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# Escaping from Mass Education - Why Harvard Pays

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January 11, 2005

## Abstract

Private universities, as opposed to publicly financed ones, are dominant in some countries and almost non-existent in others. We develop a dynamic model to demonstrate that private providers emerge as soon as they can profitably sell an elite signal to the most highly talented. As private providers engage in cream skimming, the returns to publicly provided education decreases, but the average return to higher education increases because of the signaling benefit created. We use numerical simulations to demonstrate the dynamic implications of our model, and provide some basic empirical evidence in support of the theory presented.

*JEL classification: H520, I220*

*Keywords: Higher (Tertiary) Education, Signaling.*

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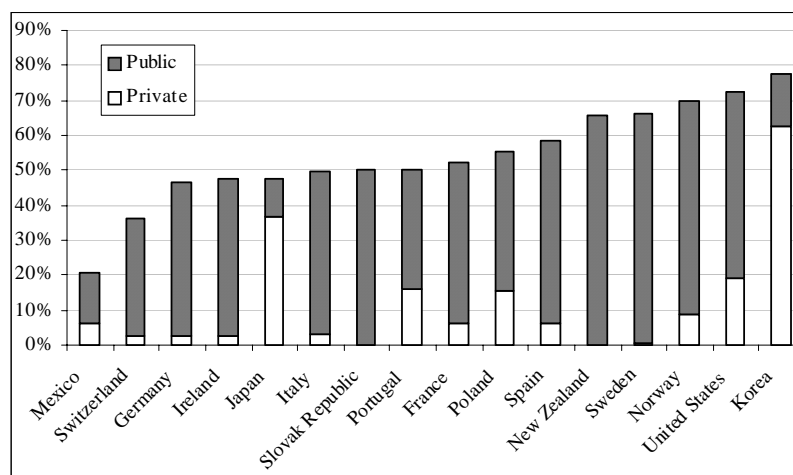
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# 1 Introduction

The degree to which higher education is provided by private rather than publicly financed universities varies substantially across countries. While total enrollment in higher education can largely be explained by wealth and income levels<sup>1</sup>, there is no established theory in the literature that explains why private providers have taken substantial market shares in some countries but remain marginal in others. In 2002, the share of private providers in the higher education sector was 32 percent in Portugal and 26 percent in the United States, but only 1 percent in Sweden and 0.1 percent in New Zealand.<sup>2</sup> More surprisingly, as can be seen in figure 1, both the absolute and the relative size of the private higher education sector are seemingly unrelated to the total size of the higher education sector - countries like New Zealand, Sweden, Norway and the US are very similar with respect to total enrollment, but show completely different patterns in the provision of higher education.

**Figure 1. Enrollment with private and public universities in selected OECD-countries.**



To shed light on the emergence and consequences of private versus public

<sup>1</sup>See, for example, Bergh and Fink (2004). This basic income/enrollment correlation is also in line with the recent growth literature which claims that the returns to higher education increase as economies move towards the technology frontier and the production shifts from imitation to innovation. See for example, Aghion et.al. (2003).

<sup>2</sup>Data on total enrollment rates comes from the Worldbank's world development indicators (WDI), and data on the relative size of the privates university sector is from the UIS / OECD / EUROSTAT 2002 Data Collection on Education Statistics (UOE). As private institutions we count only those defined by the UOE as private and independent.

providers of higher education, we develop a model where higher education serves as a signal of unobservable talent (Spence, 1973), but also has a positive effect on workers' productivity. In the model, each individual receives a wage which is based on the average talent of all individuals with the same type of education. The model predicts that the entry of private providers depends on the shape of the talent distribution, the degree of subsidization within public education and on the fixed cost of entering the higher education market. When the talent distribution is more compressed, less can be gained from enrolling the most highly talented into private institutions. Similarly, the higher the fixed costs of entering, the later private universities will emerge and the slower the growth of the private sector will be. The effect of subsidies to public education, on the other hand, is theoretically more ambiguous. Higher subsidies increase the relative price of the services offered by private institutions, and thus make it harder to compete for potential new entrants. On the other hand, higher subsidies have a positive incentive effect on overall enrollment. Since public subsidies increase the overall enrollment rate but decrease the relative size of the private sector, the effect of public subsidies on total enrollment in private institutions of higher education is uncertain.

