The Political Economy of Tertiary Education

- Work in Progress -

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Abstract

In this paper we present a theory on the political economics of higher education. We show that in a model where heterogeneous and income maximizing agents simultaneously vote on higher education subsidies and general redistributive policies, higher education subsidies will always receive majority support even if they are targeted only to a small minority.

Building on a model of legislative bargaining we determine the equilibrium outcomes for educational subsidies and demonstrate that the degree of subsidization chosen in the political equilibrium will decrease over time as private wealth holdings increase in the economy.

Last, we use a large panel data set based on Worldbank data to provide empirical evidence for the theory presented and demonstrate that the implications of our model are largely confirmed by the data.

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

JEL Classification: P16, O10.

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1 Introduction

The degree of public subsidization of higher education across countries is remarkable; while most Western European countries spend between 30 and 50% of their respective GDP per capita per student in tertiary education, countries at the lower end of the international scale like Peru or Korea spend less than 10%, and countries on the high end of the scale like Ethiopia and Kenya spend more than 500% of their per capita income for the same purpose.

Given that even in the countries with the highest enrollment rates only a minority of the population benefits from higher education, the strong and consistent support for higher education appears puzzling from a political viewpoint. While growth externalities or credit market constraints may well recommend for such policies from a normative viewpoint, we choose a strictly positive approach in this paper, trying to understand the forces driving the political support for public expenditure on higher education. The analysis provided in this paper does not distinguish between the various forms of subsidization within higher education. Treating all forms of subsidization the same, we implicitly assume that the government uniformely distributes its expenditure among agents enrolled in higher education, and does not specifically target funds to particular groups. While this assumption may appear strong from a theoretical and especially from a political viewpoint, it appears to be quite consistent with the empirically observed patterns of higher education expenditure[1].

Based on this assumption, we develop a model, where agents that are heterogeneous along the dimensions of wealth and talent try to maximize their income by choosing their ideal level of higher education subsidies and general redistributive transfers. Modelling the political decision process as an infinite legislative bargaining game, we demonstrate that public education will always emerge in all political equilibria, since the rich agents will support those of the poor who want to trade off general redistributive policies against higher spending on public education.

We show that this effect is particularly strong as long as the share of the poor among the population is relatively large, and will slowly decrease over time as the average wealth holdings in the economy increase. This finding is quite strong, since it implies that the degree of subsidization will be the smaller the larger the fraction of agents that gains access to higher

[1] According to a recent study by the UOE (a statistical cooperation between UN, OECD and Eurostat), no member country spends more than 10% of the higher education budget on targeted scholarships. While most funding is channeled through the public provision of higher education, those countries that have significant budgets for scholarships like Denmark or Sweden provide study grants to any student desiring to enroll into university.

education, or, to put it the other way around, the more exclusive higher education, the more it will profit from public subsidization.

In the last section of this paper, we use a large panel data set based on Worldbank data to empirically evaluate the theory developed in this paper and find that the main predictions of the model are well supported by the data - the wealthier a country and the higher the overall access rates to higher education, the lower the relative subsidy each student receives.

The model presented here follows the relatively stream of literature linking the political economics of education with those of general redistributive politics pioneered by Perotti (1993), who uses a setup where human capital generates a positive externality for all agents, but the access to education depends on post-tax income of agents. Perotti argues that redistribution should lead to more educational investment in relatively rich countries where the poor can attend school with some income transfers and less in relatively poor ones where income taxation deprives middle and high income agents of funds needed to finance education.

While Glomm/Ravikumar (1998) and Epple/Romano (1995) stress the redistributive character of public education, Fernandez and Rogerson (1995) show that such a policy may be regressive, if rich and middle income agents have the means to vote for lower public spending on education in order to keep poor agents away from higher education.

To our knowledge, the work closest to the setup presented here is Levy (2004), who demonstrates that in a static model 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. The model presented here uses a more complex economic background, stressing both direct and indirect (relative) wage effects of higher education, generalizing Levy's (2004) results in a dynamic setup designed to match the historical evolution of higher public education.

The rest of the paper procedes as usual: we present the basic setup in the following section, and then discuss the political outcomes in a static and dynamic framework in section 3 of the paper. Section 4 provides some empirical evidence, while we use section 5 to summarize and conclude this paper.

2 The Model

2.1 General Setup

We consider a non-overlapping generation model, where period t a generation t consisting of a continuum of heterogeneous agents of size 1 is born. At the beginning of their lives, all agents receive basic (primary and secondary) education, and decide whether or not to enroll into higher education depending on the associated cost and premiums. Agents are mildly altruistic, and derive utility from their own consumption, and from leaving bequests to their descendants. The utility function of an agent i in period t is given by:

$$U_t^i = \frac{(c_t^i)^{1-\beta}(b_{t+1}^i)^{\beta}}{\beta^{\beta}(1-\beta)^{1-\beta}} \tag{1}$$

