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ANTI-DUMPING DUTIES AND MACROECONOMIC DYNAMICS IN A FIXED EXCHANGE RATE REGIME

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ABSTRACT

This paper uses New Open Economy Macroeconomics with micro-foundation as an analytical framework integrates the characteristics of imperfect competition market and anti-dumping behavior into the two-country (home country and foreign country) model. The goal is to discuss the dynamic effect on different macroeconomic variables (e.g. consumption, output, price) if the home country executes anti-dumping duties when foreign countries engage in dumping behaviors. Through theoretical inference and simulation analysis, this paper discovers that when the dumping margin is lower, the consumption and output will show the phenomenon of mis-adjustment, and the price will appear to be undershooting by an anti-dumping duty shock. When the dumping margin is higher, consumption will present undershooting, the output will appear to be overshooting, and the price will present mis-adjusting or undershooting by an anti-dumping duty shock.

JEL: F12, F13, F41

KEYWORDS: Anti-Dumping Duties, Micro Foundations, Fixed Exchange Rate Regime, Macroeconomic Dynamics, New Open Economy Macroeconomics

INTRODUCTION

With the increasing speed of globalization, companies compete with rivals from all over the world to gain a larger market share (Amiri Aghdaie et al., 2012; Riasi and Amiri Aghdaie, 2012). Although globalization can help 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 possible damage of globalization is the threat of dumping and predatory pricing.

Since the World Trade Organization (WTO) was established in 1995, liberalization and globalization have become the mainstream in global economic and trading. However, after several years of operating, some countries in development or low-development realized that opening their markets may not bring direct economic and trade benefits. They have thus refused to open their markets. On the other hand, developing and developed countries usually use many safeguard measures against imports, like antidumping policies, to execute their protectionism. According to General Agreement on Tariffs and Trade (GATT), dumping means "one country sells their products to other country with a price lower than normal value." According to the "Agreement on Anti-dumping" of WTO, if a foreign country was proved to engage in dumping on a home country, and was causing material injury in the home country, the home country can execute antidumping duties toward the foreign country. Hence, in the last 30 years, antidumping policies have become one of the main financial tools of every country.

Furthermore, since the exchange rate represents the currency value inside and outside of country, it bears the important mission of bridging and adjusting finances inside and outside of country. Therefore, most of the literature analyzed the effects of antidumping duty under the floating exchange rate regime (Feinberg,

1989; Knetter and Prusa, 2000; Irwin, 2005). However, if a country prefers a fixed exchange rate regime, the exchange rate will lose its function of transmission in the economic system. The dynamic effect of antidumping duties on macroeconomic variables has not been fully examined. Examining this phenomenon is the purpose of this paper.

The initial development of open economy analysis is mainly presented in the Mundell-Fleming model (Mundell, 1963; Fleming, 1962) and Dornbusch (1976)'s model of Keynes doctrine as the base of theory. Although these early models of open economy revealed and explained the relationship between some of the major macroeconomic variables, there is a common defect, namely, lack of a micro-foundation. Lucas (1976) suggested that changes in macroeconomic variables may affect decisions of individuals, resulting in a change in the relationship among macroeconomic variables. So, the shortage of micro-foundation analysis on the macro economy will produce a bias. The birth of New Open Economy Macroeconomics (hereinafter referred to as NOEM) further opened a new phase to open development of macroeconomics. NOEM is a new generation method to open economy research proposed by Obstfeld and Rogoff (1995). NOEM is characterized by both micro-foundation and monopolistic competition market structure. It is suitable for analyzing the impact of exogenous shocks in the macro economy. This paper used NOEM as the basis for analysis.

This paper is divided into four sections. Section 2 constructs a theoretical model. Section 3 provides a simulation analysis, which discusses the dynamic effect of antidumping duty shock on microeconomic variables. Section 4 presents conclusions and suggestions.

