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Does monetary expansion improve welfare under habit formation?

Wataru Johdo
Tezukayama University

Abstract

This paper studies how introducing habit formation to the two-sector small open economy model of Obstfeld and Rogoff (1995) and Lane (1997) affects the impact of a monetary surprise on welfare. In this model with endogenous habit formation, we examine agents' responses to a monetary expansion shock, taking into account the negative effect of habit formation on future consumption utility. We show that when habit formation is relatively important in the utility function, the monetary expansion decreases welfare.

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Contact: Wataru Johdo - johdo@tezukayama-u.ac.jp.
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1. Introduction

Over the past two decades, a large number of empirical studies have demonstrated the existence of habit formation in consumption decisions (e.g., Constantinides (1990), Ferson and Constantinides (1991), Fuhrer (2000) and Fuhrer and Klein (2006)). Motivated by this empirical evidence, a large number of theoretical studies have examined the effects of habit formation in many areas, especially in macroeconomics and finance. However, until now, no study has attempted to introduce the hypothesis of habit formation into small open economy models in the new open economy macroeconomics (NOEM) literature.[1] The purpose of this paper is to contribute to the theoretical literature by generalizing the two-sector small open economy model of Obstfeld and Rogoff (1995) to include habit formation, and examine how the strength of habit formation affects the response of welfare to monetary policy shocks.

In a related study, Lane (1997) uses the two-sector small open economy model of Obstfeld and Rogoff (1995) and studies how key macroeconomic variables and the exchange rate are influenced by monetary policy shocks. However, in his model, a time-separable utility function is assumed. We present an interesting result that is not observed in the NOEM literature: a surprise monetary expansion decreases welfare if habit formation is relatively important in the utility function.

2. The model

Following Obstfeld and Rogoff (1995) and Lane (1997), we consider a small open economy with two sectors, a traded goods sector and a nontraded goods sector, with nominal price rigidities. The traded goods sector is characterized by a single homogeneous endowment, and the price of traded goods is determined in perfectly competitive world markets. Meanwhile, the nontraded goods sector is a monopolistically competitive market with differentiated goods. In this model, a unit mass of agents is characterized as both consumers and producers, where each agent produces a unit of nontraded differentiated goods. The agents have perfect foresight, derive their utility from consuming a homogeneous good and a group of differentiated goods and from holding real money balances, and incur the cost of expending labor (or production) effort.

The crucial departure of the model developed in this paper from the models of Obstfeld and Rogoff (1995) and Lane (1997) is to allow habit formation in the agents' consumption behavior. With habit formation, for a given level of current consumption, the agent's current consumption utility depends negatively on the level of habit determined by past consumption. Following the formulation in Abel (1990), we assume that agents' consumption utility at time t is affected by the habit stock multiplicatively, $[(C_t/(h_t)^{\eta})^{1-\sigma} - 1]/(1-\sigma)$, where C_t is the agent's own consumption in period t, h_t is the level of habit, the parameter η (we assume $0 \le \eta < 1$) measures the importance of habit formation in the utility function, and σ is the coefficient of relative risk aversion, where $\sigma > 1$ is assumed.[2] In this specification, for $0 < \eta < 1$, when η is larger, the agent

[1] The seminal contribution to the NOEM literature is Obstfeld and Rogoff (1995). For a survey of the NOEM models, see Lane (2001).

[2] The specification of this form of habit formation is also used by Carroll (2000), Carroll et al. (2000), Fuhrer (2000), and Faria (2001).

