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## Welfare, Revenue and Indirect Tax Harmonization under the Origin Principle

MIGUEL-ÁNGEL LÓPEZ-GARCÍA \*  
*Universidad Autónoma de Barcelona*

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### Abstract

This paper discusses whether some propositions concerning the effects of indirect tax harmonization that have been derived when taxes are levied on a destination basis and revenue is returned to the individuals as a lump-sum transfer can, when accurately reformulated, be extended to a framework where commodities are taxed according to the origin principle and the governments use their revenue to finance the purchase of goods and services. Using a two-country model, it is argued that a non-uniform proportional convergence of domestic taxes towards a properly designed «average» tax structure can be characterized as potentially Pareto-improving. However, these reforms will not, in general, lead to a strict Pareto-improvement where every country is better off without any need for international transfers.

*Keywords:* indirect tax harmonization, origin principle, reform of commodity taxes.

*JEL Classification:* F15, H87.

### 1. Introduction

Some of the contributions in the recent literature on multilateral tax reforms have focused on the discussion of the welfare effects arising from indirect tax harmonization policies [Keen (1987, 1989), Turunen-Red and Woodland (1990), Keen and Lahiri (1993), Kanbur and Keen (1993), López-García (1996)]. The main ideas emerging from this literature are that, under «normal» circumstances, there exist harmonizing reforms that generate a potential Pareto improvement, and that there are «exceptional» situations under which those reforms are also actually Pareto improving. In the models underlying these contributions taxes are levied according to the destination principle (under which taxes are paid in the country where the good is consumed) and it is usually assumed that tax revenue is returned to the individuals as a lump-sum transfer. As expected, this assumption emerges as one of the

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main limitations of the analysis in its application as a support to the harmonizing efforts that have been carried out in the European Union.

Subsequent papers by Delipalla (1997), Lockwood (1997), Lahiri and Raimondos-Møller (1998) and López-García (1998) have discussed the effects of a number of harmonizing rules in the presence of revenue requirements or provision of public goods in a variety of frameworks. Although there are important differences in these models (concerning the structure of the model itself and the assumptions about public goods production), it can be inferred from them that there may still be a welfare case for harmonization even where governments use tax revenue to finance public goods. All these papers continue to assume that commodity taxes are levied on a destination basis.

In 1997, the European Commission proposed a radical reform of indirect (i.e. value-added) taxation that, in essence, can be decomposed in two parts. On the one hand, a shift from the current destination principle to the origin principle (under which taxes are paid in the country where the good is produced). On the other, harmonization of tax rates across member states. This objective, however, emerges as a long-term one. In the meanwhile, there exists some kind of mixed system, in which the destination system is maintained for transactions between firms but cross-border purchases by individuals are actually taxed on an origin basis.

The purpose of this paper is to discuss whether some propositions referring to indirect tax harmonization derived from models with taxation according to the destination principle and with revenue returned to the consumers as lump-sum transfers, can also be extended to a situation where taxes are levied on an origin basis and where governments use their revenue to finance the purchase of goods and services. The model is midway between Keen's (1987, 1989) and some of those reviewed above. It is simpler in so much as that it ignores the optimal provision of public goods, and, as in Delipalla (1997), international transfers both between individuals and between governments are assumed to be feasible. The effects of indirect tax harmonization under the origin principle in the presence of public goods have recently been analyzed by Lucas (2001) in a model similar to that used in Lahiri and Raimondos-Møller (1998), i.e., with world consumer prices taken as exogenous. His harmonizing rule, however, is actually that advanced in López-García (1996), which is a particular case of the one introduced below.

This paper also has another objective. In López-García (1996) a parallel is drawn between the effects of harmonization under both principles. One of the limitations of this analysis, however, is that tax revenue is returned to the individuals in each country as a transfer. A related paper, López-García (1998), discusses whether some propositions concerning the effects of harmonization (under the destination principle) when tax receipts are returned to the consumers may also apply when they are used to finance government demands. A further aim of this paper is, therefore, to verify whether we can extend the above-mentioned parallel to the present context. This extrapolation does not seem to be a direct one. As much is inferred in a recent paper by Keen, Lahiri and Raimondos-Møller (2002). They argue that the results on indirect tax harmonization in Keen and Lahiri (1993), extending those in the com-

petitive case to a model with imperfect competition (two oligopolists playing Cournot) where taxes are levied on a destination basis, do not hold under the origin principle. In particular, they show that, abstracting from revenue effects, harmonization under the destination principle is a potential Pareto improvement, but harmonization under the origin principle may be (i.e., it will be under some circumstances) Pareto-worsening.

Using a two-country model, it is argued that a family of indirect tax harmonization policies, to be precise a non-uniform proportional convergence of domestic taxes towards an appropriately designed «average» tax structure, can be characterized as potentially Pareto-improving. However, these reforms will not, in general, lead to an actual Pareto-improvement, where each country is better off without any need for offsetting international transfers. Furthermore, this result does not depend on whether or not the initial position is a Nash equilibrium, which contrasts with the case where tax revenue is returned to the consumers as a transfer.

The structure of the paper is as follows. The framework and the assumptions of the model are set up in section 2. Section 3 provides a general characterization of multilateral tax reforms. Section 4 discusses Nash equilibrium tax structures, in which each country deploys its taxes under the assumption that the other one will not modify its actions. Section 5 explores the notion of harmonizing reforms, and analyzes those implying a non-uniform proportional convergence of domestic taxes towards an appropriately designed target structure. Sections 6 and 7 present two propositions concerning the welfare and revenue effects of the harmonizing rules presented in section 5, focusing on whether they result in a potential or an actual Pareto-improvement. Section 8 summarizes with some final comments.

