Does Indirect Tax Harmonization Deliver Pareto Improvements in the Presence of Global Public Goods?

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CESIFO WORKING PAPER NO. 2668
CATEGORY 1: PUBLIC FINANCE
JUNE 2009

CESifo *Working Paper No. 2668*

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Abstract

This paper identifies conditions under which, starting from *any* tax distorting equilibrium, destination- and origin-based indirect tax-harmonizing reforms are potentially Pareto improving in the presence of global public goods. The first condition (unrequited transfers between governments) requires that transfers are designed in such a way that the marginal valuations of the global public goods are equalized, whereas the second (conditional revenue changes) requires that the change in global tax revenues, as a consequence of tax harmonization, is consistent with the direction of inefficiency in global public good provision relative to the (modified) Samuelson rule. Under these conditions, tax harmonization results in redistributing the gains from a reduction in global deadweight loss and any changes in global tax revenues according to the Pareto principle. And this is the case independently of the tax principle in place (destination or origin).

JEL Code: F15, H21, H41, H87.

Keywords: origin principle, destination principle, indirect tax harmonization, reform of commodity taxes, global/local public goods.

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First version: June 1, 2009
Financial support from the Catalan Government Science Network (SGR2005-177 and XREPP) and the Spanish Ministry of Education and Science Research Project (SEJ2006-4444) is gratefully acknowledged (Kotsogiannis and Lopez-Garcia).

1 Introduction

The establishment of the European Common Market in the 1960s, and its transformation into the European Union Internal Market in the early 1990s, recognized the need for (some form of) tax harmonization of national tax systems.[1] The reason for this has stemmed from the fact that indirect taxation can constitute an immediate barrier to the free movement of goods, or freedom to provide services, in a single market. They can also distort competition, with adverse effects on the efficient allocation of resources. One set of issues behind the recognition for the need of tax harmonization concerned the treatment of movement of initial taxes towards a common target-tax. This issue—and, consequently, the welfare implications of indirect tax harmonization—has received considerable attention by the academic literature during the last two decades.

The first step towards formally evaluating such a consideration was taken by Keen (1987, 1989) who established that a move of destination-based commodity taxes (commodities are taxed by—and revenues accrue to—the country that final consumption takes place) towards an *appropriately* weighted[2] tax average would indeed generate potential Pareto improvements. Subsequently, such a conclusion—but for a different weighted[3] tax average—was also shown to hold under the origin principle of taxation (commodities are taxed by—and revenues accrue to—the country that produces them), Lopez-Garcia (1996).

A limitation of this early work, however, concerned with the allocation of tax revenues: Tax revenues were returned to consumers in a lump-sum fashion and, thus, potentially important effects through public good expenditure were ignored. Delipalla (1997) incorporated local public goods into the framework of Keen (1987) and showed that the Keen's (1987) tax-harmonizing reforms under the destination principle can lead to a potential Pareto improvement[4] under a fairly restrictive condition: That of the tax-harmonizing reforms satisfying conditional revenue neutrality.[5] This is also true under the origin principle of taxation, Kotsogiannis, Lopez-Garcia and Myles (2005).[6]

The case of imperfectly competitive markets has also received some attention—Keen and Lahiri (1993), Keen, Lahiri and Raimondos-Møller (2002), and Kotsogiannis and Lopez-Garcia (2007)—verifying, to a large extent, the conclusions, regarding the desirability of tax harmonization, derived by the earlier literature.[7]

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[1]The EC Treaty, and under Article 93, specifically provides for the European Union Council of Ministers to adopt provisions for the harmonization of Member States' rules in the area of indirect taxation. Indeed, tax harmonization has been quite pronounced for indirect taxation, following the adoption of a common VAT tax system that is based on the approximation of tax rates.

[2]The weights being the demand responses of the participating countries.

[3]The weights, under the origin principle, being the supply responses of the participating countries.

[4]See also Lahiri and Raimondos-Møller (1998), and Lopez-Garcia (1998).

[5]Conditional revenue neutrality requires that, conditional on the tax-harmonizing reforms, global tax revenues remain unchanged.

[6]Lockwood (1997), specializing the production technology, has established alternative conditions for Pareto-improving harmonization.

[7]Keen and Lahiri (1998) investigate the welfare consequences of switching from the destination to the

With the risk of oversimplification, a common theme that emerges from the contributions that have explicitly considered *local* public goods (either within a perfectly or imperfectly competitive environment) is that tax harmonization might be more difficult to deliver Pareto improvements in the presence of such goods.[8] While this is generally true (and the analytics in this paper will confirm it), it does not mean that tax harmonization is a policy that should not be pursued. To the contrary, tax harmonization combined with an appropriate way of allocating revenues may be (and indeed will be shown to be) a potentially Pareto improving fiscal policy.[9] And this is the objective of this paper: To revisit the issue regarding the desirability of tax harmonization, but to do so from a different perspective: That of *global* public goods.[10] In particular, this paper asks: Does, starting from any tax distorting equilibrium, a particular and popular form of tax-harmonization deliver potential Pareto improvements under global public goods? If not, what additional elements are required to support a Pareto improvement? And, finally, does the answer to the above questions hinge upon the tax principle, destination or origin, in place?

The issue of global public goods and tax harmonization has been entirely overlooked in the literature. This neglect is rather surprising given that: (a) There is a wide range of public goods that share the characteristics of global public goods (the most obvious ones being environmental clean up, measures for the prevention of infectious diseases, and world peace and international security), and (b) the convergence of tax systems is still an issue that is high on the policy agenda.[11]

The analytics show that, starting from *any* tax distorting equilibrium, harmonization of taxes towards a weighted average target-tax does generate Pareto improvements, but it does so—unless global public goods are provided following the Samuelson rule—under two conditions: Availability of unrequited transfers between governments and conditional revenue changes that are consistent with the direction of inefficiency in global public good provision relative to the Samuelson rule. The first condition, as will be seen later on, implies that transfers are designed in such a way that the overall gains from the provision of global public goods are distributed among countries, whereas the second ensures that

origin principle. This analysis has been extended to include trade costs (Haufler, Schjelderup and Stahler (2000)), and product differentiation (Haufler and Pfluger (2004), and Hashimzade, Khovadaisi and Myles (2005)). There is an extensive literature that compares destination- and origin-based commodity taxes. Lockwood (2001) presents an excellent unified account of the early literature.

