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WEAKLY NONSEPARABLE PREFERENCE AND THE CURRENT ACCOUNT: YES, THERE IS A HARBERGER–LAURSEN–METZLER EFFECT

Shinsuke Ikeda

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The Institute of Social and Economic Research
Osaka University
6-1 Mihogaoka, Ibaraki, Osaka 567-0047, Japan

Weakly Nonseparable Preference and the Current Account: Yes, There is a Harberger-Laursen-Metzler Effect

Shinsuke IKEDA[*] [†]

The Institute of Social and Economic Research, Osaka University

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Abstract

We examine the current account effect of a terms-of-trade deterioration for a small country model, incorporating weakly nonseparable preference à la Shi (1994) under endogenous time preference. This enables us to emphasize a welfare change as an important determinant of the current account. Unlike in the literature, even with increasing marginal impatience, the Harberger-Laursen-Metzler effect occurs if consumers' preference toward imports is wealth-enhanced enough: in that case a terms-of-trade deterioration must reduce steady-state welfare so as to shift preference away from imports to exports. Several empirical implications are also derived.

Keywords: The Harberger-Laursen-Metzler effect; time preference; weakly nonseparable preference; current account

JEL classification: F41; F32

[*]Correspondence. The Institute of Social and Economic Research, Osaka University, 6-1 Mihogaoka, Ibaraki, Osaka 567-0047, Japan. Telephone: +81(6)6879-8568. Fax: +81(6)6878-2766. E-mail: ikeda@iser.osaka-u.ac.jp

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1 Introduction

Since Harberger (1950) and Laursen and Metzler (1950) developed the Keynesian view that a terms-of-trade deterioration decreases savings by reducing real income, this effect – the Harberger-Laursen-Metzler effect – has so far attracted much attention in various contexts in macroeconomics. Since the effect implies that the current account will deteriorate in response to a terms-of-trade worsening if changes in investment and the government deficit are negligible, it is usually discussed in the context of current-account dynamics (e.g., Obstfeld (1982), Svensson and Razin (1983), Persson and Svensson (1985), Sen and Turnovsky (1989), Mansoorian (1993), Backus (1993), and Backus et al. (1994)).[1]

Obstfeld (1982) is the first to question whether or not there can be a Harberger-Laursen-Metzler effect in a modern intertemporal utility-maximizing framework. Using a small country model with Uzawa's (1968) time preference, he gives a negative answer to this question, showing that a permanent terms-of-trade deterioration causes real expenditures to decrease sharply, and thereby improves the current account. Svensson and Razin (1983) attribute his result to Uzawa's assumption that the degree of impatience measured by the rate of time preference is increasing in current welfare. In that case, the equilibrium dynamics are stable and, at the same time, given the Uzawa-Obstfeld setting, there is a unique target level of steady-state welfare determined by the constant world interest rate. Thus, in response to a terms-of-trade deterioration and to the resultant real-income reduction, the current account should run a surplus in the short run to enable consumers to attain the steady-state target expenditures.

However, fixed steady-state welfare is not of logical necessity of recursive preference, although many international finance models including Obstfeld's have this property. This comes from the implicit assumption that consumers' preference is weakly separable. In that case, steady-state time preference depends solely on welfare. Since steady-state time preference must equal the world interest rate, steady-state welfare is then fixed by the world interest rate. Instead, if preference is weakly nonseparable, steady-state welfare can adjust freely to a terms-of-trade deterioration, so that even with increasing impatience the current account could deteriorate so as to generate the wel-

[1] For surveys of discussions before 1980's on the Harberger-Laursen-Metzler effect, see Obstfeld (1982) and Svensson and Razin (1983).

fare adjustment. Actually, using a two-period model with a general (possibly, weakly nonseparable) preference structure, Svensson and Razin (1983) show that the current-account effect of a terms-of-trade deterioration is of ambiguous sign owing to three different effects: (i) a direct effect, caused by a revaluation of the net export vector; (ii) a wealth or welfare effect, due to a welfare change; and (iii) a pure substitution effect, which results from compensated changes in consumption caused by the relative-price change. However, their discussion based on general preference is limited to the two-period framework and it is unclear how it can be extended to dynamic settings.

The purpose of this paper is to re-examine the effect of a terms-of-trade deterioration on a small open economy using an infinite-horizon model with weakly nonseparable preference.[2] Our model owes much to the procedures used by Shi (1994) to specify weakly nonseparable preference by extending the familiar recursive preference model à la Uzawa (1968) and Epstein and Hynes (1983).[3] Weak nonseparability is incorporated in such a way that the intratemporal marginal rate of substitution between exportable and importable goods depends on future consumption of these goods through current welfare. Relative preferences toward the two goods then depend on current welfare and hence current wealth. When wealth increases, preference toward one good can be more or less enhanced than that toward the other good. With such a preference bias, a permanent deterioration in the terms of trade induces a change in steady-state welfare and wealth so as to cause preference to shift away from imports in favor of exports. This will affect current-account dynamics.

As a main result, we indeed find that, when preference toward imports is sufficiently wealth-enhanced, a terms-of-trade deterioration worsens largely steady-state welfare, so that, even under increasing impatience, the current

[2] We assume away any adjustments on the production side. For this respect, see Persson and Svensson (1985) and Sen and Turnovsky (1989). By integrating saving and investment dynamics in an overlapping-generation model, Persson and Svensson show that the Harberger-Laursen-Metzler effect can have any sign for plausible parameter values. Sen and Turnovsky discuss the effect by incorporating the labor-leisure choice and costly investment. For analyses using models of a stochastic exchange economies, see Backus (1993) and Backus et al. (1994).

[3] Weakly nonseparable preference under endogenous time-preference formation is considered by Lucas and Stokey (1984), Judd (1985), Epstein, Ham, and Zin (1988), and Shi (1994). Shi (1994) conducts the most systematic analysis on this topic. He characterizes the consumption-leisure choice under weakly nonseparable preference to discuss implications of distortionary taxation on capital and/or labor.

account will deteriorate to support the welfare change. In so doing, we reformulate the three effects which Svensson and Razin decompose using our description of the steady-state equilibrium. In this sense, the present attempt could be regarded as a dynamic extension of their analysis or a synthesis of theirs and Obstfeld's (1982).

