large family sizes and an unstable economic environment made bequeathing very expensive if not impossible for a majority of the population in the early 20th century, recent data suggest that intentional bequests have become more of a

[1]Source: World Development Indicators 2002, % Tertiary School Enrollment (gross).

mainstream phenomenon in industrialized countries. According to the Health and Retirement Study (HRS), 49.3% of US citizens aged 55 or older indicated to be certain to leave some positive bequest to the following generations in 2000[2]. In a similar survey in Italy[3], 39.9% of respondents provided the same answer.

In this chapter we argue that the growth processes of social security expenditure, human capital investment and intergenerational transfers are not independent, but strongly linked to each other. As long as economies are relatively poor, altruistically motivated agents have small capital endowments, so that they can only partially support the education of their descendants and will never leave bequests. With rising incomes, private bequest constraints gradually become less binding, and an increasing share of the old generation divides their incomes between own consumption and gifts to the following generation. Open bequest channels imply that young agents can appropriate some positive fraction of transfers made to the old in general, and some fraction of the intergenerational redistribution implicit in PAYGO pension systems in particular. Once the wealth spillovers across generations are sufficiently large, the introduction and, more importantly, also the continuation of a pension system will always be supported by a majority of the population.

Public education systems redistribute within each generation, and thus receive majority support independent of the level of economic development as long as the median is below the mean income. Since the existence of public education has a positive effect on total human capital investment, public education systems raise economic growth and lower the cost of pension systems. The introduction of pension systems, on the other hand, raises the returns to educational investment,

[2]According to the surveys of the Health and Retirement Study (HRS), the percentage of respondents indicating a 100% subjective probability of leaving a bequest larger then US$ 10,000 increased from 42.8% in 1994 to 47% in 2000.

[3]Survey on Health, Aging and Wealth (SHAW) , conducted by the Center for Studies in Economics and Finance (CSEF), Salerno, in 2002.

and thus generates higher demand for public education. From a political perspective, public education and social security systems therefore mutually enforce and complement each other in the long run.

The theory on the historical development of PAYGO pension system presented in this chapter follows previous work by Browning (1975), Cukierman and Meltzer (1989) and Tabellini (1990) in attempting to understand the majority support for pension systems as a policy benefiting the minority of the old. In Browning's model, political support for pension systems always arises since elections are once and for all, and the net present value of the pension system for middle aged agents is positive. In the model presented by Cukierman and Meltzer, human capital is fixed, so that the crowding out of private savings causes general equilibrium effects that are positive for the returns to physical capital and negative for wages. As a consequence, a majority consisting of the poorest and the richest agents opts in favor of debt policies in general, and pension systems in particular. In Tabellini's model, pension systems are redistributive, and thus receive majority support by the coalition of the old and the poor young.

In this chapter, we show that neither of the assumptions made in the previous literature is necessary to generate majority support for PAYGO pension systems; we demonstrate that the presence of intentional intergenerational wealth transfers alone is sufficient to guarantee the political emergence and sustainability of PAYGO social security pension systems independent of the institutional and macroeconomic settings.

The chapter is structured as follows: In section 2, we introduce the basic economic setup of our model. In section 3, we present a general analysis of public education and social security. In section 4, we briefly discuss the implications of our model for the historical implementation and growth of social security and public education systems, and present some cross-sectional evidence. We conclude the chapter with a short summary in section 5.

4.2 The Model Structure

We consider an overlapping generations model, where in every period t a continuum of heterogeneous individuals is born and lives for three periods. Agents are infants in the first period, young in the second, and old in the third period. During their infancy, agents receive education which is financed by their parents. In the second period, agents work and earn labor income, which they use to consume, to invest into their children's education and to save for their retirement. Old agents do not participate in the labor market, and use their accumulated savings for their own consumption and for leaving bequests. Agents differ with respect to their human capital and with respect to their private inherited wealth. The population grows at an exogenously given rate of $n-1$, so that each individual has exactly n descendants.

4.2.1 The Production Sector

The economy is characterized by a standard neoclassical, constant-returns-to-scale production technology. Abstracting from capital stock effects, we analyze a small and open economy, where capital and labor are used to produce a single homogeneous good. Output is uniquely determined by the amounts of physical and human capital employed in the economy. While the access to capital for firms is unrestricted, the human capital stock disposable for production is endogenously determined by domestic investment in education. The total output Y at time t is given by:

$$Y_t = F(A_t, K_t, H_t) = A_t H_t^{1-\alpha} K_t^{\alpha}; \qquad \alpha \in (0,1) \tag{4.1}$$

where K_t and H_t are the total stocks of physical and human capital[4] at time t, respectively, and A_t is the corresponding technology employed in the economy. The production sector is perfectly competitive. Producers choose a profit maxi-

[4] We denote individual characteristics by small letters, while capital letters are used for aggregate measures.

mizing level of production for a given wage per efficiency unit of labor w_t and the exogenous interest rate r. The levels of human and physical capital employed in any period are determined by

$$\{K_t, H_t\} = \arg\max[F(A_t, K_t, H_t) - w_t H_t - r_t K_t], \tag{4.2}$$

so that the inverse demands for human and physical capital are given by

$$r_t = F'_K(A_t, K_t, H_t) = \alpha A_t (\frac{H_t}{K_t})^{1-\alpha}, \tag{4.3}$$

$$w_t = F'_H(K_t, H_t) = (1-\alpha) A_t (\frac{K_t}{H_t})^{\alpha}. \tag{4.4}$$

Since we assume a constant interest rate r and increasing productivity, equation (4.3) implies that the ratio of physical to human capital goes up over time. Plugging the optimal human to physical capital ratio into (4.4), the wage rate w_t is given by

$$w_t = (1-\alpha) A_t \frac{(\alpha A_t)^{\frac{\alpha}{1-\alpha}}}{r^{\frac{\alpha}{1-\alpha}}} = (1-\alpha) A_t^{\frac{1}{1-\alpha}} \left(\frac{\alpha}{r}\right)^{\frac{\alpha}{1-\alpha}}. \tag{4.5}$$

4.2.2 The Formation of Human Capital

The human capital h_t^i of agent i of generation t is determined by her talent θ_t^i as well as the parents' investment into her education e_{t-1}^i, and is measured in efficiency units of labor. Each agent's talent is a function of her parent's talent and a stochastic component such that $\theta_t^i = \delta_1 \theta_{t-1}^i + \delta_2 \varepsilon_t^i$, where ε_t^i is a random draw from some distribution $F(\mu, \sigma^2)$[5]. If parents do not invest at all into the education of an individual, the individual acquires basic skills, and supplies exactly θ_t^i efficiency units of labor. For positive parental spending on education $\frac{e_{t-1}^i}{n}$, the

[5] We assume parameters δ_1, δ_2 such that the within generation (probability) distribution of talent $G(\theta^i)$ is stationary in mean and variance over time, thus $\delta_1, \delta_2 \in (0,1)$ and $\delta_1 + \delta_2 = 1$.

efficiency units of labor achieved by individual i of generation t are given by

$$h_t^i = \theta_t^i f(\frac{e_{t-1}^i}{n}) \tag{4.6}$$

where f is some generic function with $f(0) = 1$ and $f_e^{'} > 0$.

Parental investment in education is divided equally among children, and the human capital returns to educational investment are assumed to be common knowledge and constant over time.

4.2.3 Preferences

Not modeling the first period of life explicitly, we distinguish between "young" and "old" agents, and denote them by superscript $j = y, o$. Individuals are altruistic and derive utility from their own consumption in each of their adult life periods (c^{iy}, c^{io}), from the investment into the human capital of their descendants e_t^i and from leaving bequests b_t^i. Each member i of generation t maximizes the following utility function:

$$\max_{c_t^{iy}, c_t^{io}, e_t^i, b_t^i} \quad u_t = u(c_t^{iy}, c_t^{io}) + u(e_t^i, b_t^i). \tag{4.7}$$

Using a standard separable logarithmic specification[6], each agent optimizes

$$\max_{c_t^{yi}, c_t^{oi}, e_t^i, b_t^i} \quad u_t^i = \log c_t^{yi} + \rho \log c_t^{oi} + \log e_t^i + \rho\beta \log(\varphi + b_t^i), \tag{4.8}$$

where $\beta \in [0, 1]$ is a parameter measuring the degree of parental altruism, with $\beta = 0$ implying fully selfish, and $\beta = 1$ implying highly altruistic parents. ρ is the private discount factor. $\varphi > 0$ is a positive constant capturing the active

[6]The model results clearly apply to a wider class of utility functions. Using more general functional forms slightly complicates the analysis without adding significant value to the argument.

bequest constraint for agents with low incomes[7]. The maximization is subject to the following constraints:

$$h_t^i w_t \geq c_t^{yi} + e_t^i + s_t^i \tag{4.9}$$

$$c_t^{oi} + b_t^i \leq (s_t^i + \frac{b_{t-1}^i}{n})r \tag{4.10}$$

$$b_t^i, e_t^i \geq 0 \tag{4.11}$$

where h_t^i is the human capital endowment of agent i in period t, s_t^i are savings, and r is the exogenous return to capital investment[8]. Equations (4.9) and (4.10) are the first and second period budget constraints, and equation (4.11) captures the non-negativity constraints on bequests and educational investment. We assume that bequests are always split equally among descendants[9], and that bequests are left at the end of each period, so that young agents cannot use the inheritance they receive for investment into their own children's human capital or for consumption during their youth[10].

Denoting each agent's life time income by $I_t^i = h_t^i w_t + \frac{b_{t-1}^i}{n}$ each agent optimally splits her income between own consumption and educational investment up to some critical income level I^*. Any additional income is divided between consumption, educational investment and bequest. More precisely, the optimal levels of consumption, educational investment and bequest for an individual i of

[7]The empirical evidence for operative bequest constraints (zero bequests) among poor households is strong. While the fraction of households leaving a bequest in the highest US wealth decile in the US is close to 1, the corresponding fraction in the bottom decile is only marginally different from zero (McGarry, 1999, and Fink et.al, 2005).

[8]$r = 1+$ interest rate.

[9]McGarry finds that equal splitting occurs in more than 80% of all cases in the US (McGarry, 1999).

[10]One may think of this assumption in terms of strategically motivated parents. Parents keep a part of their wealth to attract their children's attention, and leave these savings plus interest to their children once they die.

generation t are given by:

$$c_t^{iy} = e_t^i = \frac{c_t^{io}}{r\rho} \begin{cases} \frac{1}{2+\rho} I_t^i & if \quad I_t^i < I^* \\ \frac{1}{2+\rho} I^* + \frac{1}{2+\rho(1+\beta)} (I_t^i - I^*) & if \quad I_t^i \geq I^* \end{cases} \tag{4.12a}$$

$$b_t^i = \begin{cases} 0 & if \quad I_t^i \leq I^* \\ \frac{\beta\rho r}{2+\rho(1+\beta)} (I_t^i - I^*) & if \quad I_t^i > I^* \end{cases} \tag{4.13a}$$

where $I^* = \frac{\varphi(2+\rho)}{r\rho\beta}$ is the critical income threshold for positive bequests, which decreases with the degree of altruism β, the market interest rate r and increases with the private discount factor ρ.

