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ARTICLES

ANOTHER VIEW OF THE J-CURVE

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Most of empirical studies find evidence of the J-Curve, but recent results cast doubt over its standard explanation. By addressing the countercyclicality of the current account and its dynamic link with the terms of trade, this paper revisits the J-Curve phenomenon using a two-good dynamic optimizing small open economy model allowing for a habit-forming behavior and capital adjustment costs. While the nonmonotonic adjustment of the current account relies on the degree of habit persistence in consumption and the magnitude of capital installation costs after an unanticipated terms of trade worsening, we show that the sizes of the long-run intertemporal elasticity of substitution under time nonseparable preferences and the import content of real consumption and investment matter as well after a temporary perturbation. As a consequence of an intertemporal speculation effect and an inertia effect, the small country reaches the long-term equilibrium with higher foreign assets after a short-lived terms of trade worsening.

Keywords: Current Account, Habit Formation, Temporary Shock, J-Curve

1. INTRODUCTION

Understanding the relationship between the current account and the relative prices is a central subject in international economics. According to early theoretical work, a terms of trade worsening deteriorates first the trade balance and then brings it in a long-run improvement. Commonly labeled the J-Curve phenomenon, the short-run and long-run dynamics of the trade balance rely on the sizes of import and export demand elasticities.[1] But recent empirical studies cast doubt over the standard J-Curve explanation. Along the elasticity approach, once trade volumes adjust,

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the fall in the home goods' relative price leads to an increase in aggregate demand for domestic products, thereby raising exports and real GDP (associated with a current account surplus phase). While data confirm the J-Curve phenomenon,[2] Leonard and Stockman (2002) and Freund (2005) show that countries experienced a real GDP decline during the years of current account improvement. Obviously, the first attempts to explain the time path followed by the trade balance after a terms of trade worsening feature serious drawbacks by ignoring intertemporal aspects, focusing only on net exports and competitiveness aspects, and relying on partial equilibrium approach. We believe that the mechanism by which relative prices may influence the current account (and not the trade balance) dynamics may be best understood by means of a dynamic general equilibrium approach, allowing saving and investment choices of forward-looking agents to explain the J-Curve phenomenon.

Given the limitation of the standard model to replicate the observed empirical facts, we revisit the J-Curve phenomenon by using a novel two-good small open economy model incorporating sound micro-theoretic foundations. Allowing for a habit-forming behavior on the consumption-side and capital installation costs on the production-side, we provide another view of the J-Curve consistent with the countercyclical current account observed in the data, considering both permanent and temporary relative price disturbances. In fact, our contribution complements two studies that propose a new explanation of deficit-surplus sequence of the current account using an intertemporal-maximizing framework.

Backus, Kehoe, and Kydland (1994) initiated the restatement of the J-Curve phenomenon within a dynamic general equilibrium model. They elaborate a two-country setup such that terms of trade are endogenous, and they analyze productivity and government spending shocks. In addition, they assume that agents have time separable preferences such that current fluctuations are mainly driven by investment dynamics, which contradicts recent empirical results [see Freund (2005) and Gruber (2002)]. Instead, we suppose that the economy is small on international capital markets and world good markets such that the terms of trade and the world interest rate are given for the country. More important, we introduce time nonseparable preferences giving rise to consumption sluggishness, which allow the current account to be determined by a more realistic interaction of saving and investment adjustment and not only by capital goods investment reaction. Finally, taking advantage of the present model's tractability to extract analytical results, we propose new insights of the current account dynamics by emphasizing the key role of the speeds of adjustment of saving (depending on habit persistence in consumption) and investment (depending on capital installation costs). Our analysis is also close to Mansoorian (1998), who introduces simultaneously habits and consumption durable goods in an endowment small open economy model to address the nonmonotonic adjustment of the current account. Two notable drawbacks to this approach are, however, worth mentioning. Mansoorian abstracts from capital accumulation and restricts his study to permanent terms of trade shocks. First, the assumption of an endowment economy eliminates the growth issue, and more particularly the countercyclicality of the current account, which is of particular

interest, as emphasized by recent empirical studies. Second, focusing exclusively on the effects of permanent perturbations severely limits the predictions of the model. We show that the short-term responses of saving and investment and long-term effects on the real consumption and the stock of foreign assets responses may be opposite to the responses obtained after a permanent perturbation.

Our formalization may be viewed as a two-good extension of Ikeda and Gombi's (1998) model by considering that consumption and investment have an import content.[3] This simple modification is particularly appealing for two reasons. First, it captures one important common characteristic to small open economies, which are strongly dependant on export income generated from a few products and highly dependent on imports for its capital formation. Ikeda and Gombi abstract from this feature. Second, our model leads to a *pure wealth* effect but also a *real interest rate* effect that interacts with an *inertia* effect, which is absent from Ikeda and Gombi's one-good model. The strength of this novel channel through which terms of trade changes may influence savings and investment depends on the duration of the shock, the domestic contents of consumption and investment expenditure, and the long-run intertemporal elasticity of substitution under time nonseparable preferences.

Our first main finding is as follows. After an unanticipated permanent terms of trade worsening, the current account originally deteriorates as the negative saving flow induced by habit persistence in consumption habits outweighs the negative investment flow if capital installation costs are sufficiently high. The current account then adjusts nonmonotonically if the speed of adjustment of habits is higher than the speed of adjustment of the capital stock. This condition is supported by Freund (2005), who shows that the current account worsens in the first phase mainly through the decline in national savings and then improves primarily through the reduced investment. In accordance with the evidence documented by Leonard and Stockman (2002), the current account adjustment is nonmonotonic and its improvement is associated with a fall in the real income.

Our second main finding is probably the most startling. Following a short-lived transitory terms of trade deterioration, real consumption and investment dynamics display a nonmonotonic adjustment. This implies in turn that the *J*-shape response of the net foreign assets is no longer constrained by the speeds of adjustment of habits and capital stock. Instead, we demonstrate that the J-Curve phenomenon relies on the combination of four effects: a *smoothing* effect originating from the temporary nature of the perturbation, an *intertemporal speculation* effect (or a *real interest rate* effect) induced by the transitory fall of consumption-based and investment-based real interest rates,[4] an *inertia* effect stemming from consumption habits, and an *hysteresis* effect because of the dependence of steady state on initial conditions. During the first phase, the negative saving flow coupled with the positive investment flow deteriorates the current account. Once terms of trade are restored back to their initial level, saving and investment flows are reversed, the current account turns to be positive, and real income falls. Finally, the small open economy reaches the new steady-state with a higher stock of foreign assets.

The paper is organized as follows. In Section 2, we present the framework of a two-good small open economy model with habit formation on the consumption-side and capital installation costs on the production-side. Then we analyze succinctly the equilibrium dynamics and the steady-state of the model. Section 3 explores the effects of an unanticipated permanent terms of trade worsening. In Section 4, we investigate the impact of an adverse transitory relative price perturbation on current account dynamics, contrasting savings and investment responses with their reactions prevailing after a permanent shock. We conclude in Section 5.

2. THE FRAMEWORK

Consider a small open economy that is populated by a constant number of identical households and firms that have perfect foresight and live forever. We normalize, without loss of generality, the number of households to one. There are four types of goods. The representative firm is completely specialized in the production of a final good that can be consumed domestically or exported. This good also can be transformed, at some cost, in capital. The domestic good is an imperfect substitute for an imported good, which can be used for consumption or investment. The country is small in world goods and capital markets and faces given terms of trade (price of the domestic good in terms of the foreign good), p, and world interest rate, r^*.

