Money Illusion and Exchange Rate Dynamics in a Small Open Economy

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Abstract

This paper investigates the role of money illusion on exchange rate dynamics in a small open economy. We find that whether the exchange rate overshoots in response to a monetary shock is not depend on the parameters such as the consumption elasticity of money demand and the degree of openness proposed by Lane (1997), but the phenomenon of money illusion, this is because the degree of correlation between money demand and consumption is lower with the existence of money illusion, hence the exchange rate must present the excessive adjustment in order to re-achieve the new equilibrium position of the money market, exchange rate overshooting takes place.

Keywords: money illusion, exchange rate dynamics, NOEM, welfare analysis

1. Introduction

The money illusion phenomenon universally and constantly exists in reality (see Miao and Xie, 2007; Georg, 2010), but most of the existing literature on the issue of money illusion are still limited to the effects within a closed economy, studies in open economy are relatively lacking. New Open Economy Macroeconomics (henceforth NOEM), proposed by Obstfeld and Rogoff (1995), is one of the innovative models that is an extension of New Keynesian theory in open economy, and have attracted much attention recently, which is also known as the New Keynesian Open Economy model (see also Bowman and Doyle, 2003), featuring both nominal price rigidities and micro-foundations. However, up until now, the money illusion phenomenon emphasized by the Keynesian school (see also Trevithick, 1975) has not been linked to the NOEM model. In order to make up for the deficiencies in the existing literature, this paper tries to explore the effects of money illusion on the dynamic adjustment process of exchange rate, with NOEM as the analytical basis.

Writing on the definitions of money illusion, Fisher (1896) was the first one to indicate that if someone regards the value of money as never changing, then the person has fallen prey to the trap of money illusion, and Fisher (1928) further pointed out that money illusion is a phenomenon that involves an individual over- or under-appreciating the value of money. Leontief (1936) considered that when demand and supply functions are not satisfied with homogeneity of degree zero in prices, money illusion is present. Patinkin (1949; 1965) defined money illusion as a phenomenon where an individual is unable to distinguish clearly real and nominal variables.

The majority of earlier studies attempted to explain the reason why "Fisher equation failed to hold" and "the short-run Philips curve has a negative slope", and the causes can be attributed the existence of money illusion (e.g. Fisher, 1930; Summers, 1982; Friedman, 1968). On the other hand, Some research tried to explore the effects of the money illusion in different markets, e.g. housing and real estate markets (e.g. Brunnermeier and Julliard, 2007; Genesove and Mayer, 2001; Piazzesi and Schneider, 2007; Case and Robert, 2003), financial markets (e.g. Georg, 2010), stock markets (e.g. Campbell and Vuolteenaho, 2004; Cohen, Polk and Vuolteenaho, 2005) and commodity markets (e.g. Fehr and Tyran, 2007; Georg, 2010). Moreover, Miao and Xie (2007) adopted an endogenous growth model to analyze the influence of money illusion on economic growth, they found that the presence of money illusion would alter an individual's consumption/saving decisions and further affect the rate of economic growth. Georg (2010) explained that money illusion would lead to an economic system being unable to achieve equilibrium through the price mechanism. From the aforementioned studies, it is not difficult to see that investigations into money illusion have been enthusiastic, but the discussions remain limited to closed economy. Murphy and Das (1976) had indicated that money illusion would influence the adjustment of the balance of payment through the exchange rate channel, but also only remained a static discussion.

NOEM was launched by Obstfeld and Rogoff (1995), under a two-country, price stickiness and micro-foundations-based dynamic general equilibrium model, it was found that when faced with a permanent monetary shock, the response of exchange rate in the short-run will immediately return to its steady state position, not resulting in overshooting. Since the paper by Obstfeld and Rogoff (1995), the study of the "exchange rate dynamics" issue has officially moved towards another new milestone with the introduction of micro-foundations. (Note 1) Following the NOEM model, Betts and Devereux (1996; 2000) focused further on investigating the effects of pricing-to-market (henceforth PTM) on the exchange rate dynamics. They found that the extent of exchange rate volatility by permanent monetary disturbance would be greater for the short-run than for the long-run because firms choose to PTM, resulting in overshooting. Lane (1997) built a small open economy model to illustrate that the parameters of the consumption elasticity of money demand and the degree of openness could affect the exchange rate dynamics. Obstfeld and Rogoff (2000) incorporated the properties of wage stickiness, non-traded goods and random shocks into the NOEM model, drawing the conclusion that exchange rates would result in overshooting when facing random exogenous shocks.

