Chapter 5 – Education financing

1. Introduction

When Milton Friedman published his famous contribution on *Capitalism and Freedom* in 1962, he devoted an entire chapter to the role of government in education. He made a careful distinction between public or private financing of education and its public (or private) provision, arguing that public financing could be justified on the ground of neighbourhood effects (positive or negative externalities on other people)[1] and/or paternalistic attitudes (concern for children of irresponsible parents), but it would not carry over to vocational education, where private return to increased skills would accrue to the individual. However, nothing could justify what he termed as the "nationalisation" of education provision, because this would reduce the parental freedom of choice. In his view, the role of government would be reduced to administering the allocation of publicly financed vouchers to families and to checking the existence of minimum requirements in approved schools.[2]

While Friedman's analysis is stringent in its market perspective, it seems to neglect some aspects of education provision that we have already highlighted in previous chapters, and in particular the existence of differences in abilities and/or in family backgrounds. Friedman viewed access to education as identical (or randomly different) individuals facing an investment opportunity, and objected to public subsidisation of choices providing private returns. However, when individuals are different under several respects (family incomes, unobservable abilities, neighbourhood effects, and so on), there is no guarantee that market allocation would automatically provide the equality of opportunity outcome, not to speak of the most efficient outcome. The problem is even exacerbated when there is intergenerational persistence of family choices.

The underlying logic of Friedman's argument is typical of neoclassical models of growth, characterised by decreasing marginal productivity of inputs.[3] Even if individuals are characterised by differences in the distribution of an accumulable asset (like family wealth or human capital), under the condition of existence of perfect financial markets, poor individuals will face a higher marginal return than rich individuals, and therefore will experience a stronger incentive to invest. As a consequence, in the long run the returns will be equalised, and a perfectly equalitarian distribution will arise.

If long run equalisation were the most likely outcome, one would be induced to abstain from any policy intervention that may distort the incentive structure and induce delays in the convergence process. But two conditions are rarely met in the field of educational investments: financial markets for education financing are imperfect (or even non existing), and individuals are differently endowed with abilities. A further complication is given by the intergenerational transmission of differences in ability endowments. In the sequel, we would explore the consequence of market solutions whenever these aspects are taken into account, and we will discuss how alternative forms of education financing may solve or exacerbate the problem. Each case will be considered under two aspects: equality of opportunities (each individual, conditional on effort, faces the same set of choices) and productive efficiency (for a given set of available resources – including individual abilities – the total output is maximum).

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[1] "A stable and democratic society is impossible without a minimum degree of literacy and knowledge on the part of most citizens and without widespread acceptance of some common set of values" (Friedman 1962, p.86).

[2] "Government could require a minimum level of schooling financed by giving parents vouchers redeemable for a specified sum per child per year if spent on 'approved' educational services" (Friedman 1962, p.89).

[3] An account of this approach can be found in the Appendix 1, where the long run convergence properties of the neoclassical models are shown along the lines of the model exposed in Stiglitz 1969.

2. The demand for education when agents differ in abilities and family incomes

A general framework for the analysis can be sketched as follows.[4] Consider an overlapping generation model, where individuals acquire education in the first period of their life, while in the second period of life they give birth to a child, work, consume, leave an inheritance and die. Individuals are born different in terms of unobservable ability, an input that cannot be purchased in any market, but that can be publicly observed at no cost. Individuals are distributed according to their ability $A_i \in \left[\underline{A}, \overline{A}\right]$ according to $F(A)$, with density $f(A) = F'(A)$. Ability can matter either in education acquisition or in the subsequent labour market career. We summarise these two cases into the following functional form, where labour market income is characterised by

$$W_{it} = W(E_{it}, A_{it}), W'_E > 0, W'_A > 0, W''_{EE} < 0, W''_{AA} < 0, W''_{EA} > 0 \tag{5.1}$$

Equation (5.1) states that labour market income W_{it} of individual i born in generation t depends positively on the amount of education she received and on her endowment of ability; both inputs exhibit the usual decreasing marginal productivity property. A crucial assumption is that education increases earnings more for abler individuals (alternatively, ability and education are complements in generating earning capability). Thus abler individuals obtain a higher return to education, and therefore face a stronger incentive to its acquisition. This assumption also has distributive implications: according to it, given two equally educated individuals, a marginal increase in the education of the brighter increases her future income more than the same increase would if assigned to the less bright. As a consequence, given the observability of talent, a benevolent planner will never allocate the same amount of education to two differently endowed individuals.[5]

Altruistic parents care about their own consumption and their children total income Y_{it+1}, which they can affect by financing their education or through direct monetary transfer

$$U_{it} = U(C_{it}, Y_{it+1}), U'_C > 0, U'_Y > 0 \tag{5.2}$$

The way in which parents contribute to education financing depends on the institutional context, whether through taxation and public provision of an identical amount to everyone, or through access to private schooling. While these aspects will be discussed in the next section, we will be content with assuming that each unit of education has a (relative) price p_E to the family, independently of public or private provision (for example, think of the opportunity cost of attending one additional year of schooling). Thus each family budget constraint is given by

$$Y_{it} = C_{it} + p_E E_{it+1} + X_{it+1} \tag{5.3}$$

where E_{it+1} is the educational expenditure a member of generation t on behalf of her child born in the next generation $t+1$, while X_{it+1} is a financial bequest to the same child. The model is closed by the definition of total income

$$Y_{it} = W_{it} + rX_{it} \tag{5.4}$$

[4] We follow the base model proposed by DeFraja 2001.

[5] This corresponds to Proposition 3 in DeFraja 2002.

By inserting equations (5.1), (5.3) and (5.4) into (5.2) and then maximising it with respect to the educational expenditure E_{it+1} and financial bequest X_{it+1}, we obtain that parents will finance the education of her child up to the point where the marginal return to education equals its relative price.[6]

$$W'_E\left(E^*_{it+1}, A_{it+1}\right) = \frac{r}{p_E}, \tag{5.5}$$

Using the implicit function theorem, it is straightforward[7] to show that

$$E^*_{it+1} = E\left(A_{it+1}\right), E' > 0, \tag{5.6}$$

that implies that abler children obtain more education because it is more profitable to invest in their education. However equation (5.5) applies only under the assumption of perfect financial markets, when parents can borrow against the future income of their child, because X_{it+1} can take either positive or negative values. When we impose the further constraint of $X^*_{it+1} \geq 0 \Leftrightarrow p_E E^*_{it+1} \leq Y_{it}$, we require that educational expenditure to be financed out of parental current income, which can prove insufficient, especially in the case of high ability children.[8]

When a parent is liquidity constrained, the educational investment becomes conditioned by available resources, and equation (5.6) has to be replaced by[9]

$$E^*_{it+1} = E\left(A_{it+1}, Y_{it}\right), E'_A > 0, E'_Y \geq 0, \tag{5.7}$$

Given a specific educational attainment (say for example college attendance), equation (5.7) depicts a locus in the $\left(Y_t, A_{t+1}\right)$ space, as described by figure 1. All families aiming at $E^*_{it+1} \geq \overline{E}$ (and capable to finance it) will invest in education, whereas all remaining families will refrain from further progress in education. The implication of this behaviour is that the proportion of children from richer families is increasing in the level of educational attainment. While children from poor families will attend the highest level of schooling only if their ability exceeds the threshold given by the implicit cost for a

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[6] The first order conditions are $\frac{\partial U}{\partial E} = -p_E U'_C + U'_Y W'_E = 0$ and $\frac{\partial U}{\partial X} = -U'_C + rU'_Y = 0$. By making use of the latter into the former we get equation (5.5) in the text. In the absence of monetary transfer, equation (5.5) would be replace by the condition $\frac{U'_C}{U'_Y} = \frac{W'_E}{p_E}$: the marginal rate of substitution of the parental choice must be equal to the market rate of return of the educational investment.

[7] It is sufficient to observe that $\frac{dE^*}{dA} = -\frac{W''_{EA}}{W''_{EE}} > 0$.

[8] Piketty 1997 contains a lengthy discussion on the reasons why potential lenders will deny credit to parents wishing to finance the education of their children using their future income as promise to debt repayment. His main point is based on the idea that children effort in the labour market might be unobservable, thus opening to moral hazard problems.

[9] The first order condition is now given by $\frac{\partial U}{\partial E} = -p_E U'_C + U'_Y W_E - \mu p_E = 0$ where μ is the Kuh-Tucker multiplier associated with the inequality constraint $p_E E^*_{i_{t+1}} \leq Y_{it}$.

parent to give up her current consumption, less able children from richer families will nevertheless attain the educational certificate, since parental resources overcompensate their lack of ability.[10]

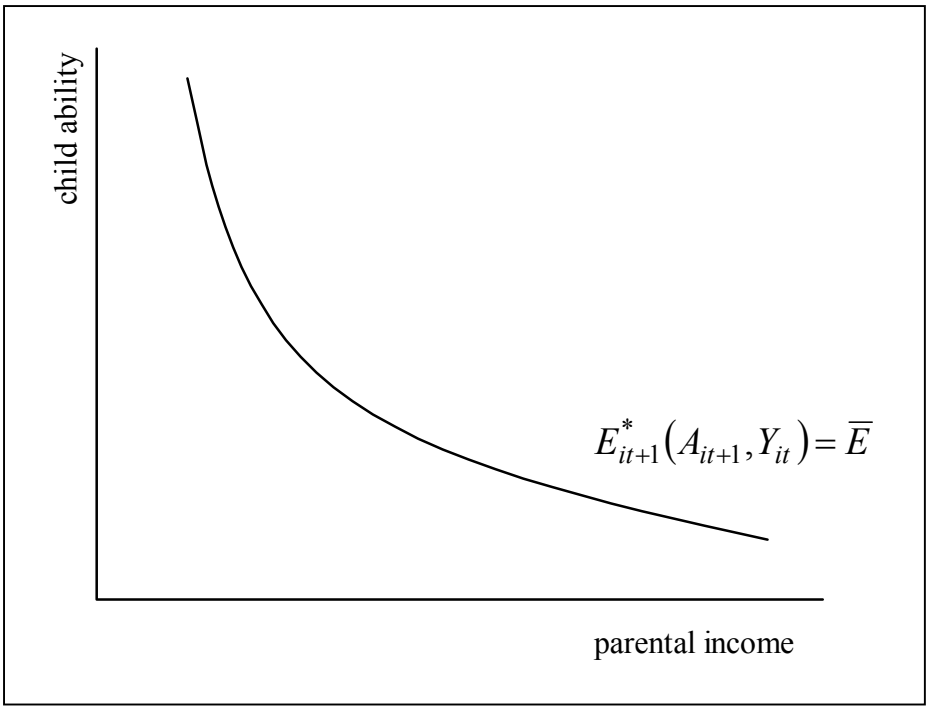

Figure 1 – The combination of ability and family income attaining a specific E^*

There are cases where different levels of attainable education are available. One case is given by the stratification of the educational system, between generalist academic-oriented secondary tracks and more vocationally oriented ones (especially at the secondary level - typical examples are the German gymnasium, the French *lycée* or the Italian *liceo*). A second case could be given by the presence of better quality private schools.[11] In the presence of peer effects, this can be the simple consequence of self-

[10] De Fraja 2002 presents a model where ability and education are complements in generating the children labour income, and the willingness to pay of parents is exploited by the government which does not observe the true ability endowment of children: "Those who get the most out of the education system are the bright children of sufficiently well-off parents…Because of these features, the optimal education policies operates in a direction opposite to a redistributive policy: brighter children are subsidised by the taxpayer and by the average children" (p.458). In a similar context, De Fraja 2001 shows that admission tests based on student ability induce a flatter relationship than the one depicted in figure 1: fewer students gain access to the higher level of education (university in his paper), but their average ability is increased.

