The Marginal Equity-Adjusted Cost of Public Funds

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November 9, 2025

Abstract

To evaluate the marginal welfare effects of taxation and of public spending, we must account for both distortionary and distributional effects. The distributional consequences of taxation, in terms of welfare, cannot be fully captured in in the measures currently used in the literature, such as the Marginal Costs of public Funds (MCF) or the the Marginal Value of Public Funds (MVPF). We propose a measure for these welfare effects and define the *Marginal Equity-Adjusted Cost of Public Funds (MECF)*. The MECF can be applied to any tax instrument and for any set of welfare weights.

Keywords: marginal cost of public funds, income inequality, lump-sum taxes, public good provision

JEL codes: H20, H40, H50.

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‡We are especially grateful to Esther Ann Boler, Felix Bierbrauer, Vidar Christiansen, Bjart Holtsmark, Simon Lang, Halvor Mehlum, Magne Mogstad, Ragnhild Schreiner, and to seminar participants at OsloMet, University of Gothenburg, University of Oslo, Skatteforum 2019, Oslo Fiscal Studies Workshop 2020, the IIPF Annual Congress 2021, and the NIPFP-IIPF International Conference on "Papers in Public Finance" 2021. The project has benefited from funding from Norwegian Fiscal Studies and The Nordic Tax Research Council.

1 Introduction

The welfare costs of raising public revenue and the value of public spending are central to a range of policy issues. Importantly, comparing costs across different tax schemes requires knowledge of the full welfare impact of using different tax instruments. Similarly, to compare the value of spending with different beneficiaries, we must be able to evaluate the full welfare effects. The literature on the costs of taxation and the value of public spending has focused mainly on efficiency and has not provided a precise and transparent method for determining the effects of taxation and spending in terms of equity.[1] This paper defines measures that capture the full welfare effects of taxation and spending, which can be applied for any set of welfare weights.

In designing a tax system, we face two main concerns: Equity and efficiency. Typically, there is a trade-off between the two, arising because the policy maker cannot observe underlying characteristics of individuals, such as their productivity. For example, while a uniform lump-sum tax can be used to raise revenue without distorting labor supply, the welfare costs will quickly become very high, as poor individuals are heavily taxed relative to their income. On the other hand, a strongly progressive tax scheme will typically create large behavioral distortions. Although disregarding equity concerns can be useful to understand the distortionary consequences of taxation or when comparing tax schemes with similar tax incidence, we generally cannot compare tax instruments or design an optimal tax scheme without accounting for the full welfare effects.[2]

Similarly, to evaluate the welfare consequences of public spending, we must account for effects both on efficiency and equity: Spending that benefits billionaires does not provide the

[1] Hendren & Sprung-Keyser (2020) derive the Marginal Value of Public Funds (MVPF), while the measure most used in the earlier literature is the Marginal Costs of Public Funds (MCF). We argue that these measures cannot fully capture the marginal welfare effects of public spending or of taxation because the distributional effects are not fully included. See Bastani (2025) for a recent review.

[2] The updated Circular No. A-4 that was issued by the Office of Management and Budget (OMB) in 2023 underlines the importance of incorporating distributional effects in public-sector cost benefit analysis, including in the measurement of the marginal costs of taxation. See `https://bidenwhitehouse.archives.gov/wp-content/uploads/2023/11/CircularA-4.pdf`, accessed November 2025.

same welfare benefits as spending benefiting disadvantaged families.[3] Although the effects of taxation and public spending must ultimately be studied empirically, theoretical measures of the costs of taxation and the value of public spending that precisely account for both distortionary and distributional effects are necessary for sound empirical analysis.

We use a stylized model of public revenue collection and spending to illustrate how to calculate the marginal welfare costs of taxation and the corresponding marginal welfare value of public spending, and define the *Marginal Equity-Adjusted Cost of Public Funds* (MECF) and the analogous *Marginal Equity-Adjusted Value of Public Funds* (MEVF). The MECF and the MEVF capture the marginal effects on both equity and efficiency of taxation, on the one hand, and of public spending, on the other.

Our benchmark is that an income loss distributed so that each individual experiences the same welfare-weighted utility loss has no distributional cost. The MECF is defined by measuring the marginal welfare costs of taxation, in terms of equity, against this benchmark.[4]

The definitions can be applied to any tax instrument or type of public spending and to any set of welfare weights. For illustration, we derive the MECF and the MEVF in a stylized model for a linear income tax schedule and for provision of one public good. Finally, we show how the adjusted Samuelson rule for second-best public good provision implies that the MECF is equalized across tax instruments and equal to the MEVF for the public good.

The main contribution of the paper is to propose a method for including the distributional effects of taxation and public spending in measures of the marginal welfare cost and value, respectively. We show that the *harmonic mean* of the welfare-weighted marginal value of income across the population represents the marginal cost of raising revenue without distortions and

[3]The irrefutable interconnection between the distortionary and distributional effects of taxation and public spending is underlined by Peter Diamond in his contribution to Blanchard & Rodrik (2021) (p. 33), where he states that "Public economics does not view equity and efficiency as separate categories but instead focuses on overall social value when considering government taxing and spending."

