*Modern Economy*, **2013, 4, 471-481**
doi:10.4236/me.2013.47051 Published Online July 2013 (http://www.scirp.org/journal/me)

# Exchange Rate and Current Account Dynamics with Habits over Consumption and Money Holdings

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Received February 18, 2013; revised March 30, 2013; accepted April 30, 2013



## ABSTRACT

Incorporating two independent habits over consumption and money holdings into a small country model, we examine the adjustment dynamics of the current account and the exchange rate to expansionary monetary and fiscal shocks under two alternative policy regimes: (1) the endogenous income transfer regime; and (2) the endogenous fiscal spending regime. In response to the shocks under regime (1), the exchange rate depreciates on impact and in the long run whereas it appreciates (depreciates) in transition if preferences for real money balances exhibit distant (adjacent) complementarity. Under regime (2), the consumption habits and the monetary habits jointly generate possibly non-monotonic current account dynamics. An induced increase in fiscal spending in regime (2) can generate a current account surplus in the case where the monetary habits exhibit strong distant complementarity.

**Keywords:** Habit Formation; Money; Exchange Rate; Current Account

## 1. Introduction

The academic as well as practical concerns about the fluctuation of exchange rates and the movement of the current account grow as the integration of the world economy progresses in the recent decades. To describe jointly the dynamics of exchange rates and the current account, there has been cumulative theoretical research that is conducted in the dynamic optimization framework. The seminal work by Obstfeld [1] is the first attempt, which specifies consumer preferences in such non-time separable form as endogenous time preferences. Mansoorian [2] and other related articles (e.g., Mansoorian and Neaime [3]) propose habit models as an alternative empirically relevant specification to examine monetary phenomena in the open economy setting. Although the studies successfully show that incorporating habit formation helps to understand open macroeconomic phenomena, the framework is restricted in the following two aspects: first, the crawling peg exchange-rate regime is assumed, so that the exchange rate is exogenously given; second, habit is specified over the sub-utility defined as the homothetic bundle of consumption and real money balances. Although these specifications enable one to apply straightforwardly the implication of habit formation to monetary issues of open economies, we need a more comprehensive framework to examine the exchange-rate and current-account dynamics by focusing on specific roles that are played by habits over real money balances and over consumption.

The purpose of this article is to do it: we examine the dynamic adjustment of the current account and the exchange rate to monetary and fiscal policies by introducing the money-specific habits as well as the consumption-specific habits in the form of weakly nonseparable preferences.[1] This specification of habits enables us to allow for different degrees of habit strength between consumption and money.[2] Whereas consumer preferences are assumed to be of the type of adjacent complementarity,[3] we will not put any restriction on the degree of monetary habits because there is no empirical report

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[1]For weakly non-separable preferences, see Shi [4]. Also see Ikeda [5] for the application of weakly non-separable preferences to a habit model.

[2]It is quite natural to think that each good and service has a different degree of habit strength. For example, so called habitual goods like tobacco and alcohol show strong degrees of habit. Playing video games can be thought as one of habitual services especially for kids. Therefore, we think that liquidity service has somewhat different degree of habit strength from consuming goods.

[3]There are empirical evidences to that consumption habits are of the type of adjacent complementarity (e.g., Constantinides [6]; Campbell and Cochrane [7]; Carroll *et al*. [8]; and Diaz *et al*. [9]).

on the strength of habits on real money balances.

By assuming that the government's budget is always balanced we analyze the effects of macroeconomic policies under two alternative regimes: (1) the endogenous income transfer regime, in which income transfer payments ($\tau$) are endogenously determined so as to retain the balanced budget for exogenous values of the money growth rate ($\mu$) and of fiscal spending ($g$); and (2) the endogenous fiscal spending regime, in which $g$ is endogenously determined so as to balance the budget for exogenous $\mu$ and $\tau$.

The results of comparative dynamics that we shall show are summarized in **Table 1**, where the results of [1] and [2] are also listed for comparison. In the endogenous income transfer regime (see column (1)), we consider the effects of monetary policy (an increase in $\mu$) and fiscal policy (an increase in $g$) separately. For the monetary policy we show that the "super neutrality of money" holds valid in the present habit model: on impact and in the long run, the policy does not affect real sector variables, with making real money balances decrease and hence the exchange rate depreciate. In transition, the exchange rate is shown to depreciate or appreciate as preferences for real money balances exhibit adjacent or distant complementarity (*i.e.*, AC or DC in the table). The fiscal policy exerts similar effects on those monetary variables due to a negative income effect. With habit persistence of consumption, on the other hand, the policy induces the current account deficit as in the familiar argument of the Keynesian type (e.g., Mansoorian [10]).

In the endogenous fiscal spending regime (as shown in column (2)), since a change in inflation tax revenues affects fiscal spending, changes in real money balances directly affect the current account. Habit formation over real money balances as well as that over consumption thus plays critical roles in generating the current account dynamics. The resulting effects on net foreign assets depend on the intertemporal complementarities of real money balances as well as of consumption. For example, although preferences for consumption are assumed to be of adjacent complementarity, the induced increase in fiscal spending causes a current account surplus if preferences for real money balances exhibit strong distant complementarity. The transition dynamics of the net foreign assets are shown to be non-monotonic under certain conditions.

To our knowledge, Shi and Epstein [11] is the unique study which addresses the exchange rate dynamics using a habit model. By incorporating habits into an endogenous time preference model of the Uzawa type, they derive cyclical dynamics of the current account and the exchange rate. However, Shi and Epstein consider habits over the homothetic bundle of consumption and money, in which habits of consumption and those of real money balances do not play independent roles. Their model also retains the same (undesirable) property for the steady state equilibrium as the models with the Uzawa utility (e.g., [1]) has. For example, an increase in fiscal spending causes long-run accumulation of external assets (see column (3) of **Table 1**). By resolving these problems, we reexamine the exchange-rate/current-account dynamics

**Table 1. The main results of comparative dynamics.**

| | (1) Endogenous $\tau$ regime | | (2) Endogenous $g$ regime | (3) Obstfeld [1] | | (4) Mansoorian [2] |
|---|---|---|---|---|---|---|
| | $\mu\uparrow$ | $g\uparrow$ | $\mu\uparrow$ with induced $g\uparrow$ | $\mu\uparrow$ | $g\uparrow$ | $\pi\uparrow$ with induced $\mu\uparrow$ |
| $m_{0+}$ | − | − | − | − | − | − |
| $s_{0+}$ | + | + | + | + | + | exogenously 0 |
| $c_{0+}$ | 0 | − | − (+) if − (+) in $\bar{c}$ | − | − | + |
| $\bar{m}$ | − | − | − | − | + | − |
| $\bar{c}$ | 0 | − | − (+) if $\left\vert \overset{\Theta}{\text{IE}} \right\vert > (<) \left\vert \overset{\oplus}{\text{SE}} \right\vert$ | + | + | − |
| $\bar{b}$ | 0 | − | − (+) if AC (strong DC) | + | + | − |
| $\dot{m}$ | − (+) if AC (DC) | − (+) if AC (DC) | − (+) if AC (DC) | + | + | − |
| $\dot{s}$ | + (−) if AC (DC) | + (−) if AC (DC) | + (−) if AC (DC) | − | − | exogenously + |
| $\dot{c}$ | 0 | − | − (+) if − (+) in $\bar{c}$ | + | + | − |
| $\dot{b}$ | 0 | − | possibly non-monotonic | + | + | − |

