

IMPERFECT COMPETITION, INDIRECT TAX HARMONIZATION
AND PUBLIC GOODS

by

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Abstract: This paper shows that the welfare implications of indirect tax harmonization in a two-country imperfectly competitive framework, are, in general, *indeterminate* in the presence of public goods: Both countries can be made *either* worse off *or* better off. This holds under both the destination- and origin principles of taxation and is in sharp contrast to existing results where revenue effects are not present. A consequence of this indeterminacy is that a precise evaluation of tax-harmonizing policies under both tax regimes requires an explicit consideration of the underlying preferences for private and public goods as well as the oligopolistic sectors' relative cost structures.

Keywords: Origin principle; destination principle; indirect tax harmonization; reform of commodity taxes; public goods

JEL classification: F15; H21; H41; H87.

1 Introduction

As part of its objective to create an efficient common market, the European Union has long undertaken a legal and political commitment to establish a common system of commodity taxation based on the origin principle (commodities are taxed by—and revenues accrue to—the country that produces them). The achievement of this objective entails the shift from the current destination principle (commodities are taxed by—and revenues accrue to—the country where consumption takes place) to the origin principle. Central to the proposals of the European Commission has been the harmonization of tax rates across member states.

Implicit in the proposal of the European Commission is that the two elements (the shift of the tax principle and tax harmonization) are independent in the sense that the implementation of the shift of the tax principle does not interfere (in welfare terms) with the harmonization of tax rates across member states. This is indeed the case in perfectly competitive markets. Keen (1987, 1989) establishes that with perfectly competitive markets tax harmonization of destination-based taxes towards an appropriately weighted average is potential Pareto improving (with appropriate compensating payments all countries gain from such a reform). Lopez-Garcia (1996) verifies, too, that origin-based tax harmonization delivers Pareto improvements. The incorporation of public goods does not, of course, affect the desirability of tax harmonization but it does place a restriction on the set of initial tax vectors for which harmonization will lead to a Pareto improvement. Indeed, the assumptions underlying the analytics, developed within perfectly competitive frameworks, by Delipalla (1997), Lockwood (1997), Lahiri and Raimondos-Møller (1998), Lopez-Garcia (1998), and Kotsogiannis, Lopez-Garcia and Myles (2005), all point to the fact that tax harmonization might be more difficult to deliver Pareto improvements in the presence of public goods. The reason for this is intuitive. With public goods the optimal tax structure in each country is determined by the preferences of its residents over public and private goods. If preferences between countries are very different, their tax structures will also be different, making harmonization a difficult proposition.

The case of imperfectly competitive markets has also received some attention. The evidence, however, as to the desirability of tax harmonization *vis à vis* the tax principle, when revenue effects are absent, is mixed: While destination-based tax harmonization *always* makes one country better off and may be Pareto-improving (Keen and Lahiri

(1993), and Keen, Lahiri and Raimondos-Møller (2002)), origin-based tax harmonization is *sure* (under certain circumstances) to lead to a strict Pareto-worsening (Keen, Lahiri and Raimondos-Møller (2002)).¹ The welfare consequences of tax harmonization so depend upon the tax principle in place. Seen from a policy perspective this is a striking result. For this is ‘... a clear case in which... harmonization is unambiguously *bad* policy,’ Keen, Lahiri and Raimondos-Møller (2002), p. 1561.²

The analysis of Keen, Lahiri and Raimondos-Møller (2002) (thereafter KLR-M) assumes that tax revenues are returned to consumers in a lump sum fashion. In reality, however, tax revenues collected from the imperfectly competitive sector are not returned in a lump sum fashion to the consumers but are used for the provision of public goods and services. This paper—in a framework that is essentially that of KLR-M but appropriately modified to deal with issues of public good provision—shows that the welfare implication of tax harmonization, starting from the non-cooperative level of taxes, is in general *indeterminate*, regardless of the tax principle. In particular, both countries can be made *either* worse off *or* better off. And this indeterminacy is in general present under both tax principles. The results of this paper so establish that, in contrast to the conclusion of KLR-M, in an oligopolistic market the choice of the tax principle and the harmonization of tax rates across countries can be considered in isolation when there are revenue effects. An implication of this is that a precise evaluation of tax-harmonizing policies under both tax regimes requires an explicit consideration of the underlying preferences for private and public goods as well as the relative cost structures of the oligopolistic sectors.

The organization of the paper is as follows. Section 2 provides the background against which the analysis is conducted. Section 3 deals with destination-based commodity harmonization, while Section 4 deals with origin-based tax harmonization. Section 5 summarizes and concludes.

