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Revenue-increasing and welfare-enhancing reform of taxes on exports

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Abstract

The loss of revenue from a reduction in export taxes has been a concern for trade policy reform in many developing countries. We discuss a strategy for selective reform of taxes on exports that enhances welfare and increases revenue. The strategy involves a reduction in the export tax on a given commodity with an offsetting increase in production tax to keep the producer price unchanged. This strategy is especially promising for exportables with a net subsidy on domestic consumption due to high export taxes and low consumption taxes.

JEL classification: H20; F13
Keywords: Export tax; Production tax; Welfare; Government revenue

1. Introduction

Trade liberalization and trade tax reform have been at the center stage of economic policy reform in developing countries during the last couple of decades. Trade policy related conditionalities have been a standard feature of the structural adjustment and stabilization policies supported by the IMF and the World Bank across a large number of developing

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Table 1

	Export tax as a percentage of trade tax revenue		
	1992	1995	2000
Argentina	8.43	2.16	1.66
Azerbaizan	n.a.	65.43	23.30
Bhutan	12.21	27.60	13.97
Burundi	13.44	38.90	29.84
Costa Rica	17.09	18.39	4.43
Cote d'Ivoire	33.36	33.59	33.70
Ethiopia	3.57	15.14	9.82
Ghana	19.04	21.23	n.a.
Indonesia	0.30	5.79	5.66
Malaysia	29.95	14.04	n.a.
Mongolia	0.00	35.07	23.10
P. New Guinea	11.66	31.13	15.61
Russia	54.66	63.59	71.91
Syria	17.81	19.21	11.51
Thailand	1.49	1.14	2.67

Note: The numbers in 1995 column include 1993 (Ghana), 1997 (Malaysia), and 1999 (Mongolia). The numbers in 2000 column include the latest year available in GFS Year Book, 2002; Azerbizan (1997), Burundi (1998), P. New Guinea and Syria (1999) and Indonesia (2001).

countries.[1] Although there seems to be a consensus among the policy advisors about the desirability of reducing trade taxes, in many developing countries the government has been less than enthusiastic in implementing the trade tax reform because of worries about loss of tax revenue.[2] The average share of trade taxes in government revenue in Africa was 36.4% over the period 1975–79, 34.8% over 1980–84, and 32.5% over 1985–89. The corresponding numbers for Asia are 26.5% (1975–79), 24.8% (1980–84), and 23.8% (1985–89) (Zee, 1996). The bulk of the trade taxes usually come from import tariffs, and the importance of export taxes as a source of revenue has further declined over the last few decades. However, there are still a number of countries where export taxes constitute an important source of trade tax revenue. Table 1 presents the share of export taxes in total trade tax revenue for 15 countries for the years 1992, 1995, and 2000. In 1995, export tax revenue was more than 10% of trade tax revenue for 12 countries, with 6 countries having more than 30%. In 2000, 8 out of 12 countries for which data were available had more than 10% of trade tax revenue from export taxes; 5 of them having more than 20%.

In a sample of 26 countries for which World Bank adjustment programs had specific conditionality for increasing revenue, revenue actually declined in 9 countries after trade and tax reform were implemented. Underestimation of revenue losses from reductions in trade taxes was identified as one of the main factors behind the decline in the revenue (Thirsk and

[1] In a sample of 250 structural adjustment operations of World Bank in 86 countries that incorporated fiscal reform during 1979–94, trade tax conditionality was included in 171 operations in 75 countries (see Thirsk and Watson, 1995).

[2] The current consensus favors a reduction in trade taxes with revenue-neutral or revenue-increasing reform of consumption taxes. For critique of the prevailing consensus, see Anderson (1996), Emran and Stiglitz (2000, 2005).

Watson, 1995). Recent estimates for sixty countries using computable general equilibrium models also show that trade liberalization is likely to reduce government revenue and an increase in other (domestic) taxes is needed to cover the revenue shortfall (see Devarajan et al., 1999). Given these undesirable revenue implications of trade reform, the quest for tax reform strategies that reduce the trade taxes without adversely affecting either government revenue or consumer welfare has been high in recent research agenda. For example, Michael et al. (1993) and Anderson (1996) analyze conditions under which a revenue-neutral reform of tariffs and consumption taxes enhances national welfare; Diewert et al. (1989) prove the existence of Pareto-improving tariff reform accompanied by changes in commodity taxes; Abe (1995) examines welfare-improving combination of tariff and commodity taxes in a small open economy with an endogenous public good; Emran and Stiglitz (2000, 2005) analyze revenue-neutral reform of trade taxes and VATs in the presence of an informal sector, while the problem of designing a revenue-neutral optimal tariff structure has been studied by Dasgupta and Stiglitz (1974), Heady and Mitra (1987), Panagariya (1994), Chambers (1994), Hatta and Ogawa (2000), among others.