The existence of money illusion has been one of the focuses of the debate between the supporters of Keynesianism and the supporters of Monetarism. However, in the existing NOEM literature, the role of money illusion has obviously been neglected. If a model is to be built on New Keynesian Open Economy, then logically, money illusion should not be ignored. Hence, this paper attempts to seek a breakthrough.

In view of above-mentioned, by taking the NOEM model as the analytical basis, this paper tries to investigate the effects of money illusion on the exchange rate dynamics and to make a welfare evaluation. We expand the model proposed by Lane (1997) for analysis by utilizing a small open economy model as the theoretical framework. Through theoretical analysis, this paper finds that the exchange rate will overshoot in response to a permanent monetary shock due to money illusion.

This paper consists of four sections. Section 1, the introduction, describes the research motives and objectives. Section 2 constructs the theoretical framework. In Section 3, we derive the equilibrium solutions with flexible price and sticky price, and a welfare assessment is carried out. Section 4 gives conclusions and suggestions.

2. Theoretical Framework

Assume that there exist a small open economy with two production sectors, a non-traded good sector, and a traded good sector. Agents are arranged on the interval [0, 1], with each agent being capable of producing and consuming a unit of non-traded goods, where the non-traded goods are provided by monopolistically competitive producers and heterogeneity exists among the non-traded goods. The traded goods sector is structured on a perfectly competitive market with the traded goods being homogeneous commodities. Domestic and foreign traded goods being perfectly substitutable and the traded goods are endowments.

Each agent can obtain a fixed quantity of traded goods, and the prices of traded goods are determined exogenously by foreign traded goods market in a small open economy. Furthermore, similarly, this paper defines an agent's inability to accurately differentiate economic variables as "real" or "nominal" as being trapped in money illusion.

2.1 Preferences

Under the theoretical framework of Lane (1997) and with the set-up of Miao and Xie (2007) taken into consideration, the money illusion is incorporated into the model where the lifetime utility function of representative agent is as follows: (Note 2)

$$U=\sum_{t=0}^{\infty}\beta^{t}\left\{\delta\log\left[C_{T,t}^{1-\eta_1}(P_{T,t}C_{T,t})^{\eta_1}\right]+(1-\delta)\log\left[C_{N,t}^{1-\eta_2}(P_{N,t}C_{N,t})^{\eta_2}\right]+\frac{\chi}{1-\varepsilon}\left[\left(\frac{M_t}{P_t}\right)^{1-\eta_3}M_t^{\eta_3}\right]^{1-\varepsilon}-\frac{\kappa}{2}y_{N,t}(z)^2\right\} \quad (1)$$

where $C_{T,t}$ is the consumption of traded goods, $C_{N,t}$ is the consumption of non-traded goods, M_t is nominal money holdings, $P_{T,t}$ denotes the prices of traded goods, $P_{N,t}$ is the prices of non-traded goods, P_t represents the domestic price index, M_t/P_t is the real money balances, and $y_{N,t}(z)$ is the production of non-traded goods by the producer z. δ is the share of the consumption of non-traded goods in consumption index, β denotes the subjective discount factor, ε is the elasticity of marginal utility of real money demand, which has a reciprocal relationship to the consumption elasticity of real money demand, χ and κ represent the degrees of importance

of real money balances and output in the utility function respectively, and η_1, η_2 and η_3 are the weights of the representative agent's regards for nominal variables, which can be used to measure the degrees of money illusion in different types. Also, in Eq. (1), $\varepsilon, \chi, \kappa > 0$; $0 \le \eta_1, \eta_2, \eta_3 \le 1$.