[4]Using this benchmark is where we depart from the existing literature. The *Marginal Costs of Public Funds* (MCF) is defined using a uniform lump-sum tax as the benchmark. See, e.g. Sandmo (1998) or Jacobs (2018). Because the uniform lump-sum tax cannot generally be defined as neutral in terms of equity, the benchmark creates a weakness in the MCF when we want to evaluate the full welfare effects of taxation.

with an equally distributed welfare-weighted utility loss. The marginal welfare cost of raising revenue can therefore be measured relative to this harmonic mean to identify the distortionary and distributional effects of taxation itself. Equivalently, the marginal welfare value of spending can be measured relative to the harmonic mean to identify the marginal distortionary and distributional effects of spending.

The paper builds on the literature on the Marginal Cost of Public Funds (MCF), analyzing the distortionary effects of taxation in representative household models, with early key contributions from Stiglitz & Dasgupta (1971) and Atkinson & Stern (1974).[5] We propose a measure for the full welfare effects of taxation, including distributional effects.

Our stylized model with linear taxation builds directly on Sandmo (1998), who shows how the marginal costs of raising public revenue can be studied in a model with income heterogeneity following Mirrlees (1971), relying on the definition of the MCF. Slemrod & Yitzhaki (2001), Kleven & Kreiner (2006), Gahvari (2006), Jacobs & de Mooij (2015), and Jacobs (2018) all build on and extend this framework.[6] Dahlby (1998) studies the costs of taxation in a similar, more general model. These contributions measure the marginal costs of taxation relative to the costs of using a (non-distortionary) uniform lump-sum tax to raise revenue.[7] As a consequence, the distributional effects of taxation are captured in the MCF only to the extent that they differ from those of a uniform lump-sum tax. Our contribution to this literature is to show how the measure of the MCF can be adjusted to precisely capture the full marginal welfare effects of taxation. We define the MECF to measure the marginal costs of a tax instrument relative to a hypothetical tax scheme that is characterized by no distortionary effects and by an equally distributed welfare-weighted utility loss across the population.

More recently, Hendren (2016) defined the Marginal Value of Public Funds (MVPF), which is used to study the marginal value of public spending in the United States by Hendren & Sprung-Keyser (2020).[8] To focus on fiscal externalities of spending, the authors explicitly

[5] See Ballard & Fullerton (1992) for a review, Browning (1976) and Browning (1987) for early empirical contributions. A closely related measure is the Marginal Excess Burden (MEB), see e.g. Mayshar (1991).

[6] Allgood & Snow (1998) study the costs of raising public revenue in a similar framework.

[7] With the exception of Dahlby (1998), who measures the costs in terms of welfare.

[8] See also Finkelstein & Hendren (2020).

exclude distributional effects. We show how our adjustment for distributional effects of taxation and spending can also be applied to define the MVPF, making it possible to compare the value of spending with beneficiaries in different income groups or with different welfare weighting.

Our findings also relate to the seminal contribution by Atkinson & Stiglitz (1976) who demonstrate that optimal nonlinear income taxation makes adjustment of commodity taxation for distributional purposes unnecessary.[9] Public good provision, unlike commodity taxation for private goods, provides an additional channel for redistribution for the policy maker (see, for example, Wilson (1991)). We demonstrate how the distributional effects of public provision of goods can be measured, and how these effects affect optimal provision of a public good in the second best.[10]

The paper is organized as follows: First, we present our stylized model in Section 2. Next, Section 3 presents our main contribution, with the definition of the MECF presented in Section 3.1 and of the corresponding MEVF in Section 3.2. In Section 3.3, we illustrate how the MECF and the MEVF enter in the adjusted Samuelson rule in a model of optimal linear income taxation and public good provision. We conclude in Section 4.

2 The Model

Social welfare. First, define social welfare, W, as the weighted sum of individual utilities across the n individuals in the economy:

$$W = \sum_i \psi_i u_i. \tag{1}$$

$\psi_i > 0$ is the welfare weight on individual i, while u_i denotes individual utility, which depends on individual consumption, c_i, labor supply, h_i and provision of a public good, G:

$$u_i(c_i, h_i, G), \tag{2}$$

with derivatives $u_{ic} > 0$, $u_{icc} < 0$, $u_{ih} < 0$, $u_{ihh} < 0$, $u_{iG} > 0$ and $u_{iGG} < 0$. Throughout, we will set the price of the consumer good to 1 and let $\lambda_i = u_{ic}$ denote the marginal individual value of

[9] See also Laroque (2005).

[10] See also Boadway & Keen (1993).

income and $\eta_i = \psi_i \lambda_i$ denote the welfare-weighted marginal value of income to individual i. λ_i thus represents the value of 1 dollar to individual i in terms of utility, while η_i represents the value in terms of welfare.

Resource constraint. Following Mirrlees (1971), we let labor productivity, not observed by the government, vary between individuals. Productivity for individual i is given by $w_i \in [\underline{w}, \overline{w}]$, in units of the private consumer good. Production by individual i, equal to (pre-tax) income for individual i, is given by $\omega_i h_i$.

