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**Pareto-improving tariff-tax reforms under  
imperfect competition**

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# Pareto-improving tariff-tax reforms under imperfect competition

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## Abstract

Constructing a duopoly model with non-constant marginal costs and a strict Pareto criterion, this paper examines welfare effects of world-price-fixing tariff reductions accompanied by adjustments of a domestic tax. If a destination-based consumption tax is used, this reform achieves a strict Pareto improvement under sufficiently decreasing marginal costs. If, in contrast, an origin-based production tax is employed, a strict Pareto improvement holds whether marginal cost is decreasing or not. Thus, we can conclude that tariff-tax reforms that improve the world welfare and are irrelevant of tax bases are possible if the targeted industry exhibits sufficiently decreasing marginal costs.

*JEL classifications:* F12, F13, H2

*Keywords:* tariff-tax reform, destination principle, origin principle, strict Pareto improvement/deterioration, duopoly

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# 1 Introduction

Trade liberalization in the form of trade tax/subsidy reductions has remarkably increased the world trade flow.<sup>1</sup> As international economics suggests, freer trade benefits an individual country and the world. Despite such advocacy of free trade, there is persistent hesitation to liberalize trade in both developing and developed countries. On the one hand, developing countries fear the expected loss in trade tax revenue that has a large share in overall government revenue as long as they are a big importing or exporting country.<sup>2</sup> In order to compensate for such a decline in trade tax revenue, the IMF and the World Bank have suggested combining trade tax reductions with appropriate adjustments of domestic taxes. On the other hand, tariff-tax reforms may make sense for developed countries since they may play a role of mitigating the negative income distribution effect on the comparative disadvantage sector led by trade liberalization.

Then, one may naturally ask how domestic taxes are adjusted to trade liberalization for ensuring welfare gains. This paper theoretically answers this question, but we differentiate it from the previous works in the following respects. First, we extend a duopoly model of Keen and Ligthart (2005). They show that a country loses from point-by-point tariff reductions combined with (destination-based) consumption tax increases, which are welfare-improving under perfect competition (Hatzipanayotou et. al, 1994, and Keen and Ligthart, 2002). Furthermore, they prove that the same is true of the tariff-tax reform that leaves the consumer price unchanged. While these results provide new insights on tariff-tax reforms, Keen and Ligthart (2005, p. 389) state that their negative results are ‘not to say, of course, that there are no circumstances in which such a coordinated tax-tariff reform will increase

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<sup>1</sup>Baier and Bergstrand (2001), for example, find evidence that tariff reductions have much larger impacts on world trade growth than trade cost reductions and income equalization.

<sup>2</sup>IMF (2005, p. 3) offers evidence suggesting that ‘the revenue from trade taxes ... continues to be a major source of government finance in many low- and middle income countries.’

welfare even in the presence of imperfect competition. We leave to future work, however, the characterization of preference and market structures that are conducive to such an outcome.<sup>7</sup>

We address the above agenda Keen and Ligthart (2005) leave, and seek welfare-improving programs of tariff reductions and domestic tax adjustments. To this end, we introduce three new ingredients into the Keen-Ligthart (2005) model. First, we allow for non-constant marginal costs in order to identify that the detrimental effects in Keen and Ligthart (2005) hinge on the assumption of constant marginal cost.<sup>3</sup> Second, we consider not only destination-based consumption taxes but also origin-based production taxes. This extension is theoretically and practically interesting since Keen and Ligthart (2005) confine analysis to the destination tax.

Finally and most importantly, we consider a tariff-tax reform that fixes the world price. The reason for paying special attention to this reform is that the terms of trade effect is arguably the most crucial elements in the arguments over trade liberalization.<sup>4</sup> While Bagwell and Staiger (1999, 2002, 2011, 2012a, b) are concerned with multilateral trade policy reforms rather than unilateral domestic policy reforms, the terms of trade effect is still significant in evaluating the unilateral tariff-tax reforms.

Besides the theoretical and empirical relevance of the terms of trade effect stressed by Bagwell and Staiger (1999, 2002, 2011, 2012a, b), the world-price-fixing tariff-tax reform has the following advantages. First, under our assumption of linear demand, the proposed reform is shown to fix foreign welfare, and hence induces no foreign retaliation. Second, our reform can leave the foreign country no-worse-off just by targeting the world price that is observable. This property is important in view of the reality that foreign welfare is unobservable.<sup>5</sup> Third, our reform strategy is useful in considering

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<sup>3</sup>Since a seminal paper of Krugman (1984), there are many works studying the role of non-constant marginal cost in international trade, e.g., Zhang and Zhang (1998), Ishikawa (2004), Ishikawa and Kuroda (2007), and Ishikawa and Mukunoki (2008a, b).

<sup>4</sup>See Bagwell and Staiger (1999, 2002, 2012a, b) and Bagwell and Staiger (2011) for the theoretical and empirical importance of the terms of trade effect, respectively.