LITERATURE REVIEW

Literature about the effects of antidumping measure can generally be divide into three types as follows. The first type is empirical analysis on the effect of antidumping duties on the upstream/downstream industry. Research in this area includes Webb (1992), Kelly and Morkre (1998), Moore and Zanardi (2011), Amiri Aghdaie et al. (2012), Riasi and Amiri Aghdaie (2012), Riasi (2015a), Riasi (2015b), Ansari and Riasi (2016), Riasi and Pourmiri (2015; 2016). The second type analyzes the effect of antidumping duty on welfare. Related research in this area includes Prusa (1996; 1999), and Staiger and Wolak (1994). The final type examines the effect of antidumping duties on international trade. Related research in this area includes Feinberg and Kaplan (1993), suggested that antidumping could create protection to the production industry. Krupp and Pollard (1996) discussed how antidumping would affect the imports of both related and unrelated import countries. Consider a country charging an import country for dumping. If the final result of an antidumping investigation proves positive, the imports of factories from the exporting country to the charging country would notably drop during and after the investigation.

Prusa (1999) found that industrialized countries would use antidumping to protect their industries, and developing countries would aggressively imitate. The effect of antidumping duty was enormous. In cases when antidumping duty was executed, the imports would reduce by 70% and the import price would increase 30%. In the cases that the dumping charge was disproved, the investigation itself reduced imports by 20%. Prusa (2001) along with Durling and Prusa (2006) also found that antidumping duties would notably reduce. This showed the destructive power for trading of antidumping. Vandenbussche and Zanardi (2010) found that antidumping measures considerably affect trade in industries which are not directly involved in the investigation. They thereby characterize antidumping investigations as a potentially powerful tool of alternative import protection. Brown (2013) found that recent increases to applied tariffs in the textiles and steel industry alone may affect up to 9 percent of Turkey's manufacturing imports.

Summarizing the above, most literature focuses on analyzing the effects of antidumping duties on industry, welfare and trade. It includes only limited discussion of macroeconomic variable impacts. Therefore, to discuss how antidumping duty affects macroeconomic variables of a country, this paper expands the New

Open Economy Macroeconomics (hereinafter referred to as NOEM) suggested by Obstfeld and Rogoff (1995). Documents related to NOEM are relevant as that theory structure used incomplete competitive market structure as an analysis framework with clear micro-foundation. For this reason, many scholars preferred the model. The model assumes that prices display rigidity in the short-term. Therefore, as the economic system faces an external shock, a dynamic adjustment process occurs. This helps us analyze long-term and short-term effects. The NOEM is suitable for analyzing dynamic effects when shocks occur. Hence, this paper uses NOEM as our analysis foundation.

Fender and Yip (2000) discussed how protective policies (tariffs) affect production and welfare based on the NOEM model. Their research showed that if the tariff is raised for the short-term, domestic production would drop. But, it had no certain effets on foreign production. Tariff policy in the long-term has the same effect as the short-term. In terms of welfare, the tariff increase would increase the domestic welfare, but would reduce foreign welfare. Hence, the import tariff would create a beggar-thy-neighbor effect. However, what really caught our attention was that antidumping policy has become a world-wide tool for trading policy. This occurred despite the lack of evidence that can clearly explain what part of the antidumping duty was playing in an open economy. Therefore, this paper discusses the long-term and short-term effect of antidumping policy on macroeconomic variables (such as consumption, output, price…etc.) if a country executes antidumping duty against a foreign country conducting dumping behavior.

THEORETICAL MODEL

Model Setting

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

1. There are two countries in the world, "home country" and "foreign country", all of the following foreign economic variables are marked as "*" for identification.

2. World population is distributed in the interval [0,1], where individuals of home country are distributed between [0,) and foreign individuals are distributed between [,1].

