

# On Radial Reductions of International Indirect Taxes under the Origin Principle\*

**Miguel Ángel López García**

Universitat Autònoma de Barcelona. Departament d'Economia Aplicada.

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## Abstract

This paper deals with the welfare effects of radial or equiproportional reductions of international indirect taxes when these are levied according to the origin principle. Focusing on the analysis of radial reductions of indirect taxes as a collective response to the tax-induced distortions on trade it is argued that this reform is potentially Pareto-improving. The discussion provides a further example of the parallelism that has sometimes been advanced between the welfare effects of multilateral tax reforms under the origin and destination principles.

**Key words:** International Indirect Taxation, Origin Principle.

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## Resumen. *Sobre las reducciones radiales de los impuestos indirectos internacionales bajo el principio de origen*

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En este trabajo se discuten los efectos en términos de bienestar derivados de las reducciones radiales o equiproporcionales de los impuestos indirectos internacionales cuando éstos se recaudan sobre la base del principio de origen. Poniendo el acento en el análisis de las reducciones radiales de los impuestos indirectos como respuesta colectiva a las distorsiones en el comercio inducidas por la imposición, se muestra que esta reforma entraña un cambio potencialmente Pareto-superior. La discusión proporciona un ejemplo adicional del paralelismo que en ocasiones se ha avanzado entre los efectos sobre el bienestar de las reformas impositivas multilaterales bajo los principios de origen y de destino.

**Palabras clave:** imposición indirecta internacional, principio de origen.

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## 1. Introduction

The theoretical contributions on tax reform have tended to analyze the effects of piecemeal tax changes as opposed to the characterization of optimal tax systems. It seems fair to say that the difficulties inherent to a global analysis are one of the reasons for this focus on local results referred to the direction of welfare-improving policy changes. In particular, the reforms entailing a proportional reduction of all distortions are among those that have received most attention. One of these propositions is the well known result by Foster and Sonnenschein (1970) and Dixit (1975) on the welfare effects of a proportional reduction of taxes on consumption. Atkinson and Stiglitz (1980) and Auerbach (1985) provide a textbook analysis of radial reduction of taxes in closed economies, and Dixit and Norman (1980) and Dixit (1985) in open economies.

On the other hand, the proposals implying an approximation of domestic tax structures, particularly the indirect ones, advanced by the European Comission, as well as the efforts that have been carried out by the countries in the European Union, provide a good example about how the contributions on tax reform may cast light on relevant phenomena in the real world. Keen (1987, 1989a) and Keen and Lahiri (1993) have discussed the effects of several harmonizing reforms of international indirect taxes when these taxes are imposed on a destination basis. Tax «harmonization» is modelled as a uniform proportional convergence of domestic taxes towards an appropriately designed target structure. Turunen-Red and Woodland (1990) provide a general characterization of the welfare effects of multilateral tax reforms under the destination principle.

According to the destination principle, internationally traded commodities are taxed at the rates prevailing in the country where final consumption takes place, this being the country which obtains the tax revenue. The alternative is the origin principle, under which taxes are levied at the rates prevailing in the country where goods are produced, and this is the country receiving the tax revenue. In a first approach to the effects of harmonizing reforms under the origin principle, López García (1996) advanced a parallelism between the analyses in Keen (1987, 1989a) referred to taxation under the destination principle and its counterpart under the origin principle and showed that the same qualitative results can be obtained concerning the welfare effects of indirect tax harmonization.

Our purpose here is similar to the one described in the previous paragraph in the sense of trying to verify whether some reasonable conjectures hold. Keen (1989b) shows that a radial reduction in taxes under the destination principle implies a potential welfare improvement, and Turunen-Red and Woodland (1990) and Tsuneki (1995) provide conditions for this reform to be strictly Pareto-improving. This paper asks whether the same kind of result emerges when taxes are levied on an origin basis. The extension does not seem to be straightforward. Keen and Lahiri (1993) showed that the results on tax harmonization in the competitive case with destination taxation can be extended to a simple model of imperfect competition where oligopolists play Cournot. One might then expect that these results could easily be generalized to the case of origin taxation. However, as Keen, Lahiri and Raimondos-Møller (1998) have shown, this is not the case.