Table notes. $\tau$: income transfer, $\boldsymbol{g}$: fiscal spending, $\boldsymbol{\mu}$: the growth rate of nominal money supply, $\boldsymbol{m}$: real money balances, $\boldsymbol{c}$: consumption, $\boldsymbol{b}$: net foreign assets, $\boldsymbol{s}$: the exchange rate (the domestic price of a unit of foreign currency), $\pi\left(\equiv \dot{s}/s\right)$: the rate of currency depreciation. The subscription 0+ represents the instantaneous time after a policy shock. A bar (dot) over a variable denotes the steady-state value (the time derivative) of the variable. AC (DC) represents adjacent (distant) complementarity of preferences for $\boldsymbol{m}$. Preferences for $\boldsymbol{c}$ are assumed to be of the type of adjacent complementarity in our framework and in column (4) of Mansoorian [2]. $\overset{\Theta}{\text{IE}}$ $\left(\overset{\oplus}{\text{SE}}\right)$ denotes the negative income (positive substitution) effect on $\bar{c}$ induced by an increase in the nominal interest rate.

using a habit model.

The remainder of the paper is structured as follows: In Section 2, we present a small open monetary model with habit formation. In the following Sections 3 and 4, we examine equilibrium dynamics of consumption, real money balances, exchange rates, and net foreign assets, and analyze the effects of macroeconomic policies on the current account and the exchange rate. The effects of monetary policy and fiscal policy under the endogenous income transfer regime are analyzed in Section 3. We analyze the effect of mixed monetary policy with fiscal policy under the endogenous fiscal spending regime, and then show possibilities of non-monotonic current account dynamics in Section 4. Section 5 concludes the paper.

## 2. The Model

Consider a small open monetary economy where identical agents live infinitely. There is only one internationally traded good in the model. Since the foreign price of the good is assumed to be constant, the rate of inflation (the rate of change in the domestic price of the good) is equal to the rate of depreciation of the domestic currency, which is denoted by $\varepsilon_t$. The representative agent is endowed with constant units $y$ of the good and consumes some of the good $c_t$ at each instant. He holds non-human wealth in the form of real money balances $m_t$ and/or internationally traded bonds $b_t$, which yields a constant interest rate $r$. He faces the following flow budget constraint:

$$\dot{a}_t = ra_t + y - \tau_t - c_t - \left(r + \varepsilon_t\right)m_t, \tag{1}$$

where total wealth $a_t$ defined as $a_t = b_t + m_t$, $\tau_t$ denotes lump-sum income transfer to the government, and a dot over a variable denotes the time derivative of the variable through the paper.

Consumption and real money balances affect utility directly as well as indirectly through forming habits. Let $z_t$ and $x_t$ represent the habit capitals with respect to consumption and real money balances, respectively. We specify $z_t$ and $x_t$ as

$$z_t \equiv \alpha\int_{-\infty}^{t} c_s \exp\left[-\alpha\left(t-s\right)\right]\mathrm{d}s$$

and

$$x_t \equiv \alpha\int_{-\infty}^{t} m_s \exp\left[-\alpha\left(t-s\right)\right]\mathrm{d}s,$$

equivalently:

$$\dot{z}_t = \alpha\left(c_t - z_t\right), \tag{2}$$

$$\dot{x}_t = \alpha\left(m_t - x_t\right), \tag{3}$$

where $\alpha$ represents the velocity of habit formation. For brevity, we have assumed that the habit velocity $\alpha$ is common for $z_t$ and $x_t$. The representative agent maximizes the following lifetime utility $U_t$:

$$U_t = \int_t^{\infty}\left[u\left(c_s, z_s\right) + v\left(m_s, x_s\right)\right]\exp\left[-r\left(s-t\right)\right]\mathrm{d}s, \tag{4}$$

where $u$ and $v$ represent felicity functions and where, to ensure the existence of the steady-state equilibrium, we assume that the discount rate is equal to the world interest rate $r$. Function $u$ is assumed to satisfy the standard regularity conditions: (C1) $u_c > 0$; (C2) $u_z \le 0$; (C3) $u_c\left(c,c\right) + u_z\left(c,c\right) > 0$; (C4) $u$ is concave in $(c,z)$ (C5) $\lim_{c\to 0} u_c\left(c,z\right) = \infty$ uniformly in $z$; and (C6)

$$\lim_{c\to 0}\left[u_c\left(c,c\right) + u_z\left(c,c\right)\right] = \infty.$$

Function $v$ is specified in the same way. The additive separable specification of the utility functions allows us to introduce weak nonseparability caused by habits, where habits of consumption and real money balances independently affect total expenditure and hence wealth accumulation.

As in Ryder and Heal [12], preference for consumption time-profile is said to display *adjacent* (*distant*) *complementarity* when

$$u_{cz}\left(c,c\right) + \frac{\alpha}{\theta + 2\alpha}u_{zz}\left(c,c\right) > (<)\,0,$$

where an increase in today's habits *ceteris paribus* enlarges (decreases) today's optimal consumption. Adjacent and distant complementarities of the preference for the time-profile of real money balances are defined similarly in terms of $v$.

The government's flow budget constraint is specified as:

$$g_t = \tau_t + \mu m_t, \tag{5}$$

where $g_t$ represents fiscal spending, $\mu$ does the growth rate of nominal money balances.

We shall consider two alternative policy regimes: (R1) the endogenous income transfer regime, in which fiscal spending $g$ is constant and lump-sum tax $\tau_t$ is chosen by the government in order to satisfy its constraint (5); and (R2) the endogenous fiscal spending regime, where lump-sum tax $\tau$ is constant and fiscal spending $g_t$ is determined so as to satisfy (5). In the endogenous income transfer regime, raising $g$ as a fiscal policy and raising $\mu$ as a monetary policy are independent policy instruments, whereas, in the endogenous fiscal policy regime, the monetary policy of raising $\mu$ inevitably changes fiscal spending $g_t$, so that the two macroeconomic policies simultaneously affect the economy. In Section 3, we shall examine the effects of monetary and fiscal policies separately in the endogenous income transfer regime. Section 4, in turn, explores the combined effect of the mixed monetary policy in the endogenous fiscal spending regime.

