

The Effects of Tariff Shocks in a New Open Economy Macroeconomics Model with Consumption Home Bias

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Abstract

The analytical framework of this paper is based on the New Open Economy Macroeconomics with the purpose to explore the long-term effects of the tariff policy on the various macroeconomic variables (such as, consumption, output, prices, exchange rate, terms of trade, etc.), and to explain the role of consumption home bias. Through theoretical derivation and simulation analysis, we found that there is a negative correlation between the tariff policy and the exchange rate, the effects of tariff policy on the variables of consumption, output, price index and terms of trade would be influenced by the home (foreign) consumers' preference behavior of imported and exported goods. When there exist asymmetry in consumption bias behaviors of the home and foreign country, reversals may occur as a result of the tariff policy on consumption, output, price index and terms of trade.

Keywords: Tariff Shocks, Consumption Home Bias, Micro-Foundation, New Open Economy Macroeconomics

1. Introduction

Mundell (1961) had been paying attention on the issue of the effects of tariff policy in the macroeconomy, while Johnson (1966) and Tower (1973) have explored the effects of tariff on output, prices, and welfare. However, the common drawback of the early literature was the adoption of comparative static analysis to discuss the effects of tariff, which cannot really observe the complete dynamic adjustment process of tariff effect. Thus, after the 80s, literature with dynamic analytical perspective as to explore the effects of tariff policy emerged, such as Eichengreen (1981), Razin and Svensson (1983), Van Wijnbergen (1987), Edwards and Wijnbergen (1987) and Roldos (1991). In order to simplify the analysis, these literatures, however, were based on perfect competitive market structure, resulting in the inconsistency between the model assumptions with the reality as well as the lack of credibility of the theoretical analysis. Later, Rama (1993), Fender and Yip (1994), Bettendorf and Heijdra (1999), Devadoss and Lanclos (2000) and Sen (2001) changed the market structure into imperfect competition as to analyze the effects of changes in tariff, being more in line with the real

world. At the same time, micro-foundation has been the trend of the studies, [Razin and Svensson \(1983\)](#) used two-period model as analytical basis and found that the effect of tariff on current account is related to inter temporal elasticity of substitution. [Roldos \(1991\)](#) used specific factor models to discuss the effect of tariff changes on current account, and found that the effect is related with the length of period of the tariff imposition as well as the rate of accumulation of capital stock. [Brock and Turnovsky \(1993\)](#) also build a specific factor model with two sectors and three factors as to analyze the effect of different types of tariff (consumption tax and investment tax) on capital accumulation. [Osang and Pereira \(1996\)](#) explored the relationship of tariff structure, welfare and economic growth rate in accordance by a endogenous growth model with small open economy framework. [Bettendorf and Heijdra \(2001\)](#) used dynamic overlapping-generations model to analyze tariff issues under imperfectly competitive market structure, and found that the increase of tariff would reduce the real output and employment, but would enhance the terms of trade. [Ikeda \(2003\)](#) found that the effect of tariff on current account shall depend on the preference of time. Further studies continue to seek for a better theoretical model for their analytical basis.

Recently, the emergence of New Open Economy Macroeconomics (henceforth NOEM) literature provided a complete framework with micro-foundation and dynamic analysis in an imperfectly competitive market structure which drove the scholars to re-examine different macroeconomic issues with the NOEM perspective; the effects of tariff effect have become one of the NOEM issues. Based on [Obstfeld and Rogoff \(1995\)](#)'s NOEM model, [Fender and Yip \(2000\)](#) analyzed the protection policies (tariff) on output and welfare level. They discovered that within the short run, the elevation of temporary tariff would reduce the home-country output, while the effect of tariff on foreign-country output is uncertain. They reached to the same conclusion for the analysis in the long run. On the other hand, in terms of welfare, the elevation of tariff would increase the home-country welfare, while it creates a negative effect towards the foreign-country welfare; thus, the elevational of the import tariff would create the effect of "beggar-thy-neighbor. However, it is worth noticing that although [Obstfeld and Rogoff \(2000\)](#) considered "home bias in consumption puzzle" as one of the six puzzles in international economics,¹ the phenomenon of "consumption home bias" has not been integrated with the effect of tariff policy under the NOEM structure. Therefore, this paper aims to further seek for a breakthrough.

