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**TRADE POLICY, EXCHANGE-RATE ADJUSTMENT AND
UNEMPLOYMENT**

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Abstract

When unemployment arises, a country often imposes an import tariff since it supposedly expands the market share of domestic firms and encourages them to hire more workers. However, such a policy improves the current account and hence appreciates the home currency. Consequently, home products lose competitiveness against foreign products and eventually employment decreases, contrary to the prior expectation. It may create more trade restrictions and trade conflicts. This paper analyzes such a mechanism of an import tariff using an open-economy model with persistent stagnation in which exchange-rate adjustment is considered.

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TRADE POLICY, EXCHANGE-RATE ADJUSTMENT AND UNEMPLOYMENT

1. Introduction

When a country faces unemployment, the government often attributes it to massive import from foreign countries and imposes a trade restriction so that domestic firms expand the market share and increase employment. A famous example was the tariff war under the Great Depression that was triggered by the Smoot-Hawley Tariff Act.¹ Although most economists agree that such a policy would more or less harm the world economy,² it has not yet been completely eliminated. In the 1980s, for example, the USA was annoyed by a huge trade deficit against Japan. Various US industries were threatened by massive Japanese exports and many employees were laid off. Consequently, trade frictions arose in various industries, such as steel, color TV, automobiles, and microchips. As a new friction occurred, the US government imposed a trade restriction to protect a threatened industry under the belief that such a protection would provide a larger market to import-competing firms and hence increase employment. In reality, however, employment did not recover as expected. The US dollar then continued to rise against the Japanese yen, causing the price competitiveness of US products to deteriorate, and new trade frictions occurred one after another.

This paper examines the abovementioned process of unemployment and currency appreciation due to a trade restriction. In doing so it introduces an import tariff into a two-country two-commodity continuous-time competitive model presented by Ono (2006) in which people rationally behave and wages and prices continue to adjust, albeit in a sluggish manner, and yet a persistent demand shortage arises. In this framework it is found that an import tariff improves the current account and raises the value of the home currency, which increases the relative price of the home products.³ Moreover, the price rise is so high that employment eventually decreases in the home country. It in turn lowers the relative price of the foreign products and improves employment in the foreign country.

In the conventional analysis of the optimal tariff with full employment and perfect competition the optimal tariff for a small country is known to be zero. In a two-country setting a positive tariff

¹ See Archibald and Feldman (1998) for the historical process of the tariff bill.

² There are empirical researches on the effect of the act, e.g., Crucini (1994), Crucini and Kahn (1996), Archibald and Feldman (1998) and Madsen (2001).

³ In fact, a recent empirical research by Santos-Paulino and Thirlwall (2004) finds that a trade liberalization worsens the current account.

benefits the tariff-imposing country and harms the other through an improvement in the terms of trade. Moreover, in the presence of unemployment, a positive tariff seems even more beneficial since it protects an import-competing industry and raises employment. In fact, Choi and Beladi (1993, 1998) assume wage and interest-rate rigidities and show that a positive tariff is beneficial even in a small economy.

However, in a small country with Harris-Todaro-type urban unemployment caused by fixed urban and flexible rural wages, Chen and Choi (1994) find that a negative tariff benefits the country. It is because they assume the country to import a capital-intensive commodity and thus an import promotion lowers the capital rent and raises the rural wage, which causes urban unemployment to decrease. Chao and Yip (2000) introduce a cash-in-advance constraint into a monetary economy with Harris-Todaro-type unemployment and find that a negative tariff can benefit the country.⁴ All of these studies consider a static framework and hence ignore the current-account adjustment that determines the exchange rate.

There are also some papers that analyze the effect of a tariff on the dynamic profile of the current account in a continuous-time dynamic optimization setting. They are e.g. Roldos (1991) with capital accumulation, Mansoorian (1993) with habit formation, and Ikeda (2003, 2006) with weakly non-separable intertemporal preferences.⁵ However, none of them consider the possibility of unemployment. Moreover, they consider a small country.⁶ Van Wijnbergen (1987) uses a two-period model with wage rigidity in the first period and analyzes the effect of a tariff on the current account and employment. Unlike the present analysis, however, it regards unemployment as a short-run phenomenon that disappears in the second period.

When analyzing unemployment in an open-economy dynamic framework, the new open economy macroeconomic models, e.g., Obstfeld and Rogoff (1995), Christiano, Eichenbaum and Evance (1997), Hau (2000), and Betts and Devereux (2000a, 2000b), are often utilized.⁷ They adopt a period analysis with monopolistic competition and nominal price/wage stickiness and assume that prices/wages can be modified only at the beginning of each period. In this setup, if a government imposes a trade restriction in the middle of a period, disequilibrium arises only in that

⁴ There are also other types of distortions that cause a negative tariff to be beneficial. For example, under an oligopolistic vertical relationship Lahiri and Ono (1999) show a negative tariff to be beneficial. See also Laure and Gervais (2002) for the same possibility with oligopolistic distortions.

⁵ Inoue (2000) adopts a two-period trade model and finds that a negative tariff can benefit the country.

⁶ Ikeda (2006) analyzes a two-country case as well.

⁷ See Lane (2001) for an extensive survey on the new open economy macroeconomics.

period and full employment is achieved in the next period and thereafter. Hence they cannot deal with persistent unemployment, which the present paper focuses on.