From the definition of real money balance, its growth

is shown as:

$$\dot{m}_t = (\mu - \varepsilon_t) m_t. \tag{6}$$

To ease terminology, we say that the domestic currency is *appreciating* (*depreciating*) when the rate of change in the exchange rate $\varepsilon_t$ is lower (higher) than the long-run core rate of inflation $\mu : \varepsilon_t < \mu \quad (\varepsilon_t > \mu)$. With the terminology, when $m_t$ increases (decreases) over time, domestic currency is appreciating (depreciating) as shown in **Figure 1**.

Now we can define the representative agent's optimization problem as follows. Given the initial values $(b_0, z_0, x_0)$, the representative agent chooses

$$C_0 = \{c_t, m_t, b_t, z_t, x_t\}_{t=0}^{\infty}$$

so as to maximize (4) subject to: (c1) the flow budget constraint (1); (c2) the habit formation of consumption (2) and of real money balances (3); and (c3) the transversality conditions.

After solving the representative agent's problem,[4] we obtain that consumption habit *z* follows the autonomous dynamics:

$$\dot{z}_t = \omega(z_t - \bar{z}), \tag{7}$$

where the stable root of the autonomous dynamics $\omega < 0$ is defined as

$$\omega = \frac{1}{2}\left(r - \sqrt{(r+2\alpha)^2 - 4\alpha(r+2\alpha)\Omega_c}\right), \tag{8}$$

where:

$$\Omega_c \equiv -\frac{1}{u_{cc}}\left(u_{cz} + \frac{\alpha}{r+2\alpha}u_{zz}\right). \tag{9}$$

A positive (negative) $\Omega_c$ implies adjacent (distant) complementarity for $c$.

We substitute this saddle trajectory (7) into (2) to obtain:

$$c_t - \bar{c} = \left(\frac{\omega+\alpha}{\alpha}\right)(z_t - \bar{z}). \tag{10}$$

To simplify discussion below, we focus on the case of adjacent complementarity, which is empirically relevant as shown in, e.g., Ferson and Constantinides [6] and Gurber [14].

**Assumption 1.** *The representative agent's preferences exhibit adjacent complementarity for consumption profile, i.e.,* $\Omega_c > 0$ *and hence* $\omega + \alpha > 0$.

Solving the representative agent problem also yields the result that monetary habit capital $x_t$ follows the autonomous dynamics (see Appendix A in [13] for derivation):

$$\dot{x}_t = \rho(x_t - \bar{x}), \tag{11}$$

[4]For detailed derivations of the analytical results in the paper, see Gombi and Ikeda [13], which is available upon request.

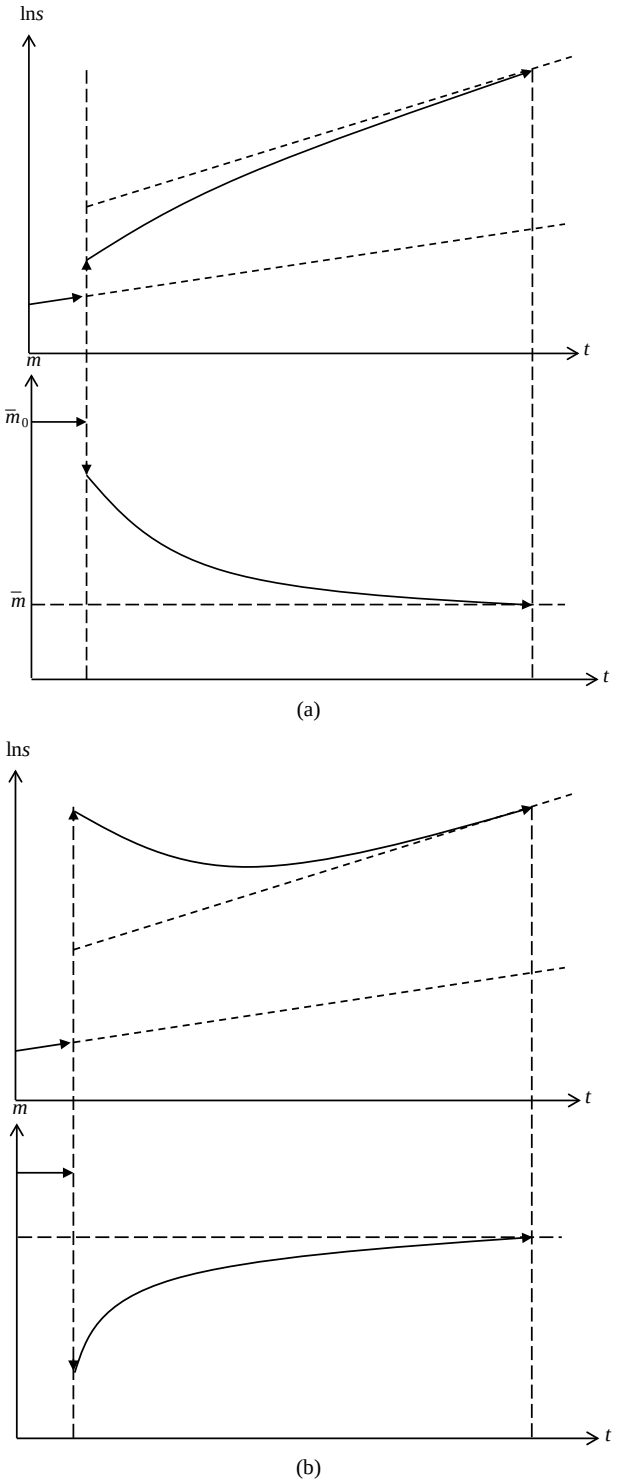



**Figure 1. Equilibrium dynamics of exchange rate *s* and real money balances *m*. (a) Currency Depreciation: $\varepsilon > \mu$ when $\alpha + \rho > 0$; (b) Currency Appreciation: $\varepsilon > \mu$ when $\alpha + \rho < 0$.**

where the root of the autonomous dynamics is denoted as $\rho$. The saddle-point stability condition of the dynamics, *i.e.*, $\rho < 0$, is satisfied if and only if

$$1-\frac{r+2\alpha}{r+\alpha}\Omega_m > 0,$$

where

$$\Omega_m \equiv -\frac{1}{v_{mm}}\left(v_{mx}+\frac{\alpha}{r+2\alpha}v_{xx}\right),$$

which is positive (negative) when preferences for real money balances are of the type of adjacent (distant) complementarity. We assume the above saddle-point stability condition.

Substituting (11) into (3) yields:

$$m_t-\bar{m}=\left(\frac{\rho+\alpha}{\alpha}\right)\left(x_t-\bar{x}\right). \tag{12}$$

As in the case of the consumption-habit dynamics (10), the sign of $\rho + \alpha$ is positive (negative) when preferences for real money balances are of the type of adjacent (distant) complementarity.

As shown in Appendix B of [13], we obtain that

$$\Omega_m \gtreqless 0 \Leftrightarrow \rho+\alpha \gtreqless 0.$$

This relationship and (12) imply the following property:

**Property 1.** *Real money balances* $m_t$ *positively* (*negatively*) *comove with their habits* $x_t$ *if preferences for real money balances exhibit adjacent (distant) complementarity,* $\Omega_m > (<) 0$ *and hence* $\rho+\alpha > (<) 0$.