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

4. Dumping behavior exists in economic system.

5. A Fixed exchange rate regime is implemented domestically.

Household

Assuming that all individuals have the same preferences, utility (U) is a function to the consumption (C), real money balances (M/P) and output level (y), the lifetime utility function is set as follows:

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

Where β is the discount factor ($0 < \beta < 1$), ε is the marginal elasticity of demand for 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 Equation 1, the consumption index of the representative consumer is defined as the function of constant elasticity of substitution (CES):

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

Where $c_h(z)$ is the consumption of domestic consumer for domestic specific products 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:

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

Where $p_h(z)$ stands for the price of domestic product z in domestic currency, $p_f(z)$ stands for the price of foreign product z in domestic currency, $p_h^*(z)$ stands for the price of domestic product z in foreign currency, $p_f^*(z)$ stands for the price of foreign product z in foreign currency. Additionally, because dumping behavior exists in the economic system, we assume the ratio of price for export products sold by both countries is lower than the price of the product sold in the 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 duties is an important tool taken by government against the unfair trade behavior of selling below normal value 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 each product, 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 Equations 2 and 3, the domestic consumption on the specific domestic and foreign products are derived 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 foreign consumptions on the specific domestic and foreign products are derived as follows:

$$c^*_{h,t}(z) = \left(\frac{(1+\tau^*)(1-\lambda) p^*_{h,t}(z)}{P^*_t} \right)^{-\delta} C^* \tag{9}$$

$$c^*_{f,t}(z) = \left(\frac{p^*_{f,t}(z)}{P^*_t} \right)^{-\delta} C^* \tag{10}$$

Where $c^*_h(z)$ is foreign consumption on the specific domestic product z, and $c^*_f(z)$ is foreign consumption on the specific foreign product z.

Government

To emphasize 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 government budget constraint 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.

Asset Market

We assuming there exists an integrated international capital market between the two countries, either of which can trade real bonds (B) in the market. The relationship between bond maturity real interest rate (r) and nominal interest rate (i) is based on the Fisher equation, expressed as:

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

The possession of bonds reflects the lending relationship between agents of the two countries, and therefore it satisfies the equation of $nB_t + (1-n)B^*_t = 0$, or

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

Where B stands for the bond possession volume of the representative domestic individual, while B^* stands for the bond possession volume of the representative foreign individual.

Budget Constraint

The budget constraint of representative individual is expressed as:

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

Where the consumers' income sources in period t include the money balances of period $t-1$ (M_{t-1}), the principal and interest of the bonds $(P_t(1+r_{t-1})B_{t-1})$, output revenue ($p_{h,t}(z)y_{h,t}(z)$), government transfer income ($P_t T_t$). Consumers can use the income for holding the money (M_t), consumption ($P_t C_t$) and bonds purchases ($P_t B_t$).

Aggregate Demand

From Equations 7 and 9, demand for goods that domestic manufacturers face can be expressed as:

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

Likewise, from Equations 8 and 10, demand for goods that foreign manufacturers face can be expressed as:

$$y^*_{f,t}(z) = nc_{f,t}(z) + (1-n)c^*_{f,t}(z) = n\left(\frac{(1+\tau)(1-\lambda)p_{f,t}(z)}{P_t}\right)^{-\delta} C + (1-n)\left(\frac{p^*_{f,t}(z)}{P^*_t}\right)^{-\delta} C^* \quad (16)$$

First Order Conditions

Under the budget constraint, specified by Equation 14, the first-order conditions of utility, specified by Equation 1 maximization is expressed as:

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

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

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

Equation 17 is the Euler Equation, which describes intertemporal consumption behaviors. Equation 18 is a money demand equation, which explains the substitution relationship between real money demand and consumption. Equation 19 is a labor supply equation, which defines the substitution relationship between labor supply and consumption, and C^W stands for the world consumption, $C_t^W \equiv nC_t + (1-n)C_t^*$.

Derivation of Steady-State

The following sections discuss the effects of antidumping duty shock on macroeconomic variables. First, consider an economic system that does not exist dumping behavior, and an 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 variable in the long-term steady state, and the subscript "$_0$" represents the macroeconomic variable 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 complete the analysis of short-term equilibrium, we change to express macroeconomic variables

in a long-term steady state with null subscript and the subscript "$_t$" represents the macroeconomic variable in a short-term steady state, with which to differentiate them.

