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Promoting education under distortionary taxation

Promoting education under distortionary taxation: equality of opportunity versus welfarism

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Abstract
A common claim in the policy discourse is that a government wishing to achieve equality of
opportunity should use public provision of education for equalisation of opportunities rather
than income taxation, which only equalizes incomes. We develop a framework in which the
tax and education provision rules in the welfarist and non-welfarist/equality of opportunity
cases can be transparently compared. We show that in addition to education policies, pro-
gressive taxation also plays a role in achieving equality of opportunity, and illustrate how its
use may differ under the two objectives. We also show how the provision of public educa-
tion depends on how private education choices respond, potentially differentially by higher-
and lower-income families.

Keywords Equality of opportunity · Income taxation · Inequality · Public good provision

1 Introduction

An often heard refrain in the policy discourse is that rather than use progressive taxation to
reduce inequality of incomes, the government should use equal public provision of educa-
tion to reduce inequality of education, and then let the distribution of income be whatever it
turns out to be. Preference for equalizing education over equalizing incomes is sometimes
argued for in terms of the presumed greater efficiency, since income taxation would distort
the choice between labour effort and leisure. But perhaps a stronger strand in the argument
is that equalizing education equalizes opportunities, and that equality of opportunity rather
than equality of incomes should be the objective of policy.

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Consider, then, an unequal society in which parents spend some of their earned incomes on the education of their children, and this parental input together with equal provision of public education leads to the educational outcomes for children. The government has at its disposal instruments of taxation as well as the level of public provision of education. How should the government choose these instruments in such a setting? The answer depends of course on the government's objectives.

Since the earning of higher incomes requires the use of higher labour effort, the appropriate measure of parental wellbeing is not income per se but utility. One strand of the literature takes as the government's objective a social welfare function defined on the distribution of utilities, which in turn are the outcomes of optimal parental choices on labour, leisure, and expenditure on inputs for children's education. This will be recognized as the classic "welfarist" formulation of the problem emanating from the work of Mirrlees (1971) – welfarist, because the government's objective function depends on, and only on, the "utility outcomes" (of parents in this case).

Contrast this with a "non-welfarist" formulation in which the government cares about, and only about, the distribution of educational outcomes, since this is the distribution of opportunity for the next generation. Parental utility functions do not matter directly in the government's objective function and thus neither do inequalities of utilities or incomes. This follows the arguments of Roemer (1998), who draws on a philosophical tradition going back to Rawls (1971), Dworkin (1981), and Sen (1985), and distinguishes between "circumstances" (factors outside the control of the individual) and "effort" (factors within the individual's control). In this view, inequalities attributable to circumstances are the only legitimate target for government intervention.

This paper frames the difference between "equality of outcomes" and "equality of opportunity" as the distinction between a "welfarist" and a "non-welfarist" objective function. This analytical distinction between welfarist and non-welfarist objective functions makes sharp the informal distinction between "outcomes based" and "opportunities based" objectives in the policy discourse. It allows us to explore in a systematic way the alternative uses of taxation and public education provision under the two types of objectives. Is it the case that under opportunities-based objectives, the tax system used to finance education expenditure should be essentially linear? And if progressive taxation is still used, what does its differential use under the two objectives depend upon? Is it the case that higher provision of equal public education can advance the opportunity based objective? Will the provision of public education in this case necessarily be higher than when the objective is welfarist? These are the types of questions to which the policy discourse gives rise, and that we set out to answer in this paper.

To further clarify the research question in the paper, we study two intertwined questions: choosing the level of taxation and whether the received government revenues should be spent on in-cash redistribution or on in-kind educational provision. The two questions are linked via the government budget constraint.

Our paper builds on a large literature on the optimal choice of taxation and public provision of education in the welfarist tradition, including but not limiting to Ulph (1977), Hare and Uplh (1979), Tuomala (1986), Brett and Weymark (2003), Bovenberg and Jacobs (2005), Gasparini and Pinto (2006), and Blumkin and Sadka (2008); and Balestrino et al. (2017). In the present paper, much of the analysis is couched in terms of the linear income tax model. The reason is that this tax system – with a lump-sum transfer – is the simplest possible one which is potentially progressive. Therefore, the model is a sufficient framework

for examining our main research question, i.e. whether the government wants to tax income in a progressive manner.[1]

In addition, our work relates to a recent, growing literature on taxation in an equality of opportunity framework. Most recently, Roemer and Ünveren ([2016]) set up an intergenerational model in which the current generation makes decisions on education for their children, the future generation. They use public provision of education as the tool to equalize opportunities. The taxes, however, are not used for redistribution but only to finance the public provision of education. Their numerical simulations show that when private acquisition of education is possible, it can undo the intended effect of state provision. The contrast to our paper is that we consider the joint optimisation of taxes and public provision of education. In the Appendix of the paper, we also provide a direct comparison to their model using a dynastic framework.

To our knowledge, there is no literature that compares public policies of taxation and education provision by directly comparing the classical welfarist formulation in the tradition of Mirrlees ([1971]) with the non-welfarist equality of opportunity formulation à la Roemer ([1998]). Our paper is a first step in this direction. By deriving and presenting optimal taxation and public provision formulae for the two approaches in a comparable manner, we are able to pinpoint the differences between them in a sharp way.