**Figure 2** illustrates Property 1. Although preferences for consumption have been often reported to display adjacent complementarities, there is no empirical evidence regarding habit-forming behavior of real money balances. Therefore, we do not put any restriction on the sign of $\Omega_m$.

In the present setting of weak nonseparability, relationship between (10) and (12) can be specified for consumption and money balance holdings, wherein we characterize the consumer preferences by using the following terminology:

**Definition 1.** *Consuming good is said to be more* (*less*) *habit forming than holding real money balances if* $\Omega_c$ *is larger* (*smaller*) *than* $\Omega_m$, *and hence if* $\omega$ *is larger* (*smaller*) *than* $\rho$.

Combining the representative agent's flow constraint (1) and the government's flow constraint (5), we obtain the balance-of-payment equation as follows:

$$\dot{b}_t = rb_t + y - g_t - c_t. \tag{13}$$

## 3. Endogenous Income-Transfer Regime

Start with the endogenous income-transfer regime. Since the dynamics of real money balances and their habits do not directly affect the balance-of-payment Equation (13), the dynamics of $b$ are generated only

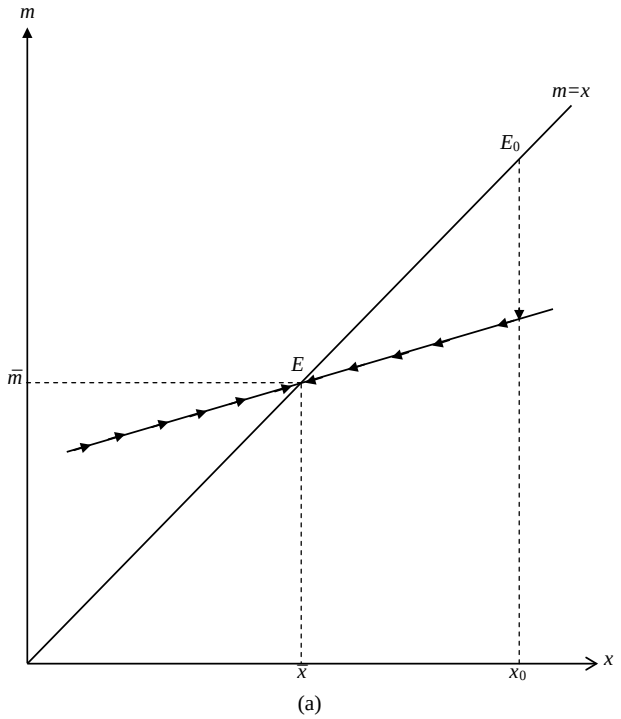



**Figure 2. Saddle path dynamics of real money balances *m* and it's monetary habits *z*. (a) Adjacent complementarity: $\alpha + \rho > 0$; (b) Distant complementarity: $\alpha + \rho < 0$.**

by consumption-habit capital $z$. Let us set local deviations $b_t - \bar{b}$ equal to $A(z_t - \bar{z})$, where $A$ is an undetermined constant. We linearize (13) around the steady-state point and substitute $b_t - \bar{b} = A(z_t - \bar{z})$ into the result. By determining $A$ such that they satisfy (13),

the equilibrium dynamics of $b_t - \bar{b}$ are obtained as:

$$b_t - \bar{b} = \frac{\omega + \alpha}{\alpha(r - \omega)}(z_t - \bar{z}). \tag{14}$$

For given initial values $(b_0, z_0, x_0)$, the steady-state equilibrium $(\bar{c}, \bar{m}, \bar{b}, \bar{z}, \bar{x}, \bar{\xi}, \bar{\zeta}, \bar{\lambda}, \bar{\varepsilon})$ is determined by the following nine equations:

$$\bar{c} = \bar{z}, \tag{15}$$

$$\bar{m} = \bar{x}, \tag{16}$$

$$\bar{\varepsilon} = \mu, \tag{17}$$

$$\bar{\xi} = \frac{u_z(\bar{z}, \bar{z})}{r + \alpha}, \tag{18}$$

$$\bar{\zeta} = \frac{v_x(\bar{x}, \bar{x})}{r + \alpha}, \tag{19}$$

$$\bar{\lambda} = u_c(\bar{z}, \bar{z}) + \frac{\alpha}{r + \alpha} u_z(\bar{z}, \bar{z}), \tag{20}$$

$$r + \mu = \mathrm{MRS}(\bar{z}, \bar{x}), \tag{21}$$

$$r\bar{b} = g + \bar{z} - y, \tag{22}$$

$$b_0 - \bar{b} = \frac{\omega + \alpha}{\alpha(r - \omega)}(z_0 - \bar{z}), \tag{23}$$

where MRS represents the steady-state marginal rate of substitution between $\bar{c}$ and $\bar{m}$:

$$\mathrm{MRS}(\bar{c}, \bar{m}) = \mathrm{MRS}(\bar{z}, \bar{x}) = \frac{v_m(\bar{x}, \bar{x}) + \frac{\alpha}{r + \alpha} v_x(\bar{x}, \bar{x})}{u_c(\bar{z}, \bar{z}) + \frac{\alpha}{r + \alpha} u_z(\bar{z}, \bar{z})} \left( \equiv \frac{U_m}{U_c} \right).$$

### 3.1. The Effect of Monetary Policy

Since (22) and (23) do not contain the monetary variables *m*, *x* and $\varepsilon$, the monetary policy here, *i.e.*, a helicopter-dropped change in $\mu$, is perfectly neutral to the consumption-related variables *c*, *z*, and *b*.[5] From (21), an increase in $\mu$ only reduces the steady-state level of real money balances $\bar{m}(=\bar{x})$, which causes the dynamic adjustment of the money-related variables $(m, x, \varepsilon)$ with leaving the steady-state values of $(\bar{c}, \bar{z}, \bar{b})$ unchanged, where the dynamics of the money-related variables follow Property 1.

This implies that an increase in costs of holding money due to a rise in $\mu$ discretely reduces real money balances and thereby causing the exchange rate to sharply depreciate on impact. Thereafter, if preferences for real money balances exhibit adjacent(distant) complementarity, real money balances gradually decrease (increase) and hence, the exchange rate experiences further depreciation (inversely appreciation) in entire transition.

