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School Fees and Vouchers when Quality of Education Matters

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Abstract

The aim of this paper is to analyse the role that quantity and quality of education may play in the design of public policies. In our model, education does not generate externalities nor is considered as a merit good, but educated people enjoy a premium on their incomes. Households live in two areas with different socio-economic characteristics. Altruistic parents choose both the amount and the quality of schooling they want for their children. The government is assumed to provide a composite education service which has a quantity as well as a quality dimension, and is financed mainly via taxes on the income of the parents. We investigate the effects on altruistic parents' social welfare of balanced-budget policy reforms aimed at introducing or raising i) school fees, and ii) vouchers meant to compensate the costs of attending high-quality schools. We show that in general school fees improve parents' welfare while vouchers do not. Parents' altruism is not enough to support high levels of quantity and quality of education: it is not necessarily sufficient to induce them to choose full-time education for their children, and is never sufficient for them to support the introduction of the voucher for quality.

Keywords: Education Policy, Redistributive taxation

JEL Classification: *H42, H52.*

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I Introduction

Education is now extensively recognized as an investment made by individuals to acquire knowledge and skills (Schultz (1961), Becker (1964)). However, the outcome of such an investment depends on a variety of inputs which may pertain to the individual and family sphere (e.g. personal talent, family income, parents' education, etc.), to the more general social environment and to specific features of the school system (e.g. schools' resources, autonomy and accountability, tracking and vocational orientation, school entry-age, teachers' characteristics, class size, peers, etc.). The importance of each of these inputs may be different for the formation of the personal human capital, and their effect may also vary at different ages of the individual.[1]

Understanding the determinants of skills' acquisition and their consequences not only for individual earnings and other aspects of life, but also for economic growth and other social sectors through positive externalities has been the object of a large part of the literature on the economics of education.[2] In recent years, however, there has been a change of perspective in the academic debate on this issue. While early works were concentrated on the role played by the quantity of education acquired by individuals in determining individual achievements and their impact on economic and social outcomes, latest works have focused their attention on the role played by the quality of education (e.g. Hanushek and Wößmann (2021, 2015, 2012, 2008)). Indeed, the same amount of education can be associated to largely different quality levels. Even if, from an empirical point of view, it is easier to assess how long students have been in school with respect to what they have learnt, and thus what they really know and which skills they have acquired, nowadays standardized achievement tests are largely used to measure skills which are valuable both in the classroom and outside (Kautz et al. (2014), Wößmann

[1] As suggested by Cuhna and Heckman (2007), the skill formation process can be considered a dynamic process made of multiple stages and some inputs may be more productive at some stages than at others. Some skills may be also developed at a higher productivity at some stages than at others.

[2] For example, education has been proved beneficial on health, education and health of children, citizenship, crime, for reducing the transmission of inequality across generations, etc. (Woessmann (2016)).

et al. (2023)). Importantly, this change in viewpoint from quantity towards quality of education has not been limited to the academic debate but it has also been central for policy-makers. For example, in 2000, the Millennium Development Goal n. 2 was to «achieve universal primary education», i.e. a quantitative perspective, while in 2015, the Sustainable Development Goal n. 4 was to «ensure inclusive and quality education for all and promote lifelong learning», i.e. a qualitative perspective. Indeed, in many Less Developing Countries, improvements obtained in terms of access to education, i.e. an indicator of quantity of education, have not been converted into improvements in quality of learning, with school children accomplishing very poorly with respect to the expected levels of learning outcome associated to standard curricula.[3]

While recently the importance of the quality of education has been largely pointed out in the empirical economic literature and, in some works, recognized as even more important than quantity of education (Hanushek and Kimko (2000), Hanushek and Wößmann (2011)), theoretical works on such an issue are still very few. One exception is the paper by Glewwe (2002) that proposes a model of schooling choices which takes into account both quantity and quality of education before providing a survey on the empirical literature concerning the relationship between school and teacher characteristics and the acquisition of cognitive abilities. In particular, it shows how altruistic parents choose the optimal values for both quantity and quality of education depending on whether quality of education is exogenous or endogenous, and on a variety of parameters describing, for example, parents' intertemporal consumption preferences, kids' learning efficiency, propensity of children to support their parents, and price of schooling.

The aim of this paper is to contribute to the theoretical analysis of the role that both quantity and quality of education may play in designing public policies, where school quantity is best interpreted as time devoted to schooling, whereas school quality refers to such elements as teachers' experience and qualification or schools' rooms and

[3]See, for example, the recent learning poverty indicator developed jointly by the World Bank and UNESCO's Institute of Statistics, to measure the percentage of children in low- and middle-income countries who cannot read and understand a simple story by the end of primary school: https://www.worldbank.org/en/topic/education/brief/what-is-learning-poverty.

learning equipment. To perform such an analysis, we consider a model where altruistic parents choose both the amount and the quality of schooling they want for their children. Education has no intrinsic value (that is, it does not generate externalities nor is it considered a merit good) but results in an income premium for those who acquire it. In our set-up, we have that (i) compulsory schooling requirements have been already met, i.e. we focus on secondary educational choices in a country where secondary education is not fully compulsory;[4] (ii) people live in two areas, say urban vs. rural, North vs South or simply different parts of a metropolitan area that have different socio-economic characteristics, one being more "developed" than the other – that is, it has, for example, a higher percentage of people employed in high-skilled jobs, a smaller informal sector, higher living standards, and, crucially, a higher school quality. The latter may occur, for example, because it is too costly to build high-quality schools in, and it is difficult to attract high-quality teachers to more disadvantaged areas such as, for example, a sparsely populated rural area with few services and amenities.

