Anti-Dumping Duties and Macroeconomic Dynamics in a Floating Exchange Rate Regime

Chung-Fu Lai[1]

[1] Department of Applied Economics, Fo Guang University, Yilan County, Taiwan

Correspondence: Chung-Fu Lai, Associate Professor, Department of Applied Economics, Fo Guang University, Yilan County, Taiwan.

Abstract

Based on the New Open Economy Macroeconomics, this paper tries to combine the characters of imperfect competition and dumping behaviors into a two-country model with micro-foundation in order to make a comparison between long-term and short-term effects of macroeconomic variables (for example, consumption, output, price, exchange rate, terms of trade), when a foreign country dumps its goods to home country and home country imposes an anti-dumping duty on imported goods. By way of theoretical derivation and simulation analysis, this paper gets a result that consumption and output will undershoot, exchange rate and terms of trade will have a mis-adjustment, but the dynamic effect on the price will be dependent on dumping margin, if the dumping margin is lower, the price will undershoot, if the dumping margin is higher, the price will have a mis-adjustment.

Keywords: anti-dumping duties, micro-foundation, macroeconomic dynamics, NOEM

1. Introduction

After the World Trade Organization (WTO) was founded in 1995, economic liberation and internationalization have become a main stream in international trade. However, after its operation for several years, in one hand the developing countries and underdeveloped countries slowly recognize that open market cannot directly bring them economic interests thus they all resist the open market. On the other hand, developing countries and developed countries often take all kinds of safeguard measures to protect their industries, for instance, anti-dumping policy. According to the definition of General Agreement on Tariffs and Trade (GATT), dumping means a firm sells its goods with a price below it normal value to other country. According to Agreement on Anti-Dumping of WTO, if the fact that an opponent country dumping sustains and such behavior has caused a material injury to the home industry, then the home country can impose anti-dumping duty on the firm. It has been 30 years that anti-dumping policy has become one of the most important international trade policies.

As to the research about economic effects of anti-dumping measures, it can be divided into 3 categories: one is "empirical analysis of the effects of anti-dumping duty on upstream and downstream industries", related literature including Webb (1992) found that imposition of anti-dumping duty will result in a decrease in import for import country, an increase in output and profit, and will benefit its upstream industry and protect its home industry, but it is not good to the downstream industry and consumers. Kelly and Morkre (1998) discovered that the relationship between anti-dumping duty and import quantity in home country is related to the elasticity of substitution between goods. Another is "the analysis in welfare effects of anti-dumping duty", related literature including Prusa (1996), he used the aggression analysis and found that the lower tax rate has no effects on import, the higher tax rate has obvious and negative effects after imposition of anti-dumping duty. Prusa (1999) found that anti-dumping duty has great impact on import, import is decreased and import price is increased. Staiger and Wolak (1994) discussed the effects of anti-dumping on the trade, that investigation effect, termination effect, and revocation effect will affect the trade. Anderson et al. (1995) found if trade obstacle exists, then anti-dumping policy will improve the social welfare of import country. The last is "the analysis of international trade effect of anti-dumping duty", related literature including Feinberg and Kaplan (1993) showed even the investigation result is negative decision, but when an allegation is filed, it will have negative effect on import. Krupp and Pollard (1996) discussed during the investigation period, the court judgment will have an impact on export and import. If it is an affirmative judgment, the export of alleged nation will be decreased dramatically during and after the investigation. Prusa (1999) explored industrial

nations usually take anti-dumping policy as protection for the industries, the developing country also follows their paths, and the effect of anti-dumping duty on import is great, which he found import is reduced by 70%, and the price is increased by 30%, and only manipulation of investigation can makes the import reduced by 20%. Prusa (2001) and Durling and Prusa (2006) both found anti-dumping duty will make the firm exports less goods to the dumped country, namely anti-dumping policy does great damage to the trade.

In summary, in regarding to related literature of anti-dumping duty effects probably play emphasis on the effect of upstream and downstream industry, social welfare and international trade and much less in connection with the discussion of macroeconomic effects. Therefore, this paper attempts to expand Obstfeld and Rogoff (1995)'s New Open Economy Macroeconomics (hereinafter referred to as NOEM) model discussing imposition of anti-dumping duty on the macroeconomic variables. The rise of NOEM research in recent years mainly because its theory framework is based on imperfect competition and has a micro-foundation, thus it attracts many attention from scholars. They reexamine all kinds of macroeconomic issues in the NOEM perspective. The analysis of effects on trade policy (e.g. Tariff) is one of the NOEM subjects.