4.3 Public Education and Social Security

4.3.1 Public Education

We start our analysis by assuming that there is no social security system, and that agents decide on public education independent of other policy choices. We assume private and public education to be perfect substitutes, so that agents are indifferent between private and publicly provided schooling. Public education is financed with a flat tax on labor income, and each student receives the same quantity of educational investment within public education. Given this setup, the maximization problem for each agent i of generation t becomes:

$$\max_{c_t^{yi}, c_t^{oi}, e_t^i, b_t^i, \tau_t^{ei}} u_t^i = \log c_t^{yi} + \rho \log c_t^{oi} + \log(e_t^i + \tau \overline{h}_t w_t) + \rho \log(\varphi + b_t^i) \tag{4.14}$$

subject to constraints (5.3) and (5.4) and the slightly modified first period constraint

$$h_t^i w_t (1-\tau) \geq c_t^{yi} + e_t^i + s_t^i. \tag{4.15}$$

$\overline{h}_t$ denotes the average human capital within generation t, τ is the education tax and $\tau \overline{h}_t w_t$ is the corresponding public per capita expenditure on education. Let us define the indirect utility v_t^i of agent i in period t as $v_t^i = v(b_{t-1}^i, h_t^i w_t, \overline{h}, \tau)$. Then, the policy preference of each agent i can be derived directly from the marginal change induced by the tax rate, which is given by

$$\frac{\partial v_t^i}{\partial \tau_t} = -\frac{\partial v_t^i}{\partial h_t^i w_t} h_t^i w_t + \frac{\partial v_t^i}{\partial e_t^i} \overline{h} w_t \tag{4.16}$$

Proposition 4 *In a median voter setup, public education always receives majority support as long as the median is strictly below the mean labor income. The size of the public education system increases with the size of the bequest the median voter receives.*

The proof for the first part of proposition 1 is straightforward. Since public education is redistributive, expression (4.16) must always be negative for any agent with $h_t^i > \overline{h}$. Therefore, public education can get majority support if and only if the human capital of the median voter $h_t^m \leq \overline{h}$.

Any agent characterized by $h_t^i < \overline{h}_t$ gets access to subsidized education within the public system, so that the marginal cost of taxation must be strictly smaller than the marginal benefit of public education and therefore $\frac{\partial v_t^i}{\partial \tau} > 0$ at $\tau = 0$. Since public education implies redistribution in kind, the marginal cost of taxation increases, while the marginal benefit of additional public expenditure strictly decreases with the educational tax τ. Maximizing (4.14) with respect to constraints (4.11), (4.10) and (4.15) the optimal tax rate τ_t^i of an agent i of generation t can be characterized as follows:

$$\tau_t^i = \begin{cases} 0 & if \;\; h_t^i \geq \overline{h} \\ 0 < \tau_t^{i*} < 1 & if \;\; h_t^i < \overline{h} \end{cases} \quad with \; \frac{\partial \tau_t^{i*}}{\partial b_{t-1}^i} > 0. \tag{4.17}$$

To see why this is the case first note that agents who have received positive bequests ($b_{t-1}^i > 0$) have higher life time incomes and thus want to save less, and to invest more into education. Larger bequests received imply a lower marginal cost and thus higher preference for first period taxation for agents with human capital below the mean. However, since educational transfers are in kind, the preferred tax rate must be strictly below zero for all agents[11].

Lemma 1 *The effect of public education on the aggregate level of human capital investment and economic growth is positive and increasing in the educational tax chosen in the political equilibrium.*

To see why public education has a positive effect on human capital investment, first assume that all agents spend the same fraction of their income on education, and that the size of the public system is small enough to allow the optimal allocation of resources between education and consumption for all agents[12]. If this was the case, public education would simply imply a wealth transfer from high labor income to low labor income, and the net effect of public education on human capital investment would be zero.

In our setup, this neutrality is generally not given. Agents with a positive net contribution to the public education system are by definition wealthier than agents who receive a net transfer, and thus spend a larger share of income on bequests and a smaller share on education than those agents who are net recipients. Second, for any tax rate $\tau > 0$, there is some number of agents ≥ 0 who prefer to spend less on education and more on consumption than what is implied in the public system. The larger the size of the public education system, the larger the fraction of agents who are constrained to spend more than their optimal choice, and the higher thus the increase in total human capital generated by the introduction of the public education system.

[11] A tax rate of one would imply zero consumption for the young, since bequests can only be consumed in the later life period.

[12] Optimality here means equality between the marginal rate of substitution of educational investment and consumption and the respective price ratio.

As long as at least one agent with human capital above the mean leaves bequests and one agent with human capital below the mean does not, or at least one net recipient is forced to spend more on education than he would like to under the public system, public education has a strictly positive effect on human capital investment and economic growth[13].

4.3.2 PAYGO Social Security Systems

Basic Features - System Design

Abstracting from within generation redistribution, we focus on fully proportional or Bismarckian pay-as-you-go social security systems. Within such systems, young agents pay a social security tax τ^s on their labor income. As opposed to fully funded systems, the revenues of this tax are not invested, but directly used to pay out pensions to the precedent generation. The pension received p_t^i by each agent i of generation t within a non redistributive PAYGO pension system are proportional to her own relative human capital $\frac{h_t^i}{H_t}$ and the total contributions by generation $t+1$, so that

$$p_t^i = \tau^s w_{t+1} H_{t+1} \frac{h_t^i}{H_t}. \tag{4.18}$$

Rearranging the right hand side of this expression, we get

$$p_t^i = \tau^s h_t^i w_t \frac{H_{t+1} w_{t+1}}{H_t w_t} = \tau^s h_t^i w_t g_{t+1}, \tag{4.19}$$

where $\tau^s h_t^i w_t$ correspond to the initial contribution of agent i of generation t and g_{t+1} reflects the rate of economic growth between periods t and $t+1$. If the rate of economic growth g_{t+1} is larger than the exogenous interest rate r, all young agents directly profit from the pension system, and majority support emerges trivially.

[13] Independent of its growth effects, public education always generates a more equal distribution of human capital and labor income over time, as it has been argued in prior work by Saint-Paul and Verdier (1992).

To focus on the more interesting case, we assume that economic growth is strictly positive, but that the economy is dynamically efficient, so that $0 < g_t < r$ for all t. Under this assumption, an operative pension system implies a suboptimal return on investment and thus a cost of $h_t^i w_t \tau^s (r - g_{t+1})$ to each young agent i of generation t. The larger agents' labor income and the smaller the rate of economic growth relative to the exogenous interest rate r, the higher is the economic cost of participating in the pension system for each young agent.

4.3.3 Pension Preferences and Majoritarian Outcomes

Following the same outline as before, we start our analysis by assuming that agents vote on social security only. To keep things tractable, we assume that each agents has perfect information regarding the overall distribution of wealth and human capital and economic growth of this own and the following generation.

Since old agents do not take the welfare of the following generations into account[14], pension systems imply a direct transfer to the old agents without any associated cost. As shown before, old agents divide their resources between own consumption and bequests. As long as their consumption level is below the exogenous threshold φ, old agents allocate all income to consumption. If accumulated savings plus the pension receipts exceed this threshold, old agents allocate a positive fraction of their resources to bequests. Therefore, the bequest b_t^i left by an old agent i of generation t to his n descendants among generation $t+1$ in the presence of a social security system is given by

$$b_t^i = \begin{cases} 0 & if \quad s_t^i r + p_t^i \leq \varphi^\beta. \\ \frac{\beta}{1+\beta}(s_t^i r + p_t^i - \varphi^\beta) & if \quad s_t^i r + p_t^i > \varphi^\beta. \end{cases} \tag{4.20}$$

It is straightforward to see that the (indirect) utility of old agents strictly

[14]This is due to the assumption that agents derive utility from giving rather than from the wellbeing of their descendants.

increases with the size of the pension system, so that old agents will always prefer a tax rate of one to any other feasible policy.

The case is more interesting for young agents. In the presence of the pension system young agents maximize (4.8) subject to (4.11) and the slightly modified constraints for period 1 and 2:

$$h_t^i w_t(1-\tau) \geq c_t^{yi} + e_t^i + s_t^i \tag{4.21}$$

$$c_t^{oi} + b_t^i \leq (\frac{b_{t-1}^i(\tau)}{n} + s_t^i)r + E(p_t^i), \tag{4.22}$$

where $E(p_t^i) = h_t^i w_t E(\tau_{t+1}) E(g_{t+1})$ is the expected pension payment, and $E(g_{t+1})$ and $E(\tau_{t+1})$ are the expected rates of economic growth and the expected social security tax rate in period $t+1$, respectively. Since pension systems redistribute incomes across generations, the size of the social security tax rate affects total human capital investment, and thus also the rate of economic growth. A larger τ implies a higher burden for young agents and thus a lower life time income. At the same time, a larger pension system implies larger bequest flows. Since human capital investment is mostly proportional to incomes, the net growth effect of pension systems depends on the net income effect for the young, and can not generally be determined. If all young agents were compensated for the economic cost of pension systems by additional bequests, the net growth effect would be positive. If no young agent receives any bequest, the opposite would be true; in all intermediate cases, the net growth effect depends on the size and distribution of bequests. We assume that agents have complete information about the distribution of incomes, and thus are able to predict the rate of economic growth as a function of the politically determined tax rate τ.

From the perspective of a young agent, the net effect of the pension system does not only depend on the expected net return $r - E(g_{t+1})$, but also on parental characteristics, i.e. the size of the savings accumulated, and the parent's relative pension claim defined over the parent's former labor income $h_{t-1}^i w_{t-1}$ and the growth rate between periods $t-1$ and t. Thus, in the presence of the pension system, the indirect utility function of a young agent i of generation t has to be restated as

$$v_t^i = v(w_t, h_t^i, s_{t-1}^i, h_{t-1}^i, w_{t-1}, g_t, g_{t+1}, \tau). \tag{4.23}$$

The marginal effect of pension taxes on individual welfare can be decomposed into three parts as follows:

$$\frac{\partial v_t^i}{\partial \tau} = -\frac{\partial v_t^i}{\partial h_t^i w_t} h_t^i w + \frac{\partial v_t^i}{\partial E(p_t^i)} \frac{\partial E(p_t^i)}{\partial \tau} + \frac{\partial v_t^i}{\partial b_{t-1}^i} \frac{\partial b_{t-1}^i}{\partial \tau} \tag{4.24}$$

The first two terms capture income effects. Since we assume dynamic efficiency, the sum of the first two terms in the expression above is negative for all agents. Thus, any young agent will strictly oppose the pension system unless the last term is positive, that is $\frac{\partial b_{t-1}^i}{\partial \tau} > 0$. In other words, a young agent i will never support the pension system if the pension payment does not lead to any wealth spillovers. Given (4.20), it is straightforward to derive the marginal change in bequests as

$$\frac{\partial b_{t-1}^i}{\partial \tau} = \begin{cases} 0 & if \quad s_{t-1}^i r + p_{t-1}^i < \varphi \\ \frac{1}{n}\frac{\beta}{1+\beta} h_{t-1}^i w_{t-1} g_t & if \quad s_{t-1}^i r + p_{t-1}^i \geq \varphi \end{cases} \tag{4.25}$$

The second row of expression (4.25) is crucial for the model, as it directly determines whether a young agent will prefer positive social security taxes.