Although strategies to raise more revenue have been a major focus of tax reform in developing countries, the theoretical literature has paid only limited attention to the conditions under which a tax reform both increases revenue and enhances welfare, two notable exceptions being Falvey (1994) and Hatzipanayotou et al. (1994). Using Motzkin's theorem of the alternative, Falvey (1994) identifies a number of cases where trade taxes and subsidies can be reformed both to increase welfare and enhance revenue (in his terminology, Welfare Increasing and Revenue Enhancing or WIRE reform). For example he shows that imposing a small import tariff on a commodity with zero initial tariff is a WIRE reform if the commodity is a net substitute of all other goods and there are no export taxes. Hatzipanayotou et al. (1994) show that, under suitable conditions, a radial reduction in tariffs with an increase in the consumption taxes in a way that leaves the consumer price vector unchanged both enhances welfare and increases government revenue. The result is especially important because it provides a simple strategy for indirect tax policy reform. Hatzipanayotou et. al. (op cit) consider radial and uniform reform of tariffs and consumption taxes. Their results, however, require stringent initial conditions. As noted in their paper, there are two sets of initial conditions under which such a "win–win" reform is possible. They are (i) both the tariffs and consumption taxes are harmonized at the initial position, and (ii) the vector of tariffs is identical to the vector of consumption taxes at the initial position. Both of these cases are of limited interest for designing an actual policy reform. Also, as shown by Emran (2000), the results derived by Hatzipanayotou et. al. (op cit) are sensitive to the assumption about costs of administration. This raises the question of whether a coordinated reform of trade taxes and consumption taxes that focuses on a single commodity at a time can be a better approach. This question has been addressed by Emran (op cit). The results show that, indeed, a revenue-neutral reform of import tax and consumption tax on a given commodity yields a welfare improvement under less stringent conditions compared to the case of a radial reform discussed above. However, as noted in his paper, a coordinated reform of export tax and consumption tax on a given commodity that leaves the consumer price unchanged cannot increase government revenue, if the taxes are assumed to be revenue-raising at the margin. This is due to the fact that a reduction in export tax increases the consumer price and thus requires an offsetting *reduction* in

consumption tax to keep the consumer price unchanged. Since both of the taxes need to be reduced, the revenue effect of such a reform is unambiguously negative, unless the taxes are on the "wrong" side of the Laffer curve to begin with.[3] In this paper, we show that there is an alternative strategy for reducing the export tax on a given commodity without compromising government's revenue objectives. The key insight is that if the reduction in export tax is accompanied by an increase in the production tax to keep the producer price unchanged, the net revenue effect of such a reform is likely to be positive when the taxes are revenue-raising at the margin which also leads to welfare improvement with lump-sum transfer. The economic intuition is that since the producer prices are kept unchanged, the reform reduces consumption subsidy on exportable commodities which improves welfare as there is no valid reasons (like nutrition efficiency effect) for providing consumption subsidy in the standard general equilibrium model used here. As the domestic consumption is cut down due to the increase in consumer price following a reduction in export tax, the volume of export goes up as the domestic production remains unchanged because of an unchanged producer price. As a result, the loss in export tax revenue is partially mitigated by a higher volume of exports. This coupled with a higher production tax can guarantee a positive revenue outcome under plausible conditions. Given the stringent fiscal predicament in most of the developing countries, it might be a difficult task for the government to eliminate export taxes even when they provide only a few percent of the trade tax revenue if the reform entails revenue loss. The need for devising ways to increase revenue while eliminating export taxes thus seems to have practical policy importance for a number of countries. Although production taxes are, in general, and for good reasons, not in favor with economists, they play an important role in developing countries. Because of the informational and administrative constraints, a consumption tax may not be a feasible option.[4] It is however, very difficult to get a suitable summary measure of the production tax rate in an economy, as noted by Gordon and Levinsohn (1990). The reason is that a variety of taxes including corporate taxes, property taxes, and sales taxes can distort the relative producer prices, especially with a large informal sector in the economy, and as such qualify as production taxes (for a discussion, see Gordon and Levinsohn (1990); Ahmad and Stern (1987)).

The rest of the paper is organized as follows. Section 1 describes the basic structure of the economy. The next section presents the results on revenue-increasing and welfare-enhancing reform of indirect taxation of exports. The paper concludes with a summary of the results and with a discussion of their limitations.

[3] We assume that all the taxes are on the "right" side of the Laffer curve so that a reduction (increase) in rates reduces (increases) revenue.

[4] Gordon and Levinsohn (1990) argue that, in low income countries, production taxes are more extensively used because they, to some extent, offset the distortions created by trade taxes, and vice versa. The beneficial role of production taxes in developing countries has also been noted, among others, by Chambers (1994), Shalizi and Squire (1990), World Development Report (1988), and Newbery (1987). The focus in that literature is, however, on the indirect taxation of import substitutes. Based on the open economy version of *production efficiency lemma* (see Diamond and Mirrlees (1971), Dasgupta and Stiglitz (1972, 1974)), it is argued that the tax on domestic production of import substitutes can be increased up to the level of import taxes so that the undue protection enjoyed by the domestic producers of import substitutes can be eliminated. This is expected to improve production efficiency and increase revenue as well.