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 $t+1$, $\beta \in (0,1)$ is a measure of (parental) altruism[2]. Then, the bequest left by an agent b_t^i to her direct descendant is given by:

$$b_{t+1}^i = \beta I_t^i \tag{2}$$

where I_t^i is the total income of agent i in period t which shall be defined in further detail below. In addition to the differences in the levels of bequests received agents differ with respect to their talent θ_t^i. We assume that agents have either high or low talent so that $\theta_t^i \in \{\theta^h, \theta^l\}$, and that the correlation of talent is imperfect within dynasties and across generations, and given by the following Markov structure:

$$\theta_{t+1}^i = \begin{cases} \theta^h & \text{with probability } p^h & if \quad \theta_t^i = \theta^h \\ \theta^h & \text{with probability } p^l & if \quad \theta_t^i = \theta^l \\ \theta^l & \text{with probability } (1-p^l) & if \quad \theta_t^i = \theta^l \\ \theta^l & \text{with probability } (1-p^h) & if \quad \theta_t^i = \theta^h \end{cases} \tag{3}$$

We assume throughout this paper that there is mild correlation of talent across generations ($p^h > p^l$) and that the overall distribution of talent is stationary over time, so that the fraction δ of highly talented agents is given by $\frac{p^l}{1+p^l-p^h}$.

[2]The simple functional form for the agents' utility facilitates the dynamic solution of the model, as it implies that each agent will leave a constant ratio β of her income to her descendant.

Given her bequest received b_t^i and her talent type θ_t^i, each agent decides whether or not to enroll into higher education. Higher education is associated with a pecuniary cost T (tuition), a talent dependent effort cost $\phi(\theta^i)$, and a premium π which is determined in the labor market.

2.2 The Production Sector

Abstracting from physical capital, we assume that high and low skill labor are the only inputs for production. Denoting by A_t the exogenously determined technology employed in the economy at time t, total output Y_t is given by:

$$Y_t = A_t H_t^{\alpha} L_t^{1-\alpha} \tag{4}$$

where H_t and L_t are the total stock of high skilled and low skilled labor respectively, and $\alpha \in (0.5, 1)$ measures the relative productivity of high skilled labor, that is labor with higher education. The production sector is perfectly competitive and the wages paid equal the marginal products of labor, so that the wage of a skilled w_t^s and unskilled w_t^u in period t are given by

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

$$w_t^u = (1-\alpha) A_t (\frac{H_t}{L_t})^{\alpha} \tag{6}$$

and the resulting wage premium π_t is given by

$$\pi_t = w_t^s - w_t^u. \tag{7}$$

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

$$\pi_t = A_t[\alpha(\frac{1-H}{H})^{1-\alpha} + (\alpha - 1)(\frac{H}{1-H})^{\alpha}]. \tag{8}$$

Proposition 1 *The premium for higher education earned in a competitive labor market is characterized as follows:*
(i) $\pi_t > 0$ *iff* $H_t < \alpha$.
(ii) $\pi'(H_t) < 0$
(iii) $\pi''(H_t) < 0$ *for* $H < \overline{a}$ *and* $\pi''(H_t) > 0$ *for* $H > \overline{a}$.

The first part of intuition is straightforward; the scarcer the supply of high skill labor, the larger the relative premium this type of labor earns in a competitive market. Part one and part three of proposition 1 follow from the Cobb-Douglas type production function; part one implies that the skill premium earned in the labor market will be positive as long as the relative supply of high skilled labor is smaller than its relative productivity, while part three implies that the decrease in the skill premium due to additional enrollment in higher education decreases up to a (threshold) point where unskilled labor is still abundant and then increases as unskilled labor becomes increasingly scarce. For a full derivation of the results, see appendix 1.1.

2.3 Higher Education and the Enrollment Decision

Following a large stream of the literature, we assume that the access to the credit market is restricted, so that agents cannot borrow to finance higher education. Therefore, any agent i in period t will decide to enroll in higher education ($e_t^i = 1$) if and only if the following two conditions are satisfied:

$$\begin{array}{ll} T_t = C - S_t \leq b_t^i & \text{(credit constraint)} \\ \pi_t(1-\tau_t) \geq T^t + \phi(\theta^i) & \text{(incentive compatibility constraint)} \end{array} \tag{9}$$

where T_t is the net tuition payment required, C is the actual cost of higher education which we assume to be constant over time, and S_t is the public subsidy provided to each student enrolling into higher education. τ_t is the income tax rate used to finance both a redistributive transfer and a higher education subsidy as shall be discussed in further detail in the following section. To keep the model simple, we assume that $\phi(\theta^h) = 0$ and $\phi(\theta^l) + T_t > \pi_t$, so that agents with low talent will never want to enroll into higher education.