Lemma 2: *The social security tax preferred by young agent i of generation t is strictly smaller than one, increases with the parental degree of altruism and parental savings as well as the rate of economic growth, and decreases with fertility and agents' labor income.*

The proof of Lemma 2 follows directly from the previous exhibition. Let us start by abstracting from within generation heterogeneity and focus on the mean agent of the young generation, assuming that her parent's labor income also corresponds to the average of her generation. Assuming a constant social security tax over time, the income effect of a marginal increase in the tax rate is positive only if

$$\frac{1}{n}\frac{\beta}{1+\beta}\tau\bar{h}w \geq \tau\bar{h}w(r - g_{t+1}) \tag{4.26}$$

which simplifies to

$$\frac{1}{n}\frac{\beta}{1+\beta} \geq r - g_{t+1}. \tag{4.27}$$

Thus, the income effect for the average young agent (with an average parent) is positive if and only if the share of the pension payments she recovers via bequest is as least as large as the direct cost of the pension system. The more altruistic parents, and the lower fertility, the higher is the respective benefit for a young agent as stated in Lemma 2. It is straightforward to generalize this result to agents with heterogeneous labor incomes. If the relative labor income of an agent i's parent is high relative to her own labor income, the share of the pension payments received by the parent exceeds the share of pension payments contributed by agent i. Technically, the larger $\frac{h^i_{t-1}}{\bar{h}_{t-1}}$ relative to $\frac{h^i_t}{\bar{h}_t}$, the larger is agent $i's$ return to the pension system. Thus, the better a child does in the labor market relative to her parents, the less likely she is to profit from the pension system. Since agents can neither borrow against their future pension claims nor against their bequests, the marginal cost of first period income taxation is convex and the tax rate preferred by young agents strictly smaller than one[15].

Proposition 5 *As long as the degree of parental altruism is sufficient, PAYGO social security systems always emerge and persist in the long run.*

Given that there n young agents for each old agents, and that all old agents always want a tax rate of one, a fraction $\frac{n-1}{2n}$ of young agents needs to be in favor of

[15]Given that parents leave their bequests at the end of their lives, a tax rate of 1 implies zero first period income which can never be optimal from an individual agent's perspective.

pension systems in order to generate majority support for such a policy. Clearly, a young agent i will choose a positive tax rate only if and only if expression (4.24) is positive. This requires two conditions to be satisfied: first, open bequest channels, and second, the expected continuation of the pension system.

The first condition is straightforward: as long as pension systems do not generate any wealth spillovers, young agents will not support such systems, and majority support for the introduction of the pension system never emerge. Since we assume positive rates of technological progress and a positive correlation of incomes across generations, the distribution of incomes shifts up over time so that the fraction of agents leaving bequests to their descendants increases. Thus, the wealth spill over generated by PAYGO pension systems strictly grows in size over time, and will always induce a critical mass of young agents to support the pension system as long as the degree of parental altruism is sufficiently large[16].

The second condition is more subtle. Each young agent will make his vote not only contingent on the additional wealth spillover generated by the pension system, but also on the expected future size of the pension. Agents know the aggregate human capital of the next generation, but do not know the tax rate that will be chosen in the political equilibrium in period $t + 1$. Young agents of generation $t + 1$ will support the continuation of the pension system only if the induced change in bequests is higher than the direct cost of the system. The induced change in bequest in return is a function of the savings of generation t. The higher the savings of generation t given some social security tax rate τ, the larger the fraction of young agents of generation $t+1$ supporting the continuation of the pension system. Since agents have complete information about the distribution of incomes, they can correctly form expectations regarding the tax rate emerging

[16]The basic condition for parental altruism can be derived directly from expression (4.26). Assuming, for example, zero population growth, a real interest rate of 3% and an economic growth rate of 2.5%, β needs to be slightly above 0.3. In the less favorable case that economic growth is only 2% p.a., β needs to be slightly above 0.8.

from the vote in the next period.

Thus, pension systems will receive majority support only if the wealth spillovers and the expected future tax rates are such that (4.24) is positive for a fraction $\frac{n-1}{2n}$ of young agents. Since the share of agents tied to their parents increases over time, the fraction of young agents supporting the pension system must also increase across generations. Once the conditions are such that a sufficient number of agents among the young generation of some generation t has the incentive to support the pension system, the strictly increasing wealth spillovers directly imply that a majority of agents in all subsequent periods $t+1, t+2..$ will support the system.

4.3.4 Joint Determination of Public Education and Social Security Systems

Having derived the political support for public education and PAYGO social security systems in independent votes, we now focus on the more interesting case where voters have to jointly determine the size of the social security system (τ^s) and public education (τ^e). To solve the issue of preference aggregation in the now bi-dimensional policy space we apply the concept of structure induced equilibrium introduced by Shepsle (1979). In our framework, a policy bundle (τ^{s*}, τ^{e*}) represents a structure induced equilibrium if τ^{s*} represents the outcome of a Majoritarian vote on τ^s if τ^e is held constant at τ^{e*}, and vice versa, τ^{e*} represents the outcome of a Majoritarian vote on τ^e if τ^s is held constant at τ^{s*}. Structure induced equilibria essentially resolve the multidimensionality problem by voting issue by issue rather than by casting a joint ballot. While this approach may not perfectly model real political processes, it is instructive for the purpose of our analysis since it allows to directly highlight the political externalities each of the two policy dimensions exhibits on the respective other dimension. The major condition for the existence of a structure induced equilibrium (τ^{s*}, τ^{e*}) is single peakedness of agents' preferences. Single peakedness in our setup requires that for any agents i there exists some preferred tax rate τ^i such that for any $\tau', \tau'' \epsilon [0,1]$ $\tau' \succ_i \tau''$ if either $\tau'' < \tau' \leq \tau^i$ or $\tau'' > \tau' \geq \tau^i$. Given the specified utility functions, this condition must always be satisfied in our model. Therefore, a structure induced equilibrium defined over (τ^{s*}, τ^{e*}) must always exist.

The characterization of the equilibrium policy choices follows directly from agents' indirect utility function, which is now given by

$$v_t^i = v(w_t, h_t; s_{t-1}^i, h_{t-1}^i, w_{t-1}, g_t, E(g_{t+1}), \tau_t^e, \tau_t^s, E(\tau_{t+1}^s)). \tag{4.28}$$

We start our analysis with educational policies, and assume that the social security tax rates τ_t^s and $E(\tau_{t+1}^s)$ are exogenously given. In the presence of pension systems, the marginal effects of an increase in the educational tax τ_t^e for an agent i in period t are given by

$$\frac{\partial v_t^i}{\partial \tau_t^e} = -\frac{\partial v_t^i}{\partial h_t^i w_t} h_t^i w_t + \frac{\partial v_t^i}{\partial e_t^i} \bar{h} w_t + \frac{\partial v_t^i}{\partial E(p_{t+1}^i)} \frac{\partial E(g_{t+1})}{\partial \tau_t^e} \tag{4.29}$$

The first two terms are identical to expression (4.16) and reflect the direct effects of educational taxation on individual utility. The last term, on the other hand, directly captures the externality generated by the coexistence of pension systems.

Lemma 3: *The educational tax chosen in the presence of PAYGO social security systems is strictly higher than the corresponding tax chosen in the absence to pension systems.*

As shown in Lemma 1, public education increases human capital investment and economic growth, and thus the returns to the pension system. The larger the size of the pension system, and the higher each agent's contribution to the pension system, the larger and more positive is this externality. Since the partial effect is positive for all agents, the coexistence of pension systems weakly increases the educational tax preferences of all agents, and strictly increases the tax preferences of those preferring a positive tax rates in an independent vote. Since agents preferring a strictly positive tax rate are a majority, the educational tax chosen in the political equilibrium with a PAYGO pension system must always be strictly larger than the educational tax chosen in an independent vote on educational policy[17].

Let us next analyze the case of pension systems assuming a given educational tax rate τ^e. As before, the marginal effect of a social security tax on the indirect utility of an agent i of generation t is given by

$$\frac{\partial v_t^i}{\partial \tau} = -\frac{\partial v_t^i}{\partial h_t^i w_t} h_t^i w + \frac{\partial v_t^i}{\partial E(p_t^i)} \frac{\partial E(p_t^i)}{\partial \tau} + \frac{\partial v_t^i}{\partial b_{t-1}^i} \frac{\partial b_{t-1}^i}{\partial \tau} \tag{4.30}$$

The effects of public education on agent's pension preferences are not as obvious as in the opposite case. The size of public education has two effects on the agents' preferences with respect to social security taxation. First, and directly evident from the previous exhibit, public education system affects the expected size of the future pension benefits. The larger the educational tax, the higher the expected rate of economic growth, and the higher thus the private return to the pension system for young agents of generation t. As highlighted before, this effect is positive for all agents, and thus unambiguously raises the support for pension system. The second effect is more subtle. Educational taxation is redistributive, and thus changes the income distribution across agents of a given generation. The higher the educational tax, the higher the net income loss for an agent with human capital above the mean. Higher educational taxes imply thus a higher marginal cost of a first period income taxation as measured by the first term in equation above for an agent with human capital above the mean.

Thus, educational taxes have an unambiguously positive effect on the social

[17] This finding is in line with previous work by Boldrin and Montes (2001), who show paygo pension systems may constitute an efficient mechanism to achieve the socially optimal level of public educational investment.

security tax preferences for agents with human capital below the mean, and an ambiguous effect for agents with human capital above the mean. Although agents with human capital below the mean are by assumption a majority, the net effect of educational expenditure on pension systems can not generally be determined.

4.4 Discussion and Empirical Interpretation

In this chapter we make two main points: the first one is a mostly historical one: the political conditions derived in the previous sections imply that public education emerge early in democratic societies, while social security systems emerge only once sufficient levels of private wealth have been accumulated in an economy. This simple implication fits well with the historical development of public education and social security. Most public education systems have a long history, and date back to the 18th and 19th century, preceding in many cases even the process of democratization[18]. Throughout the 20th century public education systems have been continued and grown moderately in most industrialized countries.

The first system vaguely resembling to current pension systems was introduced by Bismarck in Germany in 1889. Most European countries started small pension systems before World War I, the US in the period between the two World Wars. Most systems were originally very small, targeted to specific groups of the population, and in some cases not based on a pay-as-you-go but on capital investment schemes. After World War II, PAYGO social security systems witnessed rapid growth in the industrialized world, becoming one of the largest budgetary items in most countries. In 1995, the average social security tax rate on labor income in OECD countries ranged between 7% in Canada and remarkable 33% in Italy[19], exceeding income taxes for a significant share of the population. By the

[18] Galor and Moav (2002a) argue that increasing returns to human capital investment forced the leading classes to support education for a broader share of the population in the 19th century.

[19] Source: ISSA.

late 1980s, pension systems had become so generous that several governments[20] had to support them with transfers from the general budget.

This remarkable growth in social security systems takes us directly to the second main point of the chapter. In this chapter we argue that intergenerational wealth flows are the key driver for the support and growth of pension system, and also, that the existence of pension system has a positive and significant effect on the size of public education system. In the remainder of this section, we will present and discuss some cross-sectional evidence to back up these two claims.

Since data on bequests are not available on an international level, the main difficulty in testing the first implication lies in finding a good measure for the overall relevance of intergenerational transfers. Following the logic of our model, we use parental altruism to proxy for this variable. The data on altruism are based on recent waves of the World Value Surveys. In each of the surveys, respondents in 80 different countries around the world were asked the following question:

"Which of the following statements best describes your views about parents' responsibilities to their children?

1. Parents' duty is to do their best for their children even at the expense of their own well-being

2. Parents have a life of their own and should not be asked to sacrifice their own well-being for the sake of their children."

We calculate the percentage of respondents agreeing with the first statement, and use it as a proxy for the degree of parental altruism in each country.

As to the generosity of pension systems, we follow the approach chosen by Mulligan and Sala-i-Martin (1999), and use the total expenditure for social security transfers as our dependent variable. Similarly, we use aggregate governmental

[20] Among others Austria, Germany, Italy and Sweden.

expenditure for education as proxy for public human capital investment. Table 2 below summarizes the main variables of interest; a full description of the data set can be found in the appendix.