2. Section 1: the model

The economy, endowed with a vector of fixed factors (L), is a competitive small open economy where all goods are internationally tradable. The set of all tradables is denoted as T which can be partitioned into two subsets: $M \subset T$ is the subset comprising of all importables, and $X \subset T$ is the subset of all exportables. There are some goods which are not taxable. This assumption of restricted taxation places the analysis in the domain of second best. For simplicity we lump all the non-taxable goods together into a single good and assume it to be an exportable. This untaxed exportable serves as the numeraire and is denoted as good '0'.[5] The production side of the economy is represented by a revenue function $G(p_0, p, L)$ which shows the maximum value of the national output produced with factors L and a convex technology when facing the producer price vector $[p_0,p]$. $G(p_0, p, L)$ is assumed to be strictly convex in p.[6] For simplicity, any pure profits, when they exist due to diminishing returns, are assumed to be untaxed.[7] This implies that the assumption of an untaxed numeraire commodity places real restrictions on the choice of taxes. The government raises revenue by taxing trade, consumption and production, and keeps a fixed amount γ of the revenue for production of public goods. The rest of the revenue is redistributed to the consumer in a lump-sum manner.[8] The tax administration is costly in the sense that when \$1 is raised as tax revenue, only $\$(1-\delta)$ adds to the government exchequer, where $\delta \in (0,1)$. The parameter δ thus represents the administrative costs of tax collection and expenditure allocation.[9] The taxes and prices in the economy before the reform are as follows:

$$q_m = 1_m + \tau_m + t_m \quad p_m = 1_m + \tau_m - v_m$$
$$q_x = 1_x - \tau_x + t_x \quad p_x = 1_x - \tau_x - v_x$$
$$q' \equiv (q'_m\ q'_x) \quad p' \equiv (p'_m\ p'_x) \quad q_0 = p_0$$
$$\tau' \equiv (\tau'_m\ -\tau'_x) \quad t' \equiv (t'_m\ t'_x) \quad v' \equiv (v'_m\ v'_x)$$

where τ is the vector of trade taxes, t is the vector of consumption taxes, v is a vector of production taxes. Furthermore, all of the international prices are normalized to one by suitable choice of units of the goods which implies, in particular, that $q_0 = p_0 = 1$. The

[5] As pointed out by an anonymous referee, the numeraire can as well be an importable good. Our assumption that it is an exportable is for the sake of concreteness.

[6] The revenue function $G(..)$ is strictly convex in p if there exist some substitutability between the taxed goods and untaxed numeraire (see Dixit, 1985, p. 344).

[7] For well-known reasons, governments in developing countries cannot impose 100% profits tax. For example, it is practically impossible to isolate any pure profit from quasi-rents (the returns to capital and entrepreneurship) in a typical small unincorporated business in developing countries (see Sah and Stiglitz, 1992).

[8] This specification where the revenue requirement for public goods production is fixed in terms of numeraire simplifies the exposition considerably. It has been fruitfully used in the literature (see for example, Diewert et al. (1989)).

[9] It is standard in the literature to ignore the costs of tax and expenditure administration (see, for example, Hatzipanayotou et al., op cit). The assumption that there are no significant costs of administration is, however, a strong one, especially in the context of developing countries where the informational and administrative constraints on government's tax policy are particularly severe (Sah and Stiglitz, op cit). Furthermore, the parameter δ can represent the efficiency costs of administrative corruption.

subscripts m and x denote importables and exportables respectively and a prime denotes a transpose of a column vector. We assume that all prices are positive. All the commodities are both consumed and produced domestically. There is a representative consumer who owns all the factors of production and maximizes a strictly quasi-concave utility function subject to the budget constraint. Let $E(q_0,q,U)$ denote the expenditure function where q_0 is the consumer price of the numeraire good, q is the vector of non-numeraire consumer prices, and U is the maximum utility level that can be achieved with expenditure E given the price vector $[q_0, q]$. Note that the expenditure function above does not include the public good supplied by the government. Since the public good is fixed in quantity throughout the analysis, for notational brevity, we suppress the public good from the expenditure function. It is assumed that both the expenditure and revenue functions are twice differentiable.[10]

The budget constraint of the representative consumer equates the expenditure to the private revenue plus the (net) lump-sum transfer.

$$E(q_0, q, U) = G(p_0, p, L) + D \tag{1}$$

$$\text{where } D = (1-\delta)R\,(\,.\,) - \gamma \tag{2}$$

where $R(\,.\,)$ is the gross government revenue and D is net transfer to the consumer after accounting for both administrative costs and revenue requirements for public goods.[11] We assume that the size of public expenditure program is small enough so that $D \geq 0$. This assumption ensures that government cannot use lump-sum tax to finance the public goods production. Government revenue from the trade, consumption, and production taxes is:

$$R(\tau, t, v) = \tau'\left(E_q - G_p\right) + t'E_q + v'G_p \tag{3}$$

where the subscripts to the functions denote the partial derivatives. In addition to the consumer budget constraint and the government revenue function, the equilibrium of the economy is characterized by the balance of trade condition which we can ignore by Walras law. So Eqs. (1) and (3) are the building blocks for analyzing any tax and tariff reform in this economy.

