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Harmonizing fiscal policy: Indirect taxes and global public goods

Miguel-Angel Lopez-Garcia

Departamento de Economia Aplicada, Universidad Autonoma de Barcelona, Bellaterra, Barcelona, Spain

Correspondence
Miguel-Angel Lopez-Garcia, Departamento de Economia Aplicada, Universidad Autonoma de Barcelona, 08193 Bellaterra, Barcelona, Spain.
Email: miguelangel.lopez@uab.cat

Abstract

This article focuses on the welfare effects of the interaction of a rule of indirect tax harmonization under the destination principle and the provision of public goods that are global in nature. It stresses the role of international transfers between governments set in order to equalize the social (i.e., worldwide) marginal cost of public funds across countries. Under this condition, it is shown how the combination of the tax and expenditure side of such a "harmonizing fiscal policy" can give rise to a potential Pareto improvement. This requires considering aggregate revenue effects (and the ensuing effects on the provision of public goods) of the fiscal reform jointly with under/over provision of public goods in the (first-best) Samuelson sense.

KEYWORDS

global public goods provision, harmonization of fiscal policy, indirect taxation

JEL CLASSIFICATION

F15, H21, H41, H87

1 | INTRODUCTION

A key concern in countries when designing their structure of indirect taxes is the fear that their tax base will shift elsewhere if commodity taxes are domestically higher than abroad. This concern

is reflected in tax legislation in the EU, and elsewhere (as in Australia and Canada), of provision for tax coordination and tax harmonization. Whatever their precise form, it is the existence of such spillovers that create a *prima facie* case for central coordination of tax matters across countries, since lack of it will result in outcomes that are inefficient from a global perspective. In the EU, for example, Directive 2006/112/EC—a recast of the Sixth Value-Added-Tax (VAT) Directive of 1977—has achieved some degree of tax harmonization with the common bands of VAT, which require a minimum VAT rate of 15% on all products (apart from exemptions and special authorizations).[1]

Not surprisingly, the appropriate form of tax harmonization has been the focus of the academic literature and policy discussions alike, in the last decades. Starting with the early contributions of Keen (1987) and Turunen-Red and Woodland (1990), the welfare implications of indirect tax harmonization under the destination principle (commodities are taxed by, and revenues accrue to, the country where final consumption takes place) have received considerable attention. The common theme of this work has been that a multilateral tax reform consisting in a move toward an appropriately weighted tax average generates a potential Pareto improvement. However, an actual Pareto improvement is more difficult to establish (Keen, 1989). Interestingly, this conclusion is general enough to encompass both taxes under the destination principle and under the origin principle (commodities are taxed by, and revenues accrue to, the country that produces them) (Lopez-Garcia, 1996).

The initial contributions on the topic assumed that tax revenues are returned to the representative consumer in each country in a lump-sum fashion. As one would expect, accounting for the allocation of tax revenues and the ensuing effects on public good provision, has important effects. The reason for this is not surprising, given that tax-harmonization is not capable, by way of design, to deal with "two margins": one arising from inefficiencies in consumption (resp. production) under the destination (resp. origin) principle, and one arising from preferences for public goods. Nevertheless, it has been shown that, under certain conditions, indirect tax harmonization can lead to welfare improvements.[2]

To discuss the welfare effects of tax harmonization, this article turns to global public goods, a very important class of public goods whose importance can hardly be exaggerated. Environmental issues, knowledge, innovation and research, public health and prevention of communicable diseases, trans-country transport networks, institutions promoting peace and international security, and institutions to sustain the global market economy provide, from different viewpoints, a far from exhaustive list. This is an issue that, surprisingly, does not seem to have received in the literature the attention it deserves.[3] In particular, the article investigates whether additional instruments to destination-based tax harmonization are required in order to ensure the existence of a welfare improvement in the presence of global public goods. Unrequited transfers between governments, to be used in financing the provision of global pubic goods, are a natural candidate for being such an additional instrument.

As argued below, the existence of such transfers emerges as a crucial component of a "harmonizing policy", that is, a multilateral *tax reform* coupled with an appropriate *expenditure rule* concerning the provision of global public goods. Here is where the concept of marginal cost of public funds, that is, the loss incurred in raising additional revenues to finance government spending (Dahlby, 2008), comes out. Focusing on the case where there are two countries, there will exist global welfare gains insofar as their respective social marginal cost of public funds differ. As a consequence, given initial arbitrary tax structures, the optimal value of the international transfer will be the one implying that the worldwide marginal cost of public funds is equalized across

countries. This will the procedure adopted below. In terms of the institutions of the real world, this can be taken to be the role of the European Structural and Investment Funds (in particular the European Regional Development Fund and Cohesion Fund) designed to support economic development across all countries within the EU.