Table 1: Data Summary

Variable	Mean	Std. Dev.	Min	Max	Obs
Social Security Expenditure (% of GDP)	7.0	6.0	0.0	22.3	102
Total Educational Expenditure (% of GDP)	4.9	2.4	0.7	23.2	105
GDP per capita (const. 1995 $, PPP)	9.2	8.1	0.6	34.5	103
Population over 65 (% of total)	8.0	4.8	1.4	17.5	104
Number of children per Woman	2.7	1.3	1.2	6.5	106
Gini coefficient	41.8	7.2	22.2	56.0	71
Altruism	74.6	11.5	44.2	93.7	52

We start our empirical analysis with social security expenditure, and test the following reduced form:

$$SocSec_i = \alpha + \beta_1 altruism_i + \beta_2 pop65_i + \beta_3 Educ_i + \beta_4 X_i + \varepsilon_i \qquad (4.31)$$

where $SocSec$ is total government expenditure for social security as a fraction of GDP, $altruism$ is our proxy for parental altruism, and $pop65$ is the share of the population older 65 and $Educ$ is total government expenditure for education. X is a matrix including additional control variables, including GDP per capita and regional controls.

Our model implies a positive coefficient both on altruism and the share of the population older than 65. While altruism is supposed to pick up the overall relevance of intergenerational links and wealth spillovers, the share of the population older than 65 captures two factors in our model: the relative size of the old electorate, and the preferences of the young. The larger the fraction of old agents, the smaller a fraction of young agents $(\frac{n-1}{2n})$ is needed to support the pension system and the larger thus the expected size of pension systems. This implication is quite generic and consistent with most or all positive theories on social security system[21]. However, our model implies that fertility works through an additional channel summarized in Lemma 2: lower rates of fertility imply that agents have to divide their inheritance with a smaller number of siblings, and thus are able to capture a larger part of the wealth spillover generated by the pension system. Since both effects go in the same direction, we expect β_2 to be strictly positive. Our model's predictions for the effect of public education on pension systems are less clear cut. Table 2 below summarizes the results.

Column 1 of Table 2 shows the results of our baseline specification. As expected, the group size effect of the old population is large and highly significant. The sign on altruism is positive and significant as predicted by our model. In column 2, we also control for public expenditure on education and the size of the general budget. Both variables have a positive sign, but neither one of them is significant. To control for potential endogeneity problems, we instrument for educational expenditure in columns 3 and 4. The instruments we use are size of the young population as well as total population size. The coefficients on educational investment becomes slightly larger, but remains non significant. In column 4 we add regional dummies to our regression as further robustness check. The results do not change.

[21] See Galasso/Profeta (2002) for a survey on the political economy of social security.

Table 2: Cross-Section: Social Security Expenditure

First Stage: Dependent Variable: Public Education Expenditure (% of GDP)				
	(1)	(2)	(3)	(4)
Total Population (Millions)			-0.003***	-0.002***
			(0.001)	(0.001)
Urbanization (% of total population)			-0.03*	-0.03*
			(0.016)	(0.016)
Partial R-squared			0.210	0.115
F-test of excluded instruments			12.85	5.66
Hansen OID test: Chi-sq P-value			0.21	0.96
Second Stage: Dependent Variable: Social Security Expenditure (% of GDP)				
	(1)	(2)	(3)	(4)
Share of population older 65 (% of total)	1.130***	1.135***	0.954***	0.841***
	(0.19)	(0.21)	(0.29)	(0.28)
Altruism[a]	0.079*	0.098**	0.116**	0.092*
	(0.05)	(0.05)	(0.05)	(0.05)
Public Expenditure on Education (% of GDP)		0.401	1.302	1.77
		(0.52)	(1.00)	(1.25)
Other Government Expenditure (% of GDP)		0.013	0.056	0.163*
		(0.09)	(0.09)	(0.09)
GDP per capita (1995 US$, PPP)	-0.041	-0.1	-0.111	0.009
	(0.11)	(0.11)	(0.10)	(0.16)
Stata Method	OLS	OLS	IVREG2	IVREG2
Additional controls	none	none	none	continents
Observations	49	48	48	48
(Centered) R-squared	0.57	0.61	0.59	0.59

Notes
a. % of people believing kids more important than parents (WVS)
** significant at 10%; ** significant at 5%; *** significant at 1%* *Robust standard errors in parentheses*

In Table 3, we run a similar set of regressions for public education expenditure. The main dependent variable is total governmental expenditure for education relative to national GDP..The results are summarized below. Column 1 of Table 3 shows the basic relation between educational expenditure, basic income and demographic controls. While the relation between per capita income and public expenditure on education is weak, smaller countries seem to spend more on education, likely indicating some economics of scale in the provision of public education.

Table 3: Cross-Section: Public Education Expenditure

First Stage Dependent Variable: Public Expenditure on Social Security (% of GDP)				
	(1)	(2)	(3)	(4)
Population 65 and older (% of total population, 1990)			0.381	0.434
			(0.43)	(0.40)
Population 65 and older (% of total population, 1970)			0.583	0.577
			(0.39)	(0.38)
Partial R-squared			0.21	0.23
F-test of excluded instruments			9.75	12.17
Hansen OID test: Chi-sq P-value			0.74	0.63
Second Stage Dependent Variable: Public Expenditure on Education (% of GDP)				
	(1)	(2)	(3)	(4)
Social Security Expenditure (% of GDP)		0.133**	0.182**	0.154*
		(0.05)	(0.08)	(0.08)
Total population ('000)	-0.003***	-0.002**	-0.001*	-0.001*
	(0.001)	(0.00)	(0.00)	(0.00)
Urbanization	-0.008	0.044	-0.01	0.006
	(0.01)	(0.03)	(0.01)	(0.01)
Share of population 14 and younger (% of total)	-0.01	0.044	0.057	0.06
	(0.03)	(0.03)	(0.04)	(0.04)
GDP per capita (1995 US$, PPP)	0.058*	0.033	0.024	0.009
	(0.03)	(0.03)	(0.04)	(0.04)
Stata Method	OLS	OLS	IVREG2	OLS
Additional controls	none	none	none	continents
Observations	86	82	82	82
(Centered) R-squared	0.14	0.22	0.21	0.31

Notes:
Robust standard errors in parentheses ** significant at 10%; ** significant at 5%; *** significant at 1%*

In column 2, we directly test the effect of social security on public education. The results strongly confirm the predictions of our model: the effect of the size of the pension system on educational expenditure is positive and highly significant.

Although our previous results imply a weak effect of public education on social security expenditure, endogeneity concerns clearly persist. To take care of these concerns we perform instrumental variable estimates in column 3 and 4 of Table 3. The instruments we use for social security systems are current and past values of relative cohort size[22]. Slightly increasing in size, the coefficient remains positive and significant. In column 4 we also add regional controls - the main results change do not change.

Summing up, the key predictions of our model seem to be well supported in cross-sectional data. While the size of pension systems appear positively correlated with parental altruism and the size of the old aged population, the effect of pension systems on the size of public education seems to be positive and highly significant across countries.

4.5 Summary and Conclusions

This chapter has presented an economic and political theory on the emergence and development of Bismarckian Social Security systems. We have used an overlapping generations model with heterogeneous and altruistic agents to show that the increasing importance of monetary transfers between generations will gradually induce a sufficient number of young agents to support pension systems in a growing economy, so that, in the long run, pension systems will always emerge and persist. We have shown that public education generally increases the feasibility of PAYGO social security systems, and that the existence of social security raises the political support and level of public educational expenditure.

The theory presented offers a new perspective on the historical evolution of PAYGO pension systems, and can easily be combined with existing theories to

[22]We also run an additional set of regressions using altruism as instrument for the size of pension systems. The results are a bit weaker, which is likely due to the loss in sample size given that the altruism variable is only available for 60% of our full sample.

provide a more complete understanding of the political economy of PAYGO social security systems. The intergenerational dynamics outlined in this chapter are not only important for understanding the developments of pension systems the past, but also shed further light on the political economy of social security reform. In the light of the model presented in this chapter, the rather conservative approach towards cutting existing pensions seen in recent reforms across Europe does not come as a surprise, and may reflect far more than mere political power of the retired population.

4.6 Appendix

4.6.1 Data Summary

Variable	Obs	Mean	Std. Dev.	Min	Max
Altruism	51	74.5	11.6	44.2	93.7
Birth per Woman	77	2.6	1.3	1.2	6.3
Population under 15 (% of total)	87	28.0	9.6	14.5	46.5
Government Exp. excl. Soc. Sec. & Educ.	99	17.1	7.2	0.7	42.6
Government Exp. excl. Soc. Sec.	101	21.7	7.5	8.5	49.9
Social Security Expenditure	101	6.9	5.9	0.0	22.3
GDP per capita (95 US$, PPP)	102	9.3	8.1	0.6	34.5
Population older 65	103	8.0	4.8	1.4	17.5
Public Education Expenditure	104	4.7	1.7	0.7	8.3
Fertility Rate	105	2.7	1.3	1.2	6.5
Total Population (Millions)	106	38.7	128.2	0.1	1262.5
Africa	107	0.10	0.31	0	1
Far East	107	0.10	0.31	0	1
Former East Block	107	0.19	0.39	0	1
Near East	107	0.08	0.28	0	1
South America	107	0.09	0.29	0	1
Urbanization	107	61.78	21.81	9.0	100.0

4.6.2 Country List

Cross-Section Social Security

Argentina, Australia, Austria, Azerbaijan, Belarus, Belgium, Brazil, Bulgaria, Canada, Chile, China, Colombia, Croatia, Czech Republic, Denmark, Dominican Rep., Estonia, Finland, France, Germany, Hungary, Iceland, Ireland, Italy, Korea, Latvia, Lithuania, Mexico, Moldova, Netherlands, Norway, Pakistan, Peru, Philippines, Portugal, Romania, Russia, Slovak Republic, Slovenia, Spain, Sweden, Switzerland, Turkey, Ukraine, United Kingdom, United States, Uruguay, Venezuela.

Cross-Section Educational Expenditure

Argentina, Australia, Austria, Belarus, Belgium, Botswana, Bulgaria, Burundi, Cameroon, Canada, Chile, China, Colombia, Costa Rica, Cyprus, Czech Republic, Denmark, Dominican Rep., Egypt, El Salvador, Estonia, Ethiopia, Finland, France, Germany, Greece, Hungary, Iceland, Indonesia, Iran, Ireland, Israel, Italy, Jamaica, Jordan, Kenya, Korea, Kuwait, Kyrgyz Republic, Latvia, Lebanon, Lithuania, Luxembourg, Malaysia, Malta, Mauritius, Mexico, Moldova, Mongolia, Moroccco, Nepal, Netherlands, New Zealand, Norway, Oman, Pakistan, Panama, Peru, Philippines, Portugal, Romania, Russia, Singapore, Slovak Republic, Slovenia, Spain, Sri Lanka, Swaziland, Sweden, Switzerland, Syrian Arab Rep., Thailand, Trinidad Tobago, Tunisia, Turkey, Ukraine, United Kingdom, United States, Uruguay, Venezuela, Vietnam, Zimbabwe.

Chapter 5

An Empirical Analysis of Bequest Motives

(Joint with Laura Puzzello[1] and Silvia Redaelli[2])

5.1 Introduction

Surprisingly little consensus is found in the empirical literature on the microeconomic foundations of individual bequests. While a large part of the field continues to interpret any end of life transfer as evidence of excess savings in the tradition of Yaari (1965)[3], several alternative theories of bequest have emerged over the last decades. Most prominent among them are the *strategic bequest motive* (Bernheim et. al., 1985), where parents bequeath to get more attention from their children, and the family of *altruistic bequest motives* (Becker, 1981), where parents draw direct utility from leaving bequests to their descendants[4]. All of these later theories

[1]Purdue University, West Lafayette, USA.

[2]Università Bocconi, Milan, Italy.