3. Section 2: producer price-neutral reform of export tax and production tax

We consider a marginal reduction in export tax on commodity $k \in X$ with an offsetting increase in the production tax so that the producer price remains unchanged. Specifically we consider the following differential policy reform:

$$\mathrm{d}v_k = v_k \mathrm{d}\alpha, \quad \mathrm{d}\tau_k = -\tau_k \mathrm{d}\beta, \quad \mathrm{d}v_k + \mathrm{d}\tau_k = 0$$
$$\text{where } 1 > \mathrm{d}\beta > 0, \text{ and } 1 > \mathrm{d}\alpha > 0 \text{ are scalars.}$$

[10] If the number of commodities is greater than that of factors in an economy, the revenue function $G(.)$ need not be differentiable (see, for example, Woodland, 1982, p.219).

[11] The author is grateful to an anonymous referee for suggesting this specification of the net transfer function.

So the post-reform production tax and export tax on commodity k are $v_k+\mathrm{d}v_k=(1+\mathrm{d}\alpha)v_k$ and $\tau_k+\mathrm{d}\tau_k=(1-\mathrm{d}\beta)\tau_k$ respectively, with $\mathrm{d}\alpha=\left(\frac{\tau_k}{v_k}\right)\mathrm{d}\beta$.

4. Government revenue

Taking total differential of the government revenue function Eq. (3) with $\mathrm{d}v_k=v_k\mathrm{d}\alpha$, $\mathrm{d}\tau_k=-\tau_k\mathrm{d}\beta$, $\mathrm{d}v_k+\mathrm{d}\tau_k=0$, we get:

$$\mathrm{d}R(.)=\left\{E_{q_k}+(\tau+t)'E_{qq_k}\right\}\tau_k\mathrm{d}\beta\equiv\Psi\tau_k\mathrm{d}\beta \tag{4}$$

Since both τ_k and $\mathrm{d}\beta$ are positive, the sign of $\mathrm{d}R(.)$ is determined by that of Ψ.

5. Consumer welfare

Taking total differential of the budget constraint of the representative consumer, we have:

$$-E_{q_k}\mathrm{d}\tau_k+E_U\mathrm{d}U=-G_{p_k}(\mathrm{d}\tau_k+\mathrm{d}v_k)+(1-\delta)\left[\frac{\partial R(.)}{\partial\tau_k}\mathrm{d}\tau_k+\frac{\partial R(.)}{\partial v_k}\mathrm{d}v_k+\frac{\partial R(.)}{\partial U}\mathrm{d}U\right] \tag{5}$$

where $\dfrac{\partial R(.)}{\partial\tau_k}=\left\{-(E_{q_k}-G_{p_k})-\tau'(E_{qq_k}-G_{pp_k})-t'E_{qq_k}-v'G_{pp_k}\right\}$

$$\frac{\partial R(.)}{\partial v_k}=\left\{G_{p_k}+\tau'G_{pp_k}-v'G_{pp_k}\right\}$$

$$\frac{\partial R(.)}{\partial U}=(\tau+t)'E_{qU}$$

Under the policy reform $\mathrm{d}v_k=v_k\mathrm{d}\alpha$, $\mathrm{d}\tau_k=-\tau_k\mathrm{d}\beta$, $\mathrm{d}v_k+\mathrm{d}\tau_k=0$, Eq. (5) simplifies to the following:

$$\Omega\mathrm{d}U=\left[(\tau+t)'E_{qq_k}-\delta\left\{E_{q_k}+(\tau+t)'E_{qq_k}\right\}\right]\tau_k\mathrm{d}\beta \tag{6}$$

Where $\Omega=[E_U-(1-\delta)(\tau+t)'E_{qU}]$. Now, since E_U is homogenous of degree one in $[q_0,q]$, Euler theorem implies that $E_{q_0U}+q'E_{qU}=E_U$. Using this we have $\Omega=[E_{q_0U}+(1-\delta)1'E_{qU}+\delta q'E_{qU}]>0$, under the standard assumption that there are no inferior commodities in the economy, because $\delta\in(0,1)$. As is well known, this implies that the equilibrium is Walrasian stable. Since $\Omega>0$, the sign of the welfare change is given by the sign of the right hand side of Eq. (6).

We first look at a simple case where all the "pure cross substitution price effects" in consumption are assumed to be zero.[12] This can be interpreted as an approximation of the

[12] Following the suggestion of an anonymous referee, we call the second derivatives of the expenditure function "pure (own and cross) substitution price effects" to distinguish them from the standard Marshallian own and cross price effects. Note also that we are not restricting the cross substitution effects in production. Since the proposed reform leaves the producer price vector unchanged, the magnitudes of the production substitution effects are irrelevant.

case where the "pure own substitution price effects" (henceforth called *pure own substitution effects*) are dominant relative to the "pure own substitution price effects" (henceforth called *pure cross substitution effects*).