The "consumption home bias puzzle" refers to the consumers' preference towards the home-country products in the real societies. Yet, the real phenomenon that occurs in the market cannot be explained by the researchers. Early studies related to consumption home bias have put most of their emphasis on the causes of home bias. For instance, trade costs ([Obstfeld and Rogoff, 2000](#); [Ried, 2009](#)), country size and the degree of openness ([Sutherland, 2005](#); [De Paoli, 2009](#)), non-traded goods ([Stockman and Dellas, 1989](#); [Pesenti and Wincoop, 2002](#)) and trade in factors of intermediate inputs ([Hillberry and Hummels, 2002](#)) are considered as the main causes of consumption home bias. Recent studies pay more attention on the effects of consumption home bias, such as [Pierdzioch \(2004\)](#) who analyzed the effects of the monetary policy on different degree of home bias and capital mobility, [Hau \(2002\)](#), [Pitterle and Steffen \(2004\)](#), [Kollmann \(2004\)](#), [Sutherland \(2005\)](#), [Leith and Lewis \(2006\)](#), [Cooke \(2010\)](#) who explored the influence of consumption home bias on exchange rate fluctuation, and [De Paoli \(2009\)](#) who discussed the welfare effect of consumption home bias and monetary policies. Last but not least, the influence of consumption home bias on the effects of the optimal monetary policy has also been the most popular issue in recent days. Relevant studies include [Faia and Monacelli \(2006\)](#), [Jondeau and Sahuc \(2008\)](#), [Galí and Monacelli \(2008\)](#) and [Wang \(2010\)](#). Clearly, enthusiasm has been put on studies related to home bias in consumption, yet there is not literature that can clearly explain the role of consumption home bias in the effect of tariff policy. Therefore, this paper is intended to make a breakthrough.

¹The six puzzles proposed by [Obstfeld and Rogoff \(2000\)](#) are "consumption home bias puzzle", "home bias in equity portfolios puzzle", "purchasing power parity puzzle", "exchange rate disconnect puzzle", "the high investment-saving correlation puzzle" and "the low international consumption correlation puzzle."

This paper is therefore divided in four sections. In addition to the introduction, the other sections are as the following: Section 2 is the construction of the theoretical model; Sections 3 makes a simulation analysis for exploring the long term effects of tariff on macroeconomic variables and the role of consumption home bias plays; Section 4 is the conclusion and recommendation.

2. Theoretical Model

2.1. Model Setting

This paper complies with the NOEM proposed by [Obstfeld and Rogoff \(1995\)](#) as theoretical basis. The main assumptions are the following:

- 1) There are two countries in the world: “home country” and “foreign country”, the following foreign economic variables are marked with “*”.
- 2) The population in the world is distributed between intervals of $[0,1]$, where home-country individuals are distributed between intervals of $[0,n)$ and foreign individuals distributed between intervals of $[n,1]$.
- 3) All individuals are consumers as well as producers, running monopolistic competitive firms and using labor for production.
- 4) Consumption home bias behavior exists in the economic system, and tariff is the only exogenous shock.

2.1.1. Household

It is assumed that all individuals have the same preferences. Utility (U) is positively proportional to consumption (C) and real money balances (M/P), and is inversely proportional with output (y). The lifetime utility function is as follows:

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

Where β is the discount factor ($0 < \beta < 1$), ε is the elasticity of marginal utility of the real money balances.² χ and κ refers to the importance of real money balances and the output in the utility function, while z refers to certain specific product.

In Eq. (1), the consumer index is defined as the function of constant elasticity of substitution (CES):

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

Where $c_h(z)$ is the consumption of the specific domestic product z by the domestic consumer; $c_f(z)$ is the consumption of the specific foreign product by the domestic consumer. α is the consumption home bias parameter of the home country as to measure the preference degree of the consumers in home country towards the domestic products. δ is the elasticity of substitution of the products between the two countries.