[3]See, e.g., Hurd/Smith (1999, 2002).

[4]A slight variation of the altruistic motive is the *capitalistic motive* proposed by Masson and Pestieau (1997), where very rich parents prefer to share their wealth and prestige with their

imply that parents consciously and intentionally leave some share of their wealth to the posterity, an assumption which has become a major building block for a large group of micro-and macroeconomic models, and one we have largely built on in the preceding chapters.

In this chapter we use recent survey data to evaluate the empirical relevance of intentional bequest motives in general, and to test the validity of the three main theories of intentional bequest in particular. In the first part of the chapter, we summarize the most commonly used theories of intentional bequest in a common framework and discuss their empirical implications. In the second part, we empirically analyze individual bequest patterns within data from the Health and Retirement Study (HRS), and confront the empirical results obtained with the theoretical predictions of the three models.

The HRS data strongly underline the importance of intentional bequests. Close to 50% of the US population forty and older in the sample indicate to be certain to leave some inheritance; around 25% indicate to be certain to leave more than US$ 100,000 at the end of their life. Consistent with all theoretical models, we find highly significant wealth effects in the data. While the average likelihood to leave a bequest larger than US$ 100k is less than 10% in the lowest wealth decile, the corresponding likelihood exceeds 80% in the highest wealth decile of the sample population. We control for a large set of individual characteristics in our empirical specifications, and find gender, race, health and retirement status to have the most significant effects on private bequest decisions.

The main variables of interest in distinguishing between the three theoretical models presented are family structure and child welfare. While altruistic models imply a negative or no effect of family size and child wealth on the parental likelihood to bequeath, strategic models predict that parents will allocate more

descendants rather than consuming it completely.

resources to relatively well off descendants in order to attract their attention. We find no significant effects of family size, and a positive effect of child welfare on the parental bequest likelihood. Moreover, we find that it is not average child income, but the wealth of the poorest child that matters, and that parents are significantly more likely to leave an inheritance if at least one of their adult descendants lives close. All of these findings appear inconsistent with altruistic models of bequest, and strongly point towards parents strategically motivated in their bequest decision.

With respect to the empirical strategy applied, the analysis presented in this chapter follows previous studies by McGarry (1999) and Hurd and Smith (1999) in focusing on individual bequest intentions rather than on actual bequest flows. Relative to these previous studies, the analysis presented here is the first one to include a full set of child level variables in the bequest regressions. Combining data on child wealth and income with the core data on respondents allows to directly estimate the relation between the relative income and transfers across generations, and, more importantly, to clearly distinguish between the various motivations underlying respondents' bequest decisions.

The rest of this chapter is organized as follows: in section 2, we briefly summarize the three standard models of intentional bequest in a unified framework. In section 3, we discuss the data set used in this chapter and present the main empirical results. We conclude this chapter with a short discussion and a summary of our results in sections 4 and 5.

5.2 Three Models of Intentional Bequest

We consider a simple overlapping generation framework. In each period a generation t with an infinite number of agents i is born, and lives for two periods. In the first period, agents work and earn labor income, in the second period they retire. Agents differ with respect to their wealth, which consists of the bequest received and their own labor income, and allocate their resources between own consumption and transfers to their n descendants. Following Becker and Tomes (1986) we define educational investment and bequests as the two principal channels of intergenerational transfers, and abstract from other possible linkages between generations[5].

5.2.1 Paternalistic Altruism

The first and most standard way to model bequeathing behavior is to assume that agents directly care about their descendants' welfare. We denote this form of altruism as *paternalistic*, since parents do not enjoy the act of giving itself, but rather care about the utility of their n descendants in the manner of a social planner. A paternalistic agent i of generation t maximizes:

$$\max_{c_t^y, c_t^o, e_t, b_t} u_t^i = u(c_t^{iy}, c_t^{io}) + \rho \eta_t^i \sum_j u(c_{t+1}^{jy}, c_{t+1}^{jo})) \tag{5.1}$$

subject to

$$I_t^i = \theta_t^i h_t(e_t^i) w + \frac{b_{t-1}^i}{n} \geq c_t^{yi} + \sum_j e_{t+1}^j + s_t^i, \tag{5.2}$$

$$c_t^{oi} + b_t^i \leq s_t^i r, \tag{5.3}$$

$$b_t^i, e_t^i \geq 0. \tag{5.4}$$

c_t^i, e_t^i, b_t^i and s_t^i are the levels of consumption, educational investment, bequests and savings chosen by agent i of generation t. ρ is the private discount rate, and r is the market interest rate. c_{t+1}^{jy} and c_{t+1}^{jo} are the levels of consumptions of each

[5]A complete analysis of intergenerational transfers should include both the transmission of genetic capital and inter-vivos flows. We abstract from these two channels in our theoretical analysis to keep the models simple, and try to control for these aspects as much as possible in the empirical analysis presented.

of agent i's descendants within generation $t+1$. I_t^i is agent i's life time income or wealth. $u(.)$ is a concave and continuous function, and $\eta_t^i \in (0,1]$ measures the individual degree of paternalistic altruism. h_t^i denotes agent i's human capital, which is a function of her parents' investment into education e_{t-1}^i and the agent's talent θ^i. We assume that $h_t' > 0, h_t'' < 0, h_t'(0) = \infty$ and normalize wages w earned per efficiency unit of human capital h to one.

Paternalistic parents care only about the welfare of their children and are ex ante indifferent between educational investment and bequests. Since $h'(e) \rightarrow \infty$ as $e \rightarrow 0$, agents whose income falls below a certain threshold will always and exclusively use educational investment to transfer wealth to the next generation. Let us define $e^{\max}$ as the level of investment such that $\theta_{t+1}^j h_{t+1}'(e_t^{j\max}) = r$. Then, the bequest given by any agent i of generation t will be positive only if

$$h_{t+1}(e_t^{j\max}) < \rho \eta_t^i I_t^i. \tag{5.5}$$

That is, no agent will leave any bequest unless his income is higher than the discounted[6] value of the income his descendants will earn, once endowed with the efficient level of educational investment $e_{t+1}^{\max}$. Agents with income below this threshold invest only into their children's education and leave no financial bequests. Agents with income above this level will invest $e_{t+1}^{\max}$ into their children's education, and leave some positive fraction of their income to their descendants.

5.2.2 "Warm Glow" or Pure Altruism

Altruism in the original sense of the word[7] implies that agents do not necessarily try to smooth incomes across generations, but rather enjoy the act of helping and

[6]By assumption, parents discount children's consumption by the altruism factor η_t^i; since children's consumption takes place in periods $t+1$ and $t+2$, parents apply also the private discount rate ρ in their evaluation of children's income.

[7]Altruism is defined as "unselfish regard for or devotion to the welfare of others." Source: Merriam-Webster OnLine, http://www.m-w.com.

giving to others. Assuming that agents also "enjoy" investing into their children's education, we can state the utility maximization of a "purely altruistic" agent as

$$\max_{c_t^{yi}, c_t^{oi}, e_t^i, b_t^i} u_t^i = u(c_t^{yi}, c_t^{oi}) + \beta_t^i u(e_t^i) + \rho \delta_t^i u(\bar{\varepsilon} + b_t^i) \tag{5.6}$$

subject to constraints (5.2), (5.3) and (5.4). β_t^i and $\delta_t^i \in [0,1]$ measure the relative utility derived from education and bequest, respectively, and $\bar{\varepsilon}$ is a positive constant allowing low income parents to leave zero bequests.

Since agents do not take the welfare of the recipient into account, the literature sometimes refers to this kind of bequest motivation as egoistic. Alternatively, these models are also referred to as models of "warm glow"[8].

The solution to maximization problem (5.6) is straightforward. Up to some income threshold defined over the parameters δ_t^i and $\bar{\varepsilon}$ agents allocate fixed fractions of their income to consumption and education; any income in excess of this threshold is split between consumption, educational investment and financial bequests.

5.2.3 Strategic Bequest Motive

Models of strategic bequests take a very different stance towards intergenerational transfers. Rather than assuming strictly benevolent parents, strategic bequest models assume parents to leave bequests at the end of their life in order to generate care and attention from their children. Since parents "trade" bequests for attention, these models have also been labelled *exchange models of bequest* (Bernheim et. al., 1985). Denoting the amount of attention parents get from their

[8]The expression "warm glow" indicates the feeling of joy people perceive when doing something "good". The expression was made popular by James Andreoni in the context of the private provision of public goods (Andreoni, 1990).

children by a_t^i, strategically motivated parents maximize

$$\max_{c_t^{yi}, c_t^{oi}, b_t^i} u_t^i = u(c_t^{yi}, c_t^{oi}) + \beta_t^i u(e_t^i) + \gamma_t^i u(a_t^i) \tag{5.7}$$

subject to constraints (5.2), (5.3) and (5.4). As before, parents derive utility from their children's education[9], but now they derive utility from their children's attention a_t^i rather than from leaving bequests. γ_t^i measures the relative utility parents derive from their children's attention. For simplicity, we assume that $a_t^i \in \{0, \overline{a}\}$, so that children provide either zero or some positive amount of attention $\overline{a}$ to their parents. Providing attention to the parent is associated with a fixed effort cost ϕ for the descendant. If young agents provide effort, they will receive a bequest when their parents die[10]. Any young agent provides attention to her parent if and only if

$$v_{t+1}^i(\theta_{t+1}^i h_{t+1}^i + \frac{b_t^i}{n}) - \phi \geq v_{t+1}^i(\theta_{t+1}^i h_{t+1}^i) \tag{5.8}$$

where v_{t+1}^i is the indirect utility function of agent i of generation $t+1$ corresponding to (5.7). The maximum level of bequest that any agent i of generation t will leave to his descendants is the level that just satisfies inequality (5.8). Let us denote this maximum level by $b_t^{i\max}$. Since the utility function is concave and effort cost is fixed, it must always be satisfied that $\frac{\partial b_t^{i\max}}{\partial h_{t+1}^i}, \frac{\partial b_t^{i\max}}{\partial \theta_{t+1}^i} > 0$. That is, the richer and the more talented a child is, the higher the bequest a parent has to offer to get attention from the child. Given this cost of buying attention, any agent will leave an inheritance if and only if the utility from receiving attention $\gamma_t^i u(\overline{a})$ is larger then the marginal utility from spending the last $b_t^{i\max}$ units of income on education and own consumption.

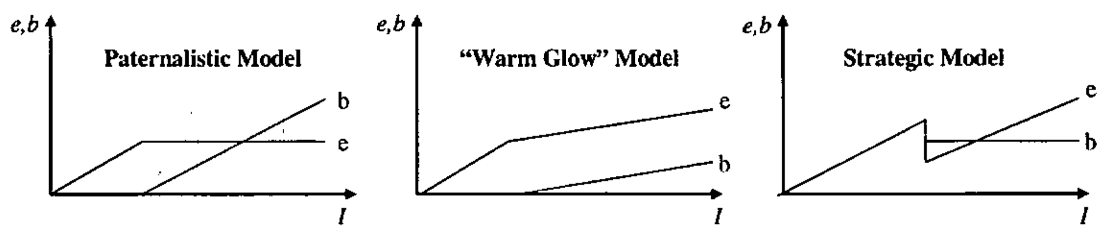
[9]The rationale for $\beta > 0$ can lie either in moral or legal obligations to support children's education, or simply be parental pride of having highly educated children. Clearly, assuming $\beta = 0$ does not change the main implications of the model.

[10]The more realistic assumption that caring for the parents increases the probability of receiving a bequest slightly complicates notation, but clearly leads to the same results.