receives less consumption utility from a given amount of current consumption. In addition, following Abel (1990) and Graham (2008), we take the level of habit h_t to be equal to the agent's own previous-period consumption: $h_t = C_{t-1}$.[3] The intertemporal objective of a typical agent at time 0 is to maximize the following lifetime utility:

$$U_0 = \sum_{t=0}^{\infty} \beta^t \left\{ \gamma \left[\frac{\left(C_{Tt} / (C_{Tt-1})^{\eta} \right)^{1-\sigma} - 1}{1-\sigma} \right] + (1-\gamma) \left[\frac{\left(C_{Nt} / (C_{Nt-1})^{\eta} \right)^{1-\sigma} - 1}{1-\sigma} \right] + \chi \log \frac{M_t}{P_t} - \frac{\kappa}{2} y_{Nt}(i)^2 \right\}, \quad (1)$$

where $0 < \beta < 1$ is a constant subjective discount factor, $y_{Nt}(i)$ is the agent's output of nontraded goods in period t, γ is the share of the consumption of traded goods, C_{Tt} is consumption of the traded good, and C_{Nt} is composite nontraded goods consumption, defined as:

$$C_{Nt} = \left(\int_0^1 C_{Nt}(i)^{(\theta-1)/\theta} di \right)^{\theta/(\theta-1)}, \quad (2)$$

where θ (> 1) is the elasticity of substitution between any two differentiated goods and $C_{Nt}(i)$ is the consumption of nontraded good i. The second term in (1) represents real money balances (M_t/P_t), where M_t denotes nominal money balances held at the beginning of period $t + 1$, and P_t is the consumption price index, which is defined as:

$$P_t = \frac{P_{Tt}^{\gamma} P_{Nt}^{1-\gamma}}{\gamma^{\gamma}(1-\gamma)^{1-\gamma}}, \quad (3)$$

where P_{Nt} is the price of nontraded goods and is defined as:

$$P_{Nt} = \left(\int_0^1 P_{Nt}(i)^{1-\theta} di \right)^{1/(1-\theta)}, \quad (4)$$

and P_{Tt} is the domestic currency price of traded goods. Because there are no trade costs, the law of one price holds for traded goods; i.e., $P_{Tt} = E_t P_{Tt}^*$, where E_t is the nominal exchange rate and P_{Tt}^* is the exogenously determined world price. A typical agent faces the following budget constraint:

$$P_{Tt}B_{t+1} + M_t = P_{Tt}(1+r)B_t + M_{t-1} + P_{Nt}(i)y_{Nt}(i) + P_{Tt}y_T - P_{Nt}C_{Nt} - P_{Tt}C_{Tt} + T_t, \quad (5)$$

[3] Fuhrer (2000) attempted to provide a justification for this assumption $h_t = C_{t-1}$ by testing for it empirically, using GMM and FIML estimates. As a result, he obtained strong evidence regarding $h_t = C_{t-1}$. Fuhrer and Klein (2006) also obtained empirical evidence on the presence of habit formation characterized by $h_t = C_{t-1}$ by using quarterly time series data for Canada, Germany, Italy, the United Kingdom, and the United States.

where B_{t+1} denotes real bonds denominated in traded goods in period $t+1$, r denotes the world real interest rate in traded goods on bonds that applies between periods $t-1$ and t, and T_t denotes lump-sum transfers from the government. In the government sector, we assume that government spending is zero and that all seignorage revenues derived from printing the national currency are rebated to the public. Hence, the government budget constraint is $M_t - M_{t-1} = T_t$. In addition, in this model, each agent is endowed with a constant amount of the traded good in each period. Therefore, as shown in (5), we can delete the subscript t from y_{Tt}; i.e., $y_{Tt} = y_T$, $\forall t$. At the first stage, agents maximize the consumption index (2) subject to a given level of expenditure on nontraded goods $P_{Nt}C_{Nt} = \int_0^1 P_{Nt}(i)C_{Nt}(i)di$ by optimally allocating differentiated nontraded goods. This static problem yields the following demand function for good i:

$$y_{Nt}(i) = \left(\frac{P_{Nt}(i)}{P_{Nt}}\right)^{-\theta} C_{NAt}, \tag{6}$$

where C_{NAt} is aggregate consumption. At the second stage, agents maximize (1) subject to (5). For simplicity, we assume $\beta(1+r)=1$. In this maximization problem, we assume that the agents take into account the negative effect of increasing their current consumption on future consumption utility through habit formation (endogenous habit formation). Then, the first-order conditions for this problem can be written as:

$$1 = \left(\frac{C_{Tt-1}}{C_{Tt}}\right)^{\eta(1-\sigma)} \left(\frac{C_{Tt+1}}{C_{Tt}}\right)^{-\sigma} \left[1 + \beta\eta\left(\frac{C_{Tt+1}}{C_{Tt}}\right)\right], \tag{7}$$

$$\left(\frac{\gamma}{1-\gamma}\right) = \left(\frac{P_{Tt}}{P_{Nt}}\right)\left(\frac{C_{Tt}}{C_{Nt}}\right)^{\sigma}\left(\frac{C_{Tt-1}}{C_{Nt-1}}\right)^{\eta(1-\sigma)}, \tag{8}$$

$$\frac{M_t}{P_t} = \left(\frac{\chi}{\gamma}\right)\left(\frac{P_{Tt}}{P_t}\right) C_{Tt}^{\sigma} C_{Tt-1}^{\eta(1-\sigma)} \left[\frac{1+\beta\eta\left(C_{Tt+1}/C_{Tt}\right)}{1-\beta\left(P_{Tt}/P_{Tt+1}\right)}\right], \tag{9}$$

$$y_{Nt}(i)^{(\theta+1)/\theta} = \gamma\left(\frac{\theta-1}{\theta\kappa}\right)\left(\frac{P_{Nt}}{P_{Tt}}\right)\left(C_{NAt}\right)^{1/\theta}\left[\left(\frac{C_{Tt}}{C_{Tt-1}^{\eta}}\right)^{1-\sigma}\left(\frac{1}{C_{Tt}}\right) - \beta\eta\left(\frac{C_{Tt+1}}{C_{Tt}^{\eta}}\right)^{1-\sigma}\left(\frac{1}{C_{Tt}}\right)\right], \tag{10}$$

where equation (7) is the Euler equation for the consumption of traded goods, (8) shows the optimal condition for the allocation of traded and nontraded goods, (9) is the optimal condition for money demand, and (10) is the labor–leisure tradeoff condition. These equations are the same as those in Obstfeld and Rogoff's model when $\eta = 0$ and $\sigma = 1$. As stated in Obstfeld and Rogoff (1995), equation (9) is the money market equilibrium condition that equates the marginal rate of substitution between consumption and money holdings (i.e., the benefit from holding real money balances) to the consumption opportunity cost of holding money. Moreover, note from equation (9) that the demand for real money balances becomes larger for higher values of η.[4] This is because an increase in the values of the parameter η reduces the marginal utility of consumption, and thereby raises the marginal rate of substitution between consumption and money holdings. Finally, the terminal condition is $\lim_{T=\infty}(1/1+r)^T\left[B_{t+T+1}+\left(M_{t+T}/P_{t+T}\right)\right]=0$.

3. Steady-state flexible price equilibrium

Henceforth, we assume that initial net foreign assets are zero ($B_0 = 0$). In the steady state, all exogenous variables are constant. Substituting (8) into (10) and considering the symmetric equilibrium $C_N = y_N = C_{NA}$, we obtain:

$$C_N = y_N = \left[\left(\frac{\theta-1}{\theta\kappa}\right)(1-\beta\eta)(1-\gamma)\right]^{\frac{1}{1+\sigma+\eta(1-\sigma)}}. \tag{11}$$

Equation (11) shows that all agents produce the same output of nontraded goods. Meanwhile, under the assumptions of zero initial net foreign assets, a separable utility function between traded goods and nontraded goods, and a fixed endowment of traded goods output, the consumption of traded goods remains constant in each period; i.e., $C_{Tt} = y_T$, $\forall t$. This implies that the current account is always balanced.