Further, we show that the emergence of private institutions in itself has a significant impact on the structure of the higher education sector. First, the entry of private providers significantly increases the average return to higher education. This is so because private higher education increases the premium for the most talented, but, by the same means, lowers the premium for public education, which then attracts a lower number of students. As a consequence, total enrollment in higher education decreases as private institutions emerge.

The theory presented here builds on Spence's (1973) seminal work on signaling and applies the basic mechanism developed therein to a dynamic framework with multiple potential education providers. Our model is related to the recent work by Hendel et al. (2001), who demonstrate that the easing of credit constraints will eliminate the pool of highly talented among the uneducated, and thus increase wage inequality over time. While this finding is in line with our model, we do not model group specific credit constraints explicitly but rather focus on the organizational structure of higher education and its implications. As to the emergence of private providers of higher education, to our knowledge, the research closest to this paper are the simulations conducted by Ortman et al. (2002). Applying various types of matching models Ortman et al. take a simulation approach to explain the recent emergence of low cost private education providers in the US. Although we also calibrate our model to the US. data

in some of the simulations, we are more interested in the high than in the low end of the market, and have a more international perspective in mind. Last, Futagami and Ishiguro (2004) use an overlapping generations model to show that there are two steady states when agents use education to signal ability. In one steady state, only high ability agents obtain education ("Elites steady state") and in the other, everybody obtains education ("Mass higher education" steady state). The model used by Futagami and Ishiguro model is a closed economy with no exogenous productivity growth, and the level of the initial capital stock determines which steady state is reached. Our model is set in an open economy, uses a dynamic framework, and leads to a unique steady state in the long run.

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

## 2 Background

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

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

Private providers can only enter the higher education market if such an entry is profitable. Profits are created by assisting the most highly talented individuals in credibly signaling their talent to employers, thereby assuring them higher wages. In the model present here, we assume that private and public institutions

have the screening technology<sup>3</sup> required for such a selection, but that only the private institutions apply it to generate profits. Since there is free entry and all entrants share the same technology, the private sector is perfectly competitive, so that all private providers operate at the optimal size<sup>4</sup> and generate zero profits in equilibrium. Given this, any private providers can and will enter precisely when it becomes profitable for a sufficient large pool of students to switch from public to private institutions.

Because the philanthropic provider is cheaper from the individual's perspective and initially offers the same signal, private entry will not occur up to a certain enrollment threshold. As long as only a few are enrolled with the philanthropic provider, there is no market for private providers. As incomes rise, enrollment with the philanthropic provider will increase, and the signaling value of completing philanthropically provided higher education will decrease. This makes it possible for private providers to offer a signaling premium large enough to enroll the required number of students to break even.

The model we present in this paper is agnostic with respect to what extent signaling and human capital explain the demand for higher education in general.<sup>5</sup> Human capital augmenting technology in higher education (which is optional but not necessary in our setup) simply increases the aggregate demand for higher education, but does not affect the qualitative results of our model.

Further, throughout the paper we assume that private and public providers dispose of the same production technologies. By this, we abstract both from arguments related to the relative performances of private and public sectors and from normative arguments based on educational content.<sup>6</sup> Second, we assume that the access to the public sector is unrestricted for all agents. In reality, the set of possible constraints in the public sector is large, ranging from highly selective high school system and placement exams to enrollment ceilings currently enacted in a large range of countries. While these "institutional" factors are crucial to understand the variation in enrollment rates across countries, they add little value to the aspect taken into consideration in this paper. Last, the model implicitly assumes that all agents enrolled in one university earn the same

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<sup>3</sup>The screening technologies applied by most private schools can be considered as complex as cost intensive, and range from basic standardized tests to personalized interviews.

<sup>4</sup>We assume some generic U-shaped cost function based on high initial fixed cost and increasing marginal costs caused by general capacity constraints.

<sup>5</sup>The signaling approach to modeling education itself is not undisputed. While some studies raise doubts regarding its validity (for example Kroch and Sjoblom 1994), others have empirically confirmed the signaling hypothesis (for example Lang and Kropp 1986 and Bedard 2001) For a comparison of the human capital models and the signaling models, see Weiss (1995).