2.4 Policy Space and Preferences

We model a two dimensional policy space, where agents have preferences about general redistribution and the public provision of higher education. We assume that labor income is taxed, while the bequests received are not[3], so that the (life time) income of each agent is given by :

[3] The more realistic case that the income tax applies also to capital returns slighly complicates the analysis, but does not qualitatively change our results at all.

$$I_t^i = b_t^i + w_t^u + R_t + e_t^i(\pi_t^i(1-\tau_t) - C + S_t)$$

where R is a redistributive transfer paid from the central budget, and $S_t \in [0, C]$ is the tuition payment required under a public and a private higher education regime respectively. Denoting the total enrollment rate by $\sigma_t = \int_0^1 e_t^i di$ the size of the redistributive transfer R can be derived directly from the government budget constraint as

$$R_t = \sigma_t(\pi_t - S_t). \tag{10}$$

We shall denote an agent as poor if $b_t^i < C$, that is, if her wealth (bequest) is insufficient to finance higher education in the absence of public subsidies. Then, the population can be divided into the following groups: the rich, divided into the talented who will always enroll into higher education as long as the net return is positive and the untalented who will never enroll into higher education independent on the degree of public subsidization, and the poor, divided into those who will never enroll, and those who will enroll if higher education is public and the incentive constraints are satisfied. Given these basic categories, the preferences can be derived as follows.

All untalented agents do not directly care about the subsidization and thus simply maximize their income; their preferred policy bundle $P(S_t, \tau_t)$ is given by

$$\arg\max_{S_t,\tau_t}\{w_t^u(S_t,\tau_t) + \tau_t\sigma_t(S_t,\tau_t)\pi_t(S_t,\tau_t) - \sigma_t(S_t,\tau_t)S_t\} \tag{11}$$

While the public subsidization of higher education does not directly benefit the poor and untalented by assumption, it affects this group in various indirect ways; first, subsidies increase enrollment in higher education, decrease the relative abundance of unskilled labor and thus increase the wage of the poor and untalented. Second, subsidies lower the scope for redistributive policies by decreasing the pre-tax wage differentials, so that the optimal tax bundle from the perspective of an untalented agent can not trivially be determined.

If young and untalented agents decide to not subsidize higher education at all, only the rich and talented will enroll and the maximum tax rate that can be charged will be such that those agents enrolling will get a zero profit from enrollment, so that $\pi_t(0)(1-\tau_t) = C$. We shall denote this policy bundle as $P_t^0(\tau_t^1, S_t^1) = (\frac{\pi_t(0)-C}{\pi_t(0)}, 0)$.

Increasing the level of subsidization relative to this corner solution has three effects from the perspective of a poor agent: first, it increases overall enrollment rates, since some of the talented but credit constrained will now get access to higher education ($\frac{\partial \sigma_t}{\partial S_t} \geq 0$). Second, the increased supply of skilled labor will decrease the labor market premiums, raising the wage of the poor, and decreasing the wage of the rich ($\frac{\partial w_t^u}{\partial S_t} \geq 0, \frac{\partial \pi_t}{\partial S_t} \leq 0$). Finally, a marginal increase in educational expenditure has a direct marginal cost of σ_t which has to be covered from the general budget revenues. Thus, a poor and untalented agent will support a positive level of subsidization as long as the net tax cost plus the induced change in poor labor wages is positive[4].

The case for the poor and talented is quite different; if poor and talented agents get access to higher education, they become high income earners, and thus oppose general redistributive taxation. For a given level of private wealth b_t^i, each agent i within this group needs a level of subsidization $S_t^i = C - b_t^i$. If the incentive compatibility constraint for agent i is satisfied, this constraint is by definition also satisfied for all other talented agents wealthier than agent i, so that the enrollment rate can easily be determined from the overall distribution of bequest as $F_t(b^i)$. If the net payoff of being the last agent to enroll is higher than the payoff to the maximization process followed by all untalented agents as displayed in (11), the agent's optimal bundle will be given by $P(S_t, \tau_t) = (C - b_t^i, \frac{C - b_t^i}{\pi(\sigma_t^i)})$.

If the net payoff is smaller than the one of the optimal payoff of remaining untrained, the agent's bundle will be determined as derived in the previous section. It should be noted here, that the preferences among the group of poor and talented are not aligned at all as it is the case for all untalented agents. Each talented agents wants a subsidy just large enough to allow her to enter higher education. Any additional subsidy will imply lower premiums and higher taxation, and will thus be strictly opposed by any agent richer than this "marginal" agent.

Last, the preferences for the rich and talented are easiest to derive. Since they always belong to the high income earners, they strictly oppose any kind of taxation directed towards redistribution. More surprisingly, the rich and talented will also generally oppose higher education subsidies; the reason for this is that higher education subsidies will not only lower the returns to higher education by allowing some poor agents to enroll, but are also exclusively paid by those enrolled, so that the net payoff of educational subsidies from the perspective of a rich and talented agents is always smaller or equal to zero.

Thus, the preferences of the various groups can be summarized as follows:

[4] $\frac{\partial w_t^u}{\partial S_t} \geq \sigma_0(1 + \tau^0 \frac{\partial \pi_t}{\partial S_t} - \frac{\partial \tau^{\max}}{\partial S_t} \pi_t^0)$

1. The utility of the rich and talented strictly decreases in the level of redistribution R and the public subsidization of higher education S.

2. The utility of all untalented agents strictly increases with the degree of redistribution R, while the effect of a public subsidization of higher education S is ambiguous and depends on the elasticity of enrollment determined by the overall distribution of wealth in the economy.

