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DOMESTIC AND TRADE TAX REFORMS IN THE PRESENCE OF A PUBLIC GOOD AND DIFFERENT NEUTRALITY CONDITIONS

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Abstract

This paper develops a perfectly-competitive general-equilibrium model of a small open economy with production of private traded goods and of a public good which is financed by revenues from trade and domestic taxes. Within this framework we consider the effects on public good provision and on welfare of the following tax reforms: (i) a producer-price-neutral reduction in export taxes and a corresponding increase in production taxes, (ii) a consumer-price-neutral reduction in tariffs and a corresponding increase in consumption taxes, and (iii) a partial tax-revenue-neutral reform in trade and domestic taxes.

Keywords: Indirect tax reforms, Government tax revenue, Public good, Welfare

J.E.L Classification: F13, H20, H21

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1. Introduction

One of the factors that have been inhibiting a faster progress on trade liberalization in many developing countries is the heavy dependence on trade taxes as a source of government revenue. For example, in the early 1990s, almost 40% of tax revenue in Pakistan came from trade taxes (Lahiri and Nasim, 2005). As a result, many countries have been, with active encouragement and help from international institutions such as the IMF, reforming their domestic tax policies along with trade liberalization in order to offset the negative effect of trade liberalization on tax revenue.

In view of the above changes in actual policy reforms, the literature on tax reforms which earlier considered reforms of one set of policies at a time,[1] has been examining the effects of simultaneous reforms of trade and domestic taxes (see, for example, Diewert et al., 1989; Beghin and Karp, 1992; Michael et al., 1993; Hatzipanayotou et al., 1994, Abe, 1995; Neary, 1998; Keen and Ligthart, 2002; Lahiri and Nasim, 2005; Emran, 2005).[2] Most of these studies consider a link between the reforms of the two sets of instruments via a "neutrality" condition. In Diewert et al. (1989), Michael et al. (1993) and Lahiri and Nasim (2005) the neutrality is in tax revenue; in Hatzipanayotou et al. (1994) and Keen and Ligthart (2002) consumer prices are kept constant, and in Emran (2005) the neutrality is in producer prices.[3] All the studies examine the effect of tax reforms on welfare, and the studies that do not impose revenue constraints also examine the effect on tax revenue.[4]

[1] Hatta (1977a, 1977b) are among the pioneering studies in the field of trade and domestic tax/subsidy reform policies. While the first paper considered reforms of trade policies, the second one examined reforms of domestic tax policies.

[2] Emran and Stglitz (2005) and Boadway and Sato (2008) introduce an informal sector in a competitive framework and examine the welfare effects of trade and consumption tax reforms.

[3] All these studies consider a perfectly competitive environment. There is also a literature regarding the welfare and revenue implications of reforms in domestic and/or trade taxes in an imperfectly competitive environment, e.g., among others, Mujumdar (2004), Keen and Ligthart (2005), Davies and Paz (2010), Naito and Abe (2008). For example, Keen and Ligthart (2005) demonstrate that under imperfect competition there can be found specific cases (examples) whereby unambiguously welfare improving reform programs under perfect competition now become unambiguously welfare worsening.

[4] Emran and Stiglitz (2005) show that in the presence of an informal sector, a tariff is a better instrument for raising revenue than a consumption tax. See Keen (2007, 2008) for a critique of this result. Atolia (2008) introduces tax evasion, and concludes that tariff reforms accompanied by changes in domestic taxes, by and large, are not revenue neutral due to the existence of tax evasion. Baunsgaard and Keen (2005) examine the actual impact on trade liberalization on tax revenue using a Panel data on

Reforms of trade taxes most often relate to reduction in tariffs on imports, and policies on exports are not explicitly dealt with as exports and imports are known to be symmetric: tariffs on imports are analytically equivalent to subsidies on exports. One notable exception is Emran (2005) who explicitly considers the welfare implications of a *producer-price-neutral* reduction in the export tax and an offsetting increase in the production tax of a given commodity.

In reality, however, in developing countries what we often observe is export taxes and not exports subsidies. There are two main motives for imposing export taxes. Sometimes they are imposed to benefit domestic consumers as export taxes on final goods and intermediate inputs reduce consumer and domestic input prices respectively. Tax on rice exports by Thailand is mainly for reducing domestic consumer prices (Piermartini, 2004); Export tax on cotton in Pakistan is for stimulating domestic yarn industry (Hudson and Ethridge, 1999); in India export tax (at 10%) and export control (in the form of minimum export prices) on goods such as leathers, basmati and non-basmati rice and cotton are also for non-revenue seeking purposes.[5] Another motive for export taxes is simply raising tax revenue. In Ghana, for example, about 12% of total tax revenue in the 1990s was from export taxes, and cocoa is one of Ghana's major exports (Piermartini, 2004). Thus, there are countries which depend a lot on revenue from tariffs on imports, and there are other countries which rely heavily on taxes on exports, and it is important to analyze these cases separately. For example, in many cases export taxes are imposed on goods that have a very limited domestic market. In case of Zimbabwe, 99% of tobacco production is exported and this good constitutes 70% of total exports by Zimbabwe (FAO, 2003). Similar remark applies to cocoa in the case of Ghana. For these cases, the most effective way of raising revenue lost due a reduction in export taxes, is to raise production taxes for those goods, and not consumption taxes.

Furthermore, more often than not tax revenues are used for the provision of public goods and services, rather than being distributed to households in a lump-sum fashion. Thus, tax reforms directly affect a government's ability to provide such goods and services. This important aspect of tax reforms is absent in the studies reviewed above, and, to the best of our knowledge, the notable exceptions are Abe

several countries, and find significant negative impact of trade liberalization on the tax revenue of the Sub-Saharan countries.

[5] See http://finance.indiamart.com/exports_imports/exports_from_india/export_charges.html. For India, revenue from export taxes constitutes only 0.15% of total tax revenue.

(1992, 1995) where not only the level of public good production but also the cost of producing it are endogenous. This adds a new dimension as tax reforms affects the unit cost of producing public goods. Abe (1992) derives sufficient conditions under which a piecemeal tariff reform and the uniform change in all tariffs improve welfare in a small open economy with public good production. Abe (1995) uses the same model structure as in Abe (1992), but considers reforms of tariffs and consumption taxes, without linking the two via any neutrality condition.

