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# A net welfare benefit approach to optimal taxation

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**Abstract**

This paper challenges the widespread notion that the labor income tax is an inherently distortionary tax instrument. Optimal tax theory considers the lump-sum tax as the only efficient or non-distortionary tax instrument. This conclusion depends on two (often implicit) assumptions: one is that the economy is operating at the optimal welfare maximizing solution, where the marginal cost of tax revenue is equal to its marginal benefit; and the other that public expenditure has no effect on taxpayers' budget constraints. However, for a government program to be worthwhile, total benefit must be greater than total cost, and it is easy to find examples where budget constraints are affected by public expenditure. This paper shows that, when the two assumptions are relaxed, the combined use of labor income and lump-sum taxes may allow a representative taxpayer to reach greater levels of welfare than the use of a lump-sum tax alone.

Keywords: optimal taxation; distortion; labor income tax; lump-sum tax

JEL codes: H21, H24, J22, D61

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## 1. Introduction

Traditional optimal tax theory generally asserts that the lump-sum tax is the only efficient tax, and uses it as a benchmark to measure the distortionary effects of other tax instruments. [1] This paper analyzes the welfare effects of the lump-sum tax and the proportional labor income tax, and shows that the superiority of the lump-sum tax does not necessarily hold when public expenditures have a positive effect on real income, and all benefits and costs of worthwhile government programs are fully accounted for.

The case for incorporating the effects of public expenditure on real income in the analysis optimal tax policy is based on the nature of public good benefits. Optimal taxation theory normally assumes that public expenditure is used to provide public goods that have direct effects on taxpayers' utility. However, many public goods, like roads, defense, regulations, etc., may not be directly enjoyable, and thus may not have a direct effect taxpayers' utility. Instead, the benefits of public goods are often realized in the form of changes in parameters that affect real income (e.g. lower prices, higher wage rates), which in turn alter the labor supply and consumption decisions.

In order to fully account for all the benefits and costs of fiscal policies, this paper makes use of the basic cost-benefit rule, the concept of marginal cost of funds, and some insights from the literature on fiscal incidence. Cost-benefit analysis suggests that a government project is worthwhile as long as the net present benefit –the difference between total benefits and total (opportunity) costs, is positive. [2] Equivalently, the literature on the marginal cost of funds

[1] Auerbach and Hines (2002) provide an overview of the traditional optimal tax theory. More recent surveys about optimal income taxation are provided by Boadway (2012) and Sørensen (2010).

[2] The literature on cost-benefit analysis is vast, and encompasses theoretical contributions on public finance and welfare economics, as well as countless applied studies. A basic review of the principles of cost-benefit analysis is provided by Boadway (2006).

recommends the government to increase public expenditure as long as the welfare benefit of the last dollar collected is greater than its welfare cost, a rule formalized by the adjusted Samuelson (1954) condition (see Ballard and Fullerton 1992).

Fiscal incidence analyses measure and compare individuals' net gains from fiscal policy, and typically follow a balanced-budget approach. [3] Under this approach the costs of government programs are used as proxies of the benefits received by different income groups, implying that total benefits must be equal to total costs. [4] This is a problem because, in practice, the benefits of public expenditure can be greater, equal or smaller than the value of taxes paid and, in particular, worthwhile government programs require by definition to create a positive surplus, or that total benefits exceed total costs (Piggot and Whalley 1987).

This paper uses the balanced-budget assumption, in the sense that public expenditure is assumed to be equal to tax revenue, but follows Piggot and Whalley (1987) in allowing the total welfare benefits of public expenditure to exceed the cost of total tax revenue. The result is a "net welfare benefit" approach that is used to analyze the optimal tax problem of determining the combination of lump-sum and labor income taxes that maximizes welfare. Distributional considerations are disregarded, thus the analysis can focus on the effect of balanced-budget government programs on the level of welfare of a representative taxpayer. Under the net welfare benefit approach the adjusted Samuelson condition and the basic cost-benefit rule are satisfied simultaneously. At the optimal level of public expenditure, the marginal cost is equal to the marginal benefit only for the last dollar spent, but inframarginal amounts of public goods are

[3] Another well known methodology is differential incidence analysis, which compares the incidence effects of using alternative tax instruments (Fullerton and Metcalf 2002). The distinction between balanced-budget and differential incidence is due to Musgrave (1959).