The public good can be produced with a unit cost q in terms of the private good, and the economy resource constraint is thus given by:

$$\sum_i c_i + qG = \sum_i w_i h_i. \tag{3}$$

Policy. We denote aggregate public revenue by R and public spending by S. The definitions of the MECF and the MEVF that we provide in Section 3 can be applied to any tax schedule and any type of public spending. However, we illustrate the MECF and the MEVF in the model described above for a simple linear tax structure, where the government sets an income tax rate $t \in [0, 1]$ and a lump-sum tax $b \gtrless 0$, and where public revenue is spent on the public good.[11] For this tax structure and spending, we have:

$$R = nb + t \sum_i \omega_i h_i \tag{4}$$

$$S = qG. \tag{5}$$

The sign of the lump-sum tax (or transfer), b, determines the progressivity of the tax schedule: $b < 0$ implies that high-income individuals pay a higher share of their income in taxes.

The first-best allocation. Before we analyze the marginal costs of taxation, we characterize the first-best allocation as a benchmark. Given the resource constraint in Equation (3),

[11] Our aim is to provide a general measure of for the marginal cost of raising public revenue, which is not contingent on the tax scheme in question. The actual size of the MECF will, of course, depend on the specific tax schedule. Similarly, while the definition of the MEVF can be applied to any public spending, the size of the MEVF will depend on what type of spending that is considered. To illustrate the method we use to include a precise measure for the distributional effects of taxation and spending in the MECF and the MEVF, however, we follow Sandmo (1998) and focus on the simple example of a linear tax structure and provision of a public good.

welfare is maximized when each individual supplies labor until their willingness to pay for leisure equals their productivity, consumption is redistributed until the welfare-weighted marginal value of income is equalized across all individuals, and the public good is provided according to the Samuelson rule (Samuelson, 1954):

$$\frac{-u_{ih}}{\lambda_i} = \omega_i \quad \forall i, \quad \eta_i = \frac{1}{q}\sum_j \psi_j u_{jG} \quad \forall i \quad \Rightarrow \quad \sum_i \frac{u_{iG}}{\lambda_i} = q \quad \text{(Samuelson rule)}. \tag{6}$$

With full information on individual productivity, the government could implement the first best using individual lump-sum taxation ensuring that the conditions in (6) are met. However, when ω_i is not observed, the government faces the well-known trade-off between equity and efficiency, as high-productivity individuals can only be taxed more heavily based on their observed income, $\omega_i h_i$.

Individual behavior. Given the linear tax schedule and the public good provision, individual i solves the problem:

$$v_i(t, b, G) = \max_{c_i, h_i} u_i(c_i, h_i, G) \;\; \text{s.t.} \;\; c_i = (1-t)w_i h_i - b.$$

The following first-order condition solves the problem and defines, together with the budget constraint, the (uncompensated) demand for the consumption good and supply of labor:

$$-\frac{u_{ih}}{\lambda_i} = (1-t)w_i \quad \Rightarrow \quad c_i(t, b, G), \qquad h_i(t, b, G). \tag{7}$$

We have:

$$\frac{\partial v_i}{\partial b} = -\lambda_i, \qquad \frac{\partial v_i}{\partial t} = -\lambda_i w_i h_i, \qquad \frac{\partial v_i}{\partial G} = u_{iG}. \tag{8}$$

In the market equilibrium, welfare will be a function of the policy parameters:

$$W(t, b, G) = \sum_i \psi_i v_i(t, b, G). \tag{9}$$

3 The Marginal Cost and Value of Public Funds

In the following, we use our stylized model to illustrate the Marginal Equity-Adjusted Cost of Public Funds (MECF) and the Marginal Equity-Adjusted Value of Public Funds (MEVF). First,

we consider the MECF and the MEVF without assuming optimality with respect to the linear tax schedule or the public good provision. Next, we consider the case where t, b and G are set to maximize welfare.

3.1 The Marginal Equity-Adjusted Cost of Public Funds (MECF)

To characterize the marginal cost of taxation, one must account for three effects of raising one additional dollar of public revenue:

1. The direct cost of a one-dollar transfer from the private to the public sector.
2. The distortionary effects of increasing taxes to raise the additional dollar.
3. The distributional effects of increasing taxes to raise the additional dollar.

The marginal cost of taxation is the sum of the second and third points: The marginal cost, or gain, arising because taxation itself affects both how efficiently we use our resources and the distribution of welfare. The direct cost, point

The direct cost of a one-dollar transfer from the private to the public sector, point 1, is the welfare cost of an one-dollar reduction in private consumption when the welfare-weighted utility loss is equally distributed. This direct cost is not a cost to taxation itself.

In our stylized model, distortionary costs (or gains) can arise if taxation affects labor supply, while distributional effects arise to the extent that the welfare loss from taxation is distributed unequally. The distributional costs (or gains) will typically be higher the higher the share of the income loss that falls on relatively poor individuals. Our staring point is that a tax increase (or an increase in spending) that results in the same welfare-weighted utility loss (or gain) for all individuals has zero distributional cost (or value).

