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ANTICIPATED AND UNANTICIPATED OIL PRICE INCREASES AND THE CURRENT ACCOUNT

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ABSTRACT

This paper examines the current-account response to anticipated future increases in real oil prices as well as to unexpected increases which may be temporary or permanent in nature. The analysis is conducted using an intertemporal two-period model of a small open economy which produces both traded and nontraded goods and imports its oil.

The paper identifies the channels through which various types of oil price increases affect the current account. The inclusion of nontraded investment and consumer goods permits oil price increases to generate intertemporal and static substitution effects in production and consumption which alter net international saving. Moreover, the relative oil—value-added ratio in the traded and nontraded sectors plays a crucial role in shaping these substitution effects and hence the current-account response.

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I. Introduction

Much research effort has been devoted to investigating the macroeconomic effects of an oil price "shock" on oil-importing nations. Since a price "shock" connotates an unanticipated disturbance, but more recent oil price hikes have been either partially or wholly expected, it is important to study the economy's response to anticipated disturbances as well. That is one purpose of this paper. It examines the current-account response to anticipated future increases in real oil prices as well as to unexpected increases which may be temporary or permanent in nature.

The paper also stresses the important role of nontraded goods in determining the current-account response to oil price increases. When the economy produces nontraded investment goods and consumer goods, oil price disturbances generate intertemporal and static substitution effects in production and consumption which alter net international saving. Moreover, the relative oil- value-added ratio in the traded and nontraded sectors plays a crucial role in shaping these substitution effects. This latter finding supports the oft-repeated observation that structural characteristics of individual oil-importing countries matter in any analysis of current-account adjustment to foreign price disturbances.

Previous studies of oil price disturbances and current-account adjustment in the small open economy (e.g. Findlay-Rodriguez (1977), Buiter (1978), Bruno-Sachs (1978), Katseli-Marion (1980), Obstfeld (1980), and Sachs (1981)) have considered only unexpected disturbances. They usually conclude that permanent unexpected oil price increases worsen the current-account of the net oil importer with limited substitution in production.

However, most of these studies fail to consider the intertemporal nature of current-account (net saving) behavior. The two recent exceptions are the excellent papers by Obstfeld (1980) and Sachs (1981). Their analyses indicate that permanent unexpected oil price increases can actually improve the current account. But neither study considers the effects of anticipated future oil price increases or the role of nontraded goods in current-account adjustment. That is the task of this paper. Using an intertemporal framework, it seeks to identify the channels through which various types of oil price increases (i.e. expected or unexpected, temporary, permanent, or future) affect the current account of an economy producing both nontraded and traded goods.

The analysis is conducted using an intertemporal two-period model of a small open economy facing given world prices and a given world rate of interest. The model itself is based on intertemporal maximizing behavior and saving is consistent with this behavior. The "dual" approach, characterized by the use of expenditure and revenue functions rather than utility and production functions, is adopted. As pointed out by Dixit and Norman (1980) and Dixit (1980), models employing duality are formally equivalent to traditional ones, but have some practical advantages, among them notational simplicity.

The rest of the paper is organized as follows. The basic model is set out in Section 2. In Section 3, the response of the current account to a change in world oil prices and world interest rates is derived, and the distinction between expected and unexpected disturbances is finally drawn. In Section 4, the results are extended to the case where there are nontraded investment and consumer goods. Section 5 provides some concluding remarks.

2. The Model

Consider a small open economy in an intertemporal framework.[1] There are two dates, 1 and 2, and two goods, one final good and one intermediate good. The country can trade on the world market at given spot prices at each date, and it also has access to a world credit market with a given world interest rate.[2] Let the date 1 final good be the numeraire. Then 1 denotes the real spot price at date 1 of final goods at date 1, and $\delta \equiv 1/(1+r)$ represents the real discount rate, where r is the real interest rate.[3] Let q^i be the relative spot price at date i of intermediate goods (in terms of final goods) at date i.

With respect to welfare and demand, assume the country can be represented by a well-behaved utility function $U(c^1, c^2)$, where c^1, c^2 are nonnegative and represent consumption at date 1 and 2, respectively. Households seek to maximize utility subject to the constraint that present-value expenditures not exceed present-value income. The dual is to minimize the expenditure necessary to attain a target utility level at given prices. The corresponding expenditure function is

$$E(1, \delta, u) \equiv \min_{c^1,\, c^2} \; c^1 + \delta c^2 \quad \text{subject to} \quad U(c^1, c^2) \geq u.$$

The small economy produces final goods (x) using capital (k), labor (ℓ), and oil (z). For simplicity, assume initially that the supplies of capital and labor are fixed and that all oil is imported. The assumption of a fixed labor supply will be dropped in Section 3 and the assumption of a fixed capital stock will be relaxed in Section 4. Firms maximize the present value of total profit. Specifically, for given world prices of final goods and oil and for given quantities of labor and capital, the firms' problem is to choose a technologically feasible x to maximize the present value of output. The corresponding maximized value of output is a function of these fixed prices and factors inputs. It is called the revenue, or national product, function. For the two-period case, we can write the revenue functions as:

$$R^1(1, q^1, \bar{\ell}^1, \bar{k}^1) + \delta R^2(1, q^2, \bar{\ell}^2, \bar{k}^2) \equiv$$

$$\max_{z^1, z^2} \quad (x^1 - q^1 z^1) + \delta(x^2 - q^2 z^2)$$

where R^1 denotes real income (value-added) at date 1 and δR^2 denotes the real present value of income at date 2.