[4] The balanced-budget approach is implicit in much of the historical literature on redistribution. For instance, it is the approach used by Buchanan (1950) when defining the concept of fiscal residuum, equal to the cost of services received minus the taxes paid by an individual.

usually characterized by positive net benefits that can be aggregated into a positive consumer surplus.

Provided that a worthwhile public policy has positive net benefits, and as long as part of those benefits consist of, or lead to, increases in real income, the paper shows that collecting taxes with a combination of lump-sum and labor income taxes may result in a greater welfare level than using only a lump-sum tax. The reason is that the labor income tax imposes a substitution effect that makes affordable a set of possibly preferable allocations that would otherwise not be affordable under the lump-sum tax alone. Since the labor income tax can be part of the welfare maximizing tax mix, we can conclude that it is not inherently distortionary as traditionally presumed in the optimal tax literature.

The next section analyzes the effects of lump-sum and labor income taxes on individual welfare, first without considering the benefits from public expenditure, and then incorporating those benefits. The last section provides a brief discussion of the main results.

## 2. Net welfare benefit effects of lump-sum taxes and labor income taxes

The objective of this section is to show that once all the benefits from public expenditure are taken into account, the labor income tax cannot be considered as a distortionary tax instrument.

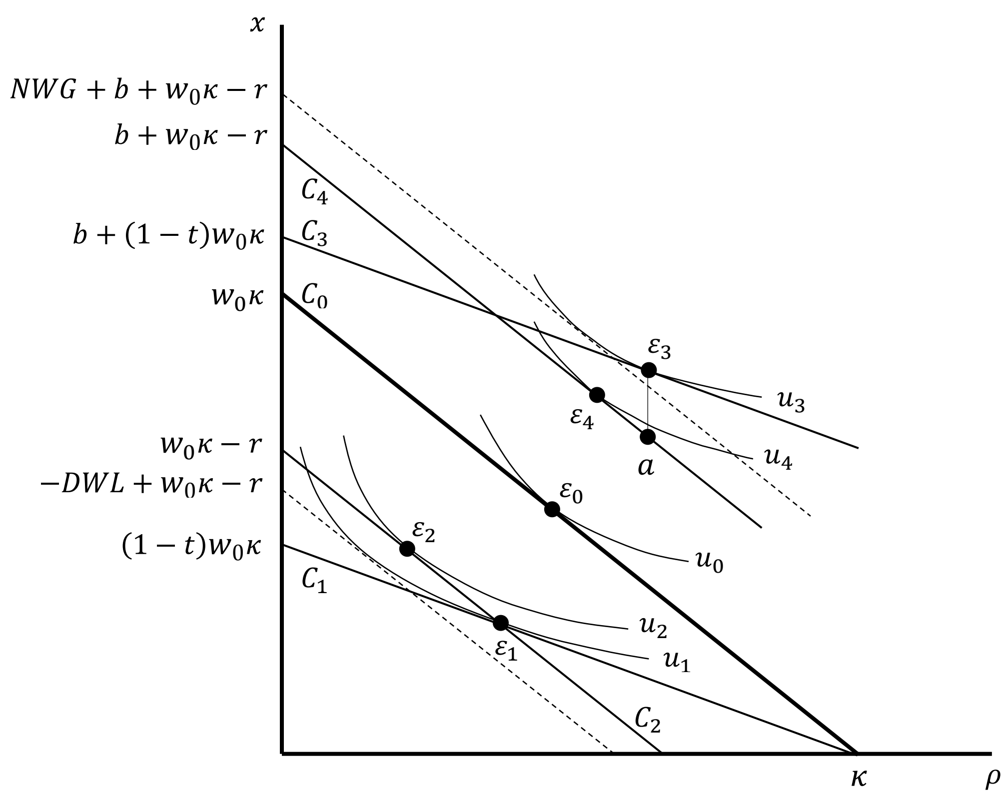
### 2.1 The traditional concept of deadweight loss

Consider an economy with identical individuals, such that redistribution is unnecessary and we can focus on efficiency only. The traditional measure of deadweight loss is described in Figure 1, which displays the preferences and budget constraint of a representative taxpayer. The vertical axis represents a composite private good $x$. Leisure $\rho$ increases rightward in the horizontal axis, where labor is defined as $l = \kappa - \rho$ and $\kappa$ is the time constraint. The initial equilibrium is at $\varepsilon_0$, where the budget constraint is tangent to the indifference curve $u_0$.

