

# Working Paper

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Fiscal Affairs Department

**Coordinating Tariff Reduction and Domestic Tax Reform**

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**Abstract**

A key obstacle to fundamental tariff reform in many developing countries is the revenue loss that it ultimately implies. This paper establishes a simple and practicable strategy for realizing the efficiency gains from tariff reform without reducing public revenues, showing that for a small open economy, a cut in tariffs combined with a point-for-point increase in domestic consumption taxes increases both welfare and public revenues. Increasingly stringent conditions are required, however, to ensure unambiguously beneficial outcomes from this reform strategy when allowance is made for such important features as nontradeable goods, intermediate inputs, and imperfect competition.

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## I. INTRODUCTION

Tariff reform continues to be a pressing policy issue in many developing countries. Reducing trade barriers is frequently a core and problematic element in programs of structural adjustment, while the prospective scale of liberalization for some countries remains substantial. Ethiopia, for example, cut its maximum nominal tariff rate from 80 to 60 percent in January 1996, and is committed to reduce it to 40 percent in 1999–2000; Malawi lowered its maximum rate from 45 to 35 percent between April 1996 and August 1997. The slow progress seen in many countries doubtless reflects in part the power of vested interests. Perhaps the most important obstacle, however, is even simpler: tariffs (under which label we here include trade taxes in general) continue to be a major source of revenue for fiscally stretched governments. In Africa, most spectacularly, the share of tariff revenue in total tax revenue, which stood at 31 percent in 1975, declined by only 4 percentage points in the next 20 years. Thus, a key concern for any such country contemplating the liberalization of its tariff structure must be with how it is to recover, from other sources, the revenue loss that must ultimately be entailed.<sup>2</sup>

The literature offers surprisingly little guidance on this. There exists a substantial and mature theoretical literature on the welfare effects of piecemeal tariff reform—central contributions including those of Hatta (1977) and Fukushima (1979), with thorough reviews provided by Dixit (1985) and Woodland (1982)—but this pays scant attention to the revenue consequences of tariff reform,<sup>3</sup> typically precluding any revenue motive for the deployment of tariffs by supposing that the revenue they yield is returned to consumers in lump-sum form. Thus, most of this literature simply assumes there to be no tax distortions other than tariffs: and if that restriction is relaxed, then many standard results of the literature fail (see Beghin and Karp (1992)). Reflecting this narrow focus of the literature on tariff reform, remarkably little has been written on coordinated tax-tariff reforms.

As a matter of general principle, it is of course well known that it is optimal for a small open economy to raise any revenue it needs by setting all tariffs to zero and relying entirely on destination-based taxes on consumption (Dixit (1985)): this indeed is a straightforward application of the Diamond-Mirrlees (1971) theorem on the desirability of maintaining

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<sup>2</sup>Partial measures of trade liberalization do not necessarily lead to lower revenue from trade taxes, and indeed Ebrill, Stotsky, and Gropp (1998) show that in many instances trade tax revenue has remained buoyant (perhaps because of protectionist motives leading to tariffs at above revenue-maximizing levels, partly too because some measures of liberalization—such as the tariffication of quotas—directly increase trade tax revenue). However, since revenue from a fully liberalized trade structure is zero, there must come a point at which liberalization reduces revenue from trade taxes.

<sup>3</sup>A notable exception being Falvey (1994) who studies conditions under which a reduction in tariffs raises both welfare and public revenue.

production efficiency. While this implies that there exists some way of replacing tariffs with domestic consumption taxes in such a way as to raise welfare while maintaining revenue, it would be helpful to go beyond this existential observation to provide policymakers with some specific guidance as to precisely what such a reform might look like.

The literature offers few such insights. Informal discussions of coordinated tariff-tax reforms are provided by Mitra (1991) and Thomas, Nash with Edwards (1991). Diewert, Turunen-Red, and Woodland (1989), Michael, Hatzipanayotou, and Miller (1991), Anderson (1997, 1999), and Tsuneki (1995) develop formal treatments of tax and tariff reform when revenue matters (in the sense that lump-sum taxes cannot be freely deployed), but very few simple strategies for reform emerge. Diewert, Turunen-Red, and Woodland (1989), for example, are mainly concerned with establishing the existence of Pareto-improving reforms of taxes and tariffs, while Anderson (1999) emphasizes that one particular form of coordination—combining a radial contraction of tariffs with a radial expansion of consumption taxes—is not unambiguously desirable. A notable exception to these again rather existential results, however, is the work of Hatzipanayotou, Michael, and Miller (1994): they establish the elegant result that, in a standard small economy, an infinitesimal radial contraction of tariffs combined with equal but opposite changes in consumption taxes, so leaving consumer prices unchanged, increases both welfare and public revenue.<sup>4</sup> These are attractive features indeed.