<sup>5</sup>While the idea of fixing welfare of the rest of the world is familiar in the literature on

whether it yields a strict Pareto improvement, i.e., it raises the home welfare without hurting the foreign country. That is, we can conclude that this reform leads to a world welfare improvement just by checking the effect on the domestic welfare.

Our conclusion is summarized as follows. If a destination-based consumption tax is employed, a tariff reduction accompanied by a consumption tax adjustment that fixes the world price raises domestic welfare when the degree of decreasing costs is sufficiently large. If, in contrast, an origin-based production tax is adopted, the world-price-fixing tariff-tax reform definitely improves welfare. These findings may serve an answer to the question raised by Keen and Ligthart (2005) above.

This paper is organized as follows. Sections 2 and 3 consider the case of a destination consumption tax and an origin-based production tax, respectively. Section 4 concludes.

## 2 Destination-based consumption tax

### 2.1 Model

We incorporate non-constant marginal costs into the Keen and Ligthart (2005) model. Suppose a market of a country, say Home, in which a Home firm (firm X) and a Foreign firm (firm Y) compete in quantities with a Cournot conjecture. Home's inverse demand is assumed linear, and denoted by  $p(x + y)$  with  $p'(\cdot) < 0$  and  $p''(\cdot) = 0$ , where  $x$  and  $y$  are the output of the Home and Foreign firms, respectively.<sup>6</sup> The production cost of each firm is given by  $c(x)$  and  $c_*(y)$  with  $c'(\cdot) > 0$  and  $c'_*(\cdot) > 0$ . The Foreign government observes laissez-faire.

The Home government imposes a destination-based consumption tax  $\tau \geq$

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customs unions, e.g., Kemp and Wan (1976), implementing it is practically difficult since welfare is unobservable. Lahiri and Raimondos-Møller (1997, p. 487) admittedly state that 'the information requirement (of the donor-welfare-fixing reform) is quite demanding.'

<sup>6</sup>The results in this paper admittedly depend on the linear demand assumption, and one can obtain no clear result under non-linear demand.

0 and an import tariff  $t \geq 0$ . Then, the profit of each firm is defined by

$$\text{Home firm} : p(x+y)x - c(x) - \tau x \quad (1)$$

$$\text{Foreign firm} : p(x+y)y - c_*(y) - \tau y - ty. \quad (2)$$

The first-order conditions for profit maximization are<sup>7</sup>

$$xp'(x+y) + p(x+y) - c'(x) - \tau = 0 \quad (3)$$

$$yp'(x+y) + p(x+y) - c'_*(y) - \tau - t = 0. \quad (4)$$

Totally differentiating (3) and (4), we have<sup>8</sup>

$$\begin{bmatrix} 2p' - c'' & p' \\ p' & 2p' - c''_* \end{bmatrix} \begin{bmatrix} dx \\ dy \end{bmatrix} = \begin{bmatrix} 1 \\ 1 \end{bmatrix} d\tau + \begin{bmatrix} 0 \\ 1 \end{bmatrix} dt,$$

which leads to the following comparative statics outcomes:

$$\frac{\partial x}{\partial \tau} = \frac{p' - c''_*}{\Delta}, \quad \frac{\partial y}{\partial \tau} = \frac{p' - c''}{\Delta} \quad (5)$$

$$\frac{\partial x}{\partial t} = -\frac{p'}{\Delta}, \quad \frac{\partial y}{\partial t} = \frac{2p' - c''}{\Delta} \quad (6)$$

$$\frac{\partial(x+y)}{\partial \tau} = \frac{2p' - c'' - c''_*}{\Delta}, \quad \frac{\partial(x+y)}{\partial t} = \frac{p' - c''}{\Delta}, \quad (7)$$

where  $\Delta$  is a determinant of the coefficient matrix of the above differentiated system:

$$\Delta \equiv \begin{vmatrix} 2p' - c'' & p' \\ p' & 2p' - c''_* \end{vmatrix} = 3(p')^2 - 2p'c'' - 2p'c''_* + c''c''_*.$$

In order to prepare for considering the welfare effect of a tariff-tax reform, we define the Home welfare as  $W \equiv CS + \Pi + T$ , where

$$CS \equiv \int_0^{x+y} p(X)dX - (x+y)p(x+y) \quad (8)$$

$$\Pi \equiv p(x+y)x - c(x) - \tau x \quad (9)$$

$$T \equiv \tau(x+y) + ty. \quad (10)$$

In these equations,  $CS$ ,  $\Pi$  and  $T$  respectively represent consumer surplus, the Home firm's profit, and government revenue, and  $x$  and  $y$  depend on the two taxes through Eqs. (3) and (4).

<sup>7</sup>The second-order conditions are  $2p'(x+y) - c''(x) < 0$  and  $2p'(x+y) - c''_*(y) < 0$ .

<sup>8</sup>In what follows, the argument of  $p(\cdot)$ ,  $c(\cdot)$  and  $c_*(\cdot)$  is suppressed.