The main result is consistent with recent empirical research. For example, Backus et al. (1994) report that signs of correlation between changes in the terms of trade and those in the trade account differ internationally. Our proposition implies that even with the endogenous time-preference model we could accommodate these mixed results consistently by incorporating weak nonseparability of preference. Another empirical implication is also derived by relating weak nonseparability to the notion of luxury goods.

The rest of the paper is organized as follows. Section 2 presents the analytical framework. Section 3 derives the equilibrium dynamics. In section 4, the effect of a permanent deterioration in the terms of trade is examined. In section 5.1, we relate our discussion to Svensson and Razin's (1983). In section 5.2, empirical implications are discussed. Section 6 concludes the paper.

2 The model

Consider a small open economy populated with infinitely-lived identical agents. They consume domestic goods d and foreign goods f. To abstract from the link between domestic investment and the current account, the economy is assumed to be endowed with constant units y^d of the domestic good and y^f of the foreign good at each instant. y^d is sufficiently large whereas y^f is small, so that a part of y^d is exported and a part of f imported.[4] By the small-country assumption, the relative price p of the foreign good in terms of the domestic one is exogenously given. The representative agent holds non-human wealth in the form of net foreign assets b. They can be traded freely at a constant interest rate r in perfect international capital markets.

Let $u(d, f)$ denote the instantaneous utility function of the representative consumer, which is assumed to satisfy the Inada condition. He or she

[4] y^f could be assumed to be zero for brevity. As will be shown below (remark 2), however, a nonzero y^f enables us to prove easily that there exists a set of parameter values such that the Harberger-Laursen-Metzler effect takes place.

maximizes the following lifetime utility:

$$U(0) \equiv \int_0^\infty u(d(t), f(t)) \exp(-\Delta(t)) \, \mathrm{d}t, \tag{1}$$

where

$$\Delta(t) = \int_0^t \delta(d(s), f(s)) \, \mathrm{d}s, \tag{2}$$

with $\delta(\cdot,\cdot)\,(>0)$ representing the instantaneous subjective discount rate. As in the literature (e.g., Obstfeld (1982) and Devereux and Shi (1991)), increasing marginal impatience is assumed: $\delta_d > 0$ and $\delta_f > 0$, where $\delta_d = \partial\delta/\partial d$, etc.[5]

To specify preference more clearly, let us construct the generating function g,

$$g(d, f, \phi) = u(d, f) - \phi\delta(d, f), \tag{3}$$

where $\phi(t)$ represents the lifetime utility $U(t)$ from the consumption stream after time t. g generates ϕ according to the differential equation,

$$\dot{\phi} = -g(d, f, \phi) \text{ s.t. } \lim_{t\to\infty} \phi(t) \exp(-\Delta(t)) = 0, \tag{4}$$

where a dot represents the time derivative, i.e., $\dot{\phi}(t) = \mathrm{d}\phi(t)/\mathrm{d}t$. The first-order partial derivatives g_d and g_f equal the current-value marginal utilities of $d(t)$ and $f(t)$ defined in terms of the Voltera derivative, e.g.,

$$\frac{\partial U(0)}{\partial d(t)} = g_d(t) \exp(-\Delta(t)).$$

We assume their positivity: $g_d > 0$ and $g_f > 0$.

The marginal rate of substitution (MRS) between d and f at time t is given by the ratio of g_f and g_d at that time: $\mathrm{d}d/\mathrm{d}f|_{U(0)=\text{const.}} = g_f/g_d$. The preference is thus weakly nonseparable when g_f/g_d depends on current welfare ϕ since ϕ depends on the future consumption stream. To characterize

[5] Formally, impatience is defined as increasing (decreasing) if the rate of time preference is increasing (decreasing) in current welfare. It is well-known that impatience is increasing (decreasing) if and only if the subjective discount rate is increasing (decreasing) in consumption (e.g., see Lucas and Stokey (1984) and Epstein (1987a)). This property holds valid also in the present model, as can easily be seen from (13) below.

the weak nonseparability, we follow Shi (1994) in introducing the following nonseparability index ξ:

$$\xi\left(d,f,\phi\right)\equiv\frac{1}{g_f/g_d}\frac{\partial\left(g_f/g_d\right)}{\partial\phi}=\frac{\delta_d}{g_d}-\frac{\delta_f}{g_f}, \tag{5}$$

where we assume $g_{df}=0$ and

$$g_{dd}<0, g_{ff}<0, \frac{\delta g_{dd}}{g_d^2}<\xi<-\frac{\delta g_{ff}}{g_f^2}. \tag{6}$$

These inequalities ensure the local concavity of the preference.[6] Furthermore, it is easy to show that (6) and the positivity of g_d and g_f imply the following technical property:

Property: ξ *satisfies:*[7]

$$\begin{aligned}\text{(i) } \xi &> 0\Rightarrow\xi^2<-\frac{r\delta_d g_{ff}}{g_d g_f^2}; \\ \text{(ii) } \xi &< 0\Rightarrow\xi^2<-\frac{r\delta_f g_{dd}}{g_f g_d^2}.\end{aligned} \tag{7}$$

Weak nonseparability is captured by a nonzero ξ. A positive (negative) ξ means that a rise in lifetime utility shifts preference away from consumption d to f (f to d). For this reason, when ξ is positive (negative), preference toward foreign goods f is referred to as *more (less) wealth-enhanced* than that toward d.[8] From (5), for any (d,f,ϕ) such that preference toward f

[6] See Shi (1994, appendix).

[7] We have $\xi<\frac{\delta_d}{g_d}$ from the definition of ξ and the positivity of δ_f/g_f. From the third inequality in (6), it follows that when $\xi>0$, we have

$$\xi^2<\frac{\delta_d}{g_d}\xi<-\frac{\delta_d}{g_d}\frac{\delta g_{ff}}{g_f^2},$$

which is (i) in (7). (ii) can be shown in the same way.