The article is organized as follows. Section 2 sets up the framework of the analysis. Section 3 provides a characterization of the welfare effects of a "harmonizing *fiscal policy*", that is, a reform à la Keen (1987, 1989) coupled with the optimal international transfer between governments. It is shown that a positive result can be obtained when aggregate revenue effects are considered *jointly* with the (first-best) Samuelson rule for providing public goods. In particular, the harmonizing policy will give rise to a potential Pareto-improvement if it increases (decreases) aggregate tax revenue and global public goods are underprovided (resp. overprovided) relative to the (first-best) Samuelson rule. Section 4 provides some further remarks.

2 | THE MODEL

The framework of the analysis is a standard general equilibrium two-country competitive trade model where governments levy destination-based taxes whose revenue is used to finance the provision of public goods that are global in nature. The two countries are labeled "home" and "foreign", and variables pertaining to the home and foreign country are denoted, respectively, by lower- and upper-case letters. There is a private sector in each country producing $N+1$ tradeable commodities under constant returns to scale. There is also a public sector in each country which produces a non-tradeable public good, g (G), that is global in nature, so that the enjoyment of the good by the home (foreign) country resident does not diminish its availability for the citizen in the foreign (home) one. Commodity taxation is destination-based, so that commodities are taxed by the country where final consumption takes place, this being the one receiving the ensuing tax revenues. The model also allows for international transfers between governments. These transfers are assumed to be set in order to equalize the social (i.e., worldwide) marginal cost of public funds. As will become clear, this institutional design plays a crucial role in the characterization of potentially Pareto-improving tax harmonizing policies.

In the home (foreign) country there is a single representative consumer with preferences described by an expenditure function $e(q,g,G,u)$ ($E(Q,G,g,U)$) for the home (foreign) country, where q (Q) is the $N+1$-vector of consumer prices of the private goods and u (U) is the utility of the consumer. The vector of compensated demands in the home (foreign) country is therefore given by e_q (E_Q), and $-e_g>0$ ($-E_g>0$) gives the marginal willingness to pay for g by the home (foreign) consumer (i.e., the marginal rate of substitution between g and the numeraire good, denoted by mrs_g (**)).[4] It is important to emphasize that the utility specification does not place any restrictions on the relationship between the two public goods, g and G. This means, in particular, that g and G can either be complements or substitutes from the point of view of consumers, that is, $-e_{gG}$ and $-E_{Gg}$ can either be positive or negative.[5]

The private sector is competitive and characterized by a "restricted revenue function" denoted as $r(p,g)$ ($R(p,G)$) for the home (foreign) country (Abe, 1992). The vector of supplies in the home (foreign) country is given by r_p (R_p), and $r_g<0$ ($R_G<0$) gives the reduction in the home (foreign) country's production of the tradeable goods—and so revenue $r(p,g)$ ($R(p,G)$)—as a consequence of an increase in the production of the global public good. The global public goods

g and G are produced with technology that exhibits constant returns to scale, implying that the marginal cost of production, given by $-r_g > 0$ $(-R_G > 0)$ (i.e., the marginal rate of transformation between the domestically supplied global public good g (G) and the numeraire in the home (foreign) country, denoted by mrt_g (MRT_G)), is constant in each country (and thus $-r_{gg} = -R_{GG} = 0$).

Denoting the destination-based commodity tax-vector in the home (foreign) country as t (T), the consumer price-vector will be $q = p + t$ $(Q = p + T)$. The homogeneity properties of the above-mentioned functions in the variables q, Q and p, imply that, without loss of generality, we can take the first tradeable commodity, good 0, to be the numeraire and also to be the untaxed commodity in both countries, so that $p_0 = q_0 = Q_0 = 1$. The international transfer from the foreign country's government to the home one's, denominated in units of numeraire, is denoted as z.