The first purpose of this paper is to develop a much more general and even more practicable strategy for reaping the efficiency gains of tariff reform without jeopardizing—indeed, while strengthening—the public finances. It is shown, again for the standard small economy, that combining *any* tariff cut that increases production efficiency with a consumption tax reform which leaves consumer prices unchanged increases both welfare and public revenue. This general proposition encompasses that of Hatzipanayotou, Michael, and Miller (1994) as a special case. It is clearly a very powerful result: it is about as close to practicability, and has about as strong properties, as one could hope for. It provides a coherent intellectual rationale for the strategy, commonly prescribed in practice, of sequencing tariff reform with the strengthening of domestic consumption taxation, often in the form of a value-added tax. The result is suggested, moreover, by the method of argument in the well-known proof of the gains from trade in the presence of distortionary taxation developed by Dixit and Norman (1980).<sup>5</sup> Yet it seems to have remained unnoticed in discussions of tariff reform.

The second purpose of the paper is then to consider the robustness of this basic result on coordinated tariff-tax reform to the recognition of other features of reality: nontradeables,

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<sup>4</sup>We use the term ‘public revenue’ to refer to total revenue from consumption taxes and tariffs.

<sup>5</sup>Though, strictly, that proof—concerned with movement all the way to free trade—deals only with the wholesale removal of tariffs, whereas the results here treat their reduction more generally.

intermediates, and imperfect competition. The last two, it will be seen, place quite fundamental limitations upon the applicability of this strategy for coordinated tax-tariff reform.

The paper is structured as follows. Section II sets out the basic result and its implications. In Section III the analysis is extended to allow for nontradeable commodities and intermediate inputs. Section IV considers the implications of imperfect competition. Section V concludes.

## II. TARIFF REFORM WITH REVENUE ENHANCEMENT

This section develops, applies, and discusses the powerful general result on coordinated tax and tariff reforms described in the Introduction.

### A. The Basic Result and Corollaries

Consider a small open economy of familiar kind, comprising a representative household, a perfectly competitive production sector, and a government. There are  $T$  commodities, all tradeable, world prices being denoted by the  $T$ -vector  $p \equiv (p_i)$ . Tariffs and destination-based consumption taxes, both in specific form,<sup>6</sup> are denoted by  $\tau$  and  $t$ , respectively. Producer prices are thus  $p + \tau$  and consumer prices  $q \equiv p + \tau + t$ . To avoid tedious qualifications, it is assumed throughout that in the initial position<sup>7</sup> and  $t + \tau \gg 0$ , and, moreover, that for each good there is initially both some domestic production and some trade; this merely enables results to be stated in terms of strict rather than weak effects.<sup>8</sup>

The preferences of the representative household are characterized by an expenditure function  $E(q, u)$  defined over consumer prices and utility  $u$ . By Shephard's lemma, consumption is given by the vector of price derivatives of the expenditure function,  $E_q(q, u)$ . For simplicity, all goods are assumed to be normal, so that  $E_{qu} \gg 0$ .

Profit maximization by the representative firm yields a revenue (or gross domestic product) function,  $R(p + \tau)$ , with standard properties. Domestic output is thus given by the  $T$ -vector

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<sup>6</sup>Because behavior is competitive it is immaterial—until Section IV—whether taxes and tariffs are defined in specific or ad valorem form.

<sup>7</sup>Some notational conventions. All vectors are column vectors, transposition being indicated by a prime. Subscripts indicate derivatives, except where the context clearly indicates otherwise. For a vector  $x = (x_i)$ :  $x \gg 0$  means  $x_i > 0 \forall i$ ;  $x > 0$  means  $x_i \geq 0 \forall i$  and  $x \neq 0$ ;  $x \geq 0$  means  $x_i \geq 0 \forall i$ .

<sup>8</sup>For example, replacing a tariff by a consumption tax in such a way as to leave the consumer price unchanged will strictly increase revenue if there is initially some domestic production, but has no effect if the initial tariff is prohibitive.

$R_p > 0$ . Primary inputs are assumed to be in fixed supply and so are suppressed. Public revenue from consumption taxes and tariffs,  $G$ , is assumed to be returned to consumers in the form of a lump-sum transfer—a feature we argue at the end of this section to be merely a simplification—so that the income-expenditure identity is

$$E(q, u) = R(p+\tau) + G, \quad (1)$$

where

$$G \equiv t' E_q(q, u) + \tau' [E_q(q, u) - R_p(p+\tau)], \quad (2)$$

the first term on the right-hand side of equation (2) being revenue from consumption taxation and the second tariff revenue.<sup>9</sup> Without loss of generality, one good is taken as numeraire and assumed to bear neither tariff nor consumption tax.

Consider then a reform which involves simultaneously cutting tariffs by  $\Delta\tau \equiv \tau_n - \tau_o < 0$  (where  $\tau_n$  denotes the 'new' and  $\tau_o$  the 'old' tariff) and increasing consumption taxes by an exactly offsetting amount (that is, setting  $\Delta t \equiv t_n - t_o = -\Delta\tau > 0$ ). While producer prices (and so domestic production) thus change in reflection of the tariff reform, consumer prices are entirely unaffected. The following shows that, so long as the tariff cut improves production efficiency—in the sense that the rearrangement of domestic production it induces increases the value of output at world prices—such a simple form of coordinated tariff reduction and domestic tax reform is always desirable:

**PROPOSITION 1:** *If all goods are tradeable, then combining a tariff cut which strictly increases the value of domestic output at world prices with a consumption tax reform that leaves consumer prices unchanged leads to a strict increase in both welfare and government revenue.*

*Proof:* Using linear homogeneity of both expenditure and revenue functions together with the market-clearing condition (1), the income-expenditure identity reduces to the balanced trade condition  $p'(E_q(q, u) - R_p(p+\tau)) = 0$ . Comparing this before and after the tariff reform, bearing in mind that consumer prices are unchanged as a consequence of the offsetting consumption tax reform, one finds

$$p'\{E_q(q, u_n) - E_q(q, u_o)\} = p'\{R_p(p+\tau_n) - R_p(p+\tau_o)\}. \quad (3)$$

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<sup>9</sup>Any pure profits are assumed to be untaxed.