## 2. A model of international trade

The framework for the analysis is a standard model of international trade where two countries, labelled as «home» and «abroad», trade in  $N + 1$  commodities, indexed as  $0, 1, \dots, N$  [see, for instance, Dixit and Norman (1980)]. The variables referring to the home (foreign) country are represented by small (capital) letters. The distributional questions within each country are ignored, and a single, representative consumer is taken to exist in each of them. Consumer behaviour is characterized by means of the expenditure functions  $e(q_0, q, u)$  and  $E(Q_0, Q, U)$ , where  $q_0$  ( $Q_0$ ) and  $q$  ( $Q$ ) denote consumer prices of goods  $0$  and  $1, \dots, N$ , and  $u$  ( $U$ ) the utility level. By well-known duality properties, the compensated demand functions for the  $N + 1$  commodities are given by  $e_0(q_0, q, u)$  and  $e_q(q_0, q, u)$  for the home country and  $E_0(Q_0, Q, U)$  and  $E_Q(Q_0, Q, U)$  for the foreign one, where the subscripts denote partial derivatives.

As far as production is concerned, it is assumed that there is only one representative firm in each country, whose technology exhibits decreasing returns to scale, and which operates in conditions of perfect competition. Its behaviour can be resumed in the profit functions  $\pi = \pi(p_0, p)$  and  $\Pi = \Pi(P_0, P)$ , where  $p_0$  ( $P_0$ ) and  $p$  ( $P$ ) are producer prices in each country.

The supply functions can therefore be written as  $\pi_0(p_0, p)$  and  $\pi_p(p_0, p)$  for the home country and  $\Pi_0(P_0, P)$  and  $\Pi_p(P_0, P)$  for the foreign one.

There is a government in each country with a revenue requirement expressed in terms of physical units of the  $N + 1$  commodities,  $g_0$  ( $G_0$ ) and  $g$  ( $G$ ). For the sake of simplicity, and specifically in order to avoid the issues associated with the optimal provision of public goods, government demands are not included in consumer preferences. The tax instruments available to each government are commodity taxes, expressed as specific taxes,  $t_0$  ( $T_0$ ) and  $t$  ( $T$ ), as well as taxes on pure profits, levied at rates  $\phi$  and  $\Phi$  in each of them.

The only distortions are due to indirect taxes, which are levied according to the origin (or source) principle. Therefore, commodities are taxed at the rates prevailing in the country where they are produced, hence it is also the one which obtains the tax revenue. As for normalization, commodity 0 is considered as the numeraire and is also taken to be the untaxed good, so that  $t_0 = T_0 = 0$ , and therefore  $q_0 = Q_0 = p_0 = P_0 = 1$ . As it is well-known, this entails a loss of generality unless pure profits are taxed away, i.e., unless  $\phi = \Phi = 1$  (or with constant returns to scale), but this ought not to be a problem in the present context.

In the absence of transport costs, the operation of the origin principle implies that consumer prices will be the same in each country,  $q = Q$ . Therefore, the relationship between non-numeraire producer prices in each country and world consumer prices can be written as:

$$p = q - t \quad P = q - T \quad [1]$$

so that the market-clearing conditions for the  $N + 1$  commodities can be expressed as:

$$e_0(1, q, u) + E_0(1, q, U) + g_0 + G_0 = \pi_0(1, q - t) + \Pi_0(1, q - T) \quad [2]$$

$$e_q(1, q, u) + E_q(1, q, U) + g + G = \pi_p(1, q - t) + \Pi_p(1, q - T) \quad [3]$$

As stated in the introduction, it is assumed, as in Delipalla (1997), that international transfers are feasible, both between governments and between individuals. If  $z_0$  stands for the lump-sum transfer, in terms of commodity 0, from the home country's consumer to the foreign's one, their budget constraints become:

$$e(1, q, u) = (1 - \phi)\pi(1, q - t) - z_0 \quad [4]$$

$$E(1, q, U) = (1 - \Phi)\Pi(1, q - T) - z_0 \quad [5]$$

where  $(1 - \phi)\pi(\cdot)$  and  $(1 - \Phi)\Pi(\cdot)$  represent lump-sum income associated with after-tax pure profits in each country. Although  $z_0$  can in principle take any sign, in one of the cases to be discussed below this transfer is used to keep one consumer's welfare unchanged after a multilateral reform of commodity taxation.

In both countries the government budget constraint implies equality between, on the one hand, the expenditure associated with the amounts of the  $N + 1$  commodities, and, on the

other hand, the revenue derived from taxing commodities and pure profits, as well as any transfer received from the other government:

$$q'g + g_0 = t'\pi_p(1, q - t) + \phi\pi(1, q - t) - m_0 \quad [6]$$

$$q'G + G_0 = T'\Pi_p(1, q - t) + \Phi\Pi(1, q - T) + m_0 \quad [7]$$

where the symbol  $'$  denotes transposition and  $m_0$  is the transfer from the home country's government to that of the foreign one. In one of the cases to be analyzed,  $m_0$  is used to maintain one government's fiscal resources unchanged after the tax reform <sup>1</sup>.

