The Effects of Tariff Policy under the Fixed Exchange Rate Regime

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Abstract

In this paper, New Open Economy Macroeconomics with micro-foundation was served as an analytical framework to explore the long-term effects of tariffs on various macroeconomic variables (e.g. consumption, output, price and terms of trade, and so on) while a country adopts a fixed exchange rate regime and with the presence of consumption home bias behavior. Through theoretical derivation and simulation analysis, we discovered that the correlation of domestic tariff rate with single variables for the long-term does not have monotonic nature, which shall depend on home (foreign) consumers' consumptive preferences on imports and exports.

Keywords: tariff shocks, consumption home bias, fixed exchange rate regime, NOEM

1. Introduction

Tariff policy has been allowed by World Trade Organization (WTO) and is one of the most important macroeconomic means that many countries have taken. It reflects an effective rate of protection and trade liberalization level throughout the country to some extent which plays an important modulation role on a country's economy. Exchange rate represents relative price of domestic and foreign currency assets, which is in charge of an important task, connecting domestic and international economy, regulating internal and external balance of economy. Reviewing the existing literature, the effects of tariffs under a floating exchange rate regime has been explicitly discussed (e.g. Batra and Ramachandean, 1980, Fender and Yip, 2000), however, when a country adopted a fixed exchange rate regime and the exchange rate cannot afford transmission function in the economic system, how was the effect of tariff policy on the macroeconomic variables has not yet been discussed completely. Furthermore, consumption home bias is a phenomenon that exists commonly in the real world, indicating that in an economic system, consumers often have a tendency to prefer domestic commodities. Herewith, this paper intended to discuss consumption home bias with the effects of tariff policy, and to analyze macroeconomic effects of tariff policy and the role of consumption home bias under the fixed exchange rate regime.

The initial development of open economy analysis featured the Mundell-Fleming model (see Mundell, 1963; Fleming, 1962) and Dornbusch (1976) model which were expanded by Keynes theory as the theoretical basis, these early open economy models, although, revealed and explained relation among some major macroeconomic variables, there was a common defect with lack of micro-foundation. Lucas (1976) suggested that the changes in the macroeconomic variables might affect individual decisions, thereby led to the change of relations among the variables of the macroeconomy, resulting deviation in the macroeconomic analysis as micro-foundation was lacked. So, the birth of New Open Economy Macroeconomics (hereinafter referred to as NOEM) further opened up a new stage. NOEM is a new generation of methods of open economy research suggested by Obstfeld and Rogoff (1995), which is characterized by both micro-foundation and monopolistic competition market structure, which was very suitable for analyzing the effects of exogenous shocks in the macroeconomy, therefore, this paper used NOEM as the basis for analysis.

What kinds of impact will the tariff policy have on the macroeconomic variables eventually? The existing literatures have many discussions and aspect for the analysis was very extensive. Since Mundell (1961) has started paying attention to the topic that the impact of tariff on the macroeconomy, thereafter, Johnson (1966) and Tower (1973) have also explored the impact of tariffs on output, prices and welfare, however, the common drawback of these early literatures is the use of comparative static analysis to discuss the effects of tariff shocks, which cannot completely observe the dynamic adjustment process of tariff shock on macroeconomy. So in the 1980s, literatures where the