2 The background

The model features two countries conveniently called ‘home’ and ‘foreign’ (variables specific to the latter country being indicated by an asterisk) with a single representative consumer residing in each. In each country there is a perfectly competitive firm that uses a single factor of production to produce, under conditions of constant return to scale, a tradeable good.³ This good is taken as the numeraire in both countries. Additionally, in each country there is a single firm producing a tradeable homogeneous good. The

consumer price for this good in the home (foreign) country is denoted by Q (Q^*). Demand for this good—denoted by D (D^*) in the home (foreign) country—is assumed to be linear, with, in particular, zero income effects but slope and intercept that are allowed to differ between the two countries, that is

$$D = \alpha - \beta Q \quad ; \quad D^* = \alpha^* - \beta^* Q^* , \quad (1)$$

where α , α^* and β , β^* are strictly positive parameters.

Both firms have linear cost structures given by $C = cX + F$ ($C^* = c^*X^* + F^*$), where X (X^*) is the quantity produced by the home (foreign) firm, and c (c^*) is the, strictly, positive marginal cost and F (F^*) is the, strictly, positive fixed cost of the home (foreign) firm.

The tradeable good may be supplied by a firm from either the home or the foreign country and so either country can be an exporter or importer of the tradeable good. Market clearing for the world, however, requires that⁴

$$D + D^* = X + X^* . \quad (2)$$

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

3 Destination principle of taxation

With both countries following the destination principle of taxation, arbitrage requires that producer prices—denoted by P (P^*) for the home (foreign) country—across countries are equalized that is, $P = P^* \equiv P_w$. Consumer prices are then given by

$$Q = P_w + t_d \quad ; \quad Q^* = P_w + t_d^* , \quad (3)$$

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

$$\Pi = (P_w - c)X - F \quad ; \quad \Pi^* = (P_w - c^*)X^* - F^* . \quad (4)$$

The revenues obtained from taxing the commodity in each country is used to provide a non-tradeable public good denoted by G (G^*) in the home (foreign) country given by

$$G = t_d D \quad ; \quad G^* = t_d^* D^* . \quad (5)$$

The per-unit cost of public good is, for simplicity, fixed and, without loss of generality, is normalized to 1. Substituting (3) into (1) and that into (2) one obtains the aggregate inverse demand function that relates the world price P_w to global production and consumption taxes, that is

$$P_w = b[(\alpha + \alpha^*) - (\beta t_d + \beta^* t_d^*) - (X + X^*)] , \quad \text{where } b \equiv 1/(\beta + \beta^*) . \quad (6)$$

Firms maximize profits, taking the fiscal instruments as given, with—following from (4) and (6)—necessary conditions

$$P_w - bX = c \quad ; \quad P_w - bX^* = c^* , \quad (7)$$

and equilibrium profits, following again from (4),

$$\Pi = bX^2 - F \quad ; \quad \Pi^* = bX^{*2} - F^* . \quad (8)$$

Profits in each country accrue to the representative consumer of that country, and so income in the home (foreign) country is $Y = \Pi$ ($Y^* = \Pi^*$).

Indirect utility in the home (foreign) country is of the form

$$V(Q, Y, G) = S(Q) + Y + \Gamma(G) \quad ; \quad V^*(Q^*, Y^*, G^*) = S^*(Q^*) + Y^* + \Gamma^*(G^*) , \quad (9)$$

where $S(Q)$ ($S^*(Q^*)$) is the consumer's surplus (the utility obtained from purchasing the private good at price Q), and $\Gamma(G)$ ($\Gamma^*(G^*)$) is the utility from the public good in the home (foreign) country. For the main results, the exact specification of the functions $\Gamma(G)$ and $\Gamma^*(G^*)$ is unimportant.⁵

The effect on home welfare⁶ of an arbitrary reform, following from (9), then, is

$$dV = (X - D)dP_w + (P_w - c)dX + (\Gamma' - 1)D dt_d + \Gamma' t_d dD . \quad (10)$$

Home utility is, clearly, affected by four effects: The first is the, familiar enough, terms of trade effect. The second one reflects the production efficiency of the home firm: the deviation, that is, of the international price of the good from the domestic cost of producing it. The third effect is related to the deviation between the marginal benefit and the marginal cost of the public good. This is reminiscent of the Samuelson rule for optimal public good provision without distortionary taxation (and thus $\Gamma' = 1$). But, of course, this rule is not applicable to the current framework, since the focus is on open economies which finance their public goods with distortionary taxation. This deviation

reflects both the cost (since for given world price a change in the home tax reduces home demand) and benefit of public good provision (since any extra revenues accrued due to a change in the home tax is spend on the home public good valued, at the margin, by Γ'). Finally, the fourth effect relates, too, to public good provision: A change in demand, at initial taxes, changes revenues valued again, at the margin, by Γ' .