Fender and Yip (2000) have been in accordance with Obstfeld and Rogoff (1995)'s NOEM model to discuss the effects of protective policy (tariff) on output and welfare. They found that raise custom duties in the short term will lead to a reduced output, but the effect on foreign output is uncertain. In the long term, the effect of tariff is the same as its effect in the short term. On the other hand, as to the welfare, the increase in tariff will improve welfare in home country, but it has a negative effect on the welfare in the foreign country, thereafter the beggar-thy-neighbor effect will occur. Nerveless, it should be noticed that though anti-dumping policy is an important tool, there is little research which could clarify its role in an open economy. Thereupon, this paper wants to make an application of NOEM model in order to discuss when dumping exists, and home country imposes anti-dumping duty on foreign firm, then what dynamic effect will have on consumption, output, price, exchange rate , terms of trade, and other macroeconomic variable.

This paper is divided into 4 sections, except for introduction, other sections are as follows: Section 2 builds a theoretical model; Section 3 is simulation analysis, which explores the effects of anti-dumping duty on macroeconomic variables in the short and long term; Section 4 is conclusion and suggestion.

2. Theoretical Model

2.1 Model Setting

This paper follows NOEM model proposed by Obstfeld and Rogoff (1995) as a theoretical basis, main assumptions are as follows:

(1). There are two countries exist in the world, "home country" and "foreign country", all of the following foreign economic variables are marked with "*".

(2). The population in the world is distributed in the interval [0,1], where home individual is distribution in [0, n), and foreign individual is distributed in [n ,1].

(3). Each individual is both consumer and producer, operating a monopoly competitor factory and using labor for production.

(4). Dumping behavior exists in economic system, where export products of both countries are sold below the price of the products sold in domestic market, and both countries may impose specific antidumping duty against the dumping behaviors of the rival country.

(5). Prices have stickiness that commodity prices are adherent and cannot changed in the short-term, and may only be fully adjusted in the long-term.

2.1.1 Household

Assuming that all individuals have the same preferences, utility (U) and consumption (C) and real money balances (M / P) are in positive proportional, and is inversely proportional to the output (y), wherein, the lifetime utility function of representative individual is set as follows:

$$ U_t = \sum_{s=t}^{\infty} \beta^{s-t} \left[\log C_s + \frac{\chi}{1-\varepsilon} \left(\frac{M_s}{P_s} \right)^{1-\varepsilon} - \frac{\kappa}{2} y_s(z)^2 \right], \ \varepsilon > 0 \tag{1} $$

Where β is the discount factor ($0 < \beta < 1$), ε is the elasticity of marginal utility of real money balances, χ

and κ represent the degree of significance of real money balances and output on the utility function, z refers to a particular product.

In Eq. (1), define the consumption index of representative consumer as the constant elasticity of substitution (CES) function:

$$C_t = \left[\int_0^n c_{h,t}(z)^{\frac{\delta-1}{\delta}} dz + \int_n^1 c_{f,t}(z)^{\frac{\delta-1}{\delta}} dz \right]^{\frac{\delta}{\delta-1}}, \quad \delta > 1 \tag{2}$$

Where $c_h(z)$ is the consumption of domestic consumer for domestic specific product z, $c_f(z)$ is the consumption of domestic consumer for foreign specific product z, and δ is the elasticity of substitution of goods between two countries.

We can deduce domestic price index (P) from the definition of consumption index (Eq. (2)) by the problem of expenditure minimization as follows:

$$P_t = \left[\int_0^n p_{h,t}(z)^{1-\delta} dz + \int_n^1 (1+\tau)(1-\lambda) p_{f,t}(z)^{1-\delta} dz \right]^{\frac{1}{1-\delta}}, \quad \tau \le \lambda \tag{3}$$

Likewise, the foreign price index (P^*) is as follows:

$$P_t^* = \left[\int_0^n (1+\tau^*)(1-\lambda) p_{h,t}^*(z)^{1-\delta} dz + \int_n^1 p_{f,t}^*(z)^{1-\delta} dz \right]^{\frac{1}{1-\delta}}, \quad \tau^* \le \lambda \tag{4}$$

In above two equations, $p_h(z)$ represents the price of home commodity z expressed in domestic currency, $p_f(z)$ represents domestic currency price of foreign commodity z, $p_h^*(z)$ represents the foreign currency price of domestic commodity z, $p_f^*(z)$ represents foreign currency price of foreign commodity z. Additionally, because dumping behavior exists in the economic system, we assume the ratio of price for export products sold by both countries lower than the price of the product sold in domestic market is λ, both countries will impose antidumping tax against the dumping behavior of the other rival country. The rate of antidumping duty for home country and foreign country are τ and τ^* respectively. The imposition of antidumping duty is important tools taken by government against the unfair trade behavior of selling below normal value in order to maintain fair trade and stabilize the domestic industry development. However, antidumping duty in general is assessed as equal to or less than the dumping margin, that is, $\tau \le \lambda$.

For any kind of goods, the law of one price is held as follows:

$$p_{h,t}(z) = E_t p_{h,t}^*(z) \tag{5}$$

$$p_{f,t}(z) = E_t p_{f,t}^*(z) \tag{6}$$

Where E represents the exchange rate.