By virtue of the normality assumption, welfare thus increases ( $u_n > u_o$ ), so long as the value of output at world prices increases. Since  $t + \tau$  is unchanged, the change in public revenue is

$$\Delta G = (t_o + \tau_o)' \{E_q(q, u_n) - E_q(q, u_o)\} + p' \{R_p(p + \tau_n) - R_p(p + \tau_o)\} + \{R(p + \tau_o) - R(p + \tau_n)\}. \quad (4)$$

The first term on the right-hand side of (4) is strictly positive due to the observation that welfare increases and the maintained assumptions that all goods are normal and  $t + \tau \gg 0$  initially; positivity of the second is a premise, and the third term is positive because all tariff rates fall and maximized revenue is increasing in producer prices.  $\square$

Proposition 1 provides a remarkably simple and practicable means of reaping the efficiency gains from tariff reform without jeopardizing the government's revenue position. All that is needed is a point-for-point adjustment of consumption taxes that exactly offsets the impact of the tariff reform on consumer prices. Intuitively, by holding consumer prices constant one ensures that the efficiency gain from the tariff reform materializes as an increase in revenue. (The result also lends itself to diagrammatic representation, which it is most convenient to provide, in a somewhat simplified context, below).<sup>10</sup>

The basic result is extremely sharp, and about as close to practicability as one could hope for. The requirement that the tariff cut improve production efficiency is a substantive one, of course: if substitution effects on production are sufficiently strong, reducing the tariff on one good could generate such a large increase in the output of some other protected good that the value of aggregate output at world prices actually falls. This, however, is a familiar issue of tariff reform design rather than of tax-tariff coordination. Indeed, the essential approach in the tariff reform literature referred to in the Introduction has been to put revenue considerations aside precisely in order to identify circumstances in which tariff cuts are assured to generate improvements in production efficiency. Proposition 1 thus provides a means by which tariff reforms that have been shown in this literature to improve efficiency can be transformed into

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<sup>10</sup>Another intuition (suggested to us by Pascalis Raimondos-Møller) may be helpful. Since a tariff is equivalent to a consumption tax and production subsidy levied at the same rate, the situation envisaged in the text—in which the instruments deployed are a tariff and a consumption tax—is equivalent to one in which the instruments are a consumption tax and a production subsidy. In this latter setting the reform equivalent to that in Proposition 1 is readily seen to be a reduced production subsidy at unchanged consumption tax. So long as that subsidy is initially positive, one would expect the consequence of this reform to be an increase in revenue (through reduced subsidy costs) and improved efficiency (as production is moved closer to value-maximizing).



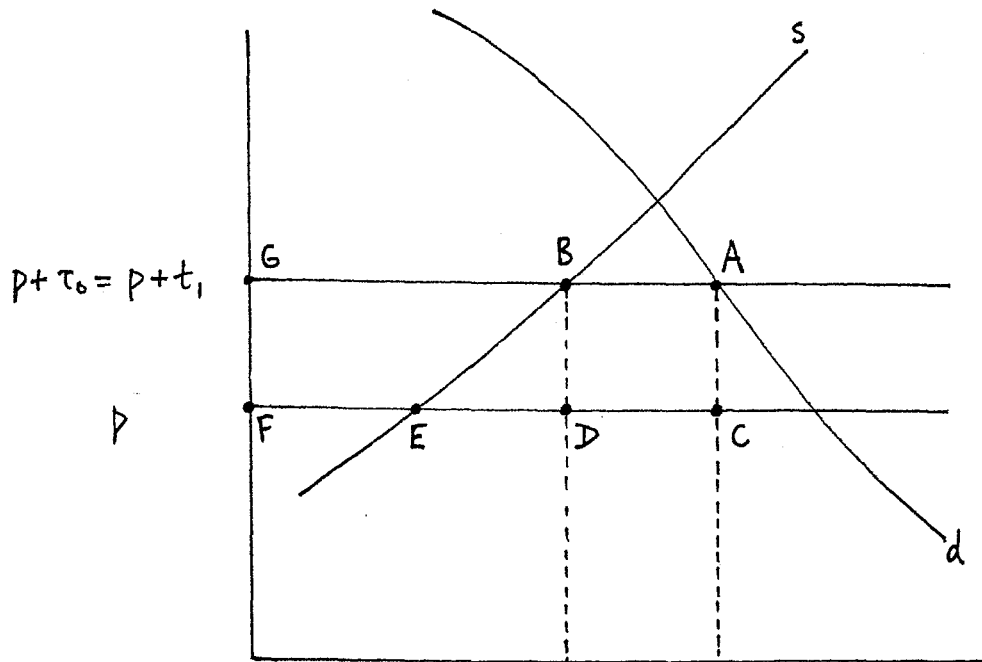
coordinated tax-tariff reforms that remain desirable when revenue is a concern. Three such corollaries are of particular interest.