## 2.2 Reform and welfare

We now investigate the welfare effect of a simultaneous change in tariffs and consumption taxes in a way to fix the world price. The reason for focusing on this specific tariff-tax reform is that with linear demand it serves to leave the Foreign welfare unchanged, and hence allows us to know whether the reform achieves a strict Pareto improvement by looking at the welfare effect on Home only. Furthermore, considering the fact that multilateral reforms are generally more costly and difficult to agree, it is useful to explore the unilateral reform defined above.

We begin by identifying how the two tax rates must change when they freeze the world price. Since the world price  $p^W$  is equal to  $p^W = p(x + y) - \tau - t$ , a change in  $\tau$  and  $t$  affects the world price as follows.

$$dp^W = \left[ p' \frac{\partial(x+y)}{\partial\tau} - 1 \right] d\tau + \left[ p' \frac{\partial(x+y)}{\partial t} - 1 \right] dt.$$

Hence, the requirement of the fixed world price is  $dp^W = 0$ , and the two taxes must change according to

$$d\tau = -\frac{p' \frac{\partial(x+y)}{\partial t} - 1}{p' \frac{\partial(x+y)}{\partial\tau} - 1} dt = -\frac{2p' - c''}{p' - c''} dt, \quad (11)$$

where use is made of (7). Substituting (11) into the right-hand side of the equation of comparative statics above, it becomes

$$-\frac{2p' - c''}{p' - c''} \begin{bmatrix} 1 \\ 1 \end{bmatrix} dt + \begin{bmatrix} 0 \\ 1 \end{bmatrix} dt = \begin{bmatrix} -\frac{2p' - c''}{p' - c''} \\ -\frac{p'}{p' - c''} \end{bmatrix} dt.$$

Therefore, all we have to do henceforth is to make a comparative statics analysis using the above right-hand side. Straightforward manipulations lead to

$$\left. \frac{\partial x}{\partial t} \right|_{dp^W=0} = -\frac{1}{p' - c''}, \quad \left. \frac{\partial y}{\partial t} \right|_{dp^W=0} = 0, \quad \left. \frac{\partial(x+y)}{\partial t} \right|_{dp^W=0} = -\frac{1}{p' - c''}. \quad (12)$$

By using (11) and (12), we now address a few properties of the world-price-fixing reform. First of all, this reform fixes not only the world price but

also the Foreign firm's output and Foreign's welfare since the Foreign firm's profit  $\Pi^*$  (which is also the Foreign welfare) is rewritten as

$$\Pi^* = (p - t - \tau)y - c_*(y) = p^W y - c_*(y),$$

and both  $p^W$  and  $y$  are fixed by this reform.<sup>9</sup>

**(Figure 1 around here)**

For the time being, let us assume that  $p' - c''$  which is satisfied if the Home firm's marginal cost is non-decreasing. Then, the effect of the present reform is illustrated in Figure 1. In the figure, the bold loci represent a pre-reform reaction curve of each firm, and  $E$  is the initial Cournot-Nash equilibrium.<sup>10</sup> When the Home government reduces an import tariff, only the Foreign firm's reaction curves shifts outward to the dashed locus, which decreases  $x$  and increases  $y$ . Eq. (11) allows us to know that the consumption tax must be raised so that the initial  $y$  is restored as (11) and (12) suggest. When the Home government raises the consumption tax, both firms' reaction curve shrinks to a dotted locus, and the post-reform equilibrium becomes  $E'$  at which  $x$  decreases.

**(Figure 2 around here)**

The foregoing argument is, on the other hand, modified if the degree of decreasing costs is high enough to have  $p' - c'' > 0$ . Figure 2 illustrates the effect of the reform in this case. While the effect of the tariff reduction is the same as the previous case, the Home government must *lower* the consumption tax. This is because the reduced tariff induces a decrease in  $x$ , and hence the Home firm's marginal cost becomes higher. This decreases  $x$  further, and domestic production eventually becomes too small. Therefore,

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<sup>9</sup>This convenient property crucially depends on the assumptions that (1) demand is linear and (2) Foreign observes *laissez-faire*.

<sup>10</sup>While the figure presumes that the Home firm's reaction curve is steeper than the Foreign firm's reaction curve, our argument holds for the opposite case, namely, the stability of the Cournot-Nash equilibrium is irrelevant.

the world price will decline as a result of the tariff reduction of Home. In order to offset such a price-reducing effect, the Home government must expand domestic consumption by *lowering* the consumption tax. Then, both firms' reaction curve shifts out, and the terminal equilibrium becomes  $E'$  at which  $x$  increases.

Comparing Figures 1 and 2, the effect on the Home firm's output is exactly the opposite depending on the sign of  $p' - c''$  whereas the Foreign firm's output is commonly fixed. This difference in the effect on the Home firm's production will play a key role in determining the welfare effect of the reform.