3. The utility of poor and talented agents is discontinuous with respect to higher education subsidies S; up to the agent's optimal level of subsidization $S_t^{i*} = C - b_t^i$ the effect of public subsidies is ambiguous; the income of agent i jumps at point S^{i*}, and then gradually decreases with any additional public expenditure on higher education. By the same line of argument, each agent's utility increases with redistribution for any $S < S^{i*}$, and strictly decreases with redistribution for any $S \geq S^{i*}$

3 The Political Process - A Model of Legislative Bargaining

Following the recent work by Austen-Smith and Wallerstein (2003) we assume that policy outcomes in the economy are shaped in a process of legislative bargaining. That is, we abstract from the electoral stage itself, and focus our analysis on the "parliamentary" or post-electoral stage, where different types of legislators, denoted as parties, represent their respective constituencies. To represent the various interest groups present in our model, we assume that there are three types of legislators: those representing the poor and untalented (left party), those representing the poor and talented (center party), and those representing the rich (right party). Alternatively, one might think of these three groups as working, middle and upper class. Each legislator maximizes the utility of her constituency.

While the preferences of all poor and untalented agents are perfectly aligned, this is not the case for the high income party (talented versus untalented) and the talented poor, where the ideal policy points varies with the levels of private wealth holdings; in both cases we assume that legislators choose the policy bundle that maximizes the total utility of their constituency.

To avoid a trivial solution, we assume that no single party, but that any coalition of two parties can form a majority. From the exhibition in the previous section, the preferences of the three groups are clear: the poor and untalented want maximum redistribution and support public education conditional on its returns. The center party wants public education and little redistribution, while the rich party generally wants little redistribution, as long as the subgroup of the talented are a majority. Given these preferences, legislators engage in a bargaining process to maximize the income of their constituency.

Since in our setup, as it is usually the case in a multidimensional policy space, the core is empty, we follow Austen-Smith and Wallerstein (2003) and previous work by Baron/Ferejohn (1989) and Banks/Duggan (2000), and assume that legislators engage in an infinite horizon bargaining process, in which in each period a randomly selected legislator can make policy proposals. If the proposal gets the support of any other party, the game ends and the policy is implemented, otherwise the next legislator can make a policy proposal.

The solution concept to 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. Each party will accept a proposal of the other parties if and only if the value of the proposal is at least as large as the continuation value of the game.

To capture the relative political influence of each group, we assume that the probability to be selected as proposal maker in each period is proportional to its relative group size; that is, the larger the fraction of a certain group, the more likely the group is to make the proposal in each round of the bargaining process. Under this assumption, the equilibrium outcomes can be characterized as follows:

Proposition 2 *For a given level of technology $A_t > 0$ and a distribution of talent θ_t^i with $\delta > 0$, the equilibrium levels of public subsidization can be characterized as follows:*
(i) $S_t > 0$.
(ii) $\frac{\partial S_t}{\partial B_t} < 0$.

The first part of proposition 2 is straightforward; as long as there is a positive fraction of talented agents among the young, public subsidies for higher education will always emerge in the political equilibrium since both the talented poor and the rich will support such a policy in order to reduce the degree of redistribution in the economy. The second part is slightly more complicated: the higher the stock of bequests in the economy (the fewer agents are bequest constrained), the lower the equilibrium level of public expenditure on higher education. The reasons for this are twofold: first, higher level of bequests imply a larger share and thus influence of the rich party; second, higher level of wealth increase the enrollment elasticity of subsidies among the poor, making both the talented poor and the rich more averse to such policies.

{full proof to be added here.}

3.1 Dynamic Analysis

Definition 3 *A sequence of agents' choices* $\{e_t^i, c_t^i, b_{t+1}^i\}_{t=0}^{\infty}$ *and a corresponding sequence of wages and wage premiums* $\{w_t,\pi_t\}$ *constitute an equilibrium of the economy given the policies* S_t, τ_t *if*
(i) e_t^i *is the utility maximizing choice for each agent* i*.*
(ii) The wage premium is determined in the labor market and given by equation (7).
(iii) each agent's type (b_t^i, θ_t^i) *follow from equations (2) and (3).*

While, by equation (3) the overall distribution of talent is stationary over time, the distributions of bequests changes over time, so that the number of agents sufficiently rich to enroll into higher education in the absence of public education varies over time. We assume that there is some initial correlation of wealth and talent, that is, that in the early stages there are relatively few highly talented agents among the poor, and that this share increases over time. If this assumption holds, the equilibrium outcome can be derived from the prior analysis; as long as the rich are only a relatively small minority, the levels of subsidization chosen in the economy will be high, and then gradually decrease as a credit constraints become less binding and overall enrollment rates increase over time.

4 Empirical Evidence

The theory presented in the previous section has two main implications: first, from a rather static perspective, public education will always emerge in a system with a democratic background, and, second, from a dynamic perspective, the degree of public subsidization will decrease over time as the average levels of private wealth and thus overall enrollment increases in an economy.