[8] Shi (1994) uses a different terminology, as discussed at the end of this section. We newly coin the terminology "more wealth-enhanced" because we can thereby see in which direction a welfare- (or wealth-) increase affects relative preferences toward the two goods, depending on signs of ξ. As conjectured from what our terminology means, we can relate index ξ to the notion of luxury goods. This will be discussed in section 5.2.

is more (less) wealth-enhanced than toward d, the MRS for f along the corresponding indifference curve, g_f/g_d, is larger (smaller) than that along the corresponding discount-rate, δ_f/δ_d, implying that consumers are more (less) willing to sacrifice f for d to keep the discount rate constant than to keep lifetime utility constant: $\left.\frac{\mathrm{d}d}{\mathrm{d}f}\right|_{U(0)=\text{const}} > (<) \left.\frac{\mathrm{d}d}{\mathrm{d}f}\right|_{\delta=\text{const}}$. Since, as shown later, the steady-state discount rate is fixed by the world interest rate, these discrepancies in the MRS's lead a demand shift between d and f, caused by an exogenous perturbation (e.g., a terms-of-trade change), to affect welfare in steady states. By contrast, Obstfeld (1982) follows Uzawa (1968) in specifying the discount rate δ as a function of felicity u, for which case both of g_f/g_d and δ_f/δ_d equal u_f/u_d, so that ξ equals zero (i.e., preference is weakly separable) and steady-state welfare is fixed by the world interest rate.[9]

The utility maximization is conducted subject to the following four constraints: (i) the flow budget constraint,

$$\dot{b}(t) = rb(t) + y^d + p(t)\,y^f - d(t) - p(t)\,f(t)\,; \tag{8}$$

(ii) the law of motion (2) for the discount factor; (iii) the initial condition, b_0 =given; and (iv) the no-Ponzi game condition, $\lim_{t\to\infty} \exp(-rt)\,b(t) = 0$. Letting λ denote the current-value shadow price of savings, the first-order conditions are given by:

$$g_d(d,\phi)\,(\equiv u_d(d,f) - \phi\delta_d(d,f)) = \lambda, \tag{9}$$

$$g_f(f,\phi)\,/g_d(d,\phi) = p, \tag{10}$$

$$\dot{\lambda} = (\delta(d,f) - r)\,\lambda. \tag{11}$$

The optimal dynamics for (b, d, f, ϕ, λ) are given by a time-profile which is generated by five equations (4) and (8) through (11) under the initial and no-Ponzi game conditions. We can reduce the system by expressing the Euler condition (11) in terms of the rate of domestic-good consumption. Define the rate of time preference ρ^d with respect to d as

$$\rho^d \equiv -\ln \left.\frac{\mathrm{d}g_d(d(t),\phi(t))\exp(-\Delta(t))}{\mathrm{d}t}\right|_{\dot{d}=0},$$

[9] Similarly, preference is weakly separable when δ is constant (time-additive preference), or when u is constant (e.g., Epstein and Hynes (1983)).

where $g_d \exp(-\Delta)$ represents the present-value marginal utility of d. Then, from (9), the Euler condition (11) can be rewritten as

$$\dot{d} = -\frac{g_d}{g_{dd}} \left(r - \rho^d (d, f, \phi) \right), \tag{12}$$

where

$$\rho^d (d, f, \phi) = \delta (d, f) - \frac{\delta_d (d, f)}{g_d (d, \phi)} g (d, f, \phi). \tag{13}$$

In exactly the same way, the optimal dynamics of foreign-good consumption can be obtained by defining the rate of time preference ρ^f with respect to f. From (10), the dynamics are not independent of (12).

By comparing ρ^d and ρ^f, we can characterize ξ from a dynamic viewpoint. In particular, from (5) and the definitions of ρ^d and ρ^f, we have around the steady state

$$\xi \gtreqless 0 \Leftrightarrow \frac{\partial \rho^d}{\partial \phi} \gtreqless \frac{\partial \rho^f}{\partial \phi},$$

implying that impatience with respect to d is more increasing in ϕ than with respect to f when $\xi > 0$, i.e., when preference toward f is more wealth-enhanced than toward d and vice versa. Since increasing impatience has a stabilizing effect on dynamics, we can follow Shi (1994) in saying d as *more (less) welfare-stabilizing* than f if $\xi > (<) 0$.[10]

3 Steady state and equilibrium dynamics

The equilibrium dynamics for (b, d, f, ϕ) are described completely by (4), (8), (10), and (12) together with the no-Ponzi game condition and the initial condition. The steady-state equilibrium, (b^*, d^*, f^*, ϕ^*), is determined by the following equations:

$$\left(\rho^d (d^*, f^*, \phi^*) = \right) \delta (d^*, f^*) = r, \tag{14}$$

$$\phi^* = u (d^*, f^*) / r, \tag{15}$$

[10] Alternatively speaking, when lifetime utility ϕ displays an increasing time path (i.e., $\dot{\phi} = -g > 0$), ρ^d is larger (smaller) than ρ^f if $\xi > (<) 0$: the increase in ϕ is supported by a slow (rapid) increase in d and a rapid (slow) increase in f . In contrast, if ϕ is on a decreasing path, a positive (negative) ξ implies that $\rho^f > (<) \rho^d$, so that the decrease in ϕ is generated by a slow decrease in d and a rapid decrease in f.

$$\frac{g_f\left(f^*, u\left(d^*, f^*\right)/\delta\left(d^*, f^*\right)\right)}{g_d\left(d^*, u\left(d^*, f^*\right)/\delta\left(d^*, f^*\right)\right)} = p, \tag{16}$$

$$rb^* + y^d + py^f = d^* + pf^*. \tag{17}$$

In the above, (14) represents $\dot{d} = 0$ where (13) and $g^* = 0$ are substituted successively into (12). (15) comes from (3) and (14) with $g^* = 0$. (16) is obtained from (10) and (15). (17) represents the external balance condition, $\dot{b} = 0$ (see (8)).

Given the terms of trade p, (14) and (16) jointly determine consumptions d^* and f^*. Steady-state welfare ϕ^* and net foreign assets b^* are then given by (15) and (17), respectively.