These results can be summarized as the following proposition:

**Proposition 1.** *Suppose that the government adopts the endogenous income-transfer regime. Then, a permanent increase in the monetary growth rate is ineffective on the consumption-related variables c, z and b. In response to the policy,*

1) *on impact and in the long-run, real money balances decrease and hence the exchange rate depreciates*; *and*

2) *in transition, exchange-rate depreciation* (*appreciation*) *takes place when liquidity preferences exhibit adjacent* (*distant*) *complementarity.*

**Figures 1** and **2** illustrate the equilibrium dynamics that are obtained in Proposition 1, where, in panels (a) and (b) of **Figure 2**, points $E_0$ and $E$ represent the pre- and post-shock equilibrium points. Although the dynamics of real money balances for adjacent complementarity (panel (a) in **Figure 2**), *i.e.*, an initial discrete reduction and subsequent over-time decrease, are similar to what Mansoorian [2] shows using a habit model of the crawling pegged exchange rate regime (as shown in column (4) of **Table 1**), the adjustment in our model is brought about by an initial discrete depreciation followed by over-time depreciation of the domestic currency value (see panel (a) of **Figure 1**). When liquidity preferences exhibit distant complementarity, in contrast, the initial discrete depreciation is so large that the exchange rate therefore appreciates over time, as Obstfeld [1] shows with using an endogenous time-preference model (see column (3) of **Table 1**). Unlike in those previous models, consumption and the current account here are not affected by the monetary policy.

### 3.2. The Effect of Fiscal Policy

Let us next analyze the steady-state effects of a once-and-for-all increase in fiscal spending *g*. Differentiating (21), (22) and (23) with respect to *g*, we obtain the steady-state effects on $\bar{b}$, $\bar{z}$, and $\bar{x}$ as follows:

$$\frac{\mathrm{d}\bar{b}}{\mathrm{d}g} = \frac{\omega + \alpha}{\alpha(r - \omega)} < 0, \tag{24}$$

$$\frac{\mathrm{d}\bar{z}}{\mathrm{d}g} = \frac{\alpha(r - \omega)}{\omega + \alpha} \frac{\mathrm{d}\bar{b}}{\mathrm{d}g} = \frac{\alpha(r - \omega)}{\omega(r + \alpha)} < 0, \tag{25}$$

$$\frac{\mathrm{d}\bar{x}}{\mathrm{d}g} = -\frac{\mathrm{MRS}_c(\bar{z}, \bar{x})}{\mathrm{MRS}_m(\bar{z}, \bar{x})} \frac{\alpha(r - \omega)}{\omega(r + \alpha)} < 0. \tag{26}$$

This implies that an increase in *g* has negative effects on the steady-state values of consumption, real money

[5] This is because 1) domestic money is internationally non-traded asset, 2) felicity functions *u*(*c*, *z*) and *v*(*m*, *x*) are specified as additively separable, and 3) the income transfer the representative agents to perfectly compensates the inflation tax induced by an increase in $\mu$ in the non-distortionary way.

balances, and net foreign assets.

From Assumption 1, (10), (14), (24), and (25), the adjustment processes of $c$ and $b$ induced by an increase in $g$ are the same results as in the literature (e.g., Mansoorian [10], Ikeda and Gombi [15]). An increase in fiscal spending leads $c$ to fall less than its long-run level $\bar{c}$ on impact, and to gradually decrease to $\bar{c}$, which induces the current account deficit.

As shown in (26), an increase in $g$ definitely reduces the steady-state real money balance $\bar{x}$. From (12), the adjustment processes of $m$ and the exchange rate depend on the intertemporal complementarity of preferences for real money balances as in the case of monetary policy depicted by **Figure 1**. We can summarize these results as the following proposition:

**Proposition 2.** *Suppose that the government adopts the endogenous income-transfer regime. Then, under Assumption* 1 *with habit formation, in response to a permanent increase in fiscal spending*,

1) *on impact and in the long-run, real money balances decrease and hence the exchange rate depreciates*; *and*

2) *in transition, jointly with the current account deficits, exchange-rate depreciation* (*appreciation*) *takes place when liquidity preferences exhibit adjacent* (*distant*) *complementarity.*

Proposition 2 shows that the dynamic relationship between the exchange rate and the current account depends crucially on the intertemporal complementarities of preferences for both consumption and money. Although preferences for consumption have been often reported to display adjacent complementarities, there is no empirical research on habit-forming behavior in money holdings. If the preferences exhibit adjacent complementarities, the instantaneous depreciation falls short of the long-run depreciation, so that the economy experiences interim currency depreciation with current account deficits. With distant complementarities for the liquidity preferences, an initial depreciation causes overshooting, which is followed by gradual appreciating process.

By using the endogenous time preference model, Obstfeld [1] shows that the same fiscal policy as in Proposition 2 causes current account surplus and currency appreciation in transition (see column (3)). Proposition 2 shows that the results of the monetary habit model, which could be empirically more relevant, totally differ from what he predicts.

## 4. Endogenous Fiscal Spending Regime

In this section let us consider the case of the endogenous fiscal spending regime, where lump-sum tax $\tau$ is constant and fiscal spending $g_t$ is determined so as to satisfy the government's flow constraint (5). Substituting (5) into the balance-of-payment equation (13), we have:

$$\dot{b}_t = rb_t + y - \tau - \mu m_t - c_t. \tag{27}$$

In contrast to the endogenous income transfer regime, the dynamics of real money balances and their habits do directly affect the balance-of-payment equation (27) in this regime, and therefore the dynamics of $b_t$ are generated not only by consumption-habit capital $z_t$, but also by liquidity-habit capital $x_t$. Using the same technique as in the previous section, the equilibrium dynamics of $b_t - \bar{b}$ are obtained as:

$$b_t - \bar{b} = \frac{\omega+\alpha}{\alpha(r-\omega)}(z_t - \bar{z}) + \frac{\mu(\rho+\alpha)}{\alpha(r-\rho)}(x_t - \bar{x}). \tag{28}$$

**Figure 3** shows the phase diagram of consumption- and liquidity-habits on the $(z,x)$-space, where point $E$ represents the steady-state point. The dynamics of the habit stocks $z_t$ and $x_t$ are generated by the autonomous Equations (7) and (11). Schedule $\dot{b} = 0$ is a trajectory that is obtained by differentiating (28), substituting (7) and (11) into the result, and setting the result equal to zero:

$\dot{b} = 0$ schedule:

$$\frac{\omega(\omega+\alpha)}{\alpha(r-\omega)}(z_t - \bar{z}) + \frac{\mu\rho(\rho+\alpha)}{\alpha(r-\rho)}(x_t - \bar{x}) = 0.$$

This depicts the set of $(z,x)$ that makes the current account balanced. As shown in panel (a) of **Figure 3**, where preferences for real money balances display adjacent complementarity, the $\dot{b} = 0$ schedule is downward sloping, whose upper (lower) side exhibits current account deficit (surplus). This is because, with adjacent complementarity of preferences for consumption, a large habit stock $z$ implies a high consumption level, which induces the current account deficits.