In line with the literature on the *Marginal Cost of Public Funds (MCF)* as defined for the representative household case, we define the MECF as the ratio between the marginal welfare loss from raising the additional dollar (points 1-3 above) and the marginal welfare loss from a one dollar decrease in private after-tax income when the welfare loss is distributed equally

across the population (point 1 above).[12] The MECF thus identifies the sum of the marginal distortionary and distributional effects of taxation. An MECF of one reflects that there are no costs to taxation on the margin, summing over the distortionary and distributional effects, while an MECF > 1 (< 1) reflects net marginal costs (gains) from taxation, in terms of welfare.

Generally, for any tax instrument x, the total marginal welfare cost to the population when the government raises one dollar of public revenue, disregarding the use of the revenue, is given by:

$$-\frac{\partial W}{\partial x}\Big/\frac{\partial R}{\partial x}. \tag{10}$$

For the two tax instruments in the linear tax scheme, we have:

$$\frac{\partial W}{\partial t} = -\sum_i \eta_i \omega_i h_i \quad \text{and} \quad \frac{\partial W}{\partial b} = -\sum_i \eta_i. \tag{11}$$

Moreover:

$$\frac{\partial R}{\partial t} = \sum_i \omega_i h_i + t\sum_i \omega_i \frac{\partial h_i}{\partial t} \quad \text{and} \quad \frac{\partial R}{\partial b} = n + t\sum_i \omega_i \frac{\partial h_i}{\partial b}. \tag{12}$$

The welfare loss expressed in (10), includes the marginal costs of raising one additional dollar of public revenue through all the three channels listed above. To capture the marginal costs of taxation itself, we must take the ratio of this total welfare loss and the isolated *equally distributed welfare loss from a one-dollar decrease in private after-tax income*, which is equivalent to the welfare loss from raising one dollar through a hypothetical individualized lump-sum tax scheme that has no distortionary effects and does not affect the distribution of welfare across individuals. In other words, we must identify the marginal cost of a hypothetical tax scheme that is non-distortionary and puts the same marginal welfare loss on each individual in the economy. It turns out that the marginal welfare loss from raising revenue through this hypothetical tax scheme is given by the *harmonic mean* of the marginal welfare-weighted value of income across the population, denoted by θ:

$$\theta \equiv \frac{1}{\frac{1}{n}\sum_i 1/\eta_i} \tag{13}$$

[12] See e.g. Ballard & Fullerton (1992). Note that the MECF is well-defined only on the left side of the Laffer curve, we will assume throughout that increasing t or b increases tax revenue.

To see that θ reflects the marginal cost of raising revenue without distortions and with equally distributed welfare losses for each individual in the economy, it is useful to start by noting that the inverse of η_i, $1/\eta_i$, represents the income loss that will reduce welfare-weighted utility for individual i by one unit. Moreover, the sum over the inverse of η_i, $\sum_i \frac{1}{\eta_i}$, represents the income loss that will reduce welfare for all individuals by one unit, while the average of the inverse of η_i, $\frac{1}{n}\sum_i \frac{1}{\eta_i}$, thus represents the income loss that will lower overall welfare by one unit through a change in welfare *that is equally distributed across the population.* Finally, the inverse of this average, the harmonic mean of η_i, represented by θ in Equation (13), thus represents the welfare loss from a decrease in total income of one dollar that is distributed so that the welfare-weighted utility loss is the same for all individuals.

Now, we can define the MECF for the general case with any tax instrument x and then apply the definition to the linear tax structure.

Definition 1 ***The Marginal Equity-Adjusted Cost of Public Funds (MECF):***
The Marginal Equity-Adjusted Cost of Public Funds for a tax instrument x is the ratio between the marginal welfare cost of raising public revenue with the tax instrument x, and the marginal welfare cost of raising revenue through a hypothetical revenue collection scheme that does not alter efficiency or equity. The MECF for tax instrument x is given by:

$$MECF_x = -\frac{1}{\theta} \cdot \frac{\partial W}{\partial x} \Big/ \frac{\partial R}{\partial x}, \tag{14}$$

with θ being the harmonic mean of the marginal welfare-weighted value of income across the population, defined by Equation (13)*.*

The MECF, as defined in Definition 1, represents the marginal welfare cost of raising revenue using tax instrument x, when both distortionary and distributional effects are taken into account.[13] The MECF can therefore be used to compare the marginal cost of raising public

[13]The MCF as defined by Sandmo (1998) and built on by, among others, Jacobs (2018) is the ratio between the marginal welfare cost of raising revenue with the instrument x and the *arithmetic mean* of η_i:

$$MCF_x = \frac{1}{\frac{1}{n}\sum_i \eta_i} \cdot \frac{\partial W}{\partial x} \Big/ \frac{\partial R}{\partial x}. \tag{15}$$

The arithmetic mean of η_i represents the marginal welfare cost of raising revenue through a uniform lump-sum

revenue across different tax schemes when the incidence differs across the income distribution (or across the population, more generally). Moreover, the MECF can be used to account for the marginal costs of taxation in evaluations of the welfare consequences of changes in the size of the public budget.

