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IMPERFECT COMPETITION, INDIRECT TAX HARMONIZATION AND PUBLIC GOODS

by

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Abstract: In a recent contribution Keen, Lahiri and Raimondos-Møller (2002) (*European Economic Review*, 46, 1559-1568), in a model of imperfect competition with no revenue effects, show that tax harmonization under the destination principle always makes one country better off and maybe Pareto-improving, whereas under the origin principle, and under certain circumstances, it leads to a strict Pareto-worsening. This paper shows that the welfare implications of (destination- and origin-based) tax harmonization are, in general, *indeterminate* when public goods are present. A consequence of this is that the choice of the tax principle and the harmonization of tax rates across countries can be considered in isolation.

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

JEL classification: F15; H21; H41; H87.

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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 that origin-based tax harmonization delivers Pareto improvements, too. The incorporation of public goods does not affect the desirability of tax harmonization. Delipalla (1997), incorporating public goods into the framework of Keen (1987, 1989), shows that, under certain conditions, indirect tax harmonization under the destination principle leads to a potential Pareto improvement. This issue is also taken up by Lahiri and Raimondos-Møller (1998), Lockwood (1997) and Lopez-Garcia (1998) who, under different production technology specifications, verify the desirability of destination-based tax harmonization. Recently, Kotsogiannis, Lopez-Garcia and Myles (2004) have established conditions under which origin-based tax harmonization, when the revenues from taxation are used for the provision of a public good, is Pareto improving.

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,

[1]Keen 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 (Haufler, Schjelderup and Stahler (2000)), and product differentiation (Khovadaisi and Myles (2004)). There is an extensive literature that compares destination and origin-based commodity taxes. Lockwood (2001) presents a unified account of the early literature.

[2]Emphasis original.

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*, both under the destination and the origin tax principle. While this indeterminacy is in general present under both tax principles, conditions are identified in which it is resolved. The results of this paper so establish that 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.

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. Each country has a single factor of production which produces, 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

$$D = \alpha - \beta Q \quad ; \quad D^* = \alpha^* - \beta^* Q^* \ , \tag{1}$$

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 that

$$D + D^* = X + X^* \ . \tag{2}$$

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

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

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

$$Q = P_w + t_d \quad ; \quad Q^* = P_w + t_d^* \,, \tag{3}$$

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

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

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

$$G = t_d D \quad ; \quad G^* = t_d^* D^* \,. \tag{5}$$

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

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

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

$$P_w - bX = c \quad ; \quad P_w - bX^* = c^* \,, \tag{7}$$

and equilibrium profits, following again from (4),

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

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

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

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 Γ and Γ^* is unimportant. It will be instructive, however, later on—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.

The effect on home welfare[4] of an arbitrary reform, following from (9), then, is

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

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

Home utility is, clearly, affected by four effects: The first is the, familiar enough, terms of trade effect. The second reflects the production efficiency of the home firm. The third effect reflects the deviation of public good provision from the level associated with the Samuelson rule ($\Gamma' = 1$), a deviation that 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, too, relates 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

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

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

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

with, for later use, perturbations

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

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

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

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

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

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

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

Clearly, the common target-tax H lies between the initial tax rates.[5]

[5]This is the generalization—proposed by Lopez-Garcia (1998), and used in Kotsogiannis, Lopez-Garcia and Myles (2004)—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 $\psi = \psi^* = 1$.

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

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

with the latter implying, in particular, that

$$\beta dt_d = -\beta^* dt_d^* \ . \tag{19}$$

The implication of this latter relationship is that, following (14), world-producer price is unaffected by the reform and so 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

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

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. Clearly, one 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. To progress a bit further on this suppose, for instance, that the rule for public good provision in both countries follows the Samuelson rule and so $\Gamma', \Gamma^{*\prime} = 1$. It is clear, then, that in this case $dV + dV^* > 0$ and so the tax harmonizing reforms deliver a potential Pareto improvement. This is intuitive. As noted previously the tax harmonizing reforms imply that the supply of output in both countries, and so world price, remain fixed at the pre-reform level. With the supply of output fixed, so is consumers' welfare derived from profits (see (8) and (9)). What is left, therefore, is the change in the deadweight loss from consumption. But this confers an unambiguous gain to the consumers: For, with the world price unchanged, global deadweight loss is reduced by convergence towards a weighted average of the initial taxes. Notice that this is the exact analogue of Keen and Lahiri (1993), and KLR-M carrying over unchanged to the case where tax revenues finance public goods.