effects of tariff shocks from a view of dynamic analysis began to emerge, such as a series of literatures displayed by Eichengreen (1981), Razin and Svensson (1983), Van Wijnbergen (1987), Edwards and Van Wijnbergen (1987) and Roldos (1991), but these literature all used perfectly competitive market structure as the basis of analysis in order to simplify the analysis, therefore, they also faced a situation that model assumptions did not match with the reality, resulting in problems of lack of credibility of theoretical analysis. So further, Rama (1993), Fender and Yip (1994), Bettendorf and Heijdra (1999), Devadoss and Lanclos (2000) and Sen (2001) turned the settings of market structure into a more realistic assumption with imperfectly competitive market to analyze the effects of the tariff shocks. At the same time, micro-foundation also was the trend of research. Razin and Svensson (1983) used two-period model with micro-foundation as the analysis base, and found that the impact of tariffs on the current account was related to the intertemporal elasticity of substitution, Roldos (1991) used specific factors model to discuss the impact of tariff changes on current accounts, he found that the effects depend on the accumulation speed of capital stock, Brock and Turnovsky (1993) established special factors model with two departments and three factors to analyze the effects of different types of tariffs (consumption tax and investment tax) on capital accumulation, Osang and Pereira (1996) discussed correlation among tariff structure, welfare and economic growth rate according to endogenous growth model in a small open economy, Bettendorf and Heijdra (2001) used dynamic overlapping-generations model to analyze tariff issue under imperfect competition of commodity markets, they found that an increase of the tariff would reduce real output and employment level in a long-term equilibrium, thereby improving the terms of trade, Ikeda (2003) found that the effect of tariff on current accounts shall be depending on the preference with imports and exports of agents, and subsequent researchers also continued to seek a more suitable theoretical model as base of analysis.

Recently, NOEM literature rise up rapidly, the model provided a complete framework on a clear micro-foundation and dynamic analysis under imperfectly competitive market structure. Therefore, relevant scholars were urged to re-examine a variety of macroeconomic issue from NOEM perspective, and the analysis on the effects of tariff policy was one of NOEM topics. Fender and Yip (2000) have ever analyzed the effects of protection policy (tariffs) on domestic (foreign) output and welfare according to NOEM model proposed by Obstfeld and Rogoff (1995). Their findings found that the increase in temporary tariff will result in decrease of domestic output, while it has uncertain effect on foreign output in the short-term, the conclusion made for the effect of tariff policy in the long-term is the same as that for short-term effect. On the other hand, for welfare, an increase of tariff will improve domestic welfare, while it gave impact on foreign welfare negative, thus the increase of import tariffs will have effect of "beggar-thy-neighbor". However, the part that aroused more attention is that although Obstfeld and Rogoff (2000) have considered "home bias in consumption puzzle" as one of six puzzles in international economics, (Note 1) the phenomenon of "home bias in consumption" has yet integrated with the research of the effects of tariff under NOEM architecture, hence, this paper further sought for breakthrough.

The so-called consumption home bias puzzle refers to a tendency of consumers on domestic goods in real world. But, this phenomenon occurred to the goods market cannot be explained by researchers. The study with topic in respect of consumption home bias has mostly focused on discussion of the causes, such as trade costs (Obstfeld and Rogoff, 2000; Ried, 2009), country size and the extent of openness (Sutherland, 2005; De Paoli, 2009), non-traded goods (Stockman and Dellas, 1989; Pesenti and Wincoop, 2002) and trade in intermediate input factor (Hillberry and Hummels, 2002), which are all main causes that scholars believed for consumption home bias. More recent studies have focused on discussion of the effect of home bias, such as Pierdzioch (2004) analyzed the effects of monetary policy on different extent of home bias and the capital mobility, Hau (2002), Pitterle and Steffen (2004), Kollmann (2004), Sutherland (2005), Leith and Lewis (2006) and Cooke (2010) discussed the effect of home bias on the exchange rate fluctuation, while De Paoli (2009) discussed the welfare effects of home bias and monetary policy. In addition, it is worthy to mention that the effect of home bias on the optimal monetary policy is also a quite hot topic, where it includes works by Faia and Monacelli (2006), Jondeau and Sahuc (2008), Galí and Monacelli (2008) and Wang (2010). Obviously, researches on the topic in respect of home bias was quite hot, however, there is no literature may clearly account for the role of home bias on the effects of tariff shocks under fixed exchange rate regime, thus inducing the motivation of this paper.