In Eq. (1), when $\eta_1 = \eta_2 = 0$, the agent pays full attention to "real" consumptions of traded goods and non-traded goods, not demonstrating any money illusion with respect to consumption behavior. If $\eta_1 = \eta_2 = 1$, the agent solely pays attention to "nominal" consumptions of traded goods and non-traded goods, demonstrating the goods markets suffer from money illusion completely. Therefore, the larger η_1, the higher the degree of money illusion with respect to consumption of traded goods, and the larger η_2, the higher the degree of money illusion with respect to consumption of non-traded goods. If $\eta_3 = 0$, the agent pays complete attention to the holdings of "real" money balances, not demonstrating any money illusion with respect to money demand, whereas when $\eta_3 = 1$, the agent only stresses the holdings of "nominal" money balances, indicating the presence of complete money illusion with respect to money demand behavior, and therefore, the larger η_3, the higher the degree of money illusion demonstrated by the agent with respect to money demand. Since money illusion phenomenon prevalently exists in consumption and money demand in reality, this paper only emphasizes the investigation of money illusion in consumption and money demand behaviors, temporarily not considering money illusion in production for simplified analysis.

The consumption of non-traded goods, C_N, is given by:

$$C_N = \left[\int_0^1 C_N(z)^{\frac{\theta-1}{\theta}} dz \right]^{\frac{\theta}{\theta-1}} \tag{2}$$

where θ is the elasticity of substitution between non-traded goods (θ>1).

From the definition of consumption index (Eqs. (1) and (2)), the price index can be derived by an expenditure minimization problem as:

$$P = \frac{P_T^{\delta} P_N^{1-\delta}}{\delta^{\delta}(1-\delta)^{1-\delta}} \tag{3}$$

where P_T and P_N represent the prices of domestic traded and non-traded goods with P_N defined as:

$$P_N = \left[\int_0^1 P_N(z)^{1-\theta} dz \right]^{\frac{1}{1-\theta}} \tag{4}$$

Because domestic and foreign traded goods being perfectly substitutable, the prices of traded goods satisfy $P_T = EP_T^*$ where P_T^* denotes the price of traded goods as determined exogenously by foreign traded goods markets, E represents the nominal exchange rate. Here, following in the steps of Lane (1997), P_T^* is normalized to 1 ($P_T^* = 1$).

2.2 Asset Market

A state-contingent bonds market is assumed to exist internationally, and the representative agent can work out the behaviors for the purchasing of international bonds through optimized decision-making. The international bonds are issued in domestic currency, r stands for the rate of return on the bonds, and transaction costs are absent in this paper. That is, the capital market possesses perfect mobility.

2.3 Budget Constraint

For the representative agent, the budget constraint is:

$$P_{T,t}B_{t+1} + P_{T,t}C_{T,t} + P_{N,t}C_{N,t} + M_t = P_{T,t}(1+r)B_t + M_{t-1} + P_{T,t}\bar{y}_{T,t} + P_{N,t}(z)y_{N,t}(z) + T_t \tag{5}$$

where B is holdings of international bonds. The left side of Eq. (5) denotes expenditure items and money balances of the representative agent in period t, including international bonds expenditures ($P_{T,t}B_{t+1}$), traded goods expenditures ($P_{T,t}C_{T,t}$), non-traded goods expenditures ($P_{N,t}C_{N,t}$) and money holdings (M_t). The right side of Eq. (5) are sources of revenue in period t, including returns from prior holdings of international bonds ($P_{T,t}(1+r)B_t$), prior money balances (M_{t-1}), incomes from endowments of traded goods ($P_{T,t}\bar{y}_{T,t}$), output revenue of non-traded goods ($P_{N,t}(z)y_{N,t}(z)$) and lump-sum government transfers (T_t).

2.4 Government

Since the emphasis of this paper is not on the adjustment costs of the money sector, Lane's (1997) set-up has been modified to assume that the government transfers all seigniorage revenues to the agents in a lump-sum fashion while not considering the adjustment costs of money supply. The government budget constraint is:

$$M_t = M_{t-1} + T_t \tag{6}$$

where M represents money supply and T is the transfer payment.

2.5 Firms

From Eqs. (2) and (4), the demand for the z^{th} variety of the non-traded goods ($y_N^d(z)$) can be derived as follows:

$$y_N^d(z) = \left[\frac{P_N(z)}{P_N}\right]^{-\theta} C_N^A \tag{7}$$

where C_N^A is the aggregate demand for non-traded goods.