We construct a perfectly-competitive general-equilibrium model of a small open economy which produces many traded goods and a non-traded public consumption good, as in Abe (1992, 1995). Tax revenues are used to finance the production of the public good. In order to differentiate between developing countries that rely on tariffs on imports from those who depend on export taxes, for revenue purposes, we consider reforms that involve (i) a decrease in export taxes and an increase in production taxes, and (ii) a reduction in tariffs and an increase in consumption taxes. For (i) we impose a producer-price neutrality condition, and for (ii) the neutrality is on consumer prices. For both (i) and (ii) we consider three types of reforms. While in the first reform, the trade tax, i.e., the tariff or the export tax, on the good with the highest tax burden is reduced; in the second reform all trade taxes are reduced. Finally, the third reform is a partial tax-revenue neutral one where tax revenue evaluated at the initial equilibrium is held constant. One of the advantages of the third type of reforms over a reform that keeps tax revenue *per se* constant is that the information requirement for its implementation is very limited for the former than for the latter.[6]

2. The Model

We consider a small, Heckscher-Ohlin, perfectly competitive open economy producing K private traded goods, and a privately produced public consumption good (g).[7] The country is endowed with a number of fixed factors, which are used in the production of the private and the public goods. Production functions of the private

[6] Delipalla and Keen (1992) examine a partial revenue-neutral reform of ad valorem and specific consumption taxes. Lahiri and Raimondos-Møller (1997) examine the welfare effect of tariff reduction when the loss of revenue is compensated by foreign aid in a partial revenue-neutral manner.

[7] The assumption of producing a single public good is made for analytical simplicity and tractability of the results. Alternatively, assuming that many public goods are either locally produced or imported at fixed world prices, presents cumbersome analytical complications without much intuitive contribution for the results.

and public goods are assumed to be homogeneous of degree one in all factors. The country is a price taker in world commodity markets.[8] The international prices of all private goods are assumed fixed and for simplicity are normalized to be equal to one. Various taxes exist on all goods in the form of ad-valorem domestic taxes, i.e., production and consumption taxes, and trade taxes, i.e., export taxes and import tariffs. Thus, for the j^{th} commodity, the domestic prices for consumers (π_j) and producers (p_j) are respectively given by $\pi_j = (1+t_j)(1+\tau_j)$ and $p_j = (1+t_j)(1-s_j)$, where an export tax is denoted by $t_j < 0$ and a tariff is denoted by $t_j > 0$; τ_j and s_j respectively denote a consumption and production tax on the j[th] commodity.

The revenue function, $R(p, g)$ gives the economy's maximum revenue from production of the traded private goods, at producers price vector $p' \equiv (p_1 ..... p_K)$,[9] and level of public good (g).[10] The $R(p, g)$ function is convex and homogeneous of degree one in producer prices, i.e., R_{pp} is a $(K \times K)$ positive semi-definite matrix and by the envelop theorem $R_{p_j} (= \partial R / \partial p_j)$ is the supply function of the j^{th} good.[11] Moreover, $R_g = -C^g$, where C^g is the unit cost of the public good, and $R_{gg} = 0$ due to our assumption of a Heckscher-Ohlin economy.[12] The property $R_g = -C^g$ implies that a unit increase in public good production causes a reduction in the value of production of private goods equal to its unit cost.

In the demand side of this economy, we assume a number of identical households who consume the K privately produced commodities and the public good (g). A representative household's preferences are captured by the expenditure function $E(\pi, g, u)$ denoting the minimum expenditure on private goods required to achieve a level of utility (u), at consumer price vector $\pi' \equiv (\pi_1 ..... \pi_K)$, and

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[8] This is a standard assumption of the literature of indirect tax reforms made, by and large, for analytical convenience. That is, terms of trade considerations are unaccounted for.

[9] Unless otherwise stated, all vectors are column vectors and for a vector x, the transpose of it is denoted by x'.

[10] See Abe (1992) for a detailed derivation of the private sector's revenue function $R(p, g)$ in the presence of production of a public good.

[11] Hereon, subscripts to all functions denote partial derivatives.

[12] The assumption $R_{gg} = 0$ implies that changes in g, which change factor supplies available for the production of private goods, do not affect its unit cost of production. Such would be the case in a conventional H-O model, where factor prices are determined by commodity prices and are independent of changes in factor endowments when the number of goods equals or exceeds the number of factors.

consumption of the public good. The $E(\pi, g, u)$ function is increasing in π, and u, decreasing in g and concave in π i.e., $E_{\pi\pi}$ is a $(K \times K)$ negative semi-definite matrix. The derivative $E_{\pi_j} = \partial E / \partial \pi_j$ is the compensated demand for good (j), E_u, the inverse of the marginal utility of income. Following standard practice of the public finance literature, we call $-E_g > 0$ the economy-wide "marginal willingness to pay for the public good provision" (e.g., see King, 1986).

The country's income-expenditure identity requires that private spending on goods must equal income from production of private and of the public goods. That is,

$$E(\pi, g, u) = R(p, g) - gR_g(p, g), \tag{1}$$

Government tax revenues (T) are generated from taxes on production, consumption, tariffs and export taxes. That is:

$$T = s'\left(\widehat{1+t}\right)R_p(p,g) + \tau'(\widehat{1+t})E_\pi(\pi,g,u) + t'\left[E_\pi(\pi,g,u) - R_p(p,g)\right] = \theta' E_\pi + \varphi' R_p, \tag{2}$$

where $\theta = (\widehat{1+t})\tau + t$ denotes the vector of total tax burden rates on consumption of goods and $\varphi = (\widehat{1+t})s - t$ is the vector of total tax burden rates on the production of goods, t, s and τ are the vectors of trade, production and consumption taxes, a "hat" over a variable, e.g., $\left(\widehat{1+t}\right)$, denotes a diagonal matrix.[13] Moreover, E_π and R_p, respectively, are the vectors of compensated demand and supply functions. The government uses all the collected tax revenues to finance the production of the public good, i.e., $-gR_g(p, g)$. The government budget constraint can be written as follows:

$$B = T + gR_g(p, g) = 0, \tag{3}$$

where B denotes the net government's budget.

