International Review of Economics and Finance 80 (2022) 1–11

Contents lists available at ScienceDirect

International Review of Economics and Finance

journal homepage: www.elsevier.com/locate/iref

Revenue-neutral or profit-neutral tariff and tax reforms under imperfect competition: Welfare implications☆

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ARTICLE INFO

JEL classification:
F12
F13

Keywords:
Tariff cuts
Domestic tax reforms
Revenue neutrality
Profit neutrality
Welfare effects

ABSTRACT

Concerns over the financial losses of government in revenues resulting from tariff reductions under trade liberalization have triggered many low-income countries to opt for a proper strategy of reforming their domestic consumption taxes. This paper analyzes the welfare effects of two coordinated tariff and tax reform strategies: one is to keep government revenue unaffected, and the other is to leave domestic profit unchanged when there are tariff cuts. Within a stylized framework of international duopoly, we identify conditions under which the tariff and tax reforms (revenue-neutral and profit-neutral) make domestic consumers better off and are welfare improving to a reforming country.

1. Introduction

Tariff and non-tariff trade barrier reforms accompanied by sound fiscal policies have allowed many countries to launch more outward-oriented development strategies and effectively utilize the opportunities for economic growth.[1] Nevertheless, the financial issues of government revenue losses resulting from trade liberalization have become a focus of growing concern among economic policymakers. Above all, low-income and lower-middle-income countries, which rely heavily on tariff revenues, are likely to bear the brunt of the pain. Based on the World Bank's income classifications of 97 economies in 2017, the average customs and other import duties as a percentage of central government tax revenue was 14.6% for 15 low-income countries, but only 1.7% for 20 high-income countries (see Fig. 1).[2] In low-income countries such as Afghanistan and the Central African Republic, customs and other import duties contributed more than one-third of all central government tax receipts.

☆ We are extremely thankful to the editor Carl Chen and three anonymous referees for their insightful comments and helpful suggestions, which led to substantial improvements in the exposition of the paper. All remaining errors are, of course, ours.

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[1] Voluminous studies have contributed to our understanding of the cases where more open economies have outperformed those inward-looking trade practices. See, e.g., Edwards (1993, 1998), Sachs and Warner (1995), Ben-David (1996), Ben-David and Loewy (1998), Frankel and Romer (1999), Anderson (1999), Irwin and Terviö (2002), Chang et al. (2009), among others.

[2] Although data are available for Somalia (64.8%), Central African Republic (41.3%) (both low-income), West Bank and Gaza (34.5%), Vanuatu (21.5%) (both lower-middle-income), Nauru (50.4%), Botswana (44.8%), Namibia (36%), Marshall Islands (22.5%) (all upper-middle-income), and for Commonwealth of the Bahamas (31.3%), St. Kitts and Nevis (29.1%), Palau (24.7%), Saudi Arabia (23%), Trinidad and Tobago (10.1%) (all high-income), these countries are not included in Fig. 1 since they strongly skew the reported averages of their income group. Fig. 1 includes data for 15 low-income, 29 lower-middle-income, 33 upper-middle-income, and 20 high-income countries.

https://doi.org/10.1016/j.iref.2022.02.029
Received 9 July 2020; Received in revised form 29 April 2021; Accepted 12 February 2022
Available online 23 February 2022

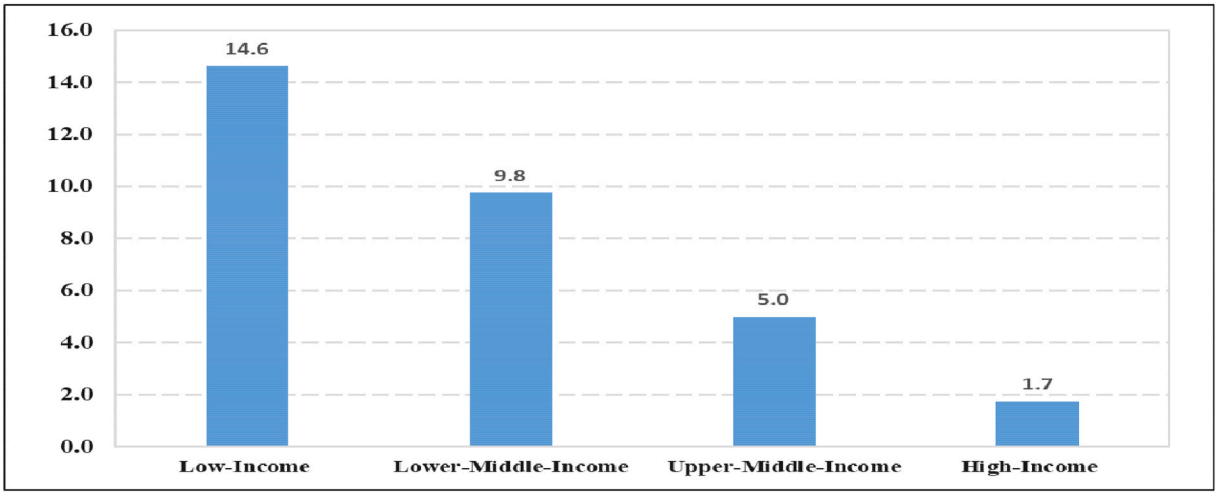

Fig. 1. *Average customs and other import duties for selected income group countries* (as a percent of central government tax revenue, 2017
).
Source*: World Development Indicators.*

