Habits and Durability in Consumption, and the Dynamics of the Current Account

by

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Abstract

A model in which consumption exhibits durability, and habits develop over the flow of services provided by them is used to study current account dynamics. Durability leads to adjacent substitutability in consumption, while habits are assumed to lead to adjacent complementarity. The adjustment of the current account may be non-monotonic. If habit effects are dominant in the short run, and durability effects in the long run, then after a terms of trade deterioration we will have a current account deficit followed by a surplus (the J-curve). In the opposite case a surplus will be followed by a deficit.

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I. Introduction

Models in which consumption exhibits durability, and habits develop over the flow of services provided by these durables have been used by a number of authors recently to study the empirical performance of the consumption based asset pricing models (see, for example, Ferson and Constantinides (1991), and Heaton (1995)). The simultaneous presence of habits and durability is found to considerably improve the empirical performance of these models.

The popular method for modelling habits is due to Ryder and Heal (1973). Thus, instantaneous utility is assumed to depend not only on current consumption but also on the habitual standard of living, modelled as a weighted average of past levels of consumption services. An important characteristic of the Ryder-Heal preferences is that with them we can have adjacent complementarity in consumption; and, thus, a very high degree of consumption smoothing motive. This has made the model very popular in the asset pricing literature.[1]

Durability in consumption, on the other hand, makes consumption expenditures in adjacent dates substitutable, as then instantaneous utility will depend on the flow of services provided by the stock of consumer durables. With simultaneous presence of habits and durability, it is assumed that habits develop over the flow of past services provided by the durable goods.

The purpose of the present paper is to work out the implications of such a model with regard to the adjustment of the current account of a small open economy. To motivate the analysis, I will consider the adjustment of the current account after a terms of trade

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[1] For example, Constantinides (1990) uses the Ryder-Heal preferences with adjacent complementarity to solve the Mehra-Prescott (1985) equity premium puzzle, while Backus, Gregory, and Telmer (1994) use it to account for the high variation in the expected return on the forward relative to spot exchange rates.

deterioration. The discussion of the macroeconomic implications of the effects of a terms of trade deterioration on savings and the current account dates back to the classic works of Harberger (1950), and Laursen and Metzler (1950) (henceforth, referred to as H-L-M).

Obstfeld (1982) was, however, the first to examine the implications of a terms of trade deterioration in an optimizing framework. He used the Uzawa (1968) preferences, in which the rate of time preference is assumed to be an increasing function of instantaneous utility. As the small open economy faces a fixed world rate of interest, there is a unique level of instantaneous utility that must be maintained in the steady state. Hence, after a terms of trade deterioration the representative agent must increase its savings, and accumulate financial assets, in order to maintain the same level of instantaneous utility in the steady state.

Obstfeld's findings were contrary to the intuition of H-L-M, and it gave rise to a large literature on examining the effect of a terms of trade deterioration in optimizing frameworks.[2] In a recent paper, Mansoorian (1993) uses the Ryder-Heal preferences to re-examine the H-L-M effect. It was shown that, by reducing the permanent real income of the representative agent, a terms of trade deterioration requires the steady state level of the habitual standards of living to fall. If preferences exhibit adjacent complementarity in consumption, then the representative agent will try to maintain the habitual standard of living it inherited from the past. In that case, after the terms of trade deterioration there will be a fall in savings and a current account deficit, as suggested by H-L-M. On the other hand, if preferences exhibit

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[2] Some of the prominent papers in this literature are by Svensson and Razin (1983), Persson and Svensson (1985), Matsuyama (1987, 1988), and Sen and Turnovsky (1989).

adjacent substitutability then the adjustment of savings and the current account will be qualitatively the same as Obstfeld's.

In the present paper, I show that with simultaneous presence of habits and durability, if there is a terms of trade deterioration then again the steady state habitual standards of living should fall. If habit effects are dominant in the short run, and durability effect in the long run, then consumption will exhibit adjacent complementarity in the short run and adjacent substitutability in the long run. In that case, after the terms of trade deterioration there will be an fall in savings and a current account deficit. But there will come a time at which the durability effects will become dominant. At that time savings will start to rise and we will have a current account surplus. Such a non-monotonic adjustment of the current account is a stylized fact known in the literature as the J-curve phenomenon. Recent evidence in support of the J-curve is provided by Backus, Kehoe, and Kydland (1994). (Also see Meade (1988), and Edwards (1989, pp. 279-284).)