Proposition 1. *Assume that all the pure cross substitution effects in consumption are zero. Then a marginal reduction in the export tax τ_k with a producer price-neutral increase in production tax v_k increases government revenue and enhances consumer welfare if the consumption of commodity k enjoys a net subsidy at the initial position and the costs of administration is lower than a threshold.*

Proof. When the pure cross substitution effects in consumption are zero, the revenue effects of the reform can be written as follows:

$$\mathrm{d}R\,(.) = \left\{E_{q_k} + (t_k - \tau_k)E_{q_k q_k}\right\}\tau_k \mathrm{d}\beta \tag{7}$$

Now observe that $E_{q_k} > 0$ by the assumption that all commodities, including k, are domestically consumed. Furthermore, $(t_k - \tau_k)E_{q_k q_k} > 0$ given the assumption that the consumption of k enjoys a net subsidy at the initial position implying $(t_k - \tau_k) < 0$. So it follows that $\mathrm{d}R(.) > 0$. □

When the pure cross substitution effects are zero, the consumer welfare increases if the following holds:

$$\mathrm{d}U > 0 \Leftrightarrow \delta < \frac{(t_k - \tau_k)E_{q_k q_k}}{[E_{q_k} + (t_k - \tau_k)E_{q_k q_k}]} \equiv \hat{\delta} \in (0, 1) \tag{8}$$

If the initial consumption tax is zero on a commodity then the requirement of a net consumption subsidy in Proposition (1) is automatically fulfilled when there is an export tax. Since many of the exports in developing countries do not bear any consumption tax, this seems to be an empirically relevant case. Furthermore, note the critical role of the assumption that the commodity in question is domestically consumed at the initial position. If domestic consumption is zero to begin with, then $E_{q_k} = 0$. Since the reform entails an increase in the consumer price, a zero initial consumption also implies that $E_{q_k q_k} = 0$. Intuitively, since the producer prices are kept unchanged, the proposed reform works through adjustments in domestic consumption as the consumer price rises. A zero domestic consumption implies that no such adjustments are possible. The policy implication is that the proposed reform will be ineffective in case of the so-called hundred percent export oriented industries like ready-made garments in Bangladesh.

Observe that if consumption of k bears a net zero indirect tax burden, i.e., if $t_k - \tau_k = 0$ at the initial position, then from Eq. (7), government revenue still increases when the reform is implemented. However, the consumer welfare actually suffers in this case. This follows from the fact that with $t_k - \tau_k = 0$, we have $\hat{\delta} = 0$, and, as a result, $\delta \in (0,1) > \hat{\delta} = 0$. So for a welfare improvement, a net subsidy on consumption of k is required along with a low enough cost of redistribution.

Note that with $t_k - \tau_k = 0$ the consumer is facing the world price, and it seems intuitive that a reduction in export tax worsens welfare, as it pushes the consumer price away from the world price.[13] However, the intuition that it is desirable (optimal) to set the consumer

[13] I would like to thank an anonymous referee for this observation.

price equal to the world prices is valid only in the special case of zero administration cost. This can be seen by setting $dU=0$ in the expression for welfare change which gives

$$t_k - \tau_k = \frac{E_{q_k}}{E_{q_k q_k}}\left[\frac{\delta}{1-\delta}\right]$$

So when the administration cost is zero ($\delta=0$) the right hand side of the above equation becomes zero implying that the net tax burden on the consumption of commodity k should be zero at optimum, that is, the optimality of confronting the consumer with world price is obtained.[14] However, with positive administration costs we have $\delta\in(0,1)$, and the right hand side of the above equation is negative, because $E_{q_k q_k}<0$. This implies that optimally $t_k^*<\tau_k^*$. Starting from an initial condition of $t_k-\tau_k=0$, the producer price-neutral reform of export tax reduces the export tax ($\tau_k\downarrow$) leaving the consumption tax undisturbed. As a result, such a reform pushes the taxes further away from the optimal structure by making $t_k>\tau_k$ after the reform.[15]

We now turn to the more general case where the pure cross substitution effects are not insignificant. Before we can state the main result here, we need the following definitions of *compound substitutability*.

6. Definitions

Consider a set of commodities $D\subseteq T$ with $k\in D$. Commodity k is called a substitute in consumption of the compound commodity D_{-k} consisting of all other commodities in set D except k, if the following holds:

$$\sum_{r\in D, r\neq k} |(\theta_r - \theta_k)|E_{q_k q_r} > 0. \tag{9}$$

where θs denote the total tax burdens (consumption tax plus trade tax) on consumption of respective commodities. For example, $\theta_r\equiv t_r+\tau_r$ is the total indirect tax burden on consumption of commodity $r\in M$.

Note that pair-wise substitutability in consumption is sufficient for compound substitutability, but not vice versa. This also implies that compound substitutability with respect to D_{-k} does not imply compound substitutability with respect to any proper subset of D_{-k}.

The above definition is due to Hatta (1986). We extend the definition in the following way. If the strict inequality in Eq. (9) is replaced by a weak one, then commodity k is called a *weak substitute* of the compound commodity D_{-k} in consumption, and if it is replaced by an equality, then k is called a *neuter* with respect to the compound commodity D_{-k} in consumption. Analogously, commodities k and r are called *pair-wise weakly*

[14] The term 'optimal' here means a situation characterized by $dU=0$.

[15] Although this interpretation is intuitive and interesting, we hasten to acknowledge that such a piecemeal move towards satisfying the first order conditions of optimality does not, in general, guarantee a welfare improvement, as is well-known from the theory of second best.

substitutable in consumption if $E_{q_k q_r} \geq 0$; and they are called *pair-wise neuter* in consumption if $E_{q_k q_r} = 0$.