[11] Private schools are typically assumed to be of better quality, on the argument that rational agents would not pay a price for a service of similar quality that is freely provided by the public sector. However private schools could be chosen for additional features: some parents elect to send their children to private schools because they explicitly support certain values, such as religion (Sanders, 2001); others because private schools have better facilities, such as libraries and laboratories, or lower transportation costs. Sometimes the quality of education or facilities is not even the main issue. Some people consider private education a status symbol (Fershtman, Murphy and Weiss, 1996), a way of improving their own and their children's social networks, of shielding their children from social problems, avoiding contact with immigrants and children with handicaps, or simply because they do not approve of the open and more heterogeneous public school environment (Gradstein and Justman, 2001). Empirical evidence on the return to private schooling is mixed: see Wright 1999 for the British evidence, and Brown and Belfield 2001 for a survey of existing literature on the overall effect of private school attendance (in terms of achievement, attainment, social outcomes and earnings). The crucial issue is how to control for sample self-selection: see the discussion in Mocan et alt. 2002.

sorting of students according to their abilities (as we have already seen in previous chapter): every parent wants to see her child in a class of brilliant students, and is willing to pay a price for it.[12]

Whatever the case, the existence of different level of educational levels creates the possibility of sorting students according to ability and family incomes. Suppose two levels of educational resources are available, E_1 and E_2, with $E_1 > E_2$. This corresponds to two loci in the (Y_t, A_{t+1}) space, where the former dominates the latter. In such a case, we should observe students from better backgrounds (namely, higher family income and/or better talent) choosing the highest quality school, whereas student of intermediate quality attend the second best school and low ability children from poor families will not attend school (or will go to public school if freely available).

The general conclusion of this family of models (see also the next chapter) is that children from richer families are over-represented in the highest levels of education. Do we find confirming evidence of this behaviour ? The next section will provide some supportive evidence of these theoretical predictions.

3. An application: the choice between private or public university in Italy

The model presented in the previous section suggests that more talented students from richer families tend to self-sort into private schools whenever:
i) private schools (or universities) are available
ii) private schools provide better quality education.
Unfortunately the second assumption is hard to verify, since school quality should be ascertained against future labour market prospects. However, conditional to the assumption that there is a positive premium in attending a private institution, we may wonder whether this induces student stratification.[13]

In the sequel we exploit the entire population of students attending an undergraduate course in economics in the city of Milan (Italy), during the academic year 1996-97.[14] When we compare our population with representative samples of the nation-wide population, by using unconditional means we notice that students attending a private university come from richer families.[15] In addition, students

[12] Epple and Romano 2002 (building on Epple and Romano 1998) propose a model based on this type of self-sorting: the peer effect makes school quality dependent on the ability composition of a school students' body; this creates an incentive for schools to cream-skimming (i.e. attracting best students). An unconditional voucher possibly exacerbates the problem, promoting a quality hierarchy of schools, whereas "…a simple tuition restriction combined with ability linked vouchers induces equal quality, competing and technically efficient schools". Otherwise, the market equilibrium yields better private schools charging the highest price, and public schools retaining the worst students.

[13] Indirect evidence of this effect in the case of university attendance in Italy can be obtained by specific surveys on labour market transitions after graduation. In a survey on students from State University in Milan (Italy) who graduated in 1997 and were interviewed in 2001, the median (net) income was 1394 euros and the median wait for the first occupation was 21 months. In a similar survey conducted on students from Bocconi University, a private university in the same city for the same year, the median income was 1549 and the median wait was less than 3 months. Both elements suggest the existence of a positive premium in expected earnings from attending a private university in Italy. Similarly, Naylor et al. 2002 find a positive premium for attending a private secondary school in England in the order of 3% after 6 month from graduation, and explain the premium as related to social networks associated with private schools.

[14] Data come from the administrative archives of the State University of Milan, Faculty of Economics, and of the Bocconi University, a private institution mainly offering courses in Economics. In the city of Milan there is a second private university, the Catholic University (Università Cattolica del Sacro Cuore), which did not make its information available to us. We suspect that Catholic University attendance includes an ideological bias towards religious education (students are required to take an extra course in theology each year) that we cannot account for. These data were collected in a joint research project with Andrea Ichino and Francesco Franzoni.

[15] Income data for the entire population are obtained from the Bank of Italy 1995 survey on Households Income and Wealth, with a sample restriction over families with children aged between 19 and 26 year old. Data on secondary school marks are obtained from a different source (Gasperoni 1997, tab.4) and are referred to the academic year 1994-95, whereas students' marks include a period comprised between 1990-91 and 1996-97.

attending these faculties seem to have obtained better scores in secondary school attendance (see table 1).

Tab.1 – Descriptive statistics concerning students attending a Faculty of Economics – Italy 1996-97

	Italian population	Students attending public university	Students attending private university
gross family income (millions of lira)			
mean family income	64.642	69.824	119.430
median family income	56.537	61.572	96.173
standard deviation income	33.882	41.543	70.150
marks at exit secondary school (in 60ths)			
average marks	44.85	47.18	51.41
standard deviation marks	6.88	6.68	7.00

Prima facie, it seems that there is some corroborating evidence in favour of the previous considerations: better students (as captured by the marks obtained at the end of secondary school, which reflect both parental education and unobservable ability) self-sort into university attendance.[16] In addition, as long as family incomes allow the financing, and the students pass an entry test, they enrol a private university. Private university attendance is significantly more expensive than public. In our reference academic year 1996-97, entry fees for a public university ranged between 687 and 1885 euros, depending on the family income. The corresponding figures for the private university ranged between 601 and 5847 euros.[17]

When we analyse the distribution of students according to (log) family income and talent, we find evidence of negative correlation (see figure 2).[18] We proxy individual talent by normalising the marks at exit of secondary school by type of secondary school, in order to account for differences in grading policies of different school types. The regression lines are negatively sloped and do not intersect, providing additional support to the idea that families invest in further education of their children provided that they reach a sufficient level of talent. While we do not directly observe children who do not enrol in university, we would expect to find them in the bottom-left portion of the same graph.

[16] Ganderton 1992 presents similar results with respect to college application and quality selection in the US case: "Wealth as proxied by the socio-economic status measure, high school grades and test scores all have a positive effect on the probability of applying to college." and also "Wealth, as proxied by the socio-economic status, and ability, as measured by test scores, both have a negative effect on the probability of choosing a public college." (Granderton 1992, p.283).

[17] It is worth noticing that a child from a poor family should in principle apply for private university attendance, spending even less than attending a public one. However entry tests based on both logic/numeracy/literacy task assessments and marks form previous schooling should ensure that only the most brilliant of them would have gained admission. In this way, the private institution can attract the best students from poorest backgrounds.

[18] The correlation between our proxy for talent and (log) family income is –0.086 (2.99) among the students in the public university and –0.12 (10.4) among the students in the private university.

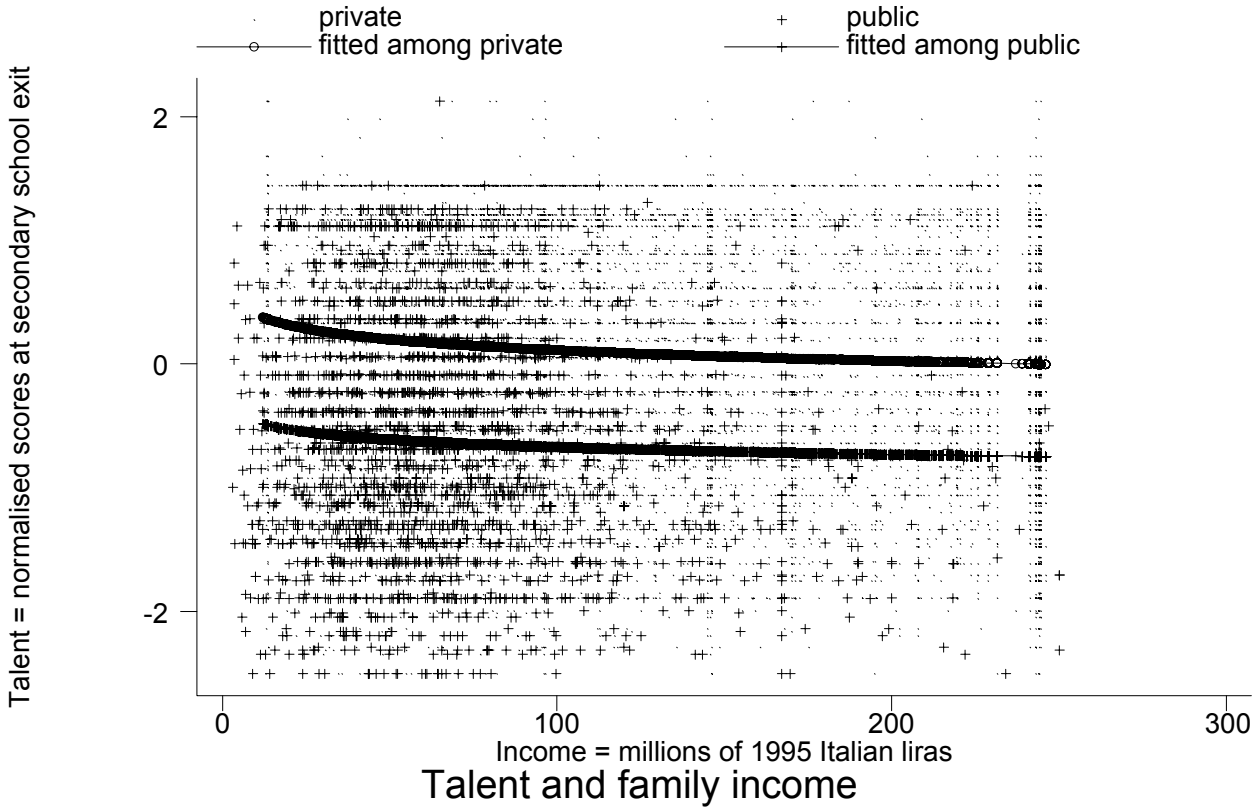

Figure 2 – Distribution of ability and family income

These considerations can be made more rigorous by analysing the choice between public and private university attendance, conditional on having already chosen to attend a faculty of economics at university.[19] In table 2 we estimate a probit model for the choice of attending a private university. This table shows that families are more likely to send children to a private institutions the better performance they have exhibited during their secondary school (as captured by the TALENT variable) and the richer they are. They are also marginally more inclined to send boys than girls to a private university, possibly reflecting a typical Southern European country attitude to invest more in male than female children. The second column of the same table hints that sorting has already begun at earlier stages, when students choose the secondary school type: brightest students were directed towards academic oriented tracks, whereas less brilliant ones were oriented towards vocational schools.[20]

[19] The sample is self-sorted twice, for both university attendance and the choice of a faculty of economics. The first choice is typically related to parental education and type of secondary school attended (see Checchi 2000). The second choice is more difficult to assess, in the absence of specific studies. The common perception of a course in Economics in Italy is quantitative oriented course, thus discouraging students with some interest in humanities.

[20] Checchi 2003 studies how the Italian educational system sorts the students according to their family background, showing that early tracking during the lower secondary school is highly correlated with parental education.

Tab.2 – Maximum likelihood probit estimation of private university attendance
Faculty of Economics – Italy 1996-97
(t-statistics in parentheses)

# obs :	16750	16750
Depvar:	priv=1	priv=1
talent	0.006	0.007
	(23.45)	(28.78)
log(inc)	0.099	0.071
	(34.51)	(27.48)
male	0.045	0.030
	(11.09)	(8.52)
classic high sch		0.066
		(14.89)
scientif high sch		0.091
		(18.11)
technical secnd sch		-0.001
		(-0.03)
foreign secnd sch		0.057
		(10.60)
Constant	yes	yes
Residence	yes	yes
pseudo-R^2	0.231	0.290

While finding evidence of sorting according to family income does not contradict previous theoretical assumption (altruistic parents, complementarity between acquired education and ability, financial market imperfections), it is also observationally equivalent to many other explanations.