The domestic price index (P) can be derived from the Eq. (2) by the problem of expenditure minimization as shown in the following:

²In Eq. (1), ε is defined as one percent of the real money demand change, the proportion of the marginal utility of real money demand caused by changes.

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

Likewise, the price index of the foreign country (P^*) is as the following:

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

From the above two equations, $p_h(z)$ indicates the price of the domestic product z denoted in the domestic currency; $p_f(z)$ indicates the price of the foreign product z denoted in domestic currency. $p_h^*(z)$ indicates the price of the domestic product z denoted in foreign currency; $p_f^*(z)$ indicates the price of the foreign product z denoted in foreign currency. α^* represents the preference degree of the foreign country consumers towards the foreign product. Also, because the tariffs exist in the economic system, we set the rate of tariff in the home country and the foreign country are τ and τ^* respectively. The change of the tariff rate is a permanent shock, that is $\tau_t = \tau_{t+1} = \tau$; $\tau_t^* = \tau_{t+1}^* = \tau^*$.

For each product, the law of one price is held as the following:

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

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

Where E represents the exchange rate.

From Eqs. (2) and (3), the consumption of the domestic specific product and the foreign specific product by the representative domestic consumers can be derived as follows:

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

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

Similarly, the consumption of the domestic specific product and the foreign specific product by the representative foreign consumers is as the following:

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

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

From the above two equations, $c_h^*(z)$ is the consumption of the domestic specific product z by foreign consumers, while $c_f^*(z)$ is the consumption of the foreign specific product z by foreign consumers.

2.1.2. Government

In order to explore the effect of tariff, it is assumed that there is no consumption expenditure in the government section. And, the government will return seigniorage and tariff revenues to the agent in lump-sum fashion. The government's budget constraint is:

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

Where the first item at the left side of the equation is the real seigniorage revenue, while the second item at the left side of the equation is the real tariff revenue, the right side of the equation is real transfer payments.

2.1.3. Asset Market

We assumed that there is an integrated international capital market between both countries. Every individual can trade real bond (B) in the international capital market. The relationship between the real interest rate (r) and the nominal interest rate (i) is as Fisher equation, that is:

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

The possession of bonds reflects the lending relationship between the residents of the two countries. Thus, it satisfies $nB_t + (1-n)B_t^* = 0$ or

$$B_t^* = -\frac{n}{1-n} B_t \quad (13)$$

Where B is the amount of bonds possessed by domestic agent, while B^* is the amount of bonds possessed by foreign agent.

2.1.4. Budget Constraint

The individual's budget constraint is as the following:

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

Where the source of incomes from period t includes: the money balance from period $t-1$ (M_{t-1}), the principal and interest of the bond from period $t-1$ ($P_t(1+r_{t-1})B_{t-1}$), the output revenue in period t ($p_{h,t}(z)y_{h,t}(z)$) and the income from government transfer ($P_t T_t$). The consumers can use such income during period t for money holding (M_t), consumption ($P_t C_t$) and bonds purchases ($P_t B_t$).

2.1.5. Aggregate Demand

From Eqs. (7) and (9), the demand for the product faced by the domestic producers is:

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

Likewise, from Eqs. (8) and (10), the demand for the product faced by the foreign producers is:

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

2.1.6. First Order Conditions

With the budget constraint (Eq.(14)), the first order condition of the utility (Eq.(1)) maximization is:

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

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

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

Where Eq. (17) is Euler equation of consumption which describes the inter temporal consumption behavior, Eq. (18) is the money demand equation for describing the substitute relationship of real money demand and the consumption, Eq. (19) is the labor supply equation for defining the substitution relationship of labor supply and consumption. In Eq. (19), C^W represents world consumption, $C_t^W \equiv nC_t + (1 - n)C_t^*$.

2.2. Derivation of Steady-State

To explore the effects of tariff on different macroeconomic variables, first, given the initial state (0 steady state) that does not exist consumption home bias behavior and tariff shock in the economic system as the baseline. Then, the steady state of the economic system is introduced. For the following symbols, the subscript “ t ” represents the different economic variables in the steady state, while “ 0 ” represents the different economic variables in the 0 steady state. For instance, C_t and C_0 represent the consumption in the long-term steady state and the initial state respectively.