Figure 1 illustrates the determination of the steady-state equilibrium. Schedules RR' and PP' represent (14) and (16), respectively. RR' represents the locus of (d^*, f^*) which equalizes the steady-state rate of time preference to the world interest rate. PP' is the locus along which the intratemporal marginal rate of substitution equals the terms of trade. The RR'-schedule, which could be referred to as the steady-state time preference curve, necessarily has a negative slope, whereas the slope of PP' can take either sign. The figure assumes a normal case in which PP' is positively sloping. The steady-state consumption basket (d^*, f^*) is determined by the intersection point E of schedules RR' and PP'. Schedule BB', which goes through point E with slope $-1/p$, represents the external balance condition, (17). The horizontal intercept, i.e., point B, equals total income in terms of exportable goods, $rb^* + y^d + py^f$. From (16), if we define a steady-state indifference curve which corresponds to the steady-state utility level at point E as

$$I(E) \equiv \left\{ (d^*, f^*) \mid \frac{u\left(d^*, f^*\right)}{\delta\left(d^*, f^*\right)} = \text{utility at point } E \right\},$$

the curve should be tangent to schedule BB' at point E.[11] Schedule BB', as a budget line, determines steady-state asset holdings required for the equilibrium consumption basket at E. At point E, the slope $-1/p$ of the external balance schedule BB' and hence the gradient $-g_d/g_f$ of the steady-state indifference curve are smaller or larger *in magnitude* than the gradient $-\delta_d/\delta_f$ of the steady-state time preference curve RR' in accordance to whether nonseparability index ξ is positive or negative. In Figure 1, ξ is assumed to be

[11] The gradient of the long-run indifference curve equals $-g_d/g_f$, which is (the negative of) the left hand side of (16).

positive. As will be shown later, the relative magnitudes of the gradients of the two schedules, RR' and BB', play an important role in determining the steady-state effects of a permanent terms-of-trade deterioration on welfare and net foreign assets.

Given the steady-state equilibrium, the local dynamic system for $n \equiv (d, \phi, b)$ can be obtained by substituting (10) into (4), (8), and (12) and by linearizing the resulting system around the steady state as $\dot{n}(t) = A\hat{n}(t)$;

$$A \equiv \begin{pmatrix} -\frac{\xi g_f^2}{g_{ff}} & \frac{g_d}{g_{dd}}\left(\frac{g_f^2 \xi^2}{g_{ff}} + \frac{r\delta_d}{g_d}\right) & 0 \\ -g_d\left(1 + p^2 \frac{g_{dd}}{g_{ff}}\right) & r + \frac{\xi g_f^2}{g_{ff}} & 0 \\ -\left(1 + p^2 \frac{g_{dd}}{g_{ff}}\right) & p\frac{\xi g_f}{g_{ff}} & r \end{pmatrix}, \tag{18}$$

where the hats placed above the variables denote deviations from their steady-state values, e.g., $\hat{d}(t) = d(t) - d^*$; and the coefficient matrix is evaluated at the steady-state point.

We can show easily that the linear system has two positive and one negative roots, where the negative root is given by

$$\omega \equiv \frac{r - \sqrt{r^2 + \frac{4g_d^2 g_f^2}{g_{dd} g_{ff}} \Psi}}{2},$$

where

$$\Psi \equiv -\left\{\xi^2 + \frac{r\delta_d\delta_f}{g_d g_f}\left(\frac{g_{dd}}{\delta_d g_d} + \frac{g_{ff}}{\delta_f g_f}\right)\right\}, \tag{19}$$

which can be shown to be positive.[12] The other roots are r and the costate root of ω. As can easily be seen, either unstable root is not smaller than r, so that any other paths than the saddle path governed by ω cannot satisfy the no-Ponzi game condition. This implies that the relevant dynamic system exhibits saddle point stability.

[12] When $\xi > 0$, we can obtain from property (i) in (7)

$$\Psi > \frac{r\delta_d g_{ff}}{g_d g_f^2} - \frac{r\delta_d\delta_f}{g_d g_f}\left(\frac{g_{dd}}{g_d\delta_d} + \frac{g_{ff}}{g_f\delta_f}\right) = -\frac{r\delta_f g_{dd}}{g_d^2 g_f} > 0.$$

In the same way, we can show the positivity of Ψ for a negative ξ by using property (ii) in (7).

The saddle dynamics can be derived from the eigen vector associated with (18) as follows:

$$\dot{b}(t) = \omega \hat{b}(t), \ \hat{b}(0) = b_0 - b^*, \tag{20}$$

$$\hat{d}(t) = \frac{g_f^2}{(g_{ff} + p^2 g_{dd})} \left\{ \frac{g_{ff}(r-\omega)}{g_f^2} + \xi \right\} \hat{b}(t), \tag{21}$$

$$\hat{f}(t) = \frac{g_f g_d}{(g_{ff} + p^2 g_{dd})} \left\{ \frac{g_{dd}(r-\omega)}{g_d^2} - \xi \right\} \hat{b}(t), \tag{22}$$

$$\hat{\phi}(t) = g_d \hat{b}(t). \tag{23}$$

Equation (20) gives monotonic saddle dynamics for the state variable, b. Given the dynamics, transitional paths for consumptions d and f and welfare ϕ are determined on stable arms (21), (22), and (23), respectively.[13] The stable arms are all positively-sloping:[14] when an unanticipated permanent deterioration in the terms of trade takes place, consumptions d and f as well as lifetime utility ϕ co-move with net foreign assets b on the transitional path. In Figure 1, the saddle trajectory for $\left(\hat{d}(t), \hat{f}(t)\right)$, which is a linear subspace obtained by eliminating $\hat{b}$ from (21) and (22), is depicted as a positively-sloping trajectory SS'. Since this schedule depicts positive co-movements of d and f generated by (endogenous) wealth variation, it can be regarded as the wealth-consumption curve or the Engel curve defined with permanent income.

4 The effects of a terms-of-trade deterioration

Let us now examine the effects of an unanticipated, permanent increase in the terms of trade at the initial point in time, $t = 0$. Since the equilibrium dynamics along the saddle arm are monotonic, short-run effects on the current account are qualitatively the same as steady-state effects on external

[13]Equation (23) is easy to understand. Letting $J(b, p)$ denote the indirect utility function, we have $\phi = J(b, p)$, implying $\hat{\phi} = J_b \hat{b}$ in the case of a permanent change in p. (23) follows from this, since by the envelope theorem the shadow price J_b of wealth equals the marginal utility g_d of domestic-good consumption.