One explanation refers to the screening role of private institutions. Independently of the quality of teaching and learning within a specific university (that should be correlated with the quality of newly formed human capital), whenever a firm knows in advance that students are sorted according to their talent between private and public institution, it will pay a positive premium to students graduating from private institutions. In such a case, private school attendance operates as a signal that is purchased in the market at a price exceeding the price of public institutions. Private education will then be demanded as long as its cost falls short of expected income gains.

A second explanation concerns the status acquisition. Whenever a degree from a private institution is perceived as an "admission ticket" to become member of the ruling elite, thanks to social networking you may achieve during your academic career, then it can be sold at a positive price in a market where public education is freely accessible.[21] When we compare the social composition of students from a private university with the entire population (as done in table 3), we notice that all occupations

[21] On the notion of social network see Montgomery 1991, where he presents a model with unobservable ability of the applicants. If a firm observes that social relations are more likely between individuals of identical ability, then it will base its hiring policy on recommendations of peers as a way of acquiring information.

comprised in the sociological concept of *elite* (entrepreneurs, professionals, firms' owners, managers) reaches the 12.8% in the entire population, while they account for 47.2% of the social background found in the private university. Seen in this perspective, accessing to a private university is equivalent to gaining admission to a private club, and families are willing to spend money for the "exclusiveness" granted by the club itself, independently of the quality content of the training received there.[22]

Tab.3 – Occupational Composition – Italy – mid 90's

	Italian population	Parents of students attending a private university
blue collar worker (or similar)	33.26	9.16
office worker	28.02	7.00
junior manager/cadre	5.21	15.55
manager, senior official, principal, headmaster, university teacher, magistrate	3.16	21.62
self-employed	12.99	15.04
member of the arts or professions	3.21	15.37
teacher	3.32	5.26
entrepreneur	6.42	10.20
owner or member of a family business	4.41	0.80

Note: The composition of the Italian population is obtained from the Bank of Italy survey conducted in 1993; for comparability reasons, the student population is restricted to those who were enrolled in the same year.

4. The collective choice over public or private schooling

Previous discussion has shown us that when individuals differ in terms of ability and income, the educational choices can magnify these differences whenever altruistic parents invest in the education of their children.[23] An additional complication has to do with the fact that most educational choices are collective ones, and as such they often ignore the externalities associated with individual choices. This has to do with the peculiar nature of education. In fact, it cannot be taken as a pure public good, since it does not possess the requirements of non-rivalry or the non-excludability.[24] Opening access to school to additional students implies additional costs (in terms of classes, teachers, libraries), and it is always possible to exclude students from accessing (using admission fees, admission tests or a combination of the two). For a publicly provided private good[25] it is not easy to determine the optimal amount of public provision.

When individuals are heterogeneous, any process of collective choice will leave at least some individual dissatisfied with the amount of educational resources chosen by the majority. In addition, unless there exists some possibility of internalising the spillover effects, the collective choice does not constitute the first best that would be chosen by a benevolent planner maximising a social welfare function. Finally, the uniform provision of education to all individuals prevents talented individuals from fully exploiting

22 This is particularly true if the dominant channel to obtain employment is represented by personal connections. At the beginning of the 90's, the 47% of interviewees in Italy declared to have found the current job through informal connections, whereas similar figures were 32% for UK and 35% for US. See Pistaferri 1999.

23 Banerjee 2002 shows that inequality persistence is can be either the consequence of absence of financial markets (as in Galor and Zeira 1993, where the family acts as imperfect substitute for the missing market) or attributed to *symbolic consumption* of education, defined as the presence of children education in the utility function of the parent in an intergenerational model of educational choice: "Symbolic consumption covers things like the 'warm glove' of giving to one's children…, pride in having children who are well educated or rich and the pleasure of being able to say that one's children go to an expensive school." (Banerjee 2002, p.7).

24 A pure collective good is defined as such if the cost of excluding an additional consumer is infinite (non-excludability) while the cost of an additional consumer is nil (non-rivalry). Cfr. Johansson 1991, p.63-64.

25 This is the definition adopted by Stiglitz 1974, p.356.

their endowment. All these aspects can be grasped by the following simple model inspired by Stiglitz (1974).

Let us consider a two period model, where in the first period of life agents invest in education, while in the second they obtain an income from work (positively correlated to individual talent and to the education acquired in the first period), consume and bequeath to their offspring. Equation (5.8) describes the educational production function in its simplest form

$$H_{it} = E_{it} \tag{5.8}$$

where H_{it} is the human capital stock achieved by individual i born in generation t that is equal to the resources E_{it} invested in her education. Labour earnings W_{it+1} are assumed to depend on both talent endowment A_{it} and human capital H_{it}, with decreasing marginal returns for both factors.

$$W_{it+1} = A_{it}^{\gamma} H_{it}^{\beta}, \qquad 0 < \gamma \leq 1, 0 < \beta < 1 \tag{5.9}$$

We assume that the child chooses her education on the basis of financial inheritance obtained from her parents and her own talent, which is freely observable. Finally individual preferences are defined over second period consumption C_{it+1} and inheritance to be left to offspring X_{it+1}. Using homothetic preferences in the Cobb-Douglas class we can write

$$U_{it} = C_{it+1}^{\alpha} X_{it+1}^{1-\alpha} \tag{5.10}$$

whereas the budget constraint is given by

$$Y_{it+1} = C_{it+1} + X_{it+1} \tag{5.11}$$

where Y_{it+1} indicates total income and price is set equal to one for simplicity. By maximising equation (5.10) under the constraint (5.11), we get the indirect utility function V_{it} as linear function of total income

$$V_{it} = \alpha^{\alpha}(1-\alpha)^{1-\alpha} \cdot Y_{it+1} = a Y_{it+1}, \qquad a = \alpha^{\alpha}(1-\alpha)^{1-\alpha} \tag{5.12}$$

We now consider alternative configurations of education financing, in order to recognize its implications on individual utilities.

4.1 - Private schooling

As a benchmark, we start by considering the absence of public schooling. Any individual can freely choose in the market a private school providing exactly the desired amount of education. She chooses to invest in education up to the point where the marginal cost of resources equals the marginal benefit in terms of earnings. By denoting with R the market interest rate and assuming perfect financial markets, we express available resources as

$$Y_{it+1} = (X_{it} - E_{it}) \cdot R + W_{it+1} = (X_{it} - E_{it}) \cdot R + A_{it}^{\gamma} E_{it}^{\beta} \tag{5.13}$$

The agent chooses the optimal amount of education by maximising her indirect utility under the budget constraint given by equation (5.13)

$$\max_{E_{it}}(aY_{it+1}) = \max_{E_{it}}\left(a\left[(X_{it} - E_{it})\cdot R + A_{it}^{\gamma}E_{it}^{\beta}\right]\right) \tag{5.14}$$

Thus we obtain the optimal demand for education under private schooling

$$E_{it}^{priv} = \left[\frac{\beta A_{it}^{\gamma}}{R}\right]^{\frac{1}{1-\beta}} \tag{5.15}$$

In accordance with what we have already derived in second chapter, abler individuals demand more education. In addition, the higher the return to education (coefficient β) and the lower the market interest rate R, the higher the demand for education.[26]

4.2 - Public schooling

We now consider the opposite case, where education is freely and uniformly provided and is financed through wealth taxation. From the government budget constraint

$$E_{it}^{pub} = \frac{\tau_t \cdot \sum_{i=1}^{n} X_{it}}{n} = \tau_t \cdot \overline{X}_t \tag{5.16}$$

where τ_t indicates the tax rate chosen by generation t,[27] n is population size and $\overline{X}_t$ is the average inheritance. Individual income is redefined accordingly as

$$Y_{it+1} = R\cdot X_{it}\cdot(1-\tau_t) + W_{it+1} = R\cdot X_{it}\cdot(1-\tau_t) + A_{it}^{\gamma}E_{it}^{\beta} = R\cdot X_{it}\cdot(1-\tau_t) + A_{it}^{\gamma}\left(\tau_t\cdot\overline{X}_t\right)^{\beta} \tag{5.17}$$

Each individual has a preferred tax rate that will depend on initial wealth and talent endowment. If we maximise the indirect utility in order to derive the preferred tax rate

$$\max_{\tau_{ti}}(aY_{it+1}) = \max_{\tau_{ti}}\left(a\left[R\cdot X_{it}\cdot(1-\tau_{ti}) + A_{it}^{\gamma}\left(\tau_{ti}\cdot\overline{X}_t\right)^{\beta}\right]\right) \tag{5.18}$$

we reach the following result

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[26] Should we abandon the assumption of perfect financial markets, the optimal investment of education could be upper-bounded by the available inheritance, and equation (5.15) has to be replaced with $E_{it}^{priv} = \min\left\{\left[\frac{\beta A_{it}^{\gamma}}{R}\right]^{\frac{1}{1-\beta}}, X_{it}\right\}$. This implies an inefficient outcome, because all individuals who are rationed according to family wealth have marginal returns exceeding marginal cost of their education.

[27] Rather implausibly, we are assuming that the optimal tax rate is chosen by the young generation before entering the labour market. An alternative framework would require that parents choose both the educational investment and the optimal tax rate: see Stiglitz 1974.

$$\tau_{it} = \frac{1}{\overline{X}_t} \cdot \left(\frac{\beta A_{it}^{\gamma}}{R} \cdot \frac{\overline{X}_t}{X_{it}} \right)^{\frac{1}{1-\beta}} \tag{5.19}$$

As in the case of private schooling, abler individuals prefer higher taxes as a way to obtain more resources invested in their education. On the contrary, the preferred tax rate declines with increasing family wealth, since rich individuals do not want to contribute to the redistribution implied by public financing of schools. In order to grasp the implication of public schooling on educational investment, we need to know how talent and wealth are jointly distributed in the population. For two particular cases we can better characterise the solution given by equation (5.19).

4.2.1 – Identical endowment of talent: $A_{it} = A, \forall i, \forall t$

In such a case, the optimal tax rate given by equation (5.19) becomes

$$\tau_{it} = \frac{1}{\overline{X}_t} \cdot \left(\frac{\beta A^{\gamma}}{R} \cdot \frac{\overline{X}_t}{X_{it}} \right)^{\frac{1}{1-\beta}} \tag{5.20}$$

Since preferences are now single-peaked,[28] we can now define the outcome of democratic choice under majority voting. Among all available proposals, the proposal from the individual with median wealth is the only one able to defeat all other proposals in pair-wise comparisons

$$\tau_t^* = \frac{1}{\overline{X}_t} \cdot \left(\frac{\beta A^{\gamma}}{R} \cdot \frac{\overline{X}_t}{X_t^{median}} \right)^{\frac{1}{1-\beta}} \tag{5.21}$$

On the contrary, if a benevolent planner maximising a social welfare function (as for example the sum of individual utility functions) undertook the choice of the optimal tax rate, the tax rate would appear as

$$\tau_t^{planner} = \frac{1}{\overline{X}_t} \cdot \left(\frac{\beta A^{\gamma}}{R} \right)^{\frac{1}{1-\beta}} \tag{5.22}$$

By comparing equation (5.21) with (5.22) we can notice that whenever $X^{median} < \overline{X}$ (which corresponds to the majority of empirically observed wealth distributions, which are typically positively skewed) the optimal level of taxation chosen under democratic voting is higher than the Pareto optimal level chosen by a planner. As a consequence, there is "excessive" investment in education, because people at the bottom of wealth distribution aim to manipulate taxation in order to increase their income opportunities through educational investments. The alternative case is given by

4.2.2 – Identical wealth endowment: $X_{it} = X_t = \overline{X}_t$

If individuals are identical in terms of family wealth, they differ in terms of talent endowment only. Once again preferences are single peaked with respect to desired taxation, and we can apply the median voter theorem to determine the tax rate chosen under majority voting

[28] Individual preferences are characterised by a unique global maximum with respect to desired tax rate, and therefore median voter theorem applies: see Grandmont 1978.

$$\tau_t = \frac{1}{\overline{X}_t} \cdot \left(\frac{\beta \left(A_t^{median} \right)^{\gamma}}{R} \right)^{\frac{1}{1-\beta}} \tag{5.23}$$

A benevolent planner would choose

$$\tau_t^{planner} = \frac{1}{\overline{X}_t} \cdot \left(\frac{\beta \widehat{A}_t^{\gamma}}{R} \right)^{\frac{1}{1-\beta}}, \widehat{A}_t^{\gamma} = \frac{\sum_{i=1}^{n} A_{it}^{\gamma}}{n} \tag{5.24}$$

where $\widehat{A}_t$ represents a non-linear combination of individual talent endowments. In the limiting case where $\gamma \to 1, \widehat{A} \to \overline{A}$, if the talent distribution is not symmetrical and positively skewed (placing more weight to below-average values), then a democratic choice of taxation leads to lower taxation and lower educational investment than the socially optimal level. This result is explained by the fact that abler individuals do not want to subsidise less able individuals, at the cost of reducing their earnings potential.