Given this definition of the MECF, the marginal cost of raising public revenue through increasing the two tax instruments in the linear tax structure, t and b, respectively, are given by:

$$MECF_t = \frac{\frac{1}{n}\sum_i w_i h_i - Cov\left(\frac{1}{\eta_i}, \eta_i w_i h_i\right)}{\frac{1}{n}\sum_i w_i h_i + \frac{1}{n} t \sum_i w_i \frac{\partial h_i}{\partial t}} \tag{16}$$

$$MECF_b = \frac{1 - Cov\left(\frac{1}{\eta_i}, \eta_i\right)}{1 + \frac{1}{n} t \sum_i w_i \frac{\partial h_i}{\partial b}}. \tag{17}$$

In both expressions, the second term in the numerator represents the marginal distributional cost (or gain), while the second term in the denominator represents the distortionary cost (or gain). The MECF is 1 only if there are no distortionary or distribution effects of the tax, or if the two work in opposite directions and exactly cancel each other out.

The distortionary effect of taxation arises if changing the tax changes labor supply, and thus government revenue, if $t > 0$. The distortionary effect can generally pull the MECF both up and down. For the income tax, t, the distortionary effect is determined by the uncompensated response in labor supply to the change in the after-tax wage. If the response in labor supply

tax on all individuals in the economy. While there are no distributional effects of raising revenue with a uniform lump-sum tax (or any other tax) in a representative-household model, the uniform lump-sum tax is regressive in an economy with income inequality (as has been acknowledged in the literature for many decades, see, for example, Atkinson & Stiglitz (1976), p. 66). The welfare loss from a reduction in consumption that is equally distributed across the population will be higher the higher the income inequality, for most sets of welfare weights. Indeed, the marginal welfare cost of the lump-sum tax (i.e., $\frac{1}{n}\sum_i \eta_i$) will typically approach infinity as the tax itself approaches the total income of the poorest individual in the economy, with standard assumptions on the utility function. The MCF as defined by Sandmo (1998) captures the marginal distributional effects of the tax instrument x only relative to those of the uniform lump-sum tax. Therefore, the full marginal distributional cost of taxation cannot be captured by this MCF in an economy with income inequality.

is negative, there is a negative effect on government revenue, increasing the MECF. For the lump-sum tax, it is the income effect alone that determines the labor supply response. Thus, if leisure is a normal good, increasing b will increase labor supply and, if $t > 0$, there is a positive effect on government revenue, decreasing the MECF.[14]

The distributional costs of taxation, i.e., the welfare cost of any unequal distribution of the tax burden, depends on the equilibrium level of inequality in welfare-weighted marginal utility from consumption.

For the income tax, the distributional cost is represented by the covariance between the welfare-weighted marginal utility loss from an increase in the income tax and the inverse of η_i: $Cov(1/\eta_i, \eta_i w_i h_i) \leq 0$. The absolute value of this covariance increases in the level of income inequality in the population, i.e., in the variance in ω_i, for most sets of welfare weigths.[15] This means that for a given set of welfare weigths, the total welfare cost from increasing the linear income tax, t, will be higher if income inequality is higher. That is because a proportional loss in after-tax income mechanically gives a higher welfare-weighted utility loss for the population if the spread in the marginal welfare-weighted value of consumption is larger.

Similarly, for the uniform lump-sum tax, b, the distributional cost is represented by the covariance between the welfare-weighted marginal utility loss from an increase in b (which is simply η_i) and its inverse, $1/\eta_i$: $Cov(1/\eta_i, \eta_i) \leq 0$. As is intuitive, the distributional cost increases in income inequality for most sets of welfare weights. The relationship between the $MECF_b$ and b itself and the absolute value of $Cov(1/\eta_i, \eta_i)$, respectively, are illustrated in Figures 1 and 2. Because an increase in b itself increases the spread in the (after-tax) welfare-weighted marginal value of consumption, the marginal distributional cost of b increases in b itself. As b approaches the income of the poorest individual in the economy net of the income tax, t, the $MECF_b$ approaches ∞ if we assume $\lim_{c_i \to 0} \partial u_i(\cdot)/\partial c_i = \infty$.

A tax change that is sufficiently progressive for the induced change in after-tax income to co-vary negatively with the welfare-weighted marginal value of income will have a distributional effect that lowers the MECF. For example, a decrease in the lump-sum tax, b, combined with

[14]The distortionary effects of taxation enters these expression the same way as they enter in the MCF as defined by Sandmo (1998) and others.

[15]Negishi weights create an exception, see below.

an increase in the income tax, t, would increase the progressivity of the system, and potentially come with a gain in terms of increased equity, depending on the size of the respective changes.