2.1. Structure of the Economy

2.1.1. Households. At each instant the representative household consumes domestic goods and foreign goods denoted by d and f. The measure of utility of consumption at t, $c(t)$, is given by the relationship $c(t) = c(d(t), f(t))$, with $c(.)$ a positive, increasing, concave, and linearly homogeneous aggregator function. The representative household maximizes the objective function:[5]

$$U[C(0)] = \int_0^{\infty} u[c(d(t), f(t)), s(t)] \exp(-\delta t)\, \mathrm{d}t, \tag{1}$$

where δ is the consumer's discount rate, and $s(t)$ a distributed lag on past real consumption as Ryder and Heal (1973),

$$s(t) = \sigma \int_{-\infty}^{t} c(d(\tau), f(\tau)) \exp(-\sigma(t - \tau))\, \mathrm{d}\tau, \tag{2}$$

with the parameter $\sigma \geq 0$ determining the relative weights of consumption at different times. The time derivative of (2) gives the dynamic equation of the habit stock:

$$\dot{s}(t) = \sigma[c(t) - s(t)]. \tag{3}$$

The lower σ, the more important is consumption in the distant past, and the slower the gap between habits and real consumption is fulfilled.

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Because $c(.)$ is homothetic, the household's maximization problem can be decomposed into two stages. At the *first stage*, the household minimizes the cost, $z_c(t) = p(t)d(t) + f(t)$, for a given level of subutility, $c(t)$, where $p(t)$ is the relative price of the domestic good. The assumption that the subutility function $c(.)$ is linear homogeneous implies that the total expense in consumption goods can be expressed as $z_c(t) = p_c(p(t))c(t)$. The ratio z_c/c gives the unit cost function dual to c (or consumption-based price index), denoted by $p_c(p)$, with $p_c' > 0$, and $p_c'' < 0$. Intratemporal allocations between domestic goods and imports follow from Sheppard's Lemma (or the envelope theorem): $d = p_c'c$ and $f = [p_c - pp_c']c$. In the *second stage*, consumers choose their real consumption, c, and rates of accumulation of consumption "experience" and traded bonds to maximize (1) subject to (2) and the flow budget constraint,

$$\dot{b}(t) = r^*b(t) + [D(t) + w(t)] - p_c(p(t))c(t), \tag{4}$$

and initial conditions $s(0) = s_0$, $b(0) = b_0$. Households' income consists of interest earnings, $r^*b(t)$, dividend payments on equity holdings, $D(t)$; moreover, households inelastically supply one unit of labor services and receive the wage, $w(t)$, per unit of time. The real stock of foreign assets held by the household, $b(t)$, is denominated in terms of the imported good.

2.1.2. Firms. Perfectly competitive firms produce output, Y, from labor, l, and capital, k, by means of a constant returns to scale production function, having the usual neoclassical properties. Like Abel and Blanchard (1983), the installation cost function $\psi(I/k)$ is assumed to satisfy:

$$\psi(0) = 0, \quad \psi'(.) > 0, \quad 2\psi'(.) + \frac{I}{k}\psi''(.) > 0. \tag{5}$$

Following Servèn (1999), we consider that domestic and imported goods are converted in an investment good according to a linearly homogeneous technology, $J(t) = J(J_D(t), J_F(t))$, with J_D and J_F the domestic and foreign inputs combined into the investment process. Because $J(.)$ is homogeneous of degree one, the investment decision can be done in two stages such as consumption choice. In the *first stage*, domestic firms minimize total investment expenditure on capital goods, from which we obtain investment demand for both the domestic and the imported equipment good. In the *second stage*, the representative firm maximizes the present value of anticipated future cash flow:

$$\max_{\{I(t),l(t)\}} \int_0^\infty D(t)e^{-r^*t}\,\mathrm{d}t$$

$$= \max_{\{I(t),l(t)\}} \int_0^\infty \{pF(k,l) - wl - p_I I[1 + \psi(I/k)]\}e^{-r^*t}\,\mathrm{d}t, \tag{6a}$$

$$\text{subject to} \quad \dot{k}(t) = I(t), \tag{6b}$$

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and the initial condition, $k(0) = k_0$. The term $J = I[1 + \psi(I/k)]$ refers to total investment expenditure, including capital installation costs; we denote by $p_I(p)$ the exact investment price index which is a function of terms of trade and has the following properties: $p_I' > 0$, $p_I'' < 0$. From Sheppard's lemma, we obtain investment demand for the domestic and the imported good: $J_D = p_I' J$ and $J_F = [p_I - pp_I']J$.

2.2. Macroeconomic Equilibrium

To obtain the macroeconomic equilibrium, we first derive the optimality conditions for households and firms and combine these with the accumulation equations. This leads to the set of equations:[6]

$$u_1(c, s) + \sigma\xi = p_c(p)\lambda, \tag{7a}$$

$$F_l(k, 1) = w/p, \tag{7b}$$

$$q/p_I(p) = [1 + \psi(I/k) + (I/k)\psi'(I/k)], \tag{7c}$$

$$\dot{\lambda} = 0, \quad \text{i.e.,} \quad \lambda = \bar{\lambda}, \tag{7d}$$

$$\dot{\xi} = (\delta + \sigma)\xi - u_2(c, s), \tag{7e}$$

$$\dot{q} = r^*q - [pF_k(k, 1) + p_I(p)(I/k)^2\psi'(I/k)], \tag{7f}$$

$$\dot{b} = r^*b + pF(k, 1) - p_c(p)c - p_I(p)I[1 + \psi(I/k)], \tag{7g}$$

and dynamic equations (3) and (6b), and the transversality conditions:

$$\lim_{t\to\infty} \bar{\lambda} b \exp(-r^*t) = \lim_{t\to\infty} \xi s \exp(-r^*t) = \lim_{t\to\infty} qk \exp(-r^*t) = 0, \tag{8}$$

where λ, ξ, q are the co-state variables associated with dynamic equations (4), (2), and (6b). The first transversality condition of (8) rules out the possibility of running up infinite debt or credit and ensures that the nation remains intertemporally solvent.

The solution of the differential equation (7e) using (8) is given by

$$\xi(t) = \int_t^\infty u_2(c(\tau), s(\tau))e^{-(\delta+\sigma)(\tau-t)}\, d\tau. \tag{9}$$

The shadow value of the reference stock is equal to the present discounted value of marginal disutility of consumption "experience," $u_2 \leq 0$, which depreciates at the rate σ. Because an increase in s reduces instantaneous welfare for a given level of real consumption, the shadow value of the habit stock is negative.

Solving (7f) forward and ruling out "bubble trajectories," we obtain

$$q(t) = \int_t^\infty \{pF_k[k(\tau), 1] + p_I(p)(I/k)^2\psi'(.)\}e^{-r^*(\tau-t)}\, d\tau. \tag{10}$$

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According to (10), the shadow price of capital is equal to the present discounted value of the sum of the marginal product of capital and the reduction of the marginal cost induced by an increase in the capital stock for a given flow of investment, both expressed in the foreign good.

The first static efficiency condition (7a) requires that along an optimal path the sum of marginal current utility of real expense and its marginal contribution to the future felicity stream derived from a higher habitual standard of living is equal to the marginal utility of wealth in the form of internationally traded bonds measured in terms of the domestic good, $p_c\lambda$. The second static efficiency condition (7b) establishes the usual equality between the marginal productivity of labor and the real wage. Equation (7c) equates the ratio of market price of installed capital to the replacement cost of capital, that is, the Tobin's q, to the marginal cost investment. The static efficiency condition (7c) implies that the rate of investment is a function of Tobin's q:

$$I/k = \kappa(q/p_I(p)), \quad \kappa'(.) > 0, \quad \kappa(1) = 0. \tag{11}$$

From (11), the rate of investment rises when the market price of capital is higher than investment replacement cost, that is to say, the Tobin's q is greater than one.