[8]This, in some sense, is not very surprising given that tax harmonization is not designed to account for the inefficiencies arising from the intensity of preferences of consumers over public goods, but it is only designed to deal with the welfare gains arising from a reduction in global deadweight loss that stems from the convergence of taxes towards an appropriately weighted average.

[9]There is a fairly sizeable literature dealing with the welfare implications of intergovernmental transfers (lump sum/equalization-formula based or both). The principle underlying these transfers is that the (central) government has the responsibility to ensure a more equitable distribution of public goods across jurisdictional units. On this see, among others, Wildasin (1989, 1991), and Smart (1998, 2007). The transfers here perform a similar role.

[10]The model is, in fact, general enough to encompass the case in which the public goods exhibit local characteristics. We turn to this later on.

[11]For a recent contribution, a first of this short, that discusses issues of efficient provision of global public goods, see Sandmo (2006).

any excess revenue gains (or losses) to be had, conditional upon the tax-harmonizing reforms, is distributed in such a way that the inefficiency in global public good provision is mitigated. Under these conditions, tax harmonization results in a potential Pareto improvement. And, interestingly, this is true—as will be shown later on—independently of the tax principle in place (destination or origin). This result reinforces, in some sense, the initially held belief of both academics and policy commentators that tax harmonization is desirable. But such statement, the analysis here will show, needs to be qualified: Tax harmonization, starting from any tax distorting equilibrium, is desirable as long as it is supplemented with a simple form of transfers between governments and the reforms deliver the appropriate conditional revenue changes.

The organization of the paper is the following. Section 2 provides the background against which the analysis is developed. Sections 3 deals with destination-based indirect tax harmonization, whereas Section 4 analyzes origin-based indirect tax harmonization. Section 5 summarizes and concludes.

2 A simple model

The issues identified in the preceding discussion will be addressed within an imperfectly competitive environment. The reason for this is that in most markets firms are neither so small as to effectively take the market price as given (as in perfectly competitive markets) nor are there many cases of private-sector firms without any competition (as in the monopolistic markets). The predominant market form is indeed oligopoly.

The model is that of Kotsogiannis and Lopez-Garcia (2007), extended to allow for non-linear demand and cost functions, and it has also been appropriately modified to deal with *global* public goods.

The world consists of two countries conveniently called 'home' and 'foreign' (variables pertaining to the foreign country being indicated by an asterisk) with a single representative consumer residing in each. Each country produces two tradeable goods. The first one is produced under constant returns to scale by a perfectly competitive firm that uses a single factor of production that is fixed in supply.[12] This good is taken as the numeraire in both countries. The second good is homogenous and is produced by a single firm in each country. The consumer price for this good in the home (foreign) country is denoted by Q (Q^*). Demand for this good in the home (foreign) country is denoted by[13]

$$D(Q)\ (D^*(Q^*)) \quad \text{with} \quad D'(Q) < 0\ (D^{*\prime}(Q^*) < 0)\ . \tag{1}$$

Both firms have nonlinear cost structures given by

$$C(X)\ \ (C^*(X^*)) \quad \text{with} \quad C'(X) > 0\ \ (C^{*\prime}(X^*) > 0) \ \ \text{and} \ \ C''(X) \geq 0\ (C^{*\prime\prime}(X^*) \geq 0)\ , \tag{2}$$

where X (X^*) is the quantity produced by the home (foreign) firm.

[12]Since the factor is fixed in supply it is suppressed from the analysis.

[13]Derivatives are denoted by primes.

The tradeable good may be supplied by the firm of either the home or the foreign country and so either country can be an exporter or importer. Market clearing for the world, however, requires that

$$D + D^* = X + X^* \ . \tag{3}$$

Events in the model unfold as follows. In stage one, governments set taxes.[14] In stage two, and given taxes, firms make their production decision holding Nash conjectures against each other. Then profits, tax revenues and utilities are realized.

We now turn to, starting from the destination, the two principles of taxation.

3 Destination principle of taxation

When both countries follow the destination principle of taxation, arbitrage requires that producer prices across countries are equalized. Denoting the international price by P, consumer prices are then given by

$$Q = P + t_d \quad ; \quad Q^* = P + t_d^* \ , \tag{4}$$

where t_d (t_d^*) is the specific tax rate on consumption in the home (foreign) country. Profits for the home country firm, denoted by Π, and for the foreign country firm, denoted by Π^*, are given, respectively, by

$$\Pi = PX - C(X) \quad ; \quad \Pi^* = PX^* - C^*(X^*) \ . \tag{5}$$

The revenues obtained from taxing the demand of the tradeable good in each country are used to provide a non-tradeable public good, denoted by G (G^*) in the home (foreign) country. These goods are termed *global* public goods and both have the characteristic of being 'pure' in the Samuelson sense: That is, the enjoyment of the public good by the citizen in the home (foreign) country does not diminish its availability for the citizen in the foreign (home) country. The use of unrequited transfers (in terms of the numeraire good) between governments will be initially assumed away and introduced only when required. Given that t_d (t_d^*) and $D(D^*)$ are the destination-based tax and demand in the home (foreign) country, respectively, public good provision in the two countries is given by[15]

$$G = t_d D \quad ; \quad G^* = t_d^* D^* \ . \tag{6}$$

The per-unit cost of public good in both countries is fixed and, for simplicity, normalized to be equal to 1.[16]

[14] As noted earlier, the analysis will not restrict attention to a particular tax equilibrium, but will seek to characterize the welfare implications of tax-harmonization starting from *any* tax distorting equilibrium. Because of this, the type of conjectures held by the governments will be left unspecified.

[15] Of course, different public goods require a different modeling framework. Here it is taken that the global public goods affect the utility of consumers and not the production capabilities of firms.