The government is assumed to provide a composite education service which has both a quantity and a quality dimension but, given the circumstances outlined above, it may find it more convenient to look at ways to subsidise student mobility rather than providing uniformly high-quality education services in all areas. The government, on the one hand, has to bear the costs of providing the service, and possibly the aforementioned subsidies which we assume to take the form of vouchers; on the other hand, to finance such expenditures, it levies lump-sum taxes on the parents and may decide to charge school fees.[5] From the household's perspective, parents have, in principle, to bear two types of expenditure for allowing their kids to attend school: a fee for each year of schooling as well as possibly take-up costs for attending better quality schools (which,

[4] There are many examples of this: within the EU, the upper age for compulsory schooling is 16 in Bulgaria, France, Greece, Hungary, Ireland, Italy, Lithuania, Luxembourg, the Netherlands, Slovakia, Spain, and 15 in Austria, Cyprus, Croatia and Malta. Also in the United Kingdom the compulsory schooling age is 16. For an analysis of compulsory education, see Balestrino *et al.* (2017) for a normative perspective, and Balestrino *et al.* (2021) for a political economy perspective.

[5] In principle, lump-sum taxes may become lump-sum subsidies if, for example, the school fees more than offset the costs.

however, may be reduced thanks to the vouchers). First, we analyse the individual optimum for a given set of policy instruments. Then, we consider a situation where the government covers education costs primarily through lump-sum taxes, and discuss the effects of balanced-budget policy reforms aimed at either introducing or raising school fees as well as vouchers for the take-up costs. The consequences of such reforms are analysed in terms of a social welfare function that only considers the utility of altruistic parents who value their children's welfare, without taking into account any positive externality or merit-good argument for education. Our main result shows that in general school fees allow to increase social welfare while vouchers decrease it.

The plan of the paper is as follows. Section 2 analyses the model on parents' choices for their kids in terms of both quantity and quality of education. The consequences for social welfare of a balanced-budget policy reform that introduces a school fee and a subsidy for quality are examined in Section 3 and 4, respectively. Section 5 contains concluding remarks.

II The model

We consider a finite horizon set-up with one parent and one child. Parents are assumed to be altruistic towards their children: the utility of a parent depends on her consumption as well as on her child's welfare, where the latter is represented by a function of the additional lifetime income that a child obtains if s/he engages in education.[6] Such educational premium depends both on quantity and quality of acquired education. A household's type i, $i = 1, 2$ depends on the area of residence: 1 is taken to identify the more developed area where wages are higher and schools have higher quality. We suppose there are n^i, $i = 1, 2$ households of each type and that the total number of households is normalised to unity ($n^1 + n^2 = 1$). All households within a given type/area are identical. Agents who live in an area, work in that area. Such absence of mobility is assumed for convenience only, and is not to be taken literally in the case of a metropolitan area interpretation

[6] Given that we do not consider the dependence of the parent's utility on her own child's utility, we assume impure altruism or a warm glow attitude, see e.g. Andreoni (1990).

where, however, people living in poor surroundings are those who have access to less paid jobs. In the case of a rural vs. urban interpretation we assume that the wage differential does not cover the commuting and/or accommodation costs.

There is one consumption good whose price is normalised to unity, produced with a constant-returns-to-scale technology in a perfectly competitive economy. The government provides a composite education service, for which we distiguish a quantity as well as a quality dimension, as we explained above. We assume, as mentioned, that quality is higher in area 1 and that the government finds it more convenient to subsidise student mobility rather than to raise area-2 quality education services. Kids can go to school in either area but, as we will better specify below, area-2 children going to school in area 1 incur in higher take-up costs. From the government perspective, there will be costs to be borne for providing the service; in order to meet such costs, the government levies lump-sum taxes on the incomes of the parents. However, it may also introduce school fees to partially or fully finance education and/or vouchers to finance students mobility.

The parents are free to choose both the amount and the quality of schooling (i.e. the area of the school) they want for their children. From the household's perspective, school attendance implies two potential sources of expenditure, a fee for each year of schooling as well as take-up costs for quality (possibly reduced by the vouchers). We begin by characterising the individual optimum for a given set of policy instruments; then, in the next sections, we analyse the effects of reforms aimed at introducing or raising i) school fees and ii) vouchers for the take-up costs.