In the following section 2 intuitively discusses the effect of an import tariff on the exchange rate and the home and foreign countries' employment and consumption in the presence of persistent unemployment. Section 3 formulates a formal model and in that framework section 4 analytically obtains the properties of the import tariff mentioned in section 2. It is shown that an import tariff that is aimed to raise employment in fact 'lowers' it by causing the exchange rate to appreciate. Section 5 summarizes and concludes this paper.

2. Outline of the Analysis

This section intuitively discusses the effect of an import tariff on employment and consumption in the home and foreign countries. Formal proofs of the properties mentioned below are given in the next section.

Suppose that there are two countries h and f , the home and foreign countries, and that the home (foreign) country produces commodity 1 (commodity 2) and exports it to the other country. The home country imposes tariff t on the import of commodity 2. Tariff t naturally improves current account \dot{b}^h , where b^h is the home country's foreign asset holding and a dot denotes a time derivative. Thus,

$$d\dot{b}^h(\omega, t)/dt > 0, \quad (1)$$

where ω is the international relative price of the foreign commodity. Under the regime of flexible exchange rates the exchange rate adjusts so that the current account balances:

$$\dot{b}^h(\omega, t) = 0.$$

Under the Marshall-Lerner condition:

$$d\dot{b}^h(\omega, t)/d\omega > 0 \text{ (the Marshall-Lerner condition),} \quad (2)$$

an increase in the relative price of the foreign commodity improves the home current account. From (1) and (2),

$$d\omega/dt < 0, \quad (3)$$

implying that an import tariff lowers the relative price of the foreign commodity.

In the trade-theoretic setting the improvement in the terms of trade, represented by (3), benefits the home country and harms the foreign country. Intuitively, since full employment is assumed in

the standard setting, an improvement in the terms of trade enables the home country to get a larger amount of the foreign commodity by selling a unit of the home commodity but makes the foreign firm get a smaller amount of the home commodity by selling a unit of its own commodity. Therefore, the home country can increase consumption of the two commodities whereas the foreign country has to reduce it.

However, a tariff may be more often imposed when the world economy faces unemployment and each country tries to expand demand for its own product so that employment increases. A historically famous example was the Smoot-Hawley Tariff Act that was passed in 1930 under the Great Depression. It is shown below that in this case an improvement in the terms of trade caused by the import tariff harms the tariff-imposing country since it worsens the international competitiveness of the home commodity, which decreases employment and consumption.

The optimal conditions in a dynamic monetary economy are summarized as

$$\rho + \eta(c^j) \frac{\dot{c}^j}{c^j} + \pi^j = R^j = v'(m^j)/u'(c^j), \quad \text{for } j = h \text{ and } f, \quad (4)$$

where π^j is the inflation rate in country j , R^j is the nominal interest rate, $v'(m^j)$ is the marginal utility of real money m^j , $u'(c^j)$ is the marginal utility of real consumption c^j , and $\eta(c^j)$ is the elasticity of $u'(c^j)$, which equals $-u''(c^j)c^j/u'(c^j)$. For simplicity, it is assumed that the two countries have the same utility function and the same subjective discount rate, which is represented by ρ . Real consumption c^j (for $j = h, f$) is

$$\begin{aligned} c^j &= p_1(\omega^j)c_1^j + p_2(\omega^j)c_2^j, \\ \omega^h &= (1 + t)\omega, \quad \omega^f = \omega, \end{aligned} \quad (5)$$

where $p_i(\omega^j)$ is the real consumer price of commodity i (for $i = 1, 2$) in country j and satisfies

$$p_2(\omega^j) = \omega^j p_1(\omega^j), \quad p_1'(\omega) < 0, \quad p_2'(\omega) > 0. \quad (6)$$

The first equality in (4) shows the Ramsey equation, which implies equality between the time preference rate and the real interest rate. The second equality gives money demand which is determined so that the asset rate of interest equals the liquidity premium of money. Thus, the three values given in (4) respectively exhibit desires for consumption, asset holding and money holding. Owing to the international asset market adjustment the home and foreign nominal interest rates satisfy

$$R^h = \dot{\varepsilon} / \varepsilon + R^f, \quad (7)$$

where ε is the exchange rate of the home currency against the foreign currency.

In such a two-country setting Ono (2006) shows that persistent unemployment arises if $v'(m)$ has a lower bound:

$$\lim_{m \rightarrow \infty} v'(m) = \beta > 0, \quad (8)$$

and nominal wage adjustments are sluggish in the following manner:

$$\dot{W}^j / W^j = \alpha(x^j - 1), \quad (9)$$

where x^j denotes the employment rate in country j and α is the adjustment speed of nominal wage W^j .⁸ For simplicity, each country's population is normalized to unity and hence employment rate x^j also exhibits the magnitude of employment. In the steady state of the present dynamics real wage $w^j (= W^j/P^j$, where P^j denotes the general price index in country j) stays constant, which implies

$$\pi^j (\equiv \dot{P}^j / P^j) = \dot{W}^j / W^j = \alpha(x^j - 1),$$

and c^j is fixed. Applying these properties to (4) yields the steady-state conditions with stagnation:

$$\rho + \alpha(x^j - 1) = R^j = \beta/u'(c^j). \quad (10)$$

From (10) it is found that an increase in employment x^j makes the time preference rate measured in the nominal term higher than the liquidity premium of money, urging people to expand consumption, and raises nominal interest rate R^j :

$$\begin{aligned} dc^j/dx^j &= c'(x^j) = \alpha c^j/[R^j \eta(c^j)] > 0, \\ dR^j/dx^j &= \alpha. \end{aligned} \quad (11)$$

