The Political Economy of Tertiary Education

- Work in Progress -

Günther Fink*
Bocconi University, I - 20136 Milan, Italy
guenther.fink@uni-bocconi.it

September 16, 2005

Abstract

This paper develops a positive theory of policies towards higher education. Access to higher education is contingent upon agents' talent and an initial capital investment, and rewarded with a skill premium endogenously determined in the labor market. The policy space comprises loans and subsidies for higher education as well as general redistributive policies. We demonstrate that the policy outcome shaped in a process of legislative bargaining displays a strong bias against loans and in favor of subsidies to education, and is generally associated with low degrees of redistribution. The more binding credit constraints in an economy, the higher the subsidy to education emerging in the political equilibrium. We use data from the OECD and the World Bank to empirically support the theoretical model presented.

Keywords: Higher education, political economics, redistribution, legislative bargaining.

JEL Classification: P16, O10.

*I am very grateful to Jim Alt, Alessandra Casarico, Giuseppe Cappelletti, Silvia Console Battilana, Eliana La Ferrara, Lucas Ferrero, Matthias Messner, Roberto Perotti, and, most of all, Guido Tabellini for the many useful comments and discussions. All remaining errors are mine.

"[Higher education is] perverse: in the name of equality, all taxpayers [are] forced to subsidise the privileged".

The Economist, September 10, 2005

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. More surprisingly, relative subsidies to higher education appear even larger in the developing world, where annual government expenditure per student in higher education on average significantly exceeded 100% of national per capita income over the last decade[1].

Table 1: GDP, Enrollment and Subsidies to Higher Education

	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.

From a political perspective, the wide diffusion and dimension of higher education subsidies are quite surprising. As shown in Table 1 above, access to tertiary education is reserved to a minor fraction of the population in most countries. 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. Although partial motivations for these subsidies have been developed over the last years[2], the puzzle regarding the close to uniform existence of publicly financed higher education and the dominance of public subsidies

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

[2] See below for a brief review of the related literature.

relative to loan programs[3] across countries has remained largely unresolved.

In this paper, we develop a formal model with heterogeneous agents and a multi-dimensional policy space to provide a complete analysis of the political dynamics underlying 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 the skill premium endogenously determined in the labor market.

In the political domain, agents determine higher education policies 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. Any transfer and subsidy to higher education has 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.

Over time, private wealth accumulates in the economy, so that the dependency on higher education subsidies, and therefore also the degree of subsidization emerging from the political equilibrium decreases. The same is not necessarily true for redistributive transfers. Although a larger share of relatively rich agents implies lower tax rates, the total effect on the size of the redistributive transfer remains uncertain since the decrease in the tax rate may be more than compensated by the simultaneous increase in the taxable wealth stock.

[3] Loan programs play a mostly inferior roles in most countries. Data on relative budget allocation between loans and subsidies are summarized in Graph 2 in the appendix.

In the second part of the paper, 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 with relatively low incomes (the more equal wealth distribution), the smaller government expenditure per student in higher education. Similarly, the more developed capital markets, and the smaller the average family size in a given country, the smaller the subsidies to higher education empirically observed. Redistributive transfers increase with national income levels and decrease with the share of high income individuals among the adult population.

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 regressive, if rich and middle income agents opt for lower degrees of subsidization in order to bar access to the poor.

Easterly and Rebelo (1993) and James (1993) provide two empirical studies which indicate a strong and positive effect of income inequality on public educational expenditure. Similarly, Sylwester (2000) finds that higher levels of initial income inequality are associated with higher public expenditure on education. 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 is in line with 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 work closest to the model presented here is Levy (2004), who demonstrates that in a static framework the trade-off between redistribution and a targeted public good like higher education leads to lower rates of redistribution and the provision of the public good as long as those who profit are a minority. As opposed to Levy's work, incomes and preferences are endogenously determined in our model, so that higher education subsidies always affect all agents, and emerge in the political equilibrium independent of the group size of the recipients.

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

2 The Model

2.1 General Setup

We consider a non overlapping generation model, where in each period a generation t consisting of a continuum of heterogeneous agents of size 1 is born. Agents are mildly altruistic, and derive utility from their own consumption and from leaving bequests to their single descendant. The utility function of an agent i in period t is given by

$$u_t^i = u(c_t^i, b_{t+1}^i) \tag{1}$$

where c_t^i is the consumption of agent i in period t, b_{t+1}^i is the bequest left to the descendant who will live in period $t+1$, and $u(.)$ is a concave function strictly increasing in both arguments. At the beginning of their lives, agents receive a bequest b_t^i from their parents and are endowed with some talent θ_t^i. For simplicity, we assume that agents have either high (θ^h) or low (θ^l) talent, and assume the probability p of any agent being of the high talent type to be independent of wealth and across generations[4].