<sup>6</sup>Concerns regarding the ideological independence of educational institutions have without any doubt been one of the major motivations for public expenditure on higher education, especially in countries traditionally subject to strong clerical institutions.

premium, which is clearly a simplification of reality<sup>7</sup>, but allows us to abstract from strategic enrollment choices and thus to keep our model tractable.

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

### 3 The Model Structure

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

#### 3.1 The Production Sector

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

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

where  $K_t$  and  $H_t$  are the total stocks of physical and human capital<sup>8</sup> at time  $t$ , and  $A_t$  captures the technology employed in the economy. The production

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<sup>7</sup>See Krueger and Dale (1999), who show that market premiums depend primarily on agent's talent and not necessarily on their strategic school choice.

<sup>8</sup>We denote individual characteristics by small letters, while capital letters are used for aggregate measures.

sector is perfectly competitive. Producers choose a profit maximizing level of production for a given wage rate  $w_t$  per efficiency unit of labor and an exogenously determined interest rate  $r$  for capital. Thus, the levels of human and physical capital in any period of time are determined by

$$\{K_t, H_t\} = \arg \max_{K_t, H_t} [Y(A_t, K_t, H_t) - w_t H_t - r_t K_t]. \quad (2)$$

The inverse demands for human and physical capital are given by

$$r_t = Y'_K(A_t, K_t, H_t) = \alpha A_t \left(\frac{H_t}{K_t}\right)^{1-\alpha}, \quad (3)$$

$$w_t = Y'_H(A_t, K_t, H_t) = (1 - \alpha) A_t \left(\frac{K_t}{H_t}\right)^\alpha. \quad (4)$$

Since we assume the interest rate  $r$  to be constant and productivity  $A_t$  to rise over time, equation (3) implies that the ratio  $\frac{H}{K}$  will decrease over time. Plugging the optimal human to physical capital ratio into (4), the wage rate  $w$  per efficiency unit of labor in each period  $t$  is given by

$$w_t = (1 - \alpha) A_t \frac{(\alpha A_t)^{\frac{\alpha}{1-\alpha}}}{r_t^{\frac{\alpha}{1-\alpha}}} = (1 - \alpha) A_t^{\frac{1}{1-\alpha}} \left(\frac{\alpha}{r_t}\right)^{\frac{\alpha}{1-\alpha}}. \quad (5)$$

which implies that the wage increases over time as  $A_t$  goes up. Firms operate in a perfectly competitive market. They know the overall distribution of talent and observe the aggregate enrollment decision, but cannot observe the talent of an individual agent.

### 3.2 The Formation of Human Capital and the Enrollment Decision

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

Following Spence (1973), we assume that higher education is costly, and that the effort cost of completing tertiary education is decreasing in the talent of each



agent.<sup>9</sup> More specifically, we assume that higher education is associated with some constant pecuniary cost and an agent specific cost  $c(\theta^i)$ , such that  $c' < 0$ .

Since firms can not observe talent, wages reflect the average talent of agents with different degrees of education. Tertiary education works as signal because the average talent of the educated will be higher than the average talent of the uneducated. The expected benefit of completing tertiary education depends on the overall wage rate which is a function of technology, and the relative wages paid by firms for educated and uneducated workers. The sequence of decisions is the following: In each period agents observe the technology level  $A_t$ , their talent  $\theta_t^i$  and the overall distribution of talent  $F(\theta)$ . Based on these parameters, agents calculate their expected premiums  $\pi_t$  of higher education, and then decide whether or not to enroll. Once enrollment decisions are made, firms observe the labor market, and determine the new relative wages based on the average talent of each group.

