A Tariff-Tax Reform in a Two-Country Model*

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This paper develops a two-country model to reexamine the effects of a tariff reduction with a consumption tax increase that has been addressed under the assumption of a small open economy. We show that this reform does not always improve welfare and government revenue due to the terms of trade deterioration, but improves market access.

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1 Introduction

Reductions and eliminations of protective trade measures, e.g., import tariffs and export subsidies, have had the most remarkable impact on expansion of the world trade flow.[1)] It is also well-established that liberalized trade benefits a country both theoretically and empirically.[2)]

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1) Baier and Bergstrand (2001, p. 22) find evidence that 'Tariff reductions still explain almost three times as much trade growth as transport-cost declines.'

2) See, for instance, Helpman (2011) for a non-technical account of the gains-from-trade theory. OECD (2009, Ch. 4) provides data suggesting the positive gains from trade liberalization.

Despite the above recognition of the welfare-improving aspect, a number of countries have still been reluctant to liberalize trade. One of the main reasons is a fear that trade liberalization inevitably entails a decrease in trade tax revenue, which accounts for a high share in total government revenue.[3)]

Given the above stylized facts, there is a large literature that links trade liberalization and a domestic tax reform. Among others, Hatzipanayotou et al. (1994) establish a novel result that one unit of tariff reduction and the same unit of consumption tax increase necessarily improve welfare and government revenue of a small open economy. Keen and Ligthart (2002) generalize this win-win result, but Kreickemeier and Raimondos-Møller (2008) call our caution since the same strategy does not always improve market access, which is defined by a value of imports evaluated at world prices.

This paper is also along this line of research, our purpose is quite different. We reconsider the above-described tariff-tax reform in a two-country model in which world prices (or terms of trade) are variable. All of the previous works introduced above adopt a common assumption of a small open economy primarily because it well approximates the developing countries. While this justification is to some extent acceptable, even developing countries can have more or less market power in the international market depending on commodities. For example, the behavior of the countries Middle-East Asia and Africa typically has a substantial influence on the world price of crude oil. Given this reality, we should turn attention to the case of a large open economy with variable world prices, and examine the validity of the results that assume

3) IMF (2005, p. 3) provides a detailed report, concluding that 'revenue from trade taxes ··· continues to be a major source of government finance in many low- and middle income countries.'

a small open economy.[4)]

To this end, we develop a two-country, two-good, perfectly competitive model. We show that the point-by-point tariff-tax reform above is no longer win-win, i.e., does not guarantee a welfare and revenue improvement. The underlying intuition is simple; the reform leads to a deterioration of terms of trade. The total effect is thus determined by the positive effect shown in the existing literature and the negative effect of terms of trade deterioration. In contrast, this reform unambiguously improves market access, which is not always the case for a small open economy. In these respects, our results are quite different from those of the existing literature. Finally, we will provide a simple sufficient condition for all of welfare, government revenue and market access to increase, i.e., the reform is win-win-win.

This paper is organized as follows. Section 2 presents a model and gives a comparative static outcome that is used in the subsequent argument. Section 3 investigates the effect of the point-by-point tariff-tax reform on welfare, government revenue and market access. Section 4 concludes.

2 A model

We construct a perfectly competitive two-country, two-good model comprising of Home and Foreign. An asterisk (*) is attached to variables and functions of Foreign. Home imports Good 1, and levies an import tariff t and a consumption tax τ both of which take a specific (per-unit) form. Hence, the consumer price and the producer price are respectively given by $p+t+\tau$ and $p+\tau$, where p is the world price of Good 1 in terms of Good 2. Supposing that Foreign observes laissez-faire, the

4) We do not claim that we are the first to take into account variable world prices. There is a literature of tariff reforms in a large-country context, e.g., Turunen-Red and Woodland (1991, 1993).

trading equilibrium is characterized by a system:

$$\begin{aligned} e(p+t+\tau,u) &= r(p+t)+\tau e_p(p+t+\tau,u) \\ &\quad +t[e_p(p+t+\tau,u)-r_p(p+t)] \qquad (1) \\ e^*(p,u^*) &= r^*(p) \qquad (2) \\ e_p(p+t+\tau,u)+e_p^*(p,u^*) &= r_p(p+t)+r_p^*(p), \qquad (3) \end{aligned}$$

where u and u^* are utility of each country, $e(\cdot)$ and $e^*(\cdot)$ are an expenditure function, $r(\cdot)$ and $r^*(\cdot)$ are a GDP (revenue) function, and subscript p stands for a partial derivative with respect to the price. All the functions are assumed to satisfy the standard properties.[5)] Eq. (1) is an expenditure-income equality of Home, where $\tau e_p(\cdot)$ is consumption tax revenue, and $t[e_p(\cdot)-r_p(\cdot)]$ is tariff revenue. Eq. (2) is a counterpart of Foreign, and (3) is a world market-clearing condition of Good 1. This system determines u, u^* and p, given the tax rates t and τ.