Tariffs or customs duties on imported goods are known to be doubly distortionary since they interfere with consumer and producer prices (e.g., Dixit, 1984). Reductions in tariffs thus would allow reforming countries to utilize efficiency gains from trade liberalization.[3] However, tariff reductions generate a risk of large fiscal imbalances in the reforming countries, jeopardizing their ability to fund critical government programs. That is why proposals for coordinated reforms, including a tariff reduction and an increase in consumption tax (like the value-added tax, hereafter VAT) as an alternative revenue-collecting instrument, have received considerable attention in empirical and theoretical trade literature. Since the VAT base is broader than that of a tariff, some reform proposals have been put forward, arguing that tariff cuts combined with even smaller than one-to-one increases in VAT can adequately compensate for any loss in government revenue (Mitra 1992). The Organization for Economic Cooperation and Development (OECD) reports that the number of countries utilizing the VAT system has increased dramatically from less than 10 in the 1960s to 168 in 2018.[4] However, the empirical studies provide mixed results regarding whether countries that lowered tariffs could fully recover their revenue losses. For example, Buettner et al. (2006) document that countries have increased their VAT revenues enough to compensate for declining tariff revenues. Baunsgaard and Keen (2010) find that while high-income and middle-income countries have fully recovered their lost trade taxes, low-income countries have typically recovered no more than 30 cents of each lost dollar.

This paper analyzes two coordinated tariff reduction and domestic consumption tax reform strategies with the objective of achieving government revenue neutrality or domestic profit neutrality for a reforming country under imperfect competition. These strategies have important policy implications for an effective reform. The revenue-neutral tariff-tax strategy allows a reforming country's government to ease budgetary pressures of tariff reduction and avoid harsh spending cuts. The profit-neutral tariff-tax strategy prevents an import-competing firm's profits from falling due to trade liberalization-induced foreign competition, on the one hand, and increases the probability of a domestic firm's survival, on the other.[5] We attempt to show that, under imperfect competition, adopting either one of these strategies can increase a reforming country's overall welfare when certain plausible conditions are satisfied. These conditions pertain to the pre-reform market demand conditions (in terms of the product price level) and whether the pre-reform tariff exceeds the pre-reform consumption tax.

The welfare implications of the various reform strategies examined in economic literature differ extensively due to variations across specified models and reforms' objectives.[6] While most theoretical work has focused on the perfectly competitive market setting, relatively less attention has been paid to markets characterized by imperfect competition. Among these studies, Mujundar (2004) analyzes the welfare effect of tariff reduction on an intermediate input combined with an increase in the profit tax rate for keeping government revenue unchanged. Interestingly, he finds that a monopolistic market structure is needed for this type of coordinated reform to guarantee welfare improvements. Keen and Ligthart (2005) study the case of imperfectly competitive markets for final goods. They focus on two reform strategies: (i) one involves a tariff cut with the point-by-point increase in destination-based consumption taxes, and (ii) the other involves an integrated tariff-tax reform that leaves consumer price unchanged. Both reforms are

[3] Welfare enhancement due to tariff reduction has been shown by studies such as Hatta (1997) and Diewert et al. (1989).
[4] See OECD Consumption Tax Trends 2018, p. 23.
[5] Baggs and Brander (2006) find that Canada-U.S. Free Trade Agreement (CUSFTA) tariff cuts lowered Canadian import-competing firms' profits. Baggs (2005) shows that CUSFTA had a significant adverse effect on the probability of survival for Canadian firms.
[6] For contributions in the literature see, e.g., Michael et al. (1993), Hatzipanayotou et al. (1994), Keen and Ligthart (2002, 2005), Emran and Stiglitz (2005), Mujundar (2004), Naito and Abe (2008), Karakosta and Tsakiris (2014), Fujiwara (2013, 2016), and Okawa and Iguchi (2016).

shown to reduce overall domestic welfare unambiguously.[7] Naito and Abe (2008) analyze a reform strategy that lowers the sum of a consumption tax and a specific tariff on an intermediate import while keeping unchanged the sum of the consumption tax and a specific tariff on the final good. The aim is to offset any shortfall in government revenue. The authors show that the reform strategy enhances welfare under certain conditions.

Fujiwara (2013) shows that the undesirable welfare outcome of Keen and Ligthart's (2005) point-by-point reform strategy applies only to those industries where the home and foreign firms' marginal costs are either constant or increasing. The same policy reform is found to improve a reforming country's welfare when marginal costs are decreasing. Fujiwara (2013) further finds that this strategy increases government revenue if the pre-reform tariff is lower than the pre-reform tax, regardless of whether marginal costs are constant or decreasing. Karakosta and Tsakiris (2014) study the welfare effects of the same reform strategies proposed by Keen and Ligthart (2005) under both Cournot and Bertrand competition in a setting that allows for product differentiation and the provision of a public good. In the scenario that government revenues are lump-sum distributed, both reforms reduce domestic welfare under Cournot. Under Bertrand competition, however, the reforms are welfare-decreasing (welfare-increasing) if products are highly differentiated (close substitutes).[8] Stressing the degree of product differentiation and the modes of competition in duopoly markets, Shim and Jeong (2016) identify the pre-reform tariff and consumption tax rates for a tariff cut to enhance welfare. Under Cournot competition, government revenue increases and social welfare may improve when the pre-reform tariff and consumption tax rates are high. Under Bertrand competition, a tariff cut yields the same results even if the pre-reform tariff and consumption tax rates are sufficiently low.