From Eqs. (2) and (3), we can deduce the consumption of domestic representative consumer for specific home/foreign commodities as follows:

$$c_{h,t}(z) = \left(\frac{p_{h,t}(z)}{P_t} \right)^{-\delta} C \tag{7}$$

$$c_{f,t}(z) = \left(\frac{(1+\tau)(1-\lambda) p_{f,t}(z)}{P_t} \right)^{-\delta} C \tag{8}$$

Likewise, the consumption that foreign representative consumer for domestic specific commodity and foreign specific commodities as follows:

$$c_{h,t}^*(z) = \left(\frac{(1+\tau^*)(1-\lambda)p_{h,t}^*(z)}{P_t^*} \right)^{-\delta} C^* \tag{9}$$

$$c_{f,t}^*(z) = \left(\frac{p_{f,t}^*(z)}{P_t^*} \right)^{-\delta} C^* \tag{10}$$

In both formulas as above, $c_h^*(z)$ is the consumption of foreign consumer for specific domestic product z, $c_f^*(z)$ is the consumption of foreign consumer for specific foreign product z.

2.1.2 Government

To emphasize on the analysis of antidumping duty effects, assume the government does not have consumption expenditure, the government returns seigniorage revenue and antidumping duty revenue to the agents in a lump-sum fashion. Hence the budget constraint of government is shown below:

$$\frac{M_t - M_{t-1}}{P_t} + \frac{\tau(1-n)p_{f,t}(z)}{P_t} = T_t \tag{11}$$

Where the first item on the left of equation is the real seigniorage revenue, the second item on the left of equation is the real antidumping duty revenue, and the right side of equation is the real government transfer payments.

2.1.3 Asset Market

Suppose that there is an integrated international capital markets between two countries, each individual can trade real bonds (B) in this international capital market, the correlation between real interest rate (r) and nominal interest rate (i) of maturing bonds is as shown in Fisher equation, namely:

$$1 + i_t = \frac{P_{t+1}}{P_t}(1 + r_t) \tag{12}$$

The holding condition of bonds reflects the lending relationship between the residents of two countries, thus satisfying $nB_t + (1-n)B_t^* = 0$, that is:

$$B_t^* = -\frac{n}{1-n}B_t \tag{13}$$

Where B is the amount of bond that domestic representative individual is holding, while B^* is the amount of bonds held by foreign representative individual.

2.1.4 Budget Constraint

Representative individual's budget constraint is set as follows:

$$M_t + P_t C_t + P_t B_t = M_{t-1} + P_t(1+r_{t-1})B_{t-1} + p_{h,t}(z)y_{h,t}(z) + P_t T_t \tag{14}$$

Where the income source of consumer in period t includes: money balances in period $t-1$ (M_{t-1}), the principal and interest sum of bonds ($P_t(1+r_{t-1})B_{t-1}$), the output revenue ($p_{h,t}(z)y_{h,t}(z)$) and government transfer income ($P_t T_t$), consumers may use this income to hold currency (M_t), consumption ($P_t C_t$) and purchase bonds ($P_t B_t$) in period t.

2.1.5 Aggregate Demand

Based on the equation of consumption of home country specific products by domestic consumer (Eq. (7)) and the equation of consumption of home country specific products by foreign consumer (Eq. (9)), it can be inferred that the demand function faced by the home manufacturers is:

$$y_{h,t}(z) = nc_{h,t}(z) + (1-n)c_{h,t}^*(z) = n\left(\frac{p_{h,t}(z)}{P_t}\right)^{-\delta} C + (1-n)\left(\frac{(1+\tau^*)(1-\lambda)p_{h,t}^*(z)}{P_t^*}\right)^{-\delta} C^* \quad (15)$$

Similarly, from the equation of consumption of foreign specific products by domestic consumer (Eq. (8)) and the equation of consumption of foreign specific products by foreign consumers (Eq. (10)), it can be inferred that the demand function faced by the foreign manufacturers is:

$$y_{f,t}^*(z) = nc_{f,t}(z) + (1-n)c_{f,t}^*(z) = n\left(\frac{(1+\tau)(1-\lambda)p_{f,t}(z)}{P_t}\right)^{-\delta} C + (1-n)\left(\frac{p_{f,t}^*(z)}{P_t^*}\right)^{-\delta} C^* \quad (16)$$

2.1.6 First Order Conditions

When consumer is under the restriction of budget constraint (Eq. (14)), the first-order conditions for the maximization of the utility (Eq. (1)) are:

$$C_{t+1} = \beta(1+r_t)C_t \quad (17)$$

$$\frac{M_t}{P_t} = \left(\frac{(1+i_t)\chi}{i_t}C_t\right)^{\frac{1}{\varepsilon}} \quad (18)$$

$$[y_t(z)]^{\frac{\delta+1}{\delta}} = \left(\frac{\delta-1}{k\delta}\right)C_t^{-1}(C_t^W)^{\frac{1}{\delta}} \quad (19)$$

Where Eq. (17) is Euler equation of consumption for describing intertemporal consumption behavior; Eq. (18) refers to a money demand equation for indicating that the substitution relationship between real money demand and consumption, and Eq. (19) is the labor supply equation for giving the alternative relation between labor supply and consumption, in which C^W represents world consumption, $C_t^W \equiv nC_t + (1-n)C_t^*$.