With a constant rate of time preference and an exogenous world interest rate, we require that

$$\delta = r^*, \tag{12}$$

in order to generate an interior solution. This standard assumption made in the literature implies that the marginal utility of wealth, λ, must remain constant over time [see (7d)], and gives rise to the zero-root property [see Sen and Turnovsky (1990)]. Unlike a small open economy model with conventional preferences and facing perfect world capital markets, the zero-root feature does not lead to an immediate jump of variables to the steady state. In contrast, the introduction of the reference stock implies a variable time preference rate, which in turn restores transitional dynamics for real consumption path. This can be seen more formally by totally differentiating equation (7a), substituting (3) and (7e), and eliminating ξ by using (7a). These manipulations lead to the following dynamic equation for real consumption:

$$\dot{c} = -\frac{p_c\lambda}{u_{11}}\left(r^* - \alpha_c\frac{\dot{p}}{p} - \rho(t)\right), \tag{13}$$

where the expression of the time preference rate is given by:[7]

$$\rho(t) = \frac{1}{p_c\lambda}[(\delta+\sigma)(u_1 - p_c\lambda) + \sigma u_2 - u_{12}\sigma(c-s)] + \delta. \tag{14}$$

Because a permanent or a transitory shock impinges on $\rho(t)$, the temporal path of real consumption is no longer flat. Instead, consumption adjusts smoothly to its steady-state value, while the time preference rate converges toward its long-run level, δ.

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2.2.1. Equilibrium dynamics. Inserting the short run static solution (11) in (6b) and (7f), linearizing them together with dynamic equations (2) and (13) around the steady state, we obtained a fourth-order linearized system featured by an independency between consumption choices and investment decisions. The Fisherian separation theorem implies that the matrix is block recursive. Because the number of predetermined variables equals the number of negative eigenvalues (say, μ_1, χ_1) and the number of jump variables equals the number of positive eigenvalues (say, μ_2, χ_2), so there exists a unique convergent path toward the steady-state if the following condition holds:

$$\Gamma < -\left(\frac{\delta+\sigma}{\delta+2\sigma}\right)u_{11}, \quad \text{with} \quad \Gamma = u_{12} + \frac{\sigma}{\delta+2\sigma}u_{22} \lesseqgtr 0. \tag{15}$$

The sign of Γ depends on u_{12}. If the marginal utility of real consumption is sufficiently increasing in the stock of habits, then Γ is positive: the preferences of the representative consumer are said to display "adjacent complementarity" [see Ryder and Heal (1973)]. If u_{12} has a negative or a low positive value, Γ is negative and preferences are said to display "distant complementarity." Inequality (15) is necessary to ensure that adjacent complementarity is not too strong and that the dynamic system exhibits a saddle point stability [see Becker and Murphy (1988)].

Using standard methods, the stable dynamic time paths followed by c and q are given by:

$$c(t) = \bar{c} + \left(\frac{\sigma+\mu_1}{\sigma}\right)(s_0 - \bar{s})e^{\mu_1 t}, \quad q(t) = \bar{q} + \left(\frac{p_I\chi_1}{\kappa'(1)\bar{k}}\right)(k_0 - \bar{k})e^{\chi_1 t}. \tag{16}$$

When the stock of habits is expected to be higher, real consumption and habitual standard of living co-vary in the same or in an opposite direction according to whether $(\sigma + \mu_1)$ is positive (adjacent complementarity) or negative (distant complementarity), that is, according to whether the marginal current utility of real consumption is sufficiently strongly increasing or decreasing (or weakly increasing) in future "consumption experience" with respect to the increase of marginal desutility of habits. Thereafter, we will assume that preferences exhibit adjacent complementarity.[8] The solution for q indicates that the capital stock and its market price covary in opposite direction along the stable branch, which is downward-sloping in the (k, q)-space.

The stable solution for $b(t)$ consistent with long-run solvency writes as follows:

$$(b(t) - \bar{b}) = -p_I(k(t) - \bar{k}) - \frac{p_c(\sigma+\mu_1)}{\sigma(\mu_1 - r^*)}(s(t) - \bar{s}). \tag{17}$$

This equation indicates that the stock of internationally traded bonds moves, along a stable path, in the same direction than the stock of habits if preferences display adjacent complementarity.

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2.2.2. Steady state. The steady state of the economy is obtained by setting $\dot{c}, \dot{s}, \dot{k}, \dot{q}, \dot{b} = 0$. Applying the *two-step* solution method described by Schubert and Turnovsky (2002), we first solve equations as functions of marginal utility of wealth expressed in terms of the foreign good, $\bar{\lambda}$, and of the terms of trade, p. This yields to the following functions:

$$\bar{s} = \bar{c} = t(\bar{\lambda}, p), \quad \bar{k} = u(p), \quad \bar{q} = p_I(p), \quad \bar{b} = v(\bar{\lambda}, p), \tag{18}$$

with $t_{\bar{\lambda}} < 0$, $t_p < 0$, $u_p > 0$, $p_I' > 0$, $v_{\bar{\lambda}} < 0$ and $v_p < 0$. In the second step, we insert these functions into the economy's intertemporal budget constraint:

$$(b_0 - \bar{b}) = -p_I(k_0 - \bar{k}) - \frac{p_c(\sigma + \mu_1)}{\sigma(\mu_1 - r^*)}(s_0 - \bar{s}), \tag{19}$$

which may be solved for the equilibrium value of the marginal utility of wealth:

$$\bar{\lambda} = g(s_0, k_0, b_0, p), \quad \lambda_s \gtrless 0, \quad \lambda_k < 0, \quad \lambda_b < 0, \quad \lambda_p < 0. \tag{20}$$

Substituting then $\bar{\lambda}$ into the other steady-state functions (18) gives the conventional steady-state values of the economy as functions of the terms of trade and the initial conditions, k_0, b_0 and s_0 (except for production-side variables, k and q). The linearized version of the nation's intertemporal budget constraint (19) implies that the steady state depends on the initial stocks k_0, b_0, and s_0. The dependency on initial conditions comes from the assumptions of infinitely lived maximizing agents having a constant rate of discount and facing perfect capital markets. This leads to the zero-root property which generates hysteresis effects, that is, temporary terms of trade disturbances have permanent effects [see Sen and Turnovsky (1990)].

3. AN UNANTICIPATED PERMANENT DETERIORATION OF TERMS OF TRADE

We investigate the effects of an unanticipated permanent decrease in the relative price of the domestic good (denoted by the subscript perm), p, from p_0 to p_1, which occurs at time $t = 0$, where the economy is originally in steady state.[9] Because of perfect foresight assumption, the transitional dynamics are affected by the expected long-run state of the economy.[10]

3.1.1. Steady-state changes. A permanent decrease in p reduces the purchasing power of exports in terms of consumption goods, $[(\bar{Y} - \bar{d})/p_c]\mathrm{d}p < 0$. The subsequent fall in the permanent real income lowers real consumption and habit stock in the long run by the same amount.[11] But because households display a habit-forming behavior, they will not cut their consumption in the short run by the same amount than in the long run because they wish to keep their habitual standard of living. Because the marginal propensity to consume is less than unity, a permanent terms of trade worsening is then followed by a negative flow of saving.