This paper divided into four sections. Except for the introduction, the other sections are arranged as follows: Section 2 constructs a theoretical model; Section 3 depicts simulation analysis to discuss the long-term effects of tariff on macroeconomic variables in a fixed exchange rate regime, and explain the role that consumption home bias plays; Section 4 includes conclusions and recommendations.

2. Theoretical Model

2.1 Model Setting

This paper follows NOEM proposed by Obstfeld and Rogoff (1995) as a theoretical basis; the main assumptions are stated 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, n) and foreign individuals are distributed between [n ,1].

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

(4). Consumption home bias exists in economic system, and tariff is the only one exogenous shock.

(5). Fixed exchange rate regime is implemented domestically.

2.1.1 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:

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

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

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

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

Where $c_h(z)$ is the consumption that domestic consumers on domestic specific product z, $c_f(z)$ is the consumption that domestic consumers on foreign specific product z, α is the parameters of consumption home bias to measure the degree of preference that domestic consumers on domestic goods, δ is the elasticity of substitution of products between countries.

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

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

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

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

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 goods z, $p_h^*(z)$ represents the foreign currency price of domestic goods z, $p_f^*(z)$ represents foreign currency price of foreign goods z, α^* represents the degree

that foreign consumer prefer foreign commodity. In addition, in this economic system with the presence of tariffs, domestic and foreign tariff rates are τ and τ^* respectively, and the change in tariff is a permanent shock, that is, $\tau_t = \tau_{t+1} = \tau$; $\tau_t^* = \tau_{t+1}^* = \tau^*$.

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:

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

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

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

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

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

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

2.1.2 Government

To focus on the exploration of effects of tariffs, assuming that government sectors have no expenditure and the government returns seigniorage revenue and tariff revenue to the agent by lump-sum fashion, the budget constraint of government is:

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

Where the first item at left side of equation is real seigniorage revenue, while the second item at left side of equation is real tariff revenue, and the right side of equation is 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 $nB_t + (1-n)B_t^* = 0$, or

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

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:

$$y_{h,t}(z) = nc_{h,t}(z) + (1-n)c_{h,t}^*(z)$$

$$= n\left(\frac{\alpha p_{h,t}(z)}{P_t}\right)^{-\delta}C + (1-n)\left(\frac{(1+\tau^*)(1-\alpha^*)p_{h,t}^*(z)}{P_t^*}\right)^{-\delta}C^* \tag{15}$$

Similarly, from on 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:

$$y_{f,t}^*(z) = nc_{f,t}(z) + (1-n)c_{f,t}^*(z)$$

$$= n\left(\frac{(1+\tau)(1-\alpha)p_{f,t}(z)}{P_t}\right)^{-\delta}C + (1-n)\left(\frac{\alpha^* p_{f,t}^*(z)}{P_t^*}\right)^{-\delta}C^* \tag{16}$$

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:

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

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

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

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 effects of tariff shocks on macroeconomic variables in the long-term are explored below. Firstly, given that economic system does not exist consumption home bias and tariff shock in the initial state (0 steady state) as a baseline in comparison, and then to deduce a long-term steady state of economy system. Among the following symbols, the subscript "$_t$" represents each economic variable under long-term steady state, and the subscript "$_0$" represents each economic variable under the initial state. For example: C_t and C_0 represent the consumption under long-term steady state and initial state respectively.

Long-term steady state describes that after going through the exogenous shock, the whole economic system reaches the convergence state. In the long-term steady state, all variables are fixed, and $B_t = B_{t+1} = 0$. Therefore, applying the government sector's budget constraint (Eq. (11)) into private sector's budget constraints (Eq. (14)), we can get:

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

Likewise, for foreign country, we have:

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

2.3 Log-linearization

In order to obtain a closed-form solution, this paper uses Uhlig (1995)'s approach. Firstly, put the model in log-linearization, 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-linearization of Price Index

Apply Eqs. (5) and (6) into Eqs. (3) and (4), and perform log-linearization, then to use the feature that the exchange rate will not change under fixed exchange rate regime ($\hat{E}_t = 0$), we have:

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

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

Subtract Eq. (23) from Eq. (22), we can acquire the difference of change on the price index between two countries as follows:

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

2.3.2 Log-linearization of the Law of One Price

If we put Eqs. (5) and (6) into log-linearization under fixed exchange rate regime ($\hat{E}_t = 0$), we can acquire:

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

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

2.3.3 Log-linearization of World Budget Constraint

We can also acquire world budget constraints equation from Eqs. (20) and (21):

$$C_{t}^{W} = nC_{t} + (1-n)C_{t}^{*}$$

$$= n\frac{p_{h,t}(z)y_{h,t}(z) + \tau(1-n)p_{f,t}(z)}{P_{t}} + (1-n)\frac{p_{f,t}^{*}(z)y_{f,t}^{*}(z) + \tau^{*}np_{h,t}^{*}(z)}{P_{t}^{*}} \tag{27}$$

Log-linearize Eq. (27) and use Eqs. (25) and (26), the following can be obtained:

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

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

2.3.4 Log-linearization of Demand Function

Put domestic and foreign demand function (Eqs. (15) and (16)) into log-linearization, we can acquire:

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

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

2.3.5 Log-linearization of Labor Supply Function

Log-linearize domestic labor supply function (Eq. (19)) and the following can be obtained:

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

Likewise, 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-linearization of Money Demand Function

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

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

Similarly, for foreign country, we have:

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

Subtract Eq. (34) from Eq. (33), we can obtain the following equation:

$$\hat{M}_{t} - \hat{M}_{t}^{*} = \frac{1}{\varepsilon}(\hat{C}_{t} - \hat{C}_{t}^{*}) + n(\alpha - (1-\alpha^{*}))p_{h,t}(z) + (1-n)((1-\alpha) - \alpha^{*})p_{f,t}^{*}(z)$$

$$+ (1-n)(1-\alpha)\hat{\tau} + n(1-\alpha^{*})\hat{\tau}^{*} \tag{35}$$

2.3.7. Log-linearization of Terms of Trade

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

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

Log-linearize the equation above under the fixed exchange rate regime ($\hat{E}_t = 0$) and the following equation can be obtained:

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

2.4 Steady-State Solution

Put Eqs. (20) and (21) into log-linearization, we can acquire:

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

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

Now, we can solve simultaneous equations on the log-linearized price index (Eqs. (22) and (23)), the law of one price after log-linearization (Eqs. (25) and (26)), world consumption after log-linearization (Eq. (28)), domestic and foreign demand function after log-linearization (Eqs. (29) and (30)), domestic and foreign labor supply function after log-linearization (Eqs. (31) and (32)), the terms of trade after log-linearization (Eq. (37)), domestic and foreign private budget constraints after log-linearization (Eqs. (38) and (39)) to acquire correlation equation on twelve endogenous and exogenous variables ($\hat{\tau}$), the twelve endogenous variable includes 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 ($\hat{y}_{f,t}^*(z)$), domestic prices of particular product in the home country ($\hat{p}_{h,t}(z)$), domestic prices of particular product in foreign country ($\hat{p}_{h,t}^*(z)$), foreign price of particular product in foreign country ($\hat{p}_{f,t}^*(z)$)), domestic price of particular product in foreign country ($\hat{p}_{f,t}(z)$)), the domestic price index ($\hat{P}_t$), the foreign price index ($\hat{P}_t^*$) and the terms of trade ($T\hat{O}T_t$).

3. The Effects of Tariff Shocks on Macroeconomic Variables

To capture the changes of the parameters of consumption home bias on the effects of tariff, we conduct a simulation analysis.