As a first step, let us identify the educational premium $y^i = y(S^i, Q^i)$ for a child belonging to a type-i household, $i = 1, 2$. Such premium depends on school quantity S^i and school quality $Q^i \in \{\overline{Q}, \underline{Q}\}$ where $\overline{Q}$ ($\underline{Q}$) is the quality level available in area 1 (area 2). We take $y(\cdot)$ to be strictly concave and assume that i) $y(0, \overline{Q}) = y(0, \underline{Q}) = 0$; ii) $y(S^i, \overline{Q}) > y(S^i, \underline{Q})$ for any given level of $S^i > 0$; and iii) $y_S(S^i, \overline{Q}) > y_S(S^i, \underline{Q})$ for any given level of $S^i \geq 0$. School time is essential and better quality makes school time more productive not only in terms of levels but also in terms of marginal productivity. Note that child time endowment is normalized to 1.[7]

[7] When children do not attend school, they might be inactive or they might work in exchange for a

Let us now turn our attention to the budget constraint of the parent. Since an adult agent has completed her education and adult leisure is taken to be fixed, she can only employ her time endowment for work: her income is therefore fixed and denoted by X^i. We posit $X^1 > X^2$, as incomes are larger in the more developed area. The parent can employ her income for her own consumption as well as for her child's schooling. She chooses for how long the kid is going to stay in school, i.e. S^i, as well as how good the quality of the school is going to be, i.e. whether the kid will go to school in area 1 or in area 2. Each year of schooling costs the fee $\phi \geq 0$.

As for quality, different people have different take-up costs. For example, given that the best schools are available in the more developed area, those who live in the other area may have to face boarding or commuting costs for their kids. Not only, better schools may involve higher costs because students are required (even if not explicitly) to buy more books, to have a computer, etc.[8] We denote by k^{ij} the take-up cost for quality of an area-i household sending its kid to school in area j. For simplicity, we normalise to zero the take-up cost of the households sending their kids to school in their area, $k^{ii} = 0$, and we set $k^{12} = k > 0$, i.e the take-up cost for area-2 households sending their kids to school in area 1 is positive.[9] The government has the opportunity to reduce such cost by means of a voucher, σ^2, that covers k either fully or in part. The voucher is only given to area-2 parents if they send their kids to school in area 1. We assume that, in the absence of government intervention, the take-up cost k is too high for these households to send their children to high-quality schools so that there will be no mobility.

In general, the lump-sum tax $T^i > 0$, $i = 1, 2$, is levied in order to cover the costs (for school quantity and quality) that are not covered by the school fees.[10] Given that

wage. One way or the other, it would make no difference for our results as long as the children's income does not affect the consumption of the parents.

[8] Even in this case, area-1 students, that is students from richer families, may face lower costs because for example they already own computers.

[9] Nothing of substance changes if we assume $k^{ii} > 0$ as long as it is lower than k. We do not explicitly consider the option of area-1 households sending their kids to school in area 2 because this is clearly suboptimal.

[10] Note that if the fees are higher than educational costs, we could have a negative T^i, $i = 1, 2$ (a

parents live in different areas, the tax can be diversified according to the household residence (since income is fixed in each area, in fact the lump sum tax is equivalent to a proportional tax with appropriate tax rate).

If C^i denotes the parent's consumption, then the budget constraint is

$$C^i + k^i + \phi S^i = X^i - T^i + \sigma^i, \qquad i = 1, 2, \tag{1}$$

where $k^1 = 0$ and k^2 can take value 0 or k depending on the quality choices of area-2 households, $\sigma^1 = 0$ and $k \geq \sigma^2 \geq 0$. The utility function of an altruistic parent then obtains as

$$U^i = u\left(C^i\right) + \beta y(S^i, Q), \qquad i = 1, 2, \tag{2}$$

where $u(.)$ is taken to be stricly concave, and β, $0 < \beta \leq 1$, is the weight that parents attribute to the welfare of their children as measured by their educational premium. In order to simplify the general optimisation problem, let us solve the budget constraint (1) for C^i and substitute it into the utility function. Then, using (1) into (2), we have that the parent chooses S^i and Q^i so as to maximize

$$U = u(X^i - T^i - k^i + \sigma^i - \phi S^i) + \beta y\left(S^i, Q^i\right), \quad i = 1, 2. \tag{3}$$

The FOC of this problem for the choice of S^i then is

$$\beta y_S \gtreqless u'\phi; \qquad i = 1, 2, \tag{4}$$

plus complementary slackness.

Consider first a situation in which $\phi = 0$; then, we have $S^i = 1$. This simply says that if education is free, a rational agent will send her kid to school as much as possible. Suppose now that $\phi > 0$ to begin with. Note first that $S^i = 1$ may obtain even with $\phi > 0$ as long as the fee is not too large. A distinct and interesting possibility is that for some range of the values of ϕ (relatively close to zero), we have $S^1 = 1$ and $0 < S^2 < 1$: lower parents' income in the less developed area, possibly coupled with lower marginal productivity of education due to lower school quality, makes area-2 children more prone to forgo full-time education. If, on the contrary, interior solutions obtain for both types

subsidy).

of households, it can be easily verified that it is always $S^1 > S^2$ when the lump-sum taxes satisfy the no re-ranking condition $X^1 - T^1 \geq X^2 - T^2$ (see Appendix 1). Note that for very high values of ϕ and low values of β it could be the case that $S^i = 0$; this extreme case will be discussed in Section 4.