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This behavior is in sharp contrast with the adjustment obtained with conventional time separable preferences because, in the latter case, the marginal propensity to consume is equal to unity, the economy jumps immediately to its new steady state, and the permanent shock leaves unaffected savings.

Regarding production decisions of domestic firms, the permanent fall in p leads to a drop in the marginal product of capital (expressed in the foreign good) greater in absolute value than the reduction of the real user cost of capital. Adjustment in the long-run calls for a lower capital stock, $\bar{k}_{\text{perm}}$. The subsequent negative investment flow makes the real income decreasing during the stable adjustment.

The long-run change in the stock of foreign assets, $\bar{b}$, is the result of two conflictory forces. This ambiguity arises from the two possibly offsetting effects that lower financial wealth and capital stock have on the long-term net foreign asset position:

$$(\mathrm{d}\bar{b}/\mathrm{d}p)|^{\text{adj}}_{\text{perm}} = \underbrace{(\mathrm{d}\bar{a}/\mathrm{d}p)|^{\text{adj}}_{\text{perm}}}_{(+)} \underbrace{-p_I(\mathrm{d}\bar{k}/\mathrm{d}p)|_{\text{perm}}}_{(-)} > 0, \tag{21}$$

where the superscript "adj" means that we refer to the adjacent complementarity case. We denote by a the financial (or nonhuman) wealth held by households, which is equal to the sum of the value of domestic equities and the value of internationally traded bonds, that is, $a = qk + b$. We assume a sufficiently strong habit persistence in consumption resulting in a long-run fall in financial wealth, which more than outweighs the long-run decline in the capital stock and therefore leads to a long-run decrease in the stock of foreign assets (keeping in mind that $\mathrm{d}p < 0$). Because in a perfect foresight intertemporal-equilibrium model the short-run dynamics of the variables are dictated by the long-run changes, the Harberger-Laursen-Metzler (H-L-M hereafter) effect, according to which a terms of trade worsening leads to an initial current account deficit, holds.[12]

3.1.2. Transitional dynamics. Having discussed the long-term responses, we now investigate the dynamic transition toward the long-run equilibrium. As the stable manifold for the stock of foreign assets is two-dimensional, its speed of convergence is a weighted average of the speeds of adjustment of saving and investment. The flexibility provided by the additional eigenvalue allows the system to match the nonmonotonic convergence of the current account featured by the data. Because we are interested in providing a new explanation of the J-Curve phenomenon, we restrict the study by assuming that: (i) the representative household's preferences exhibit adjacent complementarity ($(\sigma + \mu_1)^{\text{adj}} > 0$), (ii) the adjustment speed $|\mu_1|$ of habits is higher than the adjustment speed $|\chi_1|$ of capital,[13] and (iii) inequality (21), according to which a permanent terms of trade worsening reduces the stock of foreign assets in the long run, holds.

Transitional dynamics can be disentangled in two phases by noting that there exists a date $t = \tilde{t}$ [with $ca(\tilde{t}) = 0$] such that the stock of foreign assets overshoots along the stable trajectory [see Figure 1(a)]. An unanticipated permanent terms

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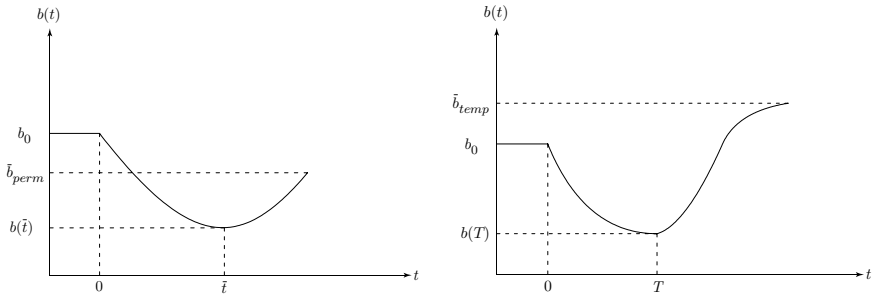

(a) A permanent terms of trade worsening and the stock of foreign assets

(b) A temporary terms of trade worsening and the stock of foreign assets

FIGURE 1. The J-Curve phenomenon.

of trade worsening leads to an immediate decumulation of foreign bonds and a deterioration in the trade balance, the initial level of b being predetermined. The current account deficit, $ca(0)$, is a consequence of the fact that the initial negative flow of saving, $S(0) < 0$, more than outweighs the influence of the initial negative flow of investment, which gives rise to the H-L-M effect (see Figure 2). The assumption of a habit-forming behavior implies a decline in real consumption but less than proportional to the reduction in permanent income, that is, generates an "excess smoothness" of consumption, and therefore leads to a fall in financial wealth. The economic intuition behind this result can be explained as follows. Agents choose $c(0)$ by assigning a positive weight to the initial stock of habits, s_0, and a weight less than one to the annuity value of total wealth deflated by the consumption price index, $r^*[b_0 + W(0)]/p_c$, i.e. the permanent income. Therefore, households will reduce initially their consumption but less than the drop in real income. Along the stable adjustment, real consumption remains above its steady-state value, which in turn leads to a decumulation of financial wealth. At the same time, high installation costs imply a slow adjustment speed of capital stock, and then a small initial decumulation of equipment goods.

During the *first phase* ($0 < t \leq \tilde{t}$), consumption experience and physical capital decrease smoothly. Because the households reduce their financial wealth faster than the domestic firms decumulate their capital stock, the nonhuman wealth approaches its steady-state faster than k as it is depicted in Figure 2. The fact that habit persistence effects dominate investment discouraging effects until date $\tilde{t}$ gives rise to an overshooting of net foreign assets' adjustment, that is, $b(\tilde{t}) < \bar{b}_{\text{perm}} < \bar{b}_0$ [see Figure 1(a)]. At time $t = \tilde{t}$, the current account changes of sign. The deterioration in the net foreign asset position is then followed by a current account surplus. Over the *second phase* (period $t > \tilde{t}$), investment influence becomes dominant over the habit effects. The rate at which saving falls turns to be lower than the rate at which investment decreases. This exercises a rise in the stock of foreign assets which converges in direction to its new lower long-run level $\bar{b}_{\text{perm}}$ [see Figure 1(a)].

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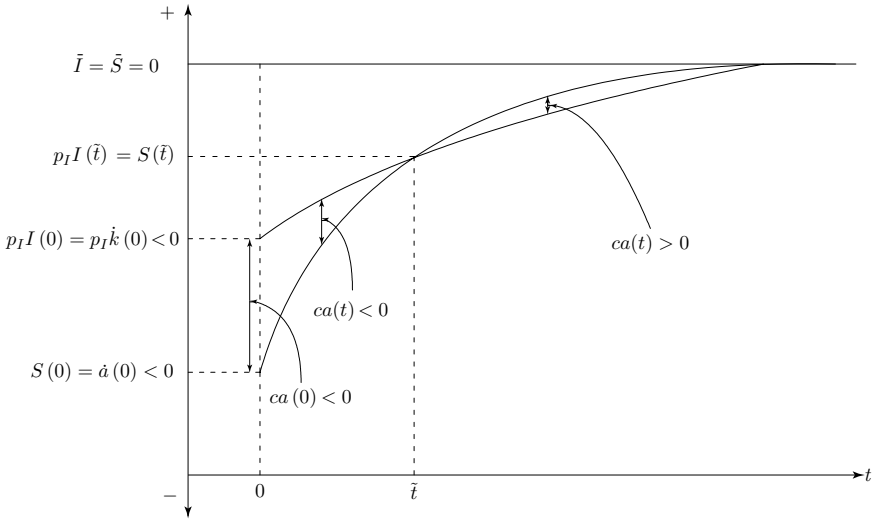

FIGURE 2. An unanticipated permanent terms of trade worsening: saving and investment dynamics.