Traditional optimal tax theory defines the deadweight loss of the labor income tax by comparing its negative effects on real income with the negative effects of an equal yield lump-sum tax. A proportional tax rate $t$ on labor income reduces the wage rate to $w_1 = (1-t)w_0$, rotating the budget constraint over $\kappa$, from $C_0$ to $C_1$. The optimum under $t$ is at $\varepsilon_1$, associated with a lower level of utility $u_1$. A lump-sum tax that raises the same amount of revenue $r$ would lead to a different equilibrium at $\varepsilon_2$, allowing the taxpayer to reach a higher utility level $u_2$. Using the expenditure function $e(w_i, u_i)$ to represent the minimum amount of money required to obtain a utility level $u_i$ with a wage rate $w_\mathrm{i}$, the (equivalent variation) measure of deadweight loss associated with the labor income tax can be expressed as $DWL = e(w_0, u_0) - e(w_0, u_1) - r$. In general, the inefficiency or $DWL$ of any tax instrument corresponds to the additional amount of money required to reach the same level of utility than an equal yield lump-sum tax.

The way in which tax revenue is spent is often disregarded in the computation of the deadweight loss. If preferences are convex, and the benefits of public goods are not taken into account, then $u_0 > u_2 > u_1$. Accounting for the direct welfare benefits of public expenditure, however, does not affect the conclusion that tax instruments other than the lump-sum tax are inefficient. For simplicity and comparability, assume that all public expenditures are used to finance non-rival and non-excludable (pure) public goods. We can think about the quantity of public goods as represented by a third dimension not shown in the two-dimensional space of Figure 1. Assuming that the budget constraint remains unaffected, a worthwhile government program would lead to a net increase in utility. In particular, if public goods are separable from private goods and leisure in the utility function, then the shape of the indifference curves is unaffected by changes in the level of public goods and the previous analysis remains valid (Browning et al. 2000). In that case, the amount of public goods would affect only the level of utility represented by each indifference curve, and a government program that is worthwhile under the labor income tax would necessarily result in $u_2 > u_1 > u_0$.

Figure 1: Net welfare effects of lump-sum and labor income taxes




## 2.2 Marginal cost of funds and the cost-benefit rule

The positive effect of public goods on utility can easily be understood in the context of the basic cost-benefit rule and the concept of marginal cost of funds. In order to formalize the argument, assume that a representative taxpayer chooses the labor supply $l$ that maximizes a quasi-concave utility function $u\{x, \rho, G\}$. Utility increases with the composite private good $x = (1-t)wl$, leisure $\rho = \kappa - l$, and the provision of a public good $G$, which is considered exogenous by the taxpayer. The taxpayer's first order condition is

$$(1-t)wu_x = u_\rho \ , \tag{1}$$

where subscripts represent derivatives with respect to the denoted variable. A benevolent government is assumed to maximize the sum of utilities of $N$ identical taxpayers, and considers the public good $G = R = Ntwl$, where $R = Nr$ is total tax revenue, as endogenous. Using (1), the first order condition for the optimal choice of $t$ can be written as

$$R_t N u_G = wLu_x \ , \tag{2.a}$$

where $R_t = Nr_t$ is marginal tax revenue and $wL = wNl$ the value of the reduction in aggregate private consumption (net of leisure gains) associated with the tax. This condition means that the government should collect taxes up to the amount at which the benefits of the last dollar spent on public goods, represented by the left hand side of (2.a), are equal to its costs –the value of the private goods sacrificed, represented by the right hand side. Rearranging, we obtain

$$N\frac{u_G}{u_x} = \frac{wL}{R_t} \, , \tag{2.b}$$

which is the well known adjusted Samuelson (1954) condition describing the optimal provision of public goods. Equations (2.a) or (2.b) determine the optimal (total) amount of public expenditure by defining the condition to be satisfied by the *last* dollar spent. Provided that marginal benefits are decreasing in $t$ and marginal costs are increasing in $t$, any inframarginal dollar spent must provide net welfare benefits to society, which is equivalent to satisfying the following inequality:

$$N\frac{u_G}{u_x} > \frac{wL}{R_t} \, . \tag{3}$$

This condition formalizes the basic cost-benefit rule requiring benefits to be greater than costs for each dollar used. [5] Furthermore, the accumulation of the net welfare benefits of all dollars spent ensures that the optimal provision of public goods leads to a level of utility that is greater than the level reached before the taxes were collected ($u_1 > u_0$). [6]

### 2.3 Possible effects of public goods on taxpayer's budget constraint

The previous discussion describes the traditional approach to the analysis of tax distortions. Public goods are assumed to provide direct utility gains on their own, and to have no effect on the representative taxpayer's budget constraint. This notion of public goods is here contested.