Before entering the labor market, agents decide whether or not to en-

[4]Despite this assumption, the model generates a strong and positive correlation of incomes across generation. A positive correlation of talent slightly complicates the analysis, but does not change the main results of this paper.

roll into higher education. Higher education is associated with a pecuniary cost C_t, a talent dependent effort cost $\phi(\theta_t^i)$, and a premium π_t earned by providing high skilled labor to the production sector. Access to the credit market is restricted, so that agents cannot borrow from the private sector to finance higher education. Any agent i decides to enroll into higher education in period t if and only if the following two conditions are satisfied:

$$\begin{aligned} C_t - S_t \leq b_t^i. & \qquad \text{(credit constraint)} \\ \pi_t(1-\tau_t^I) \geq C_t - S_t + \phi(\theta^i), & \qquad \text{(incentive compatibility constraint)} \end{aligned} \tag{2}$$

where C_t is the cost of higher education, S_t is the public subsidy provided to each student enrolling into higher education, and τ_t^I is the tax rate levied on labor income. 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 agent never enrolls into higher education[5].

Private wealth is uniformly distributed in the interval $[b_t^{\min}, b_t^{\max}]$. We assume that $0 < b_t^{\min} < C_t < b_t^{\max}$, so that some, but not all agents can afford to enroll into higher education without public subsidization. We refer to agents with private wealth $b_t^i \geq C_t$ as rich, and, correspondingly, to agents with wealth below this level as poor.

Abstracting from physical capital[6], we assume that high and low skilled labor are the only inputs for production, so that total output Y_t is given by:

$$Y_t = H_t^{\alpha} L_t^{1-\alpha}. \tag{3}$$

H_t and L_t 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_t^s and unskilled w_t^u in period t are given by

$$w_t^s = \alpha(\frac{L_t}{H_t})^{1-\alpha} \tag{4}$$

[5] Another way to interpret this assumption is that agents marked with θ^h have a positive return to higher education, while all other agents face negative returns on human capital investment.

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

$$w_t^u = (1-\alpha)(\frac{H_t}{L_t})^{\alpha}, \tag{5}$$

so that the wage premium π_t equals

$$\pi_t = w_t^s - w_t^u. \tag{6}$$

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

$$\pi_t = \alpha(\frac{1-H_t}{H_t})^{1-\alpha} + (\alpha - 1)(\frac{H_t}{1-H_t})^{\alpha}, \tag{7}$$

which simplifies to

$$\pi_t = \frac{\alpha - H_t}{H_t^{1-\alpha}(1-H_t)^{\alpha}}. \tag{8}$$

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_t is strictly positive.

2.2 Policy Space and Timing

In each period, agents decide on[7] 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_t 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[8].

In addition to higher education policies, agents can use a generic per capita transfer R_t to redistribute incomes. Redistributive transfers, as well as any subsidy for higher education S_t have to be financed by taxes on wealth (τ_t^b) or income (τ_t^I). Dropping time subscripts for notational convenience,

[7] The political process will be discussed in further detail in the following section.

[8] 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 setting.

the government's budget constraint in each period is given by

$$R + HS = \tau^b \overline{b} + \tau^I \overline{w}, \tag{9}$$

where $\overline{b}$ and $\overline{w} = w^u + H\pi$ are the mean levels of bequest 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. The wealth tax τ^b is raised and agents take their enrollment decision.

3. Wages are determined in the labor market and workers get paid. Agents pay income taxes and receive the redistributive transfer R.

4. Agents consume and leave bequests to their descendants.

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. Since output is a function of human capital investment the social planner maximizes

$$Max_H \; H^\alpha (1-H)^{1-\alpha} - HC. \tag{10}$$

The first order condition implies

$$\alpha \left(\frac{1-H}{H}\right)^{1-\alpha} - (1-\alpha)\left(\frac{H}{1-H}\right)^\alpha - C = 0, \tag{11}$$

which, by (7), equals

$$\pi(H^*) = C, \tag{12}$$

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[9], 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 achieved by a combination of subsidies and income taxes. As long as $\pi \geq C - S$, any agent with high talent will enroll into higher education if she has sufficient wealth to do so. 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

$$p \int_{b^{i*}}^{\infty} f(b^i) di = H^*. \tag{13}$$

where $f(b^i) = \frac{1}{b^{\max} - b^{\min}}$ is the density function of individual bequests, and p is the fraction of highly talented agents as defined before. Given that net returns to education are strictly positive at H^*, it is easy to see that the socially optimal enrollment rate H^* can be reached by setting the subsidy S to

$$S^* = C - b^{i*}. \tag{14}$$

The maximum feasible income tax rate at the socially optimal level of human capital follows directly from the previous exhibition. Plugging (12) into the incentive constraint (2) at $\pi(H^*) = C$, we get $C(1 - \tau^I) = C - S^*$, which implies a maximum feasible income tax of

$$\tau^I_{\max} = \frac{S^*}{C}. \tag{15}$$

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 (15) is exactly identical to the subsidy received S^*, and

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

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 (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. ■

2.4 Policy Preferences I: The Rich and Talented

We classify agents as rich and talented if they have both the wealth and talent to enroll into higher education without public subsidization. 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. Given our setup, the rich and talented can generally be assumed to prefer income to wealth taxation[10]. Under this assumption, the life time income maximization with respect to subsides for the rich and talented can be expressed as

$$\max_S w^s(S)(1 - \tau^I(S)) + S. \tag{16}$$

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 (16) as

$$\max w^s(S) + S(1 - \alpha). \tag{17}$$

The first order condition implies

$$-\frac{\partial w^s}{\partial H}\frac{\partial H}{\partial S} = 1 - \alpha. \tag{18}$$

[10] This requires $\frac{b^{\max}+C}{2\bar{b}} > \frac{w^s}{w^u}$ 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

$$\alpha(\frac{1-\gamma^{RT}}{\gamma^{RT}})^{1-\alpha} > \alpha(\frac{1-p}{p})^{1-\alpha} + C(1-\alpha), \tag{19}$$

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

$$\gamma^{RT} < \frac{1}{\chi+1}, \tag{20}$$

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. 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 rich and talented always strictly prefer zero to full subsidization, and therefore oppose any government policy.