Joint consideration of these two cases suggests that democratic choice of educational investment through tax financing is very likely to lead to under- or over-investment in education, it being impossible to achieve Pareto optimal levels of investment.

4.3 – Mixed system (pubblic+private) schooling

We now allow the coexistence of public schooling together with a private supply of education, addressed to either richer or abler individuals who want to invest additional resources in education beyond the universal provision to all students. As illustration of the possible outcomes, we retain previous assumption of individuals that are identical with respect to family wealth, but are different in terms of talent. The optimal level of taxation chosen under a democratic choice is

$$E_t^{pub} = \left(\frac{\beta \left(A_t^{median} \right)^{\gamma}}{R} \right)^{\frac{1}{1-\beta}} \tag{5.25}$$

and the indirect utility associated to i-th individual is equal to

$$V_{it}^{pub} = a \left[R \cdot \left(X_t - E_t^{pub} \right) + A_{it}^{\gamma} E_t^{pub^{\beta}} \right] \tag{5.26}$$

Notice that the indirect utility (5.26) increases in individual talent. Let us now consider an individual considering the possibility of turning to the private sector, while continuing to finance the public sector because taxes cannot be waived. To obtain her optimal amount of education, she has to solve a problem identical to (5.14), where wealth is now net of taxation. Her optimal choice is analogous to equation (5.15) and the indirect utility function is given by

$$V_{it}^{mix} = a\left[R \cdot \left(X_t - E_t^{pub}\right) - R \cdot E_{it}^{mix} + A_{it}^{\gamma} E_t^{mix^{\beta}}\right] =$$
$$= a\left[R \cdot \left(X_t - E_t^{pub}\right) - R \cdot \left(\frac{\beta A_{it}^{\gamma}}{R}\right)^{\frac{1}{1-\beta}} + A_{it}^{\gamma}\left(\frac{\beta A_{it}^{\gamma}}{R}\right)^{\frac{\beta}{1-\beta}}\right] \tag{5.27}$$

where E_{it}^{mix} is the optimal demand of education to the private sector by individuals that still pay the cost of the public sector (since they cannot avoid taxation). By equations (5.26) and (5.27) we identify a marginal type (call her the κ-th individual) who makes no distinction between attending public schools or private ones

$$A_{\kappa t}^{\gamma} E_t^{pub^{\beta}} = A_{\kappa t}^{\gamma}\left(\frac{\beta A_{\kappa t}^{\gamma}}{R}\right)^{\frac{\beta}{1-\beta}} - R \cdot \left(\frac{\beta A_{\kappa t}^{\gamma}}{R}\right)^{\frac{1}{1-\beta}} \tag{5.28}$$

By solving equation (5.28) in terms of $A_{\kappa t}$ we can identify the marginal type

$$A_{\kappa t} = \left[\frac{R}{\beta} \cdot \frac{E_t^{pub^{(1-\beta)}}}{(1-\beta)^{(1-\beta)/\beta}}\right]^{\frac{1}{\gamma}} \tag{5.29}$$

It is easy to show that all individuals with a talent endowment greater than $A_{\kappa t}$ will obtain a higher prospective income (and utility) by turning to the private sector. This leads to the presumption that private schools are better quality because better talented people selfsort there.[29]

Let us note that the marginal κ-th individual changes with the quantity of educational resources invested in the public sector. As a consequence, the population share of private schools declines with the educational investment in the public sector.[30] From a formal point of view, this renders it hard to provide a closed solution to the determination of the optimal rate of taxation. The outflow of ablest students towards the private sector raises per-student resources for the remaining population in the public sector. This implies an improvement in the quality of the public sector that may call for a reduction in the optimal tax rate chosen under democratic voting. However, the improvement of educational investment in the private sector calls people back from the private sector. In this perspective, preferences lose the property of single peakedness, and multiple equilibria become endemic.[31]

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[29] Bertola and Checchi 2001 show that when the secondary school system is stratified this presumption may prove false, because the brightest students tend to choose high schools rather than vocational ones. In this way private schools retain a role as remedial schools for less talented children from rich families.

[30] Using a representative sample of Italian families interviewed in 1993, Checchi and Jappelli 2002 show that the probability of attending a private school is negatively affected by both subjective judgments on the quality of the local public school and objective measures of available resources in the public sector (like pupil/teacher ratios).

[31] The property of single peakedness gets lost because people enrolling in private schools will vote for zero taxation (since they do not want to subsidise other people remaining in the public sector). Conversely, the outflow of ablest students lowers the talent endowment of the median voter, who has now the incentive to raise her optimal tax rate in order to obtain subsidisation from people attending private schools. See the 4th section in Stiglitz 1974.

5. Growth and inequality under public or private schooling

The previous model has shown us that families may have an incentive to under-invest in education to escape the redistributive nature of public schooling financed through general taxation. The existence of these disincentives yields macroeconomic implications, both in terms of growth and inequality persistence. Intuitively, the greater the possibility for each family to get closer to the desired amount of education for their children without incurring the implicit cost of subsidising poorer families, the greater will be the overall investment in education. As a consequence, the larger the between-school variation (either through a well established private sector or thanks to a decentralised educational system) the higher should be the observed educational attainment. As long as the investment in human capital has a positive impact onto the growth rate of the economy, we should expect greater growth in countries (or regions) where there is a wider array of alternative schooling. There is (almost) always a drawback. Stronger growth trades off with greater income inequality, since greater variation of educational attainments should be correlated with greater dispersion in incomes.[32]

To prove these claims more formally, we will proceed with an overlapping generations structure, where individuals live for two periods. We now take into account the potential disincentive effect of income taxation by including a choice over effort in the initial period of life. Therefore, when young all individuals choose their spare time allocation between leisure and study. Newly formed human capital will depend upon available resources and effort, and in turn will affect labour income earned during the second period of life. Consumption and bequest are the only two alternative destinations of labour income.[33]

5.1 - Private schooling

We start our exposition by considering a simplified educational system, where only private schools area available, such that each agent may choose the desired amount of education. Given the intrinsic difficulties in studying the evolving distribution of talents and incomes, we simplify the problem by assuming that individuals are identical in all respects but family incomes. Under the drastic assumption of absence of financial markets, human capital investment in your own child is the only available asset to transfer resources across generations. This can be represented by the following relationship

$$W_{t+1} = H_{t+1} = S_t^{\theta} X_t^{\gamma} H_t^{\beta} \tag{5.30}$$

The equation (5.30) tells us that labour income W_{t+1} earned in the second period of life $(t+1)$ by an individual born in generation t is proportional (for simplicity equal) to human capital H_{t+1} acquired during the first period of life.[34] Human capital formation is the outcome of three contributing elements: *individual effort*, as measured by the amount of leisure T_t waived in favour of school attendance $S_t = 1 - T_t$ (where the endowment of time available $\overline{T}$ has been normalised to unity); the amount of

[32] Checchi 2001 studies the relationship between educational inequality and income inequality, finding some evidence of an inverted U-shaped relationship between the twos (when measured by Gini concentration indices). Teulings and vanReenen 2003 analyse the crucial role played by the constant return rate assumption when studying this relationship.

[33] We base our exposition on the model proposed by Glomm and Ravikumar 1992.

[34] The identity $W_t = H_t$ can be thought as the result of a simplified production technology exhibiting constant returns to scale where the sole production factor is given by human capital.

financial resources X_t inherited from the family and devoted to education financing;[35] *family background*, as proxied by the level of parental human capital H_t, in order to take into account both "nature and nurture" channels in inter-temporal persistence.

Altruistic preferences (as in equation (5.2)) take into account leisure consumption when young $(T_t = 1 - S_t)$ and commodity consumption C_{t+1} plus bequeath X_{t+1} when old[36]

$$U(T_t, C_{t+1}, X_{t+1}) = \log(1 - S_t) + \log C_{t+1} + \log X_{t+1} \tag{5.31}$$

whereas the budget constraint is represented by

$$W_{t+1} = C_{t+1} + X_{t+1} \tag{5.32}$$

Using the human capital production technology described by equation (5.30), and exploiting the homoteticity property for preferences, it is easy to derive the optimal choices[37]

$$C_{t+1}^* = \frac{W_{t+1}}{2} = \frac{H_{t+1}}{2} \tag{5.33}$$

$$X_{t+1}^* = \frac{W_{t+1}}{2} = \frac{H_{t+1}}{2} \tag{5.34}$$

$$S_t^* = \frac{2\theta}{2\theta + 1} \tag{5.35}$$

Given the fact that individuals remain identical across generations, we can plug the optimal choices (5.34) and (5.35) undertaken by parents into equation (5.30) that describe the human capital formation of the child. As a consequence, we get the inter-temporal dynamics of human capital and/or income (given the one-to-one correspondence between the two)

$$H_{t+1} = \left(\frac{2\theta}{2\theta + 1}\right)^{\theta} \left(\frac{H_t}{2}\right)^{\gamma} H_t^{\beta} = \left[\frac{1}{2^{\gamma}} \left(\frac{\theta}{1/2 + \theta}\right)^{\theta}\right] H_t^{\gamma+\beta} = \Theta H_t^{\gamma+\beta} \tag{5.36}$$

Re-expressing it using logarithms (denoted by small letters)

$$\log H_{t+1} = h_{t+1} = \log \Theta + (\gamma + \beta) h_t \tag{5.37}$$

Equation (5.37) represents the law of motion in both human capital (and income). Intergenerational persistence is due to education financing based on family wealth (γ parameter) and cultural background (β parameter). Since $(\gamma + \beta) > \beta$, the present model is consistent with the idea that intergenerational persistence is higher in the absence of suitable financial markets for education financing.

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[35] Notice that these resources are earmarked for education financing, since the individual does not have the possibility to divert them to alternative uses, like consumption.

[36] Again for simplicity, there is no intertemporal discounting.

[37] These solutions can be easily obtained by a two-step procedure: initially suppose a given W_{t+1} and find the optimal choices for C_{t+1} and X_{t+1}; then substitute these optimal choices into equation (5.31), make use of equation (5.30) and solve for S_t.

If we now make the additional assumption that incomes W_t (or human capitals H_t, since the two are by assumption identical) are lognormally distributed within each generation (with generation specific mean μ_t and variance σ_t^2), we obtain the evolution of income distribution across generations[38]

$$\mu_t = \log\Theta + (\gamma+\beta)\mu_{t-1} \tag{5.38}$$

$$\sigma_t^2 = (\gamma+\beta)^2\,\sigma_{t-1}^2 \tag{5.39}$$

We now observe that the higher the γ and β parameters, the higher will be the growth rate of the economy, as described by the mean income (or mean human capital). Notice that financial wealth is also proportional to human capital, and therefore evolves with the same law of motion (see equation (5.34)). Since individual incomes follow the same dynamics (given by equation (5.37)) the entire economy expands at the same growth rate.