To address the welfare effects of the tax reform one needs to relate the change of welfare to the instruments of tax policy. Making use of (1), (2) and (7), one obtains

$$P_w = 1/3 \{b(\alpha + \alpha^*) - b(\beta t_d + \beta^* t_d^*) + (c + c^*)\} , \quad (11)$$

$$X = 1/3b \{b(\alpha + \alpha^*) - b(\beta t_d + \beta^* t_d^*) + (c^* - 2c)\} , \quad (12)$$

$$X^* = 1/3b \{b(\alpha + \alpha^*) - b(\beta t_d + \beta^* t_d^*) + (c - 2c^*)\} , \quad (13)$$

with, for later use, perturbations

$$dP_w = -(b/3) [\beta dt_d + \beta^* dt_d^*] \quad ; \quad dX = dX^* = -(1/3) [\beta dt_d + \beta^* dt_d^*] . \quad (14)$$

Substitution—after using (1) and (7)—of (14) into (10), after some straightforward manipulations, gives

$$\begin{aligned} dV = & \frac{\beta b}{3} \left\{ (D - 2X) + \frac{3(\Gamma' - 1)D}{\beta b} - \Gamma' t_d (2\beta + 3\beta^*) \right\} dt_d + \\ & + \frac{\beta^* b}{3} \left\{ (D - 2X) + \Gamma' t_d \beta \right\} dt_d^* . \end{aligned} \quad (15)$$

Expression (15) and its foreign analogue are at the heart of the analysis that follows.

A tax harmonizing reform that has the features noted in the introduction—a convergence of the initial taxes towards a common target-tax and the common target-tax being a weighted average of the initial taxes—is

$$\begin{bmatrix} dt_d \\ dt_d^* \end{bmatrix} = \delta \begin{bmatrix} \psi (H - t_d) \\ \psi^* (H - t_d^*) \end{bmatrix} , \quad (16)$$

where δ is a small positive scalar, ψ, ψ^* are arbitrary positive numbers and H is the common target-tax given by

$$H = \left[\frac{\beta \psi}{\beta \psi + \beta^* \psi^*} \right] t_d + \left[\frac{\beta^* \psi^*}{\beta \psi + \beta^* \psi^*} \right] t_d^* . \quad (17)$$

Clearly, on the one hand, the common target-tax H lies between the initial tax rates, t_d, t_d^* , and on the other the tax-harmonizing reform in (16) implies a process of a non-uniform convergence of domestic taxes towards the common target-tax H .⁷

Combining (16) and (17) one obtains the change in the two countries' tax rates required by tax harmonization

$$dt_d = \frac{\delta\beta^*\psi\psi^*(t_d^* - t_d)}{\psi\beta + \psi^*\beta^*} \quad ; \quad dt_d^* = -\frac{\delta\beta\psi\psi^*(t_d^* - t_d)}{\psi\beta + \psi^*\beta^*}, \quad (18)$$

with the latter implying, in particular, that⁸

$$\beta dt_d = -\beta^* dt_d^*. \quad (19)$$

The implication of this latter relationship is that, following (14), the world-producer price, P_w , is unaffected by the reform and so, following again equation (14), is the supply of the tradeable good in each country.

Having described the tax-harmonizing reform being used we are now in a position to evaluate its impact on welfare. Two welfare criteria are, typically, used: Potential Pareto improvement in the sense that $dV + dV^* > 0$ (the country that gains compensates, implicitly, the country that loses from the reform), and actual Pareto improvements implying that $dV, dV^* > 0$ (and so both countries gain without the need of international compensation). We start with the former.

Adding expressions (15) and its foreign analogue, and making use of (18), the effect of the tax harmonizing reform on global welfare is given by

$$dV + dV^* = \frac{\delta\beta\beta^*\psi\psi^*(t_d^* - t_d)}{\psi\beta + \psi^*\beta^*} \left\{ (t_d^* - t_d) + (\Gamma'^* - 1)(t_d^* - D^*/\beta^*) - (\Gamma' - 1)(t_d - D/\beta) \right\}. \quad (20)$$

Close inspection of (20) reveals that it cannot be readily signed. This difficulty arises from the second and third terms in (20) which capture the revenue impact of the change of the tax bases in the two countries. One of course could be tempted to find sufficient conditions that ensure $dV + dV^* > 0$. Though this is a clear possibility, this task does not seem to offer a promising avenue in identifying reasonable and easily interpretable conditions under which tax harmonization delivers a potential Pareto improvement.