Having (12) in mind, we examine the effect of the world-price-fixing tariff-tax reform on Home's welfare. Differentiating (8), (9) and (10) with respect to  $t$ , we obtain

$$\begin{aligned}
\left. \frac{\partial CS}{\partial t} \right|_{dp^W=0} &= -(x+y)p' \left. \frac{\partial(x+y)}{\partial t} \right|_{dp^W=0} = \frac{(x+y)p'}{p' - c''} \\
\left. \frac{\partial \pi^X}{\partial t} \right|_{dp^W=0} &= -x \left. \frac{\partial \tau}{\partial t} \right|_{dp^W=0} = \frac{x(2p' - c'')}{p' - c''} \\
\left. \frac{\partial T}{\partial t} \right|_{dp^W=0} &= (x+y) \left. \frac{\partial \tau}{\partial t} \right|_{dp^W=0} + \tau \left. \frac{\partial(x+y)}{\partial t} \right|_{dp^W=0} + y \\
&= y - \frac{(x+y)(2p' - c'')}{p' - c''} - \frac{\tau}{p' - c''}.
\end{aligned}$$

By summing these effects up, we have the overall welfare effect:

$$\left. \frac{\partial W}{\partial t} \right|_{dp^W=0} = \frac{xp' - \tau}{p' - c''} = -\frac{p - c'}{p' - c''}, \quad (13)$$

where the last equality follows from the first-order condition (3). Eq. (13) establishes:

**Proposition 1.** *A coordinated tariff reduction and an increase (resp. decrease) in the destination-based consumption tax in a way to fix the world price reduce (resp. raise) the Home welfare, and achieve a strict Pareto deterioration (resp. improvement) if  $p' - c'' < 0$  (resp.  $p' - c'' > 0$ ).*

**Proof.** Since we have assumed  $dt < 0$ , the direction in the Home welfare associated with the present reform becomes

$$\text{sign}\{dW\} = \text{sign}\{p' - c''\},$$

which immediately leads to the above result.

**(Table 1 around here)**

The intuition behind Proposition 1 is well-understood by using the first and second rows of Table 1. As has already been addressed, the proposed reform to fix the world price results in fixing the output and welfare of Foreign. This requirement yields two scenarios depending on the sign of  $p' - c''$ . Let us see the first row of the table that assumes that  $p' - c'' < 0$ . Then, our reform decreases the Home firm's output, which gives rise to a higher domestic price and a smaller consumer surplus. Moreover, the profit of the Home firm declines due to profit-shifting from Home to Foreign. While the effect on government revenue is indeterminate, the negative effects on consumer surplus and the firm profit play a dominant role, thereby reducing welfare of Home. Invoking that the Foreign welfare is unchanged with this reform, this means that the proposed reform is strictly Pareto deteriorating.

If, on the other hand,  $p' - c''$  is positive, all the above arguments are reversed as the second row of Table 1 shows, and hence this reform promises a strict Pareto improvement, namely, it improves the world welfare without any international lump-sum transfer. In this case, both the Home consumer and firm gain from the reform, and so welfare improves. In this sense, if increasing returns are sufficiently strong, this reform could be recommended from the criterion of a strict Pareto improvement.

### 3 Origin-based production tax

#### 3.1 Model

While the last section assumes that a destination-based consumption tax is available as a domestic tax policy, this section replaces this assumption with the assumption of an origin-based production tax. This analysis makes much sense since it enables us to find which between destination- or origin-based taxes should be adopted in tariff-tax reforms of the kind we consider. We will demonstrate that employing the production tax unambiguously achieves a strict Pareto improvement regardless of the sign of  $c''$ . Since the procedure of proving this result is the same as that of Proposition 1, it suffices to outline the argument.

Letting  $s \geq 0$  be an origin-based production tax imposed on domestic production, the profit of each firm is defined by

$$\text{Home firm} : p(x + y)x - c(x) - sx$$

$$\text{Foreign firm} : p(x + y)y - c_*(y) - ty.$$

The first-order conditions for profit maximization are

$$xp'(x + y) + p(x + y) - c'(x) - s = 0 \quad (14)$$

$$yp'(x + y) + p(x + y) - c'_*(y) - t = 0. \quad (15)$$

Given the assumption of linear demand, total differentiation of (14) and (15) yields

$$\begin{bmatrix} 2p' - c'' & p' \\ p' & 2p' - c''_* \end{bmatrix} \begin{bmatrix} dx \\ dy \end{bmatrix} = \begin{bmatrix} 1 \\ 0 \end{bmatrix} ds + \begin{bmatrix} 0 \\ 1 \end{bmatrix} dt,$$

which gives the comparative statics outcome:

$$\frac{\partial x}{\partial s} = \frac{2p' - c''_*}{\Delta}, \quad \frac{\partial y}{\partial s} = -\frac{p'}{\Delta} \quad (16)$$

$$\frac{\partial x}{\partial t} = -\frac{p'}{\Delta}, \quad \frac{\partial y}{\partial t} = \frac{2p' - c''}{\Delta} \quad (17)$$

$$\frac{\partial(x + y)}{\partial s} = \frac{p' - c''_*}{\Delta}, \quad \frac{\partial(x + y)}{\partial t} = \frac{p' - c''}{\Delta}. \quad (18)$$