Heaton, on the other hand, using a different methodology and data set from Backus *et. al.*'s, finds evidence in favour of the durability effects (adjacent substitutability) being dominant in the short run, and the habit effects (adjacent complementarity) in the long run. In that case, after a terms of trade deterioration we will be a current account deficit, which will then be followed by a surplus.

The paper is organized as follows. The model is presented in section II. The effects of a terms of trade deterioration are discussed in section III. Some concluding remarks are made in section IV.

II. The Model

The objective function of the representative agent is a two good variant of that used by Heaton:

$$\int_0^\infty e^{-\theta t}\, U(s_t + \omega_t, h_t)\, dt, \tag{1}$$

where θ is the rate of time preference, and for any time t ω_t is a utility measure of the services provided by the agent's current purchases of the home and foreign goods, c_t^f and c_t^h. It is defined as

$$\omega_t = \omega(c_t^f, c_t^h), \tag{2}$$

where $\omega(\cdot)$ is a homothetic subutility function.

I model s_t as a weighted sum of ω_τ ($\tau < t$), with exponentially declining weights given to more distant values of ω_τ:

$$s_t = \int_{-\infty}^{t} e^{\delta(\tau - t)}\, \omega_\tau\, d\tau, \tag{3}$$

where $\delta > 0$.

In a one good model, s_t would be a weighted sum of past levels of consumption expenditures. Then, s_t would be the stock of durable goods available at time t, and δ the rate of depreciation of the durables. In the present two good model, on the other hand, ω_τ is a utility measure of the goods purchased at time τ. Modelling durability in this way, instead of durability in each of the two goods separately, will simplify the analysis. Alternatively, one can view this way of modelling durability as attempting to capture an important aspect of preferences, rather than modelling durability *per se*. Note that $s_t + \omega_t$ is the total services of the durable goods that are enjoyed at time t.

From (3) it follows that the evolution of s_t is given by

$$\dot{s}_t = \omega_t - \delta s_t \tag{4}$$

The habitual standard of living are developed over the flow of past consumption services. Thus, h_t is a weighted sum of $(s_\tau + \omega_\tau)$ $(\tau < t)$, with exponentially declining weights given to more distant values of $s_\tau + \omega_\tau$:

$$h_t = \rho e^{-\rho t} \int_{-\infty}^{t} e^{\rho \tau} \left[s_\tau + \omega_\tau \right] d\tau, \tag{5}$$

where $\rho > 0$. From (5) it follows that the evolution of h_t is given by

$$\dot{h}_t = \rho \left[s_t + \omega_t - h_t \right]. \tag{6}$$

I maintain assumption (P.1)-(P.5) of Ryder and Heal (pp. 2-3), regarding the momentary utility function. Thus, momentary utility is assumed to be: (P.1) increasing in the current flow of services consumed, $U_1 > 0$; (P.2) non-increasing in habits, $U_2 \leq 0$; (P.3) increasing in uniformly maintained ω, i.e., $U_1(x, x) + U_2(x, x) > 0$ for all $x > 0$; (P.4) concave in its two arguments; and (P.5) $\lim_{x \to 0} U_1(x, h) = \infty$ and $\lim_{x \to 0} [U_1(x, x) + U_1(x, x)] = \infty$.

As the purpose of this paper is to work out the implications of the simultaneous presence of habits and durability in consumption, the production side of the model is kept as simple as possible. I assume that at any point in time the country is endowed with y units of the home good and nothing of the foreign good. The home good is taken to be the numeraire, while the price of the foreign good is fixed abroad at p. The world rate of interest, r, and the price of the internationally traded bonds are also fixed abroad. Thus, the flow budget constraint of the agent is

$$\dot{B}_t = rB_t + y - Z_t, \tag{7}$$

where Z_t is aggregate expenditures at time t ($c_t^h + pc_t^f$), and B_t is the country's net foreign asset position.