Suppose now, to see another possibility, that both countries have symmetric preferences for the private and the public good with, in particular, Γ', $\Gamma^{*\prime} = \bar{\Gamma}$. This is, clearly, a restrictive specification that conveniently removes the dependency of the impact of the reforms on the preferences for the public goods. But it is nevertheless a valuable case to consider since it vividly brings out the main forces at work.[6] In this case (20)

[6]See also Keen and Lahiri (1998) for a similar restriction on the marginal valuation for public good.

reduces to[7] $dV + dV^* = \delta\bar{\beta}\psi\psi^*(t_d^* - t_d)^2\left(2\bar{\Gamma} - 1\right)/(\psi + \psi^*)$ and so the tax harmonizing reforms in (16) and (17) attain a potentially Pareto improvement (worsening) if and only if $\bar{\Gamma} > (<)1/2$. The marginal valuation for the public good, then, emerges as the crucial determinant of the welfare consequences of the tax harmonizing reforms. There is a simple intuition behind this. Tax harmonization has three effects; the first effect relates to the change in global deadweight loss, the second to the change in global tax revenues, and the third to the change in the global cost of providing the public goods. The first effect clearly leaves consumer welfare unchanged. For, with both countries having the same preferences for the private good, and with tax harmonization dictating that the changes in taxes should be equal in absolute value,[8] the reduction in deadweight loss in the high tax country is equal to the increase in the deadweight loss of the low tax country. Second, tax harmonization strictly increases global tax revenues.[9] For, in this case, the gain in tax revenues of the low tax country more than offsets the loss in revenues of the high tax country. Finally, the global cost (equivalent to the loss in revenue at unchanged demand) of providing the public goods has increased. It is the sum of these two latter effects, (a sum that depends of course on the marginal valuation, given—it will be recalled—by $\bar{\Gamma}$, of the global tax revenues raised) that gives rise (or not) to the potential Pareto changes.

Unfortunately, outside of these two special cases 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

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

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

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. Turing 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 $\Gamma^{*\prime} > 1$ it may be that $t_d^{*N} > 0$ either because $D^* < 2X^*$ or $D^* \geq 2X^*$. If, however, $\Gamma^{*\prime} < 1$ 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

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

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[7]This straightforwardly follows after noting, following (1), that $(D/\bar{\beta} - D^*/\bar{\beta}) = (t_d^* - t_d)$, where $\bar{\beta} \equiv \beta = \beta^*$,

[8]This readily follows from setting equal weights in (19).

[9]It is easy to see this. Perturbation of global revenues, denoted by Ω, gives $d\Omega = t_d dD + D dt_d + t_d^* dD^* + D^* dt_d^*$. Making now use of (1), the fact that $dt_d = -dt_d^*$, $(D/\bar{\beta} - D^*/\bar{\beta}) = (t_d^* - t_d)$ and (18), the change in global revenues is given by $d\Omega = 2\delta\bar{\beta}\psi\psi^*\left(t_d^* - t_d\right)^2/\left(\psi + \psi^*\right) > 0$.

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,

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

and

$$dV^* = \left\{ t_d^{*N} \Gamma^{*\prime} - (\Gamma^{*\prime} - 1) D^*/\beta^* \right\} \beta dt_d \,. \tag{25}$$

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.[10] 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.[11]

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

[10] This is, of course, outside the cases discussed after (20).

[11] Although 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, $\Gamma' = 1.1$ is less than that of the foreign, $\Gamma^{*\prime} = 2$. (All numbers have been rounded to three decimal points. In this example and in that of footnote 14 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 $c = 2 < c^* = 4$. Using now (1), (11)-(13) and (21)-(22), one obtains $D = 3.091$, $D^* = 3.047$, $X = 0.069$, $X^* = 6.069$, $P_w = 4.023$, and $t_d^N = 0.583$, $t_d^{*N} = 0.613$, and so the exporting country (foreign) sets a higher tax than the importing one (home). Positing now reform parameters, $\delta = 0.8$ and $\psi = \psi^* = 1$, tax harmonization, following (18), entails changing of taxes according to $dt_d = 0.012 = -dt_d^*$. Following (24)-(25) the change in welfare in the home and the foreign counties, respectively, are given by $dV = -0.008$, $dV^* = -0.014$, and so both countries are hurt by tax harmonization. Examples in which the reform deliver a Pareto-improvement do also exist.