5.2.4 Summary of Models and Empirical Implications

All three models presented share two common features by construction: educational investment increasing with parental wealth and altruism, and bequests becoming relevant only beyond a certain income threshold. Paternalistic models imply a direct substitution of bequests for education. A similar trade-off exists for strategic models and models of pure altruism, although this effect is significantly less pronounced for these two latter models as summarized in Graph 1 below.

Graph 1: Model Comparison Wealth Effects



Despite the theoretical divergence in the implicit income consumption paths an empirical distinction of the three models along the dimension of wealth is rather difficult. Fortunately, more obvious differences between the three models emerge when analyzing the effects of family structure. "Warm glow" models imply that family size does not matter for bequests[11], since donors enjoy the act of giving itself and do not take recipient characteristics into account. This is clearly not the case for the two other models. Paternalistic models imply that parents invest into their descendants' human capital before leaving financial bequests. A larger number of descendants requires more educational investment, and thus decreases the individual likelihood to leave bequests. The case is more ambiguous for strategic models. From the perspective of a strategic agent, a larger number of children increases the chance of having one child with a relatively low income and thus relatively cheap to buy. If parents could freely allocate bequests to their children,

[11] Family size clearly matters for the education of the children, who will have to divide the resources received from their parents.

larger families would thus increase the likelihood of strategic interaction between parent and child. However, in practice, uneven distributions of bequests may not be feasible[12]. Parents may feel obliged to split bequests in a roughly equal manner not only for reasons of fairness or equality, but also because of legal requirements[13]. With roughly equal splitting, a larger number of children clearly increases the price of buying attention for a strategic agent. Hence, the net effect of family size on a strategic agent's likelihood to leave a positive bequest remains uncertain[14].

The implications for child welfare are very similar to those of family structure. While purely altruistic agents theoretically do not take their children's wealth into account in their bequest decision, paternalistic agents try to smooth incomes across generations. Thus, paternalistic agents will leave more bequests to descendants with (relatively) lower incomes. The wealthier the children of a paternalistic agent, the more unlikely is the agent to leave bequests. Strategic agents, on the other hand, are only interested in the poorest individual among their descendants. The wealthier the poorest child, the higher the price to buy attention. Thus, higher levels of child wealth decrease the probability, but increase the quantity of bequest left by a strategically motivated agent. Table 1 below summarizes the main predictions of the three theories.

Table 2: Marginal Effects of Family Size and Child Welfare

	$\frac{\partial prob(bequest>0)}{\partial(Family\ Size)}$	$\frac{\partial prob(bequest>0)}{\partial(Child\ Wealth)}$	$\frac{\partial(bequest)}{\partial(Child\ Wealth)}$
Paternalistic Models	<0	<0	<0
"Warm Glow" Models	0	0	0
Strategic Models	$\gtrless 0$	<0	>0

[12] McGarry (1999) finds that over 80% of US wills divide the estate exactly equally.

[13] Equal splitting can also be considered the most efficient form of bequeathing if one assumes that parents are worried about distorting their children's labor market effort (Gatti, 1999).

[14] This is based on the assumption that parents want the attention of exactly one child. If parents want all their children to care, family size unambiguously raises the price of buying attention.

5.3 Empirical Estimation and Results

5.3.1 Data and Methodology

The data set used in this chapter builds on the Health and Retirement Study (HRS), a longitudinal survey conducted every two years since 1992 by the Institute for Social Research (ISR) at the University of Michigan. The survey is representative of the US population forty and older[15]. In this chapter, we only use the second wave of the survey, which contains the most detailed information about family structure, children's education and financial background. The main variables of interest within this second wave are summarized in Table 1 below. For a full description of all variables used in the regression analysis, please see Appendix A.1.

The full sample, summarized in the first two columns of Table 1, consists of 14,972 respondents, with an average respondent age of 64 years. The child level information is available for roughly 60% of this sample. The respondents in the sub sample with child information are on average slightly younger and richer than the respondents in the full sample. The average age in the child sample is 57. The average levels of income and wealth[16] exceed the corresponding values in the full sample by 20% and 10%, respectively, presumably reflecting the aggregate increase in private income and wealth over time.

[15]The original HRS sample cohort represents individuals born in 1931-41, aged 51-61 at the first interview in1992. In 1993 individuals born before 1924 have been included in the AHEAD cohort. The 1994 survey we use contains both of these cohorts.

[16]Note that all wealth and income data are on the household level.

Table 1: Summary Statistics

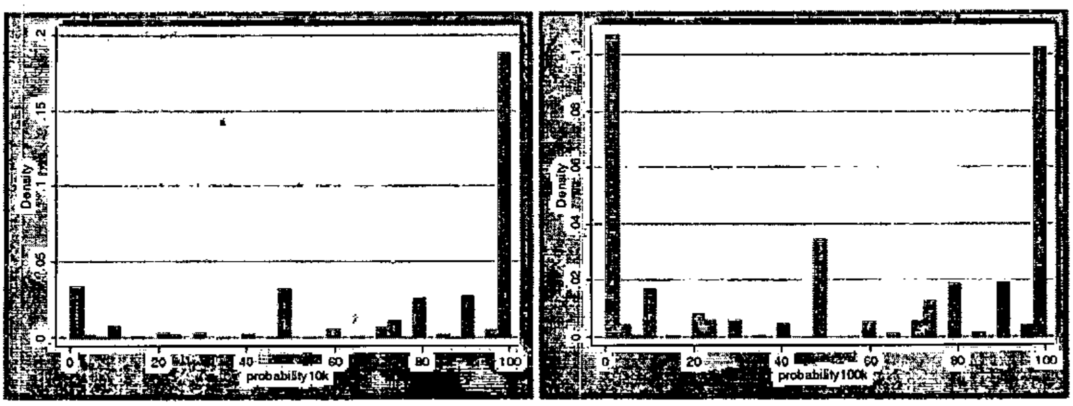
	Full Sample			Child Level Sample		
	Mean	*Std. Dev.*	*Obs*	*Mean*	*Std. Dev.*	*Obs*
Age	63.94	10.62	14972	57.02	5.29	9368
Education (years)	11.81	3.30	14968	12.15	3.10	9364
Gender	.59	.49	14972	.57	.49	9368
African American	.14	.34	14972	.15	.36	9368
Household Income (US$ 10k)	4.38	7.26	14972	5.24	7.45	9368
Household Wealth (US$ 100k)	2.21	4.45	14972	2.39	4.62	9368
Number of Children	3.44	2.05	14970	3.61	2.03	9368
Certain to leave bequest > 10k	.43	.49	14972	.45	.50	9368
Certainty to leave bequest >100k	.18	.39	14480	.18	.39	9306
Child Level Variables						
Grandchildren				4.07	4.27	9368
Child Education (avg., years)				12.50	3.05	9368
Child Income (avg., US$ 10k)				3.38	2.58	3794
Pct. of children owning home				.40	.35	9368

The main variable of interest in our empirical analysis are parental bequest intentions. This variable is derived from the following survey question:

"Including property and other valuables that you might own, what are the chances that you [and your (husband/wife/partner)] will leave an inheritance totaling $10,000 or more?"

Respondents are instructed to interpret 0 as "absolutely no chance" and 100 as "absolutely certain". If the respondent indicates a probability larger than 30, the question is repeated with a threshold level of US$ 100,000. The distribution of answers in the survey sample is summarized in Figure 1 below.

Figure 1: Subjective probability to leave a bequest



panel A: bequest $\geq 10k$ **panel B: bequest $\geq 100k$**

As shown in panel A, the fraction of agents indicating to be certain to leave a bequest of US$ 10,000 is surprisingly large, exceeding 43% in the full sample. The fraction indicating to be sure to leave a bequest larger or equal to 100k is significantly smaller: only 18% of respondents indicate to be certain to leave an inheritance of this size.

The major issue with subjective bequest probabilities is their empirical interpretation. A respondent indicating a probability of 90% to leave a bequest of US$ 10,000 may do so because she is not completely certain about her bequest intentions; alternatively, she may do so because she has no bequest intentions, but simply assesses the likelihood of dying with less than US$ 10,000 of financial reserves to be rather small.

To minimize the problem of distinguishing between bequest intentions and life time uncertainty, we restrict our analysis to agents who report subjective probabilities of 100%, implying a likelihood of zero to consume all their wealth before dying. If agents are certain to hold some positive wealth at the moment of their death, the actual bequests left can be considered to be mostly intentional.

Clearly, one may want to question the truthfulness of the answers given. While there might be an incentive for agents to over-indicate their propensity to bequeath in order to appear generous, there might also be incentives to underreport bequest for tax reasons, so that the direction of the bias is not clear. Hurd and Smith use exit interviews to compare actual with intended bequests in the HRS empirically, and come to the conclusion that "*...subjective bequest probabilities are valid predictors of actual bequest probabilities*" (Hurd/Smith, 1999, p. 16).

5.3.2 Empirical Specifications and Results

Our empirical analysis is organized in two parts. In the first part, we use our full sample to test our model predictions with respect to wealth and family structure. In the second part, we restrict our analysis to the subset of individuals where we dispose of a complete set of child level information in order to directly test the effect of child welfare on the parental likelihood to bequeath.

Part I: Household Level Analysis

The HRS's household level data are extremely rich, providing very detailed measures of wealth and income, together with individual characteristics such as age, race, religion and health. The main dependent variable we use in our analysis is a binary variable which equals one if individuals are certain to leave a bequest and zero otherwise. Table 2 summarizes the main results from the maximum likelihood Probit[17] analysis.

Column 1 of Table 2 shows our baseline specification. As expected, the probability to leave a bequest larger or equal to US$ 10k strongly increases with household income and wealth, and is positively related to self perceived health.

[17] We replicate all regressions with logit models and obtain highly similar results.

Table 2: Full Sample Analysis

Dependent Variable: Probability Respondents Leaves Bequest Larger 10k				
	(1)	(2)	(3)	(4)
Respondent Characteristics				
Age	-0.002***	-0.003***	-0.003***	-0.002***
	(5.21)	(7.14)	(6.07)	(2.60)
Education (years)	0.022***	0.015***	0.013***	0.016***
	(15.26)	(10.34)	(7.84)	(6.37)
Gender	-0.099***	-0.104***	-0.112***	-0.120***
	(9.20)	(9.53)	(8.88)	(7.12)
Married	0.028***	-0.042***	-0.037***	-0.051***
	(2.59)	(3.82)	(2.90)	(2.70)
Self-reported Health	-0.041***	-0.026***	-0.026***	-0.019***
	(11.47)	(7.41)	(6.22)	(2.93)
Retired	0.060***	0.044***	0.044***	
	(7.12)	(5.24)	(4.47)	
Catholic	0.017*	0.014	0.014	0.014
	(1.91)	(1.52)	(1.31)	(0.88)
African American	-0.097***	-0.050***	-0.052***	-0.082***
	(8.27)	(4.09)	(3.53)	(3.50)
Household Characteristics				
Number of Children	-0.009***	-0.005**	-0.017***	-0.018**
	(4.55)	(2.29)	(3.60)	(2.56)
Current Income (US$ 10k)	0.005***	0.003***	0.004***	0.006**
	(3.77)	(3.02)	(2.75)	(2.41)
Wealth (US$ 100k)	0.027***			
	(9.61)			
Squared Wealth	-0.000***			
	(6.75)			
Wealth Quintile I		-0.006	0.072	0.781**
		(0.81)	(0.86)	(2.46)
Wealth Quintile II		0.531***	0.535***	0.525***
		(17.40)	(12.42)	(5.82)
Wealth Quintile III		0.097***	0.100***	0.115***
		(4.19)	(3.67)	(2.74)
Wealth Quintile IV		0.071***	0.076***	0.077***
		(6.97)	(6.60)	(4.42)
Wealth Quintile V		0.005***	0.004**	0.007**
		(3.13)	(2.54)	(2.22)
Restrictions	none	none	age >60	Retired = 1
Regional Dummies	Yes	Yes	Yes	Yes
Pseudo R-Squared	0.12	0.15	0.15	0.17
Observations	17493	17493	13397	5920

Notes:
Coefficients reflect the change in the probability for an infinitesimal change in each independent, continuous variable and the discrete change in the probability for dummy variables. Robust z statistics in parentheses.
* significant at 10%; ** significant at 5%; *** significant at 1%

On average, agents who perceive their health to be excellent[18] appear 16% more likely to leave a bequest than agents with poor health. This sizeable effect likely reflects expected future medical cost, but may also pick up some general individual attitudes. The estimated coefficients on gender and education are somewhat surprising. On average, male respondents appear 10% more likely than female ones to leave a bequest, which may reflect either systematic differences in life expectancy, or, alternatively, general preferences towards leaving inheritances. Interesting are also racial differences in the likelihood to bequeath, with Afro-American respondents being significantly less likely to leave an inheritance relative to the average respondent. Similarly, Catholic respondents seem more bound to leave an inheritance than agents of other confessions. We also add a dummy for retired agents, and find a positive and significant effect.