Finally, at the new steady state, investment ceases, capital, and, hence, output are reduced. Levels of habits and real consumption are lower than at the initial steady state. As decumulation of foreign bonds outweighs their accumulation during the second phase, b is definitively reduced. Because current account must be balanced in the long run, the losses in interest earnings from abroad must be compensated by an improvement of the trade balance. The dynamic behavior of macroeconomic aggregates in the present formal setup is consistent with recent empirical results: (i) saving and investment covary [see Tesar (1991)] as we depicted in Figure 2; (ii) investment and real consumption are procyclical [see, e.g., Mendoza (1995)]; and, more important, (iii) current account is countercyclical, that is, the surplus phase is associated with a decline in real income [see, e.g., Freund (2005), Leonard and Stockman (2002)].

4. AN UNANTICIPATED TEMPORARY DETERIORATION OF TERMS OF TRADE

We turn now to the study of an unanticipated transitory terms of trade perturbation (denoted by the subscript temp). We suppose that the home goods' relative price decreases unexpectedly at time $t = 0$ from the original level p_0 to level p_1 over the period $0 \leq t < T$, and reverts back at time T permanently to its initial level $p_T = p_2 = p_0$. The temporary nature of the perturbation requires to consider two periods, say, period 1 ($0 \leq t < T$) and period 2 ($t \geq T$).

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4.1.1. Long-term effects. In this section, we focus on the long-term effects induced by temporary relative price movements. We have underlined previously that the model displays the zero-root property leading to an hysteresis phenomenon. The two-good extension of Ikeda and Gombi's (1998) model turns out to be particularly interesting because a transitory adverse shift in a country's terms of trade may induce opposite responses of macroeconomic aggregates with respect to a permanent perturbation in the short run, and, more important, in the long run. The sign of changes in real consumption and the stock of foreign assets are no longer clear-cut, as the *intertemporal speculation* effect, induced by transitorily lower (consumption-based and investment-based) real interest rates, plays against the *wealth* effect. The main departure from conventional preferences rests on a crucial additional influence on consumption-side variables, say, an *inertia* effect. Because agents fully internalize that for a given increase in real consumption, the gain in utility will be partly reduced by the adjustment of the habit stock ($u_2 \leq 0$), changes in real consumption are dampened. The sluggish adjustment of consumption makes possible its long-term rise.

The ultimate steady-state changes compared to the initial $\bar{c}_0, \bar{b}_0$ for an unanticipated transitory shock can be calculated as:

$$\left.\frac{\mathrm{d}\bar{c}}{\mathrm{d}p}\right|_{\text{temp}} = t_{\bar{\lambda}} \left.\frac{\mathrm{d}\bar{\lambda}}{\mathrm{d}p}\right|_{\text{temp}} \gtreqless 0, \quad \left.\frac{\mathrm{d}\bar{b}}{\mathrm{d}p}\right|^{\text{adj}}_{\text{temp}} = v_{\bar{\lambda}} \left.\frac{\mathrm{d}\bar{\lambda}}{\mathrm{d}p}\right|_{\text{temp}} \lesseqgtr 0. \tag{22}$$

As terms of trade return back to their initial level, the long-term changes in real consumption and in the stock of foreign assets are mainly determined by the change in the equilibrium value of the marginal utility of wealth.

Unlike a two-good model with conventional time separable preferences or a one-good model with habit formation, an unanticipated temporary terms of trade worsening leaves undeterminate the change in the equilibrium value of the marginal utility of wealth:

$$\left.\frac{\mathrm{d}\bar{\lambda}}{\mathrm{d}p}\right|_{\text{temp}} = \left(1 - e^{-r^* T}\right) \left.\frac{\mathrm{d}\bar{\lambda}}{\mathrm{d}p}\right|_{\text{perm}} - \frac{p_c' \bar{\lambda}}{p_c} \frac{r^*}{\mu_1} (e^{-r^* T} - e^{-\mu_2 T}) \lesseqgtr 0, \tag{23}$$

where $p_c'/p_c \equiv \alpha_c/p$, and $(e^{-r^* T} - e^{-\mu_2 T})$ is positive since $\mu_2 > r^*$. From expression (23), an adverse transitory relative price disturbance exerts on $\bar{\lambda}$ two conflictory influences. The *wealth* effect comes from the fall of the real income, which reduces the present value of wealth. The first term on the right-hand side of (23) indicates that the change of the marginal utility of wealth equals the change after a permanent terms of trade shock, λ_p, scaled-down by the term $0 < (1 - e^{-r^* T}) < 1$. The *intertemporal speculation* effect coupled with an *inertia* effect works in an opposite direction of the *wealth* effect. This phenomenon reflected by the second term may outweigh the *wealth* effect if the shock's persistence is not too high (i.e., a low value of T) or the share of domestic goods in consumption expenditure is important (i.e., a high value of α_c) or the habit persistence in consumption is strong

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(i.e., a low value of $|\mu_1|$). Because the case of a predominating *intertemporal speculation* effect remains the most interesting one as it leads to some new conclusions and allows to provide another explanation of the J-Curve, we concentrate on this situation. From the earlier discussion, the marginal utility of wealth is permanently reduced following a short-lived temporary terms of trade worsening.

Because the relative price perturbation has no permanent effects on k, and therefore on the real domestic product, a fall in $\bar{\lambda}$ implies a permanent rise in real consumption, which in turn must be exactly outweighed by higher interest revenues from abroad in order to guarantee the equilibrium of the current account at the new steady-state. Formally, in the new long-run equilibrium, the gross national product must be equal to the absorption, that is:

$$p_2 F(\bar{k}_{\text{temp}}, 1) + r^* \bar{b}_{\text{temp}} = p_c(p_2)\bar{c}_{\text{temp}}, \tag{24}$$

where $p_2 = p_0$ and $\bar{k}_{\text{temp}} = \bar{k}_0$. When $\bar{c}_{\text{temp}} > \bar{c}_0 > \bar{c}_{\text{perm}}$, the long-run foreign assets stock must be higher, $\bar{b}_{\text{temp}} > \bar{b}_0 > \bar{b}_{\text{perm}}$, in order to allow the small open economy to reach the steady state.

The long-term rise of real consumption contrasts markedly with Obstfeld's (1983) result. Such dynamics emerge because households wish to maintain their new higher standard of living induced by a greater purchasing power in terms of consumption goods. The *inertia* effect makes possible the rising temporal path of real consumption after a negative perturbation through the fall by a sufficient amount of the time preference rate below the consumption-based real interest rate. A habit-forming behavior departs from the behavior prevailing with time separable preferences because agents raise their consumption only gradually. As agents expect to be accustomed to the greater level of consumption experience, their financial wealth accumulation behavior tends to amplify the *intertemporal speculation* effect in the long run. The dynamics of real consumption over the unstable (period 1) and stable (period 2) periods affect the accumulation of internationally traded bonds which in turn influence the once-for-all jump of the marginal utility of wealth.

4.1.2. Transitional dynamics and the J-Curve. We show now that current account dynamics may exhibit a sequence of deficit-surplus after an unanticipated temporary terms of trade worsening. Before investigating the initial reaction of the current account, it is convenient to explore the forces underlying the optimal responses of investment and real consumption at time $t = 0^+$.