By substituting the government budget constraint (Equation 11) to the private budget constraint (Equation 14), and assuming that $B_{t-1} = 0$, the following equation is obtained:

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

Likewise, the following equation is obtained for the foreign country:

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

Log-linearization

To get a closed-form solution, this paper used the approach suggested by Uhlig (1995). The model was first given the log-linearization process and then its parameters are given values for simulation analysis. The variables are given the log-linearization process near the initial state to obtain their volatility. The superscript symbol "∧" denotes the variables going through the log-linearization process. For example, given $\hat{X}_t$ is the result of variable X_t going through the log-linearization process near initial state (X_0), then:

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

Log-Linearized Versions of Price Index

By substituting Equations 5 and 6 into Equations 3 and 4, respectively, and process the log-linearization under fixed exchange rate regime ($\hat{E}_t = 0$), then the following equations are obtained:

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

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

Subtract Equation 23 from Equation 22 to get the difference of price index changes of the two countries:

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

Log-Linearized Versions of the Law of One Price

Under the fixed exchange rate regime ($\hat{E}_t = 0$), applying Equations 5 and 6 the process of log-linearization, results in the following equations:

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

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

Log-Linearized Versions of World Budget Constraint

Based on Equations 20 and 21, the world budget constraint is obtained as follows:

$$C_t^W = nC_t + (1-n)C_t^*$$
$$= n\left(-\hat{B}_t + \frac{p_{h,t}(z)y_{h,t}(z) + \tau(1-n)p_{f,t}(z)}{P_t}\right) + (1-n)\left(-\hat{B}_t^* + \frac{p_{f,t}^*(z)y_{f,t}^*(z) + \tau^* np_{h,t}^*(z)}{P_t^*}\right) \quad (27)$$

And then, based on Equations 25 and 26, gives Equation 27 the log-linearization process to obtain the following equation:

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

Log-Linearized Versions of Demand Function

Give Equations 15 and 16 the process of log-linearization, and the following equations are obtained:

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

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

Log-Linearized Versions of Labor Supply Function

Give Equation 19 the log-linearization process to obtain the following equation:

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

Likewise, the foreign labor supply function is processed to obtain the following equation:

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

Log-Linearized Versions of Money Demand Function

Give Equation 18 the log-linearization process to obtain the following equation:

$$\hat{M}_t - \hat{P}_t = \frac{1}{\varepsilon}\hat{C}_t \quad (33)$$

Likewise, the foreign money demand function is processed to obtain the following equation:

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

Subtract Equation 33 from Equation 34 and use Equation 24 to obtain the following equation:

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

Log-Linearized Versions of Terms of Trade

The term of trade (referred to as *TOT*) is defined as the ratio of export good price to import good price, expressed as:

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

Under the fixed exchange rate regime ($\hat{E}_t = 0$), the above equation is given a log-linearization process to obtain the following equation:

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

Steady-State Solution

Equations 20 and 21 are given the log-linearization process to obtain the following equations:

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

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

Under a fixed exchange rate regime ($\hat{E}_t = 0$), the price can be fixable adjusted in the long-term, also $\hat{B}_t = \hat{B}_{t+1} = 0$. We then seek a solution for a total of 12 simultaneous equations which including log-linearized versions of price index (Equations 22 and 23), law of one price (Equations 25 and 26), world consumption (Equation 28), demand function (Equations 29 and 30), labor supply function (Equations 31 and 32), terms of trade (Equation 37), private budget constrains (Equations 38 and 39) to acquire correlation equations for tariff shock ($\hat{\tau}$) and antidumping duty shock and domestic consumption ($\hat{C}_t$), foreign consumption ($\hat{C}^*_t$), world consumption ($\hat{C}^W_t$), domestic output ($\hat{y}_{h,t}(z)$), foreign output ($\hat{y}^*_{f,t}(z)$), domestic prices of particular product produced by domestic country ($\hat{p}_{h,t}(z)$), foreign prices of particular product produced by domestic country ($\hat{p}^*_{h,t}(z)$), foreign prices of particular product produced by foreign country ($\hat{p}^*_{f,t}(z)$)), domestic prices of particular product produced by foreign country ($\hat{p}_{f,t}(z)$), domestic price index ($\hat{P}_t$), foreign price index ($\hat{P}^*_t$) and terms of trade ($\hat{TOT}_t$).