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

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

$$\hat{\theta}_t^u = \int_0^{\underline{\theta}_t^{pu}} \theta_i f(\theta) d\theta, \quad (6)$$

$$\hat{\theta}_t^{pu} = \int_{\underline{\theta}_t^{pu}}^{\underline{\theta}_t^{pk}} \theta_i f(\theta) d\theta, \quad (7)$$

$$\hat{\theta}_t^{pk} = \int_{\underline{\theta}_t^{pn}}^{\underline{\theta}_t^{p_{n-1}}} \theta_i f(\theta) d\theta \text{ for } n = 2..k, \quad (8)$$

$$\hat{\theta}_t^{p_1} = \int_{\underline{\theta}_t^{p_1}}^{\infty} \theta_i f(\theta) d\theta. \quad (9)$$

Agents who enroll into higher education augment their human capital by  $\delta$ , so that the market premiums  $\pi_t$  paid in the labor market is

$$\pi_t^j = (\delta \hat{\theta}_t^j - \hat{\theta}_t^u) w_t \quad (10)$$

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

Denoting the tuition fee charged by institution  $j$  by  $T^j$ , an agent  $i$  will enroll

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<sup>9</sup>Lower cost for the talented does not only model less effort required within universities, but also higher chances of getting scholarships, or higher chances to finish degrees faster.

into publicly provided higher education if

$$\pi_t^{pu} = (\delta \widehat{\theta}_t^{pu} - \widehat{\theta}_t^u) w_t \geq T^{pu} + c(\theta_t^i) \quad (11)$$

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

$$\pi^{pr} - \pi_t^{pu} = (\widehat{\theta}_t^{pr} - \widehat{\theta}_t^{pu}) \delta w_t \geq T^{pr} - T^{pu} \quad (12)$$

where, as before,  $pr \in \{p_1, p_2, \dots, p_k\}$  represents all private institutions.

Since we assume the tuition cost of higher education to be constant in real terms and wages to rise over time, (11) becomes less binding and overall enrollment increases over time as aggregate productivity  $A$  increases.

### 3.3 The University Sector

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

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

New entrants face fixed and marginal costs like the incumbent, but have no outside resources to cover their costs, so that the tuition fee  $T^{pr}$  charged by any private provider must cover the full economic cost. Since this tuition cost is higher than the subsidized cost charged by the incumbent, entry can only be successful if the institution can offer additional premiums to its students. Abstracting from other diversification strategies<sup>10</sup>, private universities compete with the cheaper philanthropic institutions by offering higher wage premiums. Since wage premiums are determined in the labor market based on each cohort's talent, private institutions can generate and offer wage premiums only by restricting their access to the most talented. The higher the average talent of

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<sup>10</sup>In reality universities can offer a whole variety of benefits to attract students, ranging from nicer campuses and better school teams to more targeted programs and more highly renowned teaching staff.

their students relative to the average talent of the students in the philanthropic institution, the higher will be the premium associated with private enrollment. On the other hand, the fewer students the entrant admits, the higher the cost it needs to charge.

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

$$T^{pr} \geq m(e^{pr}) + \frac{X}{e^{pr}} \quad (13)$$

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

Since effort costs and the productivity effect  $\delta$  are the same for private and public providers of higher education, the wage premium generated by the difference in the talent pool must at least offset the difference in the tuition charged. At any point in time  $t$  potential students observe the state of the technology and their own as well as the talent of the others, and then decide whether or not to enroll.<sup>11</sup> Once the enrollment decision is taken by the students, private firms decide whether or not they will enter the education market. From a dynamic perspective, it follows directly from the setup outlined above that the first private institution will emerge as soon as

$$\delta \left[ \int_{\theta_t^{p1}}^{\infty} \theta_i f(\theta) d\theta - \int_{\theta_t^{pu}}^{\theta_t^{p1}} \theta_i f(\theta) d\theta \right] w_t > T^{p1} - T^{pu}. \quad (14)$$

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

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<sup>11</sup>We have reduced the dynamics of the model to the private firms. Explicit modeling of the interactions between private and public institutions drastically reduces the dynamic tractability of the system without adding significant value to the analysis.

### 3.4 The Equilibrium of the Economy

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

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

(ii) The enrollment decision by each agent  $i$  in period  $t$  is individually and optimally determined given  $A_t$  and  $F(\theta)$  such that inequalities (11) and (12) are satisfied.

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

(iv) The relative wages and premiums  $\pi_t$  for agents not enrolled ( $w_t^u$ ), enrolled in public education ( $w_t^{pu}$ ) and those enrolled in private institutions ( $w_t^{pr}$ ) are given by the period specific wage per efficiency unit of labor  $w_t$  times the average talent of the corresponding group as determined by equations (6) to (9), and the human capital augmenting factor  $\delta$ .