The consequence of the change in (27) and (28) alters the steady-state relationships (22) and (23) as follows:

$$r\bar{b} = \tau - y + \bar{z} + \mu\bar{x}, \tag{29}$$

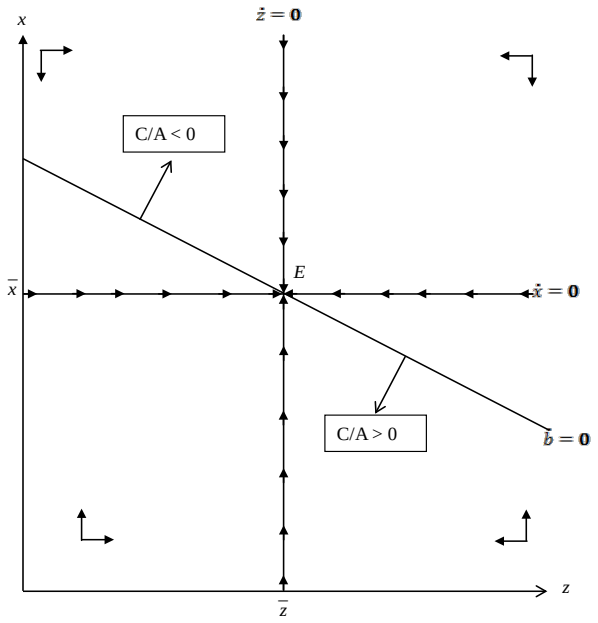
$$b_0 - \bar{b} = \frac{\omega+\alpha}{\alpha(r-\omega)}(z_0 - \bar{z}) + \frac{\mu(\rho+\alpha)}{\alpha(r-\rho)}(x_0 - \bar{x}). \tag{30}$$

The rest of the steady-state relationships (15) through (21) remains the same in this regime. The steady-state values of $(\bar{z},\bar{x},\bar{b})$ are jointly determined from (21), (29), and (30). Given $(\bar{z},\bar{x},\bar{b})$, the other steady-state variables $(\bar{c},\bar{m},\bar{\xi},\bar{\zeta},\bar{\lambda},\bar{\varepsilon})$ are determined by (15) through (20).

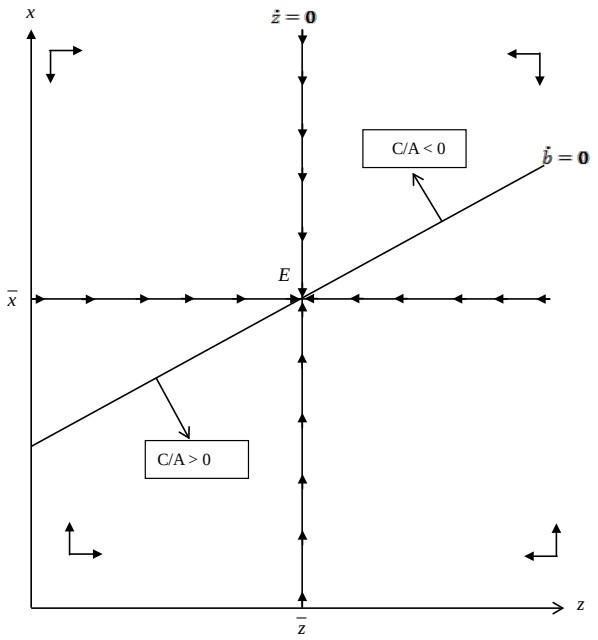
### 4.1. The Effect of Mixed Monetary Policy

In the endogenous fiscal spending regime, monetary policy such as a rise in $\mu$ accompanies with the increase in fiscal spending $g_t$, therefore this *mixed* policy should have the combined effects of the monetary and




(a)




(b)

**Figure 3. Phase diagram of money-habits *x* and consumption-habits *z* with the signs of the current account. (a) Adjacent complementarity: $\alpha + \rho > 0$; (b) Distant complementarity: $\alpha + \rho < 0$.**

fiscal policy. Then, let us consider a once-and-for-all increase in $\mu$. By differentiating (21), (29), and (30) with respect to $\mu$, the steady-state effects on $\bar{z}$ and $\bar{x}$ are obtained as:

$$\frac{\mathrm{d}\bar{z}}{\mathrm{d}\mu} = \frac{1}{\Delta}\left[\frac{\bar{x}v_{mm}}{U_c}\left(1-\frac{r+2\alpha}{r+\alpha}\Omega_m\right) - \frac{\mu\rho}{r-\rho}\left(1+\frac{r}{\alpha}\right)\right] \gtreqless 0, \quad (31)$$

$$\frac{\mathrm{d}\bar{x}}{\mathrm{d}\mu} = \frac{1}{\Delta}\left[\frac{(r+\mu)\bar{x}u_{cc}}{U_c}\left(1-\frac{r+2\alpha}{r+\alpha}\Omega_c\right) + \frac{\omega}{r-\omega}\left(1+\frac{r}{\alpha}\right)\right] < 0, \quad (32)$$

where:

$$\Delta \equiv \frac{\mu\rho}{r-\rho}\left(1+\frac{r}{\alpha}\right)\frac{(r+\mu)u_{cc}}{U_c}\left(1-\frac{r+2\alpha}{r+\alpha}\Omega_c\right) + \frac{\omega}{r-\omega}\left(1+\frac{r}{\alpha}\right)\frac{v_{mm}}{U_c}\left(1-\frac{r+2\alpha}{r+\alpha}\Omega_m\right),$$

which is positive under saddle-point stability.

The mixed monetary policy has two effects on the steady-state values of consumption-habit and liquidity-habit capitals $(\bar{z},\bar{x})$: 1) an income effect, which is a negative effect caused by a decrease in real income owing to the increase in fiscal spending; and 2) a substitution effect, *i.e.*, demand shifts from $m$ toward $c$ owing to the rise in $\mu$. In (31) and (32), the first terms, which are proportionate to the steady-state real money balance $\bar{x}$, represent the income effect and the second terms represent the substitution effect. Both of the effects affect $\bar{x}$ negatively, so that $\bar{x}$ definitely decreases and hence the exchange rate depreciates on impact and in the long-run. The sign of the overall effect on $\bar{z}$ depends on the relative magnitudes of the negative income effect and the positive substitution effect.

To examine the steady-state effect on external asset holdings $\bar{b}$, we differentiate (29) by $\mu$ and substitute (31) and (32) into the result to obtain:

$$\frac{\mathrm{d}\bar{b}}{\mathrm{d}\mu} = \frac{1}{\Delta}\left[\Lambda\bar{x} + \frac{\mu(\alpha+r)}{\alpha(r-\omega)(r-\rho)}(\omega-\rho)\right], \quad (33)$$

where:

$$\Lambda \equiv \frac{(\omega+\alpha)v_{mm}}{\alpha(r-\omega)U_c}\left(1-\frac{r+2\alpha}{r+\alpha}\Omega_m\right) + \frac{\mu(r+\mu)(\rho+\alpha)u_{cc}}{\alpha(r-\rho)U_c}\left(1-\frac{r+2\alpha}{r+\alpha}\Omega_c\right),$$

which is negative when preferences for real money balances exhibit adjacent complementarity or relatively weak distant complementarity, which can be dominated by the adjacent complementarity of preferences for consumption defined by Assumption 1.