To know the effects of a simultaneous change in two taxes, let us differentiate the above system totally:

$$\begin{bmatrix} e_u-(\tau+t)e_{pu} & 0 & e_p-r_p-\tau e_{pp}-t(e_{pp}-r_{pp}) \\ 0 & e_{u^*}^* & e_p^*-r_p^* \\ e_{pu} & e_{pu^*}^* & e_{pp}+e_{pp}^*-r_{pp}-r_{pp}^* \end{bmatrix} \begin{bmatrix} du \\ du^* \\ dp \end{bmatrix}$$
$$= \begin{bmatrix} (\tau+t)e_{pp} \\ 0 \\ -e_{pp} \end{bmatrix} d\tau + \begin{bmatrix} \tau e_{pp}+t(e_{pp}-r_{pp}) \\ 0 \\ r_{pp}-e_{pp} \end{bmatrix} dt, \qquad (4)$$

where subscripts u and u^* refer to a partial derivative with respect to u and u^*, respectively. We assume a Warlasian stability of the world market of Good 1, which requires the determinant of the coefficient matrix denoted by Δ to be negative:

5) See any elementary textbook of trade theory, e.g., Dixit and Norman (1980), Woodland (1982), Wong (1995), and Feenstra (2003).

$$\Delta \equiv \begin{vmatrix} e_u - (\tau + t)e_{pu} & 0 & e_p - r_p - \tau e_{pp} - t(e_{pp} - r_{pp}) \\ 0 & e^*_{u^*} & e^*_p - r^*_p \\ e_{pu} & e^*_{pu^*} & e_{pp} + e^*_{pp} - r_{pp} - r^*_{pp} \end{vmatrix}$$

$$= -\tau e_{pu}\left[e^*_{u^*}\left(e^*_{pp} - r_{pp} - r^*_{pp}\right) - e^*_{pu^*}\left(e^*_p - r^*_p\right)\right]$$

$$-te_{pu}\left[e^*_{u^*}\left(e^*_{pp} - r^*_{pp}\right) - e^*_{pu^*}\left(e^*_p - r^*_p\right)\right] - e^*_{u^*}e_{pu}(e_p - r_p)$$

$$-e_u e^*_{pu^*}\left(e^*_p - r^*_p\right) + e_u e^*_{u^*}\left(e_{pp} + e^*_{pp} - r_{pp} - r^*_{pp}\right) < 0. \qquad (5)$$

And, we make another assumption:[6)]

Assumption (Hatta normality condition). $e_u - \tau e_{pu} > 0$.

If one assumes a quasi-linear preference with zero income effect on the demand of Good 1, this condition is definitely satisfied. The subsequent sections utilize these preliminaries to identify the effects of tariff-tax reforms.

3 Effects of a tariff-tax reform

Based on the comparative statics outcomes in the last section, this section examines the effects of a strategy of a tariff-tax reform that has been received considerable attention in the literature. We focus on a reform of $d\tau = -dt > 0$, i.e., one unit of tariff reduction is accompanied by one unit of consumption tax increase. As Keen and Ligthart (2002, 2005) and Kreickemeier and Raimondos-Møller (2008) claim, this reform has been recommended by the IMF and the World Bank since it is not only simple but also needs no knowledge of the economy's fundamentals (utility and production functions) that are generally unknown to the government. Under this reform, the right-hand side of (4) becomes

6) See Hatta (1977a, b).

$$\begin{bmatrix} (\tau+t)e_{pp} \\ 0 \\ -e_{pp} \end{bmatrix} d\tau - \begin{bmatrix} \tau e_{pp} + t(e_{pp} - r_{pp}) \\ 0 \\ r_{pp} - e_{pp} \end{bmatrix} d\tau = \begin{bmatrix} tr_{pp} \\ 0 \\ -r_{pp} \end{bmatrix} d\tau.$$

3.1 Welfare

The effect of this reform on u, u^* and p is obtained as

$$\left.\frac{\partial u}{\partial \tau}\right|_{d\tau+dt=0} = \frac{r_{pp}\left\{(e_p - r_p)e^*_{u^*} - \tau e^*_{u^*}e_{pp} + t\left[\left(e^*_{pp} - r^*_{pp}\right)e^*_{u^*} - \left(e^*_p - r^*_p\right)e^*_{pu^*}\right]\right\}}{\Delta} \tag{6}$$

$$\left.\frac{\partial u^*}{\partial \tau}\right|_{d\tau+dt=0} = -\frac{(e_p - r_p)\,(e_u - \tau e_{pu})\,r_{pp}}{\Delta} > 0 \tag{7}$$

$$\left.\frac{\partial p}{\partial \tau}\right|_{d\tau+dt=0} = -\frac{(e_u - \tau e_{pu})\,e^*_{u^*}r_{pp}}{\Delta} > 0. \tag{8}$$

From (6), the effect of the reform on Home welfare is ambiguous. This sign ambiguity comes from two opposing effects. The first effect is explained in details in Hatzipanayotou et al. (1994) and Keen and Ligthart (2002) in a context of a small open economy. Invoking that the effect of a tariff reduction is equivalent to a reduction in a consumption tax and a production subsidy, the present reform has no net effect on consumption, and enhances a production efficiency by decreasing subsidy-distorted production.