First, it is well known that for a small economy the value of output at world prices is maximized by setting all tariffs to zero.<sup>11</sup> It is then immediately apparent from Proposition 1 that:

*COROLLARY 1(a): Eliminating all tariffs and amending domestic consumption taxes so as to leave consumer prices unchanged strictly increases both welfare and government revenue.*

This case (specialized further to  $T=2$ ) lends itself to a simple diagrammatic interpretation that is also helpful in developing an understanding of the more general result.<sup>12</sup> Suppose that there are initially no consumption taxes, but only a tariff  $\tau_o$ . In Figure 1, consumption is at  $A$ , production at  $B$ , and public revenue is  $ABCD$ . Replacing the tariff by a consumption tax at the same rate,  $t_1 = \tau_o$ , consumption remains at  $A$  but production shifts to  $E$ . Public revenue rises to  $ACFG$ , with the additional revenue of  $BDFG$  exceeding the reduction in producer surplus  $BEFG$  by the amount of the improvement in production efficiency,  $BDE$ .

Figure 1. Coordinated Tax-tariff Reform in Partial Equilibrium



<sup>11</sup>From the definition of the revenue function,  $p'R_p(p) = R(p) \geq p'R_p(p+\tau)$ .

<sup>12</sup>As will become clear, a similar but more complex diagram is easily constructed to capture the more general case in Proposition 1.

As a second corollary, Proposition 1 also encompasses the important result of Hatzipanayotou, Michael, and Miller (1994) referred to in the Introduction. A radial contraction of all tariffs is one particular kind of reform that increases the value of output at world prices. Setting  $d\tau = -\theta\tau$  for some small scalar  $\theta > 0$  and assuming linear homogeneity and convexity of the revenue function implies that  $d(p'R_p(p+\tau)) = \theta p'R_{pp}(p+\tau)d\tau = \theta\tau'R_{pp}\tau \geq 0$ , the inequality being strict if there is sufficient substitutability in production.<sup>13</sup> Another straightforward application of Proposition 1 therefore gives:

**COROLLARY 1(b)** [Hatzipanayotou, Michael, and Miller (1994)]: *A radial contraction of tariffs accompanied by an increase in consumption taxes that leaves consumer prices unchanged strictly increases both welfare and public revenue.*

As a third corollary—illustrating further how Proposition 1 enables one to use tariff reforms known from the literature with no revenue constraint to improve production efficiency as the basis for reforms that raise both welfare and revenues—consider a ‘concertina’ reform: reducing the highest tariff rate to the second highest level while holding all other tariff rates constant. This is readily shown to increase the value of output at world prices so long as the good concerned is a substitute in production for all other goods (in the sense that an increase in its producer price reduces output of all other goods).<sup>14</sup> Thus:

**COROLLARY 1(c)**: *Reducing the highest proportional tariff rate (on good  $k$ , say) while increasing the consumption tax on  $k$  so as to leave its consumer price constant increases both welfare and public revenue, so long as  $k$  is a substitute in production for all other goods.*

## B. Further Discussion

Proposition 1 is evidently powerful. Three aspects merit further comment:

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<sup>13</sup>See Dixit and Norman (1980), p. 130.

<sup>14</sup>Denoting by  $r_{ij}$  the  $ij$ -th element of  $R_{pp}$ , reducing the tariff on good  $k$  gives

$$d(p'R_p) = -\tau'R_{pp}d\tau = -\sum_i \tau_i^* p_i r_{ik} (d\tau_k) = d\tau_k \sum_i (\tau_k^* - \tau_i^*) p_i r_{ik},$$

where the first equality uses linear homogeneity of the revenue function, the second is cast in terms of ad valorem tariffs, indicated by an asterisk; and the last uses the further implication of homogeneity that  $\sum_i p_i r_{ik} = 0$ . If  $r_{ik} < 0 \forall i$ , reducing the highest tariff rate thus implies  $d(p'R_p) > 0$ .

First, it has been assumed that tax and tariff revenues are returned to the consumer as a lump-sum transfer. This is tantamount to supposing that the marginal cost of public funds (MCPF) is unity: that is, that the government has access to lump-sum taxes. A more realistic approach would be to assume that the government needs to rely on distorting taxes to finance the provision of public goods leading to a marginal cost of public funds greater than unity. A simple way of capturing this (as, for instance, in Neary (1994)) would be to pre-multiply  $G$  in (1) by some parameter  $\delta > 1$  representing the MCPF. But allowing in this way for a MCPF greater than unity would clearly only strengthen the conclusions above: it would attach more weight to an effect of reform that Proposition 1 shows is clearly beneficial—the increase in public revenue—and so only reinforce the tendency for the overall effect of the reform to be desirable.<sup>15</sup> The assumption of a unitary MCPF simplifies the analysis, and if anything understates the generality of the result.