As for the choice of school quality, we have that area-1 households choose $\overline{Q}$ because they do not incur in take-up costs when enrolling their children in area-1 schools; instead, area-2 households will choose either $\overline{Q}$ or $\underline{Q}$, depending on the presence and level of the voucher σ^2.

Comparative statics can be performed when we have interior solutions for S^i. Let us define $\widehat{\phi}^i$ as the lowest level of ϕ such that FOC (4) becomes an equality. When $\phi \geq \widehat{\phi}^i$, so that interior solutions obtain, it is immediate to verify that we have:

$$\frac{\mathrm{d}S^i}{\mathrm{d}X^i} = -\frac{\mathrm{d}S^i}{\mathrm{d}T^i} = \frac{\phi u''}{[\beta y_{SS} + \phi^2 u'']} > 0, \qquad i = 1, 2, \tag{5}$$

$$\frac{\mathrm{d}S^2}{\mathrm{d}\sigma^2} = -\frac{\mathrm{d}S^2}{\mathrm{d}T^2} = \frac{\phi u''}{[\beta y_{SS} + \phi^2 u'']} > 0, \qquad \text{for } \sigma^* < \sigma^2 \leq k, \tag{6}$$

$$\frac{\mathrm{d}S^i}{\mathrm{d}\phi} = \frac{(u' - \phi S^i u'')}{[\beta y_{SS} + \phi^2 u'']} < 0, \qquad i = 1, 2, \tag{7}$$

where σ^* is the lowest value that makes the voucher effective, i.e. that makes it optimal for area-2 households to accept it and choose high-quality schools (send their kids to area 1). The quantity of education is decreasing in the school fee and in the lump-sum tax. As far as σ^2 is concerned, an increase in the voucher increases the time spent in school by area-2 children provided the voucher is above the minimum effective level.

When $\phi < \widehat{\phi}^i$, a corner solution with $S^i = 1$ obtains and no comparative statics applies. With a little abuse of notation we can state that

$$\left.\frac{\mathrm{d}S^i}{\mathrm{d}X^i}\right|_{\phi<\widehat{\phi}^i} = -\left.\frac{\mathrm{d}S^i}{\mathrm{d}T^i}\right|_{\phi<\widehat{\phi}^i} = \left.\frac{\mathrm{d}S^i}{\mathrm{d}\sigma^2}\right|_{\phi<\widehat{\phi}^i} = \left.\frac{\mathrm{d}S^i}{\mathrm{d}\phi}\right|_{\phi<\widehat{\phi}^i} = 0, \quad i = 1, 2. \tag{8}$$

Finally, for future use, we denote the indirect utility of a parent as a function of the policy instruments as

$$V^i = V(\phi, \sigma^2, T^i), \quad i = 1, 2. \tag{9}$$

Accordingly, it is easy to check the following:

$$\frac{\partial V^i}{\partial \phi} = -u' S^i < 0; \quad \frac{\partial V^i}{\partial T^i} = -u' < 0, \quad i = 1, 2. \tag{10}$$

III Balanced-budget policy reforms: school fees

In the previous section we have taken the education policy as given, but the subsidy σ^2 *for education quality* and the school fee ϕ *for education quantity* are in fact policy instruments which are not necessarily used by the public authority. Let us now investigate first the introduction of tuition fees starting from a situation were $\phi = 0$ and education is only financed by means of the lump-sum tax T^i, $i = 1, 2$, and then further increases in the fees when they are already positive. In particular, we will focus on a balanced-budget revenue reform such that the government raises ϕ at the margin, adjusting T^i at the same time so as to leave the budget unaffected. Our ultimate aim is to check the effects of such policy measure on social welfare, but we start from looking at the effect on the budget.

The public revenue constraint is given by

$$B \equiv \phi\left(n^1 S^1 + n^2 S^2\right) + n^1 T^1 + n^2 T^2 - n^2 \Delta T^2 + \\ - \left[\gamma_S (n^1 S^1 + n^2 S^2) + \gamma_Q (n^1 Q^1 + n^2 Q^2)\right] = 0, \quad (11)$$

with $\gamma_S, \gamma_Q > 0$, where γ_S and γ_Q denote the (constant) marginal cost of providing the required amount of school quality and quantity, respectively.[11] Note that we have $Q^1 = \overline{Q}$, while as far as Q^2 is concerned, the analysis in this section applies both to the case where $\sigma^2 < \sigma^*$ so that area-2 households choose $Q^2 = \underline{Q}$, and to the case where $\sigma^2 \geq \sigma^*$ so that area-2 households choose $Q^2 = \overline{Q}$.

Let us consider the effects of the introduction of a tuition fee on the choice of school quantity. When $\phi = 0$ and education is fully financed through the lump-sum taxes, we know from Section 2 that $S^i = 1$, $i = 1, 2$. In other words, young people go to school full time independently of their area of residence. The situation will not change if ϕ is raised slightly above zero, while T^i, $i = 1, 2$, is simultaneously lowered so as to keep $B = 0$. Recalling that $\widehat{\phi}^i$ is the lowest level of ϕ such that the FOC for S^i in (4) becomes an equality, this will actually occur as long as $\phi < \widehat{\phi}^i$.