[16] Notice that the analysis is not concerned with which country will provide the public good. What it is concerned with is whether, given that countries provide global public goods, tax harmonization can deliver a potential Pareto improvement. Consequently, the assumption that both countries are equally efficient in the production of global public goods is not a restrictive one.

The private goods are perfect substitutes and so the world price P depends only on the world production $X + X^*$. Substituting (4) into (1) and that into (3) one obtains

$$P\left(X + X^*\right) \ , \tag{7}$$

with, in particular, following from (3),

$$P' = 1/(D' + D^{*\prime}) < 0 \ , \tag{8}$$

where the inequality follows from the property of the demand functions in (1).

Firms maximize profits, taking the fiscal instruments of the two countries as given, with—following from (5) and (7)—necessary conditions[17]

$$\begin{aligned} P + P'X &= C' \ , & (9) \\ P + P'X^* &= C^{*\prime} \ . & (10) \end{aligned}$$

Profits in each country are assumed to accrue to the representative consumer of that country and so indirect utility in the home and foreign country is, respectively, of the form

$$V(Q, \Pi, G, G^*) = CS(Q) + \Pi + \Gamma(G, G^*) \quad ; \quad V^*(Q^*, \Pi^*, G^*, G) = CS^*(Q^*) + \Pi^* + \Gamma^*(G^*, G) \ , \tag{11}$$

where $CS(Q)$ ($CS^*(Q^*)$) is the consumer's surplus (the utility obtained from purchasing the private good at price Q (Q^*)), and $\Gamma(G, G^*)$ ($\Gamma^*(G^*, G)$) is the utility from global public goods in the home (foreign) country.[18]

The effect on home welfare[19] of an arbitrary reform, following from (11), then, is

$$dV = (X - D)dP + (P - C')dX + (\Gamma_G - 1)D\,dt_d + \Gamma_G t_d\,dD + \Gamma_{G^*} D^*\,dt_d^* + \Gamma_{G^*} t_d^* dD^* \ . \tag{12}$$

Equation (12) shows that home country utility is affected by a number of effects. The first one, given by $X - D$, is the terms of trade effect: If the home country exports the good, and so $X > D$, then an increase in the price of the good increases home welfare and reduces, since, in this case $X^* - D^* < 0$, the foreign one. The second effect, given by $P - C'$, reflects the production efficiency of the home firm: The deviation, that is, of the international price of the good produced in the home country from the domestic cost of producing it. The third effect, given by $\Gamma_G - 1$, relates to the deviation of the home country public good provision between the marginal benefit and the marginal cost of the public good (excluding the benefit it confers to the foreign country). The fourth effect relates, too, to public good provision: A change in demand, at initial taxes, changes revenues valued at the margin by the home consumer by Γ_G. The term $\Gamma_{G^*} D^*$ relates to

[17] Second order conditions are assumed to hold. Appendix A discusses, though briefly, issues related to the stability of the equilibrium in the Cournot competition stage of the model.

[18] The underlying assumption here is that utility is additively separable between the (sub)utility from private and public goods, with the (sub)utility function associated with private goods being quasi-linear (with the linear part being the utility derived from the consumption of the numeraire good). Notice also that (11) does not place any restriction on the relationship between G and G^*.

[19] Where appropriate, and for brevity, the expressions for the foreign country, being analogous to the home country ones, are omitted.

the change in utility because of the global nature of the public good the foreign country provides: An increase in the tax rate of the foreign country increases tax revenues there by D^* and so public good provision in the foreign country valued by the home country citizen by Γ_{G^*}. Finally, the last term reflects, too, the effect of foreign global public good provision on home utility: With the foreign country tax being fixed at the pre-reform level, an increase in foreign country's demand increases its tax revenues and so its global public good provision (valued again by Γ_{G^*}).

The evaluation of these effects, and so the evaluation of (12), under a tax-harmonizing reform is the central issue of this paper. Attention now turns to the tax-harmonizing reforms.

Destination-based tax-harmonizing reforms

The theoretical literature referred to in the introductory section has looked primarily at a tax-harmonizing reform that features a convergence of the initial taxes towards a common target-tax, with the target-tax being an average of the initial taxes. The destination-based tax reform, in the present context, takes the form

$$\begin{bmatrix} dt_d \\ dt_d^* \end{bmatrix} = \delta \begin{bmatrix} \psi\left(H_d - t_d\right) \\ \psi^*\left(H_d - t_d^*\right) \end{bmatrix} , \tag{13}$$

where δ is a small positive number and $\psi,\ \psi^*$ are arbitrary but positive numbers. The target-tax H_d is a weighted average of the existing tax structures—where the weights depend upon the local demand responses D' and $D^{*\prime}$—and is given by[20]

$$H_d = \frac{\psi D'}{\psi D' + \psi^* D^{*\prime}} t_d + \frac{\psi^* D^{*\prime}}{\psi D' + \psi^* D^{*\prime}} t_d^* . \tag{14}$$

Making use of (14) in (13), the change in the tax rates required by harmonization is given by

$$dt_d = \frac{\delta\psi\psi^* D^{*\prime}}{\psi D' + \psi^* D^{*\prime}}\left(t_d^* - t_d\right) , \tag{15}$$

$$dt_d^* = -\frac{\delta\psi\psi^* D'}{\psi D' + \psi^* D^{*\prime}}\left(t_d^* - t_d\right) , \tag{16}$$

which imply that

$$D' dt_d = -D^{*\prime} dt_d^* . \tag{17}$$

Equation (17) has an interesting implication. It implies that (a claim shown in Appendix A) the international price P, and so the world supply of the tradeable good $X + X^*$, remain unchanged (and so does world demand). It is, thus, intuitive that, in this case, the welfare consequences of tax harmonization will depend upon the distortion imposed on world consumer surplus as well as the revenue impact (appropriately weighted by the

[20]It has to be noted that the tax-harmonizing reform in (13) is more general than the one that has frequently appeared in the literature, and in particular in Keen (1987, 1989). The generality here stems from the fact that the convergence of taxes is not uniform but it is weighted by ψ and ψ^*. Notice also that the weights of the target-tax H_d, given by $\psi D' / \left(\psi D' + \psi^* D^{*\prime}\right)$ and $\psi^* D^{*\prime} / \left(\psi D' + \psi^* D^{*\prime}\right)$, are—following from the fact that $D', D^{*\prime} < 0$ and $\psi, \psi^* > 0$—strictly positive.

marginal valuation of the global public goods) of tax harmonization. Indeed this is the case.