Although both Keen (1989b) and Turunen-Red and Woodland (1990) assume the existence of taxes as well as tariffs, an important difference is that Keen considers a reduction in all distortions (i.e., both taxes and tariffs) while Turunen-Red and Woodland only analyze a reduction of taxes. Actually, this is the reason for their different conclusions (the policy is potentially welfare-improving in Keen and may be a strict Pareto improvement in Turunen-Red and Woodland), since a radial reduction only of taxes in the presence of tariffs does not entail a shift towards the no-tax situation. On the other hand, Tsuneki (1995) also deals with both instruments, but the proportional reduction of commodity taxes is accompanied by harmonization of tariffs and he assumes there are no cross effects in consumption and production. To avoid these considerations, we will assume away tariffs, focusing on radial reductions of indirect taxes as a collective response to the tax-induced distortions on trade.

It should be noted that since the model neglects the questions associated with the governments providing public goods and/or having revenue requirements, a gradual reduction of taxes implies a movement towards the no-tax situation, which is the optimal one in this framework. As a consequence, the analysis focuses on the possibilities of distortion of trade through internal taxation. Section 2 presents the basic model, where two countries trade in an arbitrary number of commodities. The welfare effects of the multilateral reform under examination are analyzed in section 3. It is shown that an equiproportional reduction of origin-based taxes is potentially Pareto-improving, in the sense that when coupled with an appropriately chosen international transfer whose purpose is to keep the welfare of one of the countries involved in the reform unchanged, it increases the welfare enjoyed by the other. Since this will be true regardless of the country whose welfare is maintained unaffected, the policy entails an outward shift of the world utility possibility curve. Section 4 concludes.

## 2. A model of international trade

The basic framework is a simple model [see Dixit and Norman (1980)] in which two countries, labelled as home and abroad, trade in  $N+1$  commodities, indexed as 0, 1, ...,  $N$ . Home (foreign) country's variables are represented by small (capital) letters. For the sake of simplicity, it is assumed that there is a single consumer in each country and that the only source of distortions is the existence of taxes on commodities, which are levied on an origin basis. Therefore, commodities are taxed at the rates prevailing in the country where they are produced, this being the one which obtains the tax revenue.

Since, neglecting transport costs, the origin principle implies that consumer prices are the same across countries, the following relationship between consumer prices  $q$  ( $=Q$ ), producer prices,  $p$  and  $P$ , and the tax parameters,  $t$  and  $T$  (expressed as specific taxes), holds:

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

This is due to the fact that under the origin principle exports are taxed and imports are exempted, so that, in equilibrium, the home (foreign) country's consumer must be indifferent between paying  $p+t$  ( $P+T$ ) for domestically produced goods and  $P+T$  ( $p+t$ ) for those imported. Without loss of generality commodity 0 is taken to be the numeraire and the untaxed good, i.e.,  $t_0 = T_0 = 0$  and  $q_0 = Q_0 = p_0 = P_0 = 1$ , and it will hereafter be taken for granted, unless otherwise stated, that vectors are of  $N$ -dimension.

Consumers are characterized by their expenditure functions,  $e(1, q, u)$  and  $E(1, q, U)$ , where  $u$  and  $U$  represent utility levels. Using subscripts to denote partial derivatives,  $e_0$ ,  $E_0$ ,  $e_q$  and  $E_q$ , will be the compensated demand functions for the  $N+1$  commodities. Perfect competition prevails, and the production side in each country is resumed in its revenue function,  $r(1, p)$  and  $R(1, P)$ , whose partial derivatives  $r_0$ ,  $R_0$ ,  $r_p$  and  $R_P$ , provide the supply functions of the  $N+1$  goods. It is assumed that tax revenue in each country,  $t' r_p(\cdot)$  and  $T' R_P(\cdot)$ , where ' denotes transposition, is returned to the consumers as a lump sum transfer. Therefore, the market-clearing conditions for the  $N+1$  goods can be written as:

$$e_0(1, q, u) + E_0(1, q, U) = r_0(1, q-t) + R_0(1, q-T) \quad [2]$$

$$e_q(1, q, u) + E_q(1, q, U) = r_p(1, q-t) + R_P(1, q-T) \quad [3]$$

Consumer's expenditure in each country equals national income evaluated at its producer prices plus tax revenue, so that the budget constraints faced by both consumers are:

$$e(1, q, u) = r(1, q-t) + t' r_p(1, q-t) - z_0 \quad [4]$$

$$E(1, q, U) = R(1, q-T) + T' R_P(1, q-T) + z_0 \quad [5]$$

where  $z_0$  represents a transfer of commodity 0 from the home country to the foreign one, whose purpose is to characterize those reforms which entail a potential Pareto-improvement, in the sense that  $u$  increases for a given  $U$ .