Okawa and Iguchi (2016) analyze the welfare effects of several tariff-tax reforms under Cournot oligopoly, where home and foreign firms supply the final good in the domestic market. The authors derive optimal tariffs and sales taxes and show that welfare-improving tariff-tax reform strategies always exist. When applying the two reform strategies proposed by Keen and Ligthart (2005), Okawa and Iguchi (2016) find that while the welfare effect of a point-for-point reform is generally not transparent, there exists a set of pre-reform tariffs and sales taxes under which a price-neutral reform strategy can be welfare-increasing. Moreover, one can find a revenue-maximizing coordinated tariff and tax reform despite that the pre-reform tariff and sales tax are not at their optimal levels. Fujiwara (2016) compares the welfare implications of the two tariff-tax reform strategies in the stylized Cournot duopoly model with constant marginal costs, both intending to leave the world price (and foreign welfare) unaffected: (i) a tariff cut combined with a destination-based consumption tax increases and (ii) a tariff cut combined with an origin-based production tax decreases. The results indicate that the first strategy lowers domestic welfare and yields a Pareto deterioration, while the second strategy raises domestic welfare and yields a Pareto improvement.[9]

Our analysis contributes to the existing literature in two aspects. First, we identify conditions under which a coordinated tariff-tax reform strategy leads to a "win-win-win" equilibrium for a reforming country to increase its consumer surplus, domestic profit, and overall welfare. To show the feasibility of such a reform strategy, we focus our study on an integrated tariff-tax reform that keeps government revenue unaffected by tariff cuts. This revenue neutrality objective is similar to that discussed in Mujumdar (2004), but from the perspective of policy instruments, we use a specific import tariff and a destination-based consumption tax as adopted in Keen and Ligthart (2005). We find that the existence of a win-win-win equilibrium depends on economic factors such as the pre-reform market price conditions, import tariffs, consumption taxes, and production technology (in terms of average or marginal costs). Second, we analyze the welfare implications of a coordinated tariff-tax reforms that leaves domestic profit unaffected. We show that this reform strategy produces the same results as the strategy that leaves domestic employment unchanged – a highly desired labor market outcome, especially for industries where tariff cuts lead to minor wage adjustments and significant employment contractions.[10] We derive conditions under which profit-neutral tariff and tax reform benefit domestic consumers, increase government revenue, and improve a reforming country's overall welfare. This demonstrates the possibility of a win-win-win equilibrium for a coordinated tariff-tax reform strategy that considers domestic profit neutrality as an objective of government policy. To the best of our knowledge, the interesting issues on the profit-neutral or domestic employment-neutral tariff and tax reforms and the resulting economic effects appear not to have been examined in the existing literature.

The remaining of the paper is organized as follows. Section 2 presents the stylized framework of an import-competing market under duopoly and discusses its comparative statics. Section 3 examines the welfare implications of two coordinated tariff-tax reforms that do not affect either government revenue or domestic profit. Section 4 concludes.

[7] The same reform strategies are found to strictly improve overall domestic welfare under perfect competition, however. For the detailed analysis, see Keen and Ligthart (2002).

[8] Karakosta and Tsakiris (2014) find that introducing a public good affects welfare outcomes only when the consumer's valuation for the public good is sufficiently high.

[9] Fujiwara (2014) studies welfare effects of the same reform strategies when marginal costs are non-constant and finds that domestic welfare still increases under the second strategy. Interestingly, the first strategy is also found to result in welfare improvement when marginal cost is sufficiently decreasing.

[10] For example, Gaston and Trefler (1997), Beaulieu (2000), and Trefler (2004) show that Canadian industries which faced Canada-U.S. Free Trade Agreement tariff cuts experienced employment losses. The first two studies also find no relationship between the average earnings in an industry and the tariffs applicable to the industry.

2. The model

We consider a stylized framework of an international Cournot duopoly where a home firm and a foreign firm compete in the home-country market for a homogenous consumption good.[11] The home firm produces output X, and the foreign firm produces output X^*. The home country's government imposes (i) a destination-based consumption tax, denoted by t, on each unit of the consumption good in the home country and (ii) a tariff, denoted by τ, on each unit of the foreign import.

We assume that demand in the home market is linear: $P = P(X+X^*)$, where $P'(\cdot) < 0$ and $P''(\cdot) = 0$. Thus, the price paid by the consumers for each unit of the good in the home market is P, and the net prices that the home and foreign firms receive are given, respectively, as $P - t$ and $P - t - \tau$. Let F be the fixed cost and c the (constant) marginal cost of each firm.[12] The competing firms independently and simultaneously solve their profit-maximization problems:

$$\underset{\{X\}}{Max}\Pi^h = (P - t - c)X - F, \tag{1}$$

$$\underset{\{X^*\}}{Max}\Pi^f = (P - t - \tau - c)X^* - F, \tag{2}$$

where Π^h and Π^f are the profit functions of the home and foreign firms, respectively.[13] The first-order conditions (FOCs) characterizing the Cournot equilibrium imply that the home firm's marginal revenue $(P'X + P)$ equals its marginal cost plus the consumption tax:

$$P'X + P = c + t, \tag{3}$$

while the foreign firm's marginal revenue $(P'X^* + P)$ is the sum of its marginal cost, the consumption tax, and the tariff:

$$P'X^* + P = c + t + \tau. \tag{4}$$

Taking the total differentiation of the FOCs in (3) and (4), allowing for any coordinated changes in tariff and tax and applying the linear demand assumption, we have

$$P'dX + P'(dX + dX^*) = dt, \tag{5}$$

$$P'dX^* + P'(dX + dX^*) = dt + d\tau. \tag{6}$$

For the rest of the paper, we refer to tariff reform as a reduction in an import tariff (i.e., $d\tau < 0$) and tax reform as a change in domestic consumption tax (dt). We denote a coordinated tariff-tax reform as $\{d\tau, dt\}$ Re-writing (5) and (6) in matrix form yields

$$\begin{bmatrix} 2P' & P' \\ P' & 2P' \end{bmatrix} \begin{bmatrix} dX \\ dX^* \end{bmatrix} = \begin{bmatrix} dt \\ dt + d\tau \end{bmatrix}, \tag{7}$$