To see this take (12) and add it to its foreign counterpart to obtain, after using (17) and the fact that the reforms imply $dP = dX = dX^* = 0$,

$$\begin{aligned} dV + dV^* \;=\; & \left[(\Gamma_G + \Gamma_G^* - 1)(Q/e + t_d) - (\Gamma_{G^*}^* + \Gamma_{G^*} - 1)(Q^*/e^* + t_d^*) - (t_d^* - t_d) \right] \\ & \frac{\delta\psi D' \psi^* D^{*\prime}}{\psi D' + \psi^* D^{*\prime}} (t_d^* - t_d) \;, \end{aligned} \tag{18}$$

where $e = D'Q/D$ ($e^* = D^{*\prime}Q^*/D^*$) denotes the home (foreign) country's price elasticity of demand.

Condition (18) shows that the welfare consequences of tax harmonization, starting from *any* tax distorting equilibrium, depend upon the *balance* of three terms.

The first term in (18), and given by $(\Gamma_G + \Gamma_G^* - 1)(Q/e + t_d)$, gives the impact of the tax-harmonizing reforms on world welfare, an impact that depends on the deviation of the home country's global public good provision from the Samuelson rule (weighted by $Q/e + t_d$, an expression that relates to the change in the home country's revenues). The second term, given by $(\Gamma_{G^*}^* + \Gamma_{G^*} - 1)(Q^*/e^* + t_d^*)$, gives, too, the impact of the tax-harmonizing reforms on global welfare, an impact that depends on the deviation of the foreign country's public good provision from the Samuelson rule (weighted by $Q^*/e^* + t_d^*$, which relates to the change in the foreign country's revenues). The third term, given by $t_d^* - t_d$, is not related to global public good provision but gives the (difference in the) change of deadweight loss, for given international price, due the change in consumer prices in both countries (as a consequence of tax harmonization).

Close inspection of the terms identified in the preceding paragraph shows that their balance—and so the existence of potential Pareto improvements—cannot be easily established. The difficulty arises from the first and second terms, which capture the revenue impact of the change in the tax bases in the two countries, as a consequence of tax harmonization. And these are terms that the tax-harmonizing reforms are not designed to account for.[21]

One natural benchmark case to consider is that in which public goods are provided according to the (modified) Samuelson rule and so $\Gamma_G + \Gamma_G^* = 1$ for the home country and $\Gamma_{G^*}^* + \Gamma_{G^*} = 1$ for the foreign country. This is clearly an extreme case, and to some extent implausible, but it does transparently remove effects arising from the inefficiencies in global public good provision in the two countries. In this case (18) reduces to

$$dV + dV^* = -\left(t_d^* - t_d\right)^2 \frac{\delta\psi D' \psi^* D^{*\prime}}{\psi D' + \psi^* D^{*\prime}} > 0 \;, \tag{19}$$

and so it is only the impact of the tax-harmonizing reform on global deadweight loss that matters for welfare. This has some straightforward intuition. Since the tax-harmonizing reforms imply that the home country (but also the world supply of) production (and so

[21] It can be shown that, in general, reforms that deliver potential Pareto improvements do exist. It is the identification of these reforms, however, that is the difficult task. On this see Karakosta (2009).

the international price of the tradeable good) remains constant at the pre-reform level, tax harmonization implies that there is no change in profits and so in utility. What is left, therefore, is the change in the deadweight loss from consumption. But this confers an unambiguous gain to consumers. The reason for this is that, with the world price of the tradeable good being unchanged, global deadweight loss is reduced by convergence of taxes towards a weighted average of the initial taxes.[22] To emphasize:

Proposition 1 *With taxes being levied under the destination principle and public goods being global, starting from any tax distorting equilibrium in which $t_d^* \neq t_d$, the tax-harmonizing reforms in (13) and (14) deliver a potential Pareto improvement if both countries follow the (modified for the case of global public goods) Samuelson rule of global public good provision.*

In one sense, this result strengthens the argument in favor of tax harmonization. But it is the explicit recognition that the level of global public good provision will in general differ from that required by the Samuelson rule that ought to concern us. This concern, however, it will be emphasized shortly, will reinforce the view for the need of a proper role of a simple form of intergovernmental transfers.[23]

Suppose now that there exist unrequited transfers between governments that can be optimally set at a stage before tax harmonization takes place. These transfers can be rationalized by assuming that there is some intervention of some outside agency (for example, a supranational government). While this agency can make use of such transfers (in an optimal sense and satisfying its budget constraint), it cannot decide on tax issues. This, in some sense, is consistent with the working of the European Union: While European Union decision-making on tax matters requires unanimity (implying that tax-harmonization will only be implemented if it delivers a potential Pareto improvement, a requirement imposed in the present analysis) intergovernmental transfers do not. In this case, it can be straightforwardly verified that maximization of (18) implies that[24]

$$\Gamma_G + \Gamma_G^* = \Gamma_{G^*} + \Gamma_{G^*}^* \equiv E_d \, , \tag{20}$$

and so, as one would expect, the marginal valuations for the global public goods are equalized. In this case (18) reduces to

$$dV + dV^* = (E_d - 1)\, d\,(G + G^*) - (t_d^* - t_d)^2 \, \frac{\delta\psi D'\psi^* D^{*\prime}}{\psi D' + \psi^* D^{*\prime}} \, , \tag{21}$$

where $d\,(G + G^*)$ denotes the change in global revenues as a consequence of tax harmonization given by

$$d\,(G + G^*) = [(Q/e + t_d) - (Q^*/e^* + t_d^*)] \, \frac{\delta\psi D'\psi^* D^{*\prime}}{\psi D' + \psi^* D^{*\prime}} \, . \tag{22}$$

[22] This is the exact analogue of Kotsogiannis and Lopez-Garcia (2007), carrying over unchanged to the case in which tax revenues finance global public goods.