The equilibrium of the country can be represented by the intertemporal budget constraint

$$E(1, \delta, u) = R^1(1, q^1) + \delta R^2(1, q^2) \tag{2.1}$$

Equation (2.1) states that the present value of expenditure equals the present value of domestic value-added.

There are many well known properties of expenditure and revenue functions [see Dixit and Norman (1980) or Varian (1978)]. For instance, the derivative of the expenditure function with respect to the price of a good is the Hicksian compensated demand for that good. The derivative of the revenue function with respect to the price of a good is the optimally chosen supply of the good. It follows that optimal consumption, production of final goods and imports of oil are given by

$$
\begin{aligned}
c^1 &= E_1(1, \delta, u) \\
c^2 &= E_2(1, \delta, u) \\
x^1 &= R_1^1 \\
x^2 &= R_1^2 \\
-z^1 &= R_2^1 \\
-z^2 &= R_2^2
\end{aligned}
\tag{2.2}
$$

where superscripts represent dates and subscripts refer to partials.

The real current-account surplus at date 1 is

$$
b^1 = (x^1 - c^1) - q^1 z^1 = R^1 - E_1 \tag{2.3}
$$

which is the excess of income at date 1 over spending at date 1.[4] In the absence of domestic investment or government deficits, the current account surplus at date 1 is equal to real saving at date 1 and represents the accumulation of net foreign assets. Equation (2.1) ensures that trade in present-value terms is balanced over the two dates, though not necessarily at each date.

3. Solving the Model

To find the effect on the date 1 current account of a change in world oil prices or interest rates, we totally differentiate (2.3). Because welfare effects are needed in the calculation of current-account effects, it is helpful to proceed by first differentiating (2.1). This differentiation yields:

$$E_u du = \lambda_{11} dq^1 + \lambda_{12} dq^2 + \lambda_{13} d\delta \tag{3.1}$$

where

$$\lambda_{11} = R_2^1 < 0$$

$$\lambda_{12} = \delta R_2^2 < 0$$

$$\lambda_{13} = R^2 - E_2 = b^2$$

In the above expression, E_u denotes the partial $\partial E/\partial u$, the inverse of the marginal utility of total (present-value) income, which is positive. The expression $E_u du$ is the income equivalent at given prices of a change in welfare. Hence $(R_2^1/E_u) dq^1$ is the (negative) effect on welfare of an increase in world oil prices at date 1, $(\delta R_2^2/E_u) dq^2$ is the (negative) effect on welfare of an increase in oil prices at date 2, and $(b^2/E_u) d\delta$ is the effect on welfare of an increase in the real discount factor. The latter effect is positive if the small country runs a trade surplus (deficit) in date 2 (1).

In order to calculate the effect of a change in world oil prices and the real discount rate on the current account, we totally differentiate (2.3), making use of (3.1). This gives

$$db^1 = \lambda_{21}dq^1 + \lambda_{22}dq^2 + \lambda_{23}d\delta \tag{3.2}$$

where

$$\lambda_{21} = R_2^1(1 - c_y^1) < 0$$

$$\lambda_{22} = -\delta c_y^1 R_2^2 > 0$$

$$\lambda_{23} = -[c_y^1 b^2 + E_{12}] < 0 \quad \text{for} \quad b^2 > 0.$$

where c_y^1 is the real marginal propensity to spend at date 1 out of real present value income.[5] The term E_{12} is a substitution effect, with $E_{12} = \partial c^1/\partial\delta > 0$.

An increase in oil prices has two effects on the current account: a <u>direct effect</u> on value added $(R_2^1 dq^1)$, which worsens the current account, and an <u>income-consumption effect</u> $[-c_y^1(R_2^1 dq^1 + \delta R_2^2 dq^2)]$, which improves the current account. Oil price increases do not generate <u>substitution effects</u> in either consumption or production since consumer prices are unaffected by oil price increases and there are as yet no intertemporal elements in production.

Let us now look at the change in the current account in the following three cases:[6]

(1) A <u>temporary increase</u> in oil prices, which is defined as $dq^1 > 0$, $dq^2 = 0$.

(2) A <u>permanent increase</u> in oil prices, which is defined as dq^1, $dq^2 > 0$.