The long-term steady state describes the economic system reaching to a state of convergence after exogenous shock. In the long-term steady state, all variables are constant, and $B_t = B_{t+1} = 0$. Therefore, when the private sector’s budget constraint (Eq. (14)) is taken into the government sector’s budget constraint (Eq. (11)), we can obtain:

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

Likewise, for the foreign country, we have:

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

2.3. Log-linearization

In order to obtain the closed-form solution, this paper adopts Uhlig (1995)’s method to apply log-linearization and simulation analyses.³The following are the log-linearized versions of the different variables. In the text, “ \wedge ” indicates the log-linearized versions of the variables.

For instance, given \hat{X}_t is the result of variable X_t going through the log-linearization process near initial state (X_0), then:

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

2.3.1. Log-linearization of Price Index

We now put Eqs. (5) and (6) into Eqs. (3) and (4). and log-linearize the two equation yield:

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

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

The difference of changes in the price index of both countries is obtained from the subtraction of Eq. (23) from Eq. (22):

$$\hat{P}_t - \hat{P}_t^* = n(\alpha - (1 - \alpha^*))p_{h,t}(z) + ((1 - n)(1 - \alpha) + n(1 - \alpha^*))\hat{E}_t$$

³Due to the complexity of the model setting, two methods are generally used in the literature as to obtain the specific closed-form solution between the endogenous and exogenous variables: logarithmic linearization and numerical simulations. This paper uses log-linearization with numerical simulations.

$$+(1-n)((1-\alpha)-\alpha^*)p_{f,t}^*(z) + (1-n)(1-\alpha)\hat{\tau} - n(1-\alpha^*)\hat{\tau}^* \quad (24)$$

2.3.2. Log-linearization of the Law of One Price

Eq. (5) and Eq. (6) are logarithmically linearized at the initial state, the following can be obtained:

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

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

2.3.3. Log-linearization of World Budget Constraint

From Eq. (20) and (21), the world's budget constraint can be obtained as follows:

$$\begin{aligned} C_t^W &= nC_t + (1-n)C_t^* \\ &= n \frac{p_{h,t}(z)y_{h,t}(z) + \tau(1-n)p_{f,t}(z)}{P_t} + (1-n) \frac{p_{f,t}^*(z)y_{f,t}^*(z) + \tau^*np_{h,t}^*(z)}{P_t^*} \end{aligned} \quad (27)$$

Apply log-initialization to Eq. (27) and utilize Eqs. (25) and (26) to yield:

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

2.3.4. Log-linearization of Demand Function

Apply log-linearization to Eqs. (15) and (16) to yield:

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

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

2.3.5. Log-linearization of Labor Supply Function

Apply log-linearization to home-country labor supply function (Eq. (19)) to yield:

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

Likewise, apply log-linearization to that foreign country:

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

2.3.6. Log-linearization of Money Demand Function

Apply log-linearization to the money demand function (Eq. (18)) to yield:

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

Likewise, for the foreign country, we have:

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

Subtract Eqs. (34) from Eq. (33) and use Eq. (24) to yield the following relation equation:

$$\begin{aligned} ((1-n)(1-\alpha) + n(1-\alpha^*))\hat{E}_t &= \hat{M}_t - \hat{M}_t^* - \frac{1}{\varepsilon}(\hat{C}_t - \hat{C}_t^*) - n(\alpha - (1-\alpha^*))p_{h,t}(z) \\ &- (1-n)((1-\alpha)-\alpha^*)p_{f,t}^*(z) - (1-n)(1-\alpha)\hat{\tau} + n(1-\alpha^*)\hat{\tau}^* \end{aligned} \quad (35)$$

2.3.7. Log-linearization of Terms of Trade

Terms of trade (*TOT*) is defined as the ratio of the price of exported good to the price of the imported good as follows:

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

Apply log-linearization to Eq. (36) to yield:

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

2.4. Steady-State Solution

Apply log-linearization to Eqs. (20) and (21) to yield:

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

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

Now, we get the simultaneous solution from the thirteen equations: the log-linearized price index (Eqs. (22) and (23)), the log-linearized law of one price (Eqs. (25) and (26)), the log-linearized world consumption (Eq. (28)), the log-linearized demand function (Eqs. (29) and (30)), the log-linearized labor supply function (Eqs. (31) and (32)), the log-linearized subtraction formula of the money demands of the home country and the foreign country (Eq. (35)), the log-linearized terms of trade equation (Eq. (37)) and the log-linearized private budget constraint of the home country and the foreign country (Eqs. (38) and (39)) as to obtain the relationships between the thirteen endogenous and exogenous variables ($\hat{\tau}$), the thirteen endogenous variables are consumption of the home country (\hat{C}_t), the consumption of the foreign country (\hat{C}_t^*), the world's consumption (\hat{C}_t^w), the output of the home country ($\hat{y}_{h,t}(z)$), the output of the foreign country ($\hat{y}_{f,t}^*(z)$), the price of the domestic specific product in domestic currency ($\hat{p}_{h,t}(z)$), the price of the domestic specific product in foreign currency ($\hat{p}_{h,t}^*(z)$), the price of the foreign specific product in foreign currency ($\hat{p}_{f,t}^*(z)$), the price of the foreign specific product in domestic currency ($\hat{p}_{f,t}(z)$), the exchange rate (\hat{E}_t), the domestic price index (\hat{P}_t), the foreign price index (\hat{P}_t^*) and the terms of trade (\hat{TOT}_t).

3. The Effects of Tariff Shocks on Macroeconomic Variables

As to capture the effects of the consumption home bias parameter changes by the tariff shock, this paper adopts simulation analysis.

3.1. Parameterisation

First, as to simplify the analysis, this paper set two economic systems with equal scale as the object of analysis. Thus, in terms of the selection of the parameters, we try to introduce empirical data of the U.S. and countries of similar scale (such as OECD nations, EU, etc.) as to analyze the effect of the tariff policy between the U.S. and countries of similar scale. Then, we followed [Bergin et al. \(2007\)](#)'s setting, given the elasticity of substitution of the products between the countries (δ) as 5; we also followed [Mankiw and Summers \(1986\)](#) as well as [Schmidt \(2006\)](#) to set the elasticity of marginal utility of the real money balances (ε) as 1; [Wang \(2010\)](#)'s setting is also adopted, the consumption home bias parameter (α) as 0.85, we also simulated the cases of $\alpha = 0.5$ and the preference for the foreign product ($\alpha = 0.15$). The parameter setting for the consumption bias of the foreign country is identical to the setting of the home country. The exogenous variable other than the rate of change of the domestic tariff ($\hat{\tau}$), such as the rate of change for the domestic money supply (\hat{M}), the rate of change for the foreign money (\hat{M}^*), the rate of change of the foreign tariff rate ($\hat{\tau}^*$) are assumed to be 0 as they are not the focus of this paper. The selection of the parameters is summarized in Table 1.

Table 1: Selection of parameters

Symbol	Meaning	Value
n	Country size	0.5
δ	Elasticity of substitution of product between countries	5
\mathcal{E}	Elasticity of marginal utility of the real money balances	1
α	Consumption bias of the home country	0.15; 0.5; 0.85
α^*	Consumption bias of the foreign country	0.15; 0.5; 0.85

3.2 Simulation and Comparative Static Analysis

As to explore the effects of tariff on the consumption, price, output, exchange rate, and terms of trade, this section uses the parameters established from the previous section for the simulation. The results of the simulation and the comparative static analysis are shown in Table 2.