In accordance with growth models in the neoclassical tradition (see the appendix), this dynamics possesses a long run equilibrium (which is identical for all agents, irrespective of initial conditions) given by

$$\overline{\mu}_{private} = \frac{\log\Theta}{1-\gamma-\beta} \tag{5.40}$$

Such equilibrium is stable whenever $(\gamma+\beta)<1$.[39]

5.2 – Publicly financed schooling

We now consider the possibility of a public intervention that offers identical quantities of education irrespective of family wealth. Public subsidies to poor families are financed through general taxation. The tax rate is chosen under majority voting, and applies to the next generation. We will term this case as *public system*. Under this case, the production technology for human capital is re-expressed as

$$W_{t+1} = H_{t+1} = S_t^{\theta} E_t^{\gamma} H_t^{\beta} \tag{5.41}$$

where E_t represents the amount of educational resources chosen by the parent generation for the schooling of the children generation, which is identically distributed to all individuals. The altruistic

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[38] When a variable $h=\log(H)$ is normally distributed, its density function is given by $f(h;\mu,\sigma^2)=\frac{1}{\sqrt{2\pi}\sigma}\exp\left[-\frac{(h-\mu)^2}{2\sigma^2}\right]$, where μ and σ^2 are respectively mean and variance of h. Then $H=\exp(h)$ will be log-normally distributed, with a density function $f(H;\mu,\sigma^2)=\frac{1}{H\sqrt{2\pi}\sigma}\exp\left[-\frac{(\log H-\mu)^2}{2\sigma^2}\right]$. In such a case mean and variance are given by $\mathrm{E}(H)=\exp\left[\mu+\frac{1}{2}\sigma^2\right]$ and $\mathrm{Var}(H)=\exp(2\mu+2\sigma^2)-\exp(2\mu+\sigma^2)$. In addition if $H\sim\log N(\mu,\sigma^2)$, then $\alpha H^{\beta}\sim\log N(\log\alpha+\beta\mu,\beta^2\sigma^2)$.

[39] If $(\gamma+\beta)=1$ there is a unique equilibrium if $\Theta=1$: in such a case $H_{t+1}=H_t$ and there is a multiplicity of equilibria (like the hysteresis in the unemployment literature). If $(\gamma+\beta)>1$ the equilibrium is unstable, and incomes diverge towards $\pm\infty$, according to initial conditions.

component of preferences is expressed in terms of parental "pleasure" for greater resources devoted to children education

$$U(T_t, C_{t+1}, E_{t+1}) = \log(1 - S_t) + \log C_{t+1} + \log E_{t+1} \tag{5.42}$$

The budget constraint takes into account the tax rate τ_t, which is chosen by parent generation to sustain education in the next generation:

$$C_{t+1} = (1 - \tau_t) W_{t+1} = (1 - \tau_t) H_{t+1} \tag{5.43}$$

The quantity of educational resources available per student depends on the overall resources collected through taxation

$$E_t = \tau_t \cdot \frac{\sum_{i=1}^{n} H_{t,i}}{n} = \tau_t \cdot \mathrm{E}[H_t] \tag{5.44}$$

Replacing equations (5.44)-(5.43)-(5.41) into (5.42) and solving for the optimal choices in time allocation and preferred taxation, we get

$$S_t^* = \frac{\theta}{1+\theta} \tag{5.45}$$

$$\tau_t^* = \frac{1}{2} \qquad \Leftrightarrow \qquad C_{t+1} = \frac{W_{t+1}}{2} \tag{5.46}$$

It is easy to recognise that this specific utility function leads parents to allocate half of their income to consumption, identically to what happened under private financing of education (see equation (5.33)). In addition, equation (5.46) indicates that the preferred tax rate does not vary across individuals, and thus we can claim it will be selected independently of the voting system. By comparing equations (5.35) and (5.45), we notice that the time optimally allocated to studying is lower than the time allocated under private financing (that we will indicate as *private system* for short). This can be explained by the appropriability of the yield of individual effort. In a private system greater effort implies greater income, greater consumption and bequests left to descendants; in a public system greater effort yet leads to greater consumption, but it spills over to *all* other individuals through taxation. In this way public financing of education works as a redistributive policy, reducing the extent of liquidity constraint by lowering at the same time the incentive to individual investment.

Replacing equations (5.44)-(5.45)-(5.46) into (5.41) we get

$$H_{t+1} = \left(\frac{\theta}{1+\theta}\right)^{\theta} \left(\frac{\mathrm{E}[H_t]}{2}\right)^{\gamma} H_t^{\beta} = \left[\frac{1}{2^{\gamma}} \left(\frac{\theta}{1+\theta}\right)^{\theta}\right] (\mathrm{E}[H_t])^{\gamma} H_t^{\beta} = \Phi \cdot (\mathrm{E}[H_t])^{\gamma} H_t^{\beta}, \; \Phi < \Theta \tag{5.47}$$

If we maintain the assumption of lognormal distribution of H_t we obtain

$$\mathrm{E}[H_t] = \exp\left[\mu_t + \frac{\sigma_t^2}{2}\right] \tag{5.48}$$

Under such a case, income distribution evolves according to

$$\mu_{t+1} = \log\Phi + \gamma\log\left(\mathrm{E}\left[H_{t-1}\right]\right) + \beta\mu_t = \log\Phi + (\gamma+\beta)\mu_t + \frac{\gamma\sigma_t^2}{2} \tag{5.49}$$

$$\sigma_t^2 = \beta^2\sigma_{t-1}^2 \tag{5.50}$$

Maintaining the assumption of stability (i.e. $(\gamma+\beta)<1$), the mean income (or equivalently the mean human capital) converges to

$$\overline{\mu}_{public} = \frac{\Phi}{1-\gamma-\beta} < \overline{\mu}_{private} = \frac{\Theta}{1-\gamma-\beta} \tag{5.51}$$

By comparing the dynamic evolution of incomes and wealth under the two regimes, we advance the following considerations:

i) both a private and a public system provide analogous growth, but the former achieves a higher long run equilibrium than the latter (see equation (5.51)). As a consequence, individuals obtain a higher level of indirect utility under a private system.[40]

ii) in a public system income inequality (as measured by σ_t^2) declines more rapidly than under a private system (as can easily be checked by comparing equations (5.39) and (5.50)). In the non-generic case of $(\gamma+\beta)=1$, income inequality keeps on unaltered in a private system, while it progressively disappears under a public system

iii) in a public system the higher the mean income the more equalitarian the initial distribution of income.[41]

iv) if we ask the population to select the educational system (whether private or public) under which they prefer to live, the old generation would always select a public system under majority voting. The reason lies in the fact that a public system ensures greater human capital accumulation for all children from families with below average incomes. For any left skewed income distribution (like the lognormal one), the median income voter always lies below the mean income family. As a consequence a public system will always be selected.

6. Education financing and school stratification

The models presented so far assume public education consisting of an equal supply of resources to all students. But in the previous chapter we have argued that there can be efficiency reasons to sort students according to their abilities (either through tests or their willingness to pay). This raises the issue of ability tracking within the public sector. Once excellence schools are introduced in the public sector, there is no reason why educational resources cannot be diversified across schools (either in a compensatory manner – more resources to less talented people – or in an efficiency-enhancing perspective – providing resources in accordance with the individual marginal benefit). This reproduces the above-mentioned trade-off between equity and efficiency, which is inescapable in the public supply of education.

[40] Things are obviously reversed if $(\gamma+\beta)>1$, but this corresponds to an unstable equilibrium.

[41] Since H_{t+1} is a concave function of H_t in equation (5.47): see the demonstration of proposition 6 in Glomm and Ravikumar 1992.

In principle, tracking students according to their ability should have the advantage of allocating resources efficiently (i.e. output maximising) to each individual.[42] But the main objection to ability tracking comes from the impossibility of disentangling measured ability from family background. Especially in countries whose educational systems are characterised by (early) ability tracking, students are sorted according to measured abilities into different types of schools, which subsequently open to different labour market positions.[43] Since measured ability during 5th grade reflects both innate ability and family background, it is not surprising to find that children of educated parents are over-represented in academic-oriented tracks (like Gymnasium). As a consequence, students with high ability but poor background may end up trapped in schooling and working careers where their talents are not fully exploited, whereas low-ability students from educated parents can achieve a university degree and access highly ranked positions.[44] Pupils with a lower socio-economic backgrounds face inequalities of educational opportunities and have to display better test scores than their counterparts with better backgrounds in order to be tracked to most academic tracks.[45]

More generally, we could argue that any school system has to find its "optimal degree of stratification". In fact school organization can be read along three dimensions: **comprehensive** vs. **stratified**, **public** vs. **private**, **centrally financed** vs. **locally financed**. The distinction between comprehensive and stratified educational systems typically emerges at the stage of secondary school: the former system offers to all students the same type of educational track, typically based on general competences (typical examples are the English and the North American school systems); the latter system sorts students according to their intended labour market position, since students and their families can choose from vocational training or academic-oriented preparation (the German system is an archetype of this organisation). While the first dimension concerns the possibility of market segmentation (in a generalist school system all customers obtain the same commodity, whereas in a stratified system customers can choose across different goods), the second one has to do with the amount of resources available. In a public system financed through general taxation all students receive an identical treatment (i.e. different students obtain the same amount of resources when they enrol in the same type of school), whereas in a private system families can choose the preferred amount of resources invested in the education of their offspring. As a consequence, the amount of resources available to students depends on family wealth (i.e. identical students from different families obtain different amounts of resources). The third divide partially overlaps with the second, as long as there are local differences in people preferences and families are territorially mobile. In a decentralised system schools characterised by high and low levels of spending on students may co-exist. If families are sufficiently mobile, they will "vote with their feet", i.e. they will (optimally) choose their residence by maximising the adherence to their preferred spending

Following Tiebout (1956), let us imagine a society formed by local communities, that are self-administered, i.e. each community chooses its preferred tax rate, to be used to finance the production

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[42] Rothschild and White (1995) have shown that such allocation can also be achieved in a private system through appropriate tuition fees. By taking into account that students are at the same time inputs and customers in the educational production sector, it is possible to device a pricing policy based on the added value received by each student. However this policy has the unpleasant feature of charging lower fees (per unit of human capital) to the brightest students, since their attendance creates a positive externality for all remaining students: "If the desirable students enhance the educational experience of other students, the university should be able to charge higher tuitions to the latter." (Rothschild and White 1995, footnote 15). Similar conclusions in DeFraja 2002 – see previous footnote 10.

[43] "Generally the decision about school track is taken by both parents and the local educational authorities, but children's measured ability remains the most important factor determining the selection process." (Schnepf 2002, p.7).

[44] "The high level of credentialism, i.e. matching qualifications to labour market positions, and the occupational segmentation of the German labour market tends to limit the likelihood of post-school correction." (Schnepf 2002, p.13).