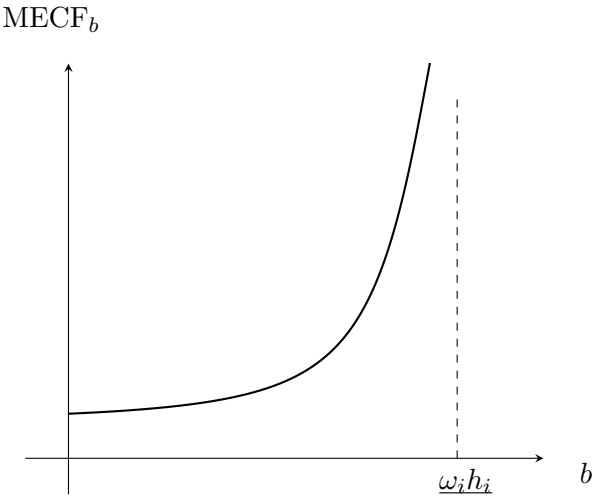


Figure 1: Illustrative example of the $MECF_b$ as a function of b, for $t = 0$. As b approaches the income of the poorest individual in the economy, denoted $\underline{\omega_i h_i}$, the spread in η_i over the population becomes very large, and, as a consequence, the $MECF_b$ becomes very large.

Finally, for both tax instruments, there will be no distributional effects of taxation if there is no inequality in η_i over the population in equilibrium,
i.e., $Cov(1/\eta_i, \eta_i) = Cov(1/\eta_i, \eta_i \omega_i h_i) = 0$. This special case, where consumption is valued equally at the margin for all individuals in the economy (in terms of welfare), can arise for two reasons. First, if there is no income inequality, i.e., $\omega_i = \omega$ for all i, and all individuals are weighted equally in the welfare function, i.e., $\psi_i = \psi$ for all i, and we assume preference homogeneity. Second, if the welfare function applies Negishi weights, i.e., $\psi_i = 1/\lambda_i$.[16]

[16]Negishi weights are commonly applied in different types of welfare analysis and is useful when the goal is to separate the distributional effects of policy or shocks from the effects in focus in the specific analysis, see e.g. Kleven & Kreiner (2006) or Hendren & Sprung-Keyser (2020). Negishi weights enable us to study the distortionary effects of taxation in isolation. However, if our goal is to analyze the total marginal costs of taxation, we should not restrict ourselves by the assumption that a dollar is worth the same to a billionaire as to the poorest individual in the economy.

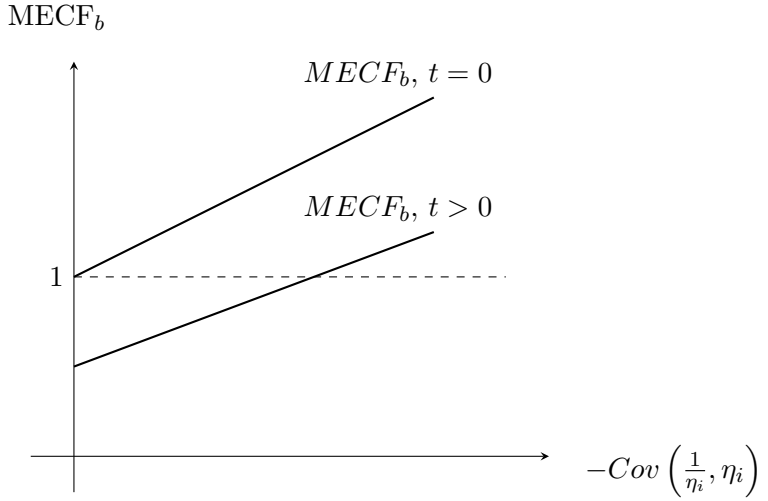


Figure 2: Illustrative example of the $MECF_b$ as a function of the spread of η_i in the population, for two different levels of t, assuming leisure is a normal good. If there is zero spread and $t = 0$, the MECF for the uniform lump-sum tax is 1. As the spread increases, the MECF increases.

3.2 The Marginal Equity-Adjusted Value of Public Funds (MEVF)

As a parallel to the MECF, this section defines the Marginal Equity-Adjusted Value of Public Funds, the MEVF. As for the costs of raising public revenue described in the previous section, we must account for three effects of one additional dollar of public spending when we want to measure the total marginal welfare effect:

1. The direct value to the population of the increase in public spending.
2. The cost or value from the distortionary effects of the increase in public spending.
3. The cost or value from distributional effects of the increase in public spending.

What we identify as the marginal value of public spending is determined by the sum of the second and third points. In our stylized model, distortions from public spending can arise if the spending itself affects the labor supply. Distributional effects arise when the welfare gain of spending is not equally distributed across the population. Typically, spending that benefits low-income individuals gives higher welfare gains than spending that benefits high-income

individuals. And spending that benefits all individuals equally measured by their marginal willingness to pay will be more valuable, in terms of welfare for a population with higher income inequality, because a given willingness to pay is typically reflected by a higher welfare-weighted utility gain for poorer individuals.

In parallel to the definition of the MECF, we define the MEVF as the ratio between the total welfare gain from adding one dollar to public spending and the direct private welfare gain from a one dollar increase in private after-tax income when the welfare increase is distributed equally.