As in the previous section, Home's welfare consists of consumer surplus, the Home firm's profit, and tax revenue:

$$CS \equiv \int_0^{x+y} p(X)dX - (x+y)p(x+y) \quad (19)$$

$$\pi \equiv p(x+y)x - c(x) - sx \quad (20)$$

$$T \equiv sx + ty. \quad (21)$$

### 3.2 Reform and welfare

Based on the preliminaries thus far, we compute the welfare effect of a tariff-tax reform that fixes the world price defined by  $p^W = p(x+y) - t$ . Since the two taxes affect the world price as

$$dp^W = p' \frac{\partial(x+y)}{\partial s} ds + \left[ p' \frac{\partial(x+y)}{\partial t} - 1 \right] dt,$$

the requirement of the fixed world price  $dp^W = 0$  implies

$$ds = - \frac{p' \frac{\partial(x+y)}{\partial t} - 1}{p' \frac{\partial(x+y)}{\partial s}} dt = \frac{2p' - c''}{p'} dt. \quad (22)$$

Substituting (22) into the right-hand side of the totally-differentiated system of equations, it becomes

$$\frac{2p' - c''}{p'} \begin{bmatrix} 1 \\ 0 \end{bmatrix} dt + \begin{bmatrix} 0 \\ 1 \end{bmatrix} dt = \begin{bmatrix} \frac{2p' - c''}{p'} \\ 1 \end{bmatrix} dt.$$

Using this right-hand side, the effects of this reform on the equilibrium outputs are

$$\left. \frac{\partial x}{\partial t} \right|_{dp^W=0} = \frac{1}{p'}, \quad \left. \frac{\partial y}{\partial t} \right|_{dp^W=0} = 0, \quad \left. \frac{\partial(x+y)}{\partial t} \right|_{dp^W=0} = \frac{1}{p'}. \quad (23)$$

Eqs. (22) and (23) convince us a few properties of the proposed reform that are parallel to the consumption tax case. First, by repeating the same argument as that of the last section, this reform fixes the output and profit of the Foreign firm as well as the world price. Thus, in order to check whether this reform is strictly Pareto-improving, we have only to examine the welfare effect on Home.

(Figure 3 around here)

Another property is explained with Figure 3 that depicts a reaction curve diagram of the present case. The pre-reform equilibrium is  $E$ , which is an intersection of the bold reaction curves. When an import tariff is reduced, only the Foreign firm's reaction curve shifts outward to the dashed locus, and thereby decreases  $x$  and increases  $y$ . Therefore, the only way to restore the initial  $y$  is to reduce the production tax so that the Home firm's reaction curve shifts to the dotted locus. Then, we can easily notice that the new equilibrium is given by  $E'$ , and that  $x$  increases after the reform.

Taking into account these observations, the effect of the policy reform above on the three welfare components is derived as

$$\begin{aligned} \left. \frac{\partial CS}{\partial t} \right|_{dp^W=0} &= -(x+y)p' \left. \frac{\partial(x+y)}{\partial t} \right|_{dp^W=0} = -(x+y) \\ \left. \frac{\partial \pi^X}{\partial t} \right|_{dp^W=0} &= -x \left. \frac{\partial s}{\partial t} \right|_{dp^W=0} = -\frac{x(2p' - c'')}{p'} \\ \left. \frac{\partial T}{\partial t} \right|_{dp^W=0} &= x \left. \frac{\partial s}{\partial t} \right|_{dp^W=0} + s \left. \frac{\partial x}{\partial t} \right|_{dp^W=0} + y + t \left. \frac{\partial y}{\partial t} \right|_{dp^W=0} \\ &= y + \frac{x(2p' - c'') + s}{p'}. \end{aligned}$$

Aggregating these effects yields

$$\left. \frac{\partial W}{\partial t} \right|_{dp^W=0} = -x + \frac{s}{p'} = \frac{p - c'}{p'} < 0, \quad (24)$$

where the last equality comes from the first-order condition (14). Thus, we have arrived at:

**Proposition 2.** *A coordinated tariff reduction and a decrease in the origin-based production tax in a way to fix the world price raise the Home welfare, and achieve a strict Pareto improvement.*

Making use of the third law of Table 1, let us intuitively interpret Proposition 2. As mentioned above, the Home government has to reduce the production tax to offset the prospective rise in the world price induced by the tariff

cut. This leads to an increase in the Home firm's output without changing the Foreign output. Consequently, this reform expands the total supply, and benefits consumer surplus of Home by lowering the domestic price. Another natural consequence is that the Home firm also gains from this reform. As is also the case in the previous section, the effect on government revenue is unclear, but Home's aggregate welfare improves since the positive effects on consumer surplus and the firm profit play a major role.