[45] Most studies compare students from different ability groups to heterogeneously grouped students finding evidence that the top students are helped by ability grouping, whereas bottom students are harmed, resulting in a net effect that can be positive or negative, but which is usually close to zero. See Betts and Shkolnik 2000. Similarly, Figlio and Page 2002 have shown that academic performance of low achievers is not hampered by ability tracking in US schools.

of a local public good (for example, the provision of education through the local public school). Under the further assumptions of territorial mobility of the population (due to low mobility costs) and optimising residential choices (each individual opts for the community associated to the highest indirect utility), the communities will stratify according to the preferred amount of public good. Individuals less interested in education provision will go for low taxation communities, whereas people concerned for education will concentrate in different communities.[46] From a theoretical point of view, there are significant analogies between local financing and private financing.[47] As a consequence, a centrally financed educational system should reduce educational inequality (since it provides the same amount of educational resources to everyone) at the cost of reduced investment in human capital, since it lessens private incentives to invest more in better endowed children.[48] Some empirical evidence seems not to contradict this theoretical expectation. As an example, in California in the 1970's a bill was passed prompting greater centralisation of education financing, in order to reduce the educational inequality, which was high especially among immigrants. The consequences were a reduction of educational disparities and an increase in the average standard of education provision across the state, which however was accompanied by an overall reduction (in the order of 10 percent points) of resources publicly and privately invested in education.[49] More generally, between 1975 and 1991 several North American states revised their financing systems in a more centralised and equalising direction. Nevertheless, there is scarce evidence of improved school achievement, as measured by SAT scores.[50] The overall effect on residential segregation is difficult to ascertain.[51]

These three dimensions (degree of curricula stratification, private share in education provision, local financing) can be combined in alternative ways, also depending on the schooling levels. A stratified, mainly public and centrally financed educational system (as in Italy) and a generalist, mixed public-private and locally financed educational system (as in the United States) are both possible. Empirically, it is straightforward to obtain information on the source of financing, but the other aspects are harder to measure. The following table 4 provides some aggregate evidence on the fact that private source of funding raises with pre-compulsory and post-compulsory education: in the first case, it pays for either insufficient public provision (and/or possible amenities like extended timetables, improved facilities,

[46] The preference revelation property is the core of Tiebout 1956 argument: since a public good provision creates incentives to free-riding, people would not reveal their true preferences in order to avoid sustaining the cost of provision. Local financing and residential sorting would solve the problem of preference revealing.

[47] Hoxby 1996 asserts that local financing achieves both *allocative efficiency* (supplying to each agent what they prefer more) and *productive efficiency* (supplying to a minimum cost, since it exerts a more direct control on resources utilisation). In addition, it embeds a self reinforcing mechanism: financing education with property taxation gives more resources to schools located in richer areas; if additional resources translates into better quality, the presence of better endowed schools makes these areas more attractive, rising ownership prices and providing additional resources to the schools themselves.

[48] The overall effect on human capital accumulation is ambiguous, since uniform provision of education raises educational attendance, whereas it nullifies the extra-investment that some families would undertake in a private/locally financed system. Using a theoretical model calibrated on US economy, Fernandez and Rogerson 1998 estimate an overall gain of 3.3% of gross domestic product (measured in terms of *compensative variation*) when passing from local financing to central financing, owing to the dominance of the former effect over the latter.

[49] See the account of passing the *Serrano proposition* (from the name of the judge raising the issue) in Fernandez and Rogerson 1999a.

[50] "We believe the data are consistent with the existence of a modest effect of school finance reforms on the gap in test scores between children from different background groups, but the evidence is mixed" (Card and Payne 1997, p.3).

[51] Nechyba 1996 makes use of a general equilibrium model with endogenous residential choice and contemporaneous presence of public and private schools, showing that local financing may reduce territorial segregation, because rich families have an incentive to relocate in poor areas (in order to pay lower taxes) and send their children in local private schools. See also Nechyba 2000 and Neal 2002.

and so on); in the second case, private return on education favours the partial transfer of costs onto the final earners of educational benefits.[52]

Table 4 – Proportion of public and private expenditure on educational institutions (1999)

	pre-primary		primary and secondary		tertiary education	
	public	private	public	private	public	private
France	95.8	4.2	92.8	7.2	84.3	15.7
Germany	62.2	37.8	75.6	24.4	91.5	8.5
Italy	98.7	1.3	98.3	1.7	80.3	19.7
Japan	48.6	51.4	91.8	8.2	44.5	55.5
Switzerland	99.9	0.1	87.7	12.3	96.7	3.3
United Kingdom	95.6	4.4	88.2	11.8	63.2	36.8
United States	90.3	9.7	90.7	9.3	46.9	53.1
OECD average	**82.2**	**17.8**	**92.1**	**7.9**	**79.2**	**20.8**

Source: OECD 2003, *Education at a glance*, Paris, table B4.2

An indirect measure of the degree of homogeneity of education provision can be obtained by examining the dispersion of students' achievements in terms of literacy and numeracy. Table 5 reproduces the decomposition of variation of student performance as recorder by the PISA assessment conducted in 2000 under the supervision of OECD. Many factors contribute to the variation in average student performance within each country: subnational differences due to different jurisdiction, width of the private sector, presence of differentiated curricula in accordance with past performance, socio-economic intake. The more centralised a schooling system, the lower will be the overall dispersion in student tests; the less stratified and/or the lower the degree of differentiation (due to either local financing or access to private education), the lower will be the between-school variation. From this table we observe the emergence of potential trade-off: stratified educational systems yield the highest between-school variation (Italy and Germany)[53], but this contributes less to overall dispersion whenever the country is centrally financed (Italy, but not Germany). On the other extreme, the more comprehensive the system, the greater will be the performance variation within each school, whereas the overall dispersion depends on the source and the amount of funding.

Table 5 – Variance decomposition in literacy ability (PISA 2000)

	Overall variation in student performance (mean=500)	between-school variation (%)	within-school variation (%)	secondary school system	private sector in secondary school
Germany	12.368	56.11	43.89	stratified	high
Italy	8.356	56.49	43.51	stratified	low
Japan	7.358	46.03	53.97	stratified	intermediate
Switzerland	10.408	43.40	56.60	stratified	intermediate
United Kingdom	10.098	20.57	79.43	comprehensive	intermediate
United States	10.979	44.69	55.31	comprehensive	intermediate

Source: first three columns: OECD 2003, *Education at a glance*, Paris, table A7.1;
fourth column: OECD 1996, *Education at a glance – OECD Indicators*, Paris (country profiles); fifth column: see table 4.

The three dimensions (namely stratification, privatisation and centralisation of the educational system) overlap with each other and are interrelated, in that all contribute to segmentation of the "market for education". Standard economic theory suggests in a segmented market, customers are more satisfied

[52] It is difficult to find similar information along the central/local dimension of financing. In 1993 74.3% of educational expenditure was locally financed in US, while the corresponding figure was 16.0% in Italy (source: table F12.1 in OECD 1996). On the comparison of different educational systems, see Checchi, Ichino and Rustichini 1999.

[53] "In school systems with differentiated school types, the clustering of students with particular socio-economic characteristics in certain schools is greater than in systems where the curriculum does not vary significantly between schools. In Austria, Belgium, the Czech Republic, Germany, Italy and the Netherlands, for example, the between-school variation associated with the fact that students attend different types of school is considerably compounded by differences in social and family backgrounds" (OECD 2003, p.82).

(since each customer gets closer to his preferred bundle of consumption), but consumption inequality increases. Inequality considerations are relevant from a social point of view: if uniformity of education generates positive externalities, segmentation can be socially sub-optimal. Gradstein and Justman (2002) have stressed the economic benefit of education as socialising force: instilling social norms; reducing potential conflict; favouring assimilation of minorities.[54] They show that public provision of uniform education financed through taxation favours quicker assimilation of minorities (and greater productivity), since it imposes a double cost onto those who wish to opt out of the public system.[55] The socialising role of schools can only be centrally regulated, since cultural contents of education are hardly monitored when decided upon at local level.[56] Grossman and Kim (1998) have added the additional benefit of educating illiterate people in order to reduce the threat they pose to educated people properties.[57] Additional social returns to uniform public provision of schooling can be found in sustaining democratic attitudes and political participation.[58]

But there is a more substantial reason why most educational systems are centrally financed, at least at compulsory level. Whenever educational achievement creates positive externalities, there is a social interest in that each individual in the society would attain a given minimum of education (at least up to the point where private and public costs fall short of social benefit). Since the private/local education financing stands on family resources, there is a risk for the society that selfish parents do not place sufficient investment in their children (either they select low quality schools or they go to live in communities characterised by low tax rates and low quality schools). In such a context, the society may insure against such a risk by promulgating compulsory education laws and/or by centralising the organisation of the educational system (including its financing) in order to reduce the individual degrees of choice (thus preventing the formation of local communities by parents uninterested in the quality of education of their children). [59]

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[54] "The economic benefits of education as a socializing force are realized in various ways. Instilling civic virtues from an early age, through education, can reduce the cost of enforcing desirable social norms. Relatedly, when society is divided along ethnic or religious lines, uniform schooling in a common culture can lessen the potential for redistributional conflict among distinct social groups. The present paper focuses on a third benefit of common socialization: the role of state schooling in reducing transaction costs by shrinking the "social distance" between individuals in the economy." (Gradstein and Justman 2002, p.1192). Gradstein and Justman 2000 argue that uniform/public education reduces potential conflict for rent seeking activities between competing ethnic groups.

[55] Parents in the minority group face a dilemma: raising children more in line with the mainstream they increase their productivity (because they reduce their distance in social transactions), but they face a psychic cost of dissonance with their own offspring. See also Gradstein and Justman 2001, where they show that majority parents have an incentive to subsidise minority parents in order to reap the externality implied by the reduction of social distances.

[56] See their main result: "Proposition 3: When the government has coercive powers to impose school curricula, centralization leads to more uniform schooling and faster income growth than decentralization, but only by imposing a greater psychic cost for parents, which may or may not outweigh its benefits. In any case, coercive centralization induces overly rapid convergence to complete uniformity, which parents find strictly inferior to the unconstrained Pareto optimum. Noncoercive centralization is a Pareto improvement over decentralized education." (Gradstein and Justman 2002, p.1192).

[57] "An egalitarian educational policy makes production more lucrative for all the poorly endowed people, and thereby decreases the amount of guarding against predators that is necessary to deter poorly endowed people from choosing to be predators." (Grossman and Kim 1998, p.4).

[58] Dee 2003 finds that educational attainment has large and statistically significant effects on subsequent voting participation and support for free speech. In addition he also shows that additional schooling appears to increase the quality of civic knowledge as measured by the frequency of newspaper readership. Yet critics of public financing of schooling object that totalitarian governments spend more in education as a way to achieve public opinion support to their actions: "Like public ownership of the news media, government-provided schooling decreases the cost of wealth transfers by changing the relative cost of acquiring different information and predisposing students to support certain transfers". (Lott 1999, p.S129).

[59] Eckstein and Zilcha 1994 present an overlapping generation model where agents are differentiated in terms of altruism and ignore the positive spill-over of education onto the growth potential of the society. In such a context, a benevolent dictator can achieve higher levels of productivity by imposing a compulsory education level, and this second best solution is superior to decentralised optimisation. A further argument in favour of compulsory education and reduced variation in schooling standards is offered by the sequential nature of the educational process: by forcing families to achieve a given

7. School voucher as a solution ?

Many authors have claimed that increasing the possibility of school choice opens the possibility of escaping the trade-off between equality and efficiency, and some of them have advocated the introduction of school vouchers as a way to achieve it. We can actually decompose this argument into due separate propositions:
i) expanding school choice renders school financing dependent on enrolment, creates an incentive to expand enrolment and therefore introduces competition among schools.
ii) expanding possibility of accessing the private sector of education raises the overall level of productivity, as long as the private sector is more efficient in using available resources
Let us discuss these points in turn.