According to Walras' law we can drop the market-clearing condition [2] for the untaxed numeraire. Therefore, the system [3]-[7] provides  $N + 4$  equations that can be solved in  $N+4$  unknowns. In this context two approaches emerge in a natural way. In the first of them, which can be labelled as «reform with international transfers», given the values of the foreign country's consumer utility,  $U$ , the vectors of commodity taxes,  $t$  and  $T$ , the vectors of non-numeraire government demands,  $g$  and  $G$ , the tax rates on pure profits,  $\phi$  and  $\Phi$ , and the foreign country's demand for the numeraire,  $G_0$ , the  $N + 4$  variables are the  $N$  world relative consumer prices,  $q$ , the home country's consumer utility level,  $u$ , the international transfer between consumers,  $z_0$ , the home country's consumption of the numeraire good,  $g_0$ , and the transfer between governments,  $m_0$ . Since both  $U$  and  $G_0$  remain constant after the reform (through the international transfers  $z_0$  and  $m_0$  respectively) this is the relevant approach to discuss whether tax harmonization entails a potential Pareto-improvement.

In the second approach, which will be called «reform without international transfers», the parameters are the tax rates,  $t$  and  $T$ , and  $\phi$  and  $\Phi$ , the non-numerarie government demands,  $g$  and  $G$ , and the international transfers,  $z_0$  and  $m_0$  (possibly equal to zero), and the  $N+4$  variables are the  $N$  world consumer prices,  $q$ , the utility levels,  $u$  and  $U$ , and the government consumptions of the numeraire,  $g_0$  and  $G_0$ . This sets up the appropriate framework to ask whether tax harmonization can be characterized as an actual Pareto-improvement, i.e. a change in which both countries are better off without any need for compensating international transfers.

### 3. A characterization of multilateral tax reforms

We are now able to consider the effects of a multilateral reform of commodity taxation,  $\{dt, dT\}$ , in the two situations outlined in the previous section. To simplify matters, it will be assumed, as in Keen (1989), Delipalla (1997), Lahiri and Raimondos-Møller (1998) and López-García (1998), that there are no income effects for the  $N$  taxed commodities, i.e.:

$$e_{qu} = E_{qU} = 0_N \quad [8]$$

where  $0_N$  is an  $N$ -vector whose components are all zero. Note here that this assumption is equivalent to assuming that all income effects are channelled through the untaxed numeraire.

Differentiating totally in [3]-[7]:

$$\Lambda dq = -[\pi_{pp}dt + \Pi_{PP}dT] \quad [9]$$

$$e_u du + [e_q - (1 - \phi)\pi_p]'dq + (1 - \phi)\pi_p' dt + dz_0 = 0 \quad [10]$$

$$E_U dU + [E_q - (1 - \Phi)\Pi_P]'dq + (1 - \Phi)\Pi_P' dT - dz_0 = 0 \quad [11]$$

$$[g - \phi\pi_p - \pi_{pp}t]'dq + dg_0 - [(1 - \phi)\pi_p - \pi_{pp}t]'dt + dm_0 = 0 \quad [12]$$

$$[G - \Phi\Pi_P - \Pi_{PP}T]'dq + dG_0 - [(1 - \Phi)\Pi_P - \Pi_{PP}T]'dt - dm_0 = 0 \quad [13]$$

where  $\Lambda = e_{qq} + E_{qq} - \pi_{pp} - \Pi_{PP}$  is the matrix of the partial derivatives of the (compensated) world excess demands for the non-numeraire commodities. Due to its standard properties,  $\Lambda$  is negative semi-definite, but we will also assume that there is enough substitutability in demand or production between the numeraire and the other goods as to ensure that  $\Lambda$  is negative definite [see Dixit and Norman (1980, chap. 5)].

If the multilateral reform of commodity taxes,  $\{dt, dT\}$ , is coupled with the international transfers  $dz_0$  and  $dm_0$  required for  $dU = 0$  and  $dG_0 = 0$ , the expressions [9]-[13] allow to obtain the effects both in terms of  $du$  and  $dg_0$ , in addition to  $dq$ . Eliminating  $dz_0$  and  $dm_0$  and manipulating one can find:

$$e_u du - [g + G - \phi\pi_p - \Phi\Pi_P]'dq = -[(1 - \phi)\pi_p' dt + (1 - \Phi)\Pi_P' dT] \quad [14]$$

$$\begin{aligned} dg_0 + [g + G - \phi\pi_p - \Phi\Pi_P - \pi_{pp}t - \Pi_{PP}T]'dq = \\ = [(1 - \phi)\pi_p - \pi_{pp}t]'dt + [(1 - \Phi)\Pi_P - \Pi_{PP}T]'dT \end{aligned} \quad [15]$$

as well as [9].

Alternatively, if the tax reform  $\{dt, dT\}$  is not combined with any international transfer, i.e.,  $dz_0 = dm_0 = 0$ , [9]-[13] characterize the effect on utility levels,  $du$  and  $dU$ , and the effect on government consumption of the numeraire,  $dg_0$  and  $dG_0$ , as well as the variation in world consumer prices,  $dq$ :

$$e_u du + [e_q - (1 - \phi)\pi_p]'dq = -(1 - \phi)\pi_p' dt \quad [16]$$

$$E_U dU + [E_q - (1 - \Phi)\Pi_P]'dq = -(1 - \Phi)\Pi_P' dT \quad [17]$$

$$dg_0 + [g - \phi\pi_p - \pi_{pp}t]'dq = [(1 - \phi)\pi_p - \pi_{pp}t]'dt \quad [18]$$

$$dG_0 + [G - \Phi\Pi_P - \Pi_{PP}T]'dq = [(1 - \Phi)\Pi_P - \Pi_{PP}T]'dT \quad [19]$$

in addition to [9] above.

#### 4. Nash equilibrium tax structures

A distinction is sometimes made in the literature on indirect tax harmonization between, on the one hand, the reforms which take as a starting point any arbitrary initial position, and, on the other hand, those in which the initial position is a Nash equilibrium [Keen (1989), Keen and Lahiri (1993), López-García (1996)].