In the case of consumption taxes, there is a possibility that welfare improves if the sign of  $c''$  is negative enough to have  $p' - c'' > 0$ . However, the above result needs no such restriction. Regardless of the sign of  $c''$ , the welfare-improving property of the reform holds. In short, if the degree of decreasing marginal cost is sufficiently large, the choice of tax principles is irrelevant in the sense that adjusting any of the destination- and origin-based taxes to tariff reductions yields a strict Pareto improvement.<sup>11</sup>

**Remark.** The analysis thus far has focused on the welfare effects of the world-price-fixing tariff-tax reforms. However, it is of some importance to look into the effect on government revenue since it is the central concern as mentioned in Introduction.

In the destination-tax case, the revenue effect is given by

$$\begin{aligned} \left. \frac{\partial T}{\partial t} \right|_{dp^w=0} &= y - \frac{(x+y)(2p' - c'')}{p' - c''} - \frac{\tau}{p' - c''} \\ &= \frac{xc'' - (3x+y)p' - p + c'}{p - c''}, \end{aligned}$$

whereas the counterpart in the origin-tax case is

$$\begin{aligned} \left. \frac{\partial T}{\partial t} \right|_{dp^w=0} &= y + \frac{x(2p' - c'') + s}{p'} \\ &= \frac{-xc'' + (3x+y)p' + p - c'}{p'}. \end{aligned}$$

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<sup>11</sup>Keen and Lahiri (1998), Haufler and Pfluger (2004), and Hashimzade et al. (2005) establish a superiority of the origin-based taxation while Keen and Lahiri (1993) and Keen et al. (2002) show the superiority of the destination-based tax.

These equations both tell that the revenue effect of the proposed reforms can be positive, i.e.,  $\partial T/\partial t|_{dp^w=0} < 0$  if the marginal cost is decreasing  $c'' < 0$ , and its negativity is sufficiently high.<sup>12</sup>

## 4 Concluding remarks

Using a simple duopoly model, we have explored whether world-price-fixing tariff reductions with appropriate adjustments of either destination-based consumption taxes or origin-based production taxes achieve a strict Pareto improvement. We have shown that under the destination principle the suggested reform reduces welfare if marginal cost is non-decreasing while it can be strictly Pareto-improving under sufficiently decreasing marginal cost. On the other hand, this reform necessarily results in a strict Pareto improvement if the origin-based production tax is employed. These findings may be useful for a practical policy-making over trade liberalization in developed and developing countries.

One may wonder whether the above results are specific to the model chosen. This guess is partially correct since we do not know whether a similar finding still holds in another market structure, e.g., Bertrand duopoly and monopolistic competition. However, we have already proved the validity of our conclusion in a perfectly competitive general equilibrium model and a duopoly model with market integration of the type of Keen and Lahiri (1993, 1998) and Keen et al. (2002). Furthermore, we have ruled out the presence of public goods. When we introduce an externality arising from public goods, our results may be modified by invoking the earlier contributions of Kotsogiannis and Lopez-Garcia (2007) and Karakosta et al. (2012). To summarize, our results have a certain validity, but may not survive some market structures with and without public goods. It is our research agenda to study whether our results survive another type of imperfect competition

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<sup>12</sup>One may wonder if the second-order condition for profit maximization is violated if  $c''$  is too negative. But, this is not the case if we use the following demand and cost specifications:  $p(x+y) = a - x - y$ ,  $a > 0$  and  $c(x) = 1 - e^{-bx}$ ,  $b > 0$ . Under this example, the positive revenue effect is guaranteed for sufficiently large  $b$ .

and the presence of public goods.