2.2 Derivation of Steady-State

The following sections discuss the effects of antidumping duty shock on macroeconomic variables. Firstly, given that the economic system does not exist dumping behavior and antidumping duty shock was not served in the initial state (0 steady state) as a baseline, and then to seek a long-term steady state of economy system. The following symbols, the subscript "$_t$" represents the macroeconomic variables in the long-term steady state, and the subscript "$_0$" represents the macroeconomic variables in the initial state. For example: C_t and C_0 represent the consumption in the long-term steady state and initial state respectively. When we were in the analysis of short-term equilibrium, we changed to express macroeconomic variables in a long-term steady state with null subscript and the subscript "$_t$" represents the macroeconomic variables in a short-term steady state, with which to differentiate them.

We now apply the government's budget constraint equation (Eq. (11)) into private sector's budget constraint equation (Eq. (14)), and assuming that $B_{t-1} = 0$, we can get:

$$C_t = -B_t + \frac{p_{h,t}(z)y_{h,t}(z) + \tau(1-n)p_{f,t}(z)}{P_t} \quad (20)$$

Likewise, for foreign country, we have:

$$C_t^* = -\hat{B}_t^* + \frac{p_{f,t}^*(z)y_{f,t}^*(z) + \tau^* n p_{h,t}^*(z)}{P_t^*} \quad (21)$$

2.3 Log-linearization

In order to obtain closed-form solution, this paper uses Uhlig (1995)'s approach. Firstly, put the model in log-linearization, then followed by granting values to the parameters in the model to perform simulation analysis. We

put each variable in the vicinity of the initial state into log-linearization for acquiring the degree of each variable fluctuating in the steady state. In this paper, the superscript " $\wedge$ " indicates the value of each variable being put into log-linearization.

For example: If $\hat{X}_t$ means the result of variable X_t being put into log-linearization in the vicinity of initial state (X_0), then:

$$\hat{X}_t \equiv \ln \frac{X_t}{X_0} \cong \frac{X_t - X_0}{X_0} \cong \frac{dX_t}{X_0}$$

2.3.1 Log-Linearized Versions of Price Index

Substitute Eqs. (5) and (6) into Eqs. (3) and (4) respectively, and process the log-linearization to obtain:

$$\hat{P}_t = n\hat{p}_{h,t}(z) + (1-n)(1-\lambda)(\hat{E}_t + \hat{p}^*_{f,t}(z) + \hat{\tau}) \tag{22}$$

$$\hat{P}^*_t = n(1-\lambda)(\hat{p}_{h,t}(z) - \hat{E}_t + \hat{\tau}^*) + (1-n)\hat{p}^*_{f,t}(z) \tag{23}$$

Subtract Eq. (23) from Eq. (22) to obtain the difference between fluctuations of price indices of two countries:

$$\hat{P}_t - \hat{P}^*_t = n\lambda p_{h,t}(z) + (1-\lambda)\hat{E}_t - (1-n)\lambda\hat{p}^*_{f,t} + (1-n)(1-\lambda)\hat{\tau} - n(1-\lambda)\hat{\tau}^* \tag{24}$$

2.3.2 Log-Linearized Versions of the Law of One Price

Put Equation (5) and (6) into log-linearization to get:

$$\hat{p}_{h,t}(z) = \hat{E}_t + \hat{p}^*_{h,t}(z) \tag{25}$$

$$\hat{p}_{f,t}(z) = \hat{E}_t + \hat{p}^*_{f,t}(z) \tag{26}$$

2.3.3 Log-Linearized Versions of World Budget Constraint

We may get the world budget constraints equation from Eqs. (20) and (21) as follows:

$$C^W_t = nC_t + (1-n)C^*_t$$

$$= n\left(-\hat{B}_t + \frac{p_{h,t}(z)y_{h,t}(z) + \tau(1-n)p_{f,t}(z)}{P_t}\right) + (1-n)\left(-\hat{B}^*_t + \frac{p^*_{f,t}(z)y^*_{f,t}(z) + \tau^* np^*_{h,t}(z)}{P^*_t}\right) \tag{27}$$