Public goods may not have only direct effects on utility, but also indirect effects through the changes they induce in other determinants of taxpayers' purchasing power. For instance, taxpayers do not necessarily enjoy roads; but instead obtain indirect benefits because roads save time. More time available for leisure and labor implies that the time constraint is an increasing function of public goods; such that $\kappa = \kappa(G)$ and $\kappa_G > 0$. In addition, less transportation time reduces the costs of production and distribution, possibly resulting in lower market prices of final goods and greater non-labor income for firms' stockholders. As a result, roads can increase welfare not because they satisfy taxpayers' preferences, but because they lead to an actual increase in taxpayer's real income, which is represented by an outward shift of the budget constraint.

There are several channels through which public goods, and public expenditure in general, can affect the budget constraint. When a government adequately corrects for market

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[5] In practice, investment needs and fixed costs often imply that not every dollar spent is associated with a net benefit; however, this complication is disregarded because it does not affect the main results of the paper.

[6] This point has previously been stressed by Piggott and Whalley (1987), who argued that it is incorrect to assume that the welfare effects of tax revenues and government expenditures must be equal.

failures we can expect the levels of efficiency and welfare to increase, and it is not difficult to find examples in which taxpayer's real income, and thus the budget constraint, are affected. The government provides a number of important services like development of the legal framework, enforcement of property rights, regulation of economic activity, etc. Individuals may not enjoy these public goods directly; they could even be unaware or indifferent about them, meaning that their utility levels could remain constant after a change in the provision of these public goods ($u_G = 0$). It is reasonable to expect that at least part of the benefits that make these services worthwhile are perceived as lower transaction costs, lower costs of capital formation and accumulation, or other factors that can positively affect real income. Similarly, when the government intervenes in an imperfectly competitive market, economic efficiency can increase and taxpayers can possibly receive benefits in the form of higher salaries and lower prices of private goods.

The effects of public expenditure on the budget constraint are not limited to unenjoyable public goods. Enjoyable public goods like parks are expected to have a positive direct effect on utility, but this does not imply that the budget constraint remains unaffected. Parks can substitute for private goods that would otherwise be purchased in their absence, freeing up resources that might (but not necessarily) increase after-tax real income. Private goods like education and health services can be subject to positive externalities. [7] When the government intervenes in order to take advantage of these externalities, overall economic efficiency increases. If these goods are considered as part of a composite private good $x$ (not $G$), then the net gain in efficiency implies that together, tax and expenditure policies can lead to an increase in real income and an outward shift of the original budget constraint.

[7] Private goods are here understood as goods or services that are both rival and excludable.

## 2.4 Net efficiency gains under the labor income tax

Once the budget constraint has shifted as a consequence of a change in the provision of public goods, utility maximization does not preclude the use of the labor income tax. To see this, assume for simplicity that the representative taxpayer does not exhibit any preference for the public good, and thus that $G$ affects utility *only* through its effects on real income. In this context, a worthwhile government program leads to an outward shift of the original budget constraint and a higher level of utility. [8]

Taking into account the several ways in which public goods can possibly affect real income, we can write

$$x = \frac{(1-t)w(G)l+b(G)}{P(G)}, \tag{4.a}$$

$$\rho = \kappa(G) - l \tag{4.b}$$

where the wage rate $w$, non-labor income $b$, the price of the composite private good $P$ (relative to the price of public goods), and the time constraint $\kappa$ are all defined as functions of $G$. Considering (4.a) and (4.b), and assuming $u_G = 0$, the first order conditions for the taxpayer and the government can be rewritten, respectively, as

$$\frac{(1-t)w}{P} u_x = u_\rho \ , \tag{5}$$

$$N[(1-t)lw_G + b_G - xP_G + (1-t)w\kappa_G] = \frac{wL}{R_t} \, . \tag{6}$$

[8] The argument is valid whenever public expenditure affects real income and shifts the (after-tax) budget constraint outward; including cases in which the taxpayer directly enjoy the public good. As long as the positive effects of public expenditure shift the budget constraint outward and move the optimal taxpayer decision under the labor income tax to a point unaffordable under the lump-sum tax (above budget constraint $C_2$), the labor income tax will possibly allow the taxpayer to reach higher levels of utility.