[13] Both the θ and φ vectors contain positive and negative elements. If the j^{th} commodity is an imported one, then the corresponding θ_j element is positive indicating an overall consumption tax-cum-tariff burden, and the corresponding φ_j element is negative, i.e., a net production subsidy, if $t_j > s_j / \left(1 - s_j\right)$. If the j^{th} commodity is an exported one, then the corresponding φ_j element is positive indicating an overall production tax-cum-export tax burden, and the corresponding θ_j element is negative, i.e., a net consumption subsidy, if $t_j < -\tau_j / \left(1 + \tau_j\right)$.

We conclude this section by deriving the effects of changes in domestic and trade taxes on gross government revenues and on welfare. Using the definitions of the $E_\pi(.)$ and $R_p(.)$ functions, we differentiate equation (2) to obtain:

$$dT = \theta' E_{\pi u} du + \left(\theta' E_{\pi g} + \varphi' R_{pg}\right) dg + \left(\theta' E_{\pi\pi} + E'_\pi\right) d\pi + \left(\varphi' R_{pp} - R_p{}'\right) dp, \qquad (4)$$

where $d\pi = d\theta = \left[\left(\widehat{1+t}\right) d\tau + \left(\widehat{1+\tau}\right) dt\right]$ and $dp = -d\varphi = -\left[\left(\widehat{1+t}\right) ds - \left(\widehat{1-s}\right) dt\right]$, $E_{\pi u}$ is a $(K \times 1)$ vector whose elements are positive assuming that all goods are normal in consumption, i.e., $E_{\pi_j u} > 0, \forall j \in K$; $E_{\pi g}$ is a $(K \times 1)$ vector whose elements capture the relationship between the private and public goods in consumption, and are positive if the j^{th} private good and the public good are complements in consumption, and negative if the j^{th} private good and the public good are substitutes. Holding utility constant and assuming that (g) is a normal commodity not all elements of the $E_{\pi g}$ vector can be positive. Similarly, R_{pg} is a $(K \times 1)$ vector whose k^{th} element if negative it indicates that the k^{th} private good is a substitute in production to the public good, and if it is positive it indicates that the k^{th} private good is a complement in production to the public good. Holding factor endowments constant, not all elements of the R_{pg} vector can be positive either.[14]

Differentiating equations (1) and (3), using equation (4) recalling that $dB = 0$ and rearranging terms we obtain:

$$\mathrm{E}_u du = -E_g dg - E'_\pi d\pi + \left(R'_p - gR'_{gp}\right) dp, \qquad (5)$$

$$\left(\theta' E_{\pi g} + \varphi' R_{pg} + R_g\right) dg = -\theta' E_{\pi u} du - \left(E'_\pi + \theta' E_{\pi\pi}\right) d\pi + \left(R'_p - \varphi' R_{pp} - gR'_{gp}\right) dp. \qquad (6)$$

Equation (5) indicates that, other things being equal, welfare rises with an increase in the public good provision; it falls with an increase in consumer prices, while an increase in producer prices entails an ambiguous welfare effect depending on the

[14] On the basis of the above, the public good cannot be an overall complement to private goods in consumption and production.

induced change in the unit cost of the public good. Equation (6) indicates how prices and utility affect the provision of the public good. An increase in utility affects the consumption levels via an income effect and therefore tax revenue. Consumer prices affect the tax base as well as the consumption levels. Producer price has an additional effect by changing the unit cost of producing the public good. Equations (5) and (6) are the main equations of the model. They're used to examine the effects of indirect tax reforms on the levels of public good provision and of welfare. That is, we design reforms of production or consumption taxes and of import tariffs or export taxes that can result in an increase in the provision of the public good and an improvement of welfare. We consider the following cases.

Case I: the proposed indirect tax reform entails, first, a simultaneous decrease in the export tax and an increase in the production tax on a k^{th} commodity, i.e., a piecemeal reform, so that its producer price is held constant; second, a simultaneous decrease in all export taxes and an increase in all production taxes, so that all producer prices remain constant. This we call a "*producer-price-neutral*" indirect tax reform.

Case II: the proposed indirect tax reform entails, first, a simultaneous decrease in the import tariff and an increase in the consumption tax on a k^{th} commodity, i.e., a piecemeal reform, so that its consumer price is held constant; second, a simultaneous decrease in all tariffs and an increase in all consumption taxes, so that all consumer prices remain constant. This we call a "*consumer-price-neutral*" indirect tax reform.

Case III: is what we call *partial tax revenue neutrality.* That is, reform of both export and production taxes or both tariffs and consumption taxes, keeping tax revenue, evaluated at the initial equilibrium, constant.

Solving equations (5) and (6), changes in the levels of the public good and welfare due to changes in producer and consumer prices are given as follows:

$$\Delta dg = \left[\left(E_u - \theta' E_{\pi u} \right) \left(R_p - g R_{gp} \right) - E_u R_{pp} \varphi \right]' dp + \left[\left(E_u - \theta' E_{\pi u} \right) E_\pi + E_u E_{\pi\pi} \theta \right]' d\pi , \quad (7)$$

$$\Delta du = \left[\left(-S_g + \theta' E_{\pi g} + \varphi' R_{pg} \right) \left(R_p - g R_{gp} \right) + E_g R_{pp} \varphi \right]' dp$$
$$\left[\left(S_g - \left(\theta' E_{\pi g} + \varphi' R_{pg} \right) \right) E_\pi + E_g E_{\pi\pi} \theta \right]' d\pi , \quad (8)$$

where $\Delta = E_u \left(R_g + \theta' E_{\pi g} + \varphi' R_{pg} \right) - E_g \theta' E_{\pi u}$ is the determinant of the (2x2) matrix of coefficients of the unknowns dg and du, in equations (5) and (6). Following Abe

(1995, pp. 879-880), we assume that an increase in public good provision reduces government net tax revenues, i.e., $(dB/dg) < 0$, and this ensures that Δ is negative. Moreover, $S_g = E_g - R_g < 0 (> 0)$ depending on whether the public good is socially under (over)-provided. The following assumption is used in some cases in the rest of the analysis:

Assumption: The public good is socially under-provided i.e., $S_g = E_g - R_g < 0$.

This is a reasonable assumption to make for a developing country. In the course of our analysis, however, we discuss the way our results change when this assumption is relaxed.