An equilibrium for this economy is a set of values for the endogenous variables $\{u, U, g, G, p\}$ that satisfy the budget constraints of the consumers and governments as well as the market-clearing condition, given the vectors of exogenous parameters $\{t, T, z\}$. The system of equations that characterizes the equilibrium is given by

$$e(q, g, G, u) = r(p, g) + t' e_q(q, g, G, u) + z, \tag{1}$$

$$E(Q, G, g, U) = R(p, G) + T' E_Q(Q, G, g, U) - z, \tag{2}$$

$$t' e_q(q, g, G, u) + z = -g r_g(p, g), \tag{3}$$

$$T' E_Q(Q, G, g, U) - z = -G R_G(p, G), \tag{4}$$

$$e_q(q, g, G, u) + E_Q(Q, G, g, U) = r_p(p, g) + R_p(p, G). \tag{5}$$

Equations (1) and (2) give, respectively, the home and foreign country consumer's budget constraint. The home and foreign government budget constraints are given by, respectively, Equations (3) and (4). Equation (5) is the worlwide market-clearing condition for private goods. By Walras' law, we can drop the market-clearing condition for commodity 0, so from now on p will be a N-vector.

The analysis will proceed by considering perturbations of the system (1)–(5), identifying fiscal reforms $\{dt, dT, dz\}$, that is, *tax and expenditure* changes (the latter also through the choice of the transfer between governments and the ensuing effects on the provision of global public goods) that generate a potential Pareto improvement. In doing so, as is standard in the literature of optimal commodity taxation and tax reform (e.g., Keen, 1989; Lahiri & Raimondos-Møller, 1998; Keen & Wildasin, 2004), it will be assumed that $e_{qu} = E_{QU} = 0_N$ (where 0_N is a vector of N zeroes), meaning that in each country income effects attach only to the untaxed numeraire commodity. To remove a further inessential complication, it will be also assumed that public good provision does not affect the compensated demands for, and the supplies of, any good other than the numeraire, and so $e_{qk} = E_{Qk} = r_{pk} = R_{pk} = 0_N$, $k = g, G$. Finally, standard properties of the expenditure function imply that the $(N + 1) \times (N + 1)$ matrix of substitution effects is negative semi-definite. It will further be assumed that there is enough substitutability between the numeraire good and all other goods so that the $N \times N$ matrices e_{qq} and E_{QQ} are negative definite (Dixit & Norman, 1980; Woodland, 1982).

3 | AGGREGATE REVENUE EFFECTS OF TAX HARMONIZATION AND THE SOCIAL MARGINAL COST OF PUBLIC FUNDS

Perturbing equations (1), (3), and (4), the effect on the utility level of the home country (with a similar expression for the foreign one) can be written as $e_u\, du = A dt + B dT + C dp + D dz$, where $e_u > 0$ is the reciprocal of the marginal utility of income of the consumer residing in the home country, A, B, and C are $(1 \times N)$ vectors, and D is a scalar. Adding this expression and its counterpart for the foreign one (involving $E_U\, dU$, where dz shows up with a minus sign), the change in global welfare, dW, can be written as a weighted average of the utility changes experienced by the consumer in each country, that is, $dW \equiv e_u du + E_U dU$.[6] Rearranging, we find

$$dW = \left[\left(m_g - 1\right)e'_q + m_g t' e_{qq}\right]dt + \left[\left(M_G - 1\right)E'_Q + M_G T' E_{QQ}\right]dT + \left[m_g t' e_{qq} + M_G T' E_{QQ}\right]dp + \left(m_g - M_G\right)dz, \tag{6}$$

where

$$m_g = \frac{e_g + E_g}{r_g} \quad ; \quad M_G = \frac{E_G + e_G}{R_G}, \tag{7}$$

can be interpreted as the *social* (i.e., worldwide) *marginal cost of public funds* associated with g and G (Dahlby, 2008).[7] From (5), the effect of a multilateral tax reform on world producer prices p is given by:

$$dp = -\Lambda^{-1}\left(e_{qq} dt + E_{QQ} dT\right). \tag{8}$$

where $\Lambda = (e_{qq} + E_{QQ} - r_{pp} - R_{pp})$ is the matrix of derivatives of compensated world excess demands for non-numeraire commodities with respect to non-numeraire prices.

Clearly, any situation where $m_g \neq M_G$ implies that, other things being the same, there is a change in the international transfer z that allows to increase global welfare in (6). Therefore, for given t and T, the optimal value of z will be the one implying $m_g = M_G = m$, which translates into the last term on the right-hand-side in (6) vanishing.