At a Nash equilibrium, each country deploys its taxes in its own interest assuming that the other one will not change its actions. The treatment of the «autonomous non-coordinated tax policy» developed by Rose (1985) when taxes are imposed on a destination basis provides a good framework for the discussion of the optimal tax problem faced by each country<sup>2</sup>. To carry out this analysis, we can use the so-called «expenditure function approach» [see Dixit and Munk (1977) and Munk (1978,1980)]. Focusing on the home country, the problem can be written as the maximization of the utility index of the consumer, subject to the budget constraint [4], and the government budget constraint [6], as well as under the condition of existence of an equilibrium. The control variables are the utility level itself,  $u$ , and the vector of producer prices for the non-numeraire commodities,  $p$ . Consumer prices,  $q$ , are determined endogenously through the market-clearing conditions [3], and the vector of taxes  $t$  can be obtained directly from [1] by simple subtraction.

Introducing the Lagrange multipliers  $\mu$  and  $\gamma$ , and omitting the international transfers  $z_0$  and  $m_0$ , the relevant Lagrangean function,  $L(\cdot)$ , can be written as:

$$L(u, p, \mu, \gamma) = u + \mu[(1 - \phi)\pi(1, p) - e(1, q, u)] + \gamma[(q - p)' \pi_p(1, p) + \phi\pi(1, p) - q' g - g_0] \quad [20]$$

The first-order conditions with respect to  $p$  are given by:

$$\frac{\partial L}{\partial p} = \mu[(1 - \phi)\pi_p - (\partial q / \partial p)' e_q] + \gamma \left[ [(\partial q / \partial p) - I_N]' \pi_p + \pi_{pp} [q - p] + \phi\pi_p - (\partial q / \partial p)' g \right] = 0_N \quad [21]$$

where  $I_N$  is the identity matrix of order  $N$  and use has been made of the fact that  $\partial e / \partial p = (\partial q / \partial p)' e_q$ . The coefficients of the matrix  $(\partial q / \partial p)$  provide the effects of a marginal change of producer prices prevailing in the home country on world consumer prices (i.e.,  $\partial q_i / \partial p_j$ ,  $i, j = 1, \dots, N$ ), so that the vector  $\partial e / \partial p = (\partial q / \partial p)' e_q$  picks up the impact of a marginal change of  $p$  on the home country's consumer expenditure.

Manipulating, [21] can be rewritten as:

$$\pi_{pp} t = \theta(1 - \phi)\pi_p - \theta(\partial q / \partial p)' e_q - (\partial q / \partial p)' [E_q + G - \Pi_p] \quad [22]$$

where  $\theta = (\gamma - \mu) / \gamma \geq 0$  is the relative marginal excess burden from distortionary taxation in the home country. The expression  $(\partial q / \partial p)' [E_q + G - \Pi_p]$  captures a «terms-of-trade effect» when setting domestic taxes, since  $-[E_q + G - \Pi_p] = [e_q + g - \pi_p]$  is the vector of home (foreign) country's imports (exports) of non-numeraire commodities.

On the other hand, the market-clearing condition [3] implicitly provides world consumer prices,  $q$ , for given values of producer prices in the home country,  $p$ , the taxes prevailing in the foreign country,  $T$ , the utility levels of both consumers,  $u$  and  $U$ , and the government demands,  $g$  and  $G$ , i.e.,  $q = q(p, T, u, U, g, G)$ . Therefore, one can find:

$$(\partial q / \partial p) = [e_{qq} + E_{qq} - \Pi_{PP}]^{-1} \pi_{pp} \quad [23]$$

Finally, manipulating in [22]-[23] and their counterparts for the foreign country ( $\Theta$  denotes its relative marginal excess burden from distortionary taxation), the Nash-equilibrium indirect tax structures,  $t_N$  and  $T_N$ , can be characterized as:

$$[e_{qq} + E_{qq} - \Pi_{PP}]t_N = -\theta e_q + \theta(1 - \phi)[e_{qq} + E_{qq} - \Pi_{PP}]\pi_{pp}^{-1}\pi_p - [E_q + G - \Pi_P] \quad [24]$$

$$[e_{qq} + E_{qq} - \pi_{pp}]T_N = -\Theta E_q + \Theta(1 - \Phi)[e_{qq} + E_{qq} - \pi_{pp}]\Pi_{PP}^{-1}\Pi_P - [e_q + g - \pi_p] \quad [25]$$

As reflected by [24], Nash-equilibrium taxes in a country, such as the home country, depend on: (i) the demands of the representative consumer ( $e_q$ ); (ii) the local responses of the aggregate demand and the supply by the foreign country ( $e_{qq} + E_{qq} - \Pi_{PP}$ ); (iii) when pure profits are not taxed away, the domestic supply ( $\pi_p$ ) and its local responses ( $\pi_{pp}$ ); and (iv) the terms-of-trade effect through imports  $-[E_q + G - \Pi_P]$ . Note here that the terms-of-trade effect operates even when  $\phi = 1$ , i.e., with full taxation of pure profits (or, equivalently, with constant returns to scale).

## 5. Non-uniform proportional convergence towards a target vector as indirect tax harmonization

The meaning of the word «harmonization» is usually taken as a synonym for making tax systems more «uniform». In turn, this leads to two types of considerations. First, a process of convergence towards a common target, and, second, the suggestion that this target is determined as some «average» of the existing tax structures.