[14]The positivity of the slopes of (21) and (22) comes from (6).

asset holdings. For example, a reduction in b^* implies a current account deterioration in the interim run.

From (14) and (15), a permanent rise in the terms of trade p affects the steady-state consumption as follows:

$$\frac{\mathrm{d}d^*}{\mathrm{d}p} = \frac{r\delta_f}{g_f^2\Psi} > 0, \frac{\mathrm{d}f^*}{\mathrm{d}p} = -\frac{r\delta_d}{g_f^2\Psi} < 0, \tag{24}$$

where $\Psi(> 0)$ is given by (19). Thus, an increase in the foreign-good price p shifts consumption from f^* in favor of d^*.

By combining these results with (15) and (17), the steady-state effects on welfare and net foreign assets can be obtained as

$$\frac{\mathrm{d}\phi^*}{\mathrm{d}p} = -\frac{\xi}{p\Psi} \gtreqless 0 \text{ as } \xi \lesseqgtr 0, \tag{25}$$

$$\frac{\mathrm{d}b^*}{\mathrm{d}p} = \frac{f^* - y^f}{r} - \frac{\xi}{g_f\Psi} \gtreqless 0 \text{ as } \frac{f^* - y^f}{r} \gtreqless \frac{\xi}{g_f\Psi}. \tag{26}$$

From (25), the steady-state effect on welfare can be either positive or negative in accordance with whether the nonseparability index ξ is negative or positive. This is because when $\xi <(>)0$, i.e., when preference toward d is more (less) wealth-enhanced than that toward f, consumers are more (less) willing to increase d for f to maintain the discount rate than to keep lifetime utility. Therefore, since any changes in (d^*, f^*) should take place to keep δ fixed at r (see (14)), the positive effect of the increase in d^* given by the first equation of (24) on steady-state welfare u^*/δ^* dominates (is dominated by) the negative effect of the decrease in f^* shown by the second equation of (24). Intuitively, steady-state welfare adjusts to a terms-of-trade deterioration in such a way that it promotes consumption substitution from f^* to d^*: when preference toward d^* is more (less) wealth- and hence welfare-enhanced than toward f^*, steady-state welfare increases (decreases) so as to enhance the preference toward d^*.

When a terms-of-trade deterioration worsens steady-state welfare largely, the stock of net foreign assets may decrease correspondingly in the steady state and, hence, the current account may deteriorate in the interim run. Indeed, (26) shows that the effect on net foreign assets b^* depends crucially on the relative magnitudes of $\frac{f^*-y^f}{r}$ and $\frac{\xi}{g_f\Psi}$, which can be interpreted as follows: First of all, in response to a rise in the import price, net foreign assets and hence the interest revenue should increase to maintain the initial living standard. $\frac{f^{*}-y^{f}}{r}$ represents this *income-compensating effect*. Secondly, as shown by (25), since steady-state welfare is affected, financial wealth should change so as to support the welfare change. When ξ is positive (negative), ceteris paribus, net foreign assets should decumulate (accumulate) so as to realize a deterioration (an improvement) in steady-state welfare. This could be referred to as the *welfare-supporting effect*. The income-compensating effect is always positive, whereas the welfare-supporting effect can take either sign.[15] When ξ is negative, a permanent rise in the terms of trade necessarily improves the steady-state position of external assets, whereas in the case of a positive ξ, the terms-of-trade deterioration can reduce the steady-state net foreign assets due to a dominant negative welfare-supporting effect, thereby causing a current-account deficit, as in the case of the Harberger-Laursen-Metzler effect.

Proposition 1 *Consider the model with weakly nonseparable preference in section 2. Then, the Harberger-Laursen-Metzler effect takes place if and only if preference for imports is so wealth-enhanced that the negative welfare-supporting effect,* $-\xi/(g_f\Psi)$*, dominates the positive income-compensating effect,* $\left(f^{*}-y^{f}\right)/r$*.*

Remark 1 *When preference is weakly separable* ($\xi = 0$)*, the welfare-supporting effect degenerates, so that the current account is necessarily improved by the income-compensating effect, as Obstfeld (1982) and Svensson and Razin (1983) show.*

Remark 2 *We can indeed choose values for exogenous variables* (p, r, y^{d}, y^{f}) *such that the Harberger-Laursen-Metzler effect occurs* ($\xi/(g_f\Psi) > \left(f^{*}-y^{f}\right)/r$)*. From (14) and (16),* (d^{*}, f^{*}) *and hence* $\xi/(g_f\Psi)$ *do not depend on* (y^{d}, y^{f}) *but solely on* (p, r)*. Therefore, starting from an arbitrary initial steady-state equilibrium such that* $\xi > 0$ *and* $f^{*}-y^{f} > 0$*, where* $\xi/(g_f\Psi)$ *may be smaller than* $\left(f^{*}-y^{f}\right)/r$*, we can construct another equilibrium satisfying* $\xi/(g_f\Psi) > \left(f^{*}-y^{f}\right)/r$ *by choosing a sufficiently large value for* y^{f} *on one hand and fixing* (p, r) *at the arbitrarily-chosen, initial values on the other.*

[15] As in footnote 13, we can clarify the meanings of the two effects by using the indirect utility function $J(b; p)$. Differentiating $\phi^{*} = J(b^{*}; p)$ and rearranging the result yield $\mathrm{d}b^{*} = (1/J_b)\mathrm{d}\phi^{*} - (J_p/J_b)\mathrm{d}p$, where the first term can be regarded as the welfare-supporting effect and the second as the income-compensating effect.