In the short-term, prices have rigidity ($\hat{p}_{h,t}(z) = 0$ ； $\hat{p}^*_{f,t}(z) = 0$), and if we log-linear the Euler equation with domestic consumption in its initial state and use the Euler equation with foreign consumption, we know the world consumption in the short-term is:

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

Under the fixed exchange rate regime ($\hat{E}_t = 0$), we can put log-linearized versions of price index (Equation 22), world consumption (Equation 28), demand function (Equations 29 and 30), labor supply function (Equations 31 and 32), private budget constrains (Equations 38 and 39) and long-term and short-term world consumption relative equation (Equation 40) to obtain the relationships between the nine endogenous and exogenous variables ($\hat{\tau}$), the nine endogenous variables are domestic consumption ($\hat{C}_t$), foreign consumption ($\hat{C}^*_t$), world consumption ($\hat{C}^W_t$), domestic output ($\hat{y}_{h,t}(z)$), foreign output ($\hat{y}^*_{f,t}(z)$),

domestic price index ($\hat{P}_t$), domestic current account ($\hat{B}_t$), foreign current account ($\hat{B}_t^*$) and interest rate ($\hat{r}_t$).

DATA AND METHODOLOGY

Because of the complexity of the model setting, two methods are frequently used to obtain a closed-form of solution between exogenous variables and endogenous variables: log-linearization and numerical simulations. Our model uses log-linearization incorporated with numerical simulation. In simulation, values of parameters must be specified as follows.

To simplify the analysis, this paper sets two economic systems with similar scale on the basis of NOEM. Therefore, when choosing the parameter value, we try our best to introduce empirical data, which focuses on USA and other countries with similar scale (e.g. OECD countries or European Union), to analyze the effect of antidumping duty shock. First, we follow the setup of Bergin et al. (2007) to set the elasticity of substitution of products between countries (δ) to 5. Then, we follow the practice from Mankiw and Summers (1986) and Schmidt (2006), to set the elasticity of marginal utility for real money balances (ε) to 1. We then refer to the current announcement from the US Financial Department about judgement results of an antidumping case about the Solar powered products sold from China to USA. In this case, the antidumping duty was 26.33% to 58.87%. This paper uses this data the export price is 25% lower than the proportion of domestic selling prices (λ) and 60% lower than the changes in domestic anti-dumping duty rate ($\hat{\tau}$). Other policy variables, from inside/outside the country, like domestic monetary supply ($\hat{M}$), foreign monetary supply ($\hat{M}^*$), foreign antidumping duty shock ($\hat{\tau}^*$) are not the focus of this discussion. We assume the rate of change of those variables is 0. Parameter (Variable) is set as seen in Table 1.

Table 1: Parameters (Variables) Selected Values

Symbol	Meaning	Value
n	Country Size	0.5
δ	Elasticity of Substitution of Products between Countries	5
ε	Elasticity of Marginal Utility for 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%

Table 1 shows the parameters (variables) selected values in this paper (including country size, elasticity of substitution of products between countries, elasticity of marginal utility for real money balances, ratio of export product price selling below its retail price, and rate of antidumping duty).

RESULTS

To explore the effects of anti-dumping duty on consumption, price, output, and terms of trade, we use the parameters established from the previous section for the simulation. The results of the simulation analysis are shown in Table 2. It is worth noting that antidumping tax should not exceed the margin of dumping.