[23] And in particular so within the European Union where this particular form of tax harmonization has been central in policy discussions during the last two decades.

[24] To see this, notice that in this case (6) becomes $G = t_d D + B$ for the home country and $G^* = t_d^* D^* - B$ for the foreign (where B denotes unrequited transfers in terms of the numeraire good). Perturbing (18) with respect to B implies that $dV + dV^* = [(\Gamma_G + \Gamma_G^*) - (\Gamma_{G^*} + \Gamma_{G^*}^*)]\, dB$ which, upon setting equal to zero, gives (20).

(21)—together with (22)—shows that there is an appealing way of expressing what is required for destination-based tax harmonization to deliver a potential Pareto improvement: All is required is that, conditional on the tax-harmonizing reforms, the direction of inefficiency in global public good provision (relative to the Samuelson rule) takes the same sign as the direction of the change in global tax revenues: If global public goods are underprovided (overprovided) relative to the Samuelson rule, in the sense that $E_d > 1$ ($E_d < 1$), and also, following from (22), $d(G + G^*) > 0$ ($d(G + G^*) < 0$), then $dV + dV^* > 0$ and so tax-harmonization delivers a potential Pareto improvement. There is a simple intuition behind this result. Tax harmonization not only reduces global deadweight loss (the second term in the right-hand-side of (21)) but also changes global tax revenues in such a way that there is an efficiency gain, relative to the Samuelson rule, in global public good provision in the two countries (the first term in the right-hand-side of (21)). Summarizing the preceding discussion:[25]

Proposition 2 *With taxes being levied under the destination principle and public goods being global, starting from any tax equilibrium in which $t_d^* \neq t_d$, the tax-harmonizing reforms in (13) and (14) deliver a potential Pareto improvement if there exist unrequited transfers that can be optimally set, and the tax-harmonizing reforms are conditional revenue increasing (decreasing) when the global public goods are underprovided (overprovided) relative to the Samuelson rule.*

Outside this case (and the one emphasized in Proposition 1), it is still possible to identify situations in which the tax-harmonizing reforms deliver a potential Pareto improvement, even *without* the use of unrequited transfers. Suppose, to see this, that $t_d > t_d^*$, that is the home country is the high tax one, and both countries underprovide the global public good—with respect to the Samuelson rule of Proposition 1—in the sense that $\Gamma_G + \Gamma_G^* > 1$ and $\Gamma_{G^*} + \Gamma_{G^*}^* > 1$. Then (13) and (14) entail a potential Pareto improvement whenever $Q/e + t_d > 0$ and $Q^*/e^* + t_d^* < 0$. The reason for this is intuitive once one realizes that $Q/e + t_d$ and its foreign counterpart are associated with the effects of a small change in tax rates on each country's tax revenue, that is $d(t_d D)/dt_d = (Q/e + t_d)(De/Q)$. In effect, the tax-harmonizing reform implies a reduction (an increase) in the tax rate of the high (low) tax country which is also the one for which the marginal effect on revenue is negative (positive). This, in turn, results in a revenue gain for both countries which, coupled with the underprovision of the global public goods in both countries, implies that $dV + dV^* > 0$.[26]

Interestingly, the conclusions reached thus far regarding the desirability of tax harmonization hold—again starting from *any* tax distorting equilibrium—even if governments provide *local* public goods. In the present framework, this will be the case if $\Gamma_G^* = \Gamma_{G^*} = 0$. Unrequited transfers between governments are still needed here in order to equalize the

[25]Suppose for instance—something that, arguably, seem to be a very restrictive requirement—the reforms are conditional neutral (as in Delipalla (1997)). In this case $d(G + G^*) = 0$, implying that the welfare loss of one country (as a consequence of tax harmonization) is exactly offset by the welfare gain of the other. In this case (18) reduces to (19) and so the tax-harmonizing reforms in (13) and (14) deliver a potential Pareto improvement.

[26]Of course, similar reasoning applies to the case where both countries overprovide—or one country underprovides and the other overprovides—the public good with respect to the Samuelson rule.

marginal valuation for local public goods consumption (and not internalize global externalities as in the case of global public goods), replacing (20) with $\Gamma_G = \Gamma^*_{G^*} \equiv E_d$. With equalized marginal valuations, the conditions on global revenues identified previously still hold, making sure that the change in global revenues (conditional on the tax-harmonizing reforms) take the appropriate direction, conferring a positive welfare gain. To emphasize:

Corollary 1 *With taxes being levied under the destination principle and public goods being local, starting from any tax equilibrium in which $t^*_d \neq t_d$, the tax-harmonizing reforms in (13) and (14) deliver a potential Pareto improvement if there exist unrequited transfers that can be optimally set, and the tax-harmonizing reforms are conditional revenue increasing (decreasing) when the local public goods are underprovided (overprovided) relative to the Samuelson rule.*

We turn now to the case in which products are taxed in the country of origin.

4 Origin principle of taxation

The analysis in the case of origin-based taxation parallels that of the destination-based taxation. To economize on space, we briefly state the necessary modifications of the model to deal with this case.

Origin-based taxes are levied by (and revenues accrue to) the country in which the commodity is produced. International arbitrage then dictates that consumer prices across countries are equalized. Denoting the international price of the good by Q and the specific tax in the home (foreign) by t_o (t^*_o), firms maximize

$$\Pi = (Q - t_o)X - C(X) \quad ; \quad \Pi^* = (Q - t^*_o)X^* - C^*(X^*) \; . \tag{23}$$

Making use of (1) and (3) gives the aggregate inverse demand given by

$$Q(X + X^*) \; , \tag{24}$$

with, following from (3),

$$Q' = 1/(D' + D^{*\prime}) < 0 \; . \tag{25}$$

Profits maximization requires

$$Q + Q'X = C' + t_o \quad ; \quad Q + Q'X^* = C^{*\prime} + t^*_o \; . \tag{26}$$

Revenues are used to provide public goods

$$G = t_o X \quad ; \quad G^* = t^*_o X^* \; . \tag{27}$$

With income given by Π and indirect utility given by (11), the effect on home welfare of an arbitrary reform is given by

$$dV = (X - D)dQ + (Q - t_o - C')dX + (\Gamma_G - 1)\, X dt_o + \Gamma_G t_o dX + \Gamma_{G^*} X^* dt^*_o + \Gamma_{G^*} t^*_o \, dX^* \; . \tag{28}$$

To address the welfare effects of a tax-harmonizing reform we relate the change of welfare to the tax-harmonizing reform. We turn now to a discussion of origin-based tax-harmonizing reforms and to a search of potential Pareto improvements.