Under linear technology the outputs of commodities 1 and 2 are respectively

$$\theta_1 x^h, \quad \theta_2 x^f, \quad (12)$$

where θ_i is the labor productivity of commodity i ($= 1, 2$), which is constant. In the steady state c^j stays constant and hence from (4) $r^j (= R^j - \pi^j)$ equals ρ for $j = h, f$. Also, each country's real current account \dot{b}^j is zero:

$$\begin{aligned} \dot{b}^h &= r^h b^h + p_1((1+t)\omega)\theta_1 x^h - c^h + [t/(1+t)]p_2((1+t)\omega)c_2^h = 0, \\ \dot{b}^f &= r^f b^f + p_2(\omega)\theta_2 x^f - c^f = 0, \\ \text{where } r^h &= r^f = \rho. \end{aligned} \quad (13)$$

⁸ See Ono (1994, 2001) for the stagnation steady state in a closed-economy context. This type of model is widely used in various analyses under persistent stagnation in a dynamic-optimization framework of a monetary economy. For example, Matsuzaki (2003) finds the effect of a consumption tax on effective demand in the presence of poor and rich people. Hashimoto (2004) examines the intergenerational redistribution effects of the public pensions system in an overlapping generations framework with the present type of stagnation. Johdo (2006) considers the relationship between R&D subsidies and unemployment in the present stagnation setting. Rodriguez-Arana (2007) examines the dynamic path with public deficit in the present stagnation case and compares it with that in the neoclassical case. Johdo and Hashimoto (2008) introduce FDI into a two-country model with the present stagnation mechanism and analyze the effect of the corporation tax on employment in each country.

Note that the third term of \dot{b}^h denotes country h 's tariff revenue and that the home country's real current account \dot{b}^h balances if and only if $\dot{b}^f = 0$.

It is naturally assumed that an increase in employment x^f raises both production and consumption and that the former effect dominates the latter so that \dot{b}^f increases, i.e.,

$$\partial \dot{b}^f / \partial x^f = p_2(\omega)\theta_2 - c'(x^f) > 0, \quad (14)$$

where $c'(x^f)$ is given by (11). Therefore, from (6), the second equation of (13) and (14) it follows that

$$dx^f/d\omega < 0, \quad dc^f/d\omega < 0,$$

i.e., an improvement in the foreign country's terms of trade worsens employment and hence lowers real consumption in the foreign country. Since the home country's tariff improves its terms of trade and worsens the foreign country's terms of trade, as shown by (3), the foreign country enjoys higher employment and consumption

$$dx^f/dt > 0, \quad dc^f/dt > 0. \quad (15)$$

The effect on the home country's employment and consumption cannot so much straightforwardly be derived from the current-account equation in (13) since there is an effect through the tariff revenue. However, as is formally proven in the next section, it eventually worsens the international competitiveness of the home commodity and hence decreases employment x^h and real consumption c^h :

$$dx^h/dt < 0, \quad dc^h/dt < 0. \quad (16)$$

The movement of nominal exchange rate ε [yen/dollar] is governed by the no-arbitrage condition between the home and foreign interest rates represented by (7). Thus, from (11), (15) and (16),

$$d(\dot{\varepsilon} / \varepsilon) / dt = \alpha(dx/dt - dx^*/dt) < 0.$$

From (3) and this property, the home country's tariff not only appreciates the home currency but also raises the appreciation speed of the home currency, both of which harm the international competitiveness of the home commodity.

3. The Formal Model

Introducing tariff t to the model of Ono (2006) this section presents a dynamic-optimization two-country model with persistent stagnation that obtains the various properties mentioned in the previous section.

Under the technology represented by (12) each firm maximizes profits:

$$(\theta_1 P_1 - W^h)x^h, \quad (\theta_2 P_2 - W^f)x^f,$$

where P_i ($i = 1, 2$) is the nominal price of commodity i and satisfies

$$\omega = \varepsilon P_2 / P_1.$$

P_1 is measured by the home currency and P_2 by the foreign currency. Under perfect competition it is always satisfied that

$$\theta_1 = W^h / P_1, \quad \theta_2 = W^f / P_2. \quad (17)$$

Because of the linear technology the firm values are zero. Thus, country j 's total asset a^j (or a^*) is the sum of its own real money m^j and real international asset b^j and thus each country's asset constraint is

$$a^j = b^j + m^j. \quad (18)$$

Note that the real values of nominal variables in the two countries have different units since tariff t makes commodity prices differ between the two countries.