To verify this claim, we use a panel dataset based on the Worldbank's World Development Indicators, which contains data on public expenditure on higher education and as well as all basic economic indicators for the period 1970 to 2000. Using all data available, we get an unbalanced panel with 7 time periods; 1970, 1975, 1980, 1985, 1990, 1995 and 2000. Given the statical problems with unbalanced panels, we also construct a reduced, but balanced panel, which contains 80 countries and 5 time periods. For a complete data summary, please see appendix 1.2.

Due to the cross-national character of our data, we start our empirical analysis with a standard fixed effects (LSDV) model, shortly noting that more general random effects (RE) models are rejected in all regressions by a standard Hausman test.

Table I below shows a first series of results for the fixed effects models for the two basic specifications and datasets:

Table I: Dependent Variable: Expenditure per Student in Tertiary Education (1995 US$, PPP))

	FE (LSDV) Models, Levels		FE (LSDV) Models, log Var.	
	1 a)	2	3 a)	4
GDP per Capita (1995$, PPP)	298.27***	174.93***	0.745***	0.698***
	(77.22)	*(64.99)*	*(0.15)*	*(0.15)*
Tertiary Enrollment	-52.55***	-39.07**	-0.347***	-0.523***
	(18.66)	*(17.07)*	*(0.07)*	*(0.09)*
Fertility	-130.25***	-162.09	-0.335*	0.21
	(42.05)	*(229.06)*	*(0.17)*	*(0.17)*
Urbanization	-202.85***	-70.2**	-0.835***	-0.355*
	(35.91)	*(32.39)*	*(0.19)*	*(0.20)*
P.c. Exp. Student Secondary	0.658***	.709***	0.121*	0.135**
	(0.20)	*(0.15)*	*(0.06)*	*(0.06)*
Total Public Education Exp. (% GDP)	699.41***	271.47***	0.847***	0.744***
	(129.55)	*(74.91)*	*(0.11)*	*(0.11)*
Panel (balanced, unbalenced)	bal	unbal	bal	unbal
Restrictions	none	none	none	none
Stata-Methold	xtreg, fe	xtreg, fe	xtreg, fe	xtreg, fe
# of Obs.	400	362	345	362
R squared	0.20	0.41	0.56	0.69
time dummies	no	no	no	yes b)

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

a) Hausmann test of random errors rejected at any signficance level.
b) Time dummies jointly significant at ***.

Columns 1 and 2 display the results in level variables for both the balanced and unbalanced panel, while columns 3 and 4 show the same regressions for logged variables. Country dummies are jointly significant in all regressions, and time dummies do appear to have a significant effect only in the last regression, but do not significantly affect the overall results once the enrollment effects are accounted for.

While the coefficients vary quite a bit especially for the regressions with the variables in logs, the sign and significance levels of the key explanatory variables seem to be quite stable across datasets with the exception of the fertility variable. The positive and highly significant coefficient on GDP per capita is hardly surprising; while the linear coefficients of around 0.2 (the GDP variable in 1000 US$) seems on average quite low in the levels regressions, a wealth elasticity around 70% seems to be fairly reasonable for the log regressions.

Most importantly, the coefficient on tertiary education enrollment is negative as expected, and highly significant in all specifications. The linear coefficients of -53 and -40 imply that a ten percentage point increase in enrollment implies a decrease in per capita spending of around 500 US$

keeping everything else constant. Given mean spending levels of 5000 US$ per student, a 10 percentage point increase in enrollment thus implies a 10% decrease in spending at the mean spending levels. The elasticity estimates of -0.3 to -0.5 seem to be more or less consistent with the linear estimates, but of course imply a relation more in line with an economies of scale story than a political one.

On the other hand, the estimates for fertility rates are quite inconsistent. Theoretically, more children per family imply a higher total cost of tertiary education funding for the same enrollment percentages, but may also have an indirect effect making the support of tertiary education more difficult for parents keeping income constant. Keeping everything else constant, the coefficient should be expected to be negative, which is always the case - but only in few cases in a significant way.

The results for the urbanization variable seem intuitive; the more concentrated the population in a country, the fewer universities need to be set up in different places, and the lower thus the cost per student on average. The last two variables, expenditure per student in secondary education and total spending on education as percentage of GDP, are supposed to measure the general generosity of public educational policies. As expected, the signs are positive and significant in all regressions; not only does the overall educational budget have a positive effect on the generosity of tertiary education spending, but tertiary education expenditure seems also to be significantly correlated with the generosity of secondary education spending. The first effect is very straightforward (even though the elasticity on the education budget appears excessively high); the second a bit more complicated: higher spending on secondary is generally also associated with lower enrollment, which implies that the mechanisms described before for tertiary may equally apply to secondary education. We further investigate into this argument below.

Before moving to secondary education spending, we run a few robustness checks on the regression results presented above. Unlike before, we strictly focus on the balanced data set here, and use logged variables in all of the regressions. Table II below shows the results.