2.5 Policy Preferences II: The Poor and Talented

The group of the poor and talented 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

$$\alpha(\frac{1-H^i}{H^i})^{1-\alpha} - \alpha(\frac{1-p}{p})^{1-\alpha} < (C - S^i_{\text{min}})(1-\alpha) = b^i(1-\alpha), \qquad (21)$$

and by S^i_{min} otherwise[11]. Since the left hand side of inequality (21) goes to zero and $b^{\min} > 0$, there are at least some agents that strictly prefer full subsidization. We assume that (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 poor and talented generally strongly prefer 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[12]. 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 hold by assumption wealth below the mean, they demand the maximum feasible degree of wealth taxation. The optimal policies for the median of the poor and talented is 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 (9) given full subsidization of higher education and the maximum feasible rate of wealth taxation.

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

[11] $1-\alpha$ 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 $1 - H\frac{b^i}{\bar{b}}$.

[12] 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.

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 this group follow directly from the life time income maximization, which is given by:

$$Max_{\tau^b,\tau^I,S}\ b^i(1-\tau^b) + w^u(1-\tau^I) + R \tag{22}$$

subject to constraints (2) and (9).

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

Proof. Optimizing (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 (4) and (5), is nothing else but $Y - HC$. The maximization of this term[13] yields $\pi_t = C_t$ as solution, which directly implies a tax rate of zero. ■

The intuition of Lemma 2 is straightforward: since the loan program eliminates the credit constraint, the incentive compatibility constraint (2) is always exactly satisfied, so that all agents have the same labor income net of taxes and tuition payments[14]. 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

$$Max_{\tau^b,\tau^I,S}\ b^i(1-\tau^b) + \tau^b\overline{b} + w^u(S) + H(S)(\tau^I\pi(S) - S). \tag{23}$$

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.*

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

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

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 (4) and (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 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.

The income maximization for unskilled agents with respect to the wealth tax τ^b has no effect on enrollment[15] 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 wealth taxation. Given that the distributions of talent and wealth are independent, the average[16] unskilled agent has a private wealth of $\overline{b}$, and is indifferent with respect to redistribution based on wealth taxation.

[15] 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.

[16] Due to our distributional assumptions, median and mean always coincide in our analysis.

3 The Political Process - A Model of Legislative Bargaining

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 different interest groups in our model, we assume that there are three types of legislators: 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[17].

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 will be 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 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 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 the majority core is always empty.

Given this, we follow Austen-Smith and Wallerstein (2003) and previous work by Baron/Ferejohn (1989) and Banks/Duggan (2000), and assume

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

that legislators engage in an infinite horizon bargaining process, where 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 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 group 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

$$u_j(S_i, \tau_i^b, \tau_i^I) \geq v_j, \tag{24}$$

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

$$v_j = \delta[\gamma_i u_j(S_i, \tau_i^b, \tau_i^I) + \gamma_k u_j(S_j, \tau_j^b, \tau_j^I) + \gamma_k u_j(S_k, \tau_k^b, \tau_k^I)]. \tag{25}$$

$\delta \in (0, 1)$ 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 (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, so that the policy bundle proposed by legislator i is given by

$$(S_{i,} \tau_i^b, \tau_i^I) = \arg\max u_j(S, \tau^b, \tau^I) \text{ subject to } (S, \tau^b, \tau^I) \in A_k \cup A_l. \tag{26}$$

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 $\{(\tau_U^I, \tau_U^b, S_U), (\tau_{PT}^I, \tau_{PT}^b, S_{PT}), (\tau_{RT}^I, \tau_{RT}^b, S_{RT})\}$. The expected levels of subsidization $\widehat{S}$ and taxation $\widehat{\tau}$ emerging in the bargaining equilibrium are nothing else than the weighted sums of the individually optimal proposals, and given by

$$\widehat{S} = \gamma_U S_U + \gamma_{PT} S_{PT} + \gamma_{RT} S_{RT}, \tag{27}$$

and

$$\begin{aligned} \widehat{\tau}^I &= \gamma_U \tau_U^I + \gamma_{PT} \tau_{PT}^I + \gamma_{RT} \tau_{RT}^I, & (28) \\ \widehat{\tau}^b &= \gamma_U \tau_U^b + \gamma_{PT} \tau_{PT}^b + \gamma_{RT} \tau_{RT}^b, & (29) \end{aligned}$$

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

$$\widehat{R} = \widehat{\tau}^b \overline{b} + \widehat{\tau}^I \overline{w}(\widehat{S}) - H(\widehat{S})\widehat{S}. \tag{30}$$

3.2 Characterization of the Bargaining Equilibrium

In the bargaining process legislators choose policies to maximize the average utility of their constituency[18], subject to at least one other party accepting the proposal. The RT try to minimize subsidies and redistribution. Preferring income to wealth taxation and low subsidies to high ones, the preferences of the RT are nearly orthogonal to the preferences of the PT. Since the RT are willing to accept positive levels of S and τ^I to keep wealth taxation low, the RT are ex ante more likely to form a coalition with the U. Similarly, the PT will focus on the U as coalition partner, since the untalented agree on high degrees of wealth taxation combined with moderate subsidies to higher education.