4. A log-linearized analysis with nominal rigidities

To examine the effects of an unanticipated permanent monetary shock, we solve a log-linear approximation of the system around the initial, zero-shock steady state. Following Obstfeld and Rogoff (1995) and Lane (1997), we assume nominal price rigidities under which the price of nontraded goods in period t is predetermined at time $t - 1$. In addition, the price of nontraded goods is assumed to be fully adjusted after one period. For any variable X_t, we use $\hat{X}_t$ ($\hat{X}_{t+1}$) to denote the short-run (long-run) percentage deviation from the initial steady-state value. The short-run percentage deviation is proportional to the degree of the nominal price rigidity under which the output of nontraded goods is determined by demand. In the long run, the price of nontraded goods adjusts perfectly to the new steady-state value to be consistent with the optimal conditions (10). First, an unanticipated permanent monetary shock is defined as $\hat{M}_t = \hat{M}_{t+1}$. In the short run, as the price of nontraded goods is sticky, we obtain $\hat{P}_{Nt} = 0$. In addition, as the consumption of traded goods remains constant in each period, we obtain $\hat{C}_{Tt} = \hat{C}_{Tt+1} = 0$. Furthermore, from (11), the long-run changes in nontraded goods consumption and output are $\hat{y}_{Nt+1} = \hat{C}_{Nt+1} = 0$. By log-linearizing equations (8) and (9), and considering $\hat{P}_{Nt} = 0$ and $\hat{C}_{Tt} = 0$, respectively, we obtain:

$$\hat{P}_{Tt} = \sigma\hat{C}_{Nt}, \tag{12}$$

[4] Using the Sidrauski (1967) model with habit formation, Faria (2001) showed that the steady-state level of money demanded in his model is greater than that of the benchmark model of Sidrauski (1967).

$$\hat{M}_t - \hat{P}_{Tt} = \frac{\beta}{1-\beta}\left(\hat{P}_{Tt} - \hat{P}_{Tt+1}\right). \tag{13}$$

Equation (12) shows that the consumption of nontraded goods is affected positively by the price of traded goods in the short run. Equation (13) shows that the price of traded goods is affected by the money supply shock. In addition, with $\hat{P}_{Nt} = 0$, the short-run response in the consumption price index is:

$$\hat{P}_t = \gamma\hat{P}_{Tt}\,. \tag{14}$$

In the long run, the economy reaches a steady state. Therefore, for the price of traded goods, we obtain $\hat{P}_{Tt+1} = \hat{P}_{Tt+2}$. Substituting $\hat{P}_{Tt+1} = \hat{P}_{Tt+2}$ into the long-run case of (13), we obtain:

$$\hat{M}_{t+1} = \hat{P}_{Tt+1}. \tag{15}$$

From the consumption price index, we obtain $\hat{P}_{t+1} = \gamma\hat{P}_{Tt+1} + (1-\gamma)\hat{P}_{Nt+1}$. Furthermore, from (8), we obtain:

$$\hat{P}_{Tt+1} + \sigma\hat{C}_{Tt+1} = \hat{P}_{Nt+1} + \sigma\hat{C}_{Nt+1}. \tag{16}$$

Substituting $\hat{C}_{Tt+1} = 0$ and $\hat{C}_{Nt+1} = 0$ into (16), we obtain $\hat{P}_{Tt+1} = \hat{P}_{Nt+1}$. Hence, by combining $\hat{P}_{t+1} = \gamma\hat{P}_{Tt+1} + (1-\gamma)\hat{P}_{Nt+1}$, $\hat{P}_{Tt+1} = \hat{P}_{Nt+1}$, and (15), we obtain:

$$\hat{M}_{t+1} = \hat{P}_{t+1} = \hat{P}_{Tt+1} = \hat{P}_{Nt+1}. \tag{17}$$

Equation (17) implies that money is neutral in the long run.

Meanwhile, in the small open economy model, because the world price of traded goods is determined exogenously and $P_{Tt} = E_t P_{Tt}^*$ always holds, we obtain $\hat{P}_{Tt} = \hat{E}_t$ in the short run. This implies that the price of traded goods reacts proportionately to the exchange rate. By substituting $\hat{P}_{Tt} = \hat{E}_t$, $\hat{M}_t = \hat{M}_{t+1}$ and (17) into (13), the short-run response of the exchange rate to a monetary shock is given by:

$$\hat{E}_t = \hat{P}_{Tt} = \hat{M}_t. \tag{18}$$

Equation (18) shows that an increase in the money supply depreciates the exchange rate proportionately.[5] Finally, from (12) and (18), we obtain:

[5] In this model, the inverse of the consumption elasticity of money demand is assumed to be unity. Therefore, the exchange rate does not overshoot its long-run value; i.e., $\hat{E}_t = \hat{M}_t = \hat{M}_{t+1}$. However, as in Obstfeld and Rogoff (1995) and Lane (1997), if the parameter is assumed to be larger than unity, we can show that the exchange rate overshoots the long-run steady-state value.

$$\hat{C}_{Nt} = \left(\frac{1}{\sigma}\right)\hat{M}_t. \tag{19}$$

Equation (19) shows that the monetary shock increases the consumption of nontraded goods in the short run. Meanwhile, the price of nontraded goods is fixed and the output of nontraded goods is determined by demand. In addition, from (6) and $P_N(i)/P_N = 1$, we obtain $\hat{y}_{Nt1} = \hat{C}_{Nt}$. Therefore, by linking this to (19), we obtain:

$$\hat{y}_{Nt} = \hat{C}_{Nt} = \left(\frac{1}{\sigma}\right)\hat{M}_t. \tag{20}$$

Equation (20) shows that the monetary shock also increases the output of nontraded goods in the short run.

5. Welfare analysis

Our interest here lies in exploring how the degree of habit formation influences the welfare effects of monetary shocks, particularly compared with the predictions of Obstfeld and Rogoff (1996) and Lane (1997), who found that in the case without habit formation, a surprise monetary expansion improves welfare through an increase in the output of the nontraded goods sector. Meanwhile, in an economy with endogenous habit formation, do domestic agents gain from a surprise monetary expansion? In this section, we show that incorporating habit formation reverses the above finding under certain conditions; i.e., a monetary expansion deteriorates welfare. Following Obstfeld and Rogoff (1996), who ignore the welfare effect of real balances, we focus on the real component of an agent's utility, which comprises terms involving consumption and labor (or production) effort. By defining the real component of an agent's utility as U_R and recalling that $\hat{C}_{Tt} = \hat{C}_{Tt+1} = \hat{C}_{Nt+1} = \hat{y}_{Nt+1} = 0$, we can rewrite equation (1) as:

$$\Delta U_R = (1-\gamma)\left[\frac{C_0^N}{\left(C_0^N\right)^{\eta}}\right]^{1-\sigma}\hat{C}_{Nt} - \kappa y_{N0}^2\hat{y}_{Nt} - \frac{\beta\eta}{1-\beta}(1-\gamma)\left[\frac{C_0^N}{\left(C_0^N\right)^{\eta}}\right]^{1-\sigma}\hat{C}_{Nt}, \tag{21}$$

where y_{N0} denotes the initial steady-state output of nontraded goods. The short-run results for nontraded consumption and output can be used to derive the impact of an unanticipated money shock on welfare. By substituting (11) and (20) into (21), we obtain:

$$\Delta U_R = \left\{(1-\gamma)\left[1-\left(\frac{\beta}{1-\beta}\right)\eta\right]\left[\frac{(\theta-1)(1-\gamma)(1-\beta\eta)}{\kappa\theta}\right]^{\frac{(1-\eta)(1-\sigma)}{1+\sigma+\eta(1-\sigma)}} - \kappa\left[\frac{(\theta-1)(1-\gamma)(1-\beta\eta)}{\kappa\theta}\right]^{\frac{2}{1+\sigma+\eta(1-\sigma)}}\right\}\hat{M}_t. \tag{22}$$

The first term in brackets on the right-hand side of equation (22) reflects the net welfare effect, composed of the welfare gain from an increase in the consumption of nontraded goods minus the negative effect of habit formation on the future consumption utility of nontraded goods (the third term in (21)). The second term is the welfare loss from an increase in the labor effort in the nontraded goods sector. Therefore, the impact of a monetary expansion on welfare is ambiguous. However, when $\eta > (1 - \beta)/\beta$, the first term on the right-hand side of equation (22) is always negative, and consequently, ΔU_R is negative.