We are also able to place alternative developments in the literature in the context of the contrast between welfarist and non-welfarist frameworks of optimal policy. We contrast our formulation of the objective function for equality of opportunity to the generalized welfare weights approach proposed by Saez and Stantcheva ([2016]), and argue their model does not fall in a pure "non-welfarist" category. Another related strand of literature is the literature on fair taxation (e.g. Fleurbaey and Maniquet [2006]; [2011]). Recent contributions to this literature that are closely related to our paper are (Fleurbaey ([2006]), Valletta ([2014]), and Fleurbaey and Valletta [2013], [2018]). They consider optimal taxation together with goods such as education and health expenditure, which affect the individual's labour productivity and over which they also have direct preferences. We discuss Fleurbaey and Valletta's model extensively and contrast our model to theirs. Even though they extend Valletta's Valletta ([2014]) simpler model by considering a continuum of types and outcomes, and a broader context of human capital investment (which can mean education or health expenditures, or a combination of both), they only consider the case of public subsidies and not of direct public provision. Further, due to multi-dimensional heterogeneity it is quite complicated to obtain more general results from their model. In this paper we present a formulation that relates the Fleurbaey and Valletta formulation to conventional formulations in the literature, allowing for easier comparisons and understandings. We also illustrate how the results differ from our chosen representation of Equality of Opportunity objectives.

The paper proceeds as follows: Section 2 lays out the basic setup, in which parents with unequal productivities choose labour effort and inputs to children's education to maximize a parental utility function. Section 3 sets out the base results for optimal taxation and public education provision of the welfarist formulation, in which the social welfare function depends only on parental utilities, as the benchmark for later comparison with the equality of opportunity case. Section 4 shows how the optimal tax and public provision formulae are changed when the objective function is non-welfarist, specialized to depending only on the distribution of educational outcomes for children. In Section 5 we contrast our formulation to other strands of literature: the generalized welfare weight model by Saez and Stantcheva

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[1] See Haaparanta et al. ([2020]) for a treatment of our framework with nonlinear taxation.

(2016) and the fairness approach to equality of opportunity in Fleurbaey and Valletta (2018), and briefly discuss other extensions of the model. Section 6 concludes the paper. We present the essential mathematical proofs and an extension to a dynastic model in the Appendices.

2 Individual behaviour

We follow closely the model structure used in Kanbur et al. (2018), allowing for comparison of the results. The framework we have in mind is one where individuals differ in their earning capacity w^i and spend their after-tax income on education and other consumption. The individual budget constraint is $y^i = (1 - \tau)z^i + b = x_c^i + x_a^i$, where $z^i = w^i l^i$ denotes labour income, and τ is a linear income tax, which the government uses to finance a lump-sum transfer b. Individual i allocates after-tax income y to private purchases of education, x_c, and other consumption, x_a. Education is thought to benefit the children of the parents who invest in education.

The government can intervene by public provision of education. Utility is $u = u\left[e^i(x_c^i, g), x_a^i, l^i\right]$, where g represents public provision of education. The overall educational level e^i is a function of private purchases and publicly provided education.

When $e^i(x_c^i, g)$ has been fixed by parents and current policies, the welfare of the children is also fixed but for future policies. Assuming that all inherent intertemporal dynamics (like the direct influence of parent's education on child's education) are absent as are also all dynamics in policy making between periods, policies adopted today will be adopted tomorrow. With the assumption that parents ignore the direct impacts of policies (expecting that policies remain unchanged over time) on children's welfare other than those arising directly from education level, our specification of the utility is an approximation of the steady welfare with education levels remaining unchanged between generations. In this case education level can be thought as an indicator of access to welfare. Thereby distribution of education can be thought as an indicator of equality of opportunity. Given this steady state interpretation we do not have to think of which generation is associated with the welfare measure we use as the basis for characterizing optimal policies. In Appendix B, we further demonstrate that the simple formulation used here can be motivated by an OLG model, where parents' welfare depends on the welfare of their children and the generations are linked by a human capital accumulation function.

The household maximizes the Lagrangian $u = u\left[e^i(x_c^i, g), x^i, l^i\right] + \lambda\left[(1 - \tau)w^i l^i + b - x_c^i - x_a^i\right]$. Its maximum value is denoted by $v^i = u\left[e(x_c^*, g), x_a^*, l^*\right] + \lambda\left[(1 - \tau)wl^* + b - x_c^* - x_a^*\right]$. The individual maximization also gives the demand functions $x_c^i = x_c^i(1 - \tau, b, g)$ and $x_a^i = x_a^i(1 - \tau, b, g)$ as well as labour supply $l^i = l^i(1 - \tau, b, g)$.

3 A welfarist benchmark

3.1 Income taxation

A welfarist government maximizes $\sum_i W\left[v^i(1 - \tau, b, g)\right]$ subject to its budget constraint $\sum_i \tau w^i l^i = Nb + N\pi g$, where π is the per-pupil cost of public education and N is the

number of households. The first-order conditions, shown in the Appendix, can be used to derive the optimal linear income tax formula:

$$\frac{\tau^*}{1 - \tau^*} = \frac{1}{\varepsilon}\left(1 - \frac{z(\beta)}{\bar{z}}\right),$$ (1)

where $\beta^i = W'\frac{\partial v^i}{\partial b}$ is the social marginal value of income for person i and $z(\beta) = \frac{\sum \beta^i z^i}{\sum \beta^i}$ denotes the welfare-weighted average income. The elasticity of total income is represented by $\varepsilon = \frac{d\bar{z}}{d(1-\tau)}\frac{(1-\tau)}{\bar{z}}$. The rule is the same as in Kanbur et al. (2018), Section 2.1. The interpretation is the following: when the government has a relatively large welfare weight on the lowest incomes, $z(\beta)$ is small relative to mean income ($\bar{z}$), and the optimal income tax rate is high. On the other hand, the optimal tax rate declines when ε increases.