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 $(\gamma^U, \gamma^{PT}, \gamma^{RT})$ where coalitions are "locally stable". That is, we

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

assume that the distribution of group sizes is such that every party i has strict preferences regarding the two possible coalition partners, that is that either $A_j \prec_i A_k$ or $A_j \succ_i A_k$ for all $i, j, k \in \{U, PT, RT)$ and $j \neq k \neq l$. If this is the case, marginal changes in group sizes always affect equilibrium outcomes, but do not affect the composition of equilibrium coalitions. Assuming this to be satisfied, 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) $\widehat{S} > 0, \frac{\partial \widehat{S}}{\partial \gamma_{PT}} > 0, \frac{\partial \widehat{S}}{\partial \gamma_{RT}} < 0, \frac{\partial \widehat{S}}{\partial \overline{b}} \leq 0.$

(iii) $\widehat{R} \geq 0, \frac{\partial \widehat{R}}{\partial \gamma_{PT}} > 0, \frac{\partial \widehat{R}}{\partial \gamma_{RT}} < 0, \frac{\partial \widehat{R}}{\partial \overline{b}} > 0.$

Lemma 4 $\frac{\partial \widehat{S}}{\partial t} < 0, \frac{\partial \widehat{R}}{\partial t} \lesseqgtr 0.$

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 by neither RT nor 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 condition must feature levels of higher education subsidies strictly larger than zero. The more likely the rich and talented agents are to propose, the more likely the coalition $U - RT$, and the higher the relative bargaining power of the RT. Therefore, the expected level of higher education subsidies must strictly decrease with γ^{RT}. 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 $\frac{\partial \widehat{S}}{\partial \overline{b}} \leq 0$.

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.

Lemma 4 summarizes the dynamic implications of the model. Since our functional assumptions regarding the utility function implies that all agents leave some fraction of their wealth to their descendants, wealth levels strictly increase over time, which does not only imply that $\frac{\partial \bar{b}}{\partial t} > 0$, but also that the group size of the PT decreases relative to the size of the RT. Both effects decrease the equilibrium degree of higher education subsidization $\widehat{S}$, so that $\frac{\partial \widehat{S}}{\partial t}$ must always be negative. The same is not necessarily true for redistribution. The gradual shift from PT to RT implies a lower equilibrium tax rate $\widehat{\tau}_b$. However, this effect is contrasted by a larger tax base $(\bar{b})$ so that the change in the total size of the redistributive transfer over time $\frac{\partial \widehat{R}}{\partial t}$ is uncertain.

4 Empirical Findings

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 more generally 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 subsidization. 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 it 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.

Since data on the distribution of wealth are scarce, and cross country data on intergenerational transfers plainly unavailable, we resort to alternative measures to proxy for the respective group sizes in our model. The closest substitute for family wealth in the framework of our model is parental income. The higher parents' incomes, the more young agents inherit, and the more support they can receive from their parents for higher education. The most obvious measure of the shape of income distributions is the Gini coefficient, which we take as basic reference point for our empirical analysis. Higher Gini coefficients imply more income concentration in the top income quintile, and thus a larger fraction of credit constrained agents in the whole population.

Since Gini data do not allow a direct identification of the group sizes relevant for our model, we use Barro and Lee's educational achievement data as alternative measure for parental incomes and wealth. Last, we use direct measures of credit market constraints to test the main predictions of our model. The less developed credit markets, the larger the group of agents depending on subsidies, and the larger thus the expected subsidy in the political equilibrium.

4.2 The Data

We use two different data sources for our empirical analysis: a small, but relatively rich data set based on OECD data, and a larger, but less detailed data set based on World Bank data. The World Bank data derive from the World Development Indicators (2002). Data for the OECD countries have been taken from the OECD's "Education at a Glance" and the OECD's Social Expenditure Database (SOCX, www.oecd.org/els/social/expenditure).

Table 2 below summarizes the main variables of interest in these two datasets[19].

[19] For a full set of descriptive statistics and a list of countries included in the regressions, please refer to the Appendix.

Table 2: Descriptive Statistics

	World Bank Sample				OECD Sample			
	Mean	*Min*	*Max*	*Stdev.*	*Mean*	*Min*	*Max*	*Stdev.*
Gross Enrollment in Tertiary Education	21.4	0.6	84.0	18.3	36.6	6.7	84.0	18.6
GDP per capita ('000, 1995 US$)	8.2	0.5	33.7	7.9	15.0	1.8	33.7	8.4
Public Expenditure per Student ('95 US$)	4290	299	13041	3342	5287	299	13041	3452
Public Expenditure per Student (% GDP/cap)	110	6	1180	173	38.6	5.6	107.9	22.3
Total Expenditure per Student ('95 US$)					8242	892	20358	4761
Redistributive Transfers (% of GDP)					8.16	0.96	15.00	3.99