2.6 First-order Conditions

To simplify the analysis, it is assumed that $\beta(1+r)=1$ holds, then to derive the optimal first-order conditions for the utility maximization problem, the representative agent's optimal choice can be obtained as follows:

$$C_{T,t+1} = C_{T,t} \tag{8}$$

$$\frac{\delta}{1-\delta} = \frac{P_{T,t}^{1-\eta_1} C_{T,t}}{P_{N,t}^{1-\eta_2} C_{N,t}} \tag{9}$$

$$\chi\left(\frac{M_t}{P_t^{1-\eta_3}}\right)^{-\varepsilon} \frac{1}{P_t^{1-\eta_3}} = \frac{\delta}{P_{T,t}^{1-\eta_1} C_{T,t}}\left(1-\beta\frac{P_{T,t}^{1-\eta_1}}{P_{T,t+1}^{1-\eta_1}}\right) \tag{10}$$

$$y_{N,t}^{\frac{1+\theta}{\theta}} = \frac{\theta-1}{\kappa\theta}\frac{(1-\delta)}{C_{N,t}}(C_{N,t}^A)^{\frac{1}{\theta}} \tag{11}$$

where Eq. (8) is standard Euler equation that explains the optimal behavior for intertemporal consumption of traded goods, Eq. (9) shows that the optimal substitution behavior for the consumptions of traded goods and non-traded goods is related to the share of the consumption of non-traded goods, Eq. (10) is the equation of money demand and clarifies the optimal substitution relationship between real money holdings and consumption, and Eq. (11) concerns the labor supply, giving the substitution relationship between production and consumption. Here, as a result of each agent showing same preferences, the symbol z in representing a particular agent, is removed.

3. Derivation of Equilibrium Solutions

3.1 Equilibrium with Flexible Price

Considering a symmetric steady state which agents hold zero foreign assets and the price index remains fixed, the consumption of traded and non-traded stays constant, implying that $C_{N,t} = C_{N,t}^A$ and the output of non-traded

goods is:

$$y_{N,t} = \left[\frac{(1-\delta)(\theta-1)}{\kappa\theta}\right]^{\frac{1}{2}} \tag{12}$$

Eq. (12) shows that as the degree of monopoly decreases, the output of non-traded goods increases. As the market structure approaches being perfectly competitive, the level of output draws closer to:

$$y_{N,t} = \left(\frac{1-\delta}{\kappa}\right)^{\frac{1}{2}}$$

3.2 Equilibrium with Sticky Price

In the short-run, the prices demonstrate a rigid characteristic, and unanticipated permanent monetary disturbance appears, the pre-determined prices of non-traded goods cannot be adjusted immediately and would subsequently lead to dynamic adjustments. (Note 3)

In order to obtain the closed-form solution, we use the log-linearization approach which widely adopted in NOEM-related literature. In the following equations, "^" indicates log-linearized values of any variables. That is,

$$\hat{X}_t = \frac{X_t - X_0}{X_0} = \frac{dX_t}{X_0} = \ln\left(\frac{X_t}{X_0}\right)$$

where " $_0$ " denotes the initial value of any variables.

Take the log-linearization of Eqs. (9) and (10), we have

$$(1-\eta_1)\hat{P}_{T,t} + \hat{C}_{T,t} = (1-\eta_2)\hat{P}_{N,t} + \hat{C}_{N,t} \tag{13}$$

$$\varepsilon\left(\hat{M}_t - (1-\eta_3)\hat{P}_t\right) = (1-\eta_1)\hat{P}_{T,t} - (1-\eta_3)\hat{P}_t + \frac{\beta(1-\eta_1)}{1-\beta}\left(\hat{P}_{T,t} - \hat{P}_{T,t+1}\right) \tag{14}$$