Clearly, the following family of multilateral tax reforms:

$$dt = \alpha\psi[H - t] \quad dT = \alpha\Psi[H - T] \quad [26]$$

where  $\psi$  and  $\Psi$  are arbitrary positive numbers and  $\alpha$  is a «small» positive scalar, fulfill the first of the above-mentioned criteria. In effect, [26] characterizes a program of domestic tax reforms entailing a *non-uniform* proportional convergence of  $t$  and  $T$  towards a common structure  $H$ . The convergence is proportional because  $\alpha\psi$  and  $\alpha\Psi$  represent the «size» of the reform in each country. It is also non-uniform because this size may differ between countries.



As for the choice of the target vector as a type of average, this paper focuses on the process of convergence towards a target vector which depends on the initial tax structures,  $t$  and  $T$ , the local supply responses in each country,  $\pi_{pp}$  and  $\Pi_{PP}$ , and the parameters  $\psi$  and  $\Psi$ . To be specific, the target vector is given by:

$$H = [\psi\pi_{pp} + \Psi\Pi_{PP}]^{-1}[\psi\pi_{pp}t + \Psi\Pi_{PP}T] \quad [27]$$

whose interpretation becomes much clearer when it is rewritten as a matrix weighted average of the existing tax structures in each country:

$$H = \Delta t + [I_N - \Delta]T \quad [28]$$

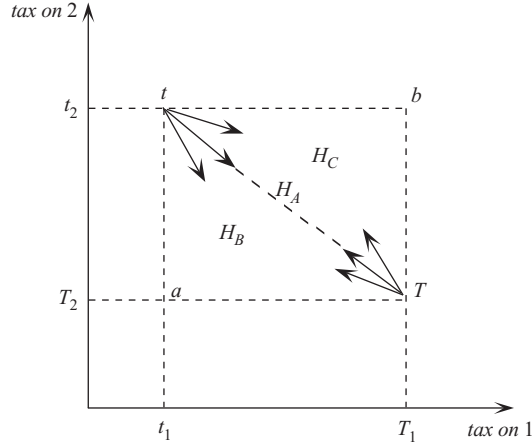
where the «weight» for the home country's structure is the matrix  $\Delta = [\psi\pi_{pp} + \Psi\Pi_{PP}]^{-1} \psi\pi_{pp}$ .

Note that the family of reforms [26]-[28] includes that analyzed in López-García (1996), which, in turn, is the counterpart under the origin principle of the reform suggested by Keen (1987, 1989) where taxes are levied on a destination basis. These authors analyze a *uniform* (i.e.,  $\psi = \Psi = 1$ ) proportional convergence of domestic taxes towards a common structure which depends on initial taxes and the local demand responses (Keen, destination principle) and the local supply responses (López-García, origin principle) <sup>3</sup>.

There are two particular cases in which [26]-[27] can have an intuitive interpretation. In the first one, when local supply responses are the same at the starting point, i.e.,  $\pi_{pp} = \Pi_{PP}$ , the target vector becomes  $H = \delta t + (1 - \delta)T$ , i.e., a convex combination of  $t$  and  $T$ , where the weights are  $\delta = \psi/(\psi + \Psi)$  for the home country and  $(1 - \delta) = \Psi/(\psi + \Psi)$  for the foreign one. In the second one, when there are no cross effects in production, i.e., when  $\pi_{pp}$  and  $\Pi_{PP}$  are diagonal matrices whose elements  $\pi_{ii}$  and  $\Pi_{ii}$  on the principal diagonal are positive, the elements of  $H$  are also a weighted average of those of  $t$  and  $T$ . In effect, under these conditions, we get  $H_i = \delta_i t_i + (1 - \delta_i)T_i$ , where the weights are now different for each commodity, and are given by  $\delta_i = \psi\pi_{ii}/(\psi\pi_{ii} + \Psi\Pi_{ii})$  for the home country's tax and  $(1 - \delta_i) = \Psi\Pi_{ii}/(\psi\pi_{ii} + \Psi\Pi_{ii})$  for the foreign's one.

Figure 1 provides an illustration of the two cases discussed in the previous paragraph in the three-good case, two of them taxed (goods 1 and 2) and the untaxed numeraire (good 0). Besides throwing light on the harmonizing features of the reforms under discussion, this figure allows us to observe the differences to the rule advanced in Keen (1987, 1989) under the destination principle and its counterpart under the origin principle discussed in López-García (1996). Without loss of generality, the initial tax structures are those associated with points  $t$  and  $T$ , where the home country has a higher (lower) tax on good 2 (good 1). When the local supply responses are identical, the target vector in Keen is  $H = (1/2)(t+T)$  at point  $H_A$ , which is in midway between  $t$  and  $T$ . However, with [27] and [28], *any* point on the  $tT$  segment is eligible to be the target vector. When there are no cross effects in production, the target vector in Keen is a weighted average of  $t_i$  and  $T_i$ , the weights being  $\pi_{ii}/(\pi_{ii} + \Pi_{ii})$  and  $\Pi_{ii}/(\pi_{ii} + \Pi_{ii})$ , thus generating *one* point in the «harmonizing box»  $taTb$ . Under [27] and [28], for given values of  $\psi$  and  $\Psi$ , a point also appears in the  $taTb$  box, but it is now possible to

find an *infinite* number of admissible values of  $H$  just modifying the parameters  $\psi$  and  $\Psi$ . In other words, both  $H_B$  and  $H_C$  are potential target vectors now, and the harmonizing reforms are illustrated by various arrows <sup>4</sup>.