Finally, the intertemporal solvency condition,

$$\lim_{t \to \infty} e^{-rt} B_t \geq 0, \tag{8}$$

prevents the representative agent from borrowing without bound.

In what follows, it will be important to keep a clear distinction between aggregate expenditures (Z) and real consumption (ω). The former is the value of goods purchased, while the latter is a utility measure of the services provided by these goods.

The problem of the representative agent is to choose a sequence of consumption levels (c_t^f, c_t^h) to maximize his utility subject to the constraints (4), (6)-(8), and the initial conditions, s_0, h_0, and B_0.

The marginal rate of substitution between the home and foreign goods at any point in time is independent of the consumption levels at other dates. Hence, as the subutility function $\omega(\cdot)$ is homothetic, the agent's maximization problem can be done in two stages. In the first stage, for a given level of expenditures, Z_t, choose c_t^f and c_t^h to maximize $\omega(c_t^f, c_t^h)$ subject to $Z_t = c_t^h + pc_t^f$. In the second stage choose the values of Z_t.

The first stage of the problem gives the indirect utility function $Z_t V(p)$, where $V' < 0$. The second stage of the problem then is

$$\underset{\{Z_t\}}{\text{Max}} \int_0^\infty e^{-\rho t} U(s_t + Z_t V(p), h_t)\, dt,$$

subject to (4), (6)-(8), and the initial conditions, s_0, h_0, and B_0.

The Hamiltonian for his problem is

$$H = U(s_t+Z_tV, h_t) + \phi_t[Z_tV - \delta s_t] + \lambda_t[\rho(s_t + Z_tV - h_t)] + \mu_t[rB_t + y - Z_t],$$

where ϕ_t, λ_t and μ_t are the shadow prices of s_t, h_t and B_t, respectively.

The optimality conditions are:

$$H_Z \equiv U_1 V + \phi V + \lambda \rho V - \mu = 0, \tag{10}$$

$$-H_s + \theta\phi \equiv -U_1 + \phi\delta - \lambda\rho + \theta\phi = \dot{\phi}, \tag{11}$$

$$-H_h + \theta\lambda \equiv -U_2 + \lambda\rho + \theta\lambda = \dot{\lambda}, \tag{12}$$

$$-H_B + \theta\mu \equiv -r\mu + \theta\mu = \dot{\mu}, \tag{13}$$

and the standard transversality conditions.

From (13) it is clear that a steady state can be reached only if

$$r = \theta. \tag{14}$$

This is a standard assumption that is made in the literature, and we will maintain it from now on. From (13) and (14) it follows that $\dot{\mu}=0$, and that μ is always at its steady state level.

Linearizing (10) around the steady state, using the fact that $\dot{\mu}=0$, we obtain

$$(Z_t - \bar{Z}) = -\frac{1}{V}(s_t - \bar{s}) - \frac{U_{12}}{U_{11}V}(h_t - \bar{h}) - \frac{\rho}{U_{11}V}(\lambda_t - \bar{\lambda}) - \frac{1}{U_{11}V}(\phi_t - \bar{\phi}), \tag{15}$$

where bars over variables denote steady state values.

Linearizing (6), (11) and (12) around the steady state, using (14) and (15), we obtain

$$\begin{bmatrix} \dot{h}_t \\ \dot{\lambda}_t \\ \dot{\phi}_t \end{bmatrix} = \begin{bmatrix} a_{11} & a_{12} & a_{13} \\ a_{21} & a_{22} & a_{23} \\ 0 & 0 & a_{33} \end{bmatrix} \begin{bmatrix} h_t - \bar{h} \\ \lambda_t - \bar{\lambda} \\ \phi_t - \bar{\phi} \end{bmatrix}, \tag{16}$$