## 4 Simulation and Empirics

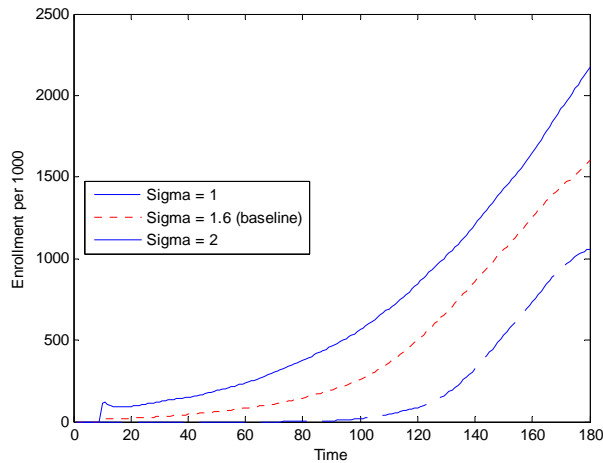
We run a simulation with 1000 agents drawn from a lognormal talent distribution parametrized to fit the current US income distribution.<sup>12</sup> The effort cost of education is given by  $c(\theta) = \frac{1}{\theta}$ . We assume that wages grow 2% per period relative to the private costs of enrolling. Higher (lower) relative wage growth rates simply leads to a faster (slower) increase in enrollment over time. For the simulations we use  $\delta = 1$  as baseline. Other specifications do not significantly alter the results, other than simply accelerating the overall enrollment process.

In our first simulation (shown in figure 2), we abstract from the private sector, to show how enrollment increases over time as the cost of education decreases relative to average income levels.

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<sup>12</sup>The ratios of incomes 90/10 and 50/10 are 14 and 3.6 in our simulated sample, which corresponds exactly to the 2002 US census data.

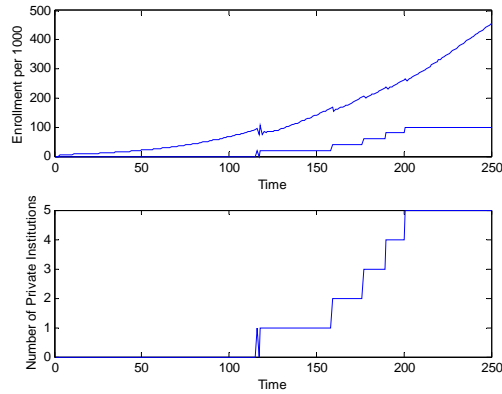
**Figure 2. Talent Distribution and Higher Education Enrollment over Time** (Baseline: US Income Distribution 2002).



While the increase in enrollment over time is mainly driven by income growth, the exact shape of the enrollment curve is determined by the shape of the talent distribution. A more compressed talent distribution means a lower signaling value of higher education, and thus lower enrollment rates at any point in time, as shown in figure 2 above.

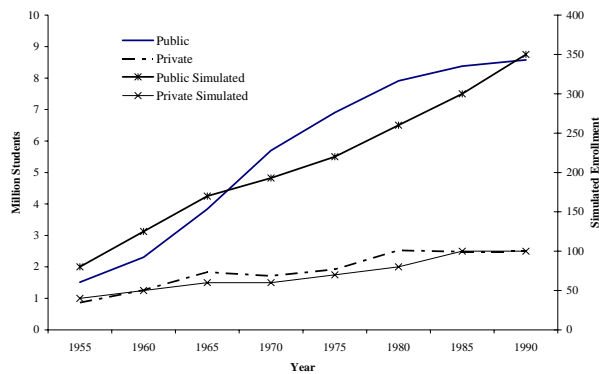
Having said this, we take the parameters from the US income distribution as our standard assumption in the remainder of this section and now add private providers to the model. We assume the optimal size for private providers to be 2% of the market, and that initially there is insufficient demand for the private institution. As enrollment increases, so does the demand for private providers, and the private institutions will emerge one by one, as shown in figure 3 below.