Proposition 1 can be illustrated by using Figure 2, where p_0 and p_1 represent initial and new import-prices, respectively. For brevity, y^f is assumed to be zero, with production income being given by point Y on the d-axis. With initial steady-state consumption point E_0, the initial stock of net foreign assets (multiplied by r) is represented by B_0Y. Recall that the signs of ξ and hence of the welfare effect are determined by the relative gradients of the steady-state time preference curve RR' and the steady-state indifference curve $I(E_0)$ (see section 3). To depict the Harberger-Laursen-Metzler effect, Figure 2 focuses on the case of a sufficiently large ξ. As illustrated by the shift to schedule P_1P_1', a terms-of-trade deterioration shifts the PP'-schedule to the right, which brings the steady-state consumption point from E_0 to E_1, and correspondingly the steady-state external asset position from YB_0 to YB_1. The consumption shift can be decomposed into two parts: the shifts from E_0 to E_{01} and from E_{01} to E_1. The former represents a compensated consumption change. The gradient of the steady-state indifference curve $I(E_0)$ at point E_{01} equals $-1/p_1$. Segment $B_0'Y$ on the horizontal axis represents net foreign assets required for the compensated consumption under price p_1. The change from B_0 to B_0' thus represents the income-compensating effect. Since the steady-state indifference curve $I\left(E_0\right)$ is flatter than the steady-state time preference curve RR' in the present case, the consumption-change from point E_{01} to E_1 causes a long-run deterioration in welfare. The resulting negative income change from point B_0' to B_1 captures the welfare-supporting effect on net foreign assets. In Figure 2, the steady-state asset position deteriorates due to the dominant negative welfare-supporting effect.

In the case of weakly separable preference ($\xi = 0$), the intratemporal marginal rate of substitution, g_f/g_d, always equals the marginal rate of substitution along the steady-state time preference curve, δ_f/δ_d. In Figure 2, this means that the steady-state time preference curve RR' coincides with the steady-state indifference curve $I\left(E_0\right)$, for which case the welfare-supporting effect, $B_0' \rightarrow B_1$, degenerates. As stated in remark 1, therefore, a terms-of-trade deterioration increases the steady-state position of external assets through the income-compensating effect, $B_0 \rightarrow B_0'$.

In sum, when preference is weakly separable, there is a unique level of living standard which should be maintained in the steady state, so that, in response to a terms-of-trade deterioration, the current account should improve to attain the target living standard. In contrast, when preference is weakly nonseparable, the steady-state welfare level is variable, and the current account will adjust so as to support the welfare change. In particular, if a terms-of-trade deterioration is sufficiently harmful in the steady state, the current account should be worsened.

Transitional paths in the interim run are determined by the stable arms given by (20) through (23). In particular, as for the initial response of consumption, when a terms-of-trade deterioration increases steady-state external assets, which is the case when preference toward imports is not sufficiently wealth-enhanced, domestic-good consumption d instantly jumps upward by less than in the long run whereas foreign-good consumption f jumps downward by more than in the long run. At the same time, the rates of time preference, ρ^d and ρ^f, decrease instantly below the interest rate, which causes $d(t)$ and $f(t)$ to approach increasingly the steady-state levels over time.[16] In contrast, when the steady-state asset position is deteriorated, the initial upward jump in d overshoots its long-run increase while the initial discrete fall in f comes short of its long-run reduction. With ρ^d and ρ^f rising instantly above r, d and f after that gradually decrease toward the steady-state levels over time.

5 Discussions

5.1 Direct, welfare, and pure substitution effects

Within a two-period model, Svensson and Razin (1983) decompose the effect of a terms-of-trade deterioration into three different effects: (i) a direct effect, caused by a revaluation of the net export vector; (ii) a wealth or welfare effect, due to a welfare change; and (iii) a pure substitution effect, which results from compensated changes in consumption caused by the relative-price change. Their discussions can be recast using our description of the steady-state equilibrium.

[16] For $t \geq 0$, we obtain from (13)

$$\hat{\rho}^d(t) = \frac{g_f^2 g_{dd}\omega}{g_d(g_{ff}+p^2 g_{dd})}\left\{\frac{g_{ff}(r-\omega)}{g_f^2}+\xi\right\}\hat{b}(t),$$

$$\hat{\rho}^f(t) = \frac{g_d g_{ff}\omega}{g_{ff}+p^2 g_{dd}}\left\{\frac{g_{dd}(r-\omega)}{g_d^2}-\xi\right\}\hat{b}(t),$$

implying that $\hat{\rho}^d(t)\,\hat{b}(t) > 0$ and $\hat{\rho}^f(t)\,\hat{b}(t) > 0$.

From (14) through (16), the steady-state consumptions satisfy

$$\frac{u\left(d^{*},f^{*}\right)}{\delta\left(d^{*},f^{*}\right)}=\phi^{*} \text{ and } \frac{g_{f}\left(f^{*},\phi^{*}\right)}{g_{d}\left(d^{*},\phi^{*}\right)}=p.$$

They are thus affected by changes in p and ϕ^{*} as

$$\begin{pmatrix} \mathrm{d}d^{*} \\ \mathrm{d}f^{*} \end{pmatrix}=\frac{1}{\Omega}\begin{pmatrix} \frac{p}{r}\left(p-\delta_{f}\right)-\frac{g_{ff}}{g_{d}} \\ \frac{1}{r}\left(\delta_{f}-p\delta_{d}\right)-\frac{pg_{ff}}{g_{d}} \end{pmatrix}\mathrm{d}\phi^{*}+\frac{1}{\Omega}\begin{pmatrix} \frac{g_{f}}{r} \\ -\frac{g_{d}}{r} \end{pmatrix}\mathrm{d}p, \qquad (27)$$

where $\Omega=-\left(g_{ff}+p^{2}g_{dd}\right)/r\ (>0)$. On the right hand side of (27), the first and second terms represent welfare and pure substitution effects on consumptions, respectively. The effect on steady-state spending $z^{*}(\equiv d^{*}+pf^{*})$ is obtained from (27) as

$$\mathrm{d}z^{*}=f^{*}\mathrm{d}p+\frac{1}{\Omega}\left(p,1\right)\begin{pmatrix} \frac{p}{r}\left(p-\delta_{f}\right)-\frac{g_{ff}}{g_{d}} \\ \frac{1}{r}\left(\delta_{f}-p\delta_{d}\right)-\frac{pg_{ff}}{g_{d}} \end{pmatrix}\mathrm{d}\phi^{*}.$$

In the above, the first term on the right hand side represents what Svensson and Razin call a direct effect and the second, a welfare or wealth effect. The direct and wealth effects thus equal our income-compensating, and welfare-supporting effects, respectively. Note, however, that pure substitution effects on both spending and the current account are always zero since, as can be seen from (16) and the second term of (27), pure substitution effects on d^{*} and f^{*} just offset each other. Proposition 1 implies that the Harberger-Laursen-Metzler effect takes place when the "wealth effect" on steady-state spending is dominantly negative.