[11] Linearity of the cost function is here assumed for the sake of simplicity. Results would be qualitatively unaltered in case of a convex cost function.

In order to formally evaluate the effect of a raise in ϕ, let us totally differentiate (11):

$$\frac{\partial B}{\partial \phi} d\phi + \frac{\partial B}{\partial T^1} dT^1 + \frac{\partial B}{\partial T^2} dT^2 = 0. \tag{12}$$

A small balanced-budget reform involving a change in ϕ can be defined as a pair (dϕ,dT) such that

$$\frac{\partial B}{\partial \phi} d\phi = - \left[\frac{\partial B}{\partial T^1} dT^1 + \frac{\partial B}{\partial T^2} dT^2 \right]. \tag{13}$$

For the sake of simplicity, we here consider a policy where the decrease in each T^i exactly compensates the effect of an increase in ϕ within each group $i = 1, 2$. In other words, no matter whether some redistribution is in place before the policy is implemented, the introduction of the fee is exactly compensated by a reduction in the lump-sum tax within each group so that

$$\frac{\partial B^i}{\partial \phi} d\phi = -\frac{\partial B^i}{\partial T^i} dT^i, \tag{14}$$

where

$$B^i \equiv \phi n^i S^i + n^i T^i - n^i \Delta T^i - \gamma_S n^i S^i - \gamma_Q n^i Q^i. \tag{15}$$

The budget's derivatives are as follows:

$$\frac{\partial B^i}{\partial \phi} = n^i S^i + (\phi - \gamma_S) n^i \frac{\partial S^i}{\partial \phi} > 0; \tag{16}$$

$$\frac{\partial B^i}{\partial T} = n^i + (\phi - \gamma_S)\, n^i \frac{\partial S^i}{\partial T} > 0; \tag{17}$$

where the signs follow from the comparative statics results (5) given that $\phi < \gamma_S$ as we are considering low levels of ϕ. Clearly, whenever the tax or the fee goes up, the budget improves; whenever they go down, it worsens. Considering an increase in ϕ, then

$$\frac{\mathrm{d}T^i}{\mathrm{d}\phi} = -\frac{\partial B^i / \partial \phi}{\partial B^i / \partial T^i} = -\frac{S^i + (\phi - \gamma_S) \frac{\partial S^i}{\partial \phi}}{1 + (\phi - \gamma_S) \frac{\partial S^i}{\partial T}}. \tag{18}$$

For $\phi = 0$ and indeed as long as $\phi < \widehat{\phi}^i$, we know from (8) that $\frac{\partial S^i}{\partial \phi} = \frac{\partial S^i}{\partial T} = 0$ because S^i stays equal to one. Consequently,

$$\left. \frac{\mathrm{d}T^i}{\mathrm{d}\phi} \right|_{\phi < \widehat{\phi}^i} = -1, \tag{19}$$

and there is no change in the expenses for education on the part of the parents.

Let us now consider the effects of increasing the school fee when it is already positive. Indeed, the picture changes starting from $\phi = \widehat{\phi}^i$, where we have that $\frac{\partial S^i}{\partial \phi}, \frac{\partial S^i}{\partial T} < 0$ even if it still is $S^i = 1$ at $\phi = \widehat{\phi}^i$. Considering the expressions in (5), it is easily checked that $\left|\frac{\partial S^i}{\partial \phi}\right| > \left|\frac{\partial S^i}{\partial T}\right|$, implying

$$\left.\frac{\mathrm{d}T^i}{\mathrm{d}\phi}\right|_{\phi=\widehat{\phi}^i} < -1. \tag{20}$$

The effect is larger than unity in absolute value: if the school fee is raised by 1 unit, this allows a reduction by more than 1 unit in the lump-sum tax to keep government revenue fixed.

This latter point offers an interesting insight. Once the school fee is already in place, exactly at the threshold level above which households do not send their kids to school full-time, it would seem pointless to raise it. But it must be remembered that educational policy impacts on taxation. Raising the fee at $\phi = \widehat{\phi}^i$ (or for that matter at any value of ϕ above that) would have the effect of lowering the lump-sum tax, as it would reduce S^i and thus trigger a reduction in T^i larger than the increase in ϕ.

Note that, given the above definition of $\widehat{\phi}^i$, it is $\widehat{\phi}^2 < \widehat{\phi}^1$ (see Appendix 2 for a formal proof). Hence, if the fee is set at $\phi = \widehat{\phi}^2$, such effect will be present only for parents living in area 2 while those living in area 1 will still choose $S^1 = 1$. In any case, from the solution of the parents' problem we know that $S^1 > S^2$. This will have interesting implications, as we will see below.

In order to make a fully-formed judgment on the nature of the marginal reforms concerning the school fee, however, we have to check the impact on welfare. Social welfare is given by

$$W = W(n^1V^1, n^2V^2), \tag{21}$$

where $W(\cdot)$ is quasi-concave and $V^i,\ i = 1,2$ is given by (9). In other words, we measure social welfare in terms of the welfare of altruistic parents who value their children's welfare in their utility functions, but we do not take into account any externality or merit-good argument. In fact, what drives educational choices in our setting is parents' altruism.