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

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

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

$$Q_w = b\left[(\alpha + \alpha^*) - (X + X^*)\right] \ . \tag{27}$$

Profits maximization requires

$$Q_w - t_o - c = bX \quad ; \quad Q_w - t_o^* - c^* = bX^* \ . \tag{28}$$

Revenues are used to provide public goods

$$G = t_o\, X \quad ; \quad G^* = t_o^*\, X^* \ . \tag{29}$$

Equations (2) and (28) solve for

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

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

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

with, for later use, perturbations

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

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

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

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

$$dV = (X - D)dQ_w + (Q_w - t_o - c)dX + (\Gamma' - 1)X dt_o + \Gamma' t_o\, dX \ . \tag{35}$$

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

$$\left[\begin{array}{c} dt_o \\ dt_o^* \end{array}\right] = \left[\begin{array}{c} \psi\,(H - t_o) \\ \psi^*\,(H - t_o^*) \end{array}\right] , \quad (37)$$

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.[12]

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

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

As with the destination principle, the level of generality of (41) posses a significant problem in the attempt to evaluate the welfare consequence of the origin-based tax harmonizing reforms in (37) and (38). It is easy to see, however, that in this case, too, there are two instances in which the reforms, starting from a tax-distorted equilibrium $t_o^* \neq t_o$, clearly attain potential Pareto improvements. The first possibility is when both countries follow the Samuelson rule in the sense that $\Gamma', \Gamma^{*\prime} = 1$. Inspection of (41) reveals that, in this case, $dV + dV^* > 0$ if and only if the high tax country is also the country with the lower marginal cost of producing the tradeable good that is, if and only if $(c - c^*)(t_o^* - t_o) > 0$. This is intuitive. Notice that, as already noted, the tax harmonizing reform ensures that the world-consumer price remains at its pre-reform level

[12]It 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.

and, as a consequence, demands in both countries remain unchanged. What changes, however, is production in both countries. Suppose, without loss of generality, that $t_o^* > t_o$ and so it is the foreign that is the high tax country and so that $c > c^*$. In this case, the harmonizing reforms call for a reduction in the foreign tax (the efficient one) and an increase in the home tax (the less efficient one) and so a reallocation of production, following (33), from the less efficient to the more efficient country. This, it has to be said, is the exact analogue of KLR-M carrying unchanged to the case in which public goods are provided according to the Samuelson rule.

Consider now the possibility that both countries value equally, at the margin, the public good in the sense that $\Gamma', \Gamma^{*\prime} = \bar{\Gamma}$, and that both firms face the same marginal cost of producing the tradeable good in the sense that $c = c^*$.[13] In this case (41), after making use of (34), reduces to $dV + dV^* = 2\psi\psi^*(t_o^* - t_o)^2(\bar{\Gamma} - 1)/b\,(\psi + \psi^*)$ and so the tax harmonizing reforms in (37) and (38) entail a potential Pareto improvement (worsening) if and only if $\bar{\Gamma} > (<)1$. Clearly, in this case too, the marginal valuation of public goods emerges as a critical determinant for the evaluation of the harmonizing reforms. This is intuitive. The tax harmonizing reforms strictly increase global tax revenues and so, with both countries valuing the public good equally, at the margin, this is welfare enhancing. But global deadweight loss also increases. To see this, suppose, without loss of generality, that the home country supplies more of the tradeable good in the world market and so $X > X^*$. In this case, following (34), $t_o^* > t_o$; the high tax country (foreign) is the country with the low supply of the tradeable good. With the world consumer price being Q_w it is, of course, the case that $P > P^*$. It is, then, easy to see that—since tax harmonization requires the change in taxes to be of equal magnitude—global deadweight loss increases. Global production, too, decreases. Clearly, then, the welfare consequences of the origin-based tax harmonizing reforms critically depend on the marginal valuation of the public good $\bar{\Gamma}$.

Outside these, admittedly, very special cases evaluation of (41) is a difficult task and sufficient conditions ensuring $dV + dV^* > 0$ are not very instructive. 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

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

$$t_o^{*N} = (b/2\Gamma^{*\prime})\left\{-(D^*+X^*) + 3(\Gamma^{*\prime} - 1)X^*\right\}\ . \tag{43}$$

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, $\Gamma', \Gamma^{*\prime} > 1$.