**Figure 1.** An illustration of harmonizing reforms when  $N = 2$ .

A simple manipulation allows us to check that the family of reforms [26]-[28] imply that the following expression holds:

$$\pi_{pp}dt + \Pi_{PP}dT = 0_N \quad [29]$$

whose substitution in [9] gives rise to  $dq = 0_N$ . Therefore, given the assumption that there are no income effects for the taxed goods, the harmonizing reforms under examination keep relative world consumer prices unchanged.

Using [29] it can also be shown that the reforms [26]-[28] imply:

$$-[t'\pi_{pp}dt + T'\Pi_{PP}dT] = \alpha[t - T]'\Xi[t - T] > 0 \quad [30]$$

where  $\Xi = \Psi\Pi_{PP}\Delta$ . To check the positivity of the right hand side in [30] we have only to demonstrate that the matrix  $\Xi$  is positive definite. This is so because it can be rewritten as  $\Xi = \Psi\Pi_{PP}[\psi\pi_{pp} + \Psi\Pi_{PP}]^{-1}\psi\pi_{pp} = [(1/\psi)\pi_{pp}^{-1} + (1/\Psi)\Pi_{PP}^{-1}]^{-1}$ , which is clearly positive definite.

## 6. Indirect tax harmonization as a potential Pareto-improvement

We can now turn to some welfare and revenue effects of the family of harmonizing reforms [26]-[28]. This section will focus on the case where international transfers are feasible,

whereas the situation in which these transfers are not admissible will be analyzed in section 7. To begin with it, note that since the reforms entail  $dq = 0$ , [14] and [15] become:

$$e_u du = -[(1-\phi)\pi_p' dt + (1-\Phi)\Pi_P' dT] \quad [31]$$

$$dg_0 = [(1-\phi)\pi_p - \pi_{pp}t]' dt + [(1-\Phi)\Pi_P - \Pi_{PP}T]' dT \quad [32]$$

The addition of the left hand sides in [31] and [32] can be interpreted as the variation in a «home country's social welfare function» whose arguments are  $u$  and  $g_0$ . On the one hand,  $e_u du$  is the income equivalent of the change in the home country's consumer utility, and, on the other hand,  $dg_0$  provides a measure of the impact of the reform on the home country's government tax revenue. Since the positions of both the foreign country's consumer and government are kept unchanged through the international transfers  $dz_0$  and  $dm_0$  that may be required, the expression  $e_u du + dg_0$  can be said that encompasses both the welfare and revenue effects of the harmonizing reform. The next step is to show that these effects are strictly positive. This is the case, since adding [31] and [32] and using [30] we obtain:

$$e_u du + dg_0 = \alpha[t - T]' \Xi [t - T] = -[t' \pi_{pp} dt + T' \Pi_{PP} dT] > 0 \quad [33]$$

Notice that this argument applies to any arbitrary initial position, thus including those where the starting point is a Nash equilibrium. Thus we have:

**Proposition 1:** *Starting from any arbitrary initial position, the family of harmonizing reforms [26]-[28], implying a non-uniform proportional convergence of all domestic tax structures towards a target vector which depends on initial taxes, local supply responses and some arbitrary positive scalars  $\psi$  and  $\Psi$ , can be said to be a potential Pareto-improvement in the sense that  $e_u du + dg_0 > 0$ .*

In other words, in so far as the welfare of the foreign country's consumer and its government consumption of the numeraire good are kept unchanged through the appropriate international transfers, the addition of the income equivalent of the home country's consumer welfare and the change in his/her government tax revenue after the reform [26]-[28], is strictly positive.

This result is parallel to that advanced in López-García (1998) under the destination principle in a similar model where the governments use their revenue to finance the purchase of goods, and extends a proposition in López-García (1996) for the origin principle in a framework where the revenue is returned to the consumers as lump-sum transfers. The underlying intuition is not very different from that in Keen (1987, 1989). When income effects are excluded, [29] assures that world consumer prices are unaffected. In turn, this implies that world aggregate demand,  $e_q + E_q + g + G$ , will not be changed, as neither will world supply,  $\pi_p + \Pi_P$ . The only effect is then a «reallocation» of production between the producers in both countries, which translates into an increased value of  $e_u du + dg_0$ .

Notice also that the extent of Proposition 1 is, in a sense, limited. It only says that  $du$  and/or  $dg_0$  will be positive. Put another way, both  $u$  and  $g_0$  may increase after the reform, but this does not exclude situations in which the home country's consumer welfare is higher

(lower) and his/her government's tax revenue has decreased (increased). It may even be the case that there is no variation in  $g_0$ , so that the only effect of the reform is to generate a welfare gain to the home country's consumer. This could be considered as the counterpart, in the present model, of Proposition 2 in Delipalla (1997), in the sense that the reform would fulfill her «conditional revenue neutrality»<sup>5</sup>.

Figure 2 illustrates the case where  $N = 1$ . It depicts the supply curves of a given commodity by two countries,  $\pi_p(\cdot)$  and  $\Pi_p(\cdot)$ . The demand side is not explicitly modelled, as the harmonizing reforms imply that the world consumer price,  $q$ , is kept unaffected. For given taxes,  $t$  and  $T$ , levied according to the origin principle, the producer prices in each country are  $p = q - t$  and  $P = q - T$ , and the conventional measures of excess burden in each of them can be represented by  $ABC$  and  $DEF$  respectively. Since harmonization entails no change in aggregate consumption, aggregate production will not change either. As a consequence, the new producer prices in each country,  $q - (t + \Delta t)$  and  $q - (T + \Delta T)$ , associated with a reform such that  $|\Delta T| > |\Delta t|$ , will generate changes in each country's production that verify  $\Delta y = -\Delta Y$ , where  $y$  and  $Y$  denote the quantities produced in each country. It can thus be seen that the reduction in excess burden in the high tax country,  $FELJ$ , is greater than the increase in excess burden in the low tax country,  $HGBC$ . Therefore, there is a gain in aggregate welfare that can be approximated by the area  $FELJ - HGBC = G'EIB'$ .