The decisions about the precise values of g and G to be supplied are taken by each government, but the international transfer between governments emerges as a powerful policy instrument. In fact, the equalization of the marginal cost of public funds in the provision of global public goods can be considered the *expenditure* side of the harmonizing fiscal policy discussed in this article. The other side concerns multilateral tax reforms, in particular, those reforms entailing a harmonization of indirect taxes.

The seminal attempt to model tax harmonization as a piecemeal reform was Keen (1987, 1989). Tax harmonization therein is described as a uniform proportional convergence of t and T toward a single tax target, H. This target is in turn defined as a matrix weighted average of the pre-existing domestic tax structures, where the weights depend on local demand responses. Formally,

$$dt = \gamma(H - t) \quad ; \quad dT = \gamma(H - T), \tag{9}$$

where γ is a small positive number and the target H is:

$$H = \left(e_{qq} + E_{QQ}\right)^{-1}\left(e_{qq}t + E_{QQ}T\right). \tag{10}$$

The interpretation of (10) becomes clearer when it is rewritten as a matrix weighted average of the tax structures in the two countries, that is,

$$H = \Omega t + (I_N - \Omega)T, \tag{11}$$

the "weights" being $\Omega = \left(e_{qq} + E_{QQ}\right)^{-1} e_{qq}$ and $(I_N - \Omega) = \left(e_{qq} + E_{QQ}\right)^{-1} E_{QQ}$ (and I_N is the identity matrix of order N).

The tax reform described in (9)-(11) has the property that it keeps world producer prices constant. Indeed, it implies

$$e_{qq}dt + E_{QQ}dT = 0_N. \tag{12}$$

so substituting into (8), $dp = 0_N$. Thus, world producer prices will remain *unchanged* after the tax reform. This implies that world supply of private goods is also unchanged. The reform merely "reallocates" the consumption of private goods among countries, with an increase in consumption efficiency. With a reduced distortion imposed on world demand, the ultimate welfare consequences of the fiscal reform will depend upon the revenue and public good provision impact of tax harmonization.

Indeed, with the international transfer z designed to equalize m_g and M_G, and with world producer prices remaining constant after the tax reform, (6) becomes

$$dW = \left[(m-1)e_q' + mt'e_{qq}\right]dt + \left[(m-1)E_Q' + mT'E_{QQ}\right]dT. \tag{13}$$

Adding and substracting $t'e_{qq}$ and $T'E_{QQ}$ in the first and second expression in brackets respectively, (13) can conveniently be rewritten as

$$dW = (m-1)\left[(e_q' + t'e_{qq})dt + (E_Q' + T'E_{QQ})dT\right] + \left(t'e_{qq}dt + T'E_{QQ}dT\right). \tag{14}$$

The second term on the right-hand side of (14) is strictly positive, as $t'e_{qq}dt + T'E_{QQ}dT = -(t-T)'\gamma E_{QQ}\Omega(t-T)$, whose positivity follows from the fact that $E_{QQ}\Omega$ is a negative definite matrix.[8] In fact, it captures the welfare-enhancing effect of tax harmonization in the absence of public goods analyzed in Keen (1987, 1989). With the tax reform ensuring that world supply of private goods remains constant, demand is reallocated so that global welfare goes up.

We have therefore to focus on the first term in (14), which reflects the effects of global public good provision. At first sight, its sign seems ambiguous However, notice that, from (3) and (4), tax revenues in each country, i and I, are $i = t'e_q + z$ and $I = T'E_Q - z$. Consequently, tax revenue effects for both countries after an arbitrary change in t, T and z are given by

$$di = (e_q' + t'e_{qq})dt + dz \quad ; \quad dI = (E_Q' + T'E_{QQ})dT - dz. \tag{15}$$

Adding di and dI, we can finally rewrite (14) as

$$dW = (m-1)(di + dI) - (t-T)'\gamma E_{QQ}\Omega(t-T), \tag{16}$$

where, as discussed above, the second term on the right-hand-side is negative. We have now to take into account that $m-1=-(e_g+E_g-r_g)/(-r_g)=-(E_G+e_G-R_G)/(-R_G)$ provides a measure of under/over provision of global public goods in both countries with respect to the (first-best) Samuelson rule. Indeed, if m is greater (resp. less) than one, it will be the case that, for both g and G, the world marginal valuations for them exceed (resp. fall short of) their respective marginal costs. Accordingly,

> **Proposition 1.** In the presence of global public good provision, the harmonizing tax reforms (9)–(10), coupled with an international transfer between governments designed to equalize the social marginal cost of public funds across countries, will give rise to a potential Pareto-improvement whenever: (i) aggregate tax revenue goes up (resp. goes down) and world marginal valuations for the public goods exceed (resp. fall short of) their respective marginal costs; or (ii) the reform entails no change in aggregate tax revenue.