The optimal condition (6) is analogous to the adjusted Samuelson condition in (2.b). [9] The left hand side represents the marginal welfare benefits of public goods, which in this case can be interpreted as the marginal efficiency gains of public expenditure. The right hand side represents the marginal cost of funds. As explain before, this condition applies to the *last* dollar only; for each of the "previous" dollars, the benefits normally exceed the costs:

$$N[(1-t)lw_G + b_G - xP_G + (1-t)w\kappa_G] > \frac{wL}{R_t}\,, \qquad (7)$$

and the sum of net benefits of the total amount of dollars spent *must* be positive in order for the government program, or total government expenditure, to be worthwhile.

Graphically, when the government collects and spends a dollar that brings net benefits, real income increases and the budget constraint shifts outward. The (last) dollar that completes the optimal amount of public expenditure has no net benefit; with that dollar budget constraint either remains unaffected or, if moves, remains tangent to the same indifference curve. If the government keeps collecting and spending money beyond the optimal level, real income is negatively affected and the budget constraint shifts inward.

In order to illustrate the effects of the possible benefits from public goods, assume for simplicity that the benefits of public goods increase real income by a discrete amount $b$. [10] In Figure 1 these benefits shift the budget constraints upward; under the labor income tax from $C_1$

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[9] The derivation of condition (6) is available in Appendix 1.

[10] Lewis (1957/1971) and Gwartney and Stroup (1983) argued that if tax revenues are used to provide valuable goods, the net income effect of a labor income tax on aggregate labor supply should be zero, and concluded that the tax increase would only have a substitution effect. This conclusion was challenged by a number of authors. One of the most relevant points of contention, shared among others by Bohanon and Van Cott (1986) and Gahvari (1986), was that even if it is true that the additional public goods provision can be interpreted as an increase in equivalent income, this increase is not equivalent to a greater purchasing power in the private goods-leisure space.

Note that in our discussion we are assuming that a government program is worthwhile not because the individual obtains benefits that have an income equivalence, but because there is an actual increase in real income. Another difference is that in this paper the marginal benefits of public expenditure are assumed to possibly lead not only to lump-sum changes in real income, but also to changes in relative prices, thus they can impose both income and substitution effects.

to $C_3$, and under the lump-sum tax from $C_2$ to $C_4$. A plausible preference structure can lead to a greater level of welfare under the labor income tax. This is the situation depicted in Figure 1. The budget under the labor income tax allows to reach a level of utility $u_3$, while the budget under the lump-sum tax allows to reach a lower level of utility $u_4$.

A change in the optimal labor choice under the labor income tax would affect the amount of tax collections and the sustainability of the government program. If tax collections are reduced, as it is the case in Figure 1, where the equilibrium under the labor income tax changes from $\varepsilon_1$ to $\varepsilon_3$, we can expect the benefits of public goods to be reduced and the budget constraint $C_3$ to shift downward. However, a lump-sum tax for the amount of the reduction of tax collections, given by the vertical difference between $\varepsilon_3$ and $a$, will ensure that equilibrium $\varepsilon_3$ is both affordable and sustainable. Since a lump-sum tax for this amount ensures that individual tax revenue is equal to $r$, then the benefits of public goods must be equal to $b$, and without affecting the wage rate under the labor income tax ($w_1$), the equilibrium must remain at $\varepsilon_3$.

At the optimal level of public expenditure the marginal cost of funds of all tax instruments must be equal. It is easy to obtain the expression for the marginal cost of funds of the lump-sum tax $s$. Private and public goods are redefined, respectively, as $x = [(1-t)wl + b - s]/P$, and $G = R = N(twl + s)$. Using (4.a), (4.b), (5) and maintaining the assumptions of the analysis, the adjusted Samuelson condition under the lump-sum tax is

$$N[(1-t)lw_G + b_G - xP_G + (1-t)w\kappa_G] = N\frac{1}{R_s}. \quad (8)$$ [11]

The left hand side, the marginal benefits from public goods, is equal to the left hand side of (6). This implies that under the optimal solution to the welfare maximization problem, the right hand sides of (6) and (8), which represent the marginal cost of funds of the labor income tax and the

[11] The derivation of condition (8) is available in Appendix 2.

lump-sum tax, respectively, must also be equal. This is a well known result in optimal taxation theory, which generalizes to the equality of the marginal cost of funds for all tax instruments used at the optimal level of public expenditure.