Transforming (partially or entirely) school financing in a direct payment proportional to the number of students enrolled increases school accountability, since customers can "vote with their feet", opting for better perceived schools and abandoning poorly performing ones. This creates a situation of *quasi markets*, where the public sector may even retain the monopoly of provision, but local agencies (the schools) have the responsibility of (and the incentives to) delivering educational services to the greater number of customers using the minimum amount of resources (the so-called *X-efficiency*). However the large scale implementation of such a system in New Zealand during the 1990's shows that this line of reasoning has problems when faced with actual implementation.[60] On one side, while theoretical considerations in terms of efficiency would advise the closure of poorly performing schools, social policy concerns recommend in the opposite direction. Peripheral city suburbs and rural areas would be deprived of educational structures, since all concerned parents would opt out, thus aggravating the problem instead of solving it. On the other side of the spectrum, over-subscribed schools do not have the incentive to expand, for the risk of diluting the homogeneity of social environment that made them so desirable to the parental population.[61] After some years of implementation, an increased polarisation of enrolment by ethnic groups and/or socio-economic groups was reported; the schools also differentiated, with the most popular schools attracting students concerned with academic curricula, best teachers and better family backgrounds.

But the core of the debate over school choice is the information set of families. Since we can always think of increased school choice as a system of school vouchers covering the full cost of attendance and fully redeemable in the public sector only,[62] the problem becomes how do families select their preferred schools. If the increased school choice creates an incentive to attract students, we expect schools to differentiate their supply, both in terms of quality (vertical differentiation) and amenities (horizontal differentiation). However, parents are mainly concerned with labour market returns of available alternatives, which can be assessed with a significant time lag and has to be valued in expected terms. As a consequence, it becomes crucial to provide families with up-to-date information, but the ability to process this type of information varies with the educational attainment of parents.[63] In

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threshold of education, a government raises the probability of transition to further levels of education. See Appleton, Hoddinott and Knight 1996.

[60] See the interesting account of this policy experiment reported in Fiske and Ladd 2000.

[61] In the New Zealand experience, oversubscribed schools were entitled to choose among students, thus shifting the system from "parental choice" to "school choice".

[62] Equivalent to the *public choice perspective* defined by Levin 1992 in his survey on school vouchers.

[63] However "… parents might use the socio-economic level of the parents of other children in the school as a proxy for school quality, based on the well-documented observation that the average achievement of students within a school is highly correlated with the socio-economic and racial composition of the student body. The positive correlation between the socio-

addition, if parents are risk averters, and the degree of risk aversion is inversely related with family wealth, then we expect that families with poor backgrounds to prefer standardised courses to differentiated ones, since they are unable to choose among existing alternatives.[64] Thus it looks as if either the efficiency gains from school competition attenuate because of the reduced demand for school differentiation, or increased school choice discriminates against less educated parents.

When we associate increased school choice with public financing of private institutions, we approach what is traditionally considered the debate over school vouchers, namely the introduction of public subsidies (partially or totally) covering school fees in the private sector (*market choice perspective* in Levin (1992) terminology). While there are a great variety of experiences of school vouchers, none of them (except the Chilean one) has been conducted on a large scale, and therefore most of the conclusions achieved in the literature have to be taken as partial equilibrium analysis.[65] This is crucial, because if most of the expected gains in student achievements derive from students self-sorting, a large-scale experiment is destined to be ineffective, since student reshuffling does not change the average educational achievement in the population. Suppose students' achievement be positively correlated with parental education and independent of school resources. Thanks to the positive correlation between education and incomes, parental choices described in section 2 will drive the children from richer and better-educated families in private schools. If we were to measure average educational attainment, we would record an average better performance among students in private schools, which cannot however be attributed to better quality education, but to self-selection only. As a consequence of this potential self-selection bias, it is impossible to assess whether private schools provide better quality education just looking at educational attainment. The introduction of school vouchers may represent in some case the equivalent of a natural experiment, where students are randomly selected for benefiting of the scholarship (often referred as the *treated group*), whereas some other statistically identical students do not get the same benefit (the so-called *control group*). When the random assignment property is respected, the average differences constitute a genuine effect of the residual factors, including the type of school attended.[66] Following this approach, Rouse (1998a) and (1998b) has carefully analysed one of the pioneer experience of introducing school vouchers in Milwaukee (Wisconsin) in 1990. These vouchers were targeted to low-income families, were only redeemable in private non-sectarian schools and were limited to 1% of the student population. Thanks to an exceeding number of applications, the participants in the program were randomly selected, the non-selected applicants representing an appropriate control case. Taking into account some attrition, Rouse finds that attending private schools raises the average test-scores of children from low background families by 1-2% points in mathematics, leaving reading and comprehending capabilities unaffected.[67]

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economic composition of a school and the performance of its students largely reflects what happens at home rather than at school". (Ladd 2002, p.7).

[64] This point is stressed by Manski 1992. It is worth noticing that, whenever the school quality is proportional to the average ability of students enrolled, it is necessary to impose come consistency requirement on expectation formation, in order to be able to characterise an equilibrium distribution of students; for this reason, both Manski 1992 and Nechyba 1996 assume perfect information on school quality when performing policy simulations in their models.

[65] Surveys of existing experiences of school vouchers are reported in Neal 2002, Ladd 2002 and Gauri and Vawda 2003.

[66] "In order to estimate the true effect of choice schools, one must control for family background (such as family income and parental education) and student ability. The goal is to control for all individual characteristics that are correlated with attending the choice school and explain higher test scores such that the only difference between the two groups of students is whether or not they have enrolled in a choice school. In general, the more similar the two groups of students are to begin with, the more credible the evaluation of the program." (Rouse 1998b, p.5). One method used to check the random assignment property is matching scores: see for example Becker and Ichino 2003.

[67] Rouse 1998a is very careful in interpreting her results in terms of *intention-to-treat* effect: "Thus, the reduced-form estimates reflect the overall potential gains from offering the vouchers. Second, as in many experimental settings, the randomisation only occurred in the intention-to-treat and as such, the reduced-form estimate is the only unambiguously unbiased estimate that one can obtain from an ordinary least squares (OLS) regression, assuming the initial selection was truly random."(p.562). Similar approach in Krueger and Zhu 2002.

While the Milwaukee experience suggests that there could be some positive effect for disadvantaged students in attending private schools, this conclusion does not necessarily extend to unrestricted voucher programs.[68] The essential question is that most of the attractive features of the private sector (selectivity of the environment, attraction of better teachers) cannot be replicated to a larger scale, because they are available in limited supply.[69]

Even if we cannot expect overall gains in educational achievements or improved cost effectiveness, still vouchers could remain desirable if they were targeted to the most disadvantaged students. However their impact is heavily dependent on how the system is designed. If schools can add further fees on top of the voucher and/or transportation is not provided, poorer families may be unable to benefit from the introduction of the voucher.[70] Further on, if oversubscribed schools are allowed to non-randomly select among the applicants, the risk of discriminating against disadvantaged students is high. Only means-tested vouchers, possibly made conditional on student ability, can possibly represent a useful policy instrument to increase the equality of opportunity in accessing the higher levels of education.[71] This does not prevent that the average ability of students remaining in the public schools is meant to decline, unless increased competition and more efficient use of teaching resources more than compensate the decline in student inputs.

The institutional design of a voucher system also has an impact on the type of incentives it offers to school managers. Using a principal-agent approach, Gauri and Vawda (2003) describe a voucher system as a linear compensation contract (since financing is made dependent on enrolment) between a principal (the central government) and several agents (the school managers). Following the equal compensation principle, they stress the point that vouchers should be inversely correlated with student abilities.[72] Using the same principle, they notice that school vouchers do not promote innovation in pedagogical activity, because this activity is not rewarded by the compensation scheme.[73] They also show that a monitoring activity is indispensable to preserve the quality of education, since otherwise schools could find it convenient to lower their standard of screening in order to attract more students and funding. Finally, following the principle of reducing the incentive effect when effort is imperfectly measured, they suggest that efficiency gains are limited when external causes (such as teacher shortages or birth-rate changes) prevent school competition.

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[68] Also in the case of the New York experiment, involving 1300 students per year, Krueger and Zhou (2003) raise doubts on previous finding of significant gains in test score for voucher recipients relative to non-recipients for African American students only.

[69] "Thus, one should expect neither higher overall achievement nor lower resource costs as a result of a shift of students from public to private schools. At most, there are likely to be small achievement gains for a selected group of African-American students. Furthermore, a universal voucher program could possibly require the government to spend more public funds on education, because some of the voucher funds would undoubtedly go to families who would otherwise have paid all of the cost of putting their children in private schools." (Ladd 2002, p.13).

[70] In the case of New York experiment, up to a quarter of selected applicant did not use the offered voucher, whereas in the Milwaukee case the percentage was even higher.

[71] The simulations of Manski 1992, Nechyba 1996, Epple and Romano 1998 and 2000 are unequivocal in predicting that unconditional vouchers yield overrepresentation of students from richer families among school voucher recipients.

[72] "Some European countries with voucher systems, recognizing the incentive that flat per-pupil payments create for schools to select relatively advantaged students and for parents to choose those "successful" schools, transfer additional resources to schools based on the composition of the student body enrolled. Holland pays 1.9 times the standard voucher value for each minority student and 1.25 times that value for an economically disadvantaged student. Sweden also transfers additional resources based on numbers of minority students and students with learning disabilities." (Gauri and Vawda 2003, p.13).

[73] "Voucher programs in Chile, New Zealand, England and Wales, Bangladesh, and Côte d'Ivoire did not promote pedagogical innovation; in fact, case studies suggest that pedagogy might have become more uniform in those countries. In voucher programs, governments will need to continue to finance and support teacher training and professional development in private schools." (Gauri and Vawda 2003, p.19).

A final point is worth mentioning with respect to political-economy considerations. As Neal (2002) has stressed, "…there are good reasons to believe that families who now live in wealthy school districts or attendance zones with high-quality public schools would suffer welfare losses under most voucher plans. Because most voucher plans break the link between residential choice and the quality of publicly funded schools, families that now enjoy access to the best public schools might see their housing wealth, which is presently linked to local school quality, fall substantially under vouchers".[74] Also considering that the private sector of education does not reach the majority of the population in almost all countries, it is rather unlikely to imagine the emergence of a vast majority of citizens supporting the generalised introduction of school vouchers. [75]

8. Subsidising or lending?

Some of the previous discussion is based on the implicit assumption that the demand for education exhibits sufficient elasticity with respect to its price, so that lowering net fees (through vouchers) can raise the demand for private education. However the empirical evidence in this respect in controversial. As we have already discussed in section 6 above, one can make a the general argument for subsidising education referring to positive externalities,[76] but this argument seems more convincing with respect to compulsory education. Primary education is especially crucial in reducing transaction costs (by spreading literacy, numeracy and the adoption of a national language), facilitating the introduction of new technologies (think of the example of reading the instructions for new appliances) and improving governance by creating an informed public. When considering developing countries, we may add the improving child health and the reduction of fertility. However, when moving to post compulsory education, the argument supporting public subsidisation weakens, since most of the benefits of additional education accrue to the individual undertaking the investment. In addition, the over-representation of children from higher socio-economic status in tertiary education attributes a regressive trait to the public expenditure for education. Despite the fact we have postponed a full discussion of measuring return to education to the next chapter, from table 6 we get the message that the economic return to education for the society is higher for initial levels of education, due to both lower costs of provision and higher productivity of the educational investment..

Table 6 – Return to education – private and social – integral method

	private return to education			social return to education		
	primary	secondary	tertiary	primary	secondary	tertiary
Sub-Saharan Africa	41.3	26.6	27.8	24.3	18.2	11.2
Asia	39.0	18.9	19.9	19.9	13.3	11.7
Europe/Middle east and North Africa	17.4	15.9	21.7	15.5	11.2	10.6
Latin America and the Caribbean	26.2	16.8	19.7	17.9	12.8	12.3
OECD countries	21.7	12.4	12.3	14.4	10.2	8.7
World	*29.1*	*18.1*	*20.3*	*18.4*	*13.1*	*10.9*

Source: Tables 1 in Psacharopulos 1994

[74] Neal 2002, p.37. Burgess and Machin 2002 discuss an empirical relationship between housing prices and primary school performance, as measured by the proportion reaching target grades in age-11 standard assessment tests, with respect to the UK case. For evidence on the US case see Clapp and Ross 2002.