An alternative way of writing the optimum rule is following Dixit and Sandmo (1977), who utilize the notion of net (of tax revenue) social marginal value of income from Diamond (1975),

$$\rho^i = \frac{\beta^i}{\mu} + \tau w^i \frac{\partial l^i}{\partial b}.$$ (2)

Here, μ is the Lagrange multiplier of the government budget constraint. Using this definition, the tax rule can be expressed as

$$\tau^* = \frac{-\text{cov}(\rho^i, z^i)}{\frac{1}{N}\sum_i w^i \frac{\partial \tilde{l}^i}{\partial(1-\tau)}},$$ (3)

where $\frac{\partial \tilde{l}^i}{\partial(1-\tau)}$ is the derivative of compensated labour supply. Again, distributional concerns are taken into account in the numerator and the denominator captures efficiency impacts.

3.2 Public provision

When the government directly provides education services, the rule for optimal provision of education is given by

$$\sum_i \beta^i m^i = \mu\left(N\pi - \sum_i \tau w^i \frac{\partial l^i}{\partial g}\right),$$ (4)

where $m^i = \frac{v_g^i}{\lambda} = \frac{v_g^i}{v_b^i}$ is the marginal rate of substitution for the public good. This is close to the first-best provision of a publicly provided private good, but the marginal rate of substitution at the left is a weighted one, and at the right a tax revenue term reduces the costs of provision if an increase in public provision increases labour supply.

Following Sandmo (1998), we denote $\gamma = \frac{\mu}{\beta}$ and $\bar{\beta} = \frac{1}{N}\sum \beta^i$ and rewrite Eq. 4 as

$$N\frac{\sum_i \beta^i m^i}{\sum_i \beta^i} = \gamma\left(N\pi - \sum \tau w^i \frac{\partial l^i}{\partial g}\right).$$ (5)

This can be rewritten as

$$\sum_i m^i(1 + \delta) = \gamma\left(N\pi - \sum_i \tau w^i \frac{\partial l^i}{\partial g}\right),$$ (6)

where $\delta = \frac{\text{cov}(\beta^i, m^i)}{\bar{\beta}\bar{m}}$ is the distributional characteristic of publicly provided education, and $\bar{m} = \frac{\sum m^i}{N}$. If the government pays no attention to distributional matters, $\delta = 0$ and the left

of Eq. 6 is just the conventional sum of the marginal rate of substitution. When distributional concerns matter, the social benefit of public provision increases if the marginal valuation of the publicly provided good is higher for households with low incomes (i.e. high social marginal value of income). In addition, the government needs to take into account the impact of public provision of tax revenues it collects from labour income via the term $\sum_i \tau w^i \frac{\partial l^i}{\partial g}$. If public provision boosts income, then the costs of public provision are reduced relative to the case where public provision would have no impact on tax revenues.

4 Equality of opportunity

As our framework is strictly paternalistic, we start with a general formulation in which the government maximizes a general paternalistic objective function, $\sum_i P(e^i(x_c^i, g), x_a^i, l^i, g)$. For the general case, the first-order conditions are:

$$\sum_i \frac{dP^i}{d(1-\tau)} + \mu \sum_i \left(\tau w^i \frac{\partial l^i}{\partial(1-\tau)} + w^i l^i \right) = 0 \tag{7}$$

$$\sum_i \frac{dP^i}{db} + \mu \sum_i \left(\tau w^i \frac{\partial l^i}{\partial b} - 1 \right) = 0 \tag{8}$$

$$\sum_i \frac{dP^i}{dg} + \mu \sum_i \left(\tau w^i \frac{\partial l^i}{\partial g} - \pi \right) = 0, \tag{9}$$

where the total derivative is, for example in the case of g, $\frac{dP^i}{dg} = \frac{\partial P^i}{\partial g} + \frac{\partial P^i}{\partial e^i} \frac{\partial e^i}{\partial g} + \frac{\partial P^i}{\partial e^i} \frac{\partial e^i}{\partial x_c^i} \frac{\partial x_c^i}{\partial g} + \frac{\partial P^i}{\partial x_a^i} \frac{\partial x_a^i}{\partial g} + \frac{\partial P^i}{\partial l^i} \frac{\partial l^i}{\partial g}$. In other words, the total impact of extra public provision depends on its direct valuation by the social planner and its indirect impact through consumption and labour supply.

After having derived general tax and public provision rules, we interpret them using societal objectives that only depend on an equitable distribution of education, defining $\sum_i P(e^i, x_a^i, l^i, g) = \sum_i \Omega^i \{ e^i [x_c^i (1 - \tau, b, g), g] \}$. This function is concave, reflecting inequality aversion in the education space. In this case, $\frac{dP^i}{dg}$ becomes $\frac{d\Omega^i}{dg} = \Omega' \frac{\partial e^i}{\partial g} + \Omega' \frac{\partial e^i}{\partial x_c^i} \frac{\partial x_c^i}{\partial g}$.

4.1 Income taxation

With general paternalistic objectives, the optimal tax rule can be expressed as a combination of a welfarist term and a paternalist corrective term (details in the Appendix):

$$\tau^* = \frac{-\text{cov}(\rho^i, z^i)}{\frac{1}{N} \sum_i w^i \frac{\partial \tilde{l}^i}{\partial(1-\tau)}} + \frac{D}{\frac{1}{N} \sum_i w^i \frac{\partial \tilde{l}^i}{\partial(1-\tau)}}. \tag{10}$$

The first term is the same as in the welfarist case in Eq. 3. The second term, where $D = \frac{C_b}{N} \frac{\sum_i z^i}{N} - \frac{C_{(1-\tau)}}{N}$ (within which $C_b = \sum_i \frac{dP^i}{db} - \sum_i \beta^i$, and $C_{1-\tau} = \sum_i \frac{dP^i}{d(1-\tau)} - \sum_i \beta^i z^i$), is a corrective term that takes into account the differences between marginal paternalistic and welfarist valuation of changes in b and $1 - \tau$. Due to this term, the tax rate is driven up relative to the welfarist case, if the paternalistic government values the lump-sum benefit b more, or take-home pay $(1 - \tau)$ less than the welfarist government. The basic principle that

the optimal tax rule is a combination of a welfarist term and a corrective term is in line with the general idea expressed for the non-linear tax by Kanbur et al. (2006).