From (7), we derive changes in output levels optimally produced by the home and foreign firms in response to a coordinated tariff-tax reform, $\{d\tau, dt\}$ This yields

$$dX = \frac{1}{3P'}(dt - d\tau); \tag{8a}$$

$$dX^* = \frac{1}{3P'}(dt + 2d\tau). \tag{8b}$$

Combining (8a) and (8b), we determine how a reform strategy affects the total amount of the product available for consumption in the home country:

$$d(X + X^*) = \frac{1}{3P'}(2dt + d\tau). \tag{9}$$

It follows from (9) that for a tariff-tax reform, $\{d\tau, dt\}$, where $d\tau < 0$, we have:

$$d(X + X^*) > 0 \text{ when } dt < \frac{|d\tau|}{2}; \tag{10a}$$

$$d(X + X^*) < 0 \text{ when } dt > \frac{|d\tau|}{2} > 0. \tag{10b}$$

The economic implications of these results are as follows. Equation (10a) indicates that a tariff reduction $(d\tau < 0)$ coordinated with either a consumption tax cut $(dt < 0)$ or a consumption tax increase by less than 50% of the tariff reduction $(0 < dt < |d\tau|/2)$, will

[11] Keen and Ligthart (2005) adopt the same analytical framework of duopolistic competition for the Case of a homogeneous good.
[12] As in Dixit (1984), we assume that the foreign firm does not incur any transportation cost in supplying the home market.
[13] The standard assumptions that $X > 0$ and $X^* > 0$ imply that $P > t + \tau + c$.

increase total output in the home country. However, equation (10b) implies that a coordinated tariff-tax reform will lower total output when an increase in domestic consumption tax ($dt > 0$) exceeds 50% of the tariff reduction.

We proceed to derive an expression for welfare variation in a country embracing economic reforms. This serves as a base for analyzing the welfare effects of two tariff-tax reform strategies to be discussed in the present study.

3. Welfare effects

As in the economics literature, we assume that a reforming country's overall welfare (W) is measured by the sum of domestic profit (Π^h), consumer surplus (CS), and government revenue (G). That is,

$$W = \Pi^h + CS + G, \tag{11}$$

where $\Pi^h = [P(X+X^*) - t - c]X - F$ as given in (1), $CS = U(X+X^*) - P(X+X^*)$, and $G = t(X + X^*) + \tau X^*$. From (11), we have the welfare change equation:

$$dW = d\Pi^h + d(CS) + dG, \tag{12}$$

where

$$d\Pi^h = P'(dX + dX^*)X - Xdt + (P - t - c)\,dX, \tag{13}$$

$$d(CS) = -P'(dX + dX^*)(X + X^*), \tag{14}$$

$$dG = dt(X + X^*) + t(dX + dX^*) + X^* d\tau + \tau dX^*. \tag{15}$$

In what follows, we first examine the welfare effects of a tariff-tax reform when the home government's objective is to keep its aggregate revenue (from import tariffs and domestic consumption taxes) unaffected (i.e., $dG = 0$). We refer to this as a coordinated revenue-neutral tariff and tax reform strategy.

We then examine the scenario where the objective is to leave the home firm's profit unaffected (i.e., $d\Pi^h = 0$). We refer to this as a coordinated profit-neutral tariff and tax reform strategy. Moreover, we show that this profit neutrality objective of a tariff-tax reform yields the same outcome as a reform strategy that keeps domestic employment unaffected (i.e., $dX = 0$). This by-product can be referred to as a coordinated employment-neutral tariff-tax reform strategy.

3.1. The revenue-neutral tariff and tax reform strategy

We begin with our analysis on the tariff-tax reform that prevents the home government's aggregate revenue from being affected by tariff reductions. First, it is necessary to determine the required change in domestic consumption tax (dt) that can offset the loss of government revenue resulting from a tariff cut. To do so, we first substitute the change in total consumption $d(X+X^*)$ from (9) into dG in (15) and then set the variation in government revenue dG to be zero. Making use of the FOCs in (5) and (6), after rearranging terms, we have the following revenue-neutrality condition:

$$dt = -\frac{1}{2}\left(\frac{3P - 4t - 5\tau - 3c}{3P - 4t - 2\tau - 3c}\right)d\tau. \tag{16}$$

We use (16) to identify the conditions under which a coordinated tariff-tax reform can achieve the revenue neutrality objective ($dG = 0$). It follows from the revenue-neutrality condition in (16) that, depending on the pre-reform product price P, there are three cases:

Case (i):

$$\frac{dt}{d\tau} < 0 \text{ for } P \in \left(c + t + \tau, \quad \frac{3c + 4t + 2\tau}{3}\right);$$

Case (ii):

$$\frac{dt}{d\tau} > 0 \text{ for } P \in \left(\frac{3c + 4t + 2\tau}{3}, \quad \frac{3c + 4t + 5\tau}{3}\right);$$

Case (iii):

$$\frac{dt}{d\tau} < 0 \text{ for } P > \frac{3c + 4t + 5\tau}{3}.$$

We present economic implications as follows. Cases (i) and (iii) imply that any tariff reduction ($d\tau < 0$) must be accompanied by a domestic consumption tax increase ($dt > 0$). Note that Case (i) exists only when the pre-reform domestic tax exceeds the pre-reform tariff (i.e.,$t > \tau$).[14] Interestingly, Case (ii) indicates that a domestic tax cut ($dt < 0$) is required to maintain the revenue neutrality condition. This result is not unexpected. Both Mujumdar (2004) and Fujiwara (2014) also show the need for similar tariff-tax coordination. When the pre-reform price falls within the range as shown in Case (ii), a reduction in tariff rate will increase domestic consumption[15] and government revenue (through increased consumer tax intake). Therefore, a domestic tax cut is indispensable to keep government revenue unaffected.