Total differentiation of (21) yields:

$$\frac{\mathrm{d}W}{\mathrm{d}\phi} = n^1\left(\frac{\partial W}{\partial V^1}\frac{\partial V^1}{\partial \phi} + \frac{\partial W}{\partial V^1}\frac{\partial V^1}{\partial T^1}\frac{\partial T^1}{\partial \phi}\right) + n^2\left(\frac{\partial W}{\partial V^2}\frac{\partial V^2}{\partial \phi} + \frac{\partial W}{\partial V^2}\frac{\partial V^2}{\partial T^2}\frac{\partial T^2}{\partial \phi}\right). \tag{22}$$

Using (10) and letting $W_i = \partial W/\partial V^i$ denote the "welfare weights", the previous equation becomes

$$\frac{\mathrm{d}W}{\mathrm{d}\phi} = n^1\left(-W_1u'S^1 + W_1u'\frac{\partial B/\partial\phi}{\partial B/\partial T^1}\right) + n^2\left(-W_2u'S^2 + W_2u'\frac{\partial B/\partial\phi}{\partial B/\partial T^2}\right). \qquad (23)$$

Consider the introduction of a school fee, starting again from a situation where $\phi = 0$. We know that as long as $0 < \phi < \widehat{\phi}^i$, nothing changes: S^i stays equal to 1, and $\frac{\partial B/\partial\phi}{\partial B/\partial T^i} = 1$ so that $\frac{\mathrm{d}W}{\mathrm{d}\phi} = 0$ and the increase in ϕ has no effect on welfare. Thus, marginal increases in the school fee above zero have no effect. If our starting point is $\widehat{\phi}^2 < \widehat{\phi}^1$, however, the derivative becomes

$$\left.\frac{\mathrm{d}W}{\mathrm{d}\phi}\right|_{\widehat{\phi}^2} = (n^2W_2u')\left(\frac{\partial B/\partial\phi}{\partial B/\partial T^2} - 1\right) > 0, \qquad (24)$$

where the sign depends on (14) and the fact that we established that $|dT^2/d\phi| > 1$ – see (20).

Hence, we can state that a marginal increase in the school fee above $\widehat{\phi}^2$ is welfare-improving: type-2 parents are better-off while the welfare of the other group is unaffected.

What about a further increase in the tuition fee (still compensated by a decrease in the lump-sum tax)? It can be checked (see Appendix 3) that a further increase in ϕ is welfare improving for parents of type-2 as long as $\phi < \gamma_S$. For them it is preferable to raise ϕ and correspondingly lower T^2 up to the point where $\phi = \gamma_S$.[12] Unless $\widehat{\phi}^1 > \gamma_S$ so that a solution with $S^1 = 1$ always obtains for type-1 families, as soon as ϕ becomes greater than $\widehat{\phi}^1$ and S^1 becomes lower than 1 in this process, also type-1 parents will see their welfare increase. If ϕ is raised above the marginal (and average) cost of quantity γ_S, parents' welfare will however start to decrease because of the large reduction of S^i. As the fee increases further, its negative impact becomes significant: at first, it will push the kids in the less developed area to reduce their education and might also push them to completely forgo education. The same will happen to the kids of the more developed area but the effect will be weaker.

Summing up, we can state the following

Proposition 1.

[12] If the public budget is balanced for each group, then T^2 is only used to finance Q^2, i.e. $T^2 = \gamma_Q Q^2$. Note that in such a case $\phi = \gamma_S$ also implies $T^1 = \gamma_Q Q^1 = \gamma_Q \overline{Q}$.

- A marginal increase in the school fee (compensated by a reduction in the lump-sum taxes) above zero has no effect on welfare;

- a marginal increase in the school fee above $\widehat{\phi}^2$ *(compensated by a reduction in the lump-sum taxes) is welfare-improving;*

- further marginal increases in the school fee (compensated by a reduction in the lump-sum taxes) are welfare-improving as long as $\phi < \gamma_S$ *.*

We may conclude that if the policy measure is evaluated according to a welfare function reflecting the preferences of the parents, the introduction of a school fee is welfare-improving as long as the introduction of the fee *reduces* the years of schooling with respect to the level that would be chosen if S^i, $i = 1, 2$, were financed through the lump-sum taxes. The quantity of education in fact may be "too high" according to the preferences of one or both the categories of parents, even if all parents are assumed to be altruistic. The more heavily the lump-sum tax is used, the more individual choices are distorted with respect to the "true" price of quantity. If however, the increase in the fee is so large as to become greater than the cost γ_S, the reduction in education will be so high as to reduce parents' welfare.

IV Balanced-budget policy reforms: vouchers

Let us now investigate the introduction of a voucher aimed at covering the take-up costs that area-2 households incur when choosing the high level of quality $\overline{Q}$. For simplicity, we consider a level of the voucher $\sigma^2 = k$, but the following analysis also applies to the case where $\sigma^* \leq \sigma^2 < k$, i.e. where the voucher is high enough to make area-2 households choose quality $\overline{Q}$. Again, we consider a case where $\sigma^2 > 0$ is compensated by an adjustment in T^2 such that B^2 stays unaltered. In other words, the lump-sum tax is raised, but a voucher equal to the raise in T^2 is simultaneously given that pays for the cost k incurred by area-2 households that send their children to the high-quality schools. Under such a policy, two alternative outcomes may occur:

Case a): area-2 parents use the voucher and choose $\overline{Q}$;

Case b): financing the voucher through the lump-sum tax is so costly that area-2 parents prefer not to send their kids to school.