Put Eq. (27) into log-linearization and use Eqs. (25) and (26) to get:

$$\hat{C}^W_t = n(-\hat{B}_t + \hat{p}_{h,t}(z) + \hat{y}_{h,t}(z) - \hat{P}_t + (1-n)(\hat{p}^*_{f,t}(z) - \hat{P}^*_t) + \hat{\tau})$$

$$+ (1-n)(-\hat{B}^*_t + \hat{p}^*_{f,t}(z) + \hat{y}^*_{f,t}(z) - \hat{P}^*_t + n(\hat{p}_{h,t}(z) - \hat{P}_t) + \hat{\tau}^*) \tag{28}$$

2.3.4 Log-Linearized Versions of Demand Function

Put domestic and foreign demand functions (Eqs. (15) and (16)) into log-linearization to get:

$$\hat{y}_{h,t}(z) = -\delta(n(\hat{p}_{h,t} - \hat{P}_t) + (1-n)(1-\lambda)(\hat{p}^*_{h,t}(z) - \hat{P}^*_t + \hat{\tau}^*) + \hat{C}^W_t \tag{29}$$

$$\hat{y}^*_{f,t}(z) = -\delta(n(1-\lambda)(\hat{p}_{f,t}(z) - \hat{P}_t) + (1-n)(\hat{p}^*_{f,t}(z) - \hat{P}^*_t + \hat{\tau})) + \hat{C}^W_t \tag{30}$$

2.3.5 Log-Linearized Versions of Labor Supply Function

Put the domestic labor supply function (Eq. (19)) into log-linearization to get:

$$(1+\delta)\hat{y}_{h,t}(z) = -\delta\hat{C}_t + \hat{C}_t^W \tag{31}$$

Similarly, for foreign country, we have:

$$(1+\delta)\hat{y}_{f,t}^*(z) = -\delta\hat{C}_t^* + \hat{C}_t^W \tag{32}$$

2.3.6 Log-Linearized Versions of Money Demand Function

Put the domestic money demand function (Eq. (18)) into log-linearization to get:

$$\hat{M}_t - \hat{P}_t = \frac{1}{\varepsilon}\hat{C}_t \tag{33}$$

Likewise, for foreign country, we have:

$$\hat{M}_t^* - \hat{P}_t^* = \frac{1}{\varepsilon}\hat{C}_t^* \tag{34}$$

Subtract Eq. (33) from Eq. (34), also use Eq. (24) to get the following relationship equation:

$$(1-\lambda)\hat{E}_t = \hat{M}_t - \hat{M}_t^* - \frac{1}{\varepsilon}(\hat{C}_t - \hat{C}_t^*) - n\lambda p_{h,t}(z) + (1-n)\lambda\hat{p}_{f,t}^* - (1-n)(1-\lambda)\hat{\tau} + n(1-\lambda)\hat{\tau}^* \tag{35}$$

2.3.7 Log-Linearized Versions of Terms of Trade

Define the terms of trade (*TOT*) as the ratio of export price to import price of the commodity, namely:

$$TOT = \frac{p_{h,t}(z)}{E_t p_{f,t}^*(z)} \tag{36}$$

Put the foregoing equation into log-linearization to get:

$$\hat{TOT} = \hat{p}_{h,t}(z) - \hat{E}_t - \hat{p}_{f,t}^*(z) \tag{37}$$

2.4 Steady-State Solution

Eqs. (20) and (21) are given the log-linearization process to obtain the following equations:

$$\hat{C}_t = -\hat{B}_t + \hat{p}_{h,t}(z) + \hat{y}_{h,t}(z) - \hat{P}_t + (1-n)(\hat{p}_{f,t}^*(z) - \hat{P}_t^* + \hat{\tau}) \tag{38}$$

$$\hat{C}_t^* = -\hat{B}_t^* + \hat{p}_{f,t}^*(z) + \hat{y}_{f,t}^*(z) - \hat{P}_t^* + n(\hat{p}_{h,t}(z) - \hat{P}_t + \hat{\tau}^*) \tag{39}$$

In the long term, the price is flexible and $\hat{B}_t = \hat{B}_{t+1} = 0$. We then use the log linearized version of price index (Eqs. (22) and (23)), log linearized version of the law of one price (Eqs. (25) and (26)), log linearized version of world consumption equation(Eq. (28)), log linearized version of demand function (Eqs. (29) and (30)), log linearized version of labor supply function (Eqs. (31) and (32)), log linearized version of domestic and foreign money demand function subtraction equation (Eq. (35)), log linearized version of terms of trade (Eq. (37)), and log linearized version of private budget constrains (Eqs. (38) and (39)) to require a solution in order to get the equation expressing the relationship of 13 endogenous variables and exogenous variables, which are domestic consumption ($\hat{C}_t$), foreign consumption ($\hat{C}_t^*$), world consumption ($\hat{C}_t^W$), domestic output ($\hat{y}_{h,t}(z)$), foreign output ($\hat{y}_{f,t}^*(z)$), the price of domestic goods in home country ($\hat{p}_{h,t}(z)$), the price of domestic goods in foreign country ($\hat{p}_{h,t}^*(z)$), the price of foreign goods in foreign country ($\hat{p}_{f,t}^*(z)$), the price of foreign goods in home country ($\hat{p}_{f,t}(z)$), exchange rate ($\hat{E}_t$), domestic price index ($\hat{P}_t$), foreign price index ($\hat{P}_t^*$), and terms of trade ($\hat{TOT}_t$).