where,

$$a_{11} = \frac{-\rho(U_{12} + U_{11})}{U_{11}}$$

$$a_{12} = \frac{-\rho^2}{U_{11}} > 0, \text{ by assumption (P.4)}$$

$$a_{13} = \frac{-\rho}{U_{11}} > 0, \text{ by assumption (P.4)}$$

$$a_{21} = \frac{(U_{12}^2 - U_{22}U_{11})}{U_{11}} > 0, \text{ by assumption (P.4)}$$

$$a_{22} = r + \frac{\rho(U_{11} + U_{12})}{U_{11}},$$

$$a_{23} = \frac{U_{12}}{U_{11}}, \text{ and}$$

$$a_{33} = 1 + r + \delta > 0.$$

In the differential equation system (16) h is a state variable, while λ and ϕ are both jump variables. Therefore, for saddlepoint stability of the system the coefficient matrix should have two positive and one negative eigenvalues. For this we need $a_{11}a_{12} - a_{12}a_{21} < 0$, which, given our assumptions (P.1)-(P.4), could be easily satisfied. If ξ is the negative eigenvalue of the coefficient matrix in (16) − that is,

$$\xi = \frac{r - \sqrt{r^2 - 4(a_{11}a_{22} - a_{21}a_{12})}}{2},$$

then the stable path to the steady state will be given by:

$$(h_t - \bar{h}) = (h_0 - \bar{h})e^{\xi t}, \tag{17}$$

$$(\lambda_t - \bar{\lambda}) = \frac{\xi - a_{11}}{a_{12}}(h_0 - \bar{h})\,e^{\xi t}, \tag{18}$$

$$(\mathbf{N}_t \,\&\, \bar{\mathbf{N}}) \;'\; 0. \tag{19}$$

To obtain the solution for s_t linearize (4) around the steady state, and then use (14) and (17)-(19), to get

$$\dot{s}_t \;'\; \&(1 \,\%\, \boldsymbol{*})(s_t \,\&\, \bar{s}) \,\&\, \mathbf{S}(h_0 \,\&\, \bar{h})e^{>t}, \tag{20}$$

where

$$\mathbf{S} \;'\; \left[\frac{U_{12}}{U_{11}} \,\%\, \frac{\mathbf{D}}{U_{11}}\,\frac{\mathbf{>} \,\&\, a_{11}}{a_{12}}\right] \;=\; \&\left(1 \,\%\, \mathbf{>}/\mathbf{D}\right).$$

The solution to (20) is

$$s_t \;'\; \bar{s} \,\&\, \frac{\mathbf{S}}{1 \,\%\, \mathbf{>} \,\%\, \boldsymbol{*}}(h_0 \,\&\, \bar{h})e^{>t} \,\%\, \left[\frac{\mathbf{S}}{1 \,\%\, \mathbf{>} \,\%\, \boldsymbol{*}}(h_0 \,\&\, \bar{h}) \,\%\, (s_0 \,\&\, \bar{s})\right]e^{\&(1\%\boldsymbol{*})t}. \tag{21}$$

To obtain the solution for B_t linearize (7) around the steady state, and use (15), (17)-(19), and (21) to get

$$B_t \;'\; \bar{B} \,\%\, \mathbf{7}_1 e^{>t} \,\%\, \mathbf{7}_2 e^{\&(1\%\boldsymbol{*})t} \,\%\, \left[(B_0 \,\&\, \bar{B}) \,\&\, \mathbf{7}_1 \,\&\, \mathbf{7}_2\right]e^{rt}, \tag{22}$$

where

$$\mathbf{7}_1 \;'\; \frac{\mathbf{S}(\boldsymbol{*} \,\%\, \mathbf{>})}{V(1 \,\%\, \mathbf{>} \,\%\, \boldsymbol{*})(\mathbf{>} \,\&\, r)}(h_0 \,\&\, \bar{h}), \tag{23}$$

and

$$\mathbf{7}_2 \;'\; \&\frac{\mathbf{S}}{V(1\%\mathbf{>}\%\boldsymbol{*})(1\%\boldsymbol{*}\%r)}(h_0 \,\&\, \bar{h}) \,\&\, \frac{1}{V(1 \,\%\, \boldsymbol{*} \,\%\, r)}(s_0 \,\&\, \bar{s}). \tag{24}$$