Area-2 parent decisions are represented through FOC (4) relating to the choice of S^2. Case a) corresponds to (4) having the form

$$\beta y_S \geq u'\phi \text{ for } S^2 = 1, \tag{25}$$

while case b) corresponds to

$$\beta y_S < u'\phi \text{ for } S^2 = 0. \tag{26}$$

Note that the level of ϕ is crucial in the conditions above. Case b) will never occur in the absence of a tuition fee (that is, if $\phi = 0$), which points out a crucial relationship between the two policy measures.

Let us consider case a), where all the children go to the high-quality schools. Now there will be a new level of the threshold on the tuition fee below which (25) holds as an inequality. Let us call it $\widetilde{\phi}^2$. By using an argument that is analogous to that in Appendix 1, it is easily checked that we still have $\widetilde{\phi}^2 < \widehat{\phi}^1$. Then, for $\phi \leq \widetilde{\phi}^2$, we have $S^2 = S^1 = 1$, while for $\phi > \widetilde{\phi}^2$, we have $S^2 < S^1 \leq 1$. In this sense, results are qualitatively similar to the results obtained in the absence of the voucher, but now the educational premium of area-2 children will be higher while the consumption of area-2 households will be lower.

If instead we compare the level of S^2 to the level that obtains in the absence of such policy measure, we cannot say whether it will be higher or lower. This will depend on the relative increase occuring in both y_S and u' as well as on the levels of β and ϕ. We cannot exclude that in some cases S^2 will be higher under the policy, namely we cannot exclude that, once parents are forced to send their kids to high quality schools, they prefer to increase their children's school time.

Note that in any case T^2 is now raised by an amount that equals k relative to when the voucher was absent. This implies that the argument of u' is lowered by the same amount, as the voucher covers the take-up costs (k is offset by σ^2).[13] Now, recall that,

[13] Note that this argument remains unaltered if the value of the voucher is lower than k but high enough to have area-2 households choose high quality schools (i.e for $\sigma^* \leq \sigma^2 < k$). In that case, the voucher T^2 is only raised by the amount of the voucher but the argument of the parent's utility function is lowered by the full amount of k, as she has to make up for the whole take-up cost.

in the absence of the voucher, area-2 parents would not have sent their children to the high-quality schools: therefore, the welfare of the parents is reduced by the introduction of a voucher for quality financed through the lump-sum tax, because this induces "too high" a quality (and consequently too high a tax) according to their preferences.

Case b) is somewhat extreme, but it may occur for relatively high values of ϕ when the discount rate β is low and take-up costs k are high, thus reducing the argument of u'. Clearly, even in this case the welfare of the parents is decreased by the policy considered.

Summing up, we can state the following

Proposition 2. *Both in case a), in which area-2 parents use the voucher and choose* $\overline{Q}$*, and in case b), in which financing the voucher through the lump-sum tax is so costly that area-2 parents prefer not to send their kids to school, the introduction of a voucher for quality financed through a lump-sum tax is welfare-reducing.*

V Concluding Remarks

The aim of this paper has been to contribute to the theoretical analysis of the role played by both quantity and quality of education in designing public policies. Our main result is that parents' altruism is not enough to support high levels of quantity and quality of education: it is not necessarily sufficient to induce them to choose full-time education for their children, and is never sufficient for them to support the introduction of the voucher for quality. Indeed, we found that school fees, that induce parents to optimally reduce the amount of education for their children, are generally welfare-improving.

We also note that the policy instrument related to quantity, namely the school fee, works independently of the instrument related to quality, i.e. the voucher. However, the converse in not true: the impact of the voucher depends, among other things, on the level of the fee. This points to an asymmetry that the policy-maker must take into account, and that is highlighted by our approach in which quality is considered as an independent dimension of education.

The above results have been obtained evaluating welfare on the ground of parents' preferences. This may seem reasonable on the part of the government because parents are the present voters who give political support. However, public authorities are in the position to take into account other important elements. First of all, they may attribute value to the externalities of education that are present both for parents' themselves and for society at large;[14] or, they may view education as a merit good. Moreover, they can take into account the welfare of children, giving it more weight than parents do in their utility functions, as for example in Haaparanta et al. (2022). Clearly, in these cases, which could be explored in further research, more weight is put on the welfare effects of both school quantity and quality, thereby possibly modifying the conclusion on the impact of the reforms - plausibly in the direction of reducing the negative impact of the vouchers and the positive impact of the fee.