Equating  $z_0$  in [4]-[5] we obtain a single «world» budget constraint which, by Walras' law can be dropped. With this procedure, [2]-[3] provide a system of  $N+1$  independent equations with  $N+1$  variables, i.e.,  $N$  relative consumer prices,  $q$ , and the home country's utility level,  $u$ , given the tax parameters,  $t$  and  $T$ , as well as the foreign country's utility level,  $U$ . Notice that although the international transfer  $z_0$  has been eliminated as a variable from the system of equations, it is implicit in the model. Actually, it plays a crucial role in keeping  $U$  constant after the reform.

Taking total differentials in [2]-[3] we can consider the effect on home country's welfare,  $du$ , of an arbitrary tax reform  $\{dt, dT\}$  for a given value of  $U$ . In matrix form we find:

$$\begin{bmatrix} e_{0u} & \lambda \\ e_{qu} & \Lambda \end{bmatrix} \begin{bmatrix} du \\ dq \end{bmatrix} = \begin{bmatrix} -(r_{0p}'dt + R_{0P}'dT) \\ -(r_{pp}dt + R_{PP}dT) \end{bmatrix} \quad [6]$$

where  $\lambda = e_{0q} + E_{0q} - r_{0p} - R_{0P}$  represents the vector of partial derivatives of the compensated world excess demand for commodity 0 with respect to non-numeraire consumer prices, and  $\Lambda = e_{qq} + E_{qq} - r_{pp} - R_{PP}$  is the  $(N \times N)$  matrix of the partial derivatives of the compensated world excess demand for non-numeraire commodities with respect to non-numeraire consumer prices. By standard duality properties,  $\Lambda$  is at least negative semidefinite. However, we will assume that there is enough substitutability in demand or production as to assure that  $\Lambda$  is negative definite [see Dixit and Norman (1980, ch. 5)].

We can manipulate in [6] to find  $du$  as a function of the reform underlying  $dt$  and  $dT$ :

$$du = \frac{1}{\alpha|\Lambda|} \begin{vmatrix} -(r_{0p}'dt + R_{0P}'dT) & \lambda' \\ -(r_{pp}dt + R_{PP}dT) & \Lambda \end{vmatrix} \quad [7]$$

where  $\alpha = e_{0u} - \lambda' \Lambda^{-1} e_{qu}$ . It can be shown that  $\alpha$  is positive whenever an increase in the world's endowment of the numeraire, for given values of the tax parameters and of the welfare enjoyed by the foreign country, is potentially Pareto-improving. We shall assume this is the case, thus sidestepping the problems associated with the transfer paradox.

### 3. Radial reductions of indirect taxes as a potential Pareto improvement

Consider now the welfare effects of a multilateral program of domestic tax reforms leading to a radial or equiproportional reduction of all taxes, i.e.:

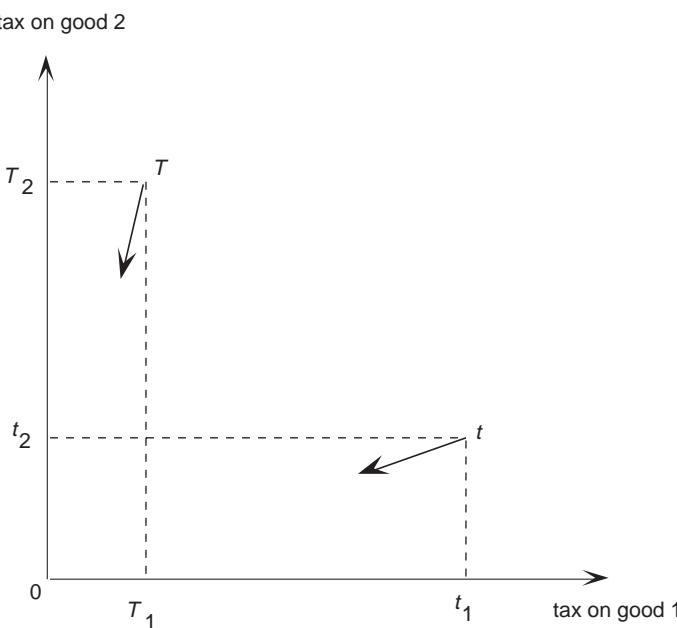
$$dt = -\beta t \quad dT = -\beta T \quad [8]$$