Next, we examine how the revenue neutrality objective affects domestic welfare. With the given condition that $dG = 0$, the welfare change equation in (12) becomes

$$dW = d\Pi^h + d(CS). \tag{17}$$

Substituting $d\Pi^h$ from (13) and $d(CS)$ from (14) into dW in (17), making use of (4), (8a), and (9), we have:

$$dW = \frac{(6P - 6c - 6t - 2\tau)dt - \tau d\tau}{3P'}. \tag{18}$$

Equation (18) indicates that dW is strictly negative if the numerator is positive. Since the parenthetical expression is positive, the first product term of the numerator has the same sign as dt, whereas the second product term is always negative.[16] Therefore, any revenue-neutral reform which combines a tariff reduction ($d\tau < 0$) and a domestic consumption tax increase ($dt > 0$) will be *welfare-reducing*. That is,

$$dW < 0 \text{ if } d\tau < 0 \text{ and } dt > 0.$$

From our discussion of the tariff-tax coordination, we already know that this result occurs when the pre-reform product price falls within the ranges shown in Cases (i) and (iii). However, when the initial product price is within the range as given in Case (ii), the revenue neutrality condition requires that any tariff reduction be combined with a tax cut. In this case, the reform's effect on domestic welfare cannot be determined unambiguously. To further discuss this point, we substitute the revenue-neutral condition from (16) into dW in (18). This yields

$$dW = -\frac{1}{P'}\left[P - t - c - \tau\left(\frac{3P - 3c - 3t - \tau}{3P - 3c - 4t - 2\tau}\right)\right]d\tau. \tag{19}$$

The sign of dW in (19) is unambiguously negative ($dW < 0$) when the pre-reform consumption tax rate is higher than the pre-reform tariff rate ($t > \tau$) and the pre-reform product price falls within the following range:

$$c + t + \tau < P < \frac{3c + 4t + 2\tau}{3}.$$

For other pre-reform conditions, the impact of the tariff-tax reform on social welfare cannot be determined unambiguously without information on market demand conditions (in terms of the product price). It is then instructive to see how the reform affects domestic consumers and the home firm's profit separately.

To study the effect on domestic consumers, we substitute the FOCs from (3)-(4) and the change in total consumption $d(X + X^*)$ from (9) back into $d(CS)$ in (14). Combining the result with the revenue-neutral tariff-tax condition as shown in (16) yields

$$d(CS) = \frac{\tau}{P'}\left(\frac{2P - 2c - 2t - \tau}{3P - 3c - 4t - 2\tau}\right)d\tau. \tag{20}$$

Equation (20) helps determine the conditions for $d(CS)$ to be positive or negative. It is easy to verify that the revenue-neutral reform benefits domestic consumers by increasing total output in the home market and lowering the product price when the pre-reform price is sufficiently high(i.e., $P > (3c + 4t + 2\tau)/3$).[17] The reform affects domestic consumers negatively only when the pre-reform product price is low and falls within the range as shown in Case (i). As explained earlier, this price range exists only when the consumption tax rate is higher than the tariff rate ($t > \tau$). Therefore, domestic consumers will always be better off under the revenue-neutral reform strategy if the pre-reform domestic tax is *lower* than the pre-reform tariff (i.e., $t < \tau$).

To see how the reform affects the home firm's profit, we substitute the FOC from (3) and both the change in home firm's output from (8a) and the change in total consumption $d(X + X^*)$ from (9) back into $d\Pi^h$ in (13). Combining the result with the revenue-neutral tariff and consumption tax condition in (16), we have:

$$d\Pi^h = -\frac{(P - t - c)}{P'}\left(\frac{3P - 3c - 4t - 3\tau}{3P - 3c - 4t - 2\tau}\right)d\tau. \tag{21}$$

[14] See a detailed analysis in Appendix A-1.
[15] See a detailed analysis in Appendix A-2.
[16] Note that $6P - 6c - 6t - 2\tau > 0$ since $P > t + \tau + c$ is required for $X^* > 0$. The second product term $\tau d\tau < 0$ since $d\tau < 0$.
[17] See a detailed analysis in Appendix A-2 and A-3.

It follows from (21) that there are three possible cases:

Case (a):

$$d\Pi^h < 0 \text{ for } P \in \left(c + t + \tau, \quad \frac{3c + 4t + 2\tau}{3}\right),$$

Case (b):

$$d\Pi^h > 0 \text{ for } P \in \left(\frac{3c + 4t + 2\tau}{3}, \quad \frac{3c + 4t + 3\tau}{3}\right),$$

Case (c):

$$d\Pi^h < 0 \text{ for } P > \frac{3c + 4t + 3\tau}{3}.$$

We present economic implications as follows. Cases (a) and (c) indicate that the revenue-neutral tariff-tax reform reduces domestic profit when the pre-reform product price falls within the specified ranges. Like Case (i) discussed earlier, Case (a) exists only when the consumption tax rate is higher than the tariff rate $(t > \tau)$. Interestingly, these results imply that the home firm's profit can increase under the revenue-neutral reform, which occurs if the pre-reform product price is within the "intermediate" range, as specified in Case (b). For this price range, any tariff reduction must be accompanied by a domestic consumption tax cut, as shown in Case (ii), inducing the home firm to expand its output and realize a higher profit.[18]

We are now in a position to combine all possible ranges of the pre-reform product price in Cases (i)-(iii) and Cases (a)-(c). Utilizing our previous result that a tariff reduction combined with a domestic tax increase lowers domestic welfare under the revenue-neutral reform, we can see how this reform strategy affects domestic consumers, the home firm's profit, and the overall welfare when $t > \tau$ or when $t < \tau$. We present these results in Tables 1 and 2.