This proposition relates the change in global welfare to, on the one hand, the interaction between aggregate revenue effects of tax changes and, on the other, the divergence between the sum of marginal valuations and marginal costs in the provision of global public goods.[9] It states conditions under which a fiscal reform $\{dt, dT, dz\}$, and the ensuing effect on the provision of global public goods $\{dg, dG\}$, will increase global welfare. Focusing on the the home country (with the same reasoning for the foreign one) a sufficient condition for di to be positive (resp. negative) is that the economy is located along the right (resp. wrong) side of the, loosely speaking, aggregate Laffer curve. In other words, across tax rates, the "mechanical effect" $e'_q dt$ (giving rise to an increase (resp. reduction) in tax revenue) outweighs the "behavioral effect" $t'e_{qq}dt$ (translating into a reduction (resp. increase) of the tax base and thus of tax revenue). In aggregate terms, little more can be said beyond stating that what matters to guarantee a rise or a fall in global tax revenues is the interaction of di and dI. When the social marginal cost of public funds is equalized across countries, that is, when $m_g=M_G=m$, the *aggregate revenue effects* of the tax reform have to be jointly considered with *under* or *over* provision of the global public goods in the (first-best) Samuelson sense. It has to be pointed out that Proposition 1 is reminiscent of Proposition 2 in Karakosta et al. (2014). There are, however, some differences between them. The first one is the market structure, an oligopoly one in the latter and a competitive one in the former. The second one is more subtle and refers to the fact that in the latter the marginal cost of providing the global public goods is assumed to be the same in both countries (i.e., $r_g=R_G=1$ in our notation). As a consequence, the condition for optimally setting the international transfer z translates into $e_g+E_g=e_G+E_G$, that is, equalizing the world marginal valuations for both public goods. This obscures the role played by z as equalizing the social marginal costs of public funds in each country. This fact has a relevant translation in terms of the institutions of the real world. Indeed, as distributional characteristics are an integral part of m_g and M_G, one can argue that equalizing them is precisely the purpose the European Structural and Investment Funds.

4 | CONCLUDING REMARKS

This article has used a two-country general equilibrium model of international trade to discuss the existence of global welfare gains as a consequence of the implementation of a fiscal policy consisting of: (i) a harmonizing reform of indirect taxation, the revenue of which is used to finance the provision of global public goods; and (ii) an international transfer between governments designed

to equalize the social (i.e., worldwide) marginal cost of public funds across countries. As for (i), the basic framework has been the harmonizing reform introduced by Keen (1987, 1989), which has the feature of keeping world producer prices constant. Concerning (ii), if the marginal cost of public funds differs across countries, a change in the intergovernmental transfer can always be devised that allows global welfare to be increased. If aggregate tax revenues go up (resp. go down) and world marginal benefit from public good provision exceeds (resp. fall short of) marginal cost, a potential Pareto improvement can unambiguously be characterized.

One can cast doubts about the feasibility of optimal transfers between governments as a companion of harmonizing reforms in order to ensure global welfare gains. However, as suggested above, when one thinks in terms of the institutions of the real world, one can argue that this is precisely the role played by the European Structural and Investment Funds, whose purpose is to support economic development across all countries within the EU. Viewed this way, and taken together with an effort to align tax structures, they constitute a true "harmonizing policy", that is, the combination of a harmonizing tax reform with an appropriate expenditure rule concerning the provision of global public goods by the participating governments. The results in this article suggest that such a policy can be a promising avenue to reach global welfare gains.

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CONFLICT OF INTEREST STATEMENT

The author declares no conflicts of interest.

DATA AVAILABILITY STATEMENT

Data sharing not applicable to this article as no datasets were generated or analyzed during the current study.

ORCID

Miguel-Angel Lopez-Garcia https://orcid.org/0000-0002-5012-1869

ENDNOTES

[1] Excise duties are also subject to minimum rates, based on Articles 191-192 of the Treaty on the Functioning of the European Union. There are, of course, forms of harmonization: one possibility is the harmonization of some policy parameters (rate and base), whereas another one is when countries set tax policy parameters independently, and rely primarily on exchange of information to resolve issues related to the taxation of intra-community trade. The analysis here focuses on the former.