To study the impact of education-only objectives, simply substituting $\sum_i \Omega^i$ $\left\{ e^i \left[x_c^i \left(1 - \tau, b, g \right), g \right] \right\}$ into Eq. 10 is not particularly instructive. In the Appendix, we derive the following more intuitive tax rule, which is in line with the welfarist term in Eq. 1:

$$\frac{\tau^*}{1 - \tau^*} = \frac{1}{\varepsilon} \left(1 - \frac{\tilde{\Omega}}{\bar{z}} \right), \tag{11}$$

where

$$\tilde{\Omega} = \frac{\sum \Omega' \frac{\partial e^i}{\partial x_c^i} \frac{\partial x_c^i}{\partial (1-\tau)}}{\sum \Omega' \frac{\partial e^i}{\partial x_c^i} \frac{\partial x_c^i}{\partial b}}, \tag{12}$$

measures the social value of the impact of the retention rate $(1 - \tau)$ on education, relative to the effect of income on education. If educational investments become relatively more sensitive to income (less sensitive to the retention rate), the value of Eq. 12 declines and hence the optimal tax is increased. The higher the income effects—especially at the bottom of the distribution, as they get a higher weight in the social evaluation function—the greater the increase in taxes. A budget-neutral increase in the marginal tax rate also implies a greater lump-sum benefit – that is, a policy that increases progressivity. The implications of this analysis are collected in Proposition 1.

Proposition 1 *A government that only cares about inequality in educational outcomes should also use progressive income taxation to even out educational outcomes. The tax system is more progressive when educational attainment is highly sensitive to income, especially among those at the bottom of the educational distribution.*

Appendix B derives a corresponding formula in an OLG setting, where the government takes into account the linkages between current policy variables and future levels of human capital. The interpretation of such a tax rule follows the same line as here, but the social planner also needs to take a stance on intergenerational distributional matters.

4.2 Public provision

Consider first a general paternalistic formulation for public provision. It can be written, following Eq. 4 as:

$$\sum_i \beta^i m^i = \mu \left(N \pi - \sum_i \tau w^i \frac{\partial l^i}{\partial g} \right) - C_g, \tag{13}$$

where $C_g = \sum_i \frac{d P^i}{d g} - \sum_i \beta^i m^i$. In other words, the rule again includes a corrective term that compares paternalistic versus welfarist marginal value of an increase in public provision. If the paternalistic valuation exceeds the welfarist one, the term reduces the costs of public provision.

Turning to public provision under Equality of Opportunity objectives, let us denote $\Omega' \frac{\partial e^i}{\partial x_c^i} \frac{\partial x_c^i}{\partial b} = \beta_\Omega^i$, which is the marginal social (gross) value of income for an Equality of

Opportunity government. Let $m_\Omega^i = \left(\frac{de^i}{dg}\right) / \left(\frac{de^i}{db}\right)$ denote the efficiency of public provision in increasing education relative to the income effect. Then, Eq. 13 can be written as

$$\sum_i \beta_\Omega^i m_\Omega^i = \mu \left(N\pi - \sum_i \tau w^i \frac{\partial l^i}{\partial g} \right), \tag{14}$$

which also implies

$$\sum_i m_\Omega^i (1 + \delta_\Omega) = \gamma_\Omega \left(N\pi - \sum_i \tau w^i \frac{\partial l^i}{\partial g} \right), \tag{15}$$

where $\gamma_\Omega = \frac{\mu}{\bar{\beta}_\Omega}$ and $\delta_\Omega = \frac{\text{cov}(\beta_\Omega^i, m_\Omega^i)}{\bar{\beta}_\Omega \bar{m}_\Omega}$ is the distributional characteristic in the Equality of Opportunity case. To interpret the provision rule in Eq. 15, notice first that in the case where the distributional characteristic δ_Ω is zero, implying that the government is not at all averse to inequality in educational attainment, the left-hand side becomes $\sum_i m_\Omega^i$, which captures the relative benefit of affecting the overall educational level via the publicly provided good versus leaving the income to the households. This benefit needs to be weighed against the cost of provision, captured by the first term at the right, $\gamma_\Omega N\pi$ ($= \mu N\pi$ in the case with no distributional concerns). As in the welfarist case, the cost of provision is reduced if the publicly provided good leads to an increase in the tax revenue, captured by the second term (this happens if $\frac{\partial l}{\partial g}$ is positive).

Consider now the influence of aversion against inequality in educational attainment, captured by δ_Ω. The denominator in m_Ω^i, $\frac{de^i}{db}$, is always positive, as education is a normal good. Its magnitude can of course vary across individuals. The sign of the numerator in m_Ω^i, $\frac{de^i}{dg}$, depends on the net impact of public provision on education. It is likely to be positive, but if public provision is a substitute for private purchases of education at the lower end of the income distribution and a complement at the upper end, the net impact of public provision could well be higher in the upper end. With no distributional concerns, this would increase the benefits of public provision. However, since β_Ω^i is small for households with high incomes, the covariance in this case would be negative, meaning that education should be under-provided relative to the case with no distributional concerns. Naturally, in the case that m_Ω^i were higher for households with low incomes, the covariance would become positive, leading to over-provision of education. This discussion is summarized below.[2]