Proposition 2. *Assume that (i) consumption of commodity k bears the lowest indirect tax burden, i.e.,* $\theta_k \leq \theta_j \ \forall j \in T$ *with strict inequality for at least one j (ii) commodity k is a substitute in consumption of the compound commodity* T_{-k}*, i.e., the compound commodity representing all other commodities except k itself. Then there exists a critical level of administration cost* $\hat{\delta}$ *such that* $\forall \delta < \hat{\delta}$*, a marginal reduction in the export tax,* τ_k*, with an offsetting increase in the production tax,* v_k *that keeps the producer price,* p_k*, unchanged, increases both government revenue, and enhances consumer welfare.*

Proof. We first look at the effects on the government revenue. From Eq. (4), we have the following

$$\mathrm{d}R(\tau, t, v) > 0 \Leftrightarrow \Psi > 0 \tag{10}$$

Now for $\Psi > 0$, it is sufficient that $(\tau + t)' E_{q q_k} \geq 0$ because $E_{q_k} > 0$. We can rewrite $(\tau + t)' E_{q q_k}$ as follows:

$$(\tau + t)' E_{q q_k} = \theta_k E_{q_k q_k} + \sum_{j \neq k,\, j \in X} \theta_j E_{q_k q_j} + \sum_{j \in M} \theta_j E_{q_k q_j} \tag{11}$$

where, as defined before, θ_j is the total indirect tax burden on consumption of commodity j. Observe that the second term on the right hand side of Eq. (11) includes the numeraire exportable commodity. This can be done because $\theta_0 = 0$ by the assumption that the numeraire commodity is untaxed.

Since E_{q_k} is homogenous of degree zero in consumer prices $[q_0, q]$, we have:

$$E_{q_k q_k} = -\frac{1}{q_k} \sum_{j \neq k} q_j E_{q_k q_j} \tag{12}$$

Using Eq. (12), we can rewrite Eq. (11) as follows:

$$\begin{aligned}(\tau + t)' E_{q q_k} &= \frac{1}{q_k} \left[\sum_{j \neq k,\, j \in X} (\theta_j - \theta_k) E_{q_k q_j} + \sum_{j \in M} (\theta_j - \theta_k) E_{q_k q_j} \right] \\ &= \frac{1}{q_k} \left[\sum_{j \neq k} (\theta_j - \theta_k) E_{q_k q_j} \right] > 0 \end{aligned} \tag{13}$$

The last inequality above follows from the assumptions that (i) commodity k is a substitute in consumption of the compound commodity T_{-k}, and (ii) consumption of k bears the lowest indirect tax burden among all commodities including the numeraire. This proves that a producer price-neutral reform in export tax and production tax on commodity k increases government revenue under the assumption of compound substitutability. The intuition behind the above result is as follows. Since the commodity k bears lower tax burden than the numeraire commodity (with zero tax, by definition), this means its consumption is, in fact subsidized at the initial position. The producer price-neutral reform cuts down this consumption subsidy without affecting the producer price vector and thus

leaving the resource allocation undisturbed. A reduction in export tax increases the consumer price of commodity k and thus reduces its own consumption but increases the consumption of its substitutes.[16] Since the indirect tax rates on the consumption of substitutes are higher (condition (ii) above), the loss in revenue from commodity k is well compensated for by the increased revenue from the substitutes. Furthermore, as we noted in the introduction, a reduction in domestic consumption of k with an unchanged production due to the unchanged producer price leads to an increase in the export volume, thus mitigating the loss in export tax revenue from k.

We now turn to the welfare effects of the reform. From Eq. (6), we have the following necessary and sufficient condition for an improvement in consumer welfare:

$$\mathrm{d}U>0 \Leftrightarrow \delta<\frac{(t+\tau)'E_{qq_k}}{\left[E_{q_k}+(t+\tau)'E_{qq_k}\right]}\equiv\hat{\delta}\in(0,1) \tag{14}$$

The fact that $\hat{\delta}\in(0,1)$ follows from Eq. (13) and the assumption that all commodities, including k, are domestically consumed. So the consumer welfare increases unambiguously if the cost of administration is lower than a threshold. The stronger the consumption substitution possibilities between commodity k and other non-numeraire commodities, and the lower is the initial level of domestic consumption (which, again, must be positive), the higher is the threshold level of administration cost. □

Now note that if k is a *weak substitute* of the compound commodity T_{-k} rather than a *substitute* as assumed in Proposition (2), the proposed reform still increases government revenue, but it may not enhance consumer welfare. Under weak substitutability, $(\tau+t)'E_{qq_k}\geq 0$, but revenue increases given the assumption that $E_{q_k}>0$. The welfare may not increase because $\hat{\delta}\in[0,1)$. In the special case of $(\tau+t)'E_{qq_k}=0$, implying that k is *neuter* in consumption with respect to the compound commodity T_{-k}, the welfare declines unambiguously, as $\delta\in(0,1)>\hat{\delta}=0$ in this case.