Note also, from equation (4), that $(\partial T/\partial g) = \theta' E_{\pi g} + \varphi' R_{pg}$. In the analysis to follow in some cases we assume that, at given domestic and trade taxes, an increase in the public good provision does not reduce the gross government revenues $(\partial T/\partial g) \geq 0$. In the course of our analysis it will be made clear how does this assumption affect the levels of public good provision and of welfare, due to the proposed tax reforms.

3. Producer-price-neutral reforms of export and production taxes

We now assume that that the government pursues a *producer-price-neutral* reform policy by simultaneously reducing export taxes and increasing production taxes. That is, a policy of reducing the export tax and increasing the production tax on a given, say k^{th} good, so that its producer price is constant, i.e., a piecemeal reform, or a policy of reducing all export taxes and increasing all production taxes so that all producer prices are constant. In this case changes in consumer prices are given by $d\pi = d\theta = \left(\widehat{1+\tau}\right) dt$. From equations (7) and (8), the effects of the *producer-price-neutral* tax reform on the levels of public good provision and of welfare are:

$$\Delta dg = \left[\left(E_u - \theta' E_{\pi u}\right) E_\pi + E_u E_{\pi\pi} \theta\right]' \left(\widehat{1+\tau}\right) dt , \tag{9}$$

$$\Delta du = \left[\left(S_g - \left(\theta' E_{\pi g} + \varphi' R_{pg}\right)\right) E_\pi + E_g E_{\pi\pi} \theta\right]' \left(\widehat{1+\tau}\right) dt \quad . \tag{10}$$

3.1 Producer-price-neutral piecemeal reform of an export and a production tax

We examine the effects on public good provision and on welfare of increasing the production tax on the k^{th} exported good, i.e., $ds_k > 0$, and of simultaneously reducing its export tax i.e., $dt_k > 0$, so that its producer price is held constant. Note that since we denote an export tax by $t_j < 0$, a reduction of its size implies that, algebraically, t_j rises.

Equations (9) and (10) can be further elaborated on by using the properties of the expenditure function, i.e., compensated demand functions are homogeneous of degree zero in prices. Specifically, $\sum_{j=1}^{K} \pi_j E_{\pi_j \pi_k} = 0$ yields $E_{\pi_k \pi_k} = -\sum_{j \neq k} \left(\pi_j / \pi_k \right) E_{\pi_j \pi_k}$, and by the reciprocity conditions we have $E_{\pi_j \pi_k} = E_{\pi_k \pi_j}$. Using the above properties and after some manipulations, the effect of the proposed *producer-price-neutral* tax reform on the levels of public good provision and welfare are given as follows:

$$-\left(1+\tau_k\right)^{-1} \Delta \frac{dg}{dt_k} = \left(E_u - \theta' E_{\pi u}\right) E_{\pi_k} - \pi_k^{-1} \sum_{j \neq k} \left(\theta_k - \theta_j\right) E_{\pi_k \pi_j}, \tag{11}$$

$$\left(1+\tau_k\right)^{-1} \Delta \frac{du}{dt_k} = \left[S_g - \left(\theta' E_{\pi g} + \varphi' R_{pg}\right)\right] E_{\pi_k} - E_g \pi_k^{-1} \sum_{j \neq k} \left(\theta_k - \theta_j\right) E_{\pi_k \pi_j}. \tag{12}$$

Given that Δ is negative and $dt_k > 0$, a public good increasing and welfare improving *producer-price-neutral* reform of production and export taxes requires that the right-hand-side of equation (11) is positive, and that of equation(12) is negative.

From equation (11) we can derive sufficient conditions under which the proposed *producer-price-neutral* reform on the k^{th} good raises the level of the public good. These conditions are, (i) the k^{th} good is a substitute to all other private goods in consumption, and (ii) the k^{th} good carries the highest net consumption subsidy relative to all other goods. Intuitively, the *producer-price-neutral* reduction of the export tax, which is an implicit production tax and consumption subsidy, and the increase of the production tax on the k^{th} good leave production of all goods unchanged, reduces the consumption of the k^{th} good and increases the consumption of all other goods assuming that the k^{th} good is a substitute to all other goods in consumption. Since the

consumption subsidy on the k^{th} good is the highest then the proposed reform, *ceteris paribus*, raises consumption tax revenue which in turn raises the public good provision. Note that since this reform keeps the producer prices constant, it has no effect on the unit cost of producing the public good.

As noted in the introduction, by and large, reforms of trade taxes have not dealt explicitly with policies on exports. One notable exception is Emran (2005) who explicitly considers the welfare implications of a *producer-price-neutral* reduction in export tax and an offsetting increase in the production tax of a given commodity, but without considering the provision of a public good.

From equation (12) we can derive sufficient conditions under which the proposed *producer-price-neutral* reform on the k^{th} good increases welfare**.** These are, (i) the public good is socially under-provided, (ii) the k^{th} good is a substitute to all other goods in consumption and it carries the highest net consumption subsidy relative to all other exported goods, and (iii) the increase in the level of the public good does not reduce government gross tax revenues, i.e., $\theta' E_{\pi g} + \varphi' R_{pg}$ is non-negative. From equation (5), note that the above-stated conditions, i.e., conditions (i) and (ii), under which there is an increase in public good provision, are not sufficient for welfare to increase as the increase in consumer price, entailed by this reform, reduces welfare. There we need additional conditions, i.e., condition (iii). Assuming the existence of only export and production taxes, i.e., $\theta < 0, \varphi > 0$, then for condition (iii) to hold it suffices that the public good and all exported goods are substitutes in consumption and complements in production. Since, however, not all goods can be complements in production with the public good, condition (iii) is satisfied if the positive effect of an increase in (g) on total consumption subsidy cost, i.e., $\theta' E_{\pi g} > 0$, dominates the negative effect on total production tax revenue, i.e., $\varphi' R_{pg} < 0$. The following proposition summarizes the main results of equations (11)-(12).

Proposition 1: *Consider a small open economy which produces many private traded goods and a public consumption good financed through trade and domestic tax revenues. Then, a producer-price-neutral small reduction of the export tax and simultaneous increase of the production tax on a* k^{th} *good:*

- *increases the provision of the public good, if the k^{th} good carries the highest net consumption subsidy relative to all other exported goods, and it is a substitute to all other private goods in consumption.*
- *improves welfare if:*
  - *(i) the public good is socially under-provided, and an increase in its level does not reduce government gross tax revenues,*
  - *(ii) the k^{th} good carries the highest net consumption subsidy relative to all other exported goods, and it is a substitute to all other goods in consumption.*

Note that in the case where the tax revenue is lump-sum distributed, condition (ii) of proposition 1 is necessary and sufficient for welfare improvement. In this case this condition is neither necessary nor sufficient.