Proposition 2 *Optimal public provision of education for a government whose social welfare function is motivated by Equality of Opportunity concerns is increasing in the impact of public provision on educational attainment relative to the impact of income on education. The provision rule suggests distorting the public provision upwards if the education level is more sensitive to public provision at the lower end of the distribution.*

Note that since also the usefulness of progressive taxation depends on *the income effects in educational attainment (Proposition 1), the two instruments are substitutes.* Whether tax revenue is used to finance larger lump-sum benefits (more tax progression) or more public education, depends crucially on m_Ω^i and its distrubution across the population. If income effects are low for low-income individuals and public provision effectively affects educational attainment ($de/db < de/dg$), the government is better off financing education

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[2]Again, the rule is extended to an OLG setting in Appendix B.

provision directly rather than redistributing taxed income via transfers. Whereas if income effects are relatively high for that group ($de/db > de/dg$), the government should rather rely on income transfers in equalising educational outcomes. For mid-range values of m_Ω^i, both instruments would play an important role. Rather than posing a strong dichotomy on tax progressivity and public provision of education, the relationship is more subtle and context-specific.

They key issue is hence whether low-income families substitute or complement education by public provision. Peltzman (1973) suggested that public education could crowd out private purchases of schooling, and could even reduce overall schooling consumption. Empirical research has since found some support for this hypothesis for example in the context of US public colleges, though the overall evidence is mixed (e.g. Castleman and Long (2013), Cellini (2009), Cohodes and Goodman (2014), and Long (2004)). Slightly more positive results have been found in the context of preschool programmes. Several papers have found the net impact of public provision to be positive, as private provision is either not substituted for public provision, or at least is substituted only partly (e.g. Brinkman et al. (2017), Bastos and Straume (2016), Bassok et al. (2014), Cascio and Schanzenbach (2013), and Cascio (2009)).

Only few papers look at heterogeneity of crowding out across income levels. Cohodes and Goodman (2014) find that public college subsidies increased enrollment among the poorest students, even though on net the programme reduced education consumption (as the poorest students formed a small share of the target population). However, Long (2004) finds the opposite, that the poorest students are more sensitive to public subsidies and education crowding out is therefore more severe at the lower end of the income distribution. In the preschool context, Brinkman et al. (2017) find no heterogeneity between poorer and less poor families in Indonesia, but Cascio and Schanzenbach (2013) find that crowding out is focused among higher-income families in the US, as they substitute private care for less expensive public care.

There is not much literature on the income effect on education, but Long's (2004) simulations suggest that changing the in-kind tuition subsidy to public schools into a non-tied grant that can be used in any college, students would consume more education by choosing four-year colleges over two-year colleges, and more selective private colleges over public colleges. Low-income students would be more sensitive to the change than high-income students.

Given the mixed results in the empirical literature, the sign of the numerator of m_Ω^i is likely to be very context-specific, although we consider it plausible that it would be more positive or less negative for poorer families. There is suggestive evidence that the denominator would be positive, and more strongly so for the disadvantaged students.

4.3 Tax rates with equality of opportunity: an illustration

While the discussion above suggests that the evidence regarding the elasticities required for a full set of computational results is still too scarce, we illustrate here with a simple numerical example the forces influencing the choice of the tax rate with Equality of Opportunity type of preferences.[3] Suppose the government has constant inequality aversion social preferences of the form $(e^{1-\eta} - 1)/(1-\eta)$, in which we use two values for η, 1 (when the social

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[3]Since simulations of public good provision are very rare even in the welfarist case, we do not consider those here.
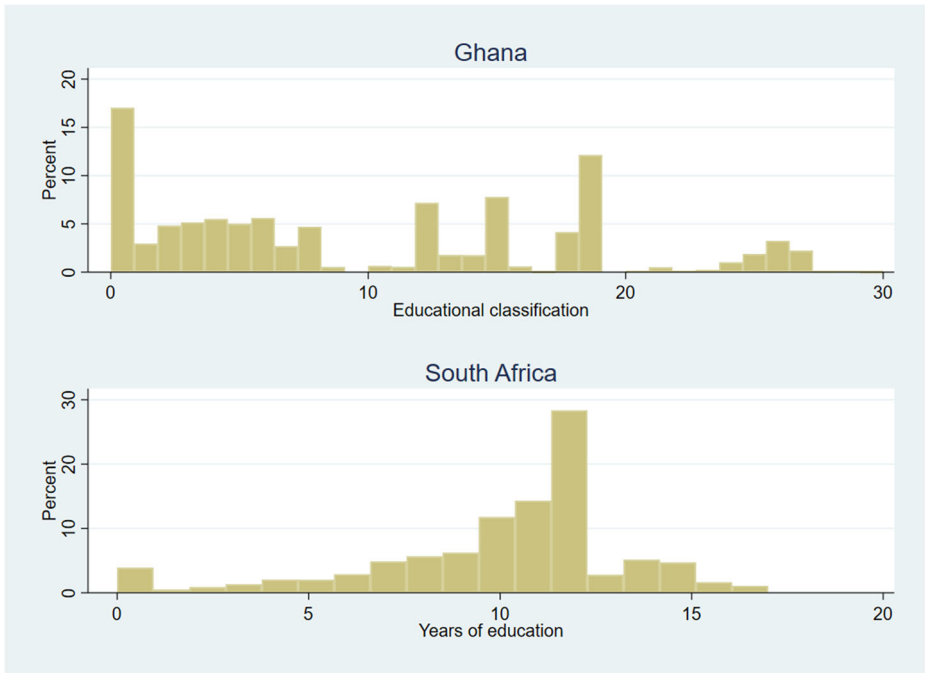
Fig. 1 Distribution of educational attainment in Ghana and South Africa. Source: Own calculations on the basis of GLSS7 (Ghana) and PALMS (South Africa) data. In Ghana, the educational classification is as follows: 0 no educ.; 1 pre-school, 2-7 primary school; 8-10 junior secondary; 9-12 middle school; 13-18 senior secondary, 19-23 vocational and polytechnic, 24- tertiary

welfare is a log function) or 3. The distribution of educational attainment is taken from two different middle-income countries: Ghana, where 17% of adult population does not have any education; and South Africa, where the mode of the distribution is 12 years of education.[4] The distributions are depicted in Fig. 1. The South African distribution is not too far away from an advanced country education profile in terms of the number of years of education.