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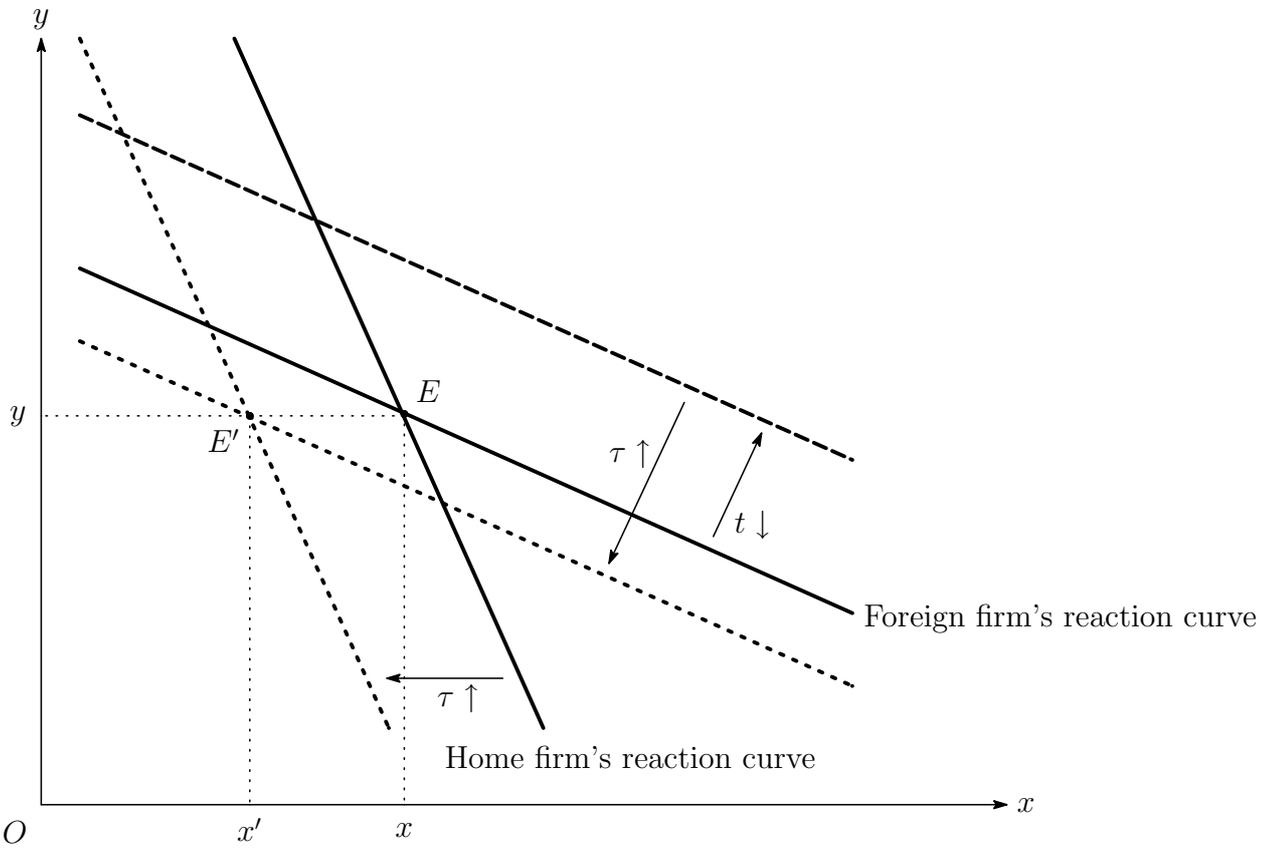


Figure 1: The Effect of the Reform: Destination-Based Consumption Tax and  $p' - c'' < 0$