3.2 Producer-price-neutral reform of all export and production taxes

We now examine the effects on public good provision and on welfare of the reduction in all export taxes, i.e., $dt_k > 0 \ \forall k \in K$, and a simultaneous increase in all production taxes, i.e., $ds_k > 0 \ \forall k \in K$, so that all producer prices remain constant, i.e., $dp_k = 0 \Rightarrow ds_k = \left[(1-s_k)/(1+t_k)\right] dt_k$. Since consumption taxes are unchanged, changes in consumer prices are given as follows: $d\tau_k = 0 \Rightarrow d\pi_k = d\theta_k = (1+\tau_k) dt_k$. We assume the following reform in every export tax, $dt_k = (1+\tau_k)^{-1} \lambda \theta_k$; λ is a positive scalar and θ_k is the net consumption subsidy on the k^{th} exported good. Using the above two expression we get that $d\theta_k = \lambda \theta_k$. That is, this change in export and production taxes results in equi-proportional reduction in all net consumption subsidies. Therefore our *producer-price-neutral* reform of export and production taxes is a combination of a radial reform of the net consumption subsidies with fixed consumption taxes and the corresponding changes in export taxes keeping producer prices constant.

Using equations (9) and (10), the effects on the levels of the public good and welfare of this *producer-price-neutral* reduction in all export taxes and increase in production taxes are given below:

$$\Delta \frac{dg}{\lambda} = \left(E_u - \theta' E_{\pi u}\right) E'_{\pi} \theta + E_u \theta' E_{\pi\pi} \theta, \tag{13}$$

$$\Delta\frac{du}{\lambda}=\left[S_g-\left(\theta' E_{\pi g}+\varphi' R_{pg}\right)\right]E'_{\pi}\theta+E_g\theta' E_{\pi\pi}\theta. \qquad (14)$$

Equation (13) shows that the above reform program increases the level of public good provision if the overall net subsidy cost on the consumption of the exported goods is non-negative, i.e., $E'_{\pi}\theta\le 0$. A **s**ufficient but not necessary condition for this to occur is that all the exported goods carry a net consumption subsidy. This condition holds if we have only export taxes and no consumption taxes. Equation (14) shows that the above reform program improves welfare if, in addition to the above condition, the public good is under-provided and the increase in the level of the public good does not reduce government gross tax revenues. In case where there are only export and production taxes, i.e., $\theta<0,\varphi>0$, and since not all goods can be complements in production to the public good, the latter condition is satisfied if the positive effect of an increase in (g) on total consumption subsidy cost dominates its negative effect on total production tax revenue. These results are summarized in the following proposition.

Proposition 2: *Consider a small open economy which produces many private traded goods and a public good financed through trade and domestic tax revenues. Assuming that the total consumption subsidy cost on all exported goods in not negative, then a producer-price-neutral reduction of all export taxes and a simultaneous increase of all production taxes that results in a radial reduction in all net consumption subsidies:*

- *increases the provision of the public good,*
- *improves welfare if the public good is under-provided and the increase in its level does not reduce government gross tax revenues.*

At this point a remark is in order, regarding the above results and our Assumption of social under-provision of the public good. As noted in the analysis of this section, this assumption has no bearing regarding the effect of the proposed reform program on the provision of the public good. It only affects its welfare results. Thus, in the unlikely case of social over-provision of the public good (i.e., S_g positive) the two producer-

price-neutral reform programs considered in this section, under the conditions stated in Propositions 1 and 2, may reduce welfare;[15] but in order to do so the over-provision of the public good has to be sufficiently large.

Concluding the section we compare our results to those of the relevant literature. Emran (2005) in a model without public goods but with costly administration of tax revenues concludes that when the "*cross-price substitution effects*" in consumption between all private goods are zero, a *producer-price-neutral* reform such as the one considered here, increases government revenues and welfare if the consumption of the k^{th} good enjoys a net subsidy and the cost of administering tax revenues is lower than a threshold (Emran 2005, Proposition 1, p. 284). In our analysis assuming zero "*cross-price substitution effects*" in consumption, first, the level of the public good unambiguously rises with a piecemeal *producer-price-neutral* reform, and it increases with the *producer-price-neutral* reform if the total consumption subsidy cost on all exported goods is not negative. Second, welfare may still fall with either *producer-price-neutral* reform program, if the increased level of the public good lowers government gross tax revenues.

4. Consumer-price-neutral reforms of tariffs and consumption taxes

In this section, we assume that the government pursues a *consumer-price-neutral* reform policy by simultaneously reducing tariffs and increasing consumption taxes. That is, a policy of reducing the tariff rate and increasing the consumption tax on a commodity, say k^{th}, so that its consumer price is constant, i.e., a piecemeal reform, or a policy of reducing all tariffs and increasing all consumption taxes so that all consumer prices are constant. In this case, changes in producer prices are given by $dp = -d\varphi = \left(\widehat{1-s}\right)dt$.

4.1 Consumer-price-neutral piecemeal reform of a tariff and a consumption tax

We examine the implications on public good provision and welfare of simultaneously reducing the tariff rate and increasing the consumption tax on an imported k^{th} good so that its consumer price remains constant, i.e., $dt_k < 0$ and

[15] Subsequent results of the analysis are similarly affected by this notion of under (over)-provision of the public good. For brevity, however, we do not raise this issue again.

$d\tau_k > 0$, so that $d\pi_k = 0 \Rightarrow d\tau_k = -\left[(1+\tau_k)/(1+t_k)\right]dt_k$. Using the same procedure as in the previous section, we obtain:

$$(1-s_k)^{-1}\Delta\frac{dg}{dt_k} = \left(E_u - \theta' E_{\pi u}\right)\left(R_{p_k} - gR_{gp_k}\right) - E_u p_k^{-1}\sum_{j\neq k}\left(-\varphi_k + \varphi_j\right)R_{p_k p_j}, \qquad (15)$$

$$(1-s_k)^{-1}\Delta\frac{du}{dt_k} = \left[\left(\theta' E_{\pi g} + \varphi' R_{pg}\right) - S_g\right](R_{p_k} - gR_{gp_k}) + E_g p_k^{-1}\sum_{j\neq k}\left(-\varphi_k + \varphi_j\right)R_{p_k p_j}. \qquad (16)$$

Since Δ is negative, for the *consumer-price-neutral* reduction in the tariff t_k and increase in the consumption tax τ_k to raise the level of the public good and improve welfare the right-hand-sides of equations (15) and (16) must be positive.