In the short term, the prices have a rigidity ($\hat{p}_{h,t}(z) = 0$; $\hat{p}_{f,t}^*(z) = 0$). Then put the domestic consumption Euler equation into log-linearization and with foreign consumption Euler equation, we can get world consumption equation in the short term as:

$$\hat{C}_t^W = \hat{C}^W - (1-\beta)\hat{r}_t \tag{40}$$

Then we can use the log-linearized version of price index (Eqs. (22) and (23)), log linearized version of law of one price (Eqs. (25) and (26)), log linearized version of world consumption equation (Eq. (28)), log linearized version of demand function (Eqs. (29) and (30)), log linearized version of labor supply function (Eqs. (31)and (32)), log linearized version of domestic and foreign money demand function subtraction equation (Eq. (35)), log linearized version of terms of trade (Eq. (37)), log linearized version of budget constrain (Eqs. (38) and (39)), log linearized version of the equation expressing a relation of world consumption under the short and long term (Eq. (40)) to require a solution in order to get the equation expressing the relationship of 14 endogenous variables and exogenous variables ($\hat{\tau}$) which are short term domestic consumption ($\hat{C}_t$), foreign consumption ($\hat{C}_t^*$), world consumption ($\hat{C}_t^W$), domestic output ($\hat{y}_{h,t}(z)$), foreign output ($\hat{y}_{f,t}^*(z)$),the price of domestic goods in foreign country ($\hat{p}_{h,t}^*(z)$), the price of foreign goods in home country ($\hat{p}_{f,t}(z)$), exchange rate ($\hat{E}_t$), domestic price index ($\hat{P}_t$), foreign price index ($\hat{P}_t^*$), domestic current account ($\hat{B}_t$), foreign current account ($\hat{B}_t^*$), interest rate ($\hat{r}_t$) and terms of trade ($\hat{TOT}_t$).

3. The Effects of Antidumping Duty on Macroeconomic Dynamics

To catch the dynamics effects of antidumping duty shock, the simulation analysis is given below.

3.1 Parameterisation

For the purpose of simplification, this paper based on the NOEM model selects two economics of equal size as subjects, thus as regards the choice of parameter we do our best to introduce some empirical evidence on effect of anti-dumping duty in US and other countries of equal size. First of all, we follow Bergin et al. (2007)'s assumption, set the value of elasticity of substitution of products between countries (δ) as 5; then follow related literature of Mankiw and Summers (1986) and Schmidt (2006), set the value of elasticity of marginal utility of real money balances (ε) as 1; then according to the verdict announced recently by US Department of Commerce about the case of the solar panels sold to US by PRC. It was imposed 26.33% to 58.87% of anti-dumping duty. This paper sets the proportion of difference between export price and domestic price of goods (λ) and the rate of anti-dumping duty change ($\hat{\tau}$) are 25% and 60% respectively. Because other poicy variables of domestic and foreign countries, such as domestic money supply ($\hat{M}$), foreign money supply ($\hat{M}^*$), foreign anti-dumping duty ($\hat{\tau}^*$), are not points in this study, we assume its rate of change to be 0. All of parameters (variables) are shown on the Table 1.

Table 1. Parameters (variables) selected values

Symbol	Meaning	Value
n	Country size	0.5
δ	Elasticity of substitution for cross-border products	5
ε	Elasticity of marginal utility of real money balances	1
λ	Ratio of export product price selling below its retail price	25%; 60%
$\hat{\tau}$	Rate of antidumping duty	25%; 60%

3.2 Simulation Analysis

This section applies the parameters (variables) values configured from previous section to conduct simulation analysis and analyze the effects of antidumping duty on exchange rate, price, consumption, output, and terms of trade, the simulation outcome as shown in Table 2.

Table 2. Long-term effect of antidumping duty on macroeconomic variables

(a) Long-term effects of domestic antidumping duty on domestic consumption

		$\hat{C}_t$	
		$\hat{\tau}$	
		0.25	0.6
λ	0.25	0.896	-
	0.6	11.994	28.785

Note: Antidumping tax should not exceed the margin of dumping.