Table 2: The long-term effect of the tariff on the macroeconomic variables

a) Long-term effect of tariff on domestic consumption

$\partial \hat{C}_i / \partial \hat{\tau}$				
α				
		0.15	0.5	0.85
α^*	0.15	0.093	0.290	0.580
	0.5	-0.228	-0.072	-0.736
	0.85	0.270	-0.012	-0.407

b) Long-term effect of tariff on foreign consumption

$\partial \hat{C}_i^* / \partial \hat{\tau}$				
α				
		0.15	0.5	0.85
α^*	0.15	0.319	0.219	0.487
	0.5	-0.230	-0.303	-1.193
	0.85	0.038	-0.274	-0.755

c) Long-term effect of tariff on world consumption

$\partial \hat{C}_i^w / \partial \hat{\tau}$				
α				
		0.15	0.5	0.85
α^*	0.15	0.206	0.254	0.534
	0.5	-0.229	-0.188	-0.965
	0.85	0.154	-0.143	-0.581

d) Long-term effect of tariff on domestic output

$\partial y_{h,t}(z) / \partial \hat{\tau}$				
α				
		0.15	0.5	0.85
α^*	0.15	-0.043	-0.200	-0.395
	0.5	0.152	0.029	0.453
	0.85	-0.199	-0.014	0.243

e) Long-term effect of tariff on foreign output

$\partial y_{f,t}^*(z) / \partial \hat{\tau}$				
α				
		0.15	0.5	0.85
α^*	0.15	-0.232	-0.140	-0.317
	0.5	0.153	0.221	0.833

	0.85	-0.006	0.205	0.532
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f) Long-term effect of tariff on domestic price index

$\partial \hat{P}_t / \partial \hat{\tau}$				
α				
α^*		0.15	0.5	0.85
	0.15	0.601	0.309	0.309
	0.5	0.022	-0.240	-1.047
	0.85	-0.013	-0.402	-0.911

g) Long-term effect of tariff on foreign price index

$\partial \hat{P}_t^* / \partial \hat{\tau}$				
α				
α^*		0.15	0.5	0.85
	0.15	0.374	0.381	0.402
	0.5	0.023	-0.010	-0.590
	0.85	0.219	-0.140	-0.564

h) Long-term effect of tariff on the price of domestic product z denoted in domestic currency

$\partial \hat{p}_{h,t}(z) / \partial \hat{\tau}$				
α				
α^*		0.15	0.5	0.85
	0.15	-0.252	0.056	0.406
	0.5	-0.896	-0.692	-1.947
	0.85	-0.083	-0.747	-1.586

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

$\partial \hat{p}_{h,t}^*(z) / \partial \hat{\tau}$				
α				
α^*		0.15	0.5	0.85
	0.15	0.642	0.743	0.742
	0.5	-0.006	0.269	-0.192
	0.85	1.231	0.666	1.064

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

$\partial \hat{p}_{f,t}(z) / \partial \hat{\tau}$				
α				
α^*		0.15	0.5	0.85
	0.15	0.458	0.179	0.822
	0.5	-0.791	-1.269	-3.920
	0.85	-1.017	-1.859	-4.164

k) Long-term effect of tariff on the price of foreign product z denoted in foreign currency

$\partial \hat{p}_{f,t}^*(z) / \partial \hat{\tau}$				
α				
α^*		0.15	0.5	0.85
	0.15	1.352	0.865	1.158
	0.5	0.100	-0.308	-2.166
	0.85	0.298	-0.446	-1.514

l) Long-term effect of tariff on exchange rate

$\partial \hat{E}_t / \partial \hat{\tau}$				
α				
α^*		0.15	0.5	0.85
	0.15	-0.894	-0.686	-0.336
	0.5	-0.890	-0.962	-1.755
	0.85	-1.314	-1.413	-2.650

m) Long-term effect of tariff γ on terms of trade

$\partial T\hat{O}_t / \partial \hat{\tau}$				
α				
		0.15	0.5	0.85
α^*	0.15	-0.710	-0.228	-0.416
	0.5	-0.105	0.577	1.973
	0.85	0.934	1.112	-2.577

It is discovered from of Table 2 (a) to Table 2 (m), within an open economy where only two countries exist (home country and foreign country), the relationships between the domestic tariff rate and macroeconomic variables (such as consumption, output, price index and terms of trade) are affected by the asymmetry in consumption bias behavior, with the only exception of the elevation of the domestic tariff rate and exchange rate which have a clear negative relationship and are not affected by the consumption bias behavior of both countries.