Observing equations (11) and (12), (15) and (16) one may note several similarities regarding the conditions under which, on the one hand, the *producer-price-neutral* reforms in export and production taxes and on the other, the *consumer-price-neutral* reforms in tariffs and consumption taxes increase public good provision and improve welfare. For this, in the remainder of the section we avoid the detailed algebra of the latter results, and instead we highlight key differences in them vis-à-vis the *producer-price-neutral* reforms. From equation (15) relative to equation (11), a factor, among others, relevant for the impact of the tariff-consumption tax *consumer-price-neutral* reform on public good provision is the relationship in production between the k^{th} private good and the public good, i.e., whether $R_{gp_k} > (<)0$. In the case of the *producer-price-neutral* reform of export and production taxes, this consideration did not appear since with constant producer prices the unit cost of the public good remains unchanged. Thus, sufficient conditions for the present piecemeal consumer-price-neutral reduction in t_k and increase in τ_k to increase the supply of the public good and improve welfare are that the k^{th} good (i) carries the highest production subsidy among all goods instead of the highest consumption subsidy, (ii) is a substitute in production instead a substitute in consumption with all other private goods, and, an additional condition, (iii) it is also a substitute in production with the public good.

We note three points relating our results in this section to standard results of the tax reforms literature with or without public good provision. First, in previous

studies of indirect tax reforms in the presence of public good provision, e.g., Abe (1992, 1995), there is no explicit analysis of the impact of the proposed tax reforms on the provision of the public good. Second, consider the literature on a *consumer-price-neutral* reform of the tariff and consumption tax on a k^{th} commodity but without provision of a public good. There, the condition requiring that the k^{th} good carries the highest total net production subsidy and that it is a substitute to all other private goods in production is a necessary and sufficient condition for improving welfare. With public good provision and endogenous cost of production for the public good, this condition is neither necessary nor sufficient for both increasing the level of the public good and improving welfare. Third, in the tax reform literature without public good provision, the k^{th} commodity is the one carrying the highest tariff, an implicit production subsidy, relative to all other imported goods. Here with domestic and trade taxes, the k^{th} commodity is required to carry the highest overall net production subsidy, without necessarily implying that it also carries the highest tariff. Finally, as the analysis thus far has shown, under perfectly competitive conditions, the results for the cases of a *producer-price-neutral* reform of export and production taxes and of a *consumer-price-neutral* reform of import tariffs and consumption taxes are, with the exception of some noted difference, by and large qualitatively similar. As mentioned in footnote 3, in the presence of imperfect competition the welfare implications of tariff and consumption tax reforms can be very different. Likewise, imperfect competition can make very different the qualitative results of the two reform programs considered here. For example, a reduction in tariffs reduces the level of protection awarded to domestic producers, which in turn lowers the level of their pure profits, and thus the level of welfare. A reduction of export taxes, under imperfect competition, results to the exact opposite effect. Namely, it increases the level of protection for the domestic firms, and thus it raises the levels of pure profits and welfare.

4.2 Consumer-price-neutral reform in all tariffs and consumption taxes

In the absence of public goods provision, a standard result of the relevant literature on trade and consumption tax reforms states that a simultaneous small reduction of all tariffs and an increase in all consumption taxes, leaving all consumer prices unchanged, unambiguously improves welfare and raises government tax revenues. In this section we examine the effects on public good provision and on

welfare of the reduction in all tariffs, i.e., $dt_k < 0 \ \forall k \in K$, and a simultaneous increase in all consumption taxes, i.e., $d\tau_k > 0 \ \forall k \in K$, so that all consumer prices remain constant, i.e., $d\pi_k = 0 \Rightarrow d\tau_k = \left[(1+\tau_k)/(1+t_k)\right]dt_k$. Since production taxes are unchanged, changes in producer prices are given as follows: $ds_k = 0 \Rightarrow dp_k = d\varphi_k = (1-s_k)dt_k$; φ_k is the net production subsidy on the k^{th} imported good. We assume the following reform in every tariff, $dt_k = (1-s_k)^{-1}\lambda\varphi_k$. Using the above two expression we get that $d\varphi_k = -\lambda\varphi_k$. That is, the above reduction in all tariffs and increase in all consumption taxes that keep all consumer prices constant results in an equi-proportional reduction in net production subsidies. Therefore, the *consumer-price-neutral* reform of tariffs and consumption taxes is a combination of the uniform reduction in net production subsidies with fixed production taxes and the corresponding change in tariffs to keep consumer prices constant. The effects of this *consumer-price-neutral* reduction in tariffs and increase in consumption taxes are given as follows:

$$\Delta\frac{dg}{\lambda} = \left(E_u - \theta' E_{\pi u}\right)(R_p - gR_{gp})'\varphi - E_u\varphi' R_{pp}\varphi, \tag{17}$$

$$\Delta\frac{du}{\lambda} = \left(\theta' E_{\pi g} + \varphi' R_{pg} - S_g\right)(R_p - gR_{gp})'\varphi + E_g\varphi' R_{pp}\varphi. \tag{18}$$

Equation (17), and (18) indicates that this *consumer-price-neutral* reform of tariffs and consumption taxes raises the provision of the public good and welfare under similar conditions as in the case of a *producer-price-neutral* reform in export and production taxes. The differences are (i) the total production subsidy cost of all imported goods being nonnegative instead of the total consumption subsidy cost on all exported goods being nonnegative, and (ii) the additional requirement that the imported goods are substitutes in production to the public good.