4.3 Empirical Specification

We start our analysis by a cross-sectional analysis of governmental expenditure on higher education. The basic equation we want to estimate is given by

$$S_i = \alpha_0 + \alpha_1 \gamma_i^{RT} + \alpha_2 \gamma_i^{PT} + \alpha_3 \gamma_i^{U} + \alpha_4 \overline{b_i} + \alpha_6 \mathbf{X}_i + \varepsilon_i, \qquad (31)$$

where $\mathbf{X}_i$ is a matrix of country specific control variables to be discussed below, and all remaining variables are defined as before. Since we assume γ^U to be constant, we can rewrite this equation as

$$S_i = (\alpha_0 + \alpha_3 \gamma_i^U) + \alpha_1 \gamma_i^{RT} + \alpha_2 (1 - \gamma_i^U - \gamma_i^{RT}) + \alpha_4 \overline{b}_t^i + \alpha_6 \mathbf{X}_i + \varepsilon_i, \quad (32)$$

and estimate the following reduced form:

$$S_i = \beta_0 + \beta_1 \widetilde{\gamma}_i^{RT} + \beta_2 \overline{b}_t^i + \beta_3 \mathbf{X}_i + \varepsilon_i, \qquad (33)$$

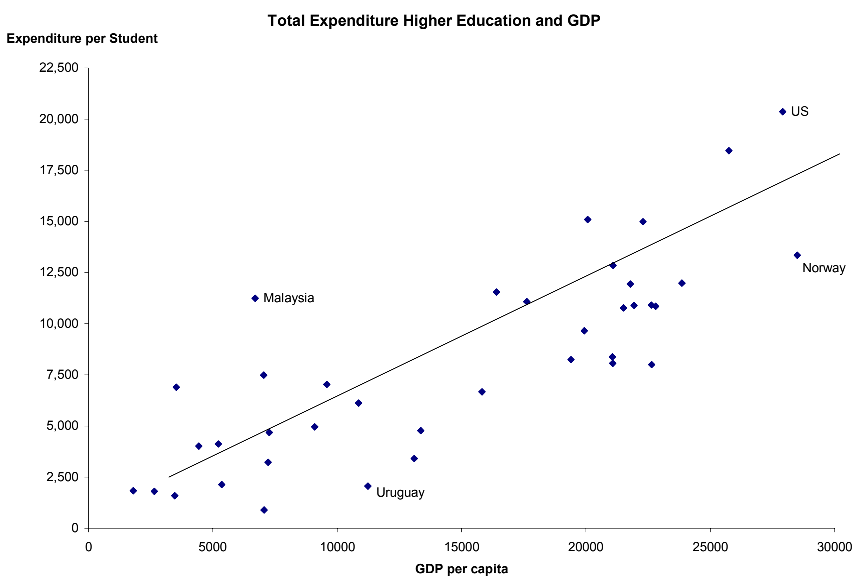
where $\beta_0 = \alpha_0 + \alpha_2 + (\alpha_3 - \alpha_2)\gamma_i^U$, $\beta_1 = \alpha_1 - \alpha_2$ and $\widetilde{\gamma}_i^{RT}$ is our proxy for the group size of the rich and talented as discussed before. By Proposition 1, $\alpha_1 = \frac{\partial S}{\partial \gamma^{RT}} < 0$ and $\alpha_2 = \frac{\partial S}{\partial \gamma^{PT}} > 0$, so that $\beta_1 = \alpha_1 - \alpha_2$ must be strictly negative. The coefficient on $\overline{b}_t^i$, the average wealth of the economy, which we proxy by national per capita income (GDP) is expected to be smaller or equal to zero.

The matrix X includes additional controls for country specific factors potentially affecting the equilibrium outcome. The most important variables for our empirical analysis are fertility, which determines families total financial burden of education relative to income, and credit market restrictions. We use number of children per woman as our control for family size, and various measures of the World Bank business environment database to directly control for the restrictiveness of capital markets.

The main unobservable variable in our empirical specification is the true cost of higher education. The strong and negative correlation between enrollment rates and higher education subsidies apparent in the aggregate data could be interpreted as evidence of economies of scale in the provision of higher education. However, this hypothesis has been strongly rejected by several microstudies in the US and the UK, which find economies of scale in the provision of higher education to be close to zero (Cohn et.al., 1989). The same is reflected in the price of private college tuition relative to GDP per capita in the US, which has increased rather than decreased over the last 20 years despite rapidly growing enrollment rates[20].

For the purpose of our study, we assume the total cost of higher education for each student to be constant relative to GDP. This assumption reflects the findings of a recent OECD study[21], which is summarized in Graph 1 below.

Graph 1: Total Expenditure for Higher Education and GDP



The correlation between total expenditure per student and GDP per capita is 0.82, and there is no evidence that richer countries with high en-

[20] Source: US College Board, 2004.
[21] Source: OECD, 2002.

rollment rates feature lower levels of expenditure. Regressing total expenditure per student on GDP per capita explains about two thirds of the total variation in expenditure, and the estimated coefficient of 0.49 implies that the average cost of studying per year across countries is roughly one half of the respective GDP per capita.