Table II: Dependent Variable: Log Expenditure per Student in Tertiary Education (1995 US$, PPP)

	OLS-PCSE a)	OLS-PCSE	Between	LSDV b)	GLS-AR1 c)	FGLS	GMM-AB d)	First Diff.
	1	2	3	4	5	6	7	8
GDP per Capita (1995$, PPP, logs)	0.51***	0.50***	0.53***	0.745***	0.86***	0.51***	0.59***	0.68***
	(0.084)	*(0.101)*	*(0.173)*	*(0.147)*	*(0.204)*	*(0.093)*	*(0.193)*	*(0.156)*
Log Tertiary Enrollment	-0.65***	-0.58***	-0.64***	-0.347***	-0.299***	-0.57***	-0.28***	-0.42***
	(0.053)	*(0.063)*	*(0.090)*	*(0.070)*	*(0.103)*	*(0.059)*	*(0.104)*	*(0.109)*
Log Fertility	-0.02	-0.09	0.05	-0.335*	-0.35	-0.11	-0.27	-0.23
	(0.085)	*(0.134)*	*(0.230)*	*(0.174)*	*(0.281)*	*(0.130)*	*(0.260)*	*(0.250)*
Log Urbanization	-0.08*	-0.176*	-0.083	-0.835***	-0.426	-0.20*	-0.40	-0.63**
	(0.041)	*(0.072)*	*(0.146)*	*(0.192)*	*(0.491)*	*(0.100)*	*(0.342)*	*(0.249)*
Log P.c. Exp. Student Secondary	0.29***	0.27***	0.27**	0.121*	0.169*	0.27***	0.23***	0.24**
	(0.053)	*(0.067)*	*(0.131)*	*(0.060)*	*(0.070)*	*(0.050)*	*(0.074)*	*(0.098)*
Log Total Public Education Expenditure	0.83***	0.64***	0.61***	0.847***	0.585***	0.63***	0.53***	0.56***
	(0.094)	*(0.112)*	*(0.208)*	*(0.110)*	*(0.126)*	*(0.099)*	*(0.132)*	*(0.095)*
Stata-Methold	xtpcse	xtpcse	xtreg	xtreg	xtregar	xtgls	xtabond	reg D.y D.x
Option		corr(ar1)	be	fe	lbi, fe	corr(ar1)	lags(1)	robust
# of Obs.	345	345	345	355	275	345	207	276
R squared	0.74	0.95	0.74	0.73	0.44		c(yt-1)= 0.22*	0.34
		rho 0.59			rho 0.44	rho 0.68		

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

a) LM Test rejects OLS at any significance levels.
b) Hausmann Test rejects random effects at any signficance level.
c) Barghava modified Durbin-Watson: 1.16
d) Arellano Bond test: H0 no autocorrelation in residuals cannot be rejected

Column 4 of Table II shows the baseline LSDV results from the previous regressions (Table I, column 3). Column 1 displays a simple Prais-Winston OLS estimator with panel corrected standard errors, while column 2 includes correction for autocorrelation of first order. Both estimates yield results highly similar to the between estimator displayed in column 3; although the regression statistics (especially the R squared of 0.95 in column 2) look nice, both the standard LM and the Hausman test indicate that a standard OLS is likely not appropriate in our setup.

In columns 5 to 8 we try to account for possible autocorrelation problems indicated by a surprisingly low DW statistics of 1.17. Column 5 displays a fixed effect within estimator including an AR1 term. The results are largely in line with our baseline, with the exception of urbanization and fertility, whose mostly identical coefficient appear to be no longer significant. Columns 6 shows a feasible GLS estimator, which largely reproduces the result from the AR(1) corrected PW estimate in column 2. The estimates of column 7 and 8 are based on first differences. While column 8 shows the results of simple OLS with first differenced variables, column 7 shows the results of the Arellano-Bond (AB) estimator. The lagged dependent variable shows up significant at a 90% confidence interval in the AB estimator, and the estimator seems to perform well in eliminating the first order autocorrelation detected before.

Even though the two difference-based estimator overall yield similar results, the coefficient on tertiary enrollment is higher in the first difference setup than in the basic fixed effects model, and lower in a AB type setup. The AB estimates are likely to be the least biased in our setup, and seem to strongly support our baseline findings with respect to enrollment and the generosity of educational spending in general, but do imply that the effects of fertility and urbanization picked up by the LSDV regression may be spurious, and generated by intertemporal dynamics not accounted for. Overall, the negative enrollment effect is highly robust with respect to the various dynamic specifications.

Summing up, the empirical results seem to consistently indicate a negative expenditure elasticity of around 0.3 with respect to enrollment rates, and a positive elasticity of around 0.6 with respect to the overall educational budget.

Next, we run similar regressions for the generosity in secondary education in order to test whether the variable behaves similarly to the tertiary education expenditure analyzed in the previous section. The results of these regressions are displayed in table III below. While random and fixed effect models (column 1 and 2) imply that the forces driving secondary education are more or less identical to the ones driving tertiary education, the dynamic models presented in column 3 and 4 imply that there is no significant effect of enrollment on per capita expenditure in secondary education.

Most of the variation in expenditure seems to be generated up by GDP per capita, which shows a surprisingly high elasticity close to 1 even in the dynamic models. More similar to the previous models, both measures of overall generosity of education spending appear significant in both dynamic setups.