5. Reform of trade and domestic taxes under "partial tax revenue neutrality"

In this section we consider what we call "*partial tax revenue neutral*" reforms of, first, export and production taxes holding tariffs and consumption taxes constant and tariffs and consumption taxes holding export and production taxes constant. According to either reform policy, it is assumed that tax revenue, evaluated at the

initial equilibrium, is constant.[16] In the first "*partial tax revenue neutral*" reform program we consider a reduction in export taxes and an increase in production taxes for which $dT = R_p'\widehat{(1+t)}ds + [E_\pi'\widehat{(1+\tau)} - R_p'\widehat{(1-s)}]dt = 0$. Thus, $ds = -\left[\widehat{(1+t)R_p'}\right]^{-1}\left[\widehat{(1+t)\mathrm{E}_\pi'} - \widehat{(1-s)R_p'}\right]dt$. Since $dp = \widehat{(1-s)}dt - \widehat{(1+t)}ds$, we have $dp = \widehat{R_p^{-1}}(1-s)E_\pi' dt$. In the second "*partial tax revenue neutral*" reform program we consider a reduction in tariffs and an increase in consumption taxes for which $dT = E_\pi'\left(\widehat{1+t}\right)d\tau + [E_\pi'\widehat{(1+\tau)} - R_p'\widehat{(1-s)}]_p dt = 0$, from which $d\tau = -\left[\widehat{(1+t)\mathrm{E}_\pi'}\right]^{-1}\left[\widehat{(1+\tau)\mathrm{E}_\pi} - \widehat{(1-s)R_p}\right]dt$. Since $d\pi = \widehat{(1+t)}d\tau + \widehat{(1+\tau)}dt$, we have $d\pi = \widehat{E_\pi^{-1}}(1-s)R_p' dt$. Equations (5) and (6), after some algebra, now become:

$$E_u du + E_g dg = -gR_{gp}'\hat{\Phi}dt, \tag{19}$$

$$\theta' E_{\pi u}du + \left(R_g + \theta' E_{\pi g} + \varphi' R_{pg}\right)dg = -\left(\Psi R_p' + gR_{gp}'\right)\hat{\Phi}dt, \tag{20}$$

where, $\Psi = dT = \left(\theta'\hat{E}_\pi^{-1}E_{\pi\pi} + \varphi'\hat{R}_p^{-1}R_{pp}\right)dt$; $\hat{\Phi} = \widehat{(1+\tau)}\hat{R}_p^{-1}\hat{E}_\pi$ in the case of the "*partial tax revenue neutral*" reform of export and production taxes and $\hat{\Phi} = \widehat{(1-s)}$ in the case of the "*partial tax revenue neutral*" reform of tariffs and consumption taxes. In what follows we examine the effects on the levels of public good provision and of welfare in each of the above cases. Using the homogeneity properties of the expenditure and revenue functions, the effects of the proposed tax reform on the levels of (g) and (u), after some algebra, are given as follows:

$$\Phi_k^{-1}\Delta\left(\frac{dg}{dt_k}\right) = -\left(1-\theta' E_{\pi u}\right)gR_{gp_k} - R_{p_k}\Psi_k$$

$$= -\left(1-\theta' E_{\pi u}\right)gR_{gp_k} + R_{p_k}\sum_{j\neq k}\left[\left(\gamma_k - \gamma_j\right)\pi_j E_{\pi_k\pi_j} + \left(\delta_k - \delta_j\right)p_j R_{p_k p_j}\right], \tag{21}$$

$$\Phi_k^{-1}\Delta\left(\frac{du}{dt_k}\right) = -\left(\theta' E_{\pi g} + \varphi' R_{pg} - S_g\right)gR_{gp_k} + E_g R_{p_k}\Psi_k$$

$$= -\left(\theta' E_{\pi g} + \varphi' R_{pg} - S_g\right)gR_{gp_k} - E_g R_{p_k}\sum_{j\neq k}\left[\left(\gamma_k - \gamma_j\right)\pi_j E_{\pi_k\pi_j} + \left(\delta_k - \delta_j\right)p_j R_{p_k p_j}\right], \tag{22}$$

[16] As mentioned in the introduction, the information requirement for this reform is very modest, compared to a *fully* tax-revenue neutral reform.

where, $\Psi_k = \theta' E_{\pi_k}^{-1} E_{\pi\pi_k} + \varphi' R_{p_k}^{-1} R_{pp_k}$, $\gamma_i = \dfrac{\theta_i}{\pi_i E_{\pi_i}}$ and $\delta_i = \dfrac{\varphi_i}{p_i R_{p_i}}$, $i = j, k$.

In the case of the "*partial tax revenue neutral*" reduction in the export tax and increase in the production tax on the k^{th} exported good, $\Phi_k = (1+\tau_k) R_{p_k}^{-1} E_{\pi_k}$, γ_i and δ_i, respectively, denote the export tax's net consumption subsidy on the i^{th} exported good as a fraction of the commodity's consumption expenditure, and the export tax's total production tax burden as a fraction of its value of production. In the case of the "*partial tax revenue n*eutral" reduction in the tariff and increase in the consumption tax on the k^{th} good, $\Phi_k = 1 - s_k$, γ_i and δ_i, respectively, denote the tariff's total consumption tax burden on the i^{th} imported good as a fraction of the commodity's consumption expenditure, and the tariff's net production subsidy on the same good as a fraction of its value of production. Equations (21) and (22), respectively, give sufficient conditions under which the "*partial tax revenue neutral*" reduction in an export tax (tariff rate) and increase in the production (consumption) tax of the k^{th} good raise the levels of public good provision and of welfare. These conditions are stated in the following proposition.

Proposition 3: *Consider a small open economy producing many private traded goods, and a public good financed through trade and domestic tax revenues.*

- *Let the k^{th} exported good be a substitute in consumption and production to all private goods, complement in production with the public good, and let it carry the highest net consumption subsidy as a fraction of its consumption expenditures and the highest net production tax burden as a fraction of the value of its production. Then, a "partial tax revenue neutral" reduction in the export tax rate on the k^{th} good and increase of its production tax*
  - *(i) raises the level of public good provision,*
  - *(ii) (ii) increases social welfare if the public good is under-supplied, and the increase in the level of the public good does not reduce government gross tax revenues.*

The conditions to increase welfare of this *partial tax revenue neutral* reduction in the tariff rate on the k^{th} good and increase in the consumption tax on the same

commodity are similar as in the case of the *partial tax revenue neutral* reduction in the export tax and increase in the production tax on the k^{th} commodity, with only one difference. The only difference is that the k^{th} good must be a substitute in production, instead of a complement in production, with the public good. The intuition is simple, when we reduce the export tax on the k^{th} good, its producer price increases and the level of the public increases if it is complement in production with this good. In the case where we reduce the tariff rate on the k^{th} good, its producer price falls and the level of the public good increases if it is substitute in production with this good.