In the short-run (period t), as the pre-determined prices of non-traded goods cannot be adjusted with a monetary shock ($\hat{P}_{N,t} = 0$), the price index is affected only by the prices of traded goods, i.e. $\hat{P}_t = \delta\hat{P}_{T,t}$. Since traded goods are endowments, the consumption of traded goods remains unchanged, i.e. $\hat{C}_{T,t} = 0$. By putting together these conditions, Eqs. (13) and (14) can be re-written as:

$$(1-\eta_1)\hat{P}_{T,t} = \hat{C}_{N,t} \tag{15}$$

$$\varepsilon\hat{M}_t = \left((1-\eta_1) - \delta(1-\varepsilon)(1-\eta_3) + \frac{\beta(1-\eta_1)}{1-\beta}\right)\hat{P}_{T,t} - \frac{\beta(1-\eta_1)}{1-\beta}\hat{P}_{T,t+1} \tag{16}$$

In the long-run (period $t+1$), all variables reach a steady state position where $\hat{P}_{T,t} = \hat{P}_{T,t+1}$, and therefore, Eq. (14) can be re-written as:

$$\varepsilon\left(\hat{M}_{t+1} - (1-\eta_3)\hat{P}_{t+1}\right) = (1-\eta_1)\hat{P}_{T,t+1} - (1-\eta_3)\hat{P}_{t+1} \tag{17}$$

By combining Eqs. (3), (9) and (17), the following is obtained:

$$\hat{M}_{t+1} = (1-\eta_1)\hat{P}_{T,t+1} = (1-\eta_2)\hat{P}_{N,t+1} = (1-\eta_3)\hat{P}_{t+1} \tag{18}$$

As known from Eq. (18), in the steady state, because agents demonstrate money illusion in their consumption behaviors of traded and non-traded goods, the effects of money supply on the prices of traded and non-traded goods

are related to the degree of money illusion with respect to consumption (η_1 and η_2), whereas the effects of money supply on the price index are related to the degree of money illusion with respect to money demand (η_3). In particular, money illusion will lower the sensitivities of agent towards the fluctuations in the price, which subsequently lead to the underestimation of the inflation rate. Such behavior of underestimating the inflation rate will worsen further as the degree of money illusion increases.

As a result of the prices of foreign traded goods being determined exogenously ($\hat{P}^*_{T.t} = 0$), the extent of change in the exchange rate and domestic traded prices after a monetary shock would present in the same proportion, i.e. $\hat{P}_T = \hat{E}$. Finally, combining Eq. (16), the extent of short-run fluctuation in the exchange rate is given by:

$$\hat{E}_t = \hat{P}_{T,t} = \frac{\beta(1-\eta_1) + \varepsilon(1-\beta)(1-\eta_3)}{(1-\eta_3)\{\beta(1-\eta_1) + (1-\beta)[(1-\eta_1) - \delta(1-\varepsilon)(1-\eta_3)]\}} \hat{M}_t \tag{19}$$

where if without considering money illusion ($\eta_1 = \eta_3 = 0$), the amplitude of fluctuation in the exchange rate depends on the consumption elasticity of money demand ($1/\varepsilon$) and the degree of openness (δ), returning to the conclusion drawn by Lane (1997). When money illusion is then introduced into the model, the degree of money illusion with respect to the consumption of traded goods (η_2) is shown to be unrelated to the exchange rate, but as the degrees of money illusion with respect to the consumption of traded goods and money demand (η_1, η_3) increase, the amplitude of fluctuation in the exchange rate also increases.

Eq. (19) also shows the exchange rate would overshoot as long as money illusion is present regardless of the value of the consumption elasticity of real money balances (ε) and the share of traded goods (δ), and the extent of exchange rate adjustment increases with a higher the degree of money illusion. These are the consequences of a weakened correlation between consumption and money demand brought about by money illusion. Therefore, in the short-run, the exchange rate must undergo a greater degree of adjustment in order to return to new equilibrium for the money market, subsequently resulting in overshooting of the exchange rate.