where  $\beta$  is a small positive number. Notice that this reform can be viewed as a particular case of «harmonizing» reform in the sense advanced by Keen (1987, 1989a), since it entails convergence towards the origin of coordinates, i.e., the no-tax situation. In effect, a program of uniform proportional convergence towards some target vector  $H$  can be expressed as  $dt = \beta[H - t]$  and  $dT = \beta[H - T]$ . Thus, [8] can be considered as the particular case where the target vector  $H$  towards which both countries «harmonize» their tax structures is the vector  $O_N$  whose  $N$  components are zeroes. Figure 1 illustrates the case with three goods, one of them (good 0) being the (universal) untaxed numeraire. Given the indirect tax structures in each country,  $t = (t_1, t_2)$  and  $T = (T_1, T_2)$ , both «converge» towards the origin of coordinates,  $0 = (0, 0)$ , which is the common goal of the «harmonizing» reform.

Let us now define the  $(N+1) \times (N+1)$  matrix,  $\tilde{\Lambda}$ , of the derivatives of the compensated world excess demands for all the  $N+1$  commodities with respect to the  $N+1$  consumer prices:

$$\begin{aligned}
 \tilde{\mathcal{A}} &= \tilde{e}_{qq} + \tilde{E}_{qq} - \tilde{r}_{pp} - \tilde{R}_{PP} = \\
 &= \begin{bmatrix} e_{00} & e_{0q} \\ e_{q0} & e_{qq} \end{bmatrix} + \begin{bmatrix} E_{00} & E_{0q} \\ E_{q0} & E_{qq} \end{bmatrix} - \begin{bmatrix} r_{00} & r_{0p} \\ r_{p0} & r_{pp} \end{bmatrix} - \begin{bmatrix} R_{00} & R_{0p} \\ R_{p0} & R_{PP} \end{bmatrix} = \begin{bmatrix} \lambda_{00} & \lambda \\ \lambda & \mathcal{A} \end{bmatrix}
 \end{aligned} \quad [9]$$

where  $\lambda_{00} = e_{00} + E_{00} - r_{00} - R_{00}$ , and the symbol  $\sim$  denotes the  $(N+1) \times (N+1)$  counterpart (i.e., including the derivatives with respect to the untaxed numeraire) of the  $N \times N$  matrix without it. By the standard properties,  $\tilde{\mathcal{A}}$  is, at least, negative semidefinite. However, under the assumptions of the model,  $\mathcal{A}$  is negative definite. In effect, since  $\mathcal{A}$  entails the addition of four negative semidefinite matrices, it can fail to be negative definite only if there exists some  $N+1$  vector  $\tilde{y}$  with non-zero components such that  $\tilde{e}_{qq}\tilde{y} = \tilde{E}_{qq}\tilde{y} = \tilde{r}_{pp}\tilde{y} = \tilde{R}_{PP}\tilde{y} = 0_{N+1}$ , where  $0_{N+1}$  is the vector whose  $N+1$  components are zeroes. But the homogeneity of degree zero in consumer (producer) prices of expenditure (revenue) functions assures that  $\tilde{e}_{qq}\tilde{q} = \tilde{E}_{qq}\tilde{q} = 0_{N+1}$  ( $\tilde{r}_{pp}\tilde{p} = \tilde{R}_{PP}\tilde{p} = 0_{N+1}$ ), which would imply  $\tilde{y} = \tilde{q} = \tilde{p} = \tilde{P}$ , which, in turn, would mean that the tax vectors  $t$  and  $T$  in [1] are zero, in contradiction with the very existence of distortions in the situation taken as a starting point.