Each household's lifetime utility is

$$U^j = \int_0^\infty \left(\hat{u}(c_1^j, c_2^j) + v(m^j) \right) \exp(-\rho s) ds,$$

$$\text{where } v'(m) > 0, \quad v''(m) < 0.$$

In order for consumer price index P^j (for $j = h, f$) to be a function of only the prices of the two commodities, $\hat{u}(c_1^j, c_2^j)$ is assumed to be of the CES type:

$$\hat{u}(c_1^j, c_2^j) = (1/\sigma) \ln[\kappa_1 (c_1^j)^\sigma + \kappa_2 (c_2^j)^\sigma], \quad \text{where } 1 > \sigma > 0.$$

Under this utility function real consumer prices of the two commodities p_1^j and p_2^j in country j are respectively

$$\begin{aligned} p_1^h &= P_1 / P^h, \quad p_1^f = (P_1 / \varepsilon) / P^f, \\ p_1^j &= p_1(\omega^j) \equiv [\kappa_1^{1/(1-\sigma)} + \kappa_2^{1/(1-\sigma)} (\omega^j)^{-\sigma/(1-\sigma)}]^{(1-\sigma)/\sigma}, \quad p_1'(\omega^j) > 0, \\ p_2^j &= p_2(\omega^j) = \omega^j p_1(\omega^j) \equiv [\kappa_1^{1/(1-\sigma)} (\omega^j)^{\sigma/(1-\sigma)} + \kappa_2^{1/(1-\sigma)}]^{(1-\sigma)/\sigma}, \quad p_2'(\omega^j) < 0, \end{aligned} \quad (19)$$

where ω^j is given in (5). The flow budget equation of each household sector measured in each real term is

$$\dot{a}^j = r^j a^j + w^j x^j - c^j - R^j m^j + z^j, \quad (20)$$

where z^j is the real lump-sum transfer, c^j is given by (5) and real interest rate r^j is

$$r^j = R^j - \pi^j.$$

From (5), (17) and (19), real wages w^h and w^f are

$$w^h = W^h/P^h = p_1((1+t)\omega)\theta_1, \quad w^f = W^f/P^f = p_2(\omega)\theta_2. \quad (21)$$

Each household maximizes life-time utility U^j subject to (18) and (20). The intratemporal optimal conditions are

$$p_1(\omega^j)c_1^j = \delta(\omega^j)c^j, \quad p_2(\omega^j)c_2^j = [1 - \delta(\omega^j)]c^j, \quad (22)$$

where $\delta(\cdot)$ is the expenditure ratio of commodity 1, which satisfies

$$\begin{aligned} \delta(\omega^j) &= \kappa_1^{1/(1-\sigma)} / [\kappa_1^{1/(1-\sigma)} + \kappa_2^{1/(1-\sigma)}(\omega^j)^{-\sigma/(1-\sigma)}], \\ 1 &> \delta(\cdot) > 0, \quad \delta'(\cdot) > 0. \end{aligned} \quad (23)$$

From (19) and (23) one finds

$$\delta(\omega^j) = 1 + p_1'(\omega^j)\omega^j/p_1(\omega^j) = p_2'(\omega^j)\omega^j/p_2(\omega^j). \quad (24)$$

From (22) and (23), the utility of consumption reduces to

$$\hat{u}(c_1^j, c_2^j) = u(c) = \ln(c^j).$$

The intertemporal optimal conditions are the same as (4) where $\eta = 1$ and $u'(c) = 1/c$ in the present case:

$$\rho + \frac{\dot{c}^j}{c^j} + \pi^j = R^j = v'(m^j)c^j, \quad \text{for } j = h \text{ and } f. \quad (25)$$

The transversality condition is

$$\lim_{s \rightarrow \infty} \lambda^j(s)a^j(s)\exp(-\rho s) = 0, \quad (26)$$

where λ^j is the co-state variable for a^j .

From (19), the equilibrium conditions of the two countries' money markets and that of the international asset market are

$$\begin{aligned} \text{the money markets:} \quad & M^h/P^h = m^h, \quad M^f/P^f = m^f, \\ \text{the asset market:} \quad & P^h b^h + \varepsilon P^f b^f = P^h \{ b^h + [p_1((1+t)\omega)/p_1(\omega)]b^f \} = 0 \end{aligned} \quad (27)$$

Commodity market adjustments are also assumed to be perfect and hence from (12) and (22),

$$\begin{aligned} \theta_1 x^h &= \varphi_1((1+t)\omega)c^h + \varphi_1(\omega)c^f, \\ \theta_2 x^f &= \varphi_2((1+t)\omega)c^h + \varphi_2(\omega)c^f, \end{aligned} \quad (28)$$

where from (24)

$$\begin{aligned}\varphi_1(\omega^j) &= \delta(\omega^j)/p_1(\omega^j), \quad \varphi_2(\omega^j) = [1 - \delta(\omega^j)]/p_2(\omega^j), \\ \varphi_1'(\omega^j) &= -\omega^j \varphi_2'(\omega^j) > 0.\end{aligned}$$

The labor market is internationally segmented and nominal-wage adjustments in both countries are assumed to be sluggish, as represented by (9).⁹ Since (9) and (17) yield

$$\dot{P}_1 / P_1 = \alpha(x^h - 1), \quad \dot{P}_2 / P_2 = \alpha(x^f - 1),$$

from (19) and (24) π^h and π^f are

$$\begin{aligned}\pi^h &= \alpha(x^h - 1) + [1 - \delta((1+t)\omega^h)] \dot{\omega}^h / \omega^h, \\ \pi^f &= \alpha(x^f - 1) - \delta(\omega^f) \dot{\omega}^f / \omega^f.\end{aligned}\tag{29}$$

The home government transfers tariff revenue $[t/(1+t)]p_2((1+t)\omega)c_2^h$ to households in a lump-sum manner while that of country 2 imposes no tariff. Therefore, applying the total differentiations of the money market equilibrium conditions in (27) to (20) yields the dynamic equations of b^h and b^f given in (13).