[75] However, Bearse et alt. 2000 have considered a political-economy model contrasting the introduction of means-tested vouchers against uniform vouchers. By calibrating their model on the US economy, they find that the poorest 45% and the richest 18% of families prefer means-tested voucher, obviously for different reasons: the poorest favour means-tested because they receive more, the richest because means-tested vouchers are associated with lower educational expenditure.

[76] Appleton 1997 offers a lengthy discussion of these externalities, ranging from inequality reduction, absence of perfect capital markets and/or insurance markets, imperfect altruism of parents, up to merit good argument (since education may be undervalued by those who had never experienced it). Barr 1993 adds the point of the 'tax dividend': by subsidising investment in human capital, a government will recollect additional tax revenues in the future

Even if there is a general consensus towards the idea that education financing should be progressively shifted to user fees as long as we go up in the educational career, it is unclear which is the most appropriate mix of education financing, because relatively little is known about the demand for post compulsory education from the empirical point of view.[77]

Admission fees affect school attendance in a non-linear way, depending on the family income. Using aggregate data to study the reform of student aid for college, McPherson and Shapiro (1991) found that the increase in net cost of university attendance in the United States had a negative effect on enrolment decision for white students from low-income families. Kane (1995) confirmed these findings providing additional non-experimental evidence of strong impact of tuition on college enrolment of poor and minority families.[78] However he noticed that the introduction of means-tested aid and/or subsidised loans (like the Pell program in US) in the 70's did not modify enrolment patterns for low-income families. However, studies based on individual data from policy experiment do suggest that enrolment decisions are strongly sensitive to financial aid.[79] Even if direct costs may not prevent the investment in further education (especially for inframarginal students), they are likely to lead to a revision of students' strategies (typically including a mixture of family support, state or university grants, loans and working) in order to finance their studies.[80]

What is largely debated in the literature is what is the optimal financing strategy of public authorities in this framework. Generally speaking, until quite recently most of governments in developed countries have promoted college enrolment by keeping tuition low through direct university subsidisation.[81] But rising school attendance at previous stages of schooling poses some challenge to the financial sustainability of this strategy. Some countries have partially switched to means-tested aid and/or subsidised loans, whereas some others have preferred to adopt different sorts of *graduate tax* or *income contingent loans*.[82] Both proposals are directed towards solving the problems of imperfect capital markets and of absence of insurance to cover the risks of pursuing higher education. In both systems students obtain funds from the government to cover tuition and living costs, and having graduated, they repay a fraction of their incomes to the government in return for the funds received. With an income contingent loan the amount of repayments has a maximum that is determined by the amount

[77] Some degree of public subsidisation of higher education can be justifiable on efficiency grounds whenever there exists complementarity in production between skilled/educated workers and unskilled/uneducated workers. See Johnson 1985.

[78] He estimates that a between state difference of 1000$ in tuition is associated to a gap in 2-year college enrolment comprised between 11% and 29% (depending on the dataset). This is also consistent with the impact of minimum wage legislation, taken as a proxy of foregone incomes, which represent the bulk of the cost of college attendance. Canton and deJong 2002 reach similar conclusions studying aggregate time series data on university attendance in the Netherlands in the post-war period.

[79] Dearden et al. 2003 analyse individual British data from a pivotal experiment conducted in 10 areas in 1999, where means-tested allowance was granted to student proceeding in postcompulsory education. They find that an allowance replacing from a quarter to a third of foregone income has a substantial and persistent impact on school access, raising enrolment in "treatment" area by 3.7 additional points. Surprisingly, very similar conclusions are obtained in a developing country context: Ravallion and Wodon 2000 report that the program "food for education", granting in-kind subsidy (rice) equivalent to 13-20% of monthly wage of working children in exchange for school attendance, was able to reduce child labour and increase school attendance (with the latter effect dominating the former one).

[80] Christou and Haliassos 1994 estimate a model where different sources of financing are combined into a production function generating educational expenditure, and individuals optimally select their preferred financial strategy.

[81] Ganderton 1992 raises the issue that in-kind subsidies (like subsidised tuition in public college) in a context characterised by quality differences can induce suboptimal matching between student ability and college quality (as measured by the average ability of applicants).

[82] See the discussion of the original proposal by Friedman and Kuznets reported in Nerlove 1975 and the reappraisal in Barr 1993 and Jacobs 2002.

borrowed,[83] whereas with a graduate tax payments are work life long. It is evident that under a graduate tax the amount of income insurance and redistribution of incomes is larger because there is no ceiling on repayments; in addition, the under income contingent loans the default risk is shifted to the society at large, whereas in the case of graduate tax it is shared among graduates. The main drawback of this system is the potential reduction in university enrolment due to the increase in the private cost of attending universities.

In his review of the Australian introduction of a graduate taxes at the end of the 1980's (raising tuition in the meanwhile), Chapman (1997) underlines the positive impact of rendering the debt repayment income contingent. If the degree of risk aversion is inversely related to family wealth, families with poor socio-economic backgrounds will be prevented from applying by the greater risk they perceive associated with an educational investment. If the repayment is made conditional on the success of the investment, they are simultaneously receiving financial aid insurance, which should increase their willingness to enrol in universities. Women in particular seem to have taken advantage of the new system, without any sizeable reduction in enrolment from poor background students.[84]

9. Summing up

In this chapter we have argued that whenever individuals are different in terms of ability and family wealth, they face different incentives to education acquisition, which cannot easily be dealt with by market solutions. When schools differ in quality, we observe the emergence of a stratified distribution, with high talent and/or wealthy family children gathered in the better quality schools.

We have then shown that the presence of externalities requires some public intervention, which however does not ensure the attainment of the social optimum: the democratic choice of educational investment through tax financing is very likely to lead to under- or over-investment in education, whereas the existence of a private sector providing educational services does not recreate the conditions for Pareto optimality. In addition, the presence of publicly provided education creates disincentives to investment in education to richer families, who wish to avoid the redistributive nature of public schooling, financed through general taxation. The existence of these disincentives yields macro-economic implications, both in terms of growth and inequality persistence.

Finally, we have questioned the identical allocation of resources to all students within the private sector, showing the pros and cons of its stratification, along available dimensions (degree of curricula stratification, private share in education provision, local financing). The chapter closes with a discussion of alternative strategies to provide public subsidy to education, including school vouchers and income contingent loans.

[83] But the repayment is quicker for more successful graduates; this distinguishes an income contingent loan from a mortgage type loan, with repayment in fixed instalments over a fixed period (like the one introduced and immediately unsuccessful in United Kingdom in 1988 – see the discussion in Barr 1993).

[84] An analogous system exists in Sweden (cfr Morris 1989). For a proposal of introduction and related cost simulations in the Netherlands see Jacobs 2002. See also the general review contained in chapter 7 of Johnes 1993.

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Appendix 1 – Income inequality in a neoclassical model of growth.[85]

Let us start with a standard production technology. The size of population coincides with the size of the labour force; wage flexibility ensures full employment. Under constant return to scale the aggregate output can be re-expressed in per-capita terms

$$\frac{Y}{L} = f\left(\frac{K}{L}, \frac{L}{L}\right) \qquad \Rightarrow \qquad y = \phi(k), \phi' > 0, \phi'' < 0 \tag{A.5.1}$$

where $y = Y/L$ is (average) per-capita income and $k = K/L$ is (average) per-capita capital. Whenever markets are perfectly competitive and firms are profit maximisers, each factor will earn the equivalent of their marginal contribution to production

$$r = \phi'(k) \tag{A.5.2}$$

$$w = \phi(k) - k \cdot \phi'(k) = \phi(k) \cdot (1 - \eta) = y \cdot (1 - \eta) \tag{A.5.3}$$

where r is the user cost of capital, w is the real wage rate (the output price being normalised to one), η is the output elasticity to capital input (depending on the curvature of the production function). Each individual i is assumed to be endowed with one unit of labour and some units of capital. Her income will thus be defined by

$$y_i = w + r \cdot k_i \tag{A.5.4}$$

where k_i is the personal wealth of the i-th agent. In this simplified context, income and wealth distribution coincide.[86] A crucial assumption is that savings constitute a fixed proportion s of earned incomes.[87] Under such assumption, individual capital accumulates according to personal savings, once we deduct capital depreciation δ [88]

$$\dot{k}_i = s \cdot y_i - \delta \cdot k_i = s \cdot w + (s \cdot r - \delta) k_i \tag{A.5.5}$$

Since in the aggregate the capital stock coincide with the aggregation of individual capital stocks (i.e. $k = \frac{K}{L} = \frac{1}{L} \cdot \sum_{i=1}^{L} k_i$), then its dynamics can be described by the following relationship

[85] We present a simplified version of the model in Stiglitz 1969.

[86] In the original model of Stiglitz 1969, the population is composed of groups of equal size, and all groups grow at the same growth rate, leaving the population distribution across groups unaffected. He also excludes inheritance strategies favouring primogenitures, and cross-group marriages. In the text we assume that each group is composed of one individual, abstracting from population growth.

[87] This result can easily be obtained under specific utility functions, and it plays the role of separating the problem of growth from the problem of distribution. Were savings a concave function of income (the marginal propensity to save would decline with individual income), the results would be unaltered. On the contrary, when savings are a convex function of income (rich people exhibit a higher propensity to save than poor individuals), then wealth distribution converges towards a non-equalitarian distribution. The last situation has been analysed by Bourguignon 1981, who showed the Pareto superiority of this latter case.

[88] In the original model, capital depreciation is neglected, but the same result obtains in per-capita terms because of the population growth.

$$\dot{k} = \frac{1}{L} \cdot \sum_{i=1}^{L} \dot{k}_i = s \cdot w + (s \cdot r - \delta) \cdot \frac{1}{L} \cdot \sum_{i=1}^{L} k_i = s \cdot w + (s \cdot r - \delta) \cdot k = s \cdot y - \delta \cdot k \qquad \text{(A.5.6)}$$

It is interesting to note that the aggregate accumulation of capital is independent of income or wealth distribution, and crucially impinges on the assumption that each individual is at the same time worker and capitalist (even allowing for different degrees of wealth possession). Equation (A.5.6) is characterised by steady-state capital stock, $k^* = \frac{s \cdot y(k^*)}{\delta}$, such that when the economic system hits it, the growth process comes to a halt.[89] When the steady–state corresponds to a stable equilibrium,[90] the economic system will converge to that level of productive capacity. When looking at individual accumulation plans, we make use of equation (A.5.6) to re-express equation (A.5.5) in the following way

$$\begin{aligned} \dot{k}_i &= s \cdot w + (s \cdot r - \delta) \cdot k - (s \cdot r - \delta) \cdot k + (s \cdot r - \delta) \cdot k_i = \\ &= [s \cdot y - \delta \cdot k] + (\delta - s \cdot r) \cdot (k - k_i) = = \dot{k} + (\delta - s \cdot r) \cdot (k - k_i) \end{aligned} \qquad \text{(A.5.7)}$$

From equation (A.5.7) we may infer that during the transition to the steady state, individuals endowed with wealth below the mean (i.e. $(k - k_i) > 0$) will grow faster, whereas the opposite situation will occur to richer-than-average individuals. Given the fact that stability conditions are identical both at aggregate and individual levels, the steady-state capital stock will be identical for all agents and will correspond to k^* independently of initial level of wealth. In the long run wealth (and income) inequality spontaneously disappears, without any redistributive intervention by the public sector.

[89] There are actually two steady states associated to the differential equation (A.5.6): the case of $k = 0$ and the case discussed in the text. The former is dynamically unstable, while the latter is stable.

[90] This applies whenever $sr < \delta$, that is when the capital stock is sufficiently high to keep its productivity sufficiently low.