**Figure 1.** Radial reductions of international indirect taxes.

The next step is to note that the right hand side in [6] can be rewritten as:

$$\begin{aligned} \begin{bmatrix} -(r_{0p}'dt + R_{0P}'dT) \\ -(r_{pp}dt + R_{PP}dT) \end{bmatrix} &= -\begin{bmatrix} r_{0p}'dt \\ r_{pp}dt \end{bmatrix} - \begin{bmatrix} R_{0P}'dT \\ R_{PP}dT \end{bmatrix} = \\ &= -\begin{bmatrix} r_{00} & r_{0p}' \\ r_{p0} & r_{pp} \end{bmatrix} \begin{bmatrix} 0 \\ dt \end{bmatrix} - \begin{bmatrix} R_{00} & R_{0P}' \\ R_{P0} & R_{PP} \end{bmatrix} \begin{bmatrix} 0 \\ dT \end{bmatrix} = -\tilde{r}_{pp} \begin{bmatrix} 0 \\ dt \end{bmatrix} - \tilde{R}_{PP} \begin{bmatrix} 0 \\ dT \end{bmatrix} \end{aligned} \quad [10]$$

and evaluating this expression for the reform under examination, i.e.,  $dt = -\beta t$  and  $dT = -\beta T$ :

$$\beta \tilde{r}_{pp} \begin{bmatrix} 0 \\ t \end{bmatrix} + \beta \tilde{R}_{PP} \begin{bmatrix} 0 \\ T \end{bmatrix} = \beta \tilde{r}_{pp} [\tilde{q} - \tilde{p}] + \beta \tilde{R}_{PP} [\tilde{q} - \tilde{P}] \quad [11]$$

where  $\tilde{q}' = (1, q')$ ,  $\tilde{p}' = (1, p')$ , and  $\tilde{P}' = (1, P')$  are  $N+1$  vectors.

Using again the property of homogeneity of degree one of expenditure (revenue) functions in consumer (producer) prices, [11] becomes:

$$-\beta [\tilde{e}_{qq} + \tilde{E}_{qq} - \tilde{r}_{pp} - \tilde{R}_{PP}] \tilde{q} = -\beta \tilde{\Lambda} \tilde{q} \quad [12]$$

and manipulating:

$$-\beta \tilde{\Lambda} \tilde{q} = (-\beta) \begin{bmatrix} \lambda_{00} & \lambda' \\ \lambda & \Lambda \end{bmatrix} \begin{bmatrix} 1 \\ q \end{bmatrix} = (-\beta) \begin{bmatrix} \lambda_{00} + \lambda' q \\ \lambda + \Lambda q \end{bmatrix} \quad [13]$$

Finally, when [7] is evaluated for the reform [8] one can obtain:

$$du = \frac{1}{\alpha |\Lambda|} \begin{vmatrix} -\beta \tilde{\Lambda} \tilde{q} & \lambda' \\ \Lambda & \Lambda \end{vmatrix} = \frac{-\beta}{\alpha |\Lambda|} \begin{vmatrix} \lambda_{00} + \lambda' q & \lambda' \\ \lambda + \Lambda q & \Lambda \end{vmatrix} = \frac{-\beta}{\alpha |\Lambda|} \begin{vmatrix} \lambda_{00} & \lambda' \\ \lambda & \Lambda \end{vmatrix} \quad [14]$$

where use has been made of the property that the determinant of a matrix is unaffected by adding to any of its columns a linear combination of the others.

As a consequence, the effect on home country's welfare after a multilateral reform implying a radial or equiproportional reduction of all taxes can be written as:

$$du = \frac{-\beta |\tilde{\Lambda}|}{\alpha |\Lambda|} \quad [15]$$

On the one hand, both  $\beta$  and  $\alpha$  are positive. On the other hand, the matrices  $\Lambda$  and  $\tilde{\Lambda}$  are both negative definite, but of orders  $N \times N$  and  $(N+1) \times (N+1)$  respectively, so that their determinants have opposite sign. It then follows that  $du$  in [14] must be positive, and the reform under examination will lead to a potential Pareto-improvement.

#### 4. Concluding Remarks

The definitive system of indirect taxation in the European Union appears as a mixed system, so that the pure origin principle does not seem to be the most realistic framework for the evaluation and design of policy. However, it may well generate indications which, together with the results that have been obtained under the destination principle, provide some insights on the working of the definitive system. Furthermore, the model used here sidesteps several important features of the real world, including distributional objectives as well as revenue constraints faced by the governments, in order to focus on tax reform as a collective response to the tax-induced distortions on trade. In any case, as suggested by Keen (1989a, p. 12), «if revenue effects do indeed prove negligible then the relevance of the arguments developed here would obviously be enhanced».

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