In Figure 2, pure substitution and wealth effects on *consumption* are depicted by the changes from points E_0 to E_{01} and from points E_{01} to E_1, respectively. The direct and wealth effects on *spending* and the current account are illustrated by the changes from B_0 to B_0' (i.e., the income-compensating effect) and from point B_0' to B_1 (i.e., the welfare-supporting effect), respectively.[17]

[17] In Figure 2, the property that the pure substitution effect on spending is zero can be seen by noting that the intercept on the d-axis of the line segment from point E_{01} with the slope of $-1/p_0$ is nearly identical to point B_0, which represents initial spending.

5.2 Empirical implications

Regarding empirical implications, it is worthwhile noting the following three points. First, Backus et al. (1994) report that signs of correlation between changes in the terms of trade and those in the trade account differ internationally. Proposition 1 shows that even with the assumption of increasing impatience we could account for this mixed result consistently by incorporating weak nonseparability.

Secondly, to obtain a testable prediction from our result, it is useful to recognize the relation between the notion of luxury goods and the sign of nonseparability index ξ. From (21) and (22), we have $\frac{\mathrm{dln}pf}{\mathrm{dln}d} = \frac{\gamma^{\mathrm{d}} + d\xi/(r-\omega)}{\gamma^{\mathrm{f}} - pf\xi/(r-\omega)}$ along the Engel curve (i.e., schedule SS' in Figure 1), where $\gamma^d = -dg_{dd}/g_d$ and $\gamma^f = -pfg_{ff}/g_f$ represent measures of the desire to smooth consumption.[18] This and the identity $\frac{d}{z}\frac{\mathrm{dln}d}{\mathrm{dln}z} + \frac{pf}{z}\frac{\mathrm{dln}pf}{\mathrm{dln}z} = 1$ imply

$$\frac{\mathrm{dln}pf}{\mathrm{dln}z} = \left(\frac{pf}{d} + \frac{\gamma^f - pf\xi/\left(r-\omega\right)}{\gamma^d + d\xi/\left(r-\omega\right)}\right)^{-1}\left(\frac{pf}{d} + 1\right).$$

Whether the consumption share of f in total spending z is increasing or decreasing in wealth is thus determined as:

$$\frac{\mathrm{d}\left(pf/z\right)}{\mathrm{d}b} \ \mathsf{R}\ 0 \Leftrightarrow \frac{\xi z}{r-\omega} + \left(\gamma^d - \gamma^f\right) \ \mathsf{R}\ 0. \tag{28}$$

Therefore, if a difference between γ^d and γ^f is negligible, the sign of ξ determines which good increases its share in total spending when wealth increases, that is, which good is a luxury. When preference toward f is more wealth-enhanced ($\xi > 0$), f is a luxury, and vice versa. Proposition 1 predicts that the Harberger-Laursen-Metzler effect likely holds valid if imports are luxuries. In the first step, the empirical validity of our proposition could be checked by examining how correlations between the current account and the terms of trade depend on the shares of luxury-goods in imports and exports.

Conversely, provided that our model successfully describes the real world, we could predict the steady-state welfare effect from empirical information about correlations between the current account and the terms of trade. For example, in Japan and many European countries like U.K. and France, it is reported that net exports and the terms of trade display strong negative correlations with each other (see Backus et al. (1994)). From proposition 1,

[18] Epstein (p.76, 1987) uses a similar terminology.

this means that ξ must be large enough, implying in turn from (15) that an increase in the terms of trade will have a substantial detrimental effect on steady-state welfare in these countries.

6 Concluding remarks

To give a new insight into current-account dynamics under endogenous time preference, we have incorporated weakly nonseparable preference. Due to adjustment through steady-state welfare changes, the Harberger-Laursen-Metzler effect can occur even if impatience is increasing in welfare.

As can easily be seen from (19), decreasing impatience would destabilize the equilibrium dynamics on the saddle path, thereby inducing various technical difficulties. To avoid this, we must incorporate some stabilizing factors into the model. For example, we can show that with capital market imperfection the equilibrium dynamics can be stable even under decreasing impatience. By using such models, it would be interesting to examine the implications of decreasing impatience for the effect of a terms-of-trade deterioration.

As a stylized fact which we have not discussed here, Backus et al. (1994) report some non-monotonic adjustments of the current account, such as the J-curve dynamics. To explain the fact, there may be several ways of extension. The most natural and direct one is to consider temporary or/and anticipated changes in the terms of trade, as in Persson and Svensson (1985). As conjectured from Obstfeld (1990), it will produce some nonmonotonic dynamics of the current account.