Investment rises or falls initially depending on wether the *intertemporal speculation* effect dominates or not the *capital profitability* effect. Whenever the negative terms of trade perturbation lasts only a short time period or the share of home goods in investment expenditure is important, the *intertemporal speculation* effect more than outweighs the *capital profitability* effect. This can be explained in an intuitive way. The shorter-lasting is the shock, the less the present value of future marginal product is affected and, therefore, the smaller is the fall in the market price of

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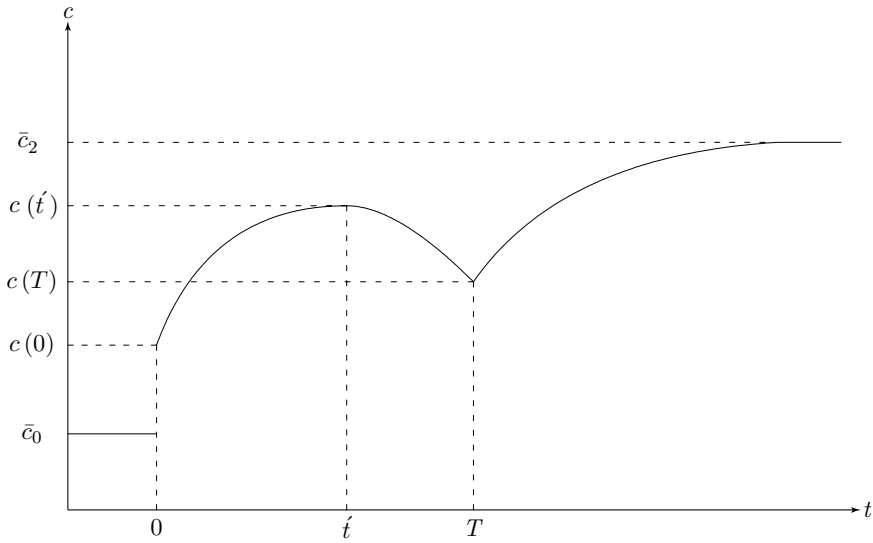

FIGURE 3. An unanticipated temporary terms of trade worsening and real consumption dynamics.

installed capital (i.e., the more moderated is the *capital profitability* effect); the higher is the domestic content in investment expenditure, α_I, the greater is the fall in the investment-based real interest rate r^I below the world interest rate r^* (i.e., the stronger is the *intertemporal speculation* effect influencing investment choices). This last effect encourages the domestic firms to benefit from the transitorily low level of the investment price index.

Turning to the *consumption*-side, as agents know that the decrease in p is only temporary, the present value of the necessary reduction in real consumption to satisfy the intertemporal budget constraint is less than for an equal but permanent decline in p. In the same time, agents wish to take the advantage of a lower cost of consumption goods that last only temporarily and benefit from it by consuming at higher rates. Under the conditions of a low value of T, a high share of domestic goods α_c in consumption expenditure, and a strong habit persistence, the domestic households raise initially their real consumption (see Figure 3).

Formally, after tedious computations, the initial response of the *current account* can be calculated as

$$\left.\frac{\mathrm{d}ca(0)}{\mathrm{d}p}\right|_{\text{temp}} = \overbrace{\left.\frac{\mathrm{d}S(0)}{\mathrm{d}p}\right|_{\text{perm}}\left(1-e^{-r^*T}\right)}^{\text{softened saving response}} - \overbrace{p_I\left.\frac{\mathrm{d}I(0)}{\mathrm{d}p}\right|_{\text{perm}}\left(1-e^{-\chi_2 T}\right)}^{\text{softened investment response}}$$

$$+ \overbrace{p_I\frac{\kappa'(1)\bar{k}}{p}e^{-\chi_2 T}\alpha_I}^{\text{intertemp. spec. effect on inv.}} - \overbrace{p_c t_p\frac{\mu_2}{\sigma}\left(1-e^{\mu_1 T}\right)e^{-r^*T}}^{\text{intertemp. spec. effect on cons.}} + \overbrace{(\bar{Y}-\bar{d})e^{-r^*T}}^{\text{smoothing effect}}. \quad (25)$$

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The sign of expression (25) depends on five key factors: (i) the length of the shock (T), (ii) the import content of investment and consumption expenditure (α_I and α_c), (iii) the marginal installation costs reflected by κ' (and measured by χ_2), (iv) the degree of habit persistence in consumption, ($|\mu_1|$), and (v) the long-run intertemporal elasticity of substitution (under time nonseparable preferences) as is shown later. The first two terms on the right-hand side of (25) indicate that saving and investment responses to a temporary shock are moderated by the factors $(1 - e^{-r^*T})$ and $(1 - e^{-\chi_2 T})$ compared to their reaction to a permanent perturbation. The shorter-lasting is the adverse terms of trade perturbation, the less are the fall in present values of real income and of the capital revenues, the lower are the responses of saving and investment, and, therefore, their initial impact on the current account. The third and fourth terms represent the *intertemporal speculation* effect that affects respectively investment and consumption decisions. The higher are the shares of domestic goods in investment and consumption expenditure, and the less persistent is the adverse terms of trade perturbation, the stronger is the *real interest rate* effect, and the more probable that the current account will deteriorate. Regarding investment choices, the higher is $\kappa'(1)$, the lower are marginal installation costs and the more investment is responsive to a terms of trade shock [see the third term of (25)]. Let us now turn to the consumption reaction to a transitory fall of the consumption-based real interest rate, r^c, below the world interest rate, r^*. With time-separable preferences and a CRRA utility functional, the fourth term reduces to $\bar{d}e^{-r^*T}/\theta$ where the intertemporal elasticity of substitution, denoted by η_{add}, is equal to $1/\theta$.[14] Allowing for habits implies that agents care not only about the level of current consumption but also their consumption experience. When the utility function is supposed to be of the CRRA form as assumed by Carroll et al. (2000), the long-run intertemporal elasticity of substitution is no longer equal to $1/\theta$ but equal to $\eta_{hab} = 1/[\gamma + \theta(1-\gamma)]$, where γ is the weight attached to accumulated consumption experience, s.[15]

The long-run intertemporal elasticity of substitution under time non-separable preferences is greater than this obtained under conventional preferences whenever $\theta > 1$ that is if $u_{12} > 0$ [see Alvarez-Cuadrado et al. (2004)]. The fourth term on the right-hand side of (25) can be rewritten as follows $(\bar{d}\mu_2\eta_{hab}/\sigma)(1-e^{\mu_1 T})e^{-r^*T}$. As with time-separable preferences, the *intertemporal speculation* effect increases with the import content of consumption expenditure, $\alpha_c \equiv (p\bar{d})/(p_c\bar{c})$. The novel result is that consumption habits amplify the *intertemporal speculation* effect compared to the conventional time separable case by raising the long-run intertemporal elasticity of substitution above the inverse of the coefficient of relative risk aversion. In response to a temporary fall in the real cost of consumption following a transitory terms of trade worsening, habits make consumers more willing to reallocate expenditure toward the present and against the future. The dampening term $-e^{\mu_1 T}$ reflects the fact that habit-forming agents dislike large and rapid changes in consumption and prefer to smooth the variation of their real consumption over time.[16] If the shock is sufficiently short, it may be desirable for households to have a temporal decreasing path of their real consumption

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immediately after the upward jump. Finally, the last and fifth term represents the impact of the consumption *smoothing* effect on the current account. This term is decreasing with the shock's persistence.[17]

The discussion on *transitional dynamics* rests on the assumption that the *intertemporal speculation* effect predominates; in particular one consider that the relative price change is short-lived. Starting off from an initial steady state (period 0), the initial rise in real consumption and investment expenditure leads to an increase in domestic absorption.[18] In addition, when the shock hits the small country, the decline in the relative price of home goods induces a fall in the real income. Therefore, because the initial stock of physical capital is predetermined the trade balance deteriorates and the current account turns negative at time $t = 0^+$ (see Figure 4).