Through Table 2, we find that in the long-term, when dumping margin is lower, an increase in antidumping duty would raise the domestic consumption, foreign consumption, world consumption, domestic price index, foreign price index, domestic prices of particular product produced by domestic country, foreign prices of particular product produced by domestic country, foreign prices of particular product produced by foreign country, and domestic prices of particular product produced by foreign country. However, it will also cause a drop of domestic and foreign output and worsen the terms of trade. When the dumping margin is higher, the effect of antidumping duty to every macroeconomic variable will change, which means when

the dumping margin is higher, a raise of antidumping duty will reduce the domestic consumption, but the domestic output will increase and terms of trade will improve. When the dumping margin and antidumping duty are both at the high level, the raise of antidumping duty will cause the domestic index to drop.

Table 2: Long-Term Effect of Domestic Antidumping Duty on Macroeconomic Variables

Domestic Consumption ($\hat{C}_t$)				**Foreign Consumption ($\hat{C}_t^*$)**				**World Consumption ($\hat{C}_t^W$)**			
		$\hat{\tau}$				$\hat{\tau}$				$\hat{\tau}$	
		0.25	0.6			0.25	0.6			0.25	0.6
λ	0.25	0.932	-	λ	0.25	1.023	-	λ	0.25	0.978	-
	0.6	-0.352	-0.845		0.6	-0.579	-0.465		0.6	-0.465	-1.117
Domestic Output ($y_{h,t}(z)$)				**Foreign Output ($y_{f,t}^*(z)$)**				**Domestic Price Index ($\hat{P}_t$)**			
		$\hat{\tau}$				$\hat{\tau}$				$\hat{\tau}$	
		0.25	0.6			0.25	0.6			0.25	0.6
λ	0.25	-0.614	-	λ	0.25	-0.690	-	λ	0.25	7.699	-
	0.6	0.216	0.518		0.6	0.405	0.971		0.6	1.060	-2.543
Foreign Price Index ($\hat{P}_t^*$)				The Price of Domestic Product z Denoted in Domestic Currency ($\hat{p}_{h,t}(z)$)				The Price of Domestic Product z Denoted in Foreign Currency ($\hat{p}_{h,t}^*(z)$)			
		$\hat{\tau}$				$\hat{\tau}$				$\hat{\tau}$	
		0.25	0.6			0.25	0.6			0.25	0.6
λ	0.25	7.675	-	λ	0.25	8.452	-	λ	0.25	8.452	-
	0.6	-1.380	-3.313		0.6	-1.328	-3.188		0.6	-1.328	-3.188
The Price of Foreign Product z Denoted in Domestic Currency ($\hat{p}_{f,t}(z)$)				**The Price of Foreign Product z Denoted in Foreign Currency ($\hat{p}_{f,t}^*(z)$)**				**Terms of Trade ($\hat{TOT}_t$)**			
		$\hat{\tau}$				$\hat{\tau}$				$\hat{\tau}$	
		0.25	0.6			0.25	0.6			0.25	0.6
λ	0.25	9.011	-	λ	0.25	9.011	-	λ	0.25	-0.559	-
	0.6	-2.229	-5.350		0.6	-2.229	-5.350		0.6	0.901	2.163

Table 2 shows the long-term effects of anti-dumping duty on the domestic consumption, foreign consumption, world consumption, domestic output, foreign output, domestic price index, foreign price index, the price of domestic product denoted in domestic currency, the price of domestic product denoted in foreign currency, the price of foreign product denoted in domestic currency, the price of foreign product denoted in foreign currency and terms of trade are ambiguous in a fixed exchange rate regime. It depends upon the dumping margin.

The economic intuition behind the conclusion above can be understood based on the explanation here. Under an open economy system with incomplete competitive market, since the government returns all income from antidumping duties to agents, the raise of antidumping duty means more quota transfer the agents will receive and consumption will also rise. As consumption increases, the price will rise and cause the terms of trade to worsen. Furthermore, as the dumping margin and antidumping duty get larger, the raise of antidumping duty might have an opposite effect on macroeconomic variables. Under the short-term, the simulation analysis result is shown in Table 3.

The results in the comparison of long-term and short-term simulation analysis in Tables 2 and 3 show:

(1). In terms of consumption, when the dumping margin is lower, consumption will show phenomenon of mis-adjustment. As the dumping margin is higher, consumption will reveal a phenomenon of undershooting by an antidumping duty shock.