We summarize the findings and their economic implications in the following proposition:

PROPOSITION 1. *In an import-competing market under imperfect competition, we have:*

(i) *For $t > \tau$ and $P \in (c+t+\tau, \ (3c+4t+2\tau)/3)$: A revenue-neutral tariff-tax reform lowers the home firm's output and increases domestic demand for the foreign firm's product. The decrease in the home firm's output exceeds the increase in the import demand, causing the total consumption in the home market to fall. Consequently, a reduction in tariff must be accompanied by a domestic consumption tax increase to offset the decline in tax intake resulting from the decreased domestic consumption. The reform affects domestic consumers and domestic firm negatively, causing overall domestic welfare to decline.*

(ii) *For $t > \tau$ and $P \in ((3c+4t+2\tau)/3, \ (3c+4t+3\tau)/3)$ or $t < \tau$ and $P \in (c+t+\tau, \ (3c+4t+3\tau)/3)$: A revenue-neutral tariff-tax reform raises the home and foreign firms' outputs, causing the total consumption in the home market to increase. As such, a reduction in tariff must be accompanied by a domestic consumption tax cut to offset the increase in tax intake resulting from the increased domestic consumption. The reform benefits domestic consumers and the home firm, causing the reforming country's overall welfare to increase.*

(iii) *Regardless of the values of t and τ when the pre-reform product price is such that $P \in ((3c+4t+3\tau)/3, \ (3c+4t+5\tau)/3)$ or $P > (3c+4t+5\tau)/3$, a revenue-neutral reform lowers the home firm's output and raises foreign firm's output. Moreover, the increase in the foreign firm's output exceeds the decrease in the home firm's output such that total consumption in the home market increases. Although the reform's effect on overall welfare is indeterminate for any pre-reform price $P \in ((3c+4t+3\tau)/3, \ (3c+4t+5\tau)/3)$, the decline in home firm's profit outweighs any gain in consumer surplus, causing the reforming country's overall welfare to fall when the pre-reform market price is critically high (i.e., $P > (3c + 4t + 5\tau)/3$).*

The results and economic implications we present in PROPOSITION 1 help identify the conditions (in terms of the pre-reform market price conditions and the pre-reform consumption tax rate relative to the pre-reform tariff rate) under which a coordinated tariff-tax reform with the revenue-neutrality objective leads to a win-win-win equilibrium in increasing consumer surplus, domestic profit, and overall welfare for a reforming country.

3.2. The profit-neutral tariff and tax reform strategy

We now proceed to analyze a coordinated tariff and tax reform strategy that exerts no impact on domestic profit. We first derive an expression showing variations in domestic profit. We then determine an adjustment in the consumption tax to any loss of revenue resulting from a tariff cut, intending to keep domestic profit unaffected.

Going back to the framework in Section 2, we plug (3), (8a), and (9) into equation (13) that shows the change in the home firm's profit. This yields

[18] Note that price range in Case (b) falls within the price range specified in Case (ii). See Appendix A-4 for the revenue-neutral reform's effect on the home and foreign firms' output.

Table 1
Welfare effects of a revenue-neutral tariff and tax reform (when $t > \tau$).

	Product price conditions			
	$c+t+\tau < P < \frac{3c+4t+2\tau}{3}$	$\frac{3c+4t+2\tau}{3} < P < \frac{3c+4t+3\tau}{3}$	$\frac{3c+4t+3\tau}{3} < P < \frac{3c+4t+5\tau}{3}$	$P > \frac{3c+4t+5\tau}{3}$
Tariff-tax coordination	$\{d\tau < 0,\ \ dt > 0\}$	$\{d\tau < 0,\ \ dt < 0\}$	$\{d\tau < 0,\ \ dt < 0\}$	$\{d\tau < 0,\ \ dt > 0\}$
CS	–	+	+	+
$\prod^h$	–	+	–	–
W	–	+	?	–

Table 2
Welfare effects of a revenue-neutral tariff and tax reform (when $t < \tau$).

	Product price conditions		
	$c+t+\tau < P < \frac{3c+4t+3\tau}{3}$	$\frac{3c+4t+3\tau}{3} < P < \frac{3c+4t+5\tau}{3}$	$P > \frac{3c+4t+5\tau}{3}$
Tariff-tax coordination	$\{d\tau < 0,\ \ dt < 0\}$	$\{d\tau < 0,\ \ dt < 0\}$	$\{d\tau < 0,\ \ dt > 0\}$
CS	+	+	+
$\prod^h$	+	–	–
W	+	?	–

$$d\Pi^h = -\frac{2}{3P'}(P-t-c)(d\tau - dt). \tag{22a}$$

To achieve the profit neutrality objective under the tariff and tax reform, we derive the conditions under which $d\Pi^h$ in (22a) is zero. Given that $(P-t-c) > 0$ and $P' < 0$, we have from (22a) that

$$d\Pi^h = 0 \text{ when } dt = d\tau, \tag{22b}$$

where $d\tau < 0$ in the presence of a tariff cut. This indicates that to keep domestic profit unchanged ($d\Pi^h = 0$), one unit of tariff reduction ($d\tau < 0$) must go with one unit of domestic tax cut ($dt < 0$). Note that the same tariff-tax relationship as shown in (22b) also holds if the government's objective is to keep the home firm's output or domestic employment unaffected ($dX = 0$). This can be easily verified by looking at equation (8a) that $dX = 0$ when $dt = d\tau$. This result is of policy importance since it implies that our analyses in this section apply to the Case of a *domestic employment-neutral* tariff-tax reform.