While the foregoing argument, which is based on an assumption of a small open economy, is still valid in the two-country model, the reform is detrimental through terms of trade deterioration (See Eq. (8)). This is because production expansion in Home decreases the Home import, which, in turn, causes a rise in the world price. Therefore, the total effect on welfare depends on the magnitude of the positive production efficiency effect relative to the negative terms of trade effect.

3.2 Revenue

In this subsection, we turn attention to the effect on government revenue. Government revenue T is defined by the sum of consumption

tax revenue and tariff revenue:

$$T = \tau e_p(p+t+\tau, u) + t\left[e_p(p+t+\tau, u) - r_p(p+t)\right], \tag{9}$$

where u and p are a function of the two tax rates through (1)-(3). Having this in mind, differentiating (9) with respect to τ and t yields

$$\begin{aligned}\frac{\partial T}{\partial \tau} &= e_p + \tau\left[\left(\frac{\partial p}{\partial \tau}+1\right)e_{pp} + \frac{\partial u}{\partial \tau}e_{pu}\right] \\ &\quad + t\left[\left(\frac{\partial p}{\partial \tau}+1\right)e_{pp} + \frac{\partial u}{\partial \tau}e_{pu} - \frac{\partial p}{\partial \tau}r_{pp}\right] \qquad (10)\\ \frac{\partial T}{\partial t} &= e_p - r_p + \tau\left[\left(\frac{\partial p}{\partial t}+1\right)e_{pp} + \frac{\partial u}{\partial t}e_{pu}\right] \\ &\quad + t\left[\left(\frac{\partial p}{\partial t}+1\right)e_{pp} + \frac{\partial u}{\partial t}e_{pu} - \left(\frac{\partial p}{\partial t}+1\right)r_{pp}\right]. \qquad (11)\end{aligned}$$

Subtracting (11) from (10), the revenue effect of the reform $d\tau = -dt > 0$ is

$$\begin{aligned}&\left.\frac{\partial T}{\partial \tau}\right|_{d\tau+dt=0} \\ &= r_p + \frac{\left\{\tau\left[(e_p - r_p)e_{pu} - e_u e_{pp}\right]e^*_{u^*} + t\left[\left(e^*_{pp} - r^*_{pp}\right)e^*_{u^*} - \left(e^*_p - r^*_p\right)e^*_{pu^*}\right]\right\} r_{pp}}{\Delta},\end{aligned} \tag{12}$$

where use is made of (6) and (8).

The sign of (12) is indeterminate for the following reason. As is mentioned in the discussion of the welfare effect, the present reform is essentially the same as a reduction in production subsidy. Therefore, the government saves a subsidy payment by r_p, which increases government revenue. On the other hand, a reform-induced rise in the world price of Good 1 (deterioration of terms of trade) increases domestic production and decreases consumption. Therefore, both the subsidy payment and the consumption tax revenue are likely to increase, from which government revenue can both increase and decrease. This is expressed by the second term in (12). To sum, the total effect is inevitably ambiguous.

3.3 Market access

The last criterion that evaluates tariff-tax reforms is market access. As stressed in Ju and Krishna (2000), Anderson and Neary (2007), and Kreickemeier and Raimondos-Møller (2008), welfare and government revenue do not suffice to assess the reform effect because the market access issue is increasingly important for developing countries and the international institutions. Given this trend, we address the market access aspect of the reform. Market access M is defined by the value of imports at the world price:[7)]

$$M \equiv p\left[e_p(p+t+\tau,u) - r_p(p+t)\right]. \tag{13}$$

The effect on M of a change in τ and t is

$$\frac{\partial M}{\partial \tau} = \frac{\partial p}{\partial \tau}(e_p - r_p) + p\left[\left(\frac{\partial p}{\partial \tau}+1\right)e_{pp} + \frac{\partial u}{\partial \tau}e_{pu} - \frac{\partial p}{\partial \tau}r_{pp}\right] \tag{14}$$

$$\frac{\partial M}{\partial t} = \frac{\partial p}{\partial t}(e_p - r_p) + p\left[\left(\frac{\partial p}{\partial t}+1\right)e_{pp} + \frac{\partial u}{\partial t}e_{pu} - \left(\frac{\partial p}{\partial t}+1\right)r_{pp}\right]. \tag{15}$$