Table III: Log Expenditure per Student in Secondary Education (1995 US$, PPP))

	RE a)	LSDV	GLS-AR(1)	GMM-AB
	1	2	3	4
GDP per Capita (1995$, PPP)	1.06***	1.32***	1.05***	0.91***
	(0.102)	*(0.102)*	*(0.187)*	*(0.205)*
Secondary Enrollment	-0.34***	-0.34***	-0.116	-0.116
	(0.099)	*(0.099)*	*(0.143)*	*(0.142)*
Fertility	-0.051	-0.051	-0.237	-0.175
	(0.152)	*(0.152)*	*(0.276)*	*(0.251)*
Urbanization	-0.53***	-0.53***	-0.68	-0.64*
	(0.192)	*(0.192)*	*(0.517)*	*(0.331)*
P.c. Exp. Student Tertiary	0.08	0.08	0.166**	0.181***
	(0.055)	*(0.055)*	*(0.069)*	*(0.067)*
Total Public Education Exp. (% GDP)	0.45***	0.45***	0.37***	0.31**
	(0.111)	*(0.111)*	*(0.130)*	*(0.134)*
Panel (balanced, unbalenced)	bal	bal	bal	bal
Stata-Methold	xtreg, re	xtreg, fe	xtregar, fe lbi	xtabond
# of Obs.	345	345	276	207
R squared	0.86	0.83	0.82	
time dummies	yes	yes	yes b)	yes

a) Hausman test reject H0 Random effects at any signficance level.
b) Modified DW satistic: 1.11

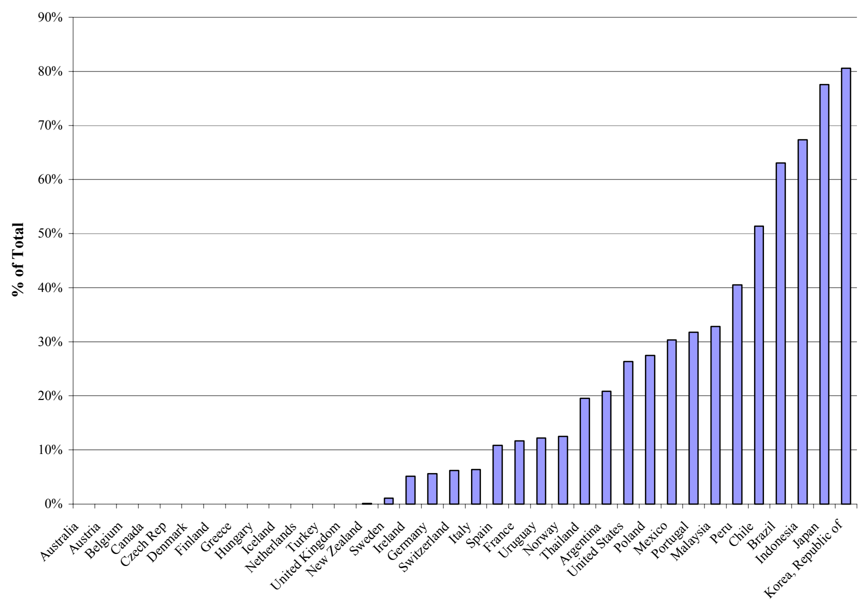
Summing up, the empirical results from the panel regression provide some strong and significant support for the political model presented in this paper; the larger the overall access to higher education, the lower the degree of public subsidization. More importantly, similar forces do not seem to apply for secondary education. This is an important finding, since one alternative explanation for the empirically observed phenomenon (lower subsidies with higher enrollment) might also be explained by economies of scale; since no economies of scale seem to be present in the area of secondary education, they are likely to not play a major role for higher education either - strenghtening the political argument presented in this paper.

4.1 A short Comment: Democratic versus Oligarchic Systems

Building on Acemoglu's (2003) recent work, one may want to introduce oligarchic systems as alternative way to determine a political equilibrium; the results of such an assumption follow straightforward from the exhibition in the previous section: As long as the talented are a majority among the rich elite , public education will never be supported, and redistribution will be set to zero in an oligarchic society. As a consequence, the distribution of incomes and bequests will become more polarized over time, and the support for public education and redistribution remain at very low levels.

Empirically, such a classification obtains some support from recent data provided by the UOE[5], which compare the provision of public higher education among the various countries, as summarized by the following graph:

Graph II: Enrollment in Private Institutions of Higher Education



The picture of the data is quite clear. About half of the countries in the sample rely exclusively on public education, while the share of students enrolled into private institutions is less than 20% in about two thirds of the sample. On the other hand, private institutions dominate the higher education sector in some of the South American and Asian country, most prominently in Japan and Korea.

Overall, the data appears to suggest that there is a strong divide between countries heavily relying on the public provision of higher education, and countries nearly exclusively relying on the private provision of higher education. Although better means of classification are needed here, one might argue that those countries relying heavily on the private provision of higher education are also the ones with a more oligarchic background, so Acemoglu's (2003) framework might at least partially be applicable in the setup presented here.