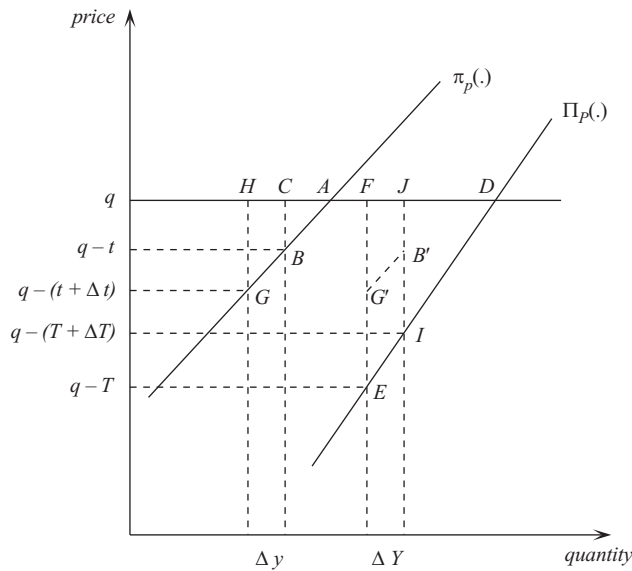


Figure 2. Tax harmonization as a potential Pareto improvement.

## 7. Indirect tax harmonization as an actual Pareto-improvement

We can now turn to the case where international transfers are not feasible and discuss whether the family of harmonizing reforms under examination may generate an actual Pareto-improvement, i.e., a situation in which both countries are better off without any need for offsetting transfers between them.

Since the reform ensures that  $dq = 0$ , [16] and [18] imply the following expressions for the home country:

$$e_u du = -(1-\phi)\pi_p dt \quad [34]$$

$$dg_0 = [(1-\phi)\pi_p - \pi_{pp}t] dt \quad [35]$$

as well as [17] and [19] give similar ones for the foreign one. Taking into account that the addition of the left hand sides in [34] and [35] can be interpreted as the variation in a «home country's social welfare function» whose arguments are  $u$  and  $g_0$ , and making an analogous interpretation for the foreign country, the change in each country's welfare can be measured as:

$$e_u du + dg_0 = -t' \pi_{pp}' dt \quad [36]$$

$$E_u dU + dG_0 = -T \Pi_{pp}' dT \quad [37]$$

Using [26] and [28] and after some manipulations, [36] can be rewritten as:

$$e_u du + dg_0 = \alpha t' \Xi t - \alpha t' \Xi T \quad [38]$$

Since, as discussed above, the matrix  $\Xi$  is positive definite, it is clear that  $t' \Xi t$  will be positive for any initial tax structure prevailing in the home country. However, there is no reason to expect any determinate sign of  $t' \Xi T$ , with the implication that, in general, the sign of  $e_u du + dg_0$  in [38] will be ambiguous.

Since the sign of  $t' \Xi T$  is uncertain when the starting point is any arbitrary position, the approach followed by Keen (1989) and López-García (1996) entails focusing on initial positions which are Nash equilibria. In fact, these authors show that «exceptional» situations exist under which, when the starting point is a Nash equilibrium, the harmonizing reforms (under the destination principle in Keen and under the origin principle in López-García) are actually Pareto improving, so that each country is better off without any need for international transfers. In their models, however, tax revenue is returned to the individuals as a lump-sum transfer, so we must check whether or not their propositions can be extended to the present framework.

Using [24] and [25], the Nash-equilibrium tax structures in each country,  $t_N$  and  $T_N$ , can be written as:

$$t_N = -\Theta[\pi_{pp} + \Lambda]^{-1}e_q + \Theta(1-\phi)\pi_{pp}^{-1}\pi_p + [\pi_{pp} + \Lambda]^{-1}[e_q + g - \pi_p] \quad [39]$$

$$T_N = -\Theta[\Pi_{pp} + \Lambda]^{-1}E_q + \Theta(1-\Phi)\Pi_{pp}^{-1}\Pi_p + [\Pi_{pp} + \Lambda]^{-1}[E_q + G - \Pi_p] \quad [40]$$

One can manipulate in these expressions to provide the case analyzed in López-García (1996), where revenue is returned to the consumers, and there is only a terms-of-trade effect when governments deploy their tax structures. If we force  $\theta = \Theta = 0$ , and making  $g = G = 0_N$  in [39] and [40], the corresponding Nash equilibrium taxes,  $\tilde{t}_N$  and  $\tilde{T}_N$ , verify:

$$\tilde{t}_N = [\pi_{pp} + \Lambda]^{-1}[e_q - \pi_p] \quad [41]$$

$$\tilde{T}_N = [\Pi_{pp} + \Lambda]^{-1}[E_q - \Pi_p] \quad [42]$$

López-García (1996) then shows that  $\tilde{t}_N' \Xi \tilde{T}_N$  is negative under certain «exceptional» conditions, so that the counterpart of [38] (with  $dg_0 = 0$ ) is positive. These conditions refer to either: (i) local supply responses which are identical at the initial position, i.e.,  $\pi_{pp} = \Pi_{pp}$ ; or (ii) there are no cross effects in production or consumption, i.e., the matrices  $e_{qq}$ ,  $E_{qq}$ ,  $\pi_{pp}$  y  $\Pi_{pp}$  are all diagonal <sup>6</sup>.