3.3 Welfare Analysis - A Special Case

Based on the model of Obstfeld and Rogoff (1995) and the model developed by Lane (1997), the changes of welfare are broken down into real and monetary parts, i.e.

$$\Delta U = \Delta U_R + \Delta U_M$$

Here, ΔU_R refers to the degree of welfare change caused by changes in consumption and output, ΔU_M denotes the degree of welfare change caused by the change in real money balances, where:

$$\Delta U_R = \delta(\eta_1 \hat{P}_{T,t} + \hat{C}_{T,t}) + (1-\delta)(\eta_2 \hat{P}_{N,t} + \hat{C}_{N,t}) - \kappa y^2_{N,0} \hat{y}_{N,t}$$

$$+ \frac{\beta}{1-\beta}\left[\delta(\eta_1 \hat{P}_{T,t+1} + \hat{C}_{T,t+1}) + (1-\delta)(\eta_2 \hat{P}_{N,t+1} + \hat{C}_{N,t+1}) - \kappa y^2_{N,0} \hat{y}_{N,t+1}\right] \tag{20}$$

$$\Delta U_M = \chi\left(\frac{M}{P^{1-\eta_3}}\right)^{1-\varepsilon}_0 \left(\hat{M}_t - (1-\eta_3)\hat{P}_t\right) \tag{21}$$

In Eq. (20), the consumption of traded goods stays unaffected ($\hat{C}_{T,t} = 0$) in the short-run, the prices of non-traded goods remain rigid ($\hat{P}_{N,t} = 0$), and the extent of fluctuations in the prices of traded goods can be given by Eq. (17). Hence, the extent of changes in the consumption and the output level of traded goods are the same as the extent of fluctuation in the exchange rate.

In the long-run, money demonstrates neutrality, the relationship between the price fluctuations of traded and non-traded goods and changes in money supply is as indicated by Eq. (20), and therefore:

$$\Delta U_R = \frac{1}{\theta}\left(\frac{\delta\eta_1}{1-\eta_1} + (1-\delta)\right)\hat{E}$$

$$= \frac{1}{\theta}\left(\frac{\delta\eta_1}{1-\eta_1} + (1-\delta)\right)\frac{\beta(1-\eta_1)+\varepsilon(1-\beta)(1-\eta_3)}{(1-\eta_3)\{\beta(1-\eta_1)+(1-\beta)[(1-\eta_1)-\delta(1-\varepsilon)(1-\eta_3)]\}}\hat{M}_t \tag{22}$$

Next, $\hat{P}_t = \delta\hat{P}_{T,t}$ is inserted into Eq. (21), and using also Eq. (19), to give

$$\Delta U_M = \chi\left(\frac{M}{P^{1-\eta}}\right)_0^{1-\varepsilon}\left[1 - \frac{\delta\left(\beta(1-\eta_1)+\varepsilon(1-\beta)(1-\eta_3)\right)}{\beta(1-\eta_1)+(1-\beta)[(1-\eta_1)-\delta(1-\varepsilon)(1-\eta_3)]}\right]\hat{M} \tag{23}$$

By integrating the effects of real and monetary parts and considering the special case where the consumption elasticity of real money demand equals to 1 ($\varepsilon = 1$), the welfare change can be obtained as:

$$\Delta U = \left[\frac{1}{\theta}\left(\frac{\delta\eta_1}{1-\eta_1}+(1-\delta)\right)\left(\frac{\beta(1-\eta_1)+(1-\beta)(1-\eta_3)}{(1-\eta_1)(1-\eta_3)}\right)+\frac{\chi\left((1-\eta_1)-\delta\left(\beta(1-\eta_1)+(1-\beta)(1-\eta_3)\right)\right)}{1-\eta_1}\right]\hat{M} \tag{24}$$

As shown by Eq. (24), we find that the effect of a monetary shock on welfare level is depend on the parameters of the subjective discount factor (β), the importance of money balances on utility (χ), the substitution elasticity among non-traded goods (θ), the degree of openness (δ), and the degree of money illusion with respect to the consumption of traded goods and money demand (η_1 and η_3).