Assuming that the cost of higher education is constant relative to GDP implies that omitting the cost variable would leave β_1, our main coefficient of interest unaffected, but that β_2 can no longer be interpreted as marginal effect of average incomes on policy outcomes. To avoid estimating a convoluted parameter, we normalize expenditure relative to national per capita income. Taking expenditure relative to GDP per capita as dependent variable increases the intercept β_0, but should allow us to directly estimate the effects of national income and the respective group sizes on the expenditure on higher education. The results of our basic cross sectional analysis are summarized in Table 3 below.

Table 3: Cross-Section: Higher Education Subsidies

Dependent Variable	*Government Expenditure per Student in Tertiary Education (1990 avg., % of GDP per capita)*			
	1	2	3	4
Gini coefficient	*3.23***	*2.4*		
	(1.64)	*(1.90)*		
GDP per capita	*-6.47****	*-1.87*	*2.96*	*0.87*
(1995 '000 US$)	*(1.73)*	*(1.48)*	*(2.66)*	*(0.75)*
Share of population with higher education		-13.94**	-6.13***	-3.16***
(% of population 25-64)		*(5.47)*	*(2.15)*	*(0.95)*
Fertility			52.68*	13.72**
(birth per woman)			*(29.47)*	*(6.45)*
Other controls	const	const	regional dummies, const	
Restrictions	none	none	none	e3exp<300, gdp>1.5k
Stata-Methold	OLS	OLS	OLS	OLS
Option	robust	robust	robust	robust
# of Obs.	81	64	81	67
R squared	0.18	0.25	0.54	0.47

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

In column 1 we test the basic relation between subsidies, GDP per capita and the Gini coefficient as our group size measure. The basic relation is as expected. The higher incomes and the lower inequality, the lower the subsidy observed. In column 2, we test our group size measures against each other. While the Gini coefficient is no longer significant, the Barro-Lee measure is highly significant and has the expected sign. The larger the fraction of agents with rich parents, the smaller the subsidy observed. We drop the Gini coefficient, and add controls for fertility and regional dummies in column 3. Fertility turns out to be significant in all regressions, well consistent with the theoretical implications of our model. More children per family imply less wealth per infant, and thus a stronger dependency on subsidies. In column 4 we test the robustness of our results, excluding both outliers in terms of income and higher education expenditure - the results do not change.

To provide more direct evidence for the relevance of credit constraints, we add indicators of financial markets to our regressions; the results are displayed in Table 4 below.

Table 4: Testing the Credit Constraint

Dependent Variable:	*Expenditure per Student in Higher Education (% of GDP per capita)*			
	I	**II**	**III**	**IV**
GDP per capita (const. 1995 US$, PPP)	-0.839	-0.825		-0.901
	(0.82)	*(0.78)*		*(0.74)*
Publicly credit registered out of 1000	-0.056**	-0.057**	-0.058**	-0.058**
	(2.13)	*(2.13)*	*(2.07)*	*(2.47)*
Privately credit registered out of 1000	-0.011	-0.012	-0.006	-0.017
	(1.08)	*(1.09)*	*(0.44)*	*(1.22)*
Total private credit over GDP	-0.063	-0.077		
	(0.56)	*(0.66)*		
Number of children per woman	15.658***	16.653***	20.740***	17.764**
	(3.51)	*(3.57)*	*(3.30)*	*(2.26)*
Barro-Lee Share			-2.262**	-2.783**
(% Adults with completed higher education)			*(2.17)*	*(2.55)*
Other Controls	constant, regional dummies			
Restrictions	e3exp<300	e3exp<300, gdpcap>1,000		
Estimation Method	OLS	OLS	OLS	OLS
Observations	81	79	61	59
R-squared	0.67	0.65	0.66	0.75

Robust t statistics in parentheses
** significant at 10%; ** significant at 5%; *** significant at 1%*

In column 1 of table 4 we jointly test several measures of credit market development. The first two measures capture the diffusion of private credit, the last one the total size of the credit market. Total private credit always appears with a negative sign, but is never significant in the regressions. The size of the registries have the expected sign, but only the public registry (which is generally the larger one) appears significant. In column 2 we exclude outliers from our sample - the results do not change. In column 3 and

4 we add the Barro-Lee measure to the regression. Relative to the previous regressions, the coefficient on the Barro-Lee variable becomes slightly smaller, but remains highly significant.

The overall results for the relevance of credit constraints and the respective group sizes strongly confirm our priors. The larger the group of credit constrained agents, or the more relevant credit constraints in general, the higher is the subsidy for higher education observed.

The effect of national income and wealth appears more ambiguous. While income has the expected sign in the very basic estimates, we cannot reject the null of a zero coefficient on income in the other specifications. One possible explanation for this result might be our educational cost assumption. If educational costs are not constant as fraction of GDP, the GDP variable may pick up both wealth and cost effects, and thus be hard to interpret. To investigate into this possibility, and to further check the robustness of the previous results, we estimate the reduced form (33) in a panel data set, where we divide the period 1975 to 2000 into five subperiods. Table 5 below summarizes the results.