3.1 Parameterisation

In order to simplify the analysis in this paper, on NOEM basis, we set two economic systems with equivalent size as the analysis objects, hence, on the aspect of selecting the parameter values, we try to introduce empirical data on the United States and countries with similar scale (such as OECD, the European Union) to analyze the effects of tariff shock between the United States and nations with similar size. First, we follow the setting mode proposed by Bergin et al. (2007) to set the elasticity of substitution of product between countries (δ) to 5, besides, we follow the practices of Mankiw and Summers (1986) and Schmidt (2006) to set the elasticity of marginal utility of real money balances (ε) to 1, then, we use the setting of consumption home bias parameter value ($\alpha = 0.85$) proposed by Wang (2010), and simulate the cases in absence of consumption home bias ($\alpha = 0.5$) and bias to foreign goods ($\alpha = 0.15$), the settings of parameter of consumption bias in foreign country is identical to the consumption home bias parameter values in home country, as for exogenous variables other than the rate of change in domestic tariff rates of ($\hat{\tau}$), such as the rate of change in domestic money supply ($\hat{M}$), the rate of change in foreign money supply ($\hat{M}^*$), the rate of change in foreign tariff ($\hat{\tau}^*$), since they were not our focus of discussion in this paper, let us assume that the change rate is 0, and parameter settings are arranged 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
ε	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

In this section, we conduct the simulation analysis which parameter values that were set in the previous section to discuss the effects of tariff shock on consumption, prices, output and terms of trade and other macroeconomic variables. The simulation and detailed comparative static analysis results are shown in Table 2.

Table 2. The long-term effects of the tariff on macroeconomic variables

(a) Long-term effect of tariff on domestic consumption

		$\partial \hat{C}_t / \partial \hat{\tau}$		
		α		
		0.15	0.5	0.85
α^*	0.15	0.257	0.270	0.635
	0.5	0.040	-0.001	-0.502
	0.85	0.185	-0.082	-0.329

(b) Long-term effect of tariff on foreign consumption

		$\partial \hat{C}_t^* / \partial \hat{\tau}$		
		α		
		0.15	0.5	0.85
α^*	0.15	0.156	0.012	0.509
	0.5	-0.203	-0.375	-1.106
	0.85	-0.175	-0.463	-0.833

(c) Long-term effect of tariff on world consumption

		$\partial \hat{C}_t^W / \partial \hat{\tau}$		
		α		
		0.15	0.5	0.85
α^*	0.15	0.206	0.141	0.572
	0.5	-0.082	-0.188	-0.804
	0.85	0.005	-0.273	-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	-0.180	-0.201	-0.433
	0.5	-0.047	-0.031	0.284
	0.85	-0.153	0.023	0.178

(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	-0.095	0.013	-0.329
	0.5	0.156	0.281	0.788
	0.85	0.147	0.340	0.597

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

		$\partial\hat{P}_t / \partial\hat{\tau}$		
		α		
		0.15	0.5	0.85
α^*	0.15	0.726	0.380	0.419
	0.5	0.309	0	-0.536
	0.85	0.216	-0.163	-0.452

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

		$\partial\hat{P}_t^* / \partial\hat{\tau}$		
		α		
		0.15	0.5	0.85
α^*	0.15	0.249	0.159	0.344
	0.5	-0.069	-0.25	-0.885
	0.85	-0.209	-0.550	-1.023

(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		
		0.15	0.5	0.85
α^*	0.15	0.475	0.342	0.618
	0.5	-0.003	-0.188	-0.988
	0.85	0.215	-0.435	-0.841

(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		
		0.15	0.5	0.85
α^*	0.15	0.475	0.342	0.618
	0.5	-0.003	-0.188	-0.988
	0.85	0.215	-0.435	-0.841

(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		
		0.15	0.5	0.85
α^*	0.15	0.625	0.177	1.082
	0.5	-0.271	-0.813	-2.554
	0.85	-0.530	-1.218	-2.259

(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		
		0.15	0.5	0.85
α^*	0.15	0.625	0.177	1.082
	0.5	-0.271	-0.813	-2.554
	0.85	-0.530	-1.218	-2.259