[2] See Delipalla (1997), Lockwood (1997), Lahiri and Raimondos-Møller (1998), Lopez-Garcia (1998) and Kotsogiannis and Lopez-Garcia (2021) for the destination principle and Lucas (2001) and Kotsogiannis et al. (2005) for the origin principle. The implications of introducing public good provision can also be illustrated by the diverging results in Keen et al. (2002) on the one hand and Kotsogiannis and Lopez-Garcia (2007) on the other.

[3] An exception is Karakosta et al. (2014).

[4] All vectors are column vectors, with a prime ($'$) indicating transposition. A subscript denotes differentiation.

[5] The case where public goods are local in nature, so that the enjoyment of the good provided by the home (foreign) country is limited to the citizen residing therein, can be covered by just forcing $e_G = E_g = 0$.

[6] Since e_u and E_U are denominated in units of numeraire per unit of utility enjoyed by the consumer in each country, $e_u du + E_U dU$ "converts" welfare changes from utils (that is, units of utility) to numerarie units. It is

usual in the literature (e.g., Turunen-Red & Woodland, 1990; 1991) to arbitrarily normalize $e_u = E_U = 1$, so that $dW = du + dU$. This money-metric re-scaling of utilities implicitly entails a classical utilitarian or Benthamite social welfare function, $W = u + U$. However, alternative, but equally arbitrary normalizations of e_u and E_U, continue to give rise to linear social welfare functions, but now with different weights attached to the consumer in each country. This procedure allows to appraise the infinitely many points along the world utility possibility curve $\Phi(u, U, t, T, z) = 0$ resulting from a fiscal reform $\{dt, dT, dz\}$.

[7] Strictly speaking, the social marginal costs of public funds are $-(e_g + E_g)/(-r_g)$ and $-(E_G + e_G)/(-R_G)$, giving anyway rise to a positive number. Notice also that m_g and M_G are unit-free.

[8] The fact that $E_{QQ}\Omega = E_{QQ}\left(e_{qq} + E_{QQ}\right)^{-1} e_{qq} = \left[e_{qq}^{-1} + E_{QQ}^{-1}\right]^{-1}$ proves that $E_{QQ}\Omega$ is negative definite.

[9] Notice that another result that emerges from (16) concerns the situation where g and G are provided following the (first-best) Samuelson rule (i.e., $e_g + E_g = r_g$ and $E_G + e_G = R_G$). Since $m = 1$, we have $dW = -(t - T)'\gamma E_{QQ}\Omega(t - T) > 0$ in (16), and global welfare goes up. In fact, this is the counterpart in the present model of the result in Keen (1987) when tax revenue is returned to the consumer in each country as a lump-sum transfer. It has to be stressed, nonetheless, that in this case g and G are *not* provided efficiently (i.e., globally optimally). This statement can be illustrated focusing on the case with fixed world producer prices. With $m_g^* = M_G^* = m^*$, and forcing $dp = 0_N$ in (6), optimal (i.e., Ramsey) taxes, t^* and T^*, can be found setting $\partial W/\partial t = \partial W/\partial T = 0_N$. For the home country this gives $t^{*\prime} = -\left[(e_g^* + E_g^* - r_g)/(e_g^* + E_g^*)\right] e_q^{*\prime}\left[e_{qq}^*\right]^{-1}$. At the level of Ramsey taxes (assuming away income effects and with demand and supply of the taxed goods being independent of public good provision), g and G are underprovided relative to the (first-best) Samuelson rule. To see this, post-multiply $t^{*\prime}$ by $e_{qq}^* t^*$, to obtain $mrs_g^* + MRS_g^* = (\alpha/\beta) mrt_g$, where $\alpha = t^{*\prime} e_q^*$ and $\beta = t^{*\prime} e_q^* + t^{*\prime} e_{qq}^* t^*$. With $t^{*\prime} e_q^* > 0$ and $t^{*\prime} e_{qq} t^* < 0$, it follows that $\alpha/\beta > 1$, and global public goods are underprovided with respect to the (first-best) Samuelson rule. When the assumption of fixed world producer prices is abandoned, any relationship between the sum of marginal rates of substitution and the marginal rate of transformation is to be expected.

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