Table 5: Panel Evidence: Higher Education Subsidies

Dependent Variable	*Government Expenditure per Student in Tertiary Education (1995 US$)*			
	1	2	3	4
Lagged Dependent			0.64***	0.65***
			(0.03)	*(0.03)*
GDP per capita	*418.44****	*399.7****	*209.9****	*213.35****
(1995 US$)	*(106.24)*	*(34.00)*	*(62.40)*	*(58.44)*
Share of population with higher education	-89.60**	-75.73***	-57.17**	-52.19**
(% of population 25-64, Barro Lee)	*(41.01)*	*(24.58)*	*(28.13)*	*(25.24)*
Birth per woman	105.72**	84.78***	40.76	35.37
	(50.14)	*(15.48)*	*(37.87)*	*(35.58)*
Stata-Methold	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	AR(1)=0.75	p(Hansen)=0.64	p(Hansen)=0.64
	rho =0.69			

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

As opposed to the cross-section, we now use absolute rather than relative expenditure per student in higher education as dependent variable. This makes the interpretation of the income coefficient more difficult, but allows us more flexibility with respect to the cost/GDP ratio. Since the Wooldridge statistic indicates a high autocorrelation of order one, we test 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 perform a FGLS estimates allowing 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.

The results with respect to the group sizes as measured by our Barro-Lee proxy strongly confirm the findings of the cross-sectional analysis as well as the main implications of our model. The coefficient on GDP per capita is now strictly positive. An increase of GDP per capita of US$ 1000 implies an increase in government expenditure per student in the range of US$ 200-400. Given that the point estimate for the cost per student/GDP per capita ratio within OECD country is around 0.5, this coefficient is relatively low, and might be interpreted as evidence of the negative wealth effect predicted by the model.

Overall, the empirical results for higher education subsidies strongly support our theoretical predictions for our main variables of interest. The larger the fraction of the population with binding credit constraints, the larger the equilibrium expenditure per student in higher education. Given the difficulties associated with identifying the true cost of higher education, the evidence is more mixed with respect to income, but nevertheless weakly supports the predictions derived from our theoretical model.

As a last step, we test the implications of our model regarding redistributive transfers. Data on redistributive transfers is limited, and stems from the OECD's Social Expenditure Database (2004). The sample contains 25 countries, and covers the period from 1980 to 2000, which we divide in 5 subperiods. We take total social expenditure excluding health and pension payments as percentage of GDP as our dependent variable[22], and run a sim-

[22] We test alternative specification where we include health expenditure in the dependent

ilar set of regressions as in the previous panel. Table 6 below summarizes the main results.

Table 6: 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	0.28***	0.30***	0.09	0.10
(1995 US$)	*(0.10)*	*(0.04)*	*(0.07)*	*(0.09)*
Share of adults with higher education	-0.06*	-0.06***	-0.05*	-0.085**
(Barro Lee)	*(0.03)*	*(0.02)*	*(0.03)*	*(0.03)*
Lagged Dependent	(rho=0.69)		0.73***	0.89***
			(0.09)	*(0.15)*
Other controls	const	const	const	const
Sample	OECD	OECD	OECD	OECD
Stata-Methold	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 at any significance 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 (γ_{RT}), the smaller the degree of redistribution observed in equilibrium. This effect is significant, and highly robust across specifications. The effect of income on redistribution is always positive as expected, but not always significant.

variable - the results do not change.

5 Summary

In this paper 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. While redistributive transfers may increase, relative government expenditure on higher education always decreases over time.

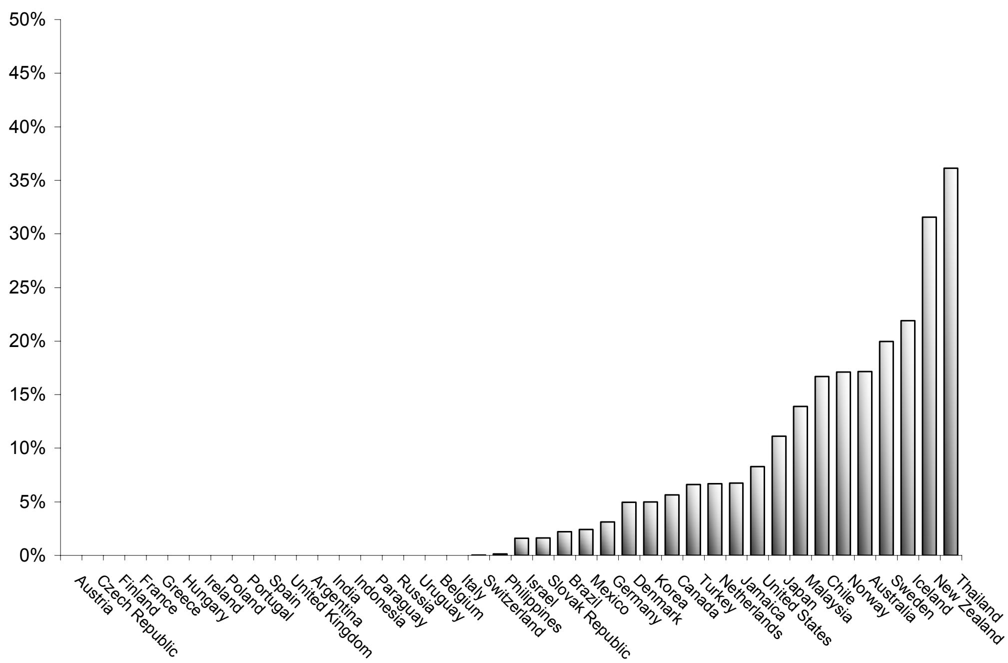
We use data from the OECD and the Worldbank to test our theory and find strong support for the main predictions of our model. The larger the fraction of the population that can afford to enroll into higher education independent of governmental support, the lower the degrees of higher education subsidization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

6 Appendix

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.