Indeed, one way of interpreting the relevance of our result is to note that they are, prima facie, somewhat counterintuitive: in a model with altruistic parents and income dispersion, why shouldn't fees be optimally reduced and/or vouchers introduced, even if the government caters to the needs of the parent rather than those of the children? Isn't in the interest of the parents to educate their children the best they can? In fact, what we show is, quite simply, that the presence of fees and the absence of vouchers avoids an inefficiently high level of expenditure in education, along both dimensions, i.e. quality and quantity. The implication is then that when the abolition of fees and the introduction of vouchers is invoked, there is an implicit assumption that education has a societal value aside from, and above of, the private one. In other words, before embarking on a discussion of how education policy should look like, we have to agree on what education is. Does it generate positive externalities? Is it a merit good or indeed a good relative to which there might biases that affect individual choices? Or is it better interpreted as a private good - albeit a complex one, with both a quality and a quantity dimension? For such an understanding is crucial to the characterisation of what a good education policy should look like.

[14] See, for example, the approach proposed by Bourguignon and Verdier (2000).

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Appendix 1

We want to show that when $X^1 - T^1 \geq X^2 - T^2$, if interior solutions obtain for both types of households, we always have $S^1 > S^2$. If interior solutions obtain, the FOCs (4) can be written as

$$\frac{y_S}{u'(X^i - T^i - k^i + \sigma^i - \phi S^i)} = \frac{\phi}{\beta}, \qquad i = 1, 2. \tag{27}$$

Suppose instead that $S^1 = S^2 = S$ and consider that $k^1 = \sigma^1 = 0$ and $k^2 - \sigma^2 \geq 0$, implying $X^1 - T^1 - \phi S > X^2 - T^2 - k^2 + \sigma^2 - \phi S$. We already assumed that the condition holds as an equality for area-1 households. Then, however, the LHS of (27) would be lower than the RHS for area-2 households, no matter whether they are choosing $\underline{Q}$ or $\overline{Q}$. For (27) to hold as an equality also for area-2 households, S^2 should be lowered so as to raise y_S and to diminish $u'(X^2 - T^2 - k^2 + \sigma^2 - \phi S^2)$. Thus, $S^1 > S^2$.

Appendix 2

We want to show that when $X^1 - T^1 \geq X^2 - T^2$, then $\widehat{\phi}^2 < \widehat{\phi}^1$. Recall that $\widehat{\phi}^i$ is the lowest level of ϕ such that the FOCs (4) hold as an equality for a household of type i, implying $S^1 = S^2 = 1$. Recall also that σ^* is the level of the voucher that makes it optimal for area-2 households to send their kids to school in area 1. We then have

$$\beta y_S(1, \overline{Q}) = \widehat{\phi}^1 u'(X^1 - T^1 - \widehat{\phi}^1), \tag{28}$$

$$\beta y_S(1, \widetilde{Q}) = \widehat{\phi}^2 u'(X^2 - T^2 - k + \sigma^2 - \widehat{\phi}^2), \tag{29}$$

where $\widetilde{Q} = \overline{Q}$ if $\sigma^* \leq \sigma^2 < k$, and $\widetilde{Q} = \underline{Q}$ otherwise . Given our assumptions on $y(S^i, Q^i)$, this implies that $y_S(1, \overline{Q}) \geq y_S(1, \widetilde{Q})$. On the other hand, if it were $\widehat{\phi}^2 \geq \widehat{\phi}^1$, it would be $\widehat{\phi}^2 u'(X^2 - T^2 - k + \sigma^2 - \widehat{\phi}^2) > \widehat{\phi}^1 u'(X^1 - T^1 - \widehat{\phi}^1)$ no matter the level of $\widetilde{Q}$ and the two FOCs could not simultaneously hold. Consequently, it must be $\widehat{\phi}^2 < \widehat{\phi}^1$.

Appendix 3

In order to show that parents' welfare is always increasing in ϕ when $\widehat{\phi} \leq \phi < \gamma_S$, consider that

$$\left.\frac{\mathrm{d}W}{\mathrm{d}\phi}\right|_{\phi<\gamma_S} = n^i W_i u' \left(\frac{\partial B/\partial\phi}{\partial B/\partial T^i} - S^i\right) > 0, \tag{30}$$

because

$$\begin{aligned}
\frac{\partial B^i/\partial\phi}{\partial B^i/\partial T^i} &= \frac{S^i+(\phi-\gamma_S)\frac{\partial S^i}{\partial\phi}}{1+(\phi-\gamma_S)\frac{\partial S^i}{\partial T}} \\
&= \frac{S^i+(\phi-\gamma_S)\dfrac{u'-\phi S^i u''}{\beta y_{SS}+\phi^2 u''}}{1-(\phi-\gamma_S)\dfrac{\phi u''}{\beta y_{SS}+\phi^2 u''}} \\
&= S^i\left(1+\frac{(\phi-\gamma_S)\dfrac{u'/S^i}{\beta y_{SS}+\phi^2 u''}}{1-(\phi-\gamma_S)\dfrac{\phi u''}{\beta y_{SS}+\phi^2 u''}}\right) > S^i.
\end{aligned} \tag{31}$$

Given this expression, it is also clear that parents' welfare reaches a maximum for $\phi = \gamma_S$ when $\frac{\partial B/\partial\phi}{\partial B/\partial T^i} = S^i$ and becomes negative for $\phi > \gamma_S$.