It is apparent that the combination of labor income tax and lump-sum tax can allow to reach a greater level of utility than the lump-sum tax alone. Using the original wage rate $w_0$, the net welfare gain ($NWG$) of the labor income tax is measured here as the equivalent income difference between the two utility levels. Since $NWG$ is positive, it is not correct to conclude that the labor income tax is a distortionary tax instrument.

In general, whenever the use of the labor income tax allows the taxpayer to afford preferable decisions that are otherwise unavailable under the lump-sum tax alone, then the labor income tax will be the source of net welfare gains.

## 3. Discussion

According to Atkinson and Stiglitz (1976), "[t]he necessity for any form of taxation different than a uniform lump-sum tax arises from the fact that individuals have different characteristics (endowments or tastes)." This paper shows that even when taxpayers have identical endowments and preferences, as long as tax and expenditure policies are subject to the basic cost-benefit rule, and public expenditure affect the ability to afford private goods (shift the budget constraint), the use of labor income taxation can possibly lead to a greater level of utility than the lump-sum tax alone. The longstanding assumption that the lump-sum tax is the only non-distortionary tax instrument is, therefore, inappropriate. There is no reason to consider the labor income tax as distortionary tax, or to assume that it creates a deadweight loss.

The implications of this conclusion are far reaching. Optimal taxation theory is partially based on the assumption that the lump-sum tax is the only non-distortionary tax instrument, and the first-best solution to the welfare maximization problem is considered to be attainable only with the exclusive use of the lump-sum tax. If any other tax instrument is used, the welfare maximizing solution is automatically labeled as second-best.

The deadweight loss of any tax different from the lump-sum tax, as traditionally defined, is equal to the equivalent income variation of the substitution effect imposed by it. [12] For this reason, the substitution effect itself, and by extension any tax induced change in relative prices, have become synonyms of tax distortions. What this paper shows is that the substitution effect is not an expression of tax distortions. In the case of the labor income tax, an increase of the tax rate leads to a negative substitution effect on labor supply. This labor supply reduction is simply the result of time allocation preferences and utility maximizing behavior; taxpayers are better off by reducing labor supply.

The identification of substitution effects with the concept of tax distortions is explicit in the literature on the marginal cost of funds. What Ballard and Fullerton (1992) label as the Pigou-Harberger-Browning tradition, considers only compensated elasticities for the measurement of the marginal cost of funds. Compensated elasticities (of labor supply, for instance), are computed after compensating for income variations, and thus consider only substitution effects. This paper is closer to what Ballard and Fullerton (1992) call the Stiglitz-Dasgupta-Atkinson-Stern approach to the measurement of the marginal cost of funds, which considers both the substitution and income effects in the measure of marginal cost of funds. [13]

[12] In Figure 1, the substitution effect of the labor income tax on labor supply corresponds to the horizontal distance between $\varepsilon_1$ and the point at which the segmented line is tangent to $u_1$.
[13] Note that dividing the numerator and denominator of the right hand side of (6) by $wL$, and assuming that $w$ is not affected by $G$, that expression can easily be shown to be equal to $1/(1+\epsilon_{L,t})$, where $\epsilon_{L,t}$ is the uncompensated

However, Atkinson and Stern (1974) separate the marginal cost of funds into a “revenue effect”, which depends on the income effects of the tax, and a “distortionary effect”, related to the substitution effect of the tax. This paper suggests that the last name is misplaced. It is true that the substitution effect results in lower tax revenue, but it is also true that it may allow to reach a higher level of utility.

## References


Atkinson, Anthony B. and Nicholas H. Stern. 1974. “Pigou, Taxation, and Public Goods.” *Review of Economic Studies*, 41(1): 119-128.

Auerbach, Alan and James Hines. 2002. "Taxation and Economic Efficiency," A. Auerbach and M. Feldstein eds., *Handbook of Public Economics*. Elsevier, 1347-1421.

Ballard Charles L. and Don Fullerton. 1992. “Distortionary Taxes and the Provision of Public Goods.” *Journal of Economic Perspectives*, 6(3): 117-131.

Boadway, Robin. 2006. “Principles of Cost-Benefit Analysis.” *Public Policy Review*, 2(1): 1-44.

Boadway, Robin. 2012. “Recent Advances in Optimal Income Taxation.” *Review of Public Economics*, 200(1): 15-39.