In (33), the first term $\Lambda\bar{x}$ on the right-hand side represents the income effect on disposable net income $y-\bar{z}-(\tau+\mu\bar{x})$. The first term in the definition of $\Lambda$ can be either negative or positive as preferences for real money balances display the adjacent or distant complementarity while the second term in $\Lambda$ is negative from Assumption 1. In sum, the first term $\Lambda\bar{x}$ is negative

unless the liquidity preference exhibits relatively strong distant complementarity. The second term of (33) represents the substitution effect on the net income, which is assumed to be positive since it seems quite natural that consumption is more habit forming than money holdings, *i.e.*, $\omega > \rho$.

Although the sign of (33) is ambiguous, the larger the habit for real money balances is, the more likely it is to be negative. For example, when preferences for real money balances is of the type of adjacent complementarity $\mathrm{d}\bar{b}/\mathrm{d}\mu$ is necessarily negative. When the preferences display sufficiently strong distant complementarity, $\mathrm{d}\bar{b}/\mathrm{d}\mu$ in turn takes positive sign.

The effects of the mixed monetary policy can be summarized as the following proposition:

**Proposition 3.** *With Assumption* 1, *suppose that a permanent increase in the growth rate of money in the endogenous fiscal spending regime takes place*. *Then*:

1) *real money balances decrease and hence the exchange rate depreciates*, *on impact and in the long-run*;

2) *exchange-rate depreciation* (*appreciation*) *takes place in transition when liquidity preferences exhibit adjacent* (*distant*) *complementarity*; *and*,

3) *the stronger the habit for real money balances is, the more likely the steady-state external assets are to decrease in response to the policy*; *In particular*,

(a) $\mathrm{d}\bar{b}/\mathrm{d}\mu$ *is negative when preferences for real money balances exhibit adjacent complementarity*, *and*,

(b) $\mathrm{d}\bar{b}/\mathrm{d}\mu$ *is positive when preferences for real money balances display sufficiently strong distant complementarity*.

Proposition 3 implies that an increase in $\mu$ affects real money balances and hence the exchange rate just in the same way as in the endogenous income transfer regime, whereas the monetary policy is not surperneutral any more: induced changes in fiscal spending affect consumption and hence the current account. Note however that the effect on the current account dynamics differs from that of an increase in fiscal spending in the previous regime. Especially when liquidity preferences display sufficiently strong distant complementarity, the current account runs surplus even though preferences for consumption are assumed to be of adjacent complementarity.

By setting $\rho = \omega$ in (33), we obtain the following corollary:

**Corollary 1.** *Suppose that with Assumption* 1, *consumer preferences are weakly separable* $(\rho = \omega)$. *Then, a permanent increase in the growth rate of money* $\mu$ *in the endogenous fiscal spending regime necessarily reduces the steady-state holding of net foreign assets* $\bar{b}$.

Corollary 1 is consistent with the literature (e.g., Mansoorian [2]), in which a permanent increase in crawling pegged rate of exchange rate definitely reduces $\bar{b}$ when preferences for homothetic consumption bundle of $(c, m)$ exhibit adjacent complementarity (as shown in column (4) of **Table 1**).

## 4.2. Transition: Possibilities of Non-Monotonic Dynamics

To examine the adjustment processes of the current account, especially focusing on the possibilities of non-monotonic transition dynamics, we substitute (10) and (12) into (28) and differentiate the result by $t$, and then obtain the following:

$$\dot{b}_t = \frac{1}{r-\omega}\dot{c}_t + \frac{\mu}{r-\rho}\dot{m}_t. \tag{34}$$

This means that the current account $\dot{b}_t$ depends positively on the growth of consumption and of real money balances, where the individual dynamics of consumption and of real money balances are given by (10) and (12). As the adjustment speeds $\omega$ of $c_t$ and $\rho$ of $m_t$, respectively, generally differ, the current account can change its signs in the middle of transition if the signs of $\dot{c}_t$ and $\dot{m}_t$ in transition are *opposite*.

Two such cases of non-monotonic current account dynamics are illustrated in panels (a) and (b) of **Figure 4** as the time profiles from the initial steady-state point $E_0$ through the turning point $T$ to the new steady-state point $E$. In each panel, since adjacent complementarity of preferences for consumption means that consumption $c_t$ positively correlates with its habit $z_t$, larger consumption habit $z_t$ from the $\dot{b} = 0$ schedule implies higher consumption level than its steady-state level $\bar{c}(=\bar{z})$, thereby inducing the current account deficits in the right-hand side of the $\dot{b} = 0$ schedule.

For the explanatory purpose, let us take only a case shown in panel (b), in which preferences for real money balances $m_t$ display distant complementarity, implying that $m_t$ is negatively correlated with its habit capital $x_t$. A rise in $\mu$ at $E_0$ caused by the mixed monetary policy reduces $\bar{c}(=\bar{z})$, and then $c_t$ monotonically decreases over time: $\dot{c}_t < 0$ (shown as $\dot{z}_t < 0$ in the panel). On the other hand, the mixed policy definitely drops down $\bar{m}(=\bar{x})$, and causing $\dot{m}_t > 0$, i.e., the opposite signs of $\dot{c}_t$ and $\dot{m}_t$ in entire transition with $\dot{x}_t < 0$ as shown in panel (b). Since consuming good is more habit forming than holding money balances in this case, the adjustment of $m_t$ is more rapid than that of $c_t$, i.e., $\omega > \rho$. The shock at point $E_0$ initially induces current account surplus because, on $\dot{b}_t$ in (34), the effect of positive $\dot{m}_t$ initially dominates the effect of negative $\dot{c}_t$. Since the dominant effect of $\dot{m}_t$ wanes faster than that of $\dot{c}_t$ due to the difference in the adjustment speeds $(\omega > \rho)$, the current account surplus lasts until the economy passes through the turning point $T$, where the countervailing effects of $\dot{c}_t$ and $\dot{m}_t$ are

totally offset on the $\dot{b}=0$ schedule, and thereafter turns to deficits as the negative effect of $\dot{c}_t$ dominates the positive effect of $\dot{m}_t$ on $\dot{b}_t$. The current account deficits continue until the economy arrives at the new steady-state levels at point $E$.

As is proved in Appendix C of [13], non-monotonic behavior of the current account does indeed take place if either the set of conditions (a1) through (a3) or the set of conditions from (b1) to (b3) in the following proposition holds valid:

**Proposition 4.** *With Assumption* 1, *in response to a permanent increase in the growth rate of money in the endogenous fiscal spending regime, the current account can display non-monotonic dynamics. In particular, the following dynamic adjustments* 1 *and* 2 *can take place*:

1) *As illustrated in* ***Figure* 4(*a*)**, *the current account runs deficits initially and then turns to surplus while the exchange rate depreciates in transition if the following three conditions are satisfied*:

(*a*1) *preferences for real money balances exhibit adjacent complementarity,* $\rho + \alpha > 0$ *while consuming goods is more habit forming than holding money balances,* $\omega > \rho$;

(*a*2) *the steady-state effect on consumption is positive,* $\mathrm{d}\bar{c}/\mathrm{d}\mu\left(=\mathrm{d}\bar{z}/\mathrm{d}\mu\right)>0$; *and,*

(*a*3) *the steady-state effect on external asset holdings is negative,* $\mathrm{d}\bar{b}/\mathrm{d}\mu<0$.