[5] A joint project by UN Statistical Office, the OECD and Eurostat, short UOE.

5 Summary

In this paper we present a dynamical framework to analyze the political economics of higher education. We demonstrate that higher education subsidies will always emerge in a legislative bargaining model where poor agents trade off redistribution against higher education access, explaining the generally very high levels of public expenditure on higher education across countries empirically observed.

Further, we demonstrate that the political support for public expenditure on higher education will slowly decrease over time as overall enrollment goes up and the subsidies become more costly from political perspective, a claim which we support with empirical evidence from a panel dataset based on Worldbank data.

6 Appendix

6.1 Labor Market Effects

Setting $A_t = 1$ to simplify the exhibition, the labor market premium π_t in any period t is given by the wage differentials, that is

$$\pi_t = \alpha(\frac{1-H}{H})^{1-\alpha} - (1-\alpha)(\frac{H}{1-H})^{\alpha} \tag{12}$$

Differentiating this expression with respect to H, we get

$$\pi'(H) = -\alpha(1-\alpha)[H^{\alpha-2}(1-H)^{1-\alpha} + 2H^{\alpha-1}(1-H)^{-\alpha} + H^{\alpha}(1-H)^{-\alpha-1}] \tag{13}$$

Since all of the terms inside the square brackets are positive, it is straightforward to see that < 0, which proves part 2 of proposition 1.

Deriving this expression once again with respect to H yields

$$\begin{aligned}\pi''(H) &= -\alpha(1-\alpha)[(\alpha-2)H^{\alpha-3}(1-H)^{1-\alpha} - 3(1-\alpha)H^{\alpha-2}(1-H)^{-\alpha} - \quad (14)\\ & 3\alpha H^{\alpha-1}(1-H)^{-1-\alpha} + (1+\alpha)H^{\alpha}(1-H)^{-\alpha-2}] \quad (15)\end{aligned}$$

While all terms on the first line of this derivative are positive, the terms on the second line are negative, so that the sign can not be determined in a general form. For the parametric assumption we have in our model ($\alpha > 0.5$), the second derivative is first positive up to some threshold, and then turns increasingly negative.

6.2 Data Description

- e3expxstud: Public Expenditure per student in tertiary education (1995 US$, PPP)
- e2exxstudc: Public Expenditure per student in secondary education (1995 US$, PPP)
- e3enrol: Gross enrollment in tertiary education (%).
- e2enrol: Gross enrollment in secondary education (%)
- e1enrol: Gross enrollment in primary education (%)
- e3pubgdp: Total public expenditure on education (as % of GDP)
- govexptot: Total government expenditure (% of GDP)
- gdpppp95: GDP per capita, constant 1995 US$ (PPP)
- urban: Percentage of population living in urban areas (UN definition)
- fert: Fertility rate (births per woman, total)
- pop14: Population aged 14 and young as % of total population

- poptot: Total population (Millions)

Variable		Mean	Std. Dev.	Min	Max	Observations	
year	overall	1990	7.079923	1980	2000	N =	400
	between		0	1990	1990	n =	80
	within		7.079923	1980	2000	T =	5
govexp	overall	27.30304	13.48723	0	96.23446	N =	400
	between		12.82709	0	59.79529	n =	80
	within		4.361259	4.129524	70.16515	T =	5
birthr~e	overall	26.14909	12.46007	7.96	56.09	N =	400
	between		12.03042	10.332	51.242	n =	80
	within		3.460231	14.86909	36.50509	T =	5
epublic	overall	4.5246	1.88599	.526	12.29	N =	400
	between		1.692359	1.370821	9.511601	n =	80
	within		.8494656	-.0809958	8.400032	T =	5
urban	overall	56.35501	24.44393	4.41474	100	N =	400
	between		24.19699	5.195636	100	n =	80
	within		4.228604	38.39096	73.72379	T =	5
e2enrol	overall	62.65257	33.06153	2.69664	154.5477	N =	400
	between		31.52955	6.438654	117.5779	n =	80
	within		10.43641	25.45455	116.8137	T =	5
e3enrol	overall	20.22418	17.9298	.3043317	94.66455	N =	400
	between		16.48327	.5219514	77.03933	n =	80
	within		7.245919	-5.562651	49.10476	T =	5
gdpppp	overall	8.543518	7.701336	0	41.76303	N =	400
	between		7.473581	0	26.55795	n =	80
	within		2.004023	-1.008109	23.74859	T =	5
e3expx~t	overall	5095.213	4139.216	0	32470.48	N =	400
	between		3596.112	0	16780.66	n =	80
	within		2081.041	-4497.153	20785.03	T =	5
e2expx~t	overall	1640.448	1882.717	0	9756.048	N =	400
	between		1764.425	0	6449.649	n =	80
	within		680.1765	-2093.188	5248.335	T =	5
le2exp~t	overall	6.958224	1.145103	2.416409	9.185642	N =	355
	between		1.097753	4.696696	8.737568	n =	71
	within		.3461442	4.365171	7.946913	T =	5

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