In terms of the effect of tariff on the domestic consumption, the elevation of the domestic tariff rate would increase the domestic consumption, with the case of “the consumption bias behavior towards the home products by foreign consumers” and “the consumption bias behavior towards foreign products by both the home and foreign consumers”. As for the rest, the elevation of tariff rate would cause the reduction of the domestic consumption. In terms of the effect of tariff on domestic output, the elevation of the domestic tariff rate would increase the domestic output, with the case of “the inexistent consumption bias behavior by foreign consumers (regardless what kind of consumption bias behavior by domestic consumers occurs)” and “the consumption bias behavior of the two countries toward the products produced by their own countries”. As for the rest, the elevation of the domestic tariff rate would cause the reduction of the domestic output. In terms of the effect of tariff on the domestic price index, the domestic tariff rate and the domestic price index have a positive correlation, with the case of “the consumption bias behavior towards the domestic products by foreign consumers (regardless what kind of consumption bias behavior by domestic consumers occurs) and “the inexistent consumption bias behavior by foreign consumption with the existent of consumption bias behavior towards foreign products by domestic consumers”. As for the rest, the domestic tariff rate and the domestic price index have a negative correlation. Lastly, in terms of the effects of tariff on terms of trade, the elevation of the domestic tariff rate would cause the elevation of terms of trade, with the following four situations: “the consumption bias behavior towards foreign products by both the domestic and foreign consumers”, “the inexistent consumption bias behavior in both home country and foreign country”, “the inexistent consumption bias behavior by the domestic consumers with the consumption bias behavior towards foreign products by foreign consumers” and “the inexistent consumption bias behavior by foreign consumers with the consumption bias behavior towards domestic products by the domestic consumers”. As for the rest, the elevation of the tariff rate would cause the deterioration of terms of trade.

The economic intuition behind the conclusion is the following: if asymmetry does not occur in the consumption bias behavior by both countries ($\alpha = \alpha^* = 0.5$), an increase in domestic tariff rate would increase the produce cost and trade cost, inhibiting the willingness of production and consumption and reducing the willingness of import of goods. This would reduce the demand of foreign exchange, causing the falling of exchange rate and the appreciation of the domestic currency. The result of the appreciation of the domestic currency would improve the terms of trade. However, if asymmetry occurs in the consumption bias behavior in the two countries, such as “both have consumption bias behavior towards the product produced by one of the country” and “the inexistence of consumption bias behavior by the consumers in one of the country, but the existence of consumption bias behavior by the consumers in the other country”, changes then may occur in the effects of the tariff rate on macroeconomic variables (except for the exchange rate).

4. Conclusion and Suggestions

So far, the development of NOEM has been more than 20 years of history; however, comparing to extensive studies of the effect of monetary and fiscal policies, research of the effects towards trade policy (such as tariff) are quite limited. Based on the reason, this paper uses NOEM proposed by Obstfeld and Rogoff (1995) as the theoretical framework and integrates the consumption home bias behavior to the model as to explore the role of home bias during the process of tariff on macroeconomic variables, hoping to provide the relevant authorities a reference for the policy making.

From the theoretical derivation and simulation analysis, we found that the elevation of the domestic tariff rate would cause the falling of exchange rate. However, the relationship with other macroeconomic variables (such as consumption, output, price index and terms of trade) depends on the consumers' asymmetric preference of the imported and exported goods in both countries. When asymmetric consumption bias occurs in the two countries, reversals may be possible between the relationships of tariff and consumption, output, price index and terms of trade.

At last, with the purpose to simplify the analysis, it is worth mentioning that the focus of this paper is on long-term analysis; thus, the economic dynamic adjustments are not highlighted, which is one of the limitations of this paper. Also, although the theoretical framework of NOEM has its importance in different economic issues, it is in fact established within several assumptions as to be easily solved. If one of the assumption or setting is further simplified (such as the form of utility function), the result may differ. This is also listed as the limitations of the research.

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