In the steady state of the present dynamics, where ω , c^h and c^f stay constant, from (25) and (29),

$$\begin{aligned}r^h &= r^f = \rho, \\ \rho + \alpha(x^h - 1) &= R^j = v'(m^j)c^j.\end{aligned}\tag{30}$$

From (13), (22) and the asset market equilibrium given in (27), \dot{b}^h and \dot{b}^f satisfy

$$\begin{aligned}\dot{b}^h &= -[p_1((1+t)\omega)/p_1(\omega)]\rho b^f + p_1((1+t)\omega)\theta_1 x^h - \{[1 + t\delta((1+t)\omega)]/(1+t)\}c^h = 0, \\ \dot{b}^f &= \rho b^f + p_2(\omega)\theta_2 x^f - c^f = 0.\end{aligned}\tag{31}$$

In the following analysis it is assumed that the international asset is held in the form of real bond measured in the international real price. Thus, b^f is not affected by a change in tariff t whereas b^h is since tariff t varies the home country's general price index.

4. An Import Tariff

Before analyzing the case of persistent unemployment the case of full employment is examined as a benchmark. In this case,

$$x^h = x^f = 1,$$

⁹ This assumption is imposed in order to allow disequilibrium to occur in the labor market; otherwise the possibility of unemployment is avoided by definition. Note that even under this assumption the possibility of the full-employment steady state is not eliminated. In fact, the full-employment steady state is presented in section 4.

and then from (31),

$$\begin{aligned} c^h &= [-\rho b^f/p_1(\omega) + \theta_1]p_1((1+t)\omega)(1+t)/[1+t\delta((1+t)\omega)], \\ c^f &= \rho b^f + p_2(\omega)\theta_2. \end{aligned} \quad (32)$$

From (24) and (32) one finds that as long as t is small, these c^h and c^f satisfy

$$\begin{aligned} \partial c^h/\partial t &= 0, \quad \partial c^h/\partial \omega < 0, \\ \partial c^f/\partial t &= 0, \quad \partial c^f/\partial \omega > 0. \end{aligned}$$

Substituting c^h and c^f given in (32) into the first equation of (28) gives the solutions of ω , c^h and c^f as functions of t only. From the solution of ω it is naturally derived that tariff t lowers ω , the relative price of the foreign commodity. Thus, from the above properties of c^h and c^f , it benefits the home country and harms the foreign country, as is consistent with the standard result on the optimal tariff.

Note that the steady-state values of ω , c^h and c^f obtained above are independent of m^j (for $j = h, f$). Given such ω , c^h and c^f , from (25) one obtains m^j that satisfies

$$v'(m^j)c^j = \rho. \quad (33)$$

Now the case where stagnation occurs in the steady state is considered. As proven by Ono (2006), it indeed occurs if $v'(m)$ has a positive lower bound as represented by (8).¹⁰ The money demand function is the relationship between R^j and m^j given by the second equality of (25):

$$R^j = v'(m^j)c^j,$$

for given c^j . Since $v''(m^j) < 0$, R^j is negatively related to m^j . In the presence of a positive lower bound of $v'(m^j)$, as m^j increases, R^j decreasingly approaches βc^j but never becomes lower than it, implying a liquidity trap to occur. In this case the solution of m^j given by (33) does not exist under the following condition:

$$\beta c^j \geq \rho \Leftrightarrow m^j \text{ does not exist,} \quad (34)$$

where c^j takes the full-employment level given by (28) in which $x^h = x^f = 1$ and (32). The appendix exhibits the range of the foreign asset position that validates (34) for both countries.¹¹ Under (34) the left-hand side of (33) exceeds the right-hand side for any m^j , implying that a desire for saving

¹⁰ Keynes (1936, Ch.17) mentions that this is an essential property of money and that under this property a shortage of effective demand obtains. See Ono (1994, pp.31-33; 2001) for the implication of this property on the effective-demand shortage caused by a liquidity trap. This property is empirically shown by Ono (1994, chap.3) using the GMM (Generalized Method of Moments), and more extensively by Ono, Ogawa, and Yoshida (2004) using both a parametric and a non-parametric approach.

¹¹ See Ono (2007) for the foreign asset position under which a country faces stagnation and the other realizes full employment in the absence of a tariff.

exceeds that for consumption if the consumption level is so high as to attain full employment. Therefore, a demand shortage arises.

In this case prices and wages continue to decline and $v'(m^j)$ converges to β .¹² Therefore, from (30),

$$\beta c^j = \rho + \alpha(x^j - 1), \quad (35)$$

which is the same as (10). Since (28) gives x^h and x^f as functions of ω , t , c^h and c^f , from (35) c^h and c^f are

$$\begin{aligned} c^h &= \phi^h(c^f, \omega; t) = [(\rho - \alpha)/\beta + c^f \varphi_1(\omega)\alpha/(\beta\theta_1)]/[1 - \varphi_1((1+t)\omega)\alpha/(\beta\theta_1)], \\ c^f &= \phi^f(c^h, \omega; t) = [(\rho - \alpha)/\beta + c^h \varphi_2((1+t)\omega)\alpha/(\beta\theta_2)]/[1 - \varphi_2(\omega)\alpha/(\beta\theta_2)]. \end{aligned} \quad (36)$$