It is instructive to investigate the effect on the foreign firm's output, which affects domestic consumption and consumer surplus. Intuitively, the revenue-neutral reform must increase foreign firm's output, causing total output for consumption in the home market to rise. This impact on foreign output can be found by substituting the profit-neutral (or employment-neutral) tariff-tax relationship in (22b) back into equations (8a)-(9). This yields

$$dX^* = dX + dX^* = \frac{d\tau}{3P'} > 0.$$

Apparently, domestic consumers benefit from the profit-neutral strategy.

Next, we examine what effect that the profit-neutral tariff-tax strategy has on a reforming country's welfare. With the objective of achieving profit neutrality ($d\Pi^h = 0$) for the domestic firm, the welfare change equation in (12) becomes

$$dW = d(CS) + dG. \tag{23}$$

Substituting $d(CS)$ from (14) and dG from (15) into dW in (23), taking into account the profit neutrality condition that $dt = d\tau$ as shown in (22b) and the FOC in (4), we have

$$dW = -\frac{1}{P'}(P-c-2t-2\tau)d\tau. \tag{24}$$

Based on the welfare change equation in (24), we have two possibilities:

$$(i)\ dW > 0 \text{ if } P \in (c+t+\tau,\ \ c+2t+2\tau); \tag{25}$$

$$(ii)\ dW < 0 \text{ if } P > c+2t+2\tau. \tag{26}$$

The economic implications are as follows. Equation (25) indicates that the profit-neutral tariff-tax reform is welfare-increasing when the pre-reform market price is moderate. Equation (26) indicates that if the pre-reform market price is sufficiently high, the reform turns out to be welfare-decreasing.

Finally, we analyze how the profit-neutral tariff-tax reform affects government revenue. This exercise is done by first substituting dX^* from (8b) and $(dX + dX^*)$ from (9) into dG in (15). We then take into account the FOCs in (3) and (4) and the profit neutrality

condition as shown in (22b) that $d\tau = dt$. This yields

$$dG = -\frac{(3P - 3c - 4t - 3\tau)}{P'}d\tau. \tag{27}$$

Equation (27) indicates that the profit-neutral tariff-tax reform increases government revenue if the pre-reform product price satisfies the following condition:

$$P \in \left(c + t + \tau, \quad \frac{3c + 4t + 3\tau}{3}\right). \tag{28}$$

If, instead, the pre-reform product price is high such that

$$P > \frac{3c + 4t + 3\tau}{3}, \tag{29}$$

the profit-neutral tariff-tax reform causes government revenue to decline. We summarize the results of the above analyses in Table 3.

We present the economic implications of the results in Table 3 as follows. The first two price ranges indicate that the profit-neutral tariff-tax reform increases the reforming country's overall welfare, provided that the pre-reform market price is low or moderate. The last price range shows that this reform may cause domestic welfare to decline when the pre-reform market price is critically high. Notice that the tariff-tax reform with a profit-neutrality objective benefits domestic consumers and can also increase government revenue when the pre-reform market price is low (i.e., $c + t + \tau < P < (3c + 4t + 3\tau)/3$). Although this reform strategy may reduce government revenue (due to the decreased tariff revenue and consumption tax intake) when the pre-reform market price is high (see equation (29)), it may increase consumer surplus in sufficient amount to offset the government revenue loss. In this Case, there is a welfare improvement. This result emerges when the pre-reform market price is within the intermediate range such that $P \in ((3c + 4t + 3\tau)/3, \quad c + 2t + 2\tau))$. Finally, the home government's revenue loss outweighs the increased consumer surplus when the pre-reform market price is sufficiently high (see equation (26)). Under this circumstance, the tariff-tax reform with a profit-neutrality objective turns out to be detrimental to the reforming country's overall welfare.

We thus have:

PROPOSITION 2. *In an import-competing market under imperfect competition, a profit-neutral reform that involves a tariff reduction should be accompanied by a domestic consumption tax cut of equal magnitude* $(dt = d\tau < 0)$. *This reform leaves the home firm's output unaffected, raises the foreign firm's output, causing the market price for domestic consumers to fall and consumer surplus to increase. When the pre-reform product price is sufficiently high* $(P > c + 2t + 2\tau)$, *the reforming country's government revenue falls, offsetting gains to consumer surplus and causing the overall domestic welfare to decrease. However, when the pre-reform product price is intermediate such that* $c + t + \tau < P < c + 2t + 2\tau$, *the reform is welfare-increasing.*

The results and their economic implications in PROPOSITION 2 help identify the conditions under which a coordinated tariff-tax reform with the profit neutrality objective benefits domestic consumers, increases government revenue, and results in a welfare improvement. This suggests the possibility of a win-win-win equilibrium for a tariff-tax reform strategy that insulates domestic profit from being affected as an objective of a reforming country's government policy.

4. Concluding remarks

Using a stylized model of international duopoly in a reforming country's imperfectly competitive market, we have analyzed the welfare implications of coordinated tariff-tax reforms that generate government revenue neutrality or domestic profit neutrality. We show plausible conditions under which a revenue-neutral tariff and consumption tax reform is welfare-improving. Interestingly, domestic consumers strictly benefit from this coordinated reform when the pre-reform tariff rate is higher than the pre-reform consumption tax rate. Furthermore, we identify the conditions under which this reform strategy results in a win-win-win outcome with higher consumer surplus, domestic profit, and overall welfare.