(2). In terms of output, when the dumping margin is lower, output will show a phenomenon of mis-adjustment. As the dumping margin is higher, output will present overshooting by an antidumping duty shock.

(3). In terms of price, when the dumping margin is higher, price will show phenomenon of mis-adjustment. As the two situations when "the dumping margin and antidumping duty rate are low" and "dumping margin is high but antidumping duty rate is low," price will present undershooting by an antidumping duty shock.

Table 3: Short-Term Effect of Domestic Antidumping Duty on Macroeconomic Variables

Domestic Consumption ($\hat{C}_t$)				Foreign Consumption ($\hat{C}_t^*$)				World Consumption ($\hat{C}_t^W$)			
		$\hat{\tau}$				$\hat{\tau}$				$\hat{\tau}$	
		0.25	0.6			0.25	0.6			0.25	0.6
λ	0.25	-0.346	–	λ	0.25	0.475	–	λ	0.25	0.064	–
	0.6	-0.285	-0.684		0.6	0.556	1.332		0.6	0.135	0.324
Domestic Output ($y_{h,t}(z)$)				Foreign Output ($y_{f,t}^*(z)$)				Domestic Price Index ($\hat{P}_t$)			
		$\hat{\tau}$				$\hat{\tau}$				$\hat{\tau}$	
		0.25	0.6			0.25	0.6			0.25	0.6
λ	0.25	0.299	–	λ	0.25	-0.385	–	λ	0.25	0.094	–
	0.6	0.26	0.624		0.6	-0.44	-1.056		0.6	0.05	0.12
Interest Rate ($\hat{r}_t$)				Domestic Current Account ($\hat{B}_t$)				Foreign Current Account ($\hat{B}_t^*$)			
		$\hat{\tau}$				$\hat{\tau}$				$\hat{\tau}$	
		0.25	0.6			0.25	0.6			0.25	0.6
λ	0.25	18.004	–	λ	0.25	0.676	–	λ	0.25	-0.906	–
	0.6	-25.125	-99.42		0.6	0.62	1.488		0.6	-1.02	-2.448

Table 3 shows that an increase in antidumping duty rates will have positive effects on foreign consumption, world consumption, domestic output, domestic price index, and domestic current account, but negative effects on the domestic consumption, foreign output, and foreign current account, the interest rate effect of changes of antidumping duty rates is ambiguous in the short-term.

CONCLUDING COMMENTS

According to the description of Agreement on Anti-dumping from WTO, when the export price of one product is lower than its domestic price, it automatically becomes a suspect of dumping toward an import country. When a specific product appears to be dumping and has created damage to industry of an import country, and this damage has any relation to dumping, the import country can apply an investigation toward specific products from the specific country. Once the import country proves the low price is damaging the industry of the import country, the import country can execute an antidumping duty toward this low priced import product. Considering antidumping policy is a fairly common trading policy tool in actual practice, this paper analyzes the dynamic effect of antidumping duty under a fixed exchange rate as analysis topic. We hope to provide reference for related government departments to execute trading relief measures.

Furthermore, there has been 20 years since NOEM was developed. However, compare to the popularity effect on monetary and fiscal shock, research on trade shock (such as antidumping duty) is rarely seen. For the above reasons, this paper discusses the dynamic effect of antidumping duty. Through theoretical deduction and simulation analysis, we discover that under a fixed exchange rate system, the dynamic effect of antidumping duty on macroeconomic variables like domestic consumption, output and price index are affected by dumping margin and antidumping duty rate. As any mutation appears in dumping margin and antidumping duty level, the process of dynamic adjustment of macro economy will appear to be undershooting, overshooting or in mis-adjustment.

NOEM theory structure displays an important role in many macroeconomic topics, but for easier explanation, the structure is usually built upon many assumptions. If we loosen one of the assumptions or setup (e.g. the type of consumption index), the result will be different. This represents a limitation of this paper.

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