The intuition of the results of this proposition follows easily from the analysis thus far. For example, consider the case of the *"partial revenue neutral"* reduction in the tariff and increase in the consumption tax on the k^{th} imported good. This reform, on the one hand, increases government revenues if, as stated in the above proposition, the k^{th} imported good is a substitute in consumption and production to all private goods, and carry the highest total consumption tax burden as a fraction of its consumption expenditures and the highest net production subsidy burden as a fraction of the value of its production.[17] On the other hand, since the k^{th} good and the public good are substitutes in production, the decrease in its tariff rate reduces the unit cost of production of the public good. As a result, *ceteris paribus*, the provision of the public good also increases. Welfare increases because (i) the public good is socially under-provided, (ii) an increase in its level does not reduce the tax revenue i.e., in equation (22) $-\left(\theta' E_{\pi g} + \varphi' R_{pg} - S_g\right) g R_{gp_k} > 0$, and (iii) due to increase in efficiency in consumption and production. A similar rationale can be followed for the case of the *"partial revenue neutral"* reduction in the export tax and increase in the production tax on the k^{th} exported good.

In the special case of zero "*cross-substitution price effects*" in production and consumption, the *"partial revenue neutral"* reduction in the tariff and increase in the consumption tax on the k^{th} imported good (i) increases the provision of the public good if the k^{th} private and the public goods are substitutes in production, and (ii) improves welfare if the public good is under-supplied and an increase in its level does

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[17] **A**pplying the condition $d\tau = -\left[\widetilde{(1+t)E'_{\pi}}\right]^{-1}[(1+\tau)E'_{\pi} - (1-s)R_p']dt$ for this *"partial revenue neutral"* tariff-consumption tax reform, the overall change in government tax revenues is given by $dT = \theta' dE_{\pi} + \varphi' dR_p = \theta' E_{\pi u} du + \left(\theta' E_{\pi g} + \varphi' R_{pg}\right) dg + R_{p_k} \Psi_k dt_k$. Then, $\partial T / \partial t_k = R_{p_k} \Psi_k < 0$.

not reduce the tax revenue. On the other hand, the "*partial revenue neutral"* reduction in the export tax and increase in the production tax on the k^{th} exported good (i) increases the provision of the public good if the k^{th} and the public goods are complements in production, and (ii) improves welfare if the public good be under-supplied and an increase in its level does not reduce the tax revenue. Finally, equations (21) and (22) indicate that if in addition to zero "*cross-substitution price effects*" in production and consumption, the public good is imported, instead of locally produced (i.e., its cost is fixed) then either of the proposed "*partial tax revenue neutral*" reforms leaves unaffected the levels of public good provision and welfare.

6. Concluding Remarks

This paper revisits the issue of reforming the structure of indirect taxes, e.g., trade taxes --tariffs and export taxes-- and domestic taxes --consumption and production taxes, in the context of a small open economy which produces a public good. The fact that the unit cost of producing the public good is endogenous in our model brings in additional analytical issues. Within this framework, we derive sufficient conditions under which specific reforms in these domestic and trade taxes lead to an increase in the public good and to an improvement in domestic welfare.

The first two reforms we consider are: (i) a *producer-price-neutral* reduction in export taxes and increase in production taxes, and (ii) a *consumer-price-neutral* reduction in tariffs and increase in consumption taxes. In each reform program, the sufficient conditions, for increasing the level of public good provision and for improving the level of welfare, are summarized in the paper's relevant propositions. These conditions, on the one hand, reflect certain relationships of the standard tax reform literature, e.g., substitutability in production and/or consumption between the taxed good and all other goods. On the other hand, they rely on certain relationships due the presence of the public good, e.g., the endogeneity of the unit cost of the public good, its social under (over)-provision, and its relationship to all private goods in consumption and production. The analysis also examines sufficient conditions under which a *producer-price-neutral* reduction in all export taxes and increase in all production taxe**s** that results in a uniform reduction in all net consumption subsidies, and a *consumer-price-neutral* reduction in all tariffs and increase in all consumption

taxes that results in a uniform reduction in all net production subsidies lead to the two-fold objective.

The last reform exercise we consider is that of domestic and trade taxes subject to, what we call *partial tax revenue neutrality*. In this case, among the conditions relevant for ensuring the increase in public good provision and in welfare are the size of what we call a tariff's total consumption tax burden as a fraction of consumption expenditure and net production subsidy as a fraction of value of production, or an export tax's net consumption subsidy burden as a fraction of consumption expenditure and total production tax as a fraction of value of production.

Some analytical limitations of our model can provide a stimulus for further research in this area. First, as we note in our introduction, a new strand of the tax-reform literature focuses on the case of developing economies introducing features such as the existence of an informal sector, e.g., a shadow economy or a rural non-farming sector, which may escape commodity tax coverage, or the existence of tax evasion. Such features may lead to shrinkage of a country's tax basis resulting to lower levels of public good provision. However, informality or evasion may equally apply to tariffs,[18] and therefore it is possible that while the increase in consumption tax reduces the consumption tax base, a reduction in tariffs can compensate it by increasing the base for tariff revenue. Second, the paper introduced a so-called "partial-tax revenue-neutral" reform of domestic and trade taxes evaluating tax revenues at the initial equilibrium. Given, however, that optimizing firms and consumers respond to changes in tax rates, this reform program does not account for possible changes in the country's tax basis. The present analysis of this case could be generalized, though it entails quite cumbersome algebraic calculations, to incorporate such changes in the tax basis and subsequently on the provision of public goods. Third, as stated, our framework is one of a small perfectly competitive open economy. Allowing for the existence of imperfectly competitive markets, a feature introduced in couple of studies in the literature of tax reforms, may bring in other analytical issues currently of no consideration. Finally, someone may argue that there may be numerous other types of reforms in domestic and trade taxes, aside to the ones presented here. Without overlooking such a possibility, we argue that the tax reforms

[18] As Lahiri et al. (2000) point out, in 1993 illegal imports into Pakistan amounted to RS. 100 billion compared to total legal imports of Rs. 259 billion. A lot of this smuggling can be attributed to high tariffs on durable goods such as televisions and bicycles.

we considered in this paper provide a natural and intuitive justification in terms of theory, real world practice, and policy proposals.

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