Unfortunately, this does not seem to be a promising avenue of research in the present context. Indeed, it is clear from mere inspection that  $t_N' \Xi T_N$  will have any sign, even under the «exceptional» situations (i) and (ii) above. This allows one to put forward the following:

**Proposition 2:** *Starting from any arbitrary initial position, the family of harmonizing reforms [26]-[28], implying a non-uniform proportional convergence of all domestic tax structures towards a target vector which depends on initial taxes, local supply responses and some arbitrary positive scalars  $\psi$  and  $\Psi$ , will not in general entail an actual Pareto improvement. The same applies when the initial position is a Nash equilibrium, in contrast to models where tax revenue is returned to the consumers as a lump-sum transfer.*

In fact, it seems that the most we can expect concerning the reforms [26]-[28] is to characterize them as a potential Pareto-improvement. Adding [36] and [37] one gets:

$$(e_u du + dg_0) + (E_U dU + dG_0) = -[t' \pi_{pp} dt + T' \Pi_{pp} dT] = \alpha[t - T]' \Xi [t - T] > 0 \quad [43]$$

whose interpretation is, in essence, the same as with [33]. In effect, the multilateral tax reform implies an increase in the value of the «supranational social welfare function» implicitly given in the left hand side of [43]. In fact, this expression only says that the addition of the income equivalents of both country's consumers' welfare variations and the revenue changes experienced by both governments, is strictly positive. It says nothing, however, about whether any specific term is positive. In this way, [33] has the advantage of focusing on the role of the international transfers between consumers and governments required for one country to be better off without the other one being worse off.

## 8. Concluding comments

The aim of this paper has been to discuss some propositions referring to the effects on consumer welfare and government revenue arising from a family of multilateral indirect tax reforms than can be labelled as harmonizing when taxes are levied according to the origin principle. It has been shown that the characterization of these policies as a potential Pareto-improvement that has been widely analyzed in models where taxes are imposed on a destination basis and where tax revenue is returned to the individuals as a transfer, can, when properly reformulated, be extended to a framework where taxes are levied on an origin basis and where the governments use their revenue to finance the purchase of goods and services. This result, however, depends on a number of restrictive assumptions. Some of these are considered standard in literature on indirect tax harmonization, but are rather unrealistic. This is notably the case with the omission in the analysis of the distributional effects among different consumers within a given country in addition to the assumption that international transfers between consumers of different countries are feasible.

It must be stressed here however that the important issue from a policy point of view is whether strict Pareto-improvements from tax harmonization can exist when the governments have to finance public goods provision or face revenue requirements that should be financed through indirect taxation, and the possibility of international transfers is excluded. The results of this paper suggest a negative answer, at least according to the model under discussion. There may, of course, exist harmonizing policies that would make all the involved countries better off without any need for offsetting international transfers, but the informational requirements as well as the associated implementation obstacles cast doubts on their practical feasibility.

## Notes

1. The model is similar to that used in López-García (1998) to discuss indirect tax harmonization under the destination principle. However, the role of the international transfer between governments,  $m_0$ , is slightly different.
2. The present model is, however, simpler, in that it excludes both the interdependence with the «rest of the world» (for example, third countries) and some institutional features related to the existence of a «supranational» government (for example, purchases of agricultural products).
3. It should be noted that Keen (1989: 7) himself suggests a program of non-uniform harmonizing reforms not different from [26], but he ends up focusing on the uniform case.
4. It can easily be shown that the admissible values of the weights when  $N = 2$  fulfill the following expression:

$$\frac{\delta_1 \pi_{11}}{(1-\delta_1) \bar{\Pi}_{11}} = \frac{\delta_2 \pi_{22}}{(1-\delta_2) \bar{\Pi}_{22}}$$

The situation analyzed by Keen is that where these ratios are equal to one.

5. Delipalla (1997) focuses on Keen's (1987, 1989) reform under the destination principle. She characterizes a reform as «conditionally revenue neutral» if it is revenue-neutral at constant international producer prices (p. 458). In our model, since taxes are levied according to the origin principle, «conditional revenue neutrality» should be interpreted in terms of constant international consumer prices.

6. In essence, the proof consists of showing that  $\tilde{I}_N' \Xi \tilde{I}_N$  can be rewritten as  $-y' \Omega y$ , where  $y$  is a vector and the matrix  $\Omega$  is positive definite. It should also be noted that López-García (1996) carries out his analysis in terms of revenue (or restricted profit) functions, but this does not affect the results.

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**Resumen**

En este trabajo se discute si algunas proposiciones referidas a los efectos de la armonización fiscal indirecta que se han derivado cuando los impuestos se gravan sobre la base del principio de destino y la recaudación se devuelve a los consumidores en forma de transferencia, pueden, convenientemente reformuladas, extenderse a un marco en que el principio impositivo es el de origen y los gobiernos usan sus ingresos fiscales para comprar bienes y servicios. Usando un modelo de dos países, se argumenta que una convergencia proporcional no uniforme de los impuestos de cada país en la dirección de una estructura impositiva «promedia» diseñada de forma adecuada, puede caracterizarse como un cambio potencialmente Pareto-superior. Sin embargo, estas reformas no darán lugar, en general, a una mejora paretiana estricta en que todos los países mejoran sin necesidad de arbitrar transferencias entre ellos.

*Palabras clave:* armonización fiscal indirecta, principio de origen, reforma de la imposición sobre mercancías.

*Clasificación JEL:* F15, H87.