Generally, for public spending denoted by x, disregarding how public revenue is raised, the total value for the population when the government increases spending by one dollar is given by:

$$\frac{\partial W}{\partial x} \Big/ \left(\frac{\partial S}{\partial x} - \frac{\partial R}{\partial x} \right). \tag{18}$$

For spending on the public good G in our stylized model, we have:

$$\frac{\partial W}{\partial G} = \sum_i \psi_i u_{iG}, \tag{19}$$

while Equations (4) and (5) imply[17]

$$\frac{\partial S}{\partial G} - \frac{\partial R}{\partial G} = q - t \sum_i \omega_i \frac{\partial h_i}{\partial G}. \tag{20}$$

Similar to the loss expressed in Equation (10), the value expressed in (18) includes the value from all three channels listed above: The direct welfare-weighted value from increased private or public consumption through public spending that is distributed equally across the population, the potential marginal loss or gain from distortionary effects of the spending, and the potential marginal loss or gain from distributional effects of the spending. To capture the marginal value of spending in terms of only distortionary and distributional effects, we must take the ratio of this total value and the isolated welfare value of a one-dollar increase in private after-tax income that is equally distributed, which is given by θ as defined in Equation (13).

[17] We assume throughout that net spending increases in G.

Definition 2 ***The Marginal Equity-Adjusted Value of Public Funds (MEVF)****:*
The Marginal Equity-Adjusted Value of Public Funds for provision of a good x is the ratio between the marginal welfare benefit from providing the good x and the marginal welfare benefit from a hypothetical public spending scheme that does not alter efficiency or equity. The MEVF for spending on good x is given by:

$$MEVF_x = \frac{1}{\theta} \cdot \frac{\partial W}{\partial x} \Big/ \left(\frac{\partial S}{\partial x} - \frac{\partial R}{\partial x} \right), \tag{21}$$

with θ being the harmonic mean of the welfare-weighted marginal value of income across the population, defined by Equation (13)*.*

The MEVF, as defined in Definition 2, represents the marginal welfare benefit from spending on good x when both distortionary and distributional effects are taken into account. The MEVF can therefore be used to compare the marginal benefit from spending on goods that have different beneficiaries, and in cost-benefit analysis of increased overall public spending.

Given this definition of the MEVF, the marginal value of spending on the public good G in our stylized model can be expressed as:

$$MEVF_G = \frac{\sum_i \frac{u_{iG}}{\lambda_i} - Cov\left(\frac{1}{\eta_i}, \psi_i u_{iG}\right)}{q - t\sum_i \omega_i \frac{\partial h_i}{\partial G}}. \tag{22}$$

The denominator in the expression reflects the marginal cost of providing the public good, adjusted for the change in tax revenue arising if the labor supply responds to changes in G. The numerator reflects the marginal value of providing the public good, represented by the sum of the marginal willingness to pay for G across the population (the first term) and an adjustment for the marginal distributional value (or cost) of G.

The marginal distributional value (or cost) of G, i.e., the effect of an unequal distribution of the marginal welfare-weighted value of the good across the population, depends on the distribution of the welfare-weighted marginal utility from G, $\psi_i u_{IG}$. If $\psi_i u_{IG}$ co-varies with the welfare-weighted marginal value of income, η_i, the covariance appearing in the expression will be negative, and the MEVF is pulled upwards. This is typically the case if low-income individuals value the public good higher than high-income individuals. Or, equivalently, if the public good is

valued higher by high-income individuals, resulting in a positive covariance term, the MEVF is pulled downwards. The marginal distributional value of the good is zero if there is no variation in the welfare-weighted marginal value of income (for example due to Negishi welfare weights), or, more generally, if there is no co-variation (negative or positive) between the welfare-weighted marginal value of the public good and the welfare-weighted marginal value of income.

The MEVF, as defined in Definition 2 and expressed for G in Equation (22), is parallel to the Marginal Value of Public Funds (MVPF) as defined by Hendren & Sprung-Keyser (2020).[18] Hendren & Sprung-Keyser (2020) focus on spending with similar beneficiaries, and therefore assume $\eta_i = \eta$ for all i. Our definition of the MEVF could guide an analysis incorporating distributional aspects of public spending into the framework of the MVPF.

3.3 The MECF and the MEVF under optimal linear taxation

The theoretical literature on the marginal costs of raising public revenue often analyse the issue under the assumption that taxes and public good provision are set to maximize welfare.[19] The definitions of the MECF and the MEVF provided in the previous sections can be applied independently of whether taxes and spending are set optimally or not. However, the assumption that the government sets taxes and spending to maximize welfare means that the MECF will be equalized across all tax instruments, and will be equal to the MEVF for all types of spending.

To illustrate how the MECF and the MEVF appear in the adjusted Samuelson rule for second-best public good provision, we solve the problem of a welfare-maximizing government for the simple linear tax scheme, in the following.

The government's problem is given by:

$$\max_{t,b,G} \sum_i \psi_i v_i(t,b,G) \quad \text{s.t.} \quad t\sum_i w_i h_i(t,b,G) + nb = qG. \tag{23}$$

With μ as the shadow value of public funds, the problem can be represented by the Lagrangian:

$$\mathcal{L} = \sum_i \psi_i v_i(t,b,G) + \mu\Big(t\sum_i w_i h_i(t,b,G) + nb - qG\Big). \tag{24}$$

[18] Assuming the denominator is weakly positive.

[19] See e.g. Atkinson & Stern (1974) or Sandmo (1998).