These two curves given above are shown in figure 1. The intersection point of the two curves, denoted by E, gives c^h and c^f as functions of ω and t . The two curves are illustrated so that for given ω consumption c^j is positive even if the other's consumption is zero, an increase in c^j raises the other's consumption and the intersection point exists. These properties are satisfied under the following conditions:

$$\begin{aligned} \rho &> \alpha, \\ A &\equiv [1 - \varphi_1((1+t)\omega)\alpha/(\beta\theta_1)][1 - \varphi_2(\omega)\alpha/(\beta\theta_2)] \\ &\quad - [\varphi_1(\omega)\alpha/(\beta\theta_1)][\varphi_2((1+t)\omega)\alpha/(\beta\theta_2)] > 0. \end{aligned} \quad (37)$$

The steady-state level of ω is determined so as to balance the current account given by (31) in which c^h and c^f are given by the intersection point of (36). In this state x^h and x^f are smaller than 1 and thus all nominal prices and wages continue to decline and m^h and m^f continue to expand. Nevertheless, the two transversality condition in (26) holds since from the money market equilibrium given in (27) and (35)

$$\dot{m}^j / m^j = -\pi^j = \rho - \beta c^j < \rho.$$

In this state the effect of import tariff t is examined in the neighborhood where

$$t = 0.$$

Totally differentiating (31) and using (24) and (35) gives

$$\begin{aligned} db^h &= (\beta p_1 \theta_1 / \alpha - 1) dc^h - (1 - \delta) p_1 \theta_1 x^h d\omega / \omega = 0, \\ db^f &= (\beta p_2 \theta_2 / \alpha - 1) dc^f + \delta p_2 \theta_2 x^f d\omega / \omega = 0. \end{aligned} \quad (38)$$

From (36) and the definitions of $\varphi_1(\omega^j)$ and $\varphi_2(\omega^j)$ in (28) it follows that

¹² See Ono (2006) for the stability and determinacy of the present dynamics when $t = 0$.

$$\begin{aligned}
dc^h &= \left(\frac{\alpha\varphi_1'[1-\alpha/(\beta p_2\theta_2)]}{A\beta\theta_1} \right) [(c^h + c^f)d\omega + c^h\omega dt], \\
dc^f &= \left(\frac{\alpha\varphi_2'[1-\alpha/(\beta p_1\theta_1)]}{A\beta\theta_2} \right) [(c^h + c^f)d\omega + c^h\omega dt].
\end{aligned} \tag{39}$$

where A is given by (37). Substituting them into (38) and using (23) and the definitions of φ_1 and φ_2 in (28) yields

$$\begin{aligned}
\omega \partial \dot{b}(\omega, t) / \partial \omega &= [\delta(1-\delta)/(1-\sigma)](c^h + c^f)\{[1-\alpha/(\beta p_1\theta_1)][1-\alpha/(\beta p_2\theta_2)]/A - (1-\sigma)\}, \\
\partial \dot{b}(\omega, t) / \partial t &= [\delta(1-\delta)/(1-\sigma)][1-\alpha/(\beta p_1\theta_1)][1-\alpha/(\beta p_2\theta_2)]c/A.
\end{aligned} \tag{40}$$

Therefore, under the Marshall-Lerner condition ($\partial \dot{b}(\omega, t) / \partial \omega > 0$), it must be valid that¹³

$$[1-\alpha/(\beta p_1\theta_1)][1-\alpha/(\beta p_2\theta_2)]/A - (1-\sigma) > 0. \tag{41}$$

Since if $t = 0$ then A in (37) reduces to

$$A \equiv \delta[1-\alpha/(\beta p_1\theta_1)] + (1-\delta)[1-\alpha/(\beta p_2\theta_2)] > 0,$$

(41) implies

$$1-\alpha/(\beta p_1\theta_1) > 0, \quad 1-\alpha/(\beta p_2\theta_2) > 0. \tag{42}$$

From (37), (40) and (42), $d\omega/dt$ satisfies

$$d\omega/dt = -[\partial \dot{b}(\omega, t) / \partial t] / [\partial \dot{b}(\omega, t) / \partial \omega] < 0. \tag{43}$$

From (7), (30), (38), (42) and (43), all the properties mentioned in section 2 obtain –i.e.,

$$\begin{aligned}
dc^h/dt &< 0, \quad dx^h/dt < 0, \quad dR^h/dt < 0, \quad d\pi^h/dt < 0, \\
dc^f/dt &> 0, \quad dx^f/dt > 0, \quad dR^f/dt > 0, \quad d\pi^f/dt > 0, \\
d\omega/dt &< 0, \quad d(\dot{\varepsilon} / \varepsilon)/dt < 0.
\end{aligned}$$

Since neither W^h nor W^f can jump and from (17) P_1 and P_2 are always set equal to W^h/θ_1 and W^f/θ_2 respectively, neither P_1 nor P_2 can jump. Therefore, (43) implies exchange rate ε ($= \omega P_1/P_2$) to jump downward when tariff t is imposed. Thereafter, exchange rate ε gradually moves along with P_1 and P_2 so that ω stays constant over time.

Intuitively, a rise in t potentially improves the current account of the tariff-imposing country, causing the value of its currency to appreciate. It causes the home commodity to lose, and the foreign commodity to gain, price competitiveness in the international market. Therefore, the other country's demand for its own commodity increases and eventually improves its employment and

¹³ It is valid when σ is close to 1 and hence the two commodities are close substitutes to each other.

consumption. In turn, the other country's demand for the tariff-imposing country's product decreases so much that employment and consumption decrease in the tariff-imposing country.