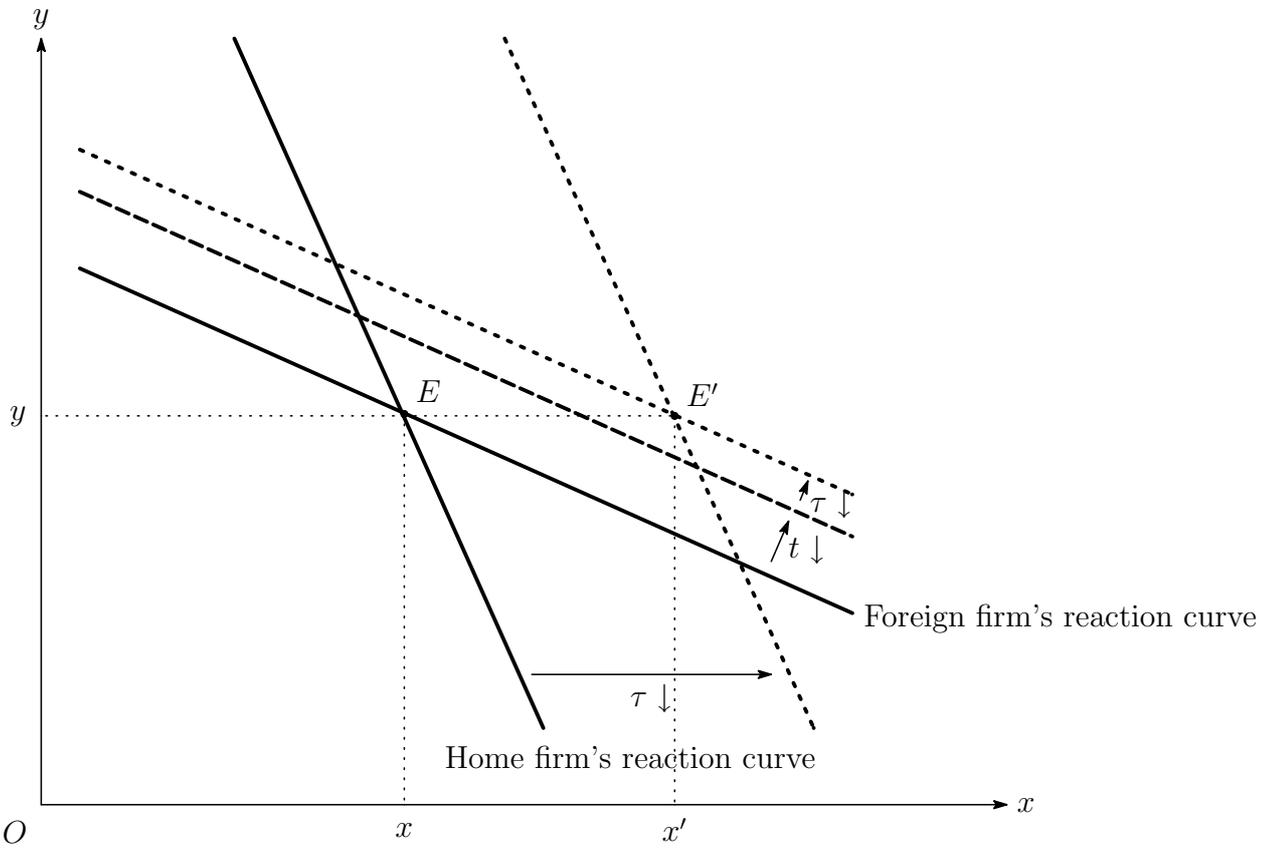


Figure 2: The Effect of the Reform: Destination-Based Consumption Tax and  $p' - c'' > 0$

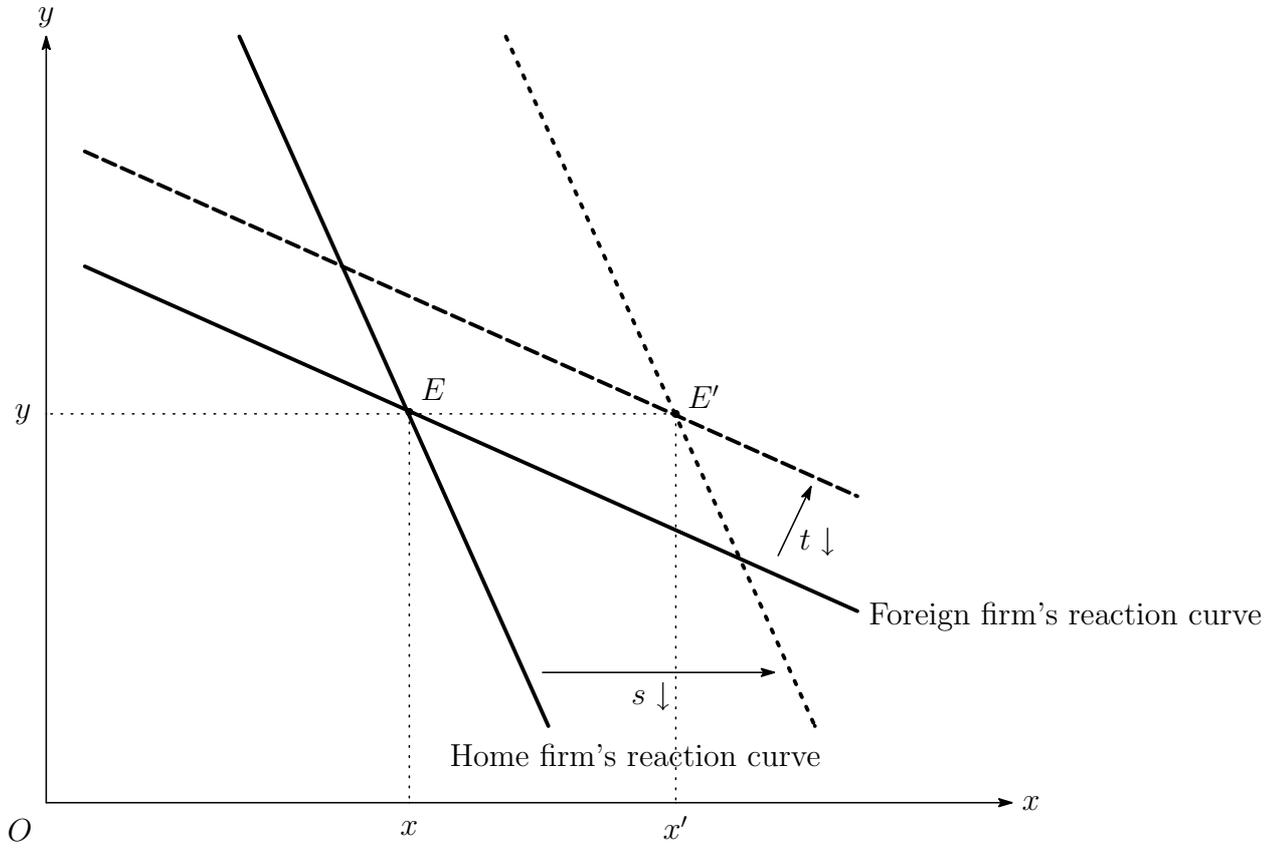


Figure 3: The Effect of the Reform: Origin-Based Production Tax

	$x$	$y$	$p$	$CS$	$\pi$	$T$	$W$	$W^*$	$W + W^*$
consumption tax (i)	-	0	+	-	-	?	-	0	-
consumption tax (ii)	+	0	-	+	+	?	+	0	+
production tax	+	0	-	+	+	?	+	0	+

Table 1: Effects of the Reform (note: (i) is the case of  $p' - c'' < 0$  and (ii) is the case of  $p' - c'' > 0$ )