Clearly, for (22) to converge we will need

$$\left[(B_0 \,\&\, \bar{B}) \,\&\, \mathbf{7}_1 \,\&\, \mathbf{7}_2\right] \;'\; 0, \tag{25}$$

which for given values B_0, h_0 and s_0, shows how $\bar{B}$, $\bar{h}$ and $\bar{s}$ should be related for saddlepoint stability. With this condition, (22) reduces to

$$B_t - \bar{B} = \Lambda_1 e^{\xi t} + \Lambda_2 e^{-(1+\delta)t}. \tag{26}$$

Equations (17)-(19), (21) and (26) give us the stable path of the model to the steady state equilibrium. From (26) it is clear that there is no reason for the adjustment of the country's net foreign asset position to be monotonic along the stable path.

III. The Effects of a Terms of Trade Deterioration

In this section I examine the effects of a permanent unanticipated terms of trade deterioration on the current account. To this end I will first consider the steady state of the model, which is characterised by equation (10), and by equations (4), (6), (7), (11), (12), with $\dot{s}=\dot{h}=\dot{B}=\dot{\phi}=\dot{\lambda}=0$. These are six equations in seven unknowns: $\bar{s}$, $\bar{h}$, $\bar{B}$, $\bar{Z}$, $\bar{\phi}$, $\bar{\lambda}$, and $\bar{\mu}$. The seventh equation is obtained from (25), which gives us the following relationship for the changes in the steady state levels of the state variables, B, s, and h:

$$d\bar{B} = \frac{\psi(r+\delta)}{V(1+\delta+r)(\xi-r)}\, d\bar{h} - \frac{1}{V(1+\delta+r)}\, d\bar{s}. \tag{27}$$

Differentiating (4), (6) and (7) in the steady state, and using (27) we obtain

$$\frac{d\bar{h}}{dp} = (1+\delta)\frac{d\bar{s}}{dp} = \frac{(1+\delta+r)\,\bar{Z}\,V'}{(\delta+r)\left[1-\dfrac{\psi r}{\xi-r}\right]} < 0.$$

Thus, a terms of trade deterioration will lead to a fall in the steady state levels of the habitual standard of living ($\bar{h}$) and the stock of durables ($\bar{s}$). The reason for this is that the terms of trade deterioration reduces the permanent real income of the representative agent. To accommodate this the habitual standard of living, and the stock of durables that are needed to maintain these standards, should fall.

It is not possible to sign the effect of the terms of trade deterioration on the steady state levels of aggregate expenditures or the country's net foreign asset position. The reason is that the adjacent substitutability effect (coming through durability) and the adjacent complementarity effect (coming through habits) have competing influences on the current account. It will be instructive to first explain how each one of these two effects in isolation will impinge on the dynamics of the current account. The result of the interaction between the two effects will then be transparent.

The effects of a terms of trade deterioration in the presence of adjacent complementarity alone are fully worked out in Mansoorian,[3] where habits are present and there is no durability in consumption. In that case, after a terms of trade deterioration the steady state habitual standards of living must fall, as permanent income has fallen. With adjacent complementarity the representative individual will want to maintain the habitual standard of living he inherited from the past. Hence, after the terms of trade deterioration savings will fall, aggregate expenditures will rise, and the country will run a current account deficit. Aggregate expenditures and the country's net foreign asset position will then decline gradually over time. Figure (1) portrays the adjustment of B for this case.

Now consider the adjustment of the model after a terms of trade deterioration with durability, and no habits. Then, preferences will exhibit adjacent substitutability; and, hence, the adjustment of the relevant variables will be the mirror image of that with adjacent

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[3] This is the case in which the condition in Proposition 1 (p. 162), for the H-L-M effect, holds.

complementarity.[4] After a terms of trade deterioration there will be an increase in savings and a current account surplus. The reason for this is as follows. The representative agent has a relatively large stock of durables when he experiences a decline in his permanent income. He, moreover, knows that his steady state stock of durable goods should fall to accommodate the decline in his permanent income. It is optimal for him to consume the services from the relatively large volume of durables that he has inherited from the past, and to save in order to replace them when their stock has gone down by the appropriate amount. Hence, in that case, after the terms of trade deterioration, there is a fall in aggregate expenditures and a current account surplus. Aggregate expenditures and the country's net foreign asset position will then increase gradually over time. Figure (2) portrays the adjustment of B for this case.