In analyzing a coordinated tariff and domestic consumption tax reform that leads to domestic profit neutrality, we show that (i) one unit of tariff reduction must go with one unit of the consumption tax cut and (ii) there is welfare improvement for a reforming country when the pre-reform product price is lower than a threshold level. The profit-neutral reform benefits domestic consumers, but it can lower government revenue and domestic welfare when the pre-reform product price is critically high. For cases where the pre-reform

Table 3
Welfare effects of a profit-neutral tariff and tax reform.

	Product price conditions		
	$c + t + \tau < P < \frac{3c + 4t + 3\tau}{3}$	$\frac{3c + 4t + 3\tau}{3} < P < c + 2t + 2\tau$	$P > c + 2t + 2\tau$
Tariff-tax coordination	$dt = d\tau(< 0)$	$dt = d\tau(< 0)$	$dt = d\tau(< 0)$
CS	+	+	+
G	+	−	−
W	+	+	−

product price is sufficiently low, a coordinated tariff-tax reform to achieve the domestic profit neutrality objective results in a win-win-win outcome with higher consumer surplus, government revenue, and overall welfare.

The analysis with this paper provides a theoretical justification to the findings in the literature that coordinated tariff-tax reforms can lead to welfare improvements, depending on a reforming country's objective and its pre-reform economic conditions. It should be noted that our analysis does not capture some specific features of the low- and middle-income countries, such as the informal and non-tradable sectors, as well as intermediate products. An extension of the analysis to account for these and other essential aspects of developing economies would allow policymakers to understand better the potential economic impacts of the coordinated tariff and tax reforms. It should also be noted that the analysis with this paper abstracts from multilateral reforms, which may involve coordination between importing and exporting countries in the face of trade liberalization. We believe that studying multilateral reforms is vital to resolve the complex issues of coordinated reforms. This is an interesting and important issue for future research.

Author statement

Both authors shared equally in their contributions in terms of conceptualization, methodology, formal analysis, and review and editing. Sargsyan contributed to the original draft and data curation. The authors declared that they did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors in funding acquisition and resources.

Appendix

A-1. The condition for Case (i) implies that

$$3c + 3t + 3\tau < 3c + 4t + 2\tau,$$

which, in turn, implies that $t > \tau$.

When $t < \tau$, we have

$$\frac{3c + 4t + 2\tau}{3} < c + t + \tau,$$

which implies that any price equal to or lower than $\frac{3c+4t+2\tau}{3}$ violates the assumption that the quantity for X^* is positive.

Based on equation (16), there are two possibilities:

(i) $P \in \left(c+t+\tau, \frac{3c+4t+5\tau}{3}\right)$, which implies that $\frac{dt}{d\tau} > 0$;

(ii) $P > \frac{3c+4t+5\tau}{3}$, which implies that $\frac{dt}{d\tau} < 0$.

A-2. Substituting the revenue-neutral tariff-tax relationship in (16) back into (9), we have:

$$dX + dX^* = \frac{1}{3P'}\left(1 - \frac{3P - 4t - 5\tau - 3c}{3P - 4t - 2\tau - 3c}\right)d\tau,$$

which is positive when $d\tau < 0$ and the pre-reform product price satisfies the condition for Case (ii). Simplifying the above expression for terms in parentheses yields

$$dX + dX^* = \frac{1}{P'}\left(\frac{\tau}{3P - 3c - 4t - 2\tau}\right)d\tau,$$

which implies that $dX + dX^* > 0$ when (*i*) $d\tau < 0$ and the pre-reform tariff is higher than the pre-reform tax $(t < \tau)$, or (*ii*) $d\tau < 0$, the pre-reform tariff is lower than the pre-reform tax $(t > \tau)$, and $P > \frac{3c+4t+2\tau}{3}$.

A-3. Given that $dP = P'(dX + dX^*)$, we substitute $(dX + dX^*)$ from (9) and the revenue-neutral tariff-tax condition from (16) into this price change equation. This yields

$$dP = \left(\frac{\tau}{3P - 3c - 4t - 2\tau}\right)d\tau,$$

which implies that $dP < 0$ when $d\tau < 0$ and $P > \frac{3c+4t+2\tau}{3}$. That is, for any pre-reform price above this threshold level, a tariff reduction leads to a decrease in product price, causing domestic consumer surplus to increase.

A-4. Given that the effect on the level of output produced by the home firm as shown in (8a) is $dX = \frac{(dt - d\tau)}{3P'}$, substituting the revenue-neutral tariff-tax condition from (16) into this output change equation yields

$$dX = -\frac{1}{2P'}\left(\frac{3P - 3c - 4t - 3\tau}{3P - 3c - 4t - 2\tau}\right)d\tau.$$

Note that $dX > 0$ for $P \in \left(\frac{3c+4t+2\tau}{3}, \frac{3c+4t+3\tau}{3}\right)$ and $d\tau < 0$.

Similarly, given that the effect on the level of output produced by the foreign firm as shown in (8b) is $dX^* = \frac{dt+2d\tau}{3P'}$, substituting the revenue-neutral tariff-tax condition in (16) into this equation yields

$$dX^* = \frac{1}{2P'}\left(\frac{3P-3c-4t-\tau}{3P-3c-4t-2\tau}\right)d\tau.$$

It follows that $dX^* > 0$ when one of the following three conditions is satisfied: (i) $d\tau < 0$ and the pre-reform tariff is higher than the pre-reform tax $(t < \tau)$, (ii) $d\tau < 0$, the pre-reform tariff is lower than the pre-reform tax $(t > \tau)$, and $c + t + \tau < P < \frac{3c+4t+\tau}{3}$, (iii) $d\tau < 0$, the pre-reform tariff is lower than the pre-reform tax $(t > \tau)$, and $P > \frac{3c+4t+2\tau}{3}$.

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