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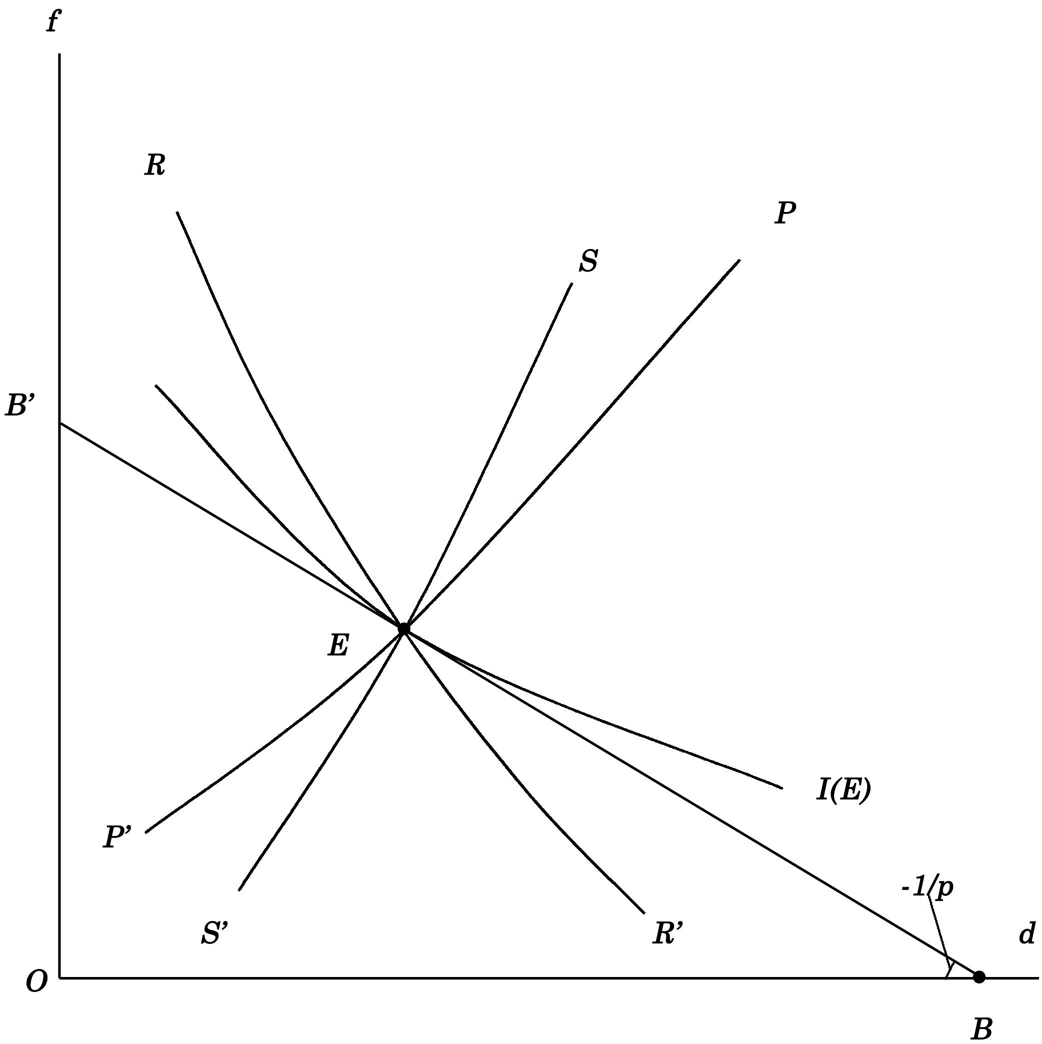

Figure 1. Steady-state equilibrium: $\xi > 0$.

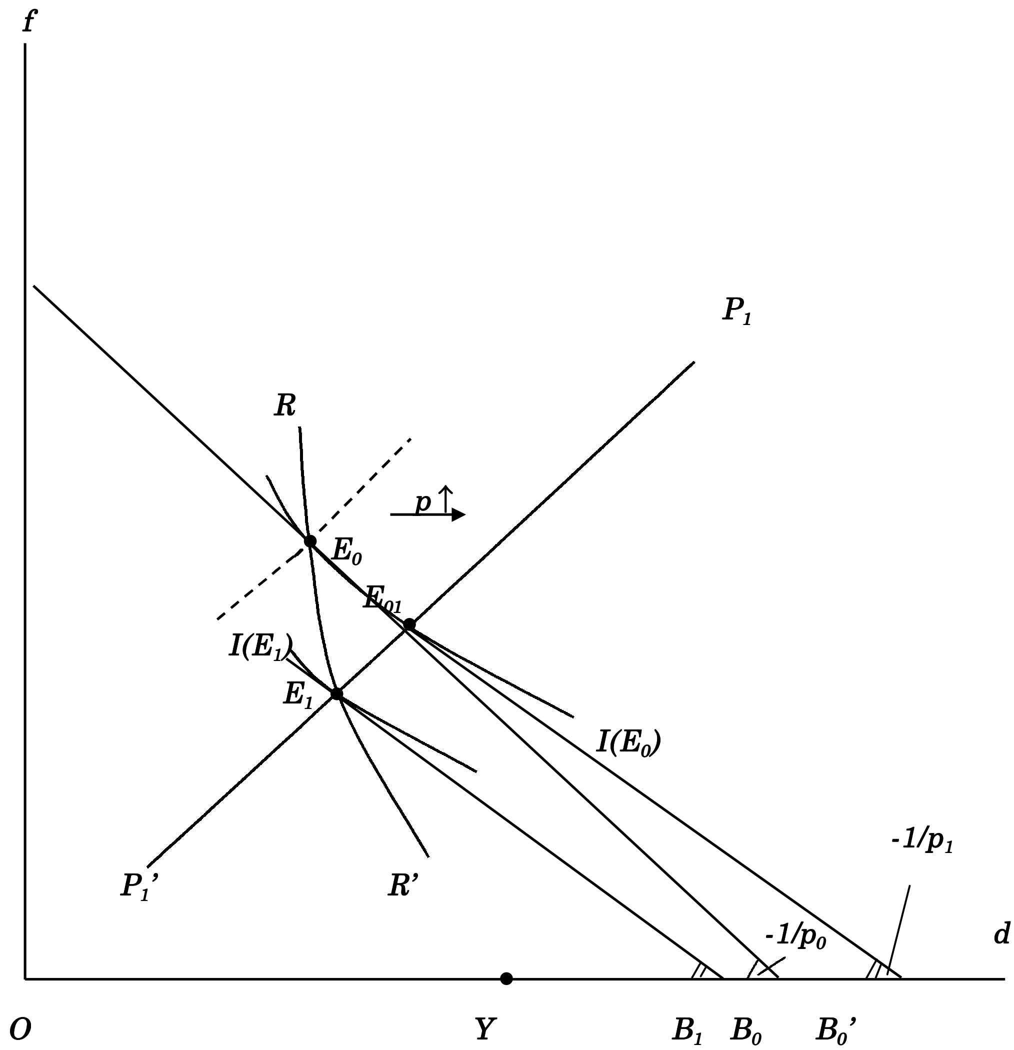

Figure 2. The effects of a terms-of-trade deterioration:
$\xi / (g_f \Psi) > (f^* - y^f)/r$.