Second, the assumption of a representative household is clearly unattractive. Relaxing it, the reform described in Proposition 1 could leave some households worse off as a result of induced changes in factor prices. Nevertheless, it is clear that consumers in the aggregate gain, so that each could gain individually with appropriate lump-sum transfers. The difficulties of arranging such compensation, however, are well known. Alternatively, if factor incomes can be taxed directly then it can be proved<sup>16</sup> that by amending those taxes so as to keep both factor and consumer prices constant in the face of reform, an efficiency-enhancing tariff reform can be combined with a reform of consumption and income taxes so as to leave all consumers better off and raise public revenues. In many contexts, however—especially those of developing countries where the issues addressed here are most likely to arise—there are severe restrictions on the deployment of distorting income taxes, so that the practical value of that extension is limited. The key point is that special measures may be needed to ensure that the factor owners most directly affected by trade liberalization also share in the potential benefit from the coordinated tax-tariff reform strategy described above.

Third, although the result is about as close to practicability as one could hope—its essence is a simple restriction on policy instruments, and it is applicable to discrete reforms—it should be recognized that its application is unlikely to be exact in practice. Tariff reforms generally involve differential changes in the rates applied to a large number of items. While optimal tax theory generally also prescribes cross-commodity variation in rates of consumption tax, policy advice—attaching more weight to administrative concerns—is typically for a very few rates of general sales tax together with a few excises. Perfect offsetting of a tariff reform might thus require a degree of differentiation in commodity tax rates that would not generally be recommended on wider grounds. In practice, exactly offsetting all effects of tariff reform on

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<sup>15</sup>A formal proof of this is omitted.

<sup>16</sup>Indeed since elastically supplied factors are a form of nontradeable good the proof is formally identical to that of Proposition 2 below.

consumer prices in the manner of Proposition 1 is thus unlikely to be possible, or perhaps desirable.

### III. EXTENSIONS

This section considers the extension of Proposition 1 to admit two important features of reality: nontradeable goods and imported intermediate inputs. Both, it will be seen, require additional conditions to ensure the desirability of the reform strategy set out in Section II.

#### A. Nontradeable Goods

Proposition 1 presumes that all final consumption goods are tradeable. Assume now that in addition to the  $T$  traded goods there are  $N$  nontraded goods, with all  $T+N$  goods used for final consumption (the importance of this being that a consumption tax can be levied on each). Consumer prices are  $q \equiv (q^T, q^N)'$ , where  $q^T \equiv p + \tau + t^T$  relates to the traded goods and  $q^N \equiv \rho + t^N$  to nontraded goods; the producer prices of the latter,  $\rho$ , are determined endogenously through the market-clearing condition for nontradeables, written as

$$E_q^N(q, u) = R_\rho(p + \tau, \rho). \quad (5)$$

The government's revenue constraint is now

$$G = (t^N)'E_q^N(q, u) + (t^T)'E_q^T(q, u) + \tau' \{E_q^T(q, u) - R_\rho(p + \tau, \rho)\}, \quad (6)$$

the right-hand side of (6) again being the sum of consumption tax and tariff revenue.

Consider then a coordinated tax-tariff reform along the lines of Proposition 1: an efficiency-improving tariff cut combined with a consumption tax reform that exactly neutralizes the effect on consumer prices. Such offsetting is easily arranged for traded goods. All that is needed, as before, is to increase taxes on traded goods point-for-point to offset tariff reductions: that is, simply set  $\Delta t^T = -\Delta \tau$ , exactly as in Proposition 1. The endogeneity of producer prices of nontraded goods makes the change in taxes on nontraded goods required to keep nontraded consumer prices unchanged more complex; the details, however, need not concern us.<sup>17</sup> The important point is that, given one additional condition, such a reform retains the desirable properties established in Proposition 1:

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<sup>17</sup>For an infinitesimal reform, perturbing (5) shows  $dq^N (= dp + dt^N) = 0$  to require that  $dt^N = (R_{\rho\rho})^{-1} \{R_{\rho\tau} d\tau - E_{qu}^N du\}$  (where of course  $du$  is also determined endogenously).

PROPOSITION 2: *Combining any tariff reform that increases the value of traded output at world prices with a consumption tax reform that leaves consumer prices unchanged increases welfare. It also increases public revenue if it reduces the maximized value of output (traded and nontraded) at producer prices.*

*Proof:* Evaluating the balanced trade condition before and after reform one finds

$$p' \{E_q^T(q, u_n) - E_q^T(q, u_o)\} = p' \{R_p(p + \tau_n, \rho_n) - R_p(p + \tau_o, \rho_o)\}, \quad (7)$$

from which the welfare part of the result follows. For the revenue part, again use the linear homogeneity of the revenue function and the market-clearing condition for nontraded goods to find, given constancy of  $q$ ,

$$\begin{aligned} \Delta G = & (t_o + \tau_o)' \{E_q^T(q, u_n) - E_q^T(q, u_o)\} + (q^N)' \{E_q^N(q, u_n) - E_q^N(q, u_o)\} \\ & + p' \{R_p(p + \tau_n, \rho_n) - R_p(p + \tau_o, \rho_o)\} + \{R(p + \tau_o, \rho_o) - R(p + \tau_n, \rho_n)\}. \end{aligned} \quad (8)$$