Equation 12 suggests that a key determinant for the tax rate is the shape of the marginal effects (or elasticities if the formula were written using elasticities) about how the changes in either the retention rate or lump-sum income influence the educational levels. That is why we experiment with three alternatives for both: a decreasing, constant, or increasing pattern (with the constant pattern equal to unitary elasticity, and the changing elasticities varying between 0.5 and 2). The elasticity of taxable income is assumed to be 0.25 across all cases.

The results are collected to Fig. 2. Concentrating first on the lower panel on the left, one notices that when the elasticity in the numerator of Eq. 12 is constant, the tax rate is higher when the income elasticity in the denominator has a decreasing shape. The intuition is that when income effects are large at the bottom of the distribution, it is worthwhile for the government to redistribute more, as this increases relatively much the educational investment at the bottom. On the other hand, for a constant denominator, the tax rate tends to be high when the elasticity in the numerator has an increasing profile. Such a profile implies

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[4]The data sources are Ghana Living Standards Survey (GLSS7), 2017; and the Post-Apartheid Labour Market Series, South Africa Kerr et al. (2019).
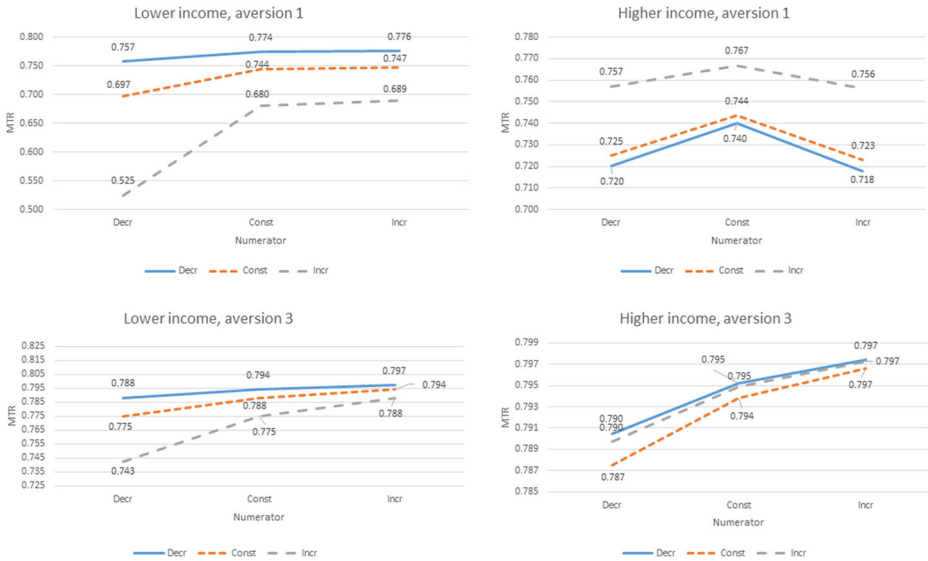
Fig. 2 Numerical income tax rate illustrations. Notes: The panels in this chart present examples of tax rates under Equality of Opportunity preferences. The results are based on the distribution of educational attainment in a lower middle income country (Ghana) on the left and in an upper middle income country (South Africa) on the right. The government is assumed to have constant (educational) inequality aversion type of preferences, with the aversion parameter equal to 1 or 3. The tax rates are shown for different assumptions governing the shape of the numerator (x-axis) and denominator (lines) of Eq. 12. The elasticities are either assumed to range from 0.5 to 2 with an increasing or decreasing pattern over the distribution of educational attainment or be constant and equal to unity. The mean earned income, $\bar{z}$, in Eq. 11 is chosen to always generate positive tax rates and the elasticity of taxable income, ε, is 0.25 in all cases

that the extent of tax distortions remains low among those who have little education. The results remain qualitatively the same for the lower income country with a lower inequality aversion and for the higher income country with a high inequality aversion. However, in the top right panel, the pattern is different: With mild distributional preferences and with more mass in the distribution in the middle, the result regarding the tax rate is more sensitive to the impacts on the middle class.[5] Note, finally, that the absolute values of the tax rates must not be interpreted literarally, as they crucially depend on the ratio $\tilde{\Omega}/\bar{z}$.

5 Alternative approaches

In this section, we connect the considerations reviewed above to two further approaches to Equality of Opportunity.

5.1 Interpretation using generalized social marginal welfare weights

Saez and Stantcheva (2016) propose a framework of generalized marginal social welfare weights, as well as an extension of the framework into modeling Equality of Opportunity.

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[5]With a stronger declining shape in the income elasticity in the denominator, the results are again qualitatively the same than for a lower income country.

These weights are represented by $\xi^i(x_c^i, x_a^i, z^i, \chi^{i,u}, \chi^{i,b}, \chi^{i,s})$. Here, $\chi^{i,u}$ denotes characteristics that enter the private utility function, $\chi^{i,s}$ those that are accounted for only by the social planner, and $\chi^{i,b}$ those characteristics that affect both individual and social welfare. As Saez and Stantcheva (2016) only illustrate their approach in the case of income tax alone, we extend it to cover public provision of education. As they show in their Online Appendix, in the case where the individual utility is a money-metric one, the approach can be thought of as if the government were maximizing $\sum_i \xi^i v^i$. When indirect utility is money-metric, the social marginal value of income to individual i is just ξ^i. If the government were welfaristic with a social welfare function of $W\{v\}$, then $\xi^i = \frac{\partial W}{\partial v^i}$.