Origin-based tax-harmonizing reforms

Under the origin principle the tax-harmonizing reform is

$$\begin{bmatrix} dt_o \\ dt_o^* \end{bmatrix} = \delta \begin{bmatrix} \psi\left(H_o - t_o\right) \\ \psi^*\left(H_o - t_o^*\right) \end{bmatrix} , \tag{29}$$

where δ is a small positive number, ψ, ψ^* are arbitrary positive numbers and H_o—the common target for the taxes—is given by

$$H_o = \left[\frac{\psi A^*}{\psi A^* + \psi^* A}\right] t_o + \left[\frac{\psi^* A}{\psi A^* + \psi^* A}\right] t_o^* , \tag{30}$$

where

$$A = Q' - C'' < 0 \quad ; \quad A^* = Q' - C^{*\prime\prime} < 0 , \tag{31}$$

with the inequality sign following from the fact that $Q' < 0, C'', C^{*\prime\prime} \geq 0$. Interestingly, the (strictly positive) weights attached to the origin-based taxes in (30) depend upon both demand, through (25), and supply responses. Following from (29) and (30), it is the case that

$$dt_o = \frac{\delta\psi\psi^* A}{\psi A^* + \psi^* A}(t_o^* - t_o) \quad ; \quad dt_o^* = -\frac{\delta\psi\psi^* A^*}{\psi A^* + \psi^* A}(t_o^* - t_o) , \tag{32}$$

and so[27]

$$\frac{1}{A} dt_o = -\frac{1}{A^*} dt_o^* . \tag{33}$$

Notice that (a claim shown in Appendix B) the implication of (33) is that world-consumer price, Q, is unaffected, and as a consequence both countries' demands are unaffected, too.

Adding now expressions (28) and its foreign analogue—after using (32)—one obtains

$$\begin{aligned} dV + dV^* &= \left[\left(\Gamma_G + \Gamma_G^* - 1\right)\left(t_o + AX\right) - \left(\Gamma_{G^*}^* + \Gamma_{G^*} - 1\right)\left(t_o^* + A^* X^*\right) + \left(C^{*\prime} - C'\right)\right] \\ &\quad \frac{\delta\psi\psi^*}{\psi A^* + \psi^* A}(t_o^* - t_o) . \end{aligned} \tag{34}$$

The level of generality of (34)—as was the case under the destination principle of taxation—posses a significant problem in the attempt to evaluate the welfare consequences of the origin-based tax-harmonizing reforms in (29) and (30). In this case too, however, there are instances in which the reforms, starting from any tax distorting equilibrium $t_o^* \neq t_o$, attain a potential Pareto improvement.

One such instance is when global public good provision follows the (modified) Samuelson rule in both countries (in the sense that $\Gamma_G + \Gamma_G^* = 1$ and also $\Gamma_{G^*}^* + \Gamma_{G^*} = 1$). In this case (34) reduces to

$$dV + dV^* = \left(C^{*\prime} - C'\right) \frac{\delta\psi\psi^*}{\psi A^* + \psi^* A}(t_o^* - t_o) . \tag{35}$$

[27]This is in contrast to the linear demand and constant marginal cost case analyzed in Kotsogiannis and Lopez-Garcia (2007) where the weights A and A^* vanish leaving $dt_o = -dt_o^*$.

Inspection of (35) reveals that the origin-based tax-harmonizing reform is potentially Pareto improving whenever $C^{*\prime} - C'$ has the opposite sign of $t_o^* - t_o$, that is if and only if the high tax country is also the country with the lower marginal cost of producing the tradeable good. This has some straightforward intuition. Notice that, as already noted, the tax-harmonizing reforms ensure that the world consumer price remains at the pre-reform level and as a consequence the demands in both countries remain unchanged. What changes, as a consequence of tax harmonization, is the production pattern of the tradeable good across the two countries. Suppose, without loss of generality, that $t_o^* > t_o$ and so it is the foreign country that is the high tax one. It is thus the case that, following (35), $dV + dV^* > 0$ if and only if the foreign country is the country that produces the tradeable good more efficiently, in the sense that $C' > C^{*\prime}$. Since tax harmonization calls for a reduction in t_o^* (and an increase in t_o), what effectively the tax reform does is to reallocate production from the home country (the inefficient one) to the foreign country (the efficient one). To emphasize:

Proposition 3 *With taxes being levied under the origin principle and public goods being global, starting from any tax distorting equilibrium in which $t_o^* \neq t_o$, the tax-harmonizing reforms in (29) and (30) deliver a potential Pareto improvement if both countries follow the (modified for the case of global public goods) Samuelson rule of global public good provision and sign$[C^{*\prime} - C']$ =sign$[t_o - t_o^*]$ (that is, if the country with the inefficient firm is also the low tax country).*

Outside the case emphasized by Proposition 3 (and the more general cases identified shortly below) inefficiencies from global public good provision will still linger making the welfare effects of tax harmonization indeterminate. A policy that improves this, as noted earlier for the destination case, is the use of unrequited transfers that can be optimally set—implying that $\Gamma_G + \Gamma_G^* = \Gamma_{G^*} + \Gamma_{G^*}^* \equiv E_o$—but also the tax-harmonizing reforms to satisfy a condition on global revenue change whose sign is in accordance with the underprovision/overprovision of global public goods, relative to the Samuelson rule. To identify these rewrite (34) as

$$dV + dV^* = \left[(E_o - 1)\, d\,(G + G^*) + (C^{*\prime} - C')\right] \frac{\delta\psi\psi^*}{\psi A^* + \psi^* A}(t_o^* - t_o) \ , \qquad (36)$$

where

$$d\,(G + G^*) = \left[(t_o + AX) - (t_o^* + A^* X^*)\right] \frac{\delta\psi\psi^*}{\psi A^* + \psi^* A}(t_o^* - t_o) \ . \qquad (37)$$