The conclusion then follows by an argument parallel to that for Proposition 1.  $\square$

The additional condition—needed for the revenue part of the result—is that tariff reform reduces the value of output at domestic producer prices (ensuring that the final term in (8) is positive). This was certain to be the case in the absence of nontradeables, as a consequence of the assumption that all tariff rates fall. Possible difficulties now arise, however, from the changes in the producer prices of nontraded goods that reform may induce. These effects are potentially complex. Recalling the market-clearing condition (5) (and footnote 14) it is sufficient for  $\rho_n = \rho_o$ , and so for maximized revenue indeed to fall, that the income elasticity of demand for nontraded goods be zero ( $E_{qu}^N = 0$ ) and that there be no substitution effects in production between tradeable goods and nontradeable goods ( $R_{p\rho} = 0$ ). Even if the producer prices of nontradeable goods do change, however, there seems no general reason to suppose that they will counteract rather than reinforce the effects on maximized revenue of the reduced producer prices of tradeables.<sup>18</sup>

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<sup>18</sup>If tradeable and nontradeable goods are substitutes, the equilibrium volume of nontradeable goods falls if the decline in demand for nontradeables—which are now more expensive—dominates the increased supply of nontradeables. Both effects depress the equilibrium price of nontradeables.

## B. Intermediate Inputs

The treatment of intermediate goods is typically a major issue in the practical evaluation and design of tariff reforms, the impact on effective rates of protection commonly being the focus of much concern. But the formal theory of tariff reform has paid disproportionately little attention to the treatment of intermediates (reflecting, no doubt, the analytical complexities that they bring).<sup>19</sup> Here we explore some of the implications of tradeable intermediates<sup>20</sup> for the strategy of coordinated tax-tariff reforms developed above.

Few simple general results seem to be available. Some central considerations emerge more clearly by considering three particular situations.

First, suppose that all intermediate goods are also used for final consumption. Then they can also all be subject to a final consumption tax, and Proposition 1 continues to hold as stated: all that is needed is to reinterpret the revenue function along lines described in Dixit and Norman (1980, p. 70).

Second, suppose instead that all intermediate goods are used to produce nontradeable final goods. Denoting by  $A$  the  $T \times N$  matrix of input-output coefficients (assumed to be fixed)—so that  $a_{ij} \geq 0$  denotes the amount of the  $i$ -th tradeable required per unit output of the  $j$ -th nontradeable—consumer prices of nontradeables are now  $q^N = \rho + t^N + A'(p + \tau)$ , where  $\rho$  reflects payments to domestic factors, and the government's revenue constraint is

$$G = (t^T)' E_q^T + (t^N)' E_q^N + \tau' [E_q^T + A E_q^N - R_p], \quad (9)$$

which differs from (6) in that tariff revenue is now also collected on intermediates. The following shows that the gist of Proposition 2 continues to apply, with the now-familiar reform strategy continuing to have the desirable features established there:

**PROPOSITION 3:** *If tradeable intermediate goods are used only to produce nontradeable consumption goods, then a coordinated tariff-tax reform that keeps consumer prices constant increases welfare so long as the value of traded output at world prices increases. Revenue also increases if the maximized value of domestic output (tradeables and nontradeables) at producer prices decreases.*

*Proof:* Comparing the trade balance condition before and after reform gives:

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<sup>19</sup>There are of course exceptions: see, especially, López and Panagariya (1992) and Panagariya (1992).

<sup>20</sup>Nontradeable intermediates add nothing novel to the issue with which we are concerned.

$$p' \{E_q^T(q, u_n) + AE_q^N(q, u_n) - E_q^T(q, u_o) - AE_q^N(q, u_o)\} = \quad (10)$$

$$p' \{R_p(p + \tau_n, \rho_n) - R_p(p + \tau_o, \rho_o)\},$$

from which the welfare part follows. For the revenue part, use the market-clearing condition for nontradeables and linear homogeneity of the revenue function to write (9) as

$$G = (t^T + \tau)' E_q^T(q, u) + (q^N - A'p)' E_q^N(q, u) + p' R_p(p + \tau, \rho) - R(p + \tau, \rho). \quad (11)$$

Comparing (11) before and after reform yields an expression differing from (8) only in that the change in demand for nontradeables is valued at  $q^N - A'p$  rather than  $q^N$ ; since  $q^N - A'p = \rho + t^N + A'\tau \gg 0$ , the result follows.  $\square$

Third, suppose that intermediates are used to produce traded goods. This is the most problematic case, for it is impossible to recoup any revenue loss from a reduction in tariffs on intermediates by raising the taxes on final consumption while, in the manner of the reforms analyzed above, at the same time leaving consumer prices unchanged. Conditions for such a reform to have the desirable properties established earlier are thus more demanding.