Together with the public budget constraint, the first-order conditions solving the problem can be expressed as follows:

$$\sum_i \frac{u_{iG}}{\lambda_i} - n\ Cov\left(\frac{1}{\eta_i}, \psi_i u_{iG}\right) = \frac{\mu}{\theta}\left(q - t\sum_i w_i \frac{\partial h_i}{\partial G}\right) \tag{25}$$

$$\frac{\mu}{\theta} = \frac{\frac{1}{n}\sum_i w_i h_i - Cov\left(\frac{1}{\eta_i}, \eta_i w_i h_i\right)}{\frac{1}{n}\sum_i w_i h_i + \frac{1}{n} t \sum_i w_i \frac{\partial h_i}{\partial t}} \tag{26}$$

$$\frac{\mu}{\theta} = \frac{1 - Cov\left(\frac{1}{\eta_i}, \eta_i\right)}{1 + \frac{1}{n} t \sum_i w_i \frac{\partial h_i}{\partial b}}. \tag{27}$$

The first condition, Equation (25), gives the adjusted Samuelson rule. The left-hand side represents the marginal value of public funds adjusted for distributional effects of provision of G, equal to the numerator in the MEVF for G as defined in Equation (22). The right-hand side represents the marginal cost of providing G, including the cost or gain from changes in labor supply, and adjusted with the fraction μ/θ, representing the MECF.[20]

μ/θ represents the MECF, because μ, the shadow value of public funds, represents the total marginal welfare cost of raising an additional dollar of public revenue, in the second-best

[20]Sandmo (1998) derives the MCF from the adjusted Samuelson rule given by his Equation (16), which is equivalent to the following reorganization of Equation (25) above, with equal welfare weights, i.e., $\eta_i = \lambda_i, \forall i$:

$$\sum_i \frac{u_{iG}}{\lambda_i}\left(1 + \frac{Cov(\lambda_i, u_{iG}/\lambda_i)}{\frac{1}{n}\sum_i \lambda_i \frac{1}{n}\sum_i \frac{u_{iG}}{\lambda_i}}\right) = \frac{\mu}{\frac{1}{n}\sum_i \lambda_i}\left(q - t\sum_i \omega_i \frac{\partial h_i}{\partial G}\right). \tag{28}$$

The left-hand side differs from (25) in the adjustment for the marginal distributional effects of public spending, which is equal to zero if the (welfare-weighted) *marginal willingness to pay* for the public good is equal across the population. On the right-hand side, Sandmo (1998) defines the MCF as the ratio between the shadow value of public funds and the average marginal value of income, as discussed in Footnote 13. As a result, the MCF for the uniform lump-sum tax is given by:

$$MCF_b = \frac{\mu}{\frac{1}{n}\sum_i \lambda_i} = \frac{1}{1 + \frac{1}{n} t \sum_i \omega_i \frac{\partial h_i}{\partial b}}, \tag{29}$$

There is no adjustment for the unequal burden, in terms of (welfare-weighted) utility, of the lump-sum tax. As a consequence, while the adjusted Samuelson rule expresses the same trade-off between the marginal cost and value of spending on the public good in both cases, the definition of the MCF derived from the formulation in Sandmo's Equation (16) cannot be used to account for the full marginal welfare effects of taxation.

allocation. As in the definition of the MECF given in Definition 1, the total marginal cost of raising revenue is divided by the marginal cost of raising revenue without affecting efficiency or equity, represented by θ.

The two final equations state that the MECF, as expressed in Equations (16) and (17), must be the same for the two tax instruments, b and t, in the second best.[21] Because the terms in the brackets on the right-hand side of (25) is the denominator in the MEVF as expressed in Equation (22), it, naturally, follows that the common MECF must also equal the MEVF for G in the second best.

4 Conclusions

The theoretical literature on the marginal costs of raising public revenue has not provided a general definition for these costs that includes a precise measure of the distributional effects of taxation. This paper defines the *Marginal Equity-Adjusted Cost of Public Funds*, the MECF, capturing both distortionary and distributional effects of taxation. The definition is based on the assumption that the welfare costs of taxation in terms of equity are zero if and only if the welfare-weighted utility loss from taxation is equally distributed in the population. Equivalently, the paper provides the parallel definition of the *Marginal Equity-Adjusted Value of Public Funds*, the MEVF.

The definitions of the MECF and the MEVF lay ground for sound empirical analysis of the marginal welfare costs of raising public revenue and the marginal value, in terms of welfare, of public spending. The measures enables comparison across tax instruments with different tax incidence and across spending types with different beneficiaries.

[21] Jacobs (2018) argues that the marginal cost of public funds (the MCF) must always be ≤ 1 in the second-best. However, this conclusion rests on the MCF for the uniform lump-sum tax being ≤ 1, *by definition*, as illustrated in footnotes 13 and 20. Because the MCF must be equal across tax instruments in the second best, Jacobs (2018) concludes that MCF≤ 1 also for other instruments. As we have shown in this paper, the conclusion that the marginal cost of raising public revenue using a uniform lump-sum tax is ≤ 1 will, however, not generally hold when the distributional consequences of taxation are fully accounted for, as in the MECF as defined in Definition 1.

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