Since we control for age and income, this finding may indicate that retired agents have stronger preferences towards bequests or, alternatively, are more certain about their life time income than agents still active in the labor market. The positive coefficient on education might be interpreted as more educated agents being on average more altruistic than less educated ones. The negative coefficient on the number of children is consistent with the findings of previous studies, and can be interpreted as evidence in support of paternalistic models. However, as we will show in the next section, this finding is not robust to the inclusion of other child level variables and shall be discussed in further detail below.

The major focus of the aggregate level analysis lies in the determination of income and wealth effects. In column 1, we control for current income, wealth and wealth squared[19] and find the expected effects: a positive coefficient on income, and a positive but decreasing effect of wealth on the likelihood to bequeath. Since all models imply that the income elasticity of wealth is highly non-linear we perform

[18] The health evaluation ranges from 1 "excellent" to 5 "poor".

[19] We also add income squared to our regressions, but never find significant effects.

spline regressions in columns 2 to 4 of Table 2. The results strongly confirm the threshold assumption implicit in all three models; while wealth effects are not significant in the lowest wealth quintile, the marginal wealth effect is largest in the second wealth quintile. Keeping all other variables at their mean, the critical income threshold implicit in all three models appears to be somewhere in the range of US$ 18,500 to $68,500. However, wealth effects remain significant in all upper quintiles, even though at a decreasing size. While a wealth increase of US$ 10,000 implies a 5% increase in the likelihood to bequeath in the second wealth quintile, the same increase shift the likelihood to bequeath only by .7% in the fourth wealth quintile, and by less than one tenth of a percentage point in the top twenty percent of the wealth distribution. In columns 3 and 4 we perform some robustness checks for this result. We focus on agents above age 60 in column 3, and on fully retired agents in column 4 to minimize lifetime income uncertainty. The only noteworthy change is slight shift in the distribution of wealth effects for the sub-sample of retired agents, where the critical threshold for positive bequest seems to be located slightly below the estimated value for the full sample.

Part II: Child Effects

Having confirmed the basic model specification with respect to wealth the main goal of the remaining section lies in a clear distinction of the three theoretical models presented. To do so, we restrict our sample to the subgroup of agents for whom we have more detailed child level information, and can thus directly measure the effects of child wealth and income on parental bequest intentions.

Using the same set of controls as in the full sample we start by testing the effect of child education on the parental likelihood to leave a bequest in Column 1 of Table 3. While child education appears to have a significant effect on the parental likelihood to bequeath, the number of children is no longer significant.

Table 3: Bequest and Education

	(1)	(2)	(3)	(4)
First Stage	**Dependent Variable: Child Education**			
Age Youngest Child			-.039***	-.029**
			(.013)	(.015)
Age Oldest Child			-.053***	-.059***
			(.013)	(.016)
Average Child Age			.0327	.029
			(.024)	(.028)
F-test of excluded Instruments			37.68	29.87
Partial R-Squared			0.054	0.050
Second Stage	**Dependent Variable: Probability to Leave a Bequest > 10k**			
Household Level Variables				
Age	-0.004**	-0.003**	-0.004**	-0.005*
	(2.48)	(2.38)	(2.19)	(1.95)
Education (years)	0.007***	0.007***	0.004	-0.001
	(2.69)	(2.69)	(0.54)	(0.12)
Gender (0 = M, 1 = F)	-0.094***	-0.101***	-0.098***	-0.145***
	(2.88)	(3.09)	(3.01)	(3.49)
Self-reported Health	-0.032***	-0.032***	-0.031***	-0.032***
	(5.38)	(5.48)	(4.78)	(3.74)
Retired	0.041***	0.042***	0.045***	0.063***
	(2.88)	(3.00)	(3.06)	(3.46)
African American	-0.042**	-0.046**	-0.052**	-0.051*
	(2.24)	(2.44)	(2.46)	(1.80)
Household Income	0.002*	0.002*	0.002	0.002
	(1.71)	(1.67)	(1.36)	(1.21)
Wealth Quintile I	-0.008	-0.008	-0.007	-0.008
	(1.03)	(1.07)	(1.00)	(1.08)
Wealth Quintile II	0.483***	0.481***	0.471***	0.544***
	(9.33)	(9.28)	(8.39)	(7.14)
Wealth Quintile III	0.112***	0.114***	0.107***	0.050
	(2.97)	(3.03)	(2.69)	(0.96)
Wealth Quintile IV	0.073***	0.073***	0.069***	0.078***
	(4.75)	(4.72)	(4.19)	(3.70)
Wealth Quintile V	0.005***	0.005***	0.005**	0.005*
	(2.65)	(2.60)	(2.46)	(1.78)
Child Level Variables				
Number of children	-0.005	-0.006	-0.003	-0.002
	(1.48)	(1.54)	(0.54)	(0.28)
Child Education	0.007*	0.006	0.021	0.040
	(1.74)	(1.60)	(0.72)	(1.01)
Inter Vivos Transfers		0.000**	0.000**	0.000
		(2.25)	(1.98)	(0.66)
Child Living Home		0.049***	0.050***	
		(3.36)	(3.44)	
Pseudo R-Squared	0.12	0.12	0.12	0.12
Observations	7350	7350	7378	4554

Notes:
Robust z statistics in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%

Given that the correlation between child education and the number of children is relatively large (-.27), the estimated family size effects from the full sample are likely spurious, reflecting average child characteristics rather than the effect of absolute family size itself. Nevertheless, the positive coefficient on education is somewhat surprising. Since education can generally be considered a good proxy for children's life time income, this finding implies positive child wealth effects in the parental bequest decision, highly inconsistent with altruistic models of bequests. However, this conclusion is not valid in the context of our estimates, which do not allow to directly control for the parental degree of altruism or interest in their children. Parental interest in their children is not only the principal driver of bequest in all models; all models imply that this variable critically affects the parental investment into education. Empirically, this implies that child education is likely to not only pick up descendant's life time income or income potential, but also the degree of altruism. We choose two strategies to distinguish these two effects. In column 2 of Table 3, we add the total of inter-vivos transfers made by parents as a proxy for their respective degree of altruism. In columns 3 and 4, we instrument for child education. The instruments we use are the age of the youngest and the oldest children, as well as the average age of all children. Child age works surprisingly well in predicting average years of children's education, reflecting the overall evolution in educational attainment over time. Since child age can generally be assumed to have no direct effect on the parental likelihood to bequeath, and to be independent of parental altruism, measures of child age should be valid instruments in our setup.

The results displayed in Columns 2 to 4 of Table 3 confirm our prior with respect to the education coefficient estimated in the previous regression. When adding inter-vivos transfers and instrumenting for education, education does no longer appear to have a significant impact on the parental likelihood to bequeath.

In columns 2 and 3 of Table 3 we also add a control for an adult child living with the parents, and find it highly significant. Agents with at least one adult child living at their home appear about 5% more likely to leave a bequest than parents where all children have left parents' home. Adult children still living with their parents may either imply particularly poor children from a paternalistic perspective, or children already taking care of their parents from a strategic perspective. In column 4 we test child education for the sub-sample of households with no child sharing the parents' home; the results do not change - the average level of child education does not appear to have any significant effect on the parental likelihood to bequeath.

The insignificant effect of (instrumented) education raises the question whether child income matters at all. In Table 4, we try to find a direct answer for this question by using data on current child income. Data on child income are associated with significant measurement error since respondents often do not know the exact income of one or all of their children, and, might, even if they do know, not reply to the question. Despite these drawbacks, current income is likely the best proxy for life time income, and should allow us to perform a final test on the relation between children's wealth and parental intentions to leave bequests. In column 1 of Table 4 we jointly test the effect of child education and average child income together with our other family structure controls. While inter-vivos transfers as our proxy for parental altruism remain significant, neither the average levels of education, nor the average income of children seem to matter. While this is clearly not consistent with a paternalistic model of bequest, it fits both with purely altruistic and strategically motivated agents. As we have highlighted in the previous sections, strategic agents will always target the poorest of their children; the poorer the child, the larger a bequest the respondent needs to offer in order to attract attention. However, the richer the poorest child, the less likely parents are also to offer bequest in exchange for care. Since our dependent variable measure the probability of leaving a bequest of a certain size, the prediction of the strategic model are ambiguous in our setup.

Table 4 - Bequest, Education and Income

	Dependent Variable: Probability to Leave a Bequest > 10k			
	(1)	(2)	(3)	(4)
Household Level Variables				
Age	-0.004*	-0.004*	-0.004**	-0.006**
	(1.87)	(1.94)	(1.97)	(2.08)
Education (years)	0.003	0.004	0.004	0.000
	(0.80)	(0.98)	(0.98)	(0.08)
Gender (0 = M, 1 = F)	-0.067	-0.068	-0.076	-0.063
	(1.40)	(1.42)	(1.56)	(0.94)
Self-reported Health[a]	-0.025***	-0.025***	-0.024***	-0.026**
	(2.85)	(2.82)	(2.77)	(2.16)
Retired	0.066***	0.066***	0.065***	0.075***
	(3.10)	(3.10)	(3.06)	(2.67)
African American	-0.037	-0.039	-0.039	-0.068
	(1.20)	(1.26)	(1.27)	(1.49)
Household Income	0.002	0.002	0.002	0.003
	(1.35)	(1.33)	(1.25)	(1.05)
Wealth Quintile I	-0.007	-0.007	-0.007	-0.008
	(0.96)	(0.96)	(0.95)	(1.09)
Wealth Quintile II	0.457***	0.456***	0.451***	0.448***
	(5.68)	(5.66)	(5.56)	(3.69)
Wealth Quintile III	0.111**	0.109**	0.112**	0.114
	(2.10)	(2.05)	(2.11)	(1.51)
Wealth Quintile IV	0.087***	0.088***	0.087***	0.082***
	(4.10)	(4.16)	(4.12)	(2.81)
Wealth Quintile V	0.003	0.003	0.003	0.004
Child Level Variables				
Number of Living Children	-0.001	0.001	0.001	-0.003
	(0.25)	(0.25)	(0.17)	(0.36)
Child Education (avg., years)	0.001	0.001	0.001	0.006
	(0.25)	(0.28)	(0.13)	(0.88)
Inter Vivos Transfers (US$ 10k)	0.093***	0.095***	0.090**	0.081
	(2.61)	(2.61)	(2.43)	(1.34)
Child Living Home	0.025	0.023	0.022	
	(1.24)	(1.16)	(1.07)	
Child Income (US$ 10k, avg.)	0.008			
	(1.58)			
Child Income (US$ 10k, min)		0.013***	0.014***	0.011*
		(2.75)	(2.94)	(1.77)
Child Income (relative to respondent)			-0.000	
			(0.84)	
Child Sample Restrictions:				
Age	> 18	>18	>18	>25
Living with Parents	YES	YES	YES	NO
Pseudo R-Squared	0.10	0.10	0.09	0.09
Observations	3593	3593	3563	1876

Notes:
a Self reported health ranges from 1 "excellent" to 5 "poor".
Robust z statistics in parentheses. Coefficients reflect marginal effects.
* significant at 10%; ** significant at 5%; *** significant at 1%

In column 2 of Table 4 we directly test the effect of the income of the poorest child of the household. The estimated coefficient is positive and remarkably significant. In columns 3 and 4 we perform further robustness checks. In column 3, we control for the average child income relative to her parents, and in column 4 we focus on children older than 25 only. The results change little - the wealthier the poorest child, the more likely parents are to leave a bequest beyond a certain threshold. Similar results emerge from the regressions for the US$ 100k bequest threshold as shown in Table A2 in the appendix.