2) *As illustrated in* ***Figure* 4(*b*)**, *the current account runs surplus initially and then turns to deficits while the exchange rate appreciates in transition if the following three conditions are met*:

(*b*1) *preferences for real money balances exhibit distant complementarity,* $\rho + \alpha > 0$;

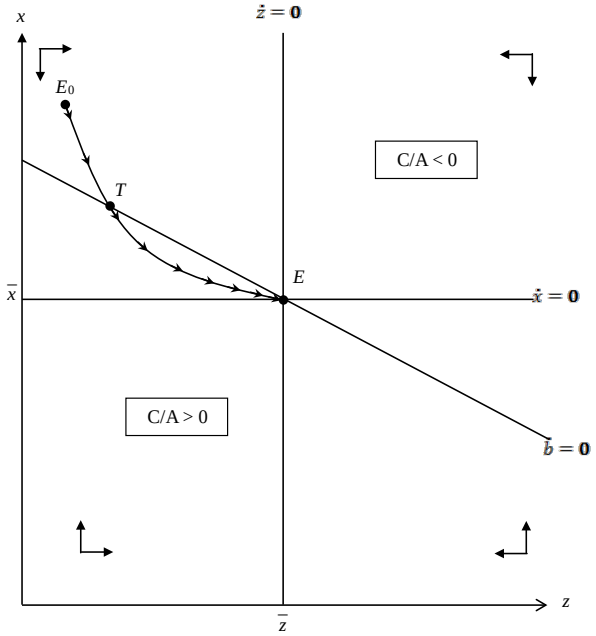
(*b*2) *the steady-state effect on consumption is negative,* $\mathrm{d}\bar{c}/\mathrm{d}\mu\left(=\mathrm{d}\bar{z}/\mathrm{d}\mu\right)<0$; *and,*

(*b*3) *the steady-state effect on external asset holdings is positive,* $\mathrm{d}\bar{b}/\mathrm{d}\mu>0$.

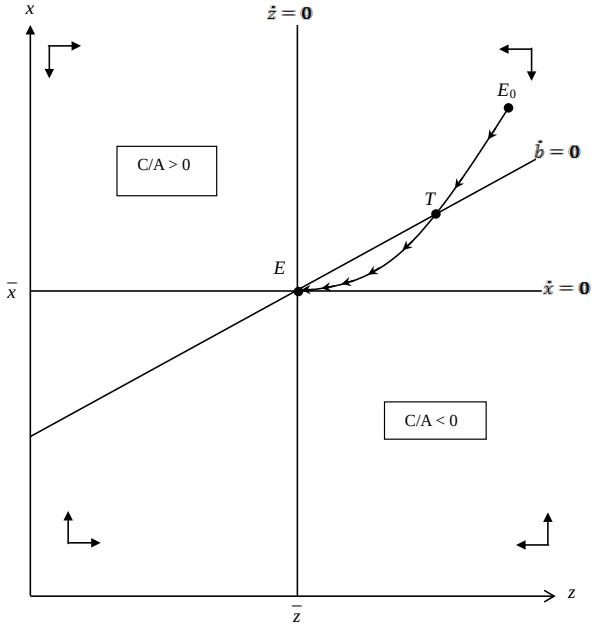
In the case of panel (a) (panel (b)), the initial current account deficits (surplus) dominates the latter current account surplus (deficits), which can be summarized as $\mathrm{d}\bar{b}/\mathrm{d}\mu<(>)0$, as conditioned in (a3) (in (b3)).[6]

Note that the non-monotonic dynamics of current account $\dot{b}$ make unclear correlation between the exchange rate $s$ and the net foreign assets $b$ since the dynamics of $s$ are always monotonic. This non-monotonic comovement of the exchange rate and the current account is one of theoretical counter-examples to the standard prediction that the exchange rate $s$ moves positively with the net foreign assets $b$ (e.g., Obstfeld [1], Obstfeld and Rogoff [16]).

[6]An applied econometrician could easily identify these two cases by observing the relation of the opposite signs between dynamics of $c_t$ and those of $m_t$ in transition: $\dot{c}_t>0$ and $\dot{m}_t<0$ in the case of panel (a) whereas $\dot{c}_t<0$ and $\dot{m}_t>0$ in the case of (b).




(a)




(b)

**Figure 4. Possible non-monotonic transition paths of current account dynamics. (a) Adjacent complementarity: $\alpha + \rho > 0$; (b) Distant complementarity: $\alpha + \rho < 0$.**

Note also that the independent habit forces over consumption and money play the critical role in generating non-monotonic dynamics of the current account. This mechanism differs from that in the existing literature discussing on non-monotonic current account dynamics: Shi and Epstein [4] incorporate habit formation and endogenous discounting; and Mansoorian and Neaime [3] focus on habits and durability. Our model proposes a

new specification to describe empirically plausible non-monotonicity of the current account dynamics.

## 5. Conclusions

Incorporating habits over consumption and over real money balances into a small country model, we have examined the dynamic adjustment of the current account and the exchange rate to monetary and fiscal policies in two alternative policy regimes: (1) the endogenous income transfer regime; and (2) the endogenous fiscal spending regime. In response to the policies under either regime, the exchange rate definitely depreciates on impact and in the long run whereas the exchange rate depreciates (appreciates) in transition if preferences for real money balances exhibit adjacent (distant) complementarity. In regime (2), the habits over consumption and real money balances jointly generate possibly non-monotonic current account dynamics, and an induced increase in fiscal spending can cause current account surplus under strong distant complementarity of real money balances.

As a possible direction for future research, it would be interesting to extend our mutually independent consumption- and money-habits model to a two-country framework as developed by Ikeda and Gombi [17] so as to contribute to producing richer implications for the movements of the current account and the exchange rate.

## 6. Acknowledgements

The authors are grateful for the helpful comments on the earlier versions circulated as [13] to Y. Ono, T. Ogawa, and the participants of the Osaka University Global COE Conference of the Economic Analysis for Time-Preference and Economic Dynamics (Matsuyama, Japan), the 72nd International Atlantic Economic Conference (Istanbul, Turkey), and the Asset Pricing Research Workshop (Osaka, Japan). They also appreciate financial supports to Gombi from the faculty research fund from 2011 to 2013 of Ritsumeikan University, and to Ikeda from Grants-in-Aid for Scientific Research (B No. 21330046) from the Japan Society for the Promotion of Science and the 21st COE Program and the Joint Usage/Research Center Project of ISER from the Ministry of Education, Culture, Sports, Science and Technology. In addition, Gombi gratitudes for facilitative supports from the School of Economics and Finance, the Collage of Business, Massey University during his sabbatical stay at Palmerston North, New Zealand as a visiting research fellow.

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