Unlike a small open economy model with time-separable preferences, the *intertemporal speculation* effect is coupled with an *inertia* effect, which prevents households from large initial changes in real consumption, insuring a growing temporal path of consumption while the time preference rate is below the consumption-based real interest rate. At time $t = \acute{t} < T$, real consumption begins its decreasing and investment keeps on increasing. The real consumption dynamics over period 1 can be clarified from the following dynamic equation:

$$\dot{c}(t) = -\frac{p_c \lambda}{u_{11}} \left(r^* - \alpha_c \frac{\dot{p}(t)}{p(t)} - \rho(t) \right) \gtreqless 0, \quad 0 < t < T, \tag{26}$$

where the gap between $r^c = r^* - \alpha_c \dot{p}/p$ and $\rho(t)$ influences the consumption adjustment over the period $0 < t \leq T$. According to (26), the greatest is the fall of the time preference rate, the highest is the domestic content in consumption expenditure, and the most likely a positive change in real consumption following its upward initial jump. Over the unstable period 1, the time preference rate increases as the stock of habits rises. At a date $t = \acute{t}$, the time preference rate is equal to the real rate of interest and the real consumption stops increasing, that is $\dot{c}(\acute{t}) = 0$ (see Figure 3). As $\rho(t)$ keeps on increasing because s rises over the entire period 1, the time-preference rate becomes higher than r^c, which in turn leads to a decreasing temporal path of c until time T. Over the first phase, the positive investment flow and the negative saving flow deteriorate without ambiguity the current account [see Figure 1(b)].

Because the growth of capital goods raises the real income and saving becomes less negative, the current account remains negative but may eventually improve (see Figure 4). *At time T*, the relative price of home goods is restored to its original level, $p_2 = p_0$.[19] The levels of economic aggregates remain unchanged in the neighborhood of time T. The consumption and investment-based real rates of interest increase abruptly to the level of the world interest rate, that is, $r^c(T^+) = r^I(T^+) = r^*$, and remain constant as the economy converges toward the final steady state. When preferences display adjacent complementarity, the marginal utility of real consumption is strongly increasing with the habitual standard of

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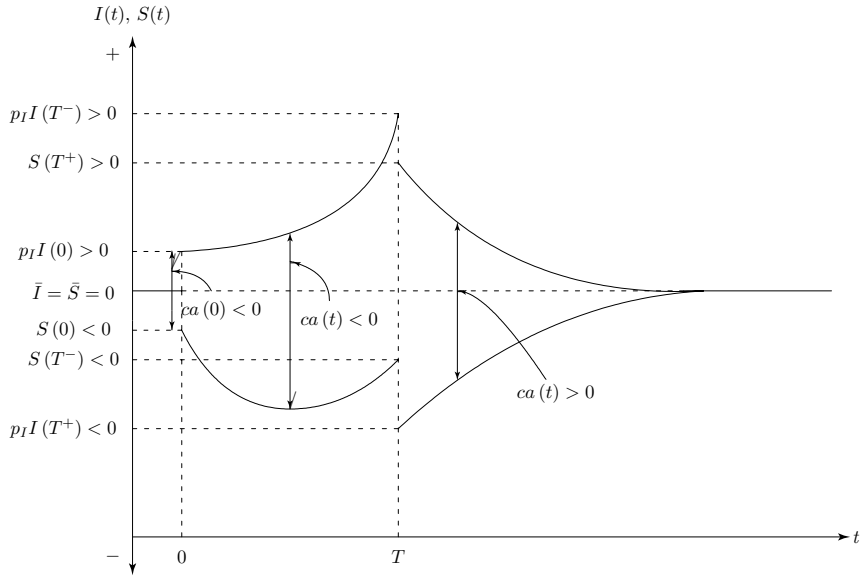

FIGURE 4. An unanticipated temporary terms of trade worsening and current account dynamics.

living ($\Gamma > 0$), and the expectation of a higher value of the habit stock in the final steady state implies that the time preference rate is below its long-run value, $\delta = r^*$. This implies a growing temporal path of real consumption, as we can see in Figure 3. While households smooth the change of c, this behavior makes possible the accumulation of financial wealth when the terms of trade are favorable (over period 2). At the same time, the absence of hysteresis effects on production-side aggregates implies that the stock of physical capital must return to its initial level, $\bar{k}_{\text{temp}} = \bar{k}_0$. Investment turns out to be negative as the investment-based real interest rate rises abruptly at time T. The real income reaches its maximum at time T^+, equal to $p_2 F[k(T^+), 1]$. The current account becomes unambiguously positive as the terms of trade improve. The economy switches back to a sustainable transition, consistent with intertemporal solvency, that satisfies the unique and overall intertemporal national budget constraint:

$$b_T - \bar{b}_2 = -p_I(k_T - \bar{k}_2) - \frac{p_c(\sigma + \mu_1)}{\sigma(\mu_1 - r^*)}(s_T - \bar{s}_2), \tag{27}$$

where the economy's unstable period 1 transition is contained in stocks k_T, s_T, and b_T serving as new initial conditions. According to the intertemporal solvency condition (27), the stocks of habits and of capital goods move respectively in the same and in an opposite direction with the stock of foreign assets.

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Because the rate of change in the stock of habits is continuous, that is, $\dot{s}(T^-) = \dot{s}(T^+) > 0$, the consumption experience keeps on increasing. The adjustment calls for a growth of real consumption as households' preferences exhibit adjacent complementarity. The consumption and capital goods adjustments deteriorate the trade balance by raising absorption and lowering real income. Thanks to the *inertia* effect, the real consumption rises smoothly while the terms of trade are favorable. A stable transition calls for rising wealth through the accumulation of internationally traded bonds [see Figures 3 and 1(b)]. Because the real income is above its long-run equilibrium value, and the investment is negative, and the real consumption is below its steady state, the current account remains positive along the stable path. Once the small open economy reaches the final steady state, the stock of equipment goods is restored to its initial level and the market price of capital is equal to the original investment price index. The real consumption and the habitual standard of living reach a higher level in the new long-run equilibrium. Because the accumulation of internationally traded bonds, when the terms of trade are favorable (over period 2), more than outweighs its decumulation over period 1, the stock of foreign assets rises in the long run.

5. CONCLUSION

In recent years, several empirical studies found evidence of the J-Curve phenomenon but cast doubt over its standard explanation. More specifically, Leonard and Stockman (2002) and Freund (2005) present new evidence on the connection between the current account and GDP, which conflict with the usual interpretation of the J-Curve provided by early theoretical models. Departing from the conventional elasticity approach, we have revisited the J-Curve phenomenon by allowing for consumption and investment sluggishness originating from a habit-forming behavior and capital adjustment costs. In addition, unlike previous two-good intertemporal optimizing models, our dynamic general equilibrium approach does not restrict the analysis of the current account-relative price link by overemphasizing the savings reaction or by assigning a prominent role to investment fluctuations because of the specification of time separable preferences.