5.4 Discussion

The empirical analysis presented in the previous sections has brought forth two main results: first, intentional bequests matter for a significant share of the elderly US population, being particularly relevant for the upper tail of the wealth distribution. Second, family size and child welfare, as measured by child wealth proxies and education, seem to have no, or a partially positive effect on parental likelihood to leave bequests. These findings, which contrast the implications of the standard paternalistic model of altruistic bequests, fit well with partial results from previous studies. Among others, McGarry (1999) and Laitner/Ohlsson (2001) note that children's education has a positive effect on the likelihood to receive bequests. While McGarry argues that education can be considered as a proxy for parental altruism, Laitner and Ohlsson interpret the positive sign as evidence for unobservable intergenerational correlation of incomes.

While we can mostly exclude Laitner and Ohlsson's argumentation in our setup, McGarry's argument clearly applies as we have shown in the previous section. When controlling for the positive correlation between children's' education and parental altruism, the positive coefficient on child education indeed does disappear.

Yet, there is no evidence at all for the negative child wealth effects implied by paternalistic models of bequest. Rather, the income of the worst-off-child appears to have a positive effect on the parental likelihood to bequeath even when controlling for education and family structure. One may want to argue that this variable could be correlated with some unobservable parental variables such as real wealth or altruism. If wealthy agents were systematically under-reporting their private possessions, the positive coefficient on child wealth might simply reflect true family wealth. The same results would emerge if more altruistic parents were to provide their kids with higher jobs or higher incomes. Given the overall quality of the HRS survey and the extremely high detail of the financial information section, we judge the measurement error in the private wealth variable to be rather low. The second issue is more tricky; we control for total size of inter-vivos transfers and educational investment as proxy of parental altruism in our final specifications, which should reduce, but of course cannot fully eliminate potential biases.

Despite some remaining empirical concerns, we find the evidence against paternalistic bequest motives overwhelming. It is not only the positive coefficient on child wealth, but also the zero effect of education, and, most importantly, the insignificance of family size that are highly inconsistent with agents using bequests to smooth incomes across generations.

Out of the three models presented in this chapter the only one fully compatible with the empirical evidence presented is the strategic one. While the insignificance of child education and family structure are well consistent with models of pure altruism, the positive coefficient on children living at home as well as the positive coefficient on the wealth of the poorest child go against the logic of such models. The results presented are probably not strong enough to completely rule out purely altruistic models of bequests; nevertheless, all results presented strongly point towards strategically motivated bequest decisions. It is by no means the conclusion of this study that parents are not altruistic; without any doubt parents spend significant shares of their resources on their children's education and also on inter-vivos transfers. If parents are truly altruistic, there are several other, and probably more efficient ways to transfer wealth to their descendants than bequests. If parents hold back wealth until the end of their life, strategic motivations are likely to dominate altruistic ones in the underlying rationale.

5.5 Summary and Conclusions

In this chapter we confront the three standard models of intentional bequest with data from the Health and Retirement Study. We show that intentional bequests are important for a sizeable share of the senior population, and that the likelihood to leave bequests is not only determined by measures of income and wealth, but also by several other individual characteristics, most prominently health, education, religion and race.

Carefully analyzing child level characteristics, we find strong evidence against paternalistic models of altruistic bequests and reject this model in favor of models of strategic exchange between parents and their children.

5.6 Appendix

5.6.1 Summary Statistics

	Full Sample		Child Level Sample	
	Mean	Standard error	Mean	Standard error
Respondent level information:				
Female	0.5797	0.4936	0.5439	0.4981
Age (years)	64.9364	11.1062	58.0345	5.0421
Married/Partenered	0.7259	0.44613	0.8282	0.3772
Education Years	11.5305	3.4742	12.2728	2.8888
Self Health Assessment	2.8200	1.1942	2.6121	1.1665
Non White	0.1444	0.3515	0.1286	0.3348
Catholic	0.2666	0.4422	0.2423	0.4285
Retired	0.4344	0.4957	0.3429	0.4747
Regions:				
North-East	0.1778	0.3823	0.1561	0.3630
West	0.1607	0.3673	0.1620	0.3685
Mid-West	0.2448	0.4300	0.2595	0.4384
South (base)	0.4166	0.4930	0.4224	0.4940
Respondent Type:				
Financial Respondent (base)	0.2061	0.4045	0.2511	0.4337
Family Respondent	0.2096	0.4070	0.2581	0.4376
Financial and Family Respondent	0.4339	0.4956	0.3323	0.4711
Neither Family Nor Financial Respondent	0.1504	0.3575	0.1585	0.3652
Number of Living Children	3.4457	2.0769	3.3196	1.8059
Total Household Wealth (100000)	2.1119	4.2819	2.7189	4.8772
Total Household Wealth (100000) Squared	22.7943	277.6584	31.1758	206.9935
Total Household Income (10000)	4.1734	7.0044	5.3836	8.2221
Total Household Wealth Splines:				
First Quintile	0.1466	0.5176	0.1599	0.0817
Second Quintile	0.4965	0.2105	0.5434	0.1935
Third Quintile	0.8414	0.3256	0.9509	0.3221
Fourth Quintile	1.2525	0.5957	1.4783	0.6372
Fifth Quintile	2.5230	3.7753	2.7023	4.3926
Total Household Income Splines:				
First Quintile	1.0080	0.2143	1.0301	0.2057
Second Quintile	1.6836	0.4123	1.8786	0.3536
Third Quintile	2.3560	0.6389	2.6991	0.6097
Fourth Quintile	3.0367	0.9832	3.6719	1.0575
Fifth Quintile	4.1734	6.2491	5.3835	7.5258
Child level information:				
Age (average)			32.4923	4.6670
Education Years (average)			13.5278	1.8365
Education years (min)			12.5274	2.1107
Education Difference			2.0930	1.9370
Average Children's Income [a)]			3.7920	2.7335
Total transfer given (parents vs children)			0.0630	0.2818
Percentage Children Owning Home			0.5155	0.3633
Percentage Children living Close			0.3707	0.3560
Number of Observations	*17,611*		*6,001*	

a) Observations on Average Children's' Incomeamount to 2584

5.6.2 Child Wealth Effects: Threshold 100k

	Dependent Variable: Probability to Leave a Bequest > 100k			
	(1)	(2)	(3)	(4)
Household Level Variables				
Age	-0.003*	-0.003*	-0.003*	-.007***
	(1.71)	(1.77)	(1.76)	(2.73)
Education (years)	0.000	0.001	0.001	-0.004
	(0.12)	(0.31)	(0.29)	(0.74)
Gender (0 = M, 1 = F)	-0.081**	-0.083**	-0.080**	-0.118**
	(2.07)	(2.11)	(2.02)	(2.14)
Self-reported Health[a]	-0.024***	-0.024***	-0.024***	-0.019*
	(3.25)	(3.22)	(3.22)	(1.73)
Retired	0.005	0.004	0.004	0.033
	(0.27)	(0.24)	(0.26)	(1.43)
African American	-0.039	-0.040	-0.041	-0.057
	(1.45)	(1.50)	(1.53)	(1.48)
Household Income	0.003**	0.003**	0.003**	0.005**
	(2.06)	(2.02)	(2.01)	(2.52)
Wealth Quintile I	-0.000	-0.000	-0.000	0.013
	(0.07)	(0.04)	(0.02)	(0.11)
Wealth Quintile II	0.192**	0.190**	0.186**	0.253*
	(2.25)	(2.24)	(2.17)	(1.81)
Wealth Quintile III	0.154***	0.151***	0.153***	0.117*
	(3.24)	(3.18)	(3.20)	(1.70)
Wealth Quintile IV	0.115***	0.116***	0.116***	0.124***
	(7.09)	(7.14)	(7.08)	(5.24)
Wealth Quintile V	0.006***	0.006***	0.006***	0.006*
	(2.76)	(2.73)	(2.73)	(1.91)
Child Level Variables				
Number of Living Children	0.004	0.006	0.006	0.005
	(0.83)	(1.30)	(1.31)	(0.67)
Child Education (avg., years)	0.037**	0.036**	0.034**	
	(2.16)	(2.10)	(2.00)	
Inter Vivos Transfers (US$ 10k)	0.076***	0.077***	0.072***	0.107**
	(3.30)	(3.33)	(2.98)	(2.37)
Child Living Home	0.007*	0.008*	0.007*	0.014**
	(1.68)	(1.73)	(1.67)	(2.28)
Child Income (US$ 10k, avg.)	0.005			
	(1.53)			
Child Income (US$ 10k, min)		0.009**	0.009**	0.005
		(2.43)	(2.47)	(0.89)
Child Income (relative to respondent)			-0.000	
			(1.23)	
Child Sample Restrictions:				
Age	> 18	>18	>18	>25
Living with Parents	YES	YES	YES	NO
Pseudo R-Squared	0.18	0.18	0.18	0.18
Observations	3291	3291	3265	1731

Notes:
a Self reported health ranges from 1 "excellent" to 5 "poor".
Robust z statistics in parentheses. Coefficients reflect marginal effects.
* significant at 10%; ** significant at 5%; *** significant at 1%

Chapter 6

Summary and Concluding Remarks

In this work we have highlighted some important aspects of the political economics of social security and education. We have shown that the policies chosen in the political equilibrium do not only shape the distribution and level of wealth, but are themselves determined by a set of more structural factors underlying a given economy. In the preceding chapter, we have demonstrated the importance of intentional bequests, and highlighted the strong link between private wealth and such end of life transfers. As we have shown in Chapter 4, the existence of private wealth spillovers itself critically affects agents' preferences with respect to PAYGO pension systems, and always guarantees majority support for such systems in the long run. The emergence of PAYGO pension systems, on the other hand, provides agents with additional incentives to support public education, and increases the extent of government intervention in the educational sector.

The positive externality of PAYGO pension systems on public education is only one example out of the large set of interactions across policy domains. In Chapter 2, we have elaborated on the interdependence of educational and general redistributive policies. As we have demonstrated, wider access to higher education does not only reduce pre-tax income inequality, but also directly lowers the aggregate demand for redistributive taxation; by the same means, wider access to higher educational also increases the profitability of private higher education, and thus significantly shapes the structure of the higher education sector in the long run as shown in Chapter 3.

This thesis has focused on education and social security as two policies where linkages across policies and generations are particular relevant and maybe most obvious. However, it should have become clear that similar arguments apply to a much wider class of political issues. A full understanding of political choices requires a careful analysis of the multiple interactions across agents and policies - we view this work as a small step into this direction.

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