Outside special cases⁹ the evaluation of the reforms in (16) and (17), starting from any tax equilibrium $t_d^* \neq t_d$, is admittedly a difficult task. Naturally then one might ask whether, by restricting taxes to those arising from Nash equilibrium, the harmonizing reforms in (16) and (17) can deliver potential and actual Pareto improvements when the countries have different preferences for the private and/or the public good. Surprisingly, in this case too, there is not a clear-cut answer. To see this notice that Nash equilibrium

level of taxes (denoted by t_d^N for the home country and t_d^{*N} for the foreign) are given, for the home country, by setting the coefficient of dt in (15), and dt^* in its foreign analogue, equal to zero. These taxes are then given, respectively, by

$$t_d^N = Z \{ (D - 2X) + 3(\Gamma' - 1)D/\beta b \} , \quad \text{with} \quad Z \equiv 1/\Gamma' (2\beta + 3\beta^*) > 0 , \quad (21)$$

$$t_d^{*N} = Z^* \{ (D^* - 2X^*) + 3(\Gamma^{*'} - 1)D^*/\beta^* b \} , \quad \text{with} \quad Z^* \equiv 1/\Gamma^{*'} (2\beta^* + 3\beta) > 0 . \quad (22)$$

Public good provision in both countries rules out negative non-cooperative equilibrium taxes. Suppose that, without loss of generality, the home country is the exporter of the good and so $D < X$. Then, following (21), for $t_d^N > 0$, $\Gamma' > 1$ must be the case. Turning now to (22) one notices that $t_d^{*N} > 0$ does not restrict the marginal valuation for public good provision in the foreign country. Even if $\Gamma^{*' > 1$ it may be that $t_d^{*N} > 0$ either because $D^* < 2X^*$ or $D^* \geq 2X^*$. If, however, $\Gamma^{*' < 1$ then $D^* > 2X^*$ must be the case.

Evaluating now (15), at the Nash equilibrium level of taxes given by (21) and (22), the change in the home country welfare is given, an envelope property, by

$$dV = \frac{\beta^* b}{3} \left\{ (D - 2X) + \Gamma' t_d^N \beta \right\} dt_d^* . \quad (23)$$

A word of clarification is in order here. Recall that the tax coordinating reform in (16) and (17) keeps the world-producer price, and so domestic supply, of the tradeable good fixed. Nevertheless, the home country welfare, as an envelope property, is affected by three effects. The first effect, the magnitude of which is $D - X$, relates to the terms of trade, the second, given by $-X$, relates to the change in profits whereas the third relates to the change in revenues, valued at the margin by Γ' , caused by a change in the home demand. A similar reasoning applies to the foreign country.

An interesting feature of (23) (and its foreign counterpart) is that the effect of tax harmonization on welfare is *indeterminate*. To see this, substituting (21) and (22) into (23) and its foreign counterpart one obtains, respectively,

$$dV = \{ t_d^N \Gamma' - (\Gamma' - 1)D/\beta \} \beta^* dt_d^* , \quad (24)$$

and

$$dV^* = \{ t_d^{*N} \Gamma^{*' - (\Gamma^{*' - 1)D^*/\beta^* \} \beta dt_d . \quad (25)$$

Close inspection of (24) and (25) reveals that, in conjunction with the possible restrictions on the marginal valuation for the public goods discussed after (22), they can have any

sign and in particular both countries may be better off (consistent with the results in KLR-M) or worse off (in contrast to the results in KLR-M). It is precisely the presence of public goods that makes the achievement of actual Pareto improvements indeterminate. Summarizing:

Proposition 1 *Starting from the Nash equilibrium level of taxes $t_d^N \neq t_d^{*N}$ and with tax revenues in both countries being used to finance public good provision, no general conclusion can be derived concerning the welfare effects of the destination-based tax harmonization in (16)-(17): Both countries can be either better off or worse off.*

Proposition 1 is so in sharp contrast to that of KLR-M who show that if revenues are returned to the consumer in a lump-sum fashion then tax harmonization entails an actual Pareto improvement. This, however, may no longer hold if revenues effects are accounted for.¹⁰

It is so clear from the preceding discussion that the welfare consequences of the harmonizing reforms in (16)-(17), when public goods are present, can only be determined once the preferences for the private and public good are known. Without specific knowledge of the parameters underlying these preferences there is no unambiguous answer to whether destination-based tax harmonization is something that should be avoided or welcome. This, of course, does not make, *a priori*, destination-based harmonization a bad policy, but it merely suggests that it should be exercised with caution in a imperfectly competitive market in which there are revenue effects. We now turn to the origin principle of taxation.