The abovementioned mechanism seems quite opposite to what policy makers usually have in mind. It may be because they ignore adjustments of commodity prices and the exchange rate. In fact, from the properties of φ_1 and φ_2 given in (28) and (36), if the exchange rate and prices are unchanged and thus relative price ω is invariant, a rise in the tariff rate shifts the ϕ^h curve in figure 1 upward and the ϕ^f curve leftward, as illustrated in figure 2. Consequently, the intersection point of the two curves moves in the north-west direction from E to E', causing the tariff-imposing country's consumption to increase and the other's consumption to decrease, as is usually expected. This property is indeed derived from (37), (39) and (42) as follows:

$$\partial c^h(\omega, t)/\partial t > 0, \quad \partial c^f(\omega, t)/\partial t < 0.$$

However, this process accompanies an improvement in the current account of the tariff-imposing country. Thus, under the flexible exchange-rate regime the exchange rate appreciates, which harms the competitiveness of the tariff-imposing country's product. The present analysis implies that the harmful effect is so strong that the tariff-imposing country's employment and consumption decrease while the other country's employment and consumption increase.

5. Conclusions

An import tariff benefits the country that imposes it because of the well-known mechanism of the optimal tariff. In the presence of unemployment it is also believed to benefit the country since it is considered to expand demand for the home commodity and raise employment and income in the home country. In this argument the exchange-rate adjustment is mostly ignored. If it is taken into account, however, the result is quite different from the usual belief. An import tariff reduces employment and consumption in the tariff-imposing country and increases them in the other country as a result of the exchange-rate adjustment.

The mechanism is the following. An import tariff reduces import and thus improves the current account. It leads the home currency to appreciate against the foreign currency so that the current account recovers the equilibrium level, causing the international relative price of the home commodity to rise. If the economy faces demand shortage, the appreciation of the home currency is so high that the amount of home production decreases. Consequently, unemployment becomes worse and consumption decreases. The appreciation of the home currency also implies a reduction

in the price of the foreign commodity. The reduction is so large that the world demand for the foreign product expands and hence both employment and consumption increase in the foreign country although its export is restricted by the importing country. Thus, the tariff-imposing country may take the tariff as being not high enough to expand home employment, which may create successive imposition of tariffs.

Appendix

The region of b^j in which the two inequalities of (28) are both valid is examined when $t = 0$. From (19), (23), (28) where $x^h = x^f = 1$, and (32), c^h and c^f are

$$\begin{aligned}c^h &= \kappa_1 \theta_1^\sigma (\kappa_1 \theta_1^\sigma + \kappa_2 \theta_2^\sigma)^{(1-\sigma)/\sigma} + \rho b^h, \\c^f &= \kappa_2 \theta_2^\sigma (\kappa_1 \theta_1^\sigma + \kappa_2 \theta_2^\sigma)^{(1-\sigma)/\sigma} - \rho b^h.\end{aligned}\tag{A1}$$

Therefore, (34) reduces to

$$\begin{aligned}\rho/\beta - \kappa_1 \theta_1^\sigma (\kappa_1 \theta_1^\sigma + \kappa_2 \theta_2^\sigma)^{(1-\sigma)/\sigma} &\leq \rho b^h (= -\rho b^f) \\&\leq \kappa_2 \theta_2^\sigma (\kappa_1 \theta_1^\sigma + \kappa_2 \theta_2^\sigma)^{(1-\sigma)/\sigma} - \rho/\beta,\end{aligned}\tag{A2}$$

where the first inequality is the condition under which the full-employment level of m^h does not exist whereas the second one is the condition under which the full-employment level of m^f does not exist.

Note that there is a region in which ρb^h that satisfies (A2) exists if β , θ_1 or θ_2 is large enough to satisfy

$$\rho/\beta \leq 2(\kappa_1 \theta_1^\sigma + \kappa_2 \theta_2^\sigma)^{1/\sigma}.$$

This condition is essentially the same as that for the stagnation steady state to obtain in Ono (2001, 2006).