(l) Long-term effect of tariff on terms of trade

		$\partial\hat{TOT}_t / \partial\hat{\tau}$		
		α		
		0.15	0.5	0.85

α^*	0.15	-0.151	0.165	-0.464
	0.5	0.268	0.625	1.566
	0.85	0.745	0.784	1.418

We may know from Table 2 (a) to (l) that an open economy system with only presence of two countries (home and foreign), and bilateral exchange rates maintaining fixed, an increase in domestic tariff rates will increase the cost of production and trade, also suppress the production will, however, due to reason that the tariff income is transferred to the agent in a lump-sum fashion, the level of consumption will increase, thereby driving the price level to rise and terms of trade to improve. But, if consumer bias behavior between two countries is in asymmetry, the foregoing conclusion will change. Wherein, on the effect of tariffs on the domestic consumption, when the "consumers in both countries do not exist consumption bias phenomenon", "foreign consumers do not have consumption bias behavior, but domestic consumers have consumption bias behavior on domestic products", "domestic consumers have no consumption bias behavior, but foreign consumers have consumption bias behavior on foreign products", and "domestic consumers have consumption bias behavior on domestic products, foreign consumers have consumption bias behavior on foreign products" are established, the rise of domestic tariff rate will result in the decline of domestic consumption. Wherein, on the effect of tariffs on domestic output, when the "consumption bias act does not exist among foreigner, but domestic consumers have consumption bias on domestic products", "domestic consumers do not have consumption bias behavior, but foreigner have consumption bias on foreign products", and "domestic consumers have consumption bias behavior on domestic products, foreign consumers have consumption bias behavior on foreign products" are established, the rise of domestic tariff rate will result in the rise of domestic output. On the aspect of the effect of tariffs on domestic price index, under the above three cases mentioned in the foregoing output aspects, the rise of domestic tariff rate will result in decline of domestic prices level, and finally, on the effect of tariffs on the terms of trade, if "consumers in both countries have consumption bias behavior on products produced by the competitor country" and "domestic consumers have consumption bias behavior on domestic products, foreign consumers have consumption bias behavior on foreign products", the rise of domestic tariff rate will cause deterioration of terms of trade.

4. Conclusion and Suggestions

There has been more than 20 years since NOEM established, however, compared to the popularity of the researches made on the effects of monetary and fiscal policy, the researches made on the effects on trade policy (such as tariffs) were relatively rare, based on the above reasons, this paper use NOEM proposed by Obstfeld and Rogoff (1995) as the theoretical framework for integrating the consumption home bias behavior into a model to explore a situation that when a country adopts a fixed exchange rate regime, what is the role of consumption home bias plays in the process of the tariff affect macroeconomic variables, we also hope that the findings herein can be provided to the relevant authorities as a reference for policy-makers.

This study contributes to the existing literature by providing a detailed account of how tariff change on macroeconomic variables in an open economy with the introduction of consumption home bias under the fixed exchange rate regime. With the findings of theoretical derivation and simulation analysis, we find out that the relationship among domestic tariff rates and macroeconomic variables (such as consumption, output, price index and terms of trade) is depending on the asymmetry degree in consumption bias on the exported and imported goods by the consumers in both countries, when the consumption bias behavior of domestic and foreign consumers is in asymmetry, the relationship that tariff shock on consumption, output, price index and the terms of trade would exist reversal possibility.

Finally, we shall give a special note that, in order to simplify the analysis, this paper only focuses on the long-term analysis, therefore, the dynamic adjustment process in the economic system was not highlighted, which was one of the limitation herein. Furthermore, although the theoretical framework of NOEM plays full of significance in each economic topic, in fact, in order to obtain closed-form solution, it is usually established under a lot of assumptions, if we try to release one of assumptions or setting (such as the type of utility function, etc.), the results obtained may differ, and such deficiency will also be included in the restriction suffered in this paper.

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Notes

Note 1. The 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.

Note 2. The elasticity of marginal utility of real money demand is defined as the degree of response in marginal utility of real money demand with the change of real money demand by 1%.