To see this, distinguish between final and intermediate goods by superscripts  $F$  and  $I$ , respectively, now characterizing production decisions in terms of a revenue function  $R(p^F + \tau^F, p^I + \tau^I)$ . Denoting derivatives with respect to the two sets of producer prices by  $R_p$ ,  $j = F, I$ , net demand for the intermediates is given by  $-R_I > 0$ . The income-expenditure identity retains the familiar form  $E(q, u) = R(p^F + \tau^F, p^I + \tau^I) + G$ , where,  $q = p + \tau^F + t$ , while government revenue is now

$$G = (\tau^F)' \{E_q(q, u) - R_F(p^F + \tau^F, p^I + \tau^I)\} - (\tau^I)' R_I(p^F + \tau^F, p^I + \tau^I) + t' E_q(q, u). \quad (12)$$

Consider, once again, a coordinated tax-tariff reform of the kind considered above—now involving reducing tariffs on either or both final and intermediate goods. One finds:

**PROPOSITION 4:** *Welfare is increased by reducing tariffs on either final or intermediate goods, or both, in such a way as to increase the value of net national output at world prices, and simultaneously adjusting consumption taxes so as to leave consumer prices unchanged. Such a reform also increases public revenue if it reduces the maximized value of net output, at producer prices.*

*Proof:* The welfare part follows in the familiar way from the trade balance condition. For the revenue part, rewrite (12) as

$$G = (t + \tau^F)' E_q(q, u) + (p^F)' R_F(p^F + \tau^F, p^I + \tau^I) + (p^I)' R_I(p^F + \tau^F, p^I + \tau^I) - R(p^F + \tau^F, p^I + \tau^I). \quad (13)$$

Comparing revenue before and after reform gives the result.  $\square$

Proposition 4 reads very similarly to the earlier result for nontradeables (Proposition 2). In each case, it is sufficient for the reform to increase not only welfare, but also revenue, that the maximized value of output, at producer prices of final and intermediate goods, fall. There is, however, an important sense in which this condition is more restrictive in the present context of intermediates than it is in the earlier one of nontradeables. As already mentioned, there was no particular reason to suppose the distinctive features of nontradeables act either toward or against such an outcome. Here, however, the distinctive features of the situation clearly point against fulfillment of the condition. While reducing tariffs on final goods tends to increase the value of output at producer prices—which is why no explicit condition to this effect is needed in Proposition 1—reducing the tariffs on intermediates would clearly tend, in itself, to *increase* the maximized value of output at domestic producer prices. Intuition then suggests that the former effect will dominate the latter, and public revenue will consequently be increased, if tariffs on final goods are cut by more, in some appropriate sense, than tariffs on intermediates. This is confirmed in:

*COROLLARY 4: Suppose tariffs are levied only on one final good and one intermediate good.<sup>21</sup> Then it is sufficient for a small reform of the kind in Proposition 4 to also increase public revenue that the tariff reductions imply a greater proportionate fall in the producer price of that final good than in the producer price of the intermediate.*

*Proof:* Denoting producer prices by  $P^i \equiv p^i + \tau^i$ ,  $i = F, I$ , perturbing  $R(p^F + \tau^F, p^I + \tau^I)$  gives  $dR = R_F P^F (dP^F/P^F) + R_I P^I (dP^I/P^I)$ ; since  $R = R_F P^F + R_I P^I > 0$ , the result follows from Proposition 4.<sup>22</sup>  $\square$

The reason why some such condition is needed is clear: the revenue lost by ‘too large’ a reduction in tariffs on intermediates cannot be recouped by bringing domestic production of final goods into taxation along with imports. The condition in Corollary 4 provides a simple sufficient condition for the tariff cut on intermediates to be small enough for this difficulty not to arise.

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<sup>21</sup>The extension to the general case is obvious but slightly cumbersome.

<sup>22</sup>If  $dP^F/P^F = dP^I/P^I < 0$  then  $dR = (dP^I/P^I)R < 0$ .



#### IV. IMPERFECT COMPETITION

It is well known that reforms which are desirable under perfect competition may be undesirable in settings of imperfect competition. This section shows that such is indeed the case of the strategy of coordinated tax-tariff reform examined above.

To establish this general point, it suffices to establish it for one specific model of imperfect competition. Here we consider a simple Cournot duopoly model, a slight variant of that familiar from Brander and Spencer (1985). The home market, we now assume, is served by two firms, one domestic and the other foreign. The two firms are identical, having constant marginal cost,  $c$ , and fixed cost,  $F$ , with profits:

$$\begin{aligned}\Pi &= \{q(X+X^*) - t - c\}X - F, \\ \Pi^* &= \{q(X+X^*) - t - \tau - c^*\}X^* - F^*,\end{aligned}\tag{14}$$

where  $X$  denotes output of the domestic firm, asterisks indicate foreign variables, and  $q(\cdot)$  is the inverse (world) demand curve. Note that both firms face the same consumption tax<sup>23</sup>  $t$ , but only the foreign firm pays the tariff  $\tau$ . It is assumed, as above, that in the initial position  $t + \tau > 0$ .