[13] This, of course, requires that demands for the private good are not symmetric. For in this case, the only tax-distorted equilibrium would be the symmetric one.

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

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

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 the 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,

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

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

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.[14]

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

[14] Although, 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 $\Gamma' = 3$, $\Gamma'^* = 2$. 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 $t_d^N = 0.116$ and $t_d^{*N} = 0.642$. It is clear then that in this case the home country (which is the less efficient country 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 $dt_o^N = 0.048 = -dt_o^{*N}$. 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.

public good in the sense that $\Gamma' = \Gamma^{*\prime} = \bar{\Gamma}$.[15] In this case adding—after making use of (40)—(45) and (46) one arrives at

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

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

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

where $\phi \equiv [2\bar{\beta}\psi\psi^*\left(c - c^*\right)^2]/(\psi + \psi^*) > 0$, 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 $\bar{\Gamma} \in (1, 4/3)$.*

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 Concluding remarks

KLR-M has shown recently that in an oligopolistic situation the welfare consequences of tax harmonization (the convergence of tax rates towards a common tax vector) 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 of and may be Pareto-improving, whereas origin based tax harmonization leads to a strict Pareto-*worsening*. An important element, however, missing from the analysis of KLR-M is revenue effects.

This paper has introduced public goods in the framework of KLR-M and, in passing, has identified conditions under which, starting from any tax-distorted equilibrium, destination- and origin-based tax harmonizing reforms are potential welfare improving. Moreover, restricting taxes to those arising from non-cooperative behaviour, the welfare consequences of tax harmonizing reforms under both principles (without further restrictions on preferences), have been shown to be *indeterminate*.

The results of this paper then suggest that, contrary to conclusion of KLR-M, (a) the choice of the tax principle and (b) the harmonization of tax rates across countries, can be considered in isolation when there are revenue effects. In particular, in a model of international oligopoly, the general *indeterminacy* concerning the welfare implications of (b) holds in spite of the choice in (a): Starting from a non-cooperative equilibrium, both countries can be either better off or worse off after a harmonizing reform regardless of the tax principle.

[15] Notice, in particular, that no assumption is made on the marginal cost of producing the tradeable good faced by both firms. Since $c \neq c^*$, this case is distinctively different from the case discussed after (41).

A precise evaluation of tax-harmonizing policies would require 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.

References

Delipalla, S., 1997, Commodity tax harmonization and public goods, Journal of Public Economics, 63, 447-466.

Haufler, A., G. Schjelderup, and F. Stahler, 2000, Commodity taxation and international trade in imperfect markets, CESifo Working Paper No. 376.

Keen, M. J., 1987, Welfare effects of commodity tax harmonization, Journal of Public Economics, 33, 107-114.

Keen, M. J., 1989, Pareto-improving indirect tax harmonization, European Economic Review, 33, 1-12.

Keen, M. J., and S. Lahiri, 1993, Domestic tax reform and international oligopoly, Journal of Public Economics, 51, 55-74.

Keen, M. J., and S. Lahiri, 1998, The comparison between destination and origin principles under imperfect competition , Journal of International Economics, 45, 323-350.

Keen, M. J., S. Lahiri, and P. Raimondos-Møller, 2002, Tax principles and tax harmonization under imperfect competition: A cautionary example, European Economic Review, 46, 1559-1568.

Khovadaisi, H., and G. D. Myles, 2004, Tax principles, product differentiation and the nature of competition, mimeo, University of Exeter.

Kotsogiannis, C., M-A. Lopez-Garcia and G. D. Myles, 2004, The origin principle, tax harmonization and public goods, forthcoming in Economics Letters.

Lahiri, S., and P. Raimondos-Møller, 1998, Public good provision and the welfare effects of indirect tax harmonisation, Journal of Public Economics, 67, 253-267.

Lockwood, B, 1997, Can commodity tax harmonisation be Pareto-improving when governments supply public goods?, Journal of International Economics, 43, 387-408.

Lockwood, B, 2001, Tax competition and tax co-ordination under destination and origin principles: A synthesis. Journal of Public Economics, 81, 279-319.

Lopez-Garcia, M-A., 1996, The origin principle and the welfare gains from indirect tax harmonization, International Tax and Public Finance, 3, 83-93.

Lopez-Garcia, M-A., 1998, On welfare and revenue effects of indirect tax harmonization, Economics Letters, 60, 185-193.