4 Origin principle of taxation

The analysis in the case of origin-based taxes parallels that of the destination-based taxes. 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 dictates that consumer prices across countries are equalized and so $Q = Q^* = Q_w$. Denoting t_o (t_o^*) the specific tax in the home (foreign) firms maximize

$$\Pi = (Q_w - t_o - c)X - F \quad ; \quad \Pi^* = (Q_w - t_o^* - c^*)X^* - F^* . \quad (26)$$

Using (1) and (2) aggregate inverse demand is

$$Q_w = b[(\alpha + \alpha^*) - (X + X^*)] . \quad (27)$$

Profits maximization requires

$$Q_w - t_o - c = bX \quad ; \quad Q_w - t_o^* - c^* = bX^* . \quad (28)$$

Revenues are used to provide public goods

$$G = t_o X \quad ; \quad G^* = t_o^* X^* . \quad (29)$$

Equations (2) and (28) solve for

$$Q_w = (1/3) \{b(\alpha + \alpha^*) + (c + c^*) + (t_o + t_o^*)\} , \quad (30)$$

$$X = (1/3b) \{b(\alpha + \alpha^*) + (c^* - 2c) + (t_o^* - 2t_o)\} , \quad (31)$$

$$X^* = (1/3b) \{b(\alpha + \alpha^*) + (c - 2c^*) + (t_o - 2t_o^*)\} , \quad (32)$$

with, for later use, perturbations

$$dQ_w = (1/3) [dt_o + dt_o^*] \quad ; \quad dX = (1/3b) [dt_o^* - 2dt_o] \quad ; \quad dX^* = (1/3b) [dt_o - 2dt_o^*] . \quad (33)$$

Notice, for later use, following from (31) and (32), that

$$X^* - X = (1/b) \{(c - c^*) + (t_o - t_o^*)\} . \quad (34)$$

With income given by $Y = \Pi$ ($Y^* = \Pi^*$) and indirect utility given by (9) the effect on home (foreign) welfare of an arbitrary reform is

$$dV = (X - D)dQ_w + (Q_w - t_o - c)dX + (\Gamma' - 1)Xdt_o + \Gamma't_o dX . \quad (35)$$

To address the welfare effects of a tax harmonizing reform we relate the change of welfare to the tax harmonizing reform. Substituting, after using (28), (33) into (35) one obtains

$$dV = \frac{1}{3} \left\{ -(D + X) - \frac{2\Gamma' t_o}{b} + 3(\Gamma' - 1)X \right\} dt_o + \frac{1}{3} \left\{ -(D - 2X) + \frac{\Gamma' t_o}{b} \right\} dt_o^* . \quad (36)$$

It is expression (36), and its foreign analogue, that form the basis of the analysis in this Section. We turn now to a discussion of origin-based tax harmonizing reforms and to a search of both potential and actual Pareto improvements.

Under the origin principle the tax harmonizing reform is

$$\begin{bmatrix} dt_o \\ dt_o^* \end{bmatrix} = \begin{bmatrix} \psi(H - t_o) \\ \psi^*(H - t_o^*) \end{bmatrix} , \quad (37)$$

where ψ, ψ^* are arbitrary positive numbers and H —the common target for the taxes—is given by

$$H = \left[\frac{\psi}{\psi + \psi^*} \right] t_o + \left[\frac{\psi^*}{\psi + \psi^*} \right] t_o^*, \quad (38)$$

and, following from (37) and (38),

$$dt_o = \frac{\psi\psi^*(t_o^* - t_o)}{\psi + \psi^*} \quad ; \quad dt_o^* = -\frac{\psi\psi^*(t_o^* - t_o)}{\psi + \psi^*}, \quad (39)$$

and so

$$dt_o = -dt_o^*. \quad (40)$$

Notice that the implication of (40) is that, following (33), world-consumer price is unaffected, and as a consequence both countries' demands are unaffected, too. This parallels the discussion of the destination principle.¹¹

Adding now expressions (36) and its foreign analogue, after using (34) and (39), one obtains

$$dV + dV^* = \frac{\psi\psi^*(t_o^* - t_o)}{b(\psi + \psi^*)} \left\{ (c - c^*) + (\Gamma' - 1)(bX - t_o) - (\Gamma^{*'} - 1)(bX^* - t_o^*) \right\}. \quad (41)$$