Thus, it is the case that $dV + dV^* > 0$ if the change in global tax revenues (conditional on the reforms) $d\,(G + G^*)$ takes the sign of $E_o - 1$ but also $C^{*\prime} - C'$ takes the opposite sign of $t_o^* - t_o$. Summarizing:

Proposition 4 *With taxes being levied under the origin principle and public goods being global, starting from any tax distorting equilibrium in which the country with the inefficient firm is also the low tax country, the tax-harmonizing reforms in (29) and (30) deliver a potential Pareto improvement if there exist unrequited transfers that can be optimally set, and the tax-harmonizing reforms are conditional revenue increasing (decreasing) when the global public goods are underprovided (overprovided) relative to the Samuelson rule.*

Outside the cases emphasized in Propositions 3 and 4, it is still possible (as with the destination principle) to identify situations in which the tax-harmonizing reform delivers a potential Pareto improvement even *without* recourse to unrequited transfers. To see this, suppose that $t_o^* > t_o$ and $C^{*\prime} < C'$—that is it is the foreign country that is both the high tax and the most efficient one—and both countries underprovide the global public good—with respect to the Samuelson rule of Proposition 3—in the sense that $\Gamma_G + \Gamma_G^* > 1$ and $\Gamma_{G^*} + \Gamma_{G^*}^* > 1$. Then, the tax-harmonizing reforms in (29) and (30) deliver a potential Pareto improvement whenever $t_o + AX < 0$ and $t_o^* + A^* X^* > 0$. The reason for this is that $t_o + AX$ (and its foreign counterpart) relate to the marginal impact of the tax-harmonizing reform on each country's revenues, that is $d(t_o X)/dt_o = (t_o + AX)/Q'$. The implication of the tax-harmonizing reform, then, is that it increases (decreases) the tax rate of the low (high) tax country, which is also the country for which the marginal effect on revenue is positive (negative). This implies that both countries gain in revenues and, therefore, in global public good provision.[28]

Tax harmonization is also desirable—again starting from *any* tax distorting equilibrium—even if governments provide *local* public goods. The reason is as before: Unrequited transfers between governments are still needed here in order to equalize the marginal valuations from local public good consumption (and not internalize global externalities as in the case of global public goods), replacing (20) with $\Gamma_G = \Gamma_{G^*}^* \equiv E_o$. With equalized marginal valuations, the conditions on global revenues identified previously still hold, making sure that the change in global revenues (conditional on the tax-harmonizing reforms) takes the appropriate direction, conferring a positive welfare gain. It is, thus, the case that:

Corollary 2 *With taxes being levied under the origin principle and public goods being local, starting from any tax distorting equilibrium in which the country with the inefficient firm is also the low tax country, the tax-harmonizing reforms in (29) and (30) deliver a potential Pareto improvement if there exist unrequited transfers that can be optimally set, and the tax-harmonizing reforms are conditional revenue increasing (decreasing) when the local public goods are underprovided (overprovided) relative to the Samuelson rule.*

The results established emphasize that, interestingly, tax harmonization in the presence of public goods deserves more attention than it has typically received. There is certainly pause for thought in the simple fact that a combination of tax harmonization and a proper role for a way to allocate global revenues can increase aggregate welfare.

5 Concluding remarks

This paper has introduced *global* public goods in an imperfectly competitive framework and identified reasonably plausible conditions under which, starting from any tax distorting equilibrium, destination- and origin-based tax-harmonizing reforms are potentially Pareto improving. The first condition (unrequited transfers between governments) requires that transfers are designed in such a way that the overall gains from the provision

[28] Similar reasoning applies to the case where both countries overprovide—or one country underprovides and the other overprovides—the public good with respect to the Samuelson rule.

of global public goods are distributed among countries, whereas the second one (conditional revenue changes) ensures that any excess revenue gain (or loss) to be had is distributed in accordance with the extent of underprovision/overprovision of global public goods, relative to the Samuelson rule. Under these conditions, tax harmonization results in a potential Pareto improvement. And, interestingly, this is true independently of the tax principle in place (destination or origin).

One can certainly question the feasibility of optimal unrequited transfers (more than the requirement for conditional revenue changes) that redistributes the gains of tax harmonization.[29] Though this appears certainly to be an unwanted additional fiscal instrument that works independently of tax harmonization, it is something that multi-country fiscal systems (like the European Union) cannot dispense with. For, given the tax base asymmetries that exist between the coordinating countries, there is always a need for allocating resources between them efficiently. In fiscal federal systems—like, for example, Canada—such reallocation of revenues takes place via intergovernmental transfers between governments that accounts for the deviation of a jurisdictional unit's tax base from the national tax base. The system of allocation of revenues between governments adopted here is the simplest one that one can thing of, thereby increasing the attractiveness of tax-harmonization.

What is, thus, important, is that one does not take a negative view of tax harmonization. To the contrary, as the analysis has shown here, careful fiscal policy can harness the strengths of tax harmonization for the social good.

[29]It is nevertheless used widely in the literature. See also footnote 9.

Appendices

Appendix A

Proof of the statement that the reform in (13) and (14) implies that $dP = dX = dX^* = 0$.