(b) Long-term effect of domestic antidumping duty on foreign consumption

		$\hat{C}_t^*$	
		$\hat{\tau}$	
		0.25	0.6
λ	0.25	0.979	-
	0.6	15.869	38.085

(c) Long-term effect of domestic antidumping duty on world consumption

		$\hat{C}_t^W$	
		$\hat{\tau}$	
		0.25	0.6
λ	0.25	0.938	-
	0.6	13.931	33.435

(d) Long-term effect of domestic antidumping duty on domestic output

		$y_{h,t}(z)$	
		$\hat{\tau}$	
		0.25	0.6
λ	0.25	-0.590	-
	0.6	-7.673	-18.415

(e) Long-term effect of domestic antidumping duty on foreign output

		$y_{f,t}^*(z)$	
		$\hat{\tau}$	
		0.25	0.6
λ	0.25	-0.660	-
	0.6	-10.902	-26.165

(f) Long-term effect of domestic antidumping duty on domestic price index

		$\hat{P}_t$	
		$\hat{\tau}$	
		0.25	0.6
λ	0.25	7.417	-
	0.6	38.042	91.3

(g) Long-term effect of domestic antidumping duty on foreign price index

		$\hat{P}_t^*$	
		$\hat{\tau}$	
		0.25	0.6
λ	0.25	7.333	-
	0.6	34.167	82.0

(h) Long-term effect of domestic antidumping duty on the price of domestic product z denoted in home currency

$$\frac{\hat{p}_{h,t}(z)}{\hat{\tau}}$$

		0.25	0.6
λ	0.25	8.139	-
	0.6	46.25	111.0

(i) Long-term effect of domestic antidumping duty on the price of domestic product z denoted in foreign currency

$$\frac{\hat{p}_{h,t}^{*}(z)}{\hat{\tau}}$$

		0.25	0.6
λ	0.25	8.074	-
	0.6	28.75	69.0

(j) Long-term effect of domestic antidumping duty on the price of foreign product z denoted in domestic currency

$$\frac{\hat{p}_{f,t}(z)}{\hat{\tau}}$$

		0.25	0.6
λ	0.25	8.675	-
	0.6	74.333	178.4

(k) Long-term effect of domestic antidumping duty on the price of foreign product z denoted in foreign currency

$$\frac{\hat{p}_{f,t}^{*}(z)}{\hat{\tau}}$$

		0.25	0.6
λ	0.25	8.611	-
	0.6	56.833	136.4

(l) Long-term effect of domestic antidumping duty on exchange rate

$$\frac{\hat{E}_{t}}{\hat{\tau}}$$

		0.25	0.6
λ	0.25	0.065	-
	0.6	17.5	42.0

(m) Long-term effect of domestic antidumping duty on terms of trade

$$\frac{\hat{TOT}_{t}}{\hat{\tau}}$$

		0.25	0.6
λ	0.25	-0.537	-
	0.6	-28.083	-67.4

From Table 2 (a) to (m), the increase of anti-dumping duty will promote domestic consumption, foreign consumption, world consumption, domestic price index, foreign price index, the price of domestic goods in home country, the price of domestic goods in foreign country, the price of foreign goods in home country, the price of foreign goods in foreign country, and exchange rate in the long term. However, it will cause a decrease in domestic output and foreign output, the deterioration of terms of trade. And the extent of anti-dumping duty on each macroeconomic variables is determined by the proportion of export price of goods lower than its domestic price. Along with the proportion is bigger and bigger, the effects will be more drastically.

The above conclusion can be explained as imperfect competition under an open economy system, because the government transfer tax revenue to agents, so the more the increase in anti-dumping duty rate then the more quota the agents would receive, and consumption will increase, thus raises the price, and promote the import demand, stimulate the demand for foreign currency, and then the exchange rate is raised, domestic currency is devalued, terms of trade is deteriorated. With the dumping margin is bigger and bigger, the impact on macroeconomic variables will be greater and greater.

The results of simulation analysis in short term equilibrium are shown as Table 3.

Table 3. Short-term effects of domestic antidumping duty on macroeconomic variables

(a) Short-term effect of domestic antidumping duty on domestic consumption

		$\hat{C}_t$	
		$\hat{\tau}$	
		0.25	0.6
λ	0.25	0.05	-
	0.6	0.137	0.328

(b) Short-term effect of domestic antidumping duty on foreign consumption

		$\hat{C}_t^*$	
		$\hat{\tau}$	
		0.25	0.6
λ	0.25	0.017	-
	0.6	0.071	0.17

(c) Short-term effect of domestic antidumping duty on world consumption

		$\hat{C}_t^W$	
		$\hat{\tau}$	
		0.25	0.6
λ	0.25	0.096	-
	0.6	0.166	0.399

(d) Short-term effect of domestic antidumping duty on domestic output

		$\hat{y}_{h,t}(z)$	
		$\hat{\tau}$	
		0.25	0.6
λ	0.25	-0.025	-
	0.6	-0.086	-0.207

(e) Short-term effect of domestic antidumping duty on foreign output

		$\hat{y}_{f,t}^*(z)$	
		$\hat{\tau}$	
		0.25	0.6
λ	0.25	0.002	-
	0.6	-0.031	-0.075