As with the destination principle, the level of generality of (41) poses a significant problem in the attempt to evaluate the welfare consequence of the origin-based tax harmonizing reforms in (37) and (38). Outside special cases evaluation of (41) is a difficult task and sufficient conditions ensuring $dV + dV^* > 0$ are not very instructive.¹² As before one may then, naturally, ask: Does a restriction of taxes to those attained at the Nash equilibrium allow us to progress further on the evaluation of the welfare consequences, especially those related to actual Pareto improvements, of the harmonizing reforms in (37) and (38). Restriction of taxes to those arising from non-cooperative behaviour typically allows for the harmonizing reforms to deliver actual Pareto improvements. Surprisingly, however, with public goods the answer to this is again ambiguous. To see this first notice that, following (36) and its foreign counterpart, the Nash equilibrium level of taxes denoted by t_o^N and t_o^{*N} are given, respectively, by

$$t_o^N = (b/2\Gamma') \{ -(D + X) + 3(\Gamma' - 1)X \}, \quad (42)$$

$$t_o^{*N} = (b/2\Gamma^{*'}) \{ -(D^* + X^*) + 3(\Gamma^{*'} - 1)X^* \}. \quad (43)$$

With positive public good provision, and so $t_o^N, t_o^{*N} > 0$, it must be that case that—following $-(D + X) < 0$, and $-(D^* + X^*) < 0$ —both the home and the foreign country marginal valuation must exceed 1 that is, $\Gamma', \Gamma^{*'} > 1$.

Evaluating now (36) (and its foreign counterpart) using (42) and (43), gives, as an envelope property

$$dV = \frac{1}{3} \left\{ -(D - 2X) + \frac{\Gamma' t_o^N}{b} \right\} dt_o^* . \quad (44)$$

It is worth noting here, too, that although the origin-based tax harmonizing reform in (37) and (38) keeps the world-consumer price, and so domestic demand for the tradeable good fixed, home (foreign) welfare is affected, as an envelope property, by three effects: the terms of trade effect, $-(D - X)$, the effect through profits, given by X , and the effect through the change in revenues valued at the margin by Γ' .

Interestingly, (44) (and its foreign counterpart) has the feature that the effect of tax harmonization on welfare is, too, *indeterminate*. To see this, re-write (by explicitly substituting (42) and (43) into (44) and its foreign counterpart) to obtain, respectively,

$$dV = \left(\frac{t_o^N \Gamma'}{b} - (\Gamma' - 1)X + X \right) dt_o^* , \quad (45)$$

$$dV^* = \left(\frac{t_o^{*N} \Gamma^{*'}}{b} - (\Gamma^{*'} - 1)X^* + X^* \right) dt_o , \quad (46)$$

which clearly both have *indeterminate* signs. This so, too, reveals that starting from the Nash equilibrium level of taxes, in general, *no conclusion* can be derived regarding whether the origin-based tax harmonizing reform in (37) and (38) in the presence of public goods can deliver an actual Pareto improvement. To emphasize this:

Proposition 2 *Starting from the Nash equilibrium level of taxes $t_o^N \neq t_o^{*N}$ and with tax revenues being used to finance public goods, no general conclusion can be derived concerning the welfare effects of the origin-based tax harmonizing reform in (37) and (38): Both countries can be either better off or worse off.*

Proposition 2 is, too, in sharp contrast to the cases analyzed in KLR-M that show that if revenues are returned to the consumer in a lump-sum fashion then origin-based tax harmonization entails an actual Pareto-worsening.¹³

Though, starting from the Nash equilibrium level of taxes, there is no general conclusion regarding actual Pareto improvements it is possible for the reforms to deliver *potential* Pareto improvements. One such instance is when preferences for the private good are the same in both countries, and so $D = D^*$, and that both countries value equally the public good in the sense that $\Gamma' = \Gamma^{*'} = \bar{\Gamma}$. In this case adding—after making use of

(40)—(45) and (46) one arrives at

$$dV + dV^* = 1/b \{2(\bar{\Gamma} - 1)(t_o^{*N} - t_o^N) - (\bar{\Gamma} - 2)(c - c^*)\} dt_o. \quad (47)$$

Subtracting now (42) from (43), after using (34), one obtains $t_o^{*N} - t_o^N = [(3\bar{\Gamma} - 4)/(5\bar{\Gamma} - 4)](c - c^*)$. Substituting now this latter expression into (47), after some straightforward manipulations, one obtains

$$dV + dV^* = \phi \bar{\Gamma}^2 (3\bar{\Gamma} - 4) / (5\bar{\Gamma} - 4)^2, \quad (48)$$

where $\phi \equiv [2\bar{\beta}\psi\psi^*(c - c^*)^2]/(\psi + \psi^*) > 0$, with $\beta = \beta^* = \bar{\beta}$. Clearly, then—following from the observation that for $t_o^N, t_o^{N*} > 0$, $\bar{\Gamma} > 1$ is required— $dV + dV^* > 0$ if and only if $\bar{\Gamma} > 4/3$ and $dV + dV^* < 0$ if $\bar{\Gamma} \in (1, 4/3)$. Summarizing:

Proposition 3 *Starting from the Nash equilibrium level of taxes $t_o^{*N} \neq t_o^N$, and assuming that both countries have the same preferences for the private and public good, the tax harmonizing reforms in (37) and (38) are potentially Pareto improving if and only if $\bar{\Gamma} > 4/3$. They are potential Pareto-worsening if and only if $\bar{\Gamma} \in (1, 4/3)$.*

Clearly, in this case, too, the welfare consequences of the reforms in (37) and (38) critically depend on the marginal valuation of the public good.

5 Summary and concluding remarks

Indirect tax harmonization has been receiving a great deal of attention both from a theoretical and a policy point of view. Its welfare effects are well established in perfectly competitive markets: In general, tax harmonization policies give rise to a potential Pareto improvement and, under some conditions, they entail an actual Pareto improvement. This has been shown to hold both under the destination- and the origin principle of taxation. Limited attention has been paid, however, to indirect tax harmonization under imperfect competition. A recent contribution by Keen, Lahiri and Raimondos-Møller (2002) has shown that in an oligopolistic situation the welfare consequences of tax harmonization critically depend on the tax principle under consideration: Destination-based harmonization of commodity taxes, starting from the non-cooperative equilibrium, *always* makes one country better off and may be Pareto-improving, whereas origin-based tax harmonization leads, under some conditions, to a strict Pareto-worsening. A crucial element, however, of this analysis is that the governments return the tax proceeds to the

consumers in a lump sum fashion. Though this assumption is a good starting point to understand the issues, it is, clearly, not the most realistic one.

This paper has introduced public goods in the framework of Keen, Lahiri and Raimondos-Møller (2002) and has shown that the welfare consequences of tax harmonizing reforms under both principles are *indeterminate*: Both countries can be *either* worse off *or* better off. The implication of this is that, contrary to the conclusion reached by Keen, Lahiri and Raimondos-Møller (2002), the choice of the tax principle and the harmonization of tax rates across countries, can be considered in isolation when there is public good provision. In particular, in a model of international oligopoly, the general *indeterminacy* concerning the welfare implications of tax harmonization holds in spite of the choice of the tax regime: Starting from a non-cooperative equilibrium, both countries can be made *either* worse off *or* better off after a tax harmonizing reform, regardless of the choice of the tax principle. A precise evaluation of tax-harmonizing policies would then require the explicit calibration of the specific equilibrium and the harmonizing reforms arising from such an equilibrium. This is certainly an avenue of research that is worth taking.

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Notes

¹Keen and Lahiri (1998) investigate the welfare consequences of switching from the destination to the origin principle. This analysis has been extended to include trade costs (Hauffer, Schjelderup and Stahler (2000)), and product differentiation (Hashimzade, Khovadai and Myles (2005), and Hauffer and Stahler (2004)). There is an extensive literature that compares destination and origin-based commodity taxes. Lockwood (2001) presents a unified account of the early literature.

²Emphasis original.

³The single factor of production is fixed in supply and is, therefore, suppressed in the analysis.

⁴Of course this is not the only model of imperfect competition within which international aspects of taxation can be addressed. Another framework that comes to mind is one in which there is product differentiation and markets are segmented (see footnote 1 for references). One can show, for instance, that, in a similar framework to the one considered here, but with product differentiation and segmented markets, any deviations from the non-cooperative level of taxes is Pareto-worsening for both countries. In this case, however, the idea (and the form) of tax harmonization, is difficult to be applied in practice.

⁵It will be instructive, however, later on and in Section 4—in order to remove the dependency of the impact of the reforms on the marginal valuation for the public good—to assume that $\Gamma(G) = \bar{\Gamma}G$ ($\Gamma^*(G^*) = \bar{\Gamma}^*G^*$) implying that the marginal valuation for the public good in the home (foreign) country does not vary with the revenues raised from the taxes levied on the imperfectly produced good.

⁶Where appropriate the expressions for the foreign country, being similar to the home ones, are omitted.

⁷This is the generalization—proposed by Lopez-Garcia (1998), and used in Kotsogiannis, Lopez-Garcia and Myles (2005)—of the seminal reform of Keen (1987, 1989). It includes as a particular case that of Keen (1987, 1989), Keen and Lahiri (1993), and KLR-M: This is the case if $\psi = \psi^* = 1$. The economic implication of ψ, ψ^* being different than 1 is that, even with countries having the same demand responses, the target-tax H can be any convex combination of the initial tax rates.