Identically to the derivation in Section 3.2, the public good provision rule then simply becomes

$$\sum_i m^i(1 + \delta_{SS}^i) = \gamma\left(N\pi - \sum_i \tau w^i \frac{\partial l^i}{\partial g}\right), \tag{16}$$

where $\delta_{SS}^i = \frac{\text{cov}(\xi^i, m^i)}{\bar{\xi}\bar{m}}$ is the distributional characteristic of publicly provided education, now defined on the basis of ξ.

The Saez–Stantcheva (SS) approach thus produces similar public provision rules as the standard welfarist model. However, it only works for such social preferences that are not paternalistic – that is, they accept individual welfare as a starting point. Therefore, our formulation above, where $\Omega(e)$ is a function of education alone and does not put any welfare weight to the consumption of other goods or leisure, is not compatible with the SS approach.

5.2 Equality of Opportunity as Fairness

The last approach to equality of opportunity we apply is a version of the fairness theory developed by, for example, Fleurbaey (2008) and Fleurbaey and Maniquet (2011). It is closely related to the theory of equality of opportunity, as the fairness theory seeks a balance between reward (right to fruits of own effort) and compensation (right for compensation due to bad circumstances beyond individual control). The questions studied in this paper have been studied from the fairness point of view in a closely related paper by Fleurbaey and Valletta (2018) focusing on optimal non-linear income taxation. We use and extend the linear taxation version presented in the working paper version of the article (Fleurbaey and Valletta 2013). In this section, we i) show that the results from the Fleurbaey–Valletta model of fairness can be formally presented in a way similar to results in the previous sections, improving their comparability; ii) show that the results from the Fleurbaey–Valletta model and from the models used in the previous sections are closely related, but not identical; and iii) show more detailed characterizations of the optimal fair policies and extend the fair tax model with public provision of education.

One important difference is that in the Fleurbaey–Valletta model, education improves personal productivity, instead of increasing individual welfare as in the other models used in this paper. But in both approaches, the key is the education production function: that the education level is a function of private investment and public provision of education. Fleurbaey and Valletta model this as an individual cost of obtaining a certain level of education for a given level of public provision. The cost function is taken as a circumstance facing individuals, and hence not their responsibility. We can implement this approach by taking

the education production function used above, $e^i \left(x_c^i, g \right)$, and inverting it to find the cost of obtaining a given level of education:

$$x_c^i = x_c^i \left(e^i, g \right), \frac{\partial x_c^i}{\partial e^i} > 0, \frac{\partial x_c^i}{\partial g} \leq 0. \tag{17}$$

The money-metric welfare is obtained by asking: with everybody facing the same circumstances, what lump-sum income transfer would make an individual indifferent between her present state and the state in which she faces the equalized circumstances? Fleurbaey and Valletta argue that the relevant circumstances are the average productivity and the average cost of education. Thus the transfer needed to make the individual indifferent between her present state and the state with harmonized circumstances is the value function of the optimization problem:

$$\min \quad x_a + \bar{x}_c \left(e, g \right) - \bar{w}l \tag{18}$$
$$s.t. \ u^i \left(e, x, l \right) \geq u^i \left(e^i, x^i, l^i \right).$$

Here, $u^i \left(e^i, x^i, l^i \right)$ is the welfare of individual i at the current allocation of resources. Thus, the value function (the transfer) for individual i is $\vartheta^i = \vartheta^i \left(\bar{x}_c, \bar{w}, u^i \left(e^i, x^i, l^i \right) \right)$.

Note that we allow for heterogeneity in individual utility functions and assume individuals to be responsible for their preferences. An individual's welfare is, for the case of linear income tax and public provision of education, given by the indirect utility function $v^i \left(t, b, g \right)$, as above. Social welfare is maximized by maximizing the welfare of the worst-off person.[6] We give this person index o (there are N individuals in total).

Our main results specify exact conditions that the worst-off person's consumption patterns, willingness to pay, and investments have to hold for the social cost of public provision to be reduced. These are more detailed than obtained in the welfarist or Equality of Opportunity approach analysed above. The details of the derivation are presented in the Appendix.

5.2.1 Linear taxation

Optimal policies maximize the money-metric measure of the worst-off person, $\vartheta^o \left(\bar{w}, \bar{c}, v^i \left(1 - \tau, b \right) \right)$. In the Appendix we show that the tax rule satisfies

$$\frac{\tau^*}{1 - \tau^*} = \frac{1}{\sum_i \theta^i \varepsilon_{l,1-\tau}^i} \left(1 - A\theta^o \right). \tag{19}$$

Here, $A \equiv 1 - \tau \sum_i \frac{w^i l^i}{Nb} \varepsilon_{l,b}^i > 0$, and $\varepsilon_{y,x}^i$ is the elasticity of y with respect to x. θ^i denotes the share of individual i's income in total income, $\theta^i \equiv \frac{w^i l^i}{\sum_i w^i l^i}$. The tax rate is positive and below unity as long as $\sum_i \theta^i \varepsilon_{l,1-\tau}^i > 0$, which is plausible, and when $A\theta^o < 1$. The formula in Eq. 19 is analogous to our results for linear tax in the other cases. The difference is that it focuses on the income of the worst-off citizen relative to the average income as