Subtracting (15) from (14), the market access effect of the reform becomes

$$\left.\frac{\partial M}{\partial \tau}\right|_{d\tau+dt=0} = -\frac{(e_u-\tau e_{pu})\left\{(e_p-r_p)e^*_{u^*} - p\left[\left(e^*_{pp}-r^*_{pp}\right)e^*_{u^*} - \left(e^*_p-r^*_p\right)e^*_{pu^*}\right]\right\}r_{pp}}{\Delta} > 0. \tag{16}$$

Eq. (16) states that the market access effect is definitely positive, which is a good property of the reform. This is obvious since both p and $e_p - r_p$ increase after the reform. In a model of a small open economy, Kreickemeier and Raimondos-Møller (2008) demonstrate that the market access effect is ambiguous. However, in the present large-country case, such an ambiguity vanishes, and we have a positive market access effect. This is because the increase in p dominates the decrease in $e_p - r_p$,

7) See the papers listed in the main text.

namely, the terms of trade effect dominates the production efficiency effect.

The findings we have derived are summarized.

Proposition. *The point-by-point tariff-tax reform (i) has an ambiguous effect on welfare, (ii) has an ambiguous effect on government revenue, and (iii) improves market access.*

As mentioned, the above-described reform is appealing since it is a simple formula, and requires no knowledge of preferences (utility functions) and production technologies (production functions) both of which are extremely difficult to know. Although this reform guarantees an improvement of both welfare and government revenue for a small open economy, the same is no longer valid for a large country. In this respect, the reform needs closer caution than has been expected. Nevertheless, we can find a situation in which the above reform becomes win-win-win. It is stated in:

Corollary. *The point-by-point tariff-tax reform improves all of welfare, revenue, and market access if the consumption tax is zero and the tariff is prohibitively high.*

Proof. Evaluating (6) and (12) at $\tau = 0$ and the prohibitive tariff at which $e_p - r_p = r_p^* - e_p^* = 0$ holds, we have

$$\left.\frac{\partial u}{\partial \tau}\right|_{d\tau+dt=0} = \frac{t\left(e_{pp}^* - r_{pp}^*\right) e_{u^*}^* r_{pp}}{\Delta} > 0$$

$$\left.\frac{\partial T}{\partial \tau}\right|_{d\tau+dt=0} = r_p + \frac{t\left(e_{pp}^* - r_{pp}^*\right) e_{u^*}^* r_{pp}}{\Delta} > 0.$$

Since the reform definitely improves market access, we have established

the above result. ||

This result needs few explanations. In the present situation, the positive effect induced by enhanced production efficiency is larger than the negative effect coming from deterioration of the terms of trade. Although the assumption that $\tau = 0$ and an initially prohibitive tariff is undoubtedly restrictive, it seems true of several developing countries. In this sense, the above result provides a useful insight.

Remark. It is possible to consider the case of an export tax, which accounts for an important share of government revenue. In this case, the welfare and revenue effects of an export tax reduction accompanied with the same unit of consumption tax increase are ambiguous for both a small and large economy.[8)]

4 Conclusion

This paper has reconsidered the effectiveness of a tariff-tax reform under variable terms of trade. In particular, we have focused on one unit of tariff reduction with one unit of consumption tax increase.

It is shown that the reform has a possibility of reducing welfare as contrasts to the existing literature establishing a welfare improvement in a context of a small open economy. Furthermore, the reform may reduce government revenue, which is the most serious concern developing countries have over trade liberalization. In contrast, the market access effect of the reform is positively evaluated. To summarize our arguments, we should be more careful about the implementation of the tariff-tax reform that has been positively assessed in the existing literature because

8) The proof, which is available from the author upon request, is straightforward just by noting that $t < 0$ and $d\tau = dt > 0$ in the export tax case.

such a reform prescription can no longer be effective if the trade volume of the country affects the world price.

Despite the above novelties, we have left much unexplored. First, we have used a canonical two-country, two-good model. It is important to reconsider our results in a higher-dimensional setting. Second, we should pay attention to imperfect competition. Relative to the literature that assumes perfect competition, there is a much smaller literature that allows for imperfect competition, e.g., Keen and Ligthart (2005), Naito and Abe (2008), and Fujiwara (2012). It is another fruitful task to extend our insight to incorporate imperfect competition. Third, our analysis rests on a static model. Following the approach of Naito (2006a, b), taking into account the dynamic effect on growth should make much sense. Finally, we have focused on unilateral reforms, namely, only Home implements tariff-tax reforms.[9] It is worth trying to extend the model to allow both Home and Foreign to make reforms. In this sense, the findings we have derived should be a starting point rather than a firmly-established result.

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