⁸In principle other tax-harmonizing reforms than the ones considered in this and Section 4 might be applicable to the present analysis. Such a treatment, however, is beyond the scope of this paper since its principal scope is to emphasize the ambiguity of a precise evaluation of tax-harmonizing policies under the two different tax regimes. More general tax-harmonizing reforms (as, for instance, those considered for the competitive case by Lockwood (1997), and Lahiri and Raimondos-Møller (1998)), if anything, are likely to further emphasize this indeterminacy.

⁹One could progress a bit further on this by restricting the marginal valuation of public goods in both countries thereby removing the dependence of the impact of the reform on the preferences for the public goods (see, footnote 5). In this case one can show that the tax harmonizing reform delivers a potential Pareto improvement, Kotsogiannis and Lopez-Garcia (2005).

¹⁰Although the indeterminacy of the welfare impact of tax harmonization is clear enough from the discussion preceding Proposition 1, it is instructive to provide a simple example that shows the possibility, in particular, that destination-based tax harmonization can be, in contrast to KLR-M, Pareto-worsening. To see this suppose that both countries have identical preferences for the private good with, in particular, $\alpha = \alpha^* = 10$ and $\beta = \beta^* = 1.5$, but the home country's marginal valuation for the public good, $\Gamma' = 3$ is greater than that of the foreign, $\Gamma^{*'} = 2$. (All numbers, and where appropriate, have been rounded to three decimal points. In this example and in that of footnote 13 we have set, for simplicity, $F = F^* = 0$.) Suppose also that the home country is more efficient in producing the tradeable good than the foreign one in the sense that $c = 3 < c^* = 4$. Using now (1), (11)-(13) and (21)-(22), one obtains $D = 2.215$, $D^* = 2.225$, $X = 3.721$, $X^* = 0.721$, $P_w = 4.240$, and $t_d^N = 0.945$, $t_d^{*N} = 0.943$, and so the exporting country (home) sets a higher tax than the importing one (foreign). Positing now reform parameters, $\delta = 0.8$ and $\psi = \psi^* = 1$, tax harmonization, following (18), entails changing of taxes according to $dt_d = 0.003 = -dt_d^*$. Following (24)-(25) the change in welfare in the home and foreign

countries, respectively, is given by $dV = -0.0004$, $dV^* = -0.002$, and so both countries are hurt by tax harmonization. Examples in which the reform delivers a Pareto improvement do also exist and are available upon request.

¹¹It is also worth noting that, following Lopez-Garcia (1996), one would expect equally that local supply responses (which would be the counterpart of the local demand responses that act as the weights to the taxes in the harmonizing reform in the destination principle) would appear here as the basis for tax harmonization. This, however, is not the case. Nevertheless, the harmonizing reform has the same effects on world-consumer price and, therefore, on demands.

¹²For two instances in which, under fairly restrictive assumption on the preferences for public goods, the reforms, starting from a tax-distorted equilibrium $t_o^* \neq t_o$, clearly attain potential Pareto improvements (for more on this see the earlier version of this paper, Kotsogiannis and Lopez-Garcia (2005)).

¹³Although, here, too, the indeterminacy of the welfare impact of tax harmonization is clear enough from the discussion in the text, it is instructive to provide a simple example that transparently shows the possibility that origin-based tax harmonization can be Pareto-*improving*. Consider the case in which both countries have identical preferences for the private good with, in particular, $\alpha = \alpha^* = 10$ and $\beta = \beta^* = 1.5$, and the home country values more than the foreign one the public good in the sense that $\Gamma^h = 3$, $\Gamma^f = 2$. Suppose also that the home country is also less efficient in producing the tradeable good with, in particular, $c = 4 > c^* = 2$. Using (1), (30)-(32) and (42)-(43) one obtains $D = D^* = 3.287$, $X = 1.077$, $X^* = 5.498$, $Q_w = 4.475$ and $t_d^h = 0.116$ and $t_d^{*h} = 0.642$. It is clear then that in this case the home country (which is the less efficient one) sets a lower tax in equilibrium than the foreign country. In this case origin-based tax harmonization, following (39), entails tax changes according to $dt_o^h = 0.048 = -dt_o^{*h}$. Changes in welfare, following (45)-(46), are then given by $dV = 0.001$, $dV^* = 0.184$. Examples with reasonable restrictions on the parameters in which the reforms deliver a Pareto-*worsening* are easy to construct and are also available upon request.

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