An important question for policy relevance of the above result is to what extent the conditions stated in Proposition (2) are likely to be satisfied for a certain commodity. If most of the exportable commodities enjoy a net subsidy on consumption due to low or non-existent consumption taxes, then the requirement that the commodity under question bears lowest indirect tax on consumption is not that restrictive. But once the net subsidy on consumption of all the exportables are eliminated by a repeated application of the reform proposed in Proposition (2), the proposition as stated above loses its applicability. This is so because the net tax on consumption of the numeraire is zero by the assumption that it is untaxed implying $\theta_0=0$. In what follows we consider a scenario where the consumption of all non-numeraire commodities bears a positive tax. The conditions required for a welfare-enhancing and revenue-increasing reform of export tax and production tax are more stringent in this case. Note that when the commodity under reform bears a positive tax burden at the initial position, the intuition emphasized before for the case where consumption is subsidized does not hold. The producer price-neutral reform cannot be looked up on essentially as a reform to reduce consumption subsidy with production side

[16] Again, note the importance of a positive domestic consumption of commodity k at the initial position for the validity of this argument.

of the economy undisturbed. With positive initial tax burden, the reform usually focuses on the commodity with lowest indirect tax burden among all non-numeraire commodities so that the substitution effects drive the consumer towards higher taxed commodities, except for the numeraire commodity. This tends to increase revenue and enhance welfare. The fact that numeraire commodity has a lower tax than the commodity under reform creates complications, as we discuss in what follows.

Proposition 3. *Assume that $\theta_0<\theta_i$ $\forall i\in T$ and $i\neq 0$ at the initial position. Then a marginal reduction in export tax on commodity k with a producer price-neutral increase in the production tax increases revenue and enhances welfare if the following (sufficient) conditions hold: (i) consumption of k bears the lowest indirect tax burden among all non-numeraire commodities, (ii) k is a weak substitute or neuter in consumption with respect to the compound commodity $T_{-k,0}$, i.e., the compound commodity consisting of all other non-numeraire commodities, (iii) k is a complement to the numeraire commodity in consumption, (iv) the cost of administration is less than a threshold.*

Proof. As in Proposition (2), a sufficient condition for a positive revenue effect of the proposed reform is that $(\tau+t)'E_{qq_k}\geq 0$. Using Eq. (13), $(\tau+t)'E_{qq_k}$ can be written as follows:

$$(\tau+t)'E_{qq_k}=\frac{1}{q_k}\left[\sum_{j\neq k}\left(\theta_j-\theta_k\right)E_{q_kq_j}\right]=\frac{1}{q_k}\left[\sum_{j\neq k,0}\left(\theta_j-\theta_k\right)E_{q_kq_j}-\theta_kE_{q_kq_0}\right]>0 \tag{15}$$

The strict inequality in Eq. (15) follows from conditions (i)–(iii) in Proposition (3) above. The reform also enhances welfare if the costs of administration are low enough to satisfy inequality (14) (see Proof of proposition 2). The new element in Proposition (3) compared to Proposition (2) is the complementarity condition between numeraire and commodity k.[17] The intuition is same as the celebrated Corlett–Hague rule of optimal taxation: it is desirable to impose a relatively higher consumption tax on a commodity that is more complementary in consumption to the untaxed commodity.[18] Note that the complementarity condition also ensures that the consumption substitutions do not militate against the objective of increasing revenue. If instead, commodity k is a substitute of the numeraire in consumption, a reduction in the consumption subsidy might lead the consumer to substitute towards the numeraire commodity which has lower tax burden (zero) than the commodity under reform. □

It is important to note that although we use weaker substitutability assumptions in Proposition (3) compared to both Propositions (1) and (2), the requirements for a welfare-enhancing and revenue-increasing reform are, in fact, more stringent in this case. First, the substitutability is assumed with respect to a smaller set of commodities, that is, both k and

[17] Note that if the export tax and consumption tax on k are numerically equal implying a zero indirect tax burden at the initial position, then it is immaterial whether k is a complement or substitute to the numeraire commodity in consumption.

[18] As emphasized by Hatta (1994), among others, the untaxed exportable commodity here plays the role of untaxed leisure in the optimal commodity taxation literature.

numeraire are excluded from the compound commodity ($T_{-k,0} \subset T_{-k}$). Second, it is, in general, much more difficult to satisfy the complementarity condition between k and the untaxed numeraire.

Although the complementarity condition between commodity k and the numeraire brings out the connection between optimal tax literature and the reform proposal discussed in this paper, it is not necessary for a welfare-enhancing and revenue-raising reform. But the price we pay for abandoning the complementarity condition is that the substitutability assumption needs to be strengthened substantially. The compound substitutability assumptions no longer suffice, we need pair-wise substitutability in consumption. The following proposition states the result.