(f) Short-term effect of domestic antidumping duty on domestic price index

		$\hat{P}_t$	
		$\hat{\tau}$	
		0.25	0.6
λ	0.25	0.031	-
	0.6	-0.008	-0.019

(g) Short-term effect of domestic antidumping duty on foreign price index

		$\dfrac{\hat{P}_t^*}{\hat{\tau}}$	
		0.25	0.6
λ	0.25	0.063	-
	0.6	0.058	0.139

(h) Short-term effect of domestic antidumping duty on the price of domestic product z denoted in foreign currency

		$\dfrac{\hat{p}_{h,t}^*(z)}{\hat{\tau}}$	
		0.25	0.6
λ	0.25	0.168	-
	0.6	0.29	0.697

(i) Short-term effect of domestic antidumping duty on the price of foreign product z denoted in domestic currency

		$\dfrac{\hat{p}_{f,t}(z)}{\hat{\tau}}$	
		0.25	0.6
λ	0.25	-0.168	-
	0.6	-0.29	-0.697

(j) Short-term effect of domestic antidumping duty on exchange rate

		$\dfrac{\hat{E}_t}{\hat{\tau}}$	
		0.25	0.6
λ	0.25	-0.168	-
	0.6	-0.29	-0.697

(k) Short-term effect of domestic antidumping duty on terms of trade

		$\dfrac{\hat{TOT}_t}{\hat{\tau}}$	
		0.25	0.6
λ	0.25	0.168	-
	0.6	0.29	0.697

(l) Short-term effect of domestic antidumping duty on interest rate

		$\dfrac{\hat{r}_t}{\hat{\tau}}$	
		0.25	0.6
λ	0.25	1.295	-
	0.6	3.225	19.625

(m) Short-term effect of domestic antidumping duty on domestic current account

		$\dfrac{\hat{B}_t}{\hat{\tau}}$	
		0.25	0.6
λ	0.25	-0.012	-
	0.6	-0.119	-0.286

(n) Short-term effect of domestic antidumping duty on foreign current account

		$\dfrac{\hat{B}_t^*}{\hat{\tau}}$	
		0.25	0.6
λ	0.25	-0.093	-
	0.6	-0.156	-0.374

From Table 2 and Table 3, when the long term and short term simulation analysis are compared, we could find that while anti-dumping duty is imposed in home country, the fluctuation rate of consumption and output in the short term is lower than that of in the long term, and appears undershooting, the fluctuation direction of exchange rate and terms of trade in the short term are opposite to that of in the long term, which has a mis-adjustment. The dynamic effect of anti-dumping duty on the price is dependent on the dumping margin. When the margin is lower, then the price will appear undershooting; while the margin is higher, the price will have a mis-adjustment.

4. Conclusion and Suggestions

With the increasing speed of globalization, companies should now compete with rivals from all over the world in order to gain a larger market share (Amiri Aghdaie et al., 2012; Riasi and Amiri Aghdaie, 2012). Although globalization can help to improve supply chains (Riasi, 2015a), financing channels (Riasi, 2015b), and marketing strategies (Ansari and Riasi, 2016; Riasi and Pourmiri, 2015, 2016), it might cause various damages to the economy as well. One of the possible damages of globalization is the threat of dumping and predatory pricing.

According to the definition in "Agreement on Anti-dumping" of WTO, when the export price of goods is lower than its domestic price then there is a suspicion of dumping. When specified goods are dumped and damaged the industry in the dumped country, and it has causal relationship between dumping and damage, the import country can apply for an investigation. Once it is deemed true, then an action can be taken to impose anti-dumping duty on the imported goods. In consideration that anti-dumping duty policy is a commonly used tool of trade policy, this paper tries to take its dynamic effect on macroeconomic variable as an subject to provide the government and its related institution for a reference when they are seeking trade remedy.

In addition, it has been 20 years since NOEM is found, however compared to the universal research in monetary and fiscal policy, research in connection with the effect on trade policy is not enough. In view of the aforementioned reason, this paper under the framework of NOEM theory discusses the dynamic effects of anti-dumping duty on macroeconomic variables. By way of theoretical derivation and simulation analysis, this paper discovers anti-dumping duty and domestic consumption, foreign consumption, world consumption, domestic price index, foreign price index, and exchange rate are positively related, but are negative related with domestic output and foreign output and terms of trade in the long term. And the larger the proportion of the export price is lower than its domestic price, the greater its effects on macroeconomic variables. When we compare the fluctuation rate in the short term with that in the long term, we can dig out that consumption and output will appear undershooting, exchange rate and trade will have a mis-adjustment. Anti-dumping duty on the dynamic effect of price is dependent on the dumping margin, when it is small, the price will undershoot, when the dumping margin is big, the price will have a mis-adjustment.

At last, we want to stress the point that the framework of NOEM model exerts itself on lots of economic issues, but in fact for simplification, it usually builds on many assumptions. If we try to release one of assumption, we will have a different result. This shortcoming is included in the limitation of this paper.

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