Backus, Kehoe, and Kydland document evidence from various countries which suggest that after a terms of trade deterioration there should be a current account deficit followed by a surplus, which eventually dies out. This is a modern restatement of the well known J-curve phenomenon. Their findings, therefore, suggest that the habit effects should be dominant immediately after the terms of trade deterioration, but that eventually they will be dominated by the effects of durability. Hence, it follows from Figures (1) and (2) that, in this case, after the increase in p there will be a deterioration in the country's net foreign asset position (current account deficit), which will then be followed by an improvement (current account surplus), as shown in Figure (3). Of course, in the presence of both habits and durability the interaction

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[4] The adjustment of the model in this case will be the same as in Mansoorian when preferences exhibit adjacent substitutability (i.e., when the H-L-M effect does not hold), with the stock of durables in the present model (s_t) replacing habits in that model (which were denoted by S_t). Again, the reader is referred to that paper for a full discussion. (A sufficient condition for adjacent substitutability in Mansoorian, p. 164, is that an increase in S_t reduces the marginal utility of real consumption.)

between the two effects will add an additional twist to the dynamics of the model. But this will not alter the general properties of the adjustment process.

The adjustment of the country's net foreign asset position along the stable path is given by (26). The negative eigenvalue **>** in the present model is the same as the eigenvalue in Mansoorian (p. 160), where $(B_t ! \bar{B})$ was proportional to $e^{>}$ (see equation (18) in that paper). Hence, the presence of the second term on the right hand side of equation (26) in the present paper is due to durability. Moreover,

$$\dot{B}_t \;'\; \mathbf{>7}_1 e^{>t} \;\&\; (1\%\mathbf{*})\, \mathbf{7}_2 e^{\&(1\%\mathbf{*})t}.$$

If we regard the first term on the right hand side of this equation to be due to habits, and the second term due to durability, then we will need $\mathbf{7}_1 > 0$ and $\mathbf{7}_2 < 0$ in order for the habit effects on B_t to be negative, and the durability effects positive. Backus *et. al.*'s empirical findings suggest that $B_0 < 0$. For this we need $(1+\mathbf{*})\mathbf{7}_2 > \mathbf{>7}_1$. Finally, for the durability effects to be dominant eventually (i.e., $B_t > 0$ when t is sufficiently large) we will need $(1+\mathbf{*})$ to be much smaller than $|\mathbf{>}|$. With these assumptions we will have the non-monotonic adjustment of the current account discussed above.

Heaton, using a methodology and data set different from that of Backus *et. al.*, however, finds evidence which suggest that the durability effects should be dominant immediately after the terms of trade deterioration, but that after a period of four months these effects will be dominated by the habit effects. Hence, his findings suggest that after a terms of trade deterioration there will be an improvement in the country's net foreign asset position (current account surplus), followed by a deterioration (current account deficits), as shown in Figure (4).

IV. Conclusions

In this paper I have employed a model in which consumption exhibits durability, and habits develop over the flow of past services provided by the durables in order to examine the effect of a terms of trade deterioration on the current account. Durability tends to make consumption in adjacent dates substitutable, while habits were assumed to make consumption in adjacent dates complementary.

It was shown that a terms of trade deterioration will require a fall in the steady state level of real consumption, as it reduces the permanent real income of the representative agent. If habit effects were dominant in the short run, and durability effects in the long run, then consumption would exhibit adjacent complementarity in the short run, and adjacent substitutability in the long run. In that case, immediately after the terms of trade deterioration there will be a fall in savings and a current account deficit. But there will be a time at which the durability effects will start to become dominant. At this time there will be an increase in savings and a current account surplus. On the other hand, if the durability effects are dominant in the short run, and habit effects in the long run, then after a terms of trade deterioration there will be a current account surplus followed by a deficit.

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