Proposition 4. *Assume that $\theta_0<\theta_i\ \forall i\in T$ and $i\neq 0$ at the initial position. Then a marginal reduction in export tax on commodity k with a producer price-neutral increase in the production tax increases revenue and enhances welfare if the following (sufficient) conditions hold: (i) k is pair-wise weak substitute in consumption with respect to all other commodities, i.e., $E_{q_kq_j}\geq 0\ \forall j\in T$ and $j\neq k$, and k is pair-wise substitute with respect to at least one non-numeraire commodity, i.e., $\exists j\in T$ and $j\neq k,0$ such that $E_{q_kq_j}>0$, (ii) the indirect tax burden on consumption of k is less than a (positive) threshold, (iii) the cost of administration is less than a threshold.*

Proof. Using Eq. (15), inequality $(\tau+t)'E_{qq_k}>0$ can be rewritten as follows:

$$\theta_k\left[\sum_{j\neq k}E_{q_kq_j}\right]<\left[\sum_{j\neq k,0}\theta_jE_{q_kq_j}\right] \tag{16}$$

But observe that the signs of the terms in inequality (16) cannot be pinned down with any of the compound substitutability assumptions. Given the assumption of a positive tax burden on the consumption of all the non-numeraire commodities at the initial position, a sufficient condition for the terms in brackets to be positive is that k is pair-wise weakly substitutable for all other commodities and is pair-wise substitutable for at least one non-numeraire commodity (condition (i) in Proposition (4)). In this case, Eq. (16) can be rewritten as follows:

$$\theta_k<\hat{\theta}_k\equiv\frac{\Sigma_{j\neq k,0}\theta_jE_{q_kq_j}}{\Sigma_{j\neq k}E_{q_kq_j}}=\frac{\Sigma_{j\neq k,0}\theta_jE_{q_kq_j}}{E_{q_kq_0}+\Sigma_{j\neq k,0}\theta_jE_{q_kq_j}} \tag{17}$$

What the inequality condition (17) implies is that, under pair-wise substitutability assumptions, the *absolute magnitude* of the indirect tax burden on consumption of k needs to be lower than a (positive) threshold to ensure a revenue-increasing and welfare-enhancing marginal tax reform. This, however, is not necessarily a more stringent requirement compared to the condition that consumption of k bears the lowest indirect tax burden among all non-numeraire commodities as in Proposition (3). The threshold is higher if (i) the substitutability between k and numeraire good is low, and (ii) the substitutability between k and all other non-numeraire goods is high. One interesting special case occurs when k and numeraire good are *pair-wise neuter* in consumption, implying $E_{q_kq_0}=0$. In this case, $\hat{\theta}_k=1$, so that if the indirect tax burden on consumption of k

is less than 100%, it is sufficient to satisfy inequality (17), because the world price is normalized to one.

Since $(\tau+t)'E_{qq_k}>0$ under conditions (i) and (ii) stated in Proposition (4), from Eq. (14) it immediately follows that $\exists\, a\hat{\delta}\in(0,1)$ such that $\forall\delta<\hat{\delta}$, the reform also enhances consumer welfare. □

7. Conclusions

In this paper, we consider sufficient conditions for simultaneous improvements in both welfare and government revenue when the export tax on a certain commodity is reduced, and the tax on its producers is increased to keep the producer price unchanged. The results indicate that it is relatively easier to effect a welfare-enhancing and revenue-increasing reform of indirect taxes on exports, if, at the initial position, the exportable commodities enjoy net subsidy on consumption. However, when the consumption of all of the non-numeraire commodities bears positive indirect tax burden at the initial position, the required conditions for such a "win–win" reform are more stringent. The policy implication is that such a reform strategy might be more promising at the start of a tax reform program, when presumably there are many exportable commodities with net subsidy on domestic consumption due to low or non-existent consumption taxes.

There are, however, some limitations to the above conclusions. First, we have ignored the existence of non-tradables in the model, following Hatzipanayotou et al. (1994). Following the arguments of Fukushima (1979), one might conjecture that the introduction of non-tradables is not likely to alter the conditions for revenue-increasing and welfare-enhancing reform. For example, consider Proposition (2) above. If the substitutability condition is extended to include both tradables and non-tradables, and the commodity under reform bears the lowest indirect tax burden among all commodities, including non-tradables, the proposition remains valid for the extended economy. However, the fact that the prices of non-traded goods are endogenously determined through domestic market clearing might complicate things. For example, the equilibrium producer prices of the non-traded goods will, in general, change as a result of a reform that concentrates on a particular exportable good. If we want to keep the producer price vector of the non-traded goods also fixed[19], then it will require careful (endogenous) selection of the production taxes (subsidies) on the non-traded goods. Furthermore, the practical applicability of the producer price-neutral reform might be compromised once the existence of a large non-traded sector in the economy is acknowledged. In most of the developing countries, non-tradables constitute largely of services and utilities which traditionally have been subsidized for consumption. With high consumption subsidy on non-tradables, it might not be easy to satisfy the condition that the commodity under tax reform bears the lowest indirect tax burden among all commodities. Another important limitation arises from the existence of a large informal sector in the economy, as emphasized recently by Emran and

[19] Since the reform needs to leave the production decisions undisturbed, it is required that the entire producer price vector remains unaltered after the reform.

Stiglitz (forthcoming) and Piggott and Whalley (2001). The agricultural exports produced by numerous small and geographically dispersed farmers may not be amenable to the production tax as envisaged here, although they might otherwise be good candidates for such a reform, because their domestic consumption is usually subsidized. Moreover, if both the formal and informal sector firms produce the same product, then a production tax will induce firms to relocate to the relatively inefficient informal sector to evade the production tax, which might prove costly from a social point of view (Palda, 1998; Emran and Stiglitz, 2000).

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