6.2 Data Description

Country List Cross Section OECD

Australia, Austria, Belgium, Canada, Chile, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, India, Indonesia, Ireland, Israel, Italy, Jamaica, Japan, Korea, Malaysia, Mexico, Netherlands, Norway, Paraguay, Philippines, Poland, Portugal, Spain, Sweden, Switzerland, Thailand, Turkey, UK, United States, Uruguay.

Country list Cross Section Worldbank:

Australia, Austria, Belgium, Botswana, Burkina Faso, Cameroon, Chile, China, Costa Rica, Cote d'Ivoire, Denmark, Ecuador, El Salvador, Estonia, Finland, France, Germany, Greece, Guinea, Hungary, India, Iran, Israel, Italy, Japan, Jordan, Kenya, Korea, Latvia, Lesotho, Madagascar, Malawi, Malaysia, Mexico, Morocco, Namibia, Nepal, Netherlands, New Zealand, Norway, Panama, Paraguay, Peru, Poland, Portugal, Senegal, Slovak Republic, South Africa, Swaziland, Sweden, Switzerland, Trinidad and Tobago, Tunisia, Ukraine, United Kingdom, United States, Uruguay, Venezuela, Vietnam, Zimbabwe.

Country List Panel

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.

Description of Variables

- e3exp: Public Expenditure per student in tertiary education (1995 US$, PPP)
- e2exp: Public Expenditure per student in secondary education (1995 US$, PPP)
- e3enrol: Gross enrollment in tertiary education (%).
- e2enrol: Gross enrollment in secondary education (%)
- e1enrol: Gross enrollment in primary education (%)
- epublic: Total public expenditure on education (as % of GDP)
- govexp: Total government expenditure (% of GDP)
- gdp: GDP per capita, constant 1995 US$ (PPP)
- urban: Percentage of population living in urban areas (UN definition)
- pop: Total population (Millions)

Cross Sectional Dataset (Worldbank):

Variable	Obs	Mean	Std. Dev.	Min	Max
pop	60	60.01	194.67	.90	1203.80
govexp	60	29.25	10.70	8.76	50.55
gini	60	40.71	10.76	24.44	70.66
e1exp	60	15.00	7.18	3.09	35.67
3exp	60	125.79	207.31	5.60	1180.05
epublic	60	5.23	2.97	1.92	23.15
e2exp	57	22.50	12.44	1.18	71.26
pop14	60	30.60	10.81	15.08	48.20
urban	60	58.69	22.90	10.19	96.90
e2enrol90	60	73.14	34.98	8.69	138.22
e2enrol80	55	59.08	31.63	3.57	122.84
e2enrol70	53	45.37	29.00	1.67	95.22
e3enrol90s	60	25.80	19.86	.57	79.11
e3enrol80s	56	16.44	12.87	.45	57.85
e3enrol70s	53	10.59	9.82	.13	50.71
gdp90s	60	9.75	8.39	.51	28.49
gdp80s	53	8.98	7.39	.51	24.37
gdp70s	53	8.02	6.48	.54	22.44
relative	60	11.40	23.09	.36	165.31
africa	60	.26	.44	0	1
latinam	60	.18	.39	0	1
asia	60	.08	.27	0	1
oecd	60	.3	.46	0	1

Panel Data Set

Variable		Mean	Std. Dev.	Min	Max	# Obs.	
Year	overall	1990	7.07	1980	2000	N =	400
	between		0	1990	1990	n =	80
	within		7.07	1980	2000	T =	5
totpop	overall	45.03	153.24	.24	1241	N =	400
	between		152.98	.25	1099	n =	80
	within		17.76414	-115	209	T =	5
govexp	overall	28.74	12.25	8.08	96.23	N =	380
	between		11.46	9.52	59.79	n =	76
	within		4.47	5.56	71.60	T =	5
e3exp	overall	155.35	284.11	1.84	2938.5	N =	400
	between		256.02	9.13	1269.0	n =	80
	within		125.81	-667	907.65	T =	5
epublic	overall	4.52	1.88	.526	12.29	N =	400
	between		1.69	1.37	9.51	n =	80
	within		.84	-.08	8.40	T =	5
pop14	overall	33.15	10.59	14.51	51.72	N =	400
	between		10.37	18.09	48.81	n =	80
	within		2.35	25.76	41.33	T =	5
urban	overall	56.35	24.44	4.41	100	N =	400
	between		24.19	5.19	100	n =	80
	within		4.22	38.39	73.7	T =	5
e2enrol	overall	62.65	33.06	2.69	154.54	N =	400
	between		31.52	6.43	117.57	n =	80
	within		10.43	25.45	116.81	T =	5
e3enrol	overall	20.22	17.92	.30	94.66	N =	400
	between		16.48	.52	77.03	n =	80
	within		7.24	-5.56	49.10	T =	5
gdpppp	overall	8.65	7.68	.49	41.76	N =	395
	between		7.45	.51	26.55	n =	79
	within		2.01	-.89	23.85	T =	5

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