Bohanon, Cecil E. and T. Norman Van Cott. 1986. "Labor Supply and Tax Rates: Comment." *The American Economic Review*, 76(1): 277-279.

Browning, Edgar, Timothy Gronberg and Liqun Liu. 2000. “Alternative Measures of the Marginal Cost of Funds.” *Economic Inquiry*, 38(4): 591-599.

Buchanan, James M. 1950. “Federalism and Fiscal Equity.” *The American Economic Review*, 40(4): 583-599.


elasticity of aggregate labor supply with respect to the labor income tax rate. Under the Pigou-Harberger-Browning tradition, the uncompensated elasticity is replaced by the compensated elasticity.

Fullerton, Don and Gilbert E. Metcalf. 2002. "Tax Incidence," A. Auerbach and M. Feldstein eds., *Handbook of Public Economics*, *Volume 4*. Elsevier, 1787-1872.

Gahvari, Firouz. 1986. “Labor Supply and Tax Rates: Comment.” *The American Economic Review*, 76:1, pp. 280-283.

Gwartney, James and Richard Stroup. 1983. “Labor Supply and Tax Rates: A Correction of the Record.” *The American Economic Review*, 73:3, pp. 446-451.

Lewis, Gregg H. 1957. “Hours of Work and Hours of Leisure.” Proceedings of the Ninth Annual Meeting of the Industrial Relations Research Association, Arno Press Inc., New York. Reprinted in 1971 in *Readings in Labor Market Analysis*, L. Reed Tripp (ed.).

Musgrave, Richard A. 1959. *The theory of public finance; a study in public economy*. New York, McGraw-Hill.

Piggott, John and John Whalley . 1987. “Interpreting Net Fiscal Incidence Calculations.” *The Review of Economics and Statistics*, 69(4): 685-694.

Samuelson, Paul A. 1954. “Pure Theory of Public Expenditure.” *The Review of Economics and Statistics*, 36:4, pp. 387-389.

Sørensen, Peter Birch. 2010. “The theory of optimal taxation: New developments and policy relevance.” *Nationaløkonomisk Tidsskrift*, 148: 212-244.

## Appendix 1. Derivation of (6)

Using the definitions of $x$ in (4.a), the marginal effect of $t$ on $x$ is:

$$\frac{\partial x}{\partial t} = \frac{[-wl+(1-t)wl_t+(1-t)w_G lR_t+b_G R_t]}{P} - \frac{[(1-t)wl+b]P_G R_t}{P^2}.$$

Using this result, as well as (4.b) and (5), the first order condition for the optimal $t$ is equal to:

$$\frac{N}{P}\left[-wl+(1-t)lw_G R_t + b_G R_t - \frac{[(1-t)wl+b]P_G R_t}{P}\right]u_x + N\kappa_G R_t u_\rho = 0\ ;$$

$$\frac{N}{P}\left[-wl+(1-t)lw_G R_t + b_G R_t - \frac{[(1-t)wl+b]P_G R_t}{P}\right]u_x + N\kappa_G R_t \frac{(1-t)w}{P} u_x = 0\ ;$$

$$N[(1-t)lw_G + b_G - xP_G + (1-t)w\kappa_G] = \frac{wL}{R_t},$$

which is equal to (6).

## Appendix 2. Derivation of (8)

Defining $x = \frac{(1-t)w(G)l+b(G)-s}{P(G\ )}$, the marginal effect of $s$ on $x$ is:

$$\frac{\partial x}{\partial s} = \frac{[(1-t)wl_s+(1-t)w_G lR_s+b_G R_s-1]}{P} - \frac{[(1-t)wl+b-s]P_G R_s}{P^2}.$$

Using this result, as well as (4.b) and (5), the first order condition for the optimal $s$ is equal to:

$$\frac{N}{P}\left[(1-t)lw_G R_s + b_G R_s - 1 - \frac{[(1-t)wl+b-s]P_G R_s}{P}\right]u_x + N\kappa_G R_s u_\rho = 0\ ;$$

$$\frac{N}{P}\left[(1-t)lw_G R_s + b_G R_s - 1 - \frac{[(1-t)wl+b-s]P_G R_s}{P}\right]u_x + N\kappa_G R_s \frac{(1-t)w}{P} u_x = 0\ ;$$

$$N[(1-t)lw_G + b_G - xP_G + (1-t)w\kappa_G] = N\frac{1}{R_s},$$

which is equal to (8).