Our main results may be summarized as follows. First, it is formally shown that the initial current deficit (or H-L-M effect) and the nonmonotonic adjustment of net foreign assets (or the J-Curve) depends on the relative strength of consumption habits and investment inertia after an unanticipated permanent terms of trade deterioration. The second main result is probably the most startling. Following an unexpected transitory fall in the home goods' relative price, the trade balance deteriorates initially, the current account adjustment displays a J-Curve pattern, and the stock of net foreign assets rises in the long run if the *intertemporal speculation* effect coupled with an *inertia* effect more than outweigh the *wealth* effect. Our interpretation of the J-Curve within an intertemporal optimizing framework contrasts markedly with the standard view of this economic phenomenon. The nonmonotonic behavior of the current account and the long-term rise of the

stock of foreign assets result from optimal consumption and investment decisions taken by infinitively-lived households and firms instead of competitiveness aspects related to the price-elasticities of demand. Moreover, although we relaxed the time-separability assumption for preferences, the model displays the zero-root property and generates an hysteresis phenomenon implying the possibility for net foreign assets to reach a higher level at the new steady state. Third, in accordance with empirical results documented by Leonard and Stockman (2002), the surplus phase of the current account (second period of the J-Curve) is associated with a decline in the real income triggered by the investment decrease. Fourth, beyond the formalization of Krugman's (1989) economic intuition about the J-Curve phenomenon, the present framework extends Obstfeld's (1983) analysis by introducing a habit-forming behavior.[20] It has been shown that real consumption adjustment may exhibit a hump-shaped response when the adverse transitory disturbance is at work and may eventually reach a higher level at the new steady state if the shock is not too long-living.

We believe that the present model predictions may provide some interesting economic lessons regarding recent economic developments. In particular, we argue that this contribution yields valuable economic insights about the macroeconomic effects of an appreciation of the euro, keeping in mind that the predictions of the theoretical model depend on the degree of persistence of the terms of trade improvement. If the appreciation is long-living, we may expect a reversed J-Curve with a deficit phase (or second phase) associated with a positive investment flow and a rise in the real income, that is, the opposite of the standard view (which predicts a fall in real income driven by declining exports). This conclusion holds after a short-lived appreciation of the euro, but a long-term decrease in the real consumption and in the stock of foreign assets should more probably arise instead of a long-run rise.

NOTES

1. See, e.g., Meade (1988).
2. See, e.g., Freund (2005), Leonard and Stockman (2002), Otto (2003).
3. Ikeda and Gombi (1998) use a one-good framework close to ours and investigate the effects of an adverse productivity shock, a rise in government spending, and a rise in capital taxes. The most striking difference is the unability of Ikeda and Gombi's model to generate the short-term and long-term effects obtained in our model. The explanation is straightforward. By abstracting from both imported consumption and capital goods, the intertemporal speculation effect is absent, making impossible for the real consumption and the stock of foreign assets to reach a higher steady-state level after an adverse perturbation.
4. Obstfeld (1983) was the first to show the possibility for real consumption to rise initially after an unanticipated transitory terms of trade worsening. Once the shock ends, real consumption reaches definitively a lower steady-state level. One of the main findings of our contribution is that relaxing the time separability assumption in preferences may lead to opposite long-term responses of real consumption. It is formally shown that real consumption may be persistently higher at the new steady state in the present formal setup. The combination of a strong habit persistence in consumption, an *intertemporal speculation* effect, and an hysteresis phenomenon plays a key role in generating the long-run change in real consumption.

5. Following Ryder and Heal (1973), the instantaneous utility function is assumed to be: (H1) increasing in current real consumption, $u_1(c, s) > 0$; (H2) nonincreasing in past real consumption, $u_2(c, s) \leq 0$; (H3) increasing in a uniformly maintained real consumption level, $u_1(c, c)+u_2(c, c) > 0$, which guarantees nonsatiation; (H4) strictly concave in c and s, $u_{11}(c, s) < 0$, $u_{22}(c, s) < 0$, and concave in (c, s), $u_{11}(c, s)u_{22}(c, s) - [u_{12}(c, s)]^2 \geq 0$; (H5) $\lim_{c\to 0} u_1(c, s) = \infty$ and $\lim_{c\to 0}[u_1(c, c) + u_2(c, c)] = \infty$.

6. The accumulation equation of foreign bonds is obtained by substituting the dividend flow's expression, $D(t)$.

7. We have defined the rate of time preference, ρ, as the negative of the logarithmic rate of change of the present-value of marginal utility of real consumption along a locally constant consumption path:

$$\rho(t) \equiv -\frac{\mathrm{d}\ln\{[u_1(c, s) + \sigma\xi]\exp(-\delta t)\}}{\mathrm{d}t}\bigg|_{\dot{c}(t)=0}.$$

8. If one retains the CRRA instantaneous utility function used by Carroll et al. (2000) [see equation (28)], we have to assume that $\theta > 1/(1 - \gamma)$ to ensure that the utility function is concave in both arguments. This condition implies in turn that preferences exhibit adjacent complementarity because $u_{12} > 0$ and a long-run intertemporal elasticity of substitution higher than the inverse of the coefficient of relative risk aversion, $1/\theta$, as empirical evidence suggests.

9. All agents perfectly understand the permanence of the terms of trade deterioration, but its occurrence at time $t = 0$ is unanticipated.

10. Like Obstfeld (1983) and Sen and Turnovsky (1989), we assume that the small open economy is a net exporter of the domestic good at the steady state, that is, $(\bar{Y} - \bar{d}) > 0$.

11. At the steady state, the stationary real consumption must coincide with the consumption experience level.

12. Recent empirical studies find strong support of the H-L-M effect [see, e.g., Otto (2003)].

13. For our purpose, we concentrate on the case in which adjustment costs are sufficiently high ($\kappa'(1)$ is low) such that $|\mu_1| > |\chi_1|$, implying a strong inertia of investment in capital goods. This condition is supported by empirical results documented by Freund (2005; see pp. 1291–1295), who shows that the current account deficit (over the first phase) is mainly demand driven and the current account improvement (over the second phase) is supply driven.

14. The subscripts "add" and "hab" refer to time separable and time nonseparable preferences.

15. Assuming that the utility function is of the CRRA form as in Carroll et al. (2000):

$$u(c, s) = \frac{1}{1-\theta}\left(\frac{c}{s^{\gamma}}\right)^{1-\theta}, \tag{28}$$

where θ is the coefficient of relative risk aversion and the parameter $\gamma \in [0, 1]$ the strength of habits, the long-run intertemporal elasticity of substitution is given by [Alvarez-Cuadrado et al. (2004)]:

$$\eta_{hab} = 1/[\gamma + \theta(1 - \gamma)] > \eta_{add} = 1/\theta \quad \text{if and only if} \quad \theta > 1.$$

As the cross-partial derivative of the felicity function, u_{12} is equal to $-\gamma(1 - \theta)c^{-\theta}h^{-\gamma(1-\theta)-1}$, its sign is positive if and only if $\theta > 1$. This in turn implies that the long-run intertemporal elasticity of substitution under an habit-forming behavior is greater than the intertemporal elasticity of substitution under time-separable preferences.

16. The more increasing is the marginal utility of real consumption with respect to the stock of habits, the lower is the absolute value of the characteristic root, $|\mu_1|$, and the smoother is the real consumption's reaction.

17. This can be explained as follows. A temporary shock results in a larger impact on current than on permanent income, and this gap is as greater as the perturbation is short-living. Therefore, the current account will be more affected the shorter-lasting is the perturbation.

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18. Because the shock is short-living, domestic households and firms wish to benefit from the fall in the real costs of consumption and capital goods, whereas they expect an improvement in the terms of trade in the near future and therefore a rise in the consumption and investment price indexes.

19. Because the switch of terms of trade was perfectly anticipated, no new information is diffused.

20. "As recent experience has confirmed, the response of trade flows to the exchange rate take years, both because consumers are slow to change habits and, even more important, because many changes in supply and sourcing require long-term investment decisions" [Krugman (1989), p. 33].

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