The intuition is straightforward. Here, we can define the rate of time preference as $\delta \equiv (1-\beta)/\beta$. In this model, remember that the parameter η ($0 \leq \eta < 1$) measures the importance of habit formation in the utility function, which is what induces agents to consume less and to increase their real money holdings through saving.[6] Therefore, an increase in the consumption of nontraded goods has a negative effect on future utility through habit formation. In particular, this effect is reflected in the third term on the right-hand side of (21). Meanwhile, the parameter δ measures the degree of the agent's preference for current consumption, which is what induces agents to increase current consumption.[7] Therefore, an increase in the consumption of nontraded goods has a positive effect on current utility because of the positive rate of time preference. This effect is reflected in the first term on the right-hand side of (21). Accordingly, for these two opposing influences on welfare, the impact on welfare of changes in the money supply is ambiguous. However, equation (22) shows that when the importance of habit formation in the utility function (η) exceeds the importance of present consumption in the utility function (δ), the negative welfare effect dominates the positive effect, and consequently the monetary expansion decreases welfare.

To ascertain the empirical plausibility of this condition ($\eta > \delta$), let us now take a look at the parameter magnitudes obtained by estimations in the literature. First, as already stated in footnote 3, based on the same specification of habit formation, Fuhrer (2000) estimates the parameters in the habit-formation consumption function. As a result, he finds that the habit-formation parameter is estimated at $\eta = 0.80$ in the standard nonlinear Generalized Method of Moments (GMM) estimation and $\eta = 0.90$ in the case of the Full Information Maximum Likelihood (FIML) estimation. On the other hand, based on the Panel Study of Income Dynamics data, Lawrance (1991) estimates the distribution of subjective rate of time preference of rich and poor households in the United States and the time preference rate (or δ) is estimated between 0.12 and 0.19. Using the wealth data in the Survey of Consumer Finances 1992, Samwick (1998) estimates the distribution of rates of time preference and the median rate of time preference is estimated at 0.076. Using the Panel Study of Income Dynamics Consumption data, Trostel and Taylor (2001) estimate the evolution of implicit discount rate over the adult life cycle and the mean value of the rate of time preference is estimated between 0.08 and 0.10. Based on an aggregate data, Hirata (2008) finds that the distribution of rates of time preference of households in Japan is estimated between

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[6] In other words, if habit formation is more important, the marginal utility of consumption is decreasing faster in the habit stocks, and therefore domestic agents have an incentive to consume less.

[7] In other words, the rate of time preference measures the degree of the agent's preference for current consumption, because under a positive rate of time preference, the agent prefers additional consumption today instead of postponing consumption until tomorrow.

0.02 and 0.04. Judging from the above, the parameter magnitudes obtained by estimations in the literature seem to confirm the plausibility of the condition $\eta > \delta$.

Incidentally, we can see the impact that the absence of habit formation ($\eta = 0$ and $\sigma = 1$) has on the welfare effect. Substituting $\eta = 0$ and $\sigma = 1$ into (22), we obtain:

$$\Delta U_R = \left(\frac{1-\gamma}{\theta}\right)\hat{M}_t . \tag{23}$$

Equation (23) shows that when there is no habit formation, domestic agents gain equally from an unanticipated money shock. As seen in (23), the benefit arises because of the initial monopoly distortion in the nontraded goods sector; i.e., the lower the value of θ, the larger the welfare gain from a monetary shock.[8] Furthermore, equation (23) is the same as that in Lane's model without habit formation.

6. Conclusions

In this paper, we provided a generalization of the models of Obstfeld and Rogoff (1995) and Lane (1997) that allows for multiplicative forms of habits in consumption. We used this generalized model to examine how allowing for habit formation changes the response of welfare to monetary policy shocks. The main finding of our analysis is that when habit formation is relatively important in the utility function, the monetary expansion decreases welfare.

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[8] Remember that the numerator of equation (23), $1 - \gamma$, is the share of the consumption of nontraded goods in the utility function.

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