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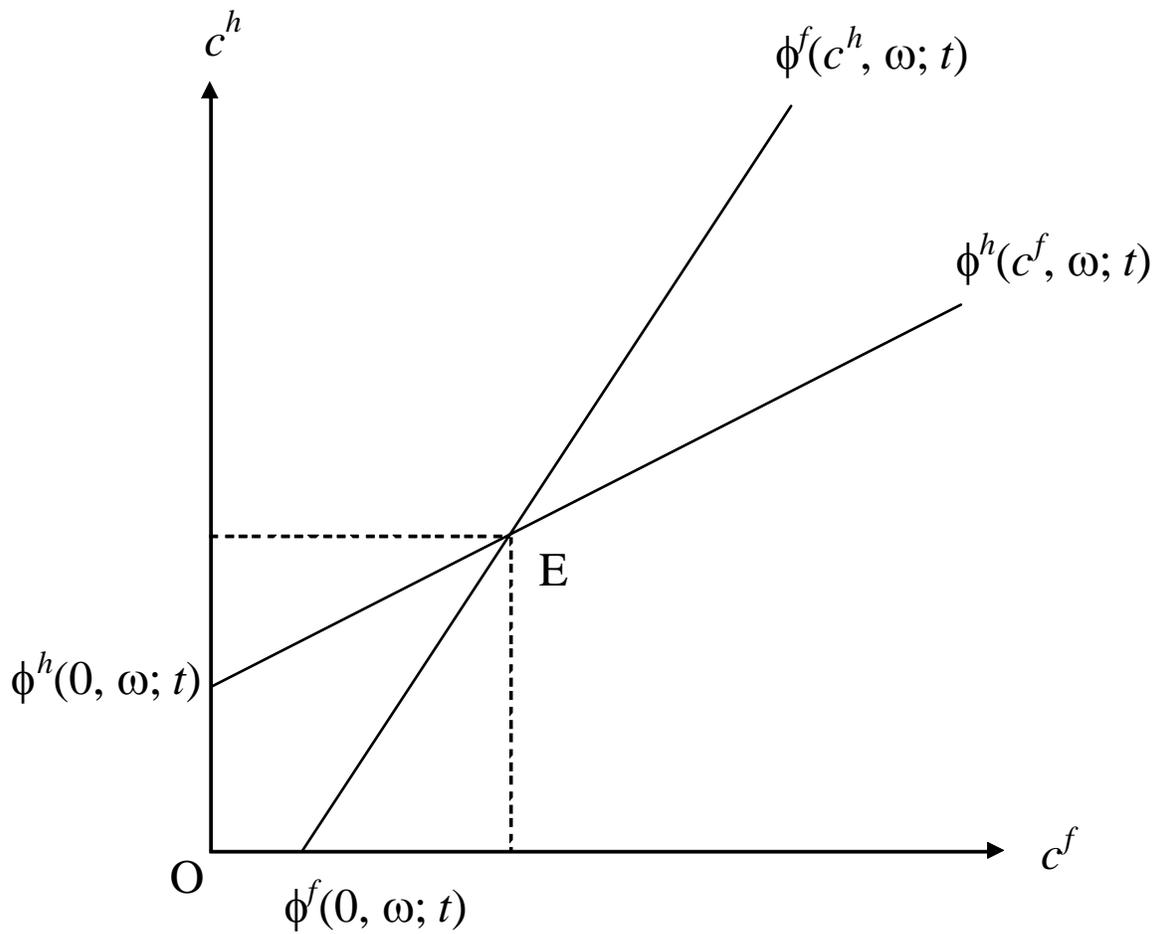


Figure 1: Interdependence of Consumption

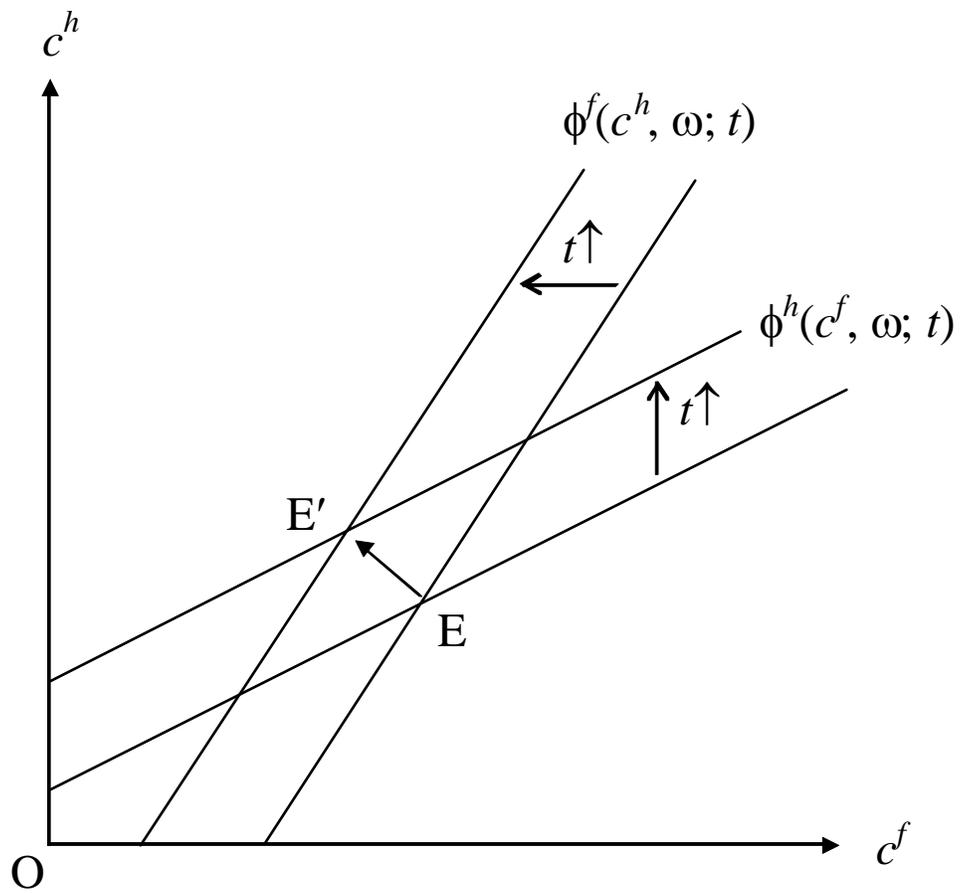


Figure 2: The Effect of a Tariff under Fixed Prices