Re-write, for convenience, the market clearing condition in (3) and the first order conditions in (9) and (10) given by, respectively,

$$\begin{aligned} D + D^* &= X + X^* \,, && \text{(A.1)} \\ P'X + P &= C' \,, && \text{(A.2)} \\ P'X^* + P &= C^{*\prime} \,. && \text{(A.3)} \end{aligned}$$

Equations (A.1)-(A.3) define the equilibrium of output and the world price of the tradeable good. Notice that sufficiency for the choice of X and X^* requires, respectively, that

$$\Pi_{XX} \equiv \alpha_d = 2P' + XP'' - C'' < 0 \,, \tag{A.4}$$

and

$$\Pi^*_{X^*X^*} \equiv \alpha^*_d = 2P' + X^*P'' - C^{*\prime\prime} < 0 \,. \tag{A.5}$$

It is also assumed that

$$\begin{aligned} \Pi_{XX^*} &\equiv \beta_d = P' + XP'' < 0 \,, && \text{(A.6)} \\ \Pi^*_{X^*X} &\equiv \beta^*_d = P' + X^*P'' < 0 \,, && \text{(A.7)} \end{aligned}$$

and so the firms' best response function are downward sloping in quantity space. Stability of equilibrium (in the Cournot stage) requires that

$$\Delta_d = \alpha_d\alpha^*_d - \beta_d\beta^*_d > 0 \,. \tag{A.8}$$

Perturbation (abusing notation somewhat) of (A.1)-(A.3)—after using the fact that, following from the demand functions, $dD = D'\,(dP + dt_d)$ $(dD^* = D^{*\prime}(dP + dt^*_d))$, but also that $P' = (D' + D^{*\prime})^{-1}$—gives in matrix form

$$\begin{bmatrix} 1 & -P' & -P' \\ 1 & \alpha_d - P' & \beta_d - P' \\ 1 & \beta^*_d - P' & \alpha^*_d - P' \end{bmatrix} \begin{bmatrix} dP \\ dX \\ dX^* \end{bmatrix} = \begin{bmatrix} -P'D'dt_d - P'D^{*\prime}dt^*_d \\ 0 \\ 0 \end{bmatrix} . \tag{A.9}$$

It can be easily verified that the determinant of the left-hand-side matrix is given by (A.8). As is typically the case, without further restrictions on the structure of the model the comparative statics are indeterminate. This, in the present context, is not problematic: All that is required here is that the comparative statics are 'well defined' in the sense that the coefficients of the components of $D'dt_d + D^{*\prime}dt^*_d$, are non-zero. It is assumed this to be the case. Solving the system of equations in (A.9) for dP, dX and dX^* one obtains

$$\begin{aligned} dP &= -\frac{\Delta_d - P'\left[(\alpha_d + \alpha^*_d) - (\beta_d + \beta^*_d)\right]}{\Delta_d}\left(D'dt_d + D^{*\prime}dt^*_d\right) \,, && \text{(A.10)} \\ dX &= -\frac{(\alpha^*_d - \beta_d)\,P'}{\Delta_d}\left(D'dt_d + D^{*\prime}dt^*_d\right) \,, && \text{(A.11)} \\ dX^* &= \frac{(\alpha_d - \beta^*_d)\,P'}{\Delta_d}\left(D'dt_d + D^{*\prime}dt^*_d\right) \,. && \text{(A.12)} \end{aligned}$$

Close inspection of (A.10) reveals that if $D'dt_d + D^{*\prime}dt_d^* = 0$, then, $dP = dX = dX^* = 0$. $\square$

Appendix B

Proof of the statement that the reform in (29) and (30) implies that $dQ = 0$.

Re-write, for convenience, the market clearing condition in (3) and the first order conditions in (26)

$$\begin{aligned} D + D^* &= X + X^* \ , & \text{(B.1)} \\ Q + Q'X &= C' + t_o \ , & \text{(B.2)} \\ Q + Q'X^* &= C^{*\prime} + t_o^*. & \text{(B.3)} \end{aligned}$$

Equations (B.1)-(B.3) define the equilibrium of output and the world price of the tradeable good. Notice that sufficiency for the choice of X and X^* requires, respectively, that

$$\Pi_{XX} \equiv \alpha_o = 2Q' + XQ'' - C'' < 0 \ , \tag{B.4}$$

and

$$\Pi^*_{X^*X^*} \equiv \alpha_o^* = 2Q' + X^*Q'' - C^{*\prime\prime} < 0 \ . \tag{B.5}$$

It is also assumed that

$$\begin{aligned} \Pi_{XX^*} &\equiv \beta_o = Q' + XQ'' < 0 \ , & \text{(B.6)} \\ \Pi^*_{X^*X} &\equiv \beta_o^* = Q' + X^*Q'' < 0 \ , & \text{(B.7)} \end{aligned}$$

and so the firms' best response function are downward sloping in quantity space. Stability of equilibrium (in the Cournot stage) requires that

$$\Delta_o = \alpha_o\alpha_o^* - \beta_o\beta_o^* > 0 \ . \tag{B.8}$$

Perturbing now (B.1)-(B.3) gives (again abusing notation somewhat) in matrix form

$$\begin{bmatrix} 1 & -Q' & -Q' \\ 1 & \alpha_o - Q' & \beta_o - Q' \\ 1 & \beta_o^* - Q' & \alpha_o^* - Q' \end{bmatrix} \begin{bmatrix} dQ \\ dX \\ dX^* \end{bmatrix} = \begin{bmatrix} 0 \\ dt_o \\ dt_o^* \end{bmatrix} . \tag{B.9}$$

Solving the system of equations in (B.9) for dQ, dX and dX^* one obtains

$$\begin{aligned} dQ &= \frac{Q'}{\Delta_o}\left[(\alpha_o^* - \beta_o^*)\, dt_o + (\alpha_o - \beta_o)\, dt_o^*\right] \ , & \text{(B.10)} \\ dX &= \frac{1}{\Delta_o}\left(\alpha_o^* dt_o - \beta_o dt_o^*\right) \ , & \text{(B.11)} \\ dX^* &= -\frac{1}{\Delta_o}\left(\beta_o^* dt_o - \alpha_o dt_o^*\right) \ . & \text{(B.12)} \end{aligned}$$

Since

$$\alpha_o^* - \beta_o^* = Q' - C^{*\prime\prime} \equiv A^* \ , \tag{B.13}$$

and

$$\alpha_o - \beta_o = Q' - C'' \equiv A \ , \tag{B.14}$$

it is the case that, following from (33), the origin-based tax-harmonizing reforms imply that $dQ = 0$. $\square$

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