For the analysis of welfare, we adopt the numerical simulation approach to observe welfare changes. Similarly to De Paoli (2009), the parameters adopted for the simulation in this paper are mostly fit the actual data for small open economy. First, the degree of openness (δ) is set to 0.5, and the subjective discount factor (β) is set equal to 0.99. Moreover, since the proportion of money balances in the utility function (χ) and the elasticity of substitution among non-traded goods (θ) would not affect the final qualitative results, reflecting them only in the differences in the extent of influence within the model, for the purpose of convenience, this paper cites the results of estimation (between 1.46 and 2.14) for Costa Rica obtained by Arce and Robles (2004) that set the value of substitution elasticity of non-traded goods to 2 ($\theta = 2$), and the parameter values for the proportion of money balances in the utility function (χ) is set to 1 which is commonly used in NOEM literature, such as the work of Bergin (2006). Finally, because the focus of this paper is on the degree of money illusion with respect to the consumption of traded goods and money demand (η_1 and η_3), for the simulation, values in the interval [0,1] are successively taken. Also, regarding the growth rate of the money supply ($\hat{M}$), the values for 0.1 is used in the simulation. The parameter and variable values adopted are summarized in Table 1, and the results of numerical simulations are as shown in Table 2.

Table 1. Choice of the parameter and variable values

Symbol	Description	Value
β	Subjective discount factor	0.99
δ	Share of traded goods	0.5
θ	Substitution elasticity of non-traded goods	2
χ	Proportion of money balances in the utility function	1
η_1	Degree of money illusion in consumptions of traded goods	[0,1]
η_3	Degree of money illusion in money demand	[0,1]
$\hat{M}$	Growth rate of money supply	0.01

Table 2. Money illusion and welfare changes

		η_1				
		0	0.2	0.4	0.6	0.8
η_3	0	0.0075	0.0081	0.0092	0.0113	0.0174
	0.2	0.0081	0.0089	0.0102	0.0128	0.0205
	0.4	0.0091	0.0102	0.0119	0.0154	0.0257
	0.6	0.0112	0.0128	0.0154	0.0206	0.0361
	0.8	0.0174	0.0205	0.0257	0.0361	0.0675

Note: The above simulation results are in a case of $\delta = 0.5$, and without consideration of the cases of $\eta_1 = 1$ and $\eta_3 = 1$ in order to obtain the solutions.

As known from the Table 2, we can find that the expansion in money supply causes the degree of activity in capital to climb, consumption as well as money demand both increase and hence improve the welfare level. Also, the higher the degree of money illusion, the higher the extent of improvement in welfare.

4. Conclusions and Suggestions

This paper combines the money illusion phenomenon with the New Keynesian Open Economy model by following Lane's (1997) framework. We analyze the role of money illusion on exchange rate dynamics in a small open economy, the results show that the main determining factors for exchange rate overshooting are not parameters such as the consumption elasticity of money demand and the degree of openness, but the presence of money illusion.

Regardless of the value of consumption elasticity of real money balances and the share of traded goods, overshooting of the exchange rate occurs as a result of the presence of money illusion, and the higher the extent of exchange rate adjustment with the higher the degree of money illusion. This is because the presence of money illusion weakens the correlation between money demand and consumption behaviors, a greater degree of adjustment must be made to the exchange rate in order to let the money market return to the new equilibrium, as a result, leading to exchange rate overshooting. On the analysis of welfare, an increase in money supply leads to a directly increase in the degree of activity in capital, as well as consumption and money demand increases with the higher the extent of money illusion. Consequently, the level of welfare improves, showing a level of improvement that increases with an increasing degree of money illusion.

Finally, for convenience, only money illusion behaviors related to the consumption and money demand are discussed in this paper. Subsequent studies can analyze the money illusion in production behavior to examine the differences in exchange rate and welfare changes. And, this paper assumes that money illusion as an exogenous parameter, this is one of the restrictions, to incorporate endogenous money illusion into the model will be a crucial issue worth to probe.

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Notes

Note 1. Dornbusch (1976) can be regarded as the pioneer in the issue of "exchange rate dynamics". He found that the expansion of the money supply will cause the extent of the fluctuation of short-run exchange rate to be greater than that of the long-run, this is because the speed of adjustment in asset market is quicker than that in commodity market, and produces the well-known exchange rates overshooting.

Note 2. Here, the lifetime utility of the representative agent demonstrating positively proportional relationships with consumption and money balances, but a negatively proportional relationship with the production of non-traded goods.

Note 3. However, in the long-run, the prices of non-traded goods can be adjusted to the steady state levels.