**Figure 3. Enrollment with public and private education providers**



The simulation results nicely illustrate our theoretical findings. Private institutions can only enter the market for higher education once the relative signaling value is sufficiently high. In our baseline simulation, the first private firm enters after public enrollment passes the 10 percent threshold and the second one at roughly 20 percent. The remaining entrants follow faster. As Figure 4 below shows, the model parameters selected fit well with the actual US enrollment data from 1955 to 1990.<sup>13</sup>

**Figure 4. Actual and Simulated Enrollment**



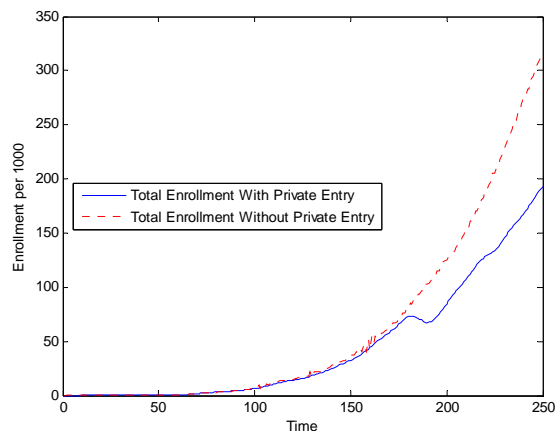
The actual number of students are displayed on the left axis of Figure 4, while the simulation results are displayed on the right hand side. The overall

<sup>13</sup>Source: US Census bureau, Historical School enrollment report.

fit of the model is quite good, and it does particularly well in predicting the relative sizes of the private and the public sector over time.

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

**Figure 5. Total enrollment with and without private providers**



Clearly, the emergence of private providers significantly reduces total enrollment rates over time. The intuition for this result is that as private providers enter the higher education market, the most highly talented students leave the public institutions. Since the premium from public education is directly determined by the average talent of the students with publicly provided education, increasing enrollment in private institutions reduces the return to public education. Therefore, total enrollment in a pluralistic system with both private and public providers will be lower than under a purely public higher education system, where all highly talent agents are pooled.

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

the simulation results for various levels of subsidies:

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

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

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

		<b>Entry Timing of Private Institutions</b>				
		<i>Degree of Subsidization</i>				
			10	40	70	100
First Private Institution	<i>Entry-Period</i>		75	93	107	116
Last Private Institution	<i>Entry-Period</i>		110	188	194	202

The first section of the table shows the enrollment effects of public subsidies in the absence of private education institutions. Subsidies are assumed to be proportional, that is the government covers some fraction of the total (private) cost of enrollment excluding the effort cost. As the table shows, the effect on enrollment of such subsidies is big in early stages of development where the cost of education is high relative to wages, while the net effect of subsidies levels off significantly in later stages of development. Switching from a subsidy of only 10% to a zero cost (100% subsidization) policy doubles enrollment after 150 simulated periods (from 8.6% to 17.1%), but has a much smaller relative effect on enrollment at the end of the simulated time period when total enrollment approaches 50 percent. This finding suggests that subsidizing higher education is a policy that will have a big effect on enrollment when higher education is limited to a small part of the population, but less so in a situation of mass higher education. To put it differently: The positive effect on enrollment of public subsidies is small relative to the effect caused by general wage growth.<sup>14</sup>

The second and third sections of the table display the effects of public sub-

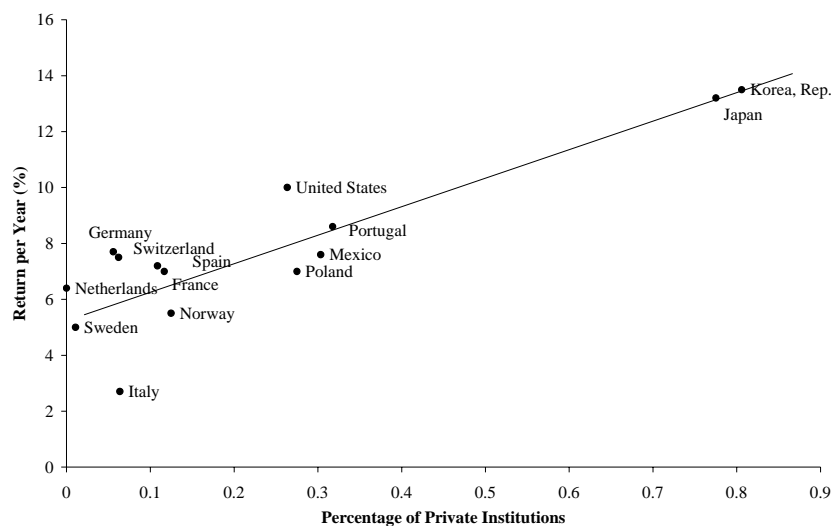
<sup>14</sup>This finding is in line with Bergh and Fink (2004), who fail to find a positive relation between public spending per student and enrollment, but do find a strong income effect on enrollment.