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[6]Fleurbaey and Valletta (2018) discuss conditions for the existence of a worst-off person. Note also that this is not, in general, equivalent to calculating the maximin policies in a welfarist setting. Here optimization is based on money-equivalent measures of welfare which are affected by the salient circumstances. As pointed out above, the fairness approach is not a special case of welfarism.

the key parameter. In other words, the theory proposes this ratio as the key parameter for analysing the fairness of linear income tax systems.[7]

5.2.2 Public provision

The optimality conditions in the fairness case can be written in exactly the same format as in the welfarist case above. This is as the fair social welfare function gives $\beta_F^o \equiv \frac{\partial \vartheta^o}{\partial v^o} \frac{\partial v^o}{\partial b}$ as the marginal social welfare weight of the worst-off person, while the weight for the others is $\beta_F^i = 0 \forall i \neq o$ (as $\frac{\partial \vartheta^o}{\partial v^i} = 0$). Thus, the public provision rule can be expressed as follows:

$$\beta_F^o m^o = \mu \left(N\pi - \sum_i \tau w^i \frac{\partial l^i}{\partial g} \right). \tag{20}$$

This is the fairness equivalent to the welfarist public provision rule in Eq. 4 and Equality of Opportunity rule in Eq. 14. However, it is difficult to infer from Equation Eq. 20 what it implies for public education compared to welfarist public provision or to Samuelson-efficient provision. To get ahead, we use again $\beta_F^o m^o = \sum_i \beta_F^i m^i$, and rewrite Eq. 20 as, equivalent to Equations Eq. 6 and Eq. 15:

$$\sum_i m^i (1 + \delta_F) = \mu \left(N\pi - \sum_i \tau w^i \frac{\partial l^i}{\partial g} \right), \tag{21}$$

where $\delta_F = \frac{\text{cov}(\beta_F^i, m^i)}{\bar{\beta}_F \bar{m}}$, with $\bar{\beta}_F \equiv \frac{\sum_i \beta_F^i}{N} = \frac{\beta_F^o}{N}$.

The "fair" demand for public education is higher (or the cost of public provision lower) than proposed by the Samuelson rule if $\delta_F > 0$. This holds if and only if

$$m^o > \frac{\sum_{i=1}^{N-1} m^i}{N - 1}, \tag{22}$$

otherwise the demand is reduced. Thus, if the worst-off person values education more than the other citizens on average, the fairness criterion suggests, ceteris paribus, extension of public education. This is of course not necessarily the case.

Note the differences to the welfarist and Equality of Opportunity cases (Eqs. 6 and 15). In both cases, distributional concerns play an important role. For the welfarist case, if the social value of income covaries positively with the private valuation of education, it increases the value of public provision. For an Equality of Opportunity minded government, the distribution of the relative effectiveness of public provision relative to income in increasing the educational level is what matters. In the fairness case, only the private valuation of education, and only by the worst-off person matters.

5.3 Other extensions of the model

In this paper, we have focused on linear income taxation in order to provide an as simple as possible framework to illustrate the research problem at hand. It is also possible to study other tax instruments in a similar manner, and in Haaparanta et al. (2020), we have extended the framework to study commodity taxation, that is, including the possibility to

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[7]Note that Fleurbaey and Valletta (2013) do not express the optimal income tax formula in a similar way as here. The formulation here focuses directly on income distribution statistic as a determinant of optimal tax as in the other approaches considered.

subsidise the consumption of education through taxation, and also combined this with non-linear income taxation. The main takeaaways from these extensions are that without direct public provision of education, an Equality of Opportunity minded government optimally encourages educational attainment via the tax system. The differential sensitivity of demand for education across the income distribution determines the degree of encouragement.

As mentioned above, one can also present the same research problem in a model of over-lapping generations, where the impact of education choices made today on the productivity of future generations is explicitly taken into account. This framework leads to similar conclusions we have reached above. (See Appendix B for the model). One difference is that the social planner needs to also take a stance on intergenerational differences. Another difference pertains to the revenue impact of policies, which now also depends on how future wages react, since the wage rates are endogenized. The overall pattern of the results remain the same, however.

6 Conclusion

Let us return to the four questions posed in the Introduction, which emerge from the policy discourse. Is it the case that progressive taxation is not used at all under opportunities-based objectives? We have shown that the argument of "progressive taxation for welfarist objectives and equal provision of public education for equality of opportunity objectives" poses a false dichotomy. Progressive taxation is a potent instrument for equalizing opportunity through equalizing education outcomes. What does the differential use of progressive taxation under the two objectives depend upon? We have derived and presented optimal tax formulae in a way that facilitates comparison between the two regimes. When educational outcomes are highly sensitive to parental inputs relative to public provision, perhaps paradoxically the case for progressive taxation tends to be stronger under the equality of opportunity objective.

Is it the case that higher provision of public education can advance the opportunity-based objective? Will the provision of public education in this case necessarily be higher than when the objective is welfarist? We have shown how answers to these questions depend on the nature of the "education production function" – the precise way in which parental and public inputs go together to produce educational outcomes for children. The extent of public provision is relatively low, if education is valued relatively more by high-income households (as might well be the case). The answers to these questions illustrate how our framework can help to address specific questions in the policy discourse.

Equality of opportunity has emerged as a major framework for the public policy discourse. This paper has attempted to present a framework in which the consequences of this framework can be compared to those of the welfarist literature. In the process we have asked and answered a number of specific questions on taxation and public provision to show the utility of the formulation. In particular, we have shown that progressive taxation and equality of opportunity are not opposed to each other. One urgent task in future research would be to make considerable progress in the evaluation of the quantitative importance of the results and comparisons about the extent of progressivity under different social welfare goals. Such progress would also require new empirical evidence on how private educational investments depend on tax rates and the publicly provided education. A rich research agenda lies ahead.

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