Cournot-Nash behavior implies the first-order conditions:

$$\begin{aligned}q'X + q - (t + c) &= 0, \\ q'X^* + q - (t + \tau + c) &= 0,\end{aligned}\tag{15}$$

where a prime denotes a partial derivative. It is assumed that both firms are active in the initial position, for which it is evidently necessary that  $q - c - t - \tau > 0$ . For sharpness of results, it is assumed further that inverse demand is linear, so that  $q'' = 0$ . Perturbing (15) gives:

$$\begin{bmatrix} dX \\ dX^* \end{bmatrix} = \frac{1}{3q'} \begin{bmatrix} 2 & -1 \\ -1 & 2 \end{bmatrix} \begin{bmatrix} dt \\ dt + d\tau \end{bmatrix}.\tag{16}$$

Indirect utility in the home country is assumed to be of the form  $v(q) + m$ , where  $m$  denotes lump-sum income: consistent with the assumed form of the inverse demand curve, there are no income effects on the demand for the good of interest. Thus,

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<sup>23</sup>The assumption that taxes and tariffs are levied in specific form is now a substantive one, but evidently inessential to the point at issue.

$$W \equiv v(q) + \Pi + t(X+X^*) + \tau X^*, \quad (17)$$

all tax and tariff revenue being assumed, as before, to be returned to the consumer as a lump-sum transfer.

The strategy for tax-tariff coordination underlying the reform in Proposition 1 can be characterized in either of two ways: as involving equal but opposite changes in taxes and tariffs ( $\Delta t = -\Delta \tau$ ), or as leaving consumer prices unchanged in the face of a tariff cut ( $\Delta q = 0$ ). Given fixed world prices, the two characterizations are equivalent. Here, however, they are not: from (16), setting  $dt = -d\tau > 0$  will typically not leave the consumer price unchanged (because it will change  $X+X^*$ ). The following shows, however, that neither kind of reform is necessarily desirable in the presence of imperfect competition; indeed, in the model considered here both actually *reduce* welfare:

PROPOSITION 5: *In the model of Cournot duopoly with linear demand described above, welfare is strictly reduced by a small tariff cut combined with either:*

- (a) *An increase in the consumption tax of the same absolute magnitude;<sup>24</sup> or*
- (b) *An increase in the consumption tax such as to leave the consumer price of the taxed good unchanged.*

*Proof.* Substituting for  $\Pi$  from (14) and perturbing for an arbitrary infinitesimal tax-tariff reform gives, on noting from Roy's identity that  $v' = -(X+X^*)$ ,

$$dW = -X^* dq + (q-c)dX + (t+\tau)dX^* + X^*(dt+d\tau). \quad (18)$$

For part (a), setting  $dt+d\tau = 0$  and noting from (16) that then

$$dX = -2dX^* = (2/3q')dt, \quad (19)$$

one finds that (18) becomes, on using (15),  $dW = (1/3q')[q-c-2q'X^*]dt < 0$ .

For part (b), since  $dq = 0$  requires  $dX = -dX^*$ , (18) in this case becomes

$$dW = (q-c-t-\tau)dX + X^*(dt+d\tau). \quad (20)$$

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<sup>24</sup>This part of the proposition—it is readily checked—requires only that home and foreign outputs be strategic substitutes, in the sense that an increase in the latter leads, all else being equal, to a reduction in the former.

From (16),  $dX = -dX^*$  requires that  $d\tau = -2dt$ . Then  $dX = (4/3q')dt < 0$  (from (16)) and  $d\tau + d\tau = -d\tau < 0$ ; thus both terms in (20) are strictly negative.  $\square$

The reason that these coordinated tax-tariff reforms are so undesirable in this setting is straightforward: the shift in rents from the domestic to the foreign firm due to the tariff cut more than offsets the efficiency gain.

## V. CONCLUSION

The formal theory of policy reform offers little guidance on what is in practice one of the more pressing reform issues facing many developing countries: how to secure the efficiency gains from eliminating remaining tariff barriers—often still considerable—while preserving the public (tax plus tariff) revenues. This paper has developed and explored one very simple strategy for doing so: simply offset tariff reductions, point-for-point, with increases in destination-based consumption taxes, thereby leaving consumer prices unchanged. For a small open economy, it has been shown, coordinated reforms of this kind are certain to increase both welfare and public (tax plus tariff) revenues, so long as the underlying tariff reform improves production efficiency.

This result provides a clear rationale for the importance commonly attached to the development of domestic sales taxes, notably the value-added tax, as an accompaniment to tariff reform. Implementing such a strategy, it has been noted, is not entirely straightforward, since it will generally not be possible to precisely offset complex tariff reforms by adjusting an indirect tax structure consisting only of a simple sales tax and a few excises. But such simple structures of indirect taxation may indeed be preferable to the more complex structures that exact offsetting would require. More fundamental limitations on the appeal of the strategy stem from the potential distributional effects of the factor price changes induced by tariff reform; dealing with these may require a more complete range of factor taxes than is generally available in developing countries. Nor does the result extend readily to deal with the reduction of tariffs on intermediate goods used to produce traded goods, since it may then be impossible to arrange offsetting adjustments to consumption taxes without affecting consumer prices. It has been too that the appeal of the simple coordination strategy does not extend routinely to settings of imperfect competition. More generally, when tariffs perform some function that is not better served by domestic tax instruments, designing beneficial coordinated reforms of taxes and tariff reforms becomes a more problematic issue, and one that may also call for some degree of coordination across countries.

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