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

Another important result of our simulations is that private education leads to higher average returns to higher education over time, even if the level of subsidies for the public institutions is held constant. The intuition behind this result is straightforward. First, the most talented agents earn very high rents in the presence of the private sector, and second, the size of the public sector shrinks, as some of the lower talent agents will no longer enroll. This result itself is interesting enough, as it fits nicely with the empirically observed correlation between the size of the private sector and education premium as summarized in figure 7 below:

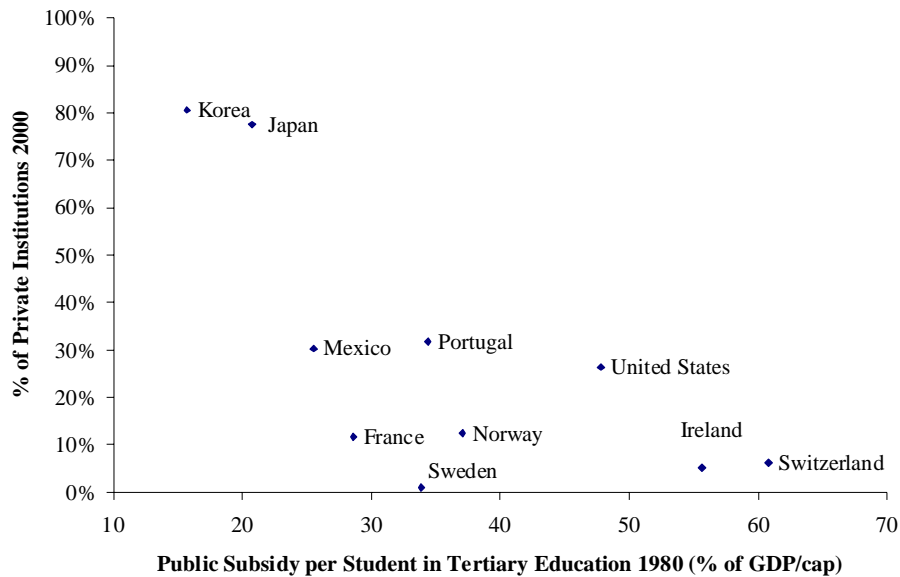
**Figure 7. Percentage of Private Institutions and the Returns to Higher Education<sup>15</sup>**



<sup>15</sup>Source: OECD.

The negative correlation between the degree of public subsidization and the relative size of the private sector predicted by the theoretical model and the simulation results is also confirmed empirically, as can be seen in figure 8 which compares current shares of private institutions to the degree of government expenditure on higher education in 1980.

**Figure 8. Percentage of Private Institutions 2000 versus Historical Degrees of Public Expenditure on Higher Education<sup>16</sup>**



## 5 Summary and Discussion

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

<sup>16</sup>Source: Institutional data: OECD, Expenditure data: WDI.

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

Finally, the model presented makes it very clear that the policy choices in higher education have distributive implications. The higher the subsidies to public institutions, the larger are enrollment rates and the smaller is the importance of private institutions. Thus, subsidizing public higher education reduces the wage gap between educated and uneducated labor. The analysis presented here makes it clear that private institutions will increase wage inequality even when there are no credit market imperfections and everybody can afford to enroll. Thus, publicly provided tertiary education may have an equalizing effect not because it has a big increase on enrollment, but because it serves to deter private providers that would otherwise lead to increased wage inequality.

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