(3) An <u>anticipated future oil price increase</u>, which refers to the case $dq^1 = 0$, $dq^2 > 0$.

All three types of oil price increases are <u>expected</u> increases. At the start of date 1, OPEC announces oil prices for dates 1 and 2. Agents can fully adjust their behavior in dates 1 and 2 in response to this announcement. Later, we shall distinguish between expected and unexpected price increases.

As can be seen in (3.2), a temporary oil price increase unambiguously reduces the current-account surplus; it has a direct negative effect on value added and a smaller positive income effect on demand.

A permanent oil price increase has a larger impact on aggregate demand and hence an ambiguous effect on the current account. As in the case of a temporary increase, it has a direct negative effect and a smaller positive income effect in date 1. But it also produces a positive income effect in date 2. If the two income effects should dominate, then the current account will improve.

An anticipated oil price increase improves the date 1 current account since it lowers welfare, inducing a drop in domestic consumption in the first period.

Up to this point, agents have been treated as having perfect foresight; they can fully adjust in dates 1 and 2 to any oil price increase that occurs in the present or the future.

Suppose we want to introduce a distinction between unexpected and expected oil price increases. One way to do this is to impose some constraint on the ability of agents to adjust their behavior in date 1 in response to an announced oil price increase. In particular, suppose that firms have limited production substitution possibilities in date 1. Any change in date 1 oil prices - whether temporary or permanent - is now unexpected in the sense that firms would have tried to alter their factor mix had they known of the forthcoming price disturbance.

As an example, assume that firms face a fixed coefficient technology in date 1. In order to have current output variable, let us also relax the assumption that there is full employment of a fixed supply of labor in date 1. Let ℓ^1 represent employment in date 1.

The economy's date 1 revenue function is now

$$R^1(1,\ q^1,\ \ell^1) \equiv \max_{\ell^1,\, z^1} x^1 - q^1 z^1$$

subject to

$$x^1 = \min(f(\ell^1,\ \bar{k}),\ \alpha z^1);\ f_\ell > 0,\ f_{\ell\ell} < 0,\ \alpha = 1.$$

Maximization of date 1 value-added requires that $x^1 = f(\ell^1) = z^1$. Hence

$$R^1(1,\ q^1,\ \ell^1) = (1 - q^1)f(\ell^1)$$

Let R^1_ℓ denote the derivative $\partial R^1/\partial \ell^1$. A standard property of the revenue function is that this derivative represents the real demand price for labor.

Suppose that the real supply price of labor in date 1 can be represented by the function $w^1(1,\ \ell^1)$. Then a labor-market equilibrium is given by

$$w^1(1,\ \ell^1) = R^1_\ell(1,\ q^1,\ \ell^1) \tag{3.3}$$

For simplicity, we ignore any intertemporal elements in labor supply, so that the real wage demanded in date 1 depends only on the price of final goods and employment at that date.

Equation (3.3) can be solved to yield the employment function $\ell^1(1, q^1)$, with $\ell^1_q < 0$.

The intertemporal budget constraint and current account are now given by

$$E(1, \delta, u) = R^1(1, q^1, \ell^1(1, q^1)) + \delta R^2(1, q^2) \tag{3.4}$$

$$b^1 = R^1(1, q^1, \ell^1(1, q^1)) - E_1 \tag{3.5}$$

Differentiating (3.4) and (3.5) we find the following effects on the current account:

$$db^1 = \lambda_{21} dq^1 + \lambda_{22} dq^2 + \lambda_{23} d\delta \tag{3.6}$$

where

$$\lambda_{21} = (R^1_2 + R^1_\ell \ell^1_q)(1 - c^1_y) < 0$$

$$\lambda_{22} = c^1_y R^2_2 > 0$$

$$\lambda_{23} = -(c^1_y b^2 + E_{12}) < 0 \quad \text{for} \quad b^2 > 0$$

Comparing (3.6) with (3.2), we see that the new term in λ_{21} represents the employment effect. We conclude that a fixed coefficient technology in date 1, combined with some real-wage rigidity, modifies the analysis to the extent that negative employment effects are now associated with an <u>unexpected</u> increase in today's oil price. Unexpected oil price increases thus have a stronger negative effect on the current account surplus than do expected oil price increases. Note that whether expected or unexpected, a temporary increase in oil prices reduces the current-account surplus and a permanent increase in oil prices has an ambiguous effect on the current account. Anticipated future oil price increases always improve today's current account.

Let us now examine how the current-account response might differ when a nontraded good is introduced.

4. Nontraded Goods

Suppose that the small economy produces nontraded goods (n) as well as traded goods (x). The nontraded goods can be consumed by domestic households or costlessly transformed into investment goods (I). Since there are only two periods, investment occurs only in period 1. Both traded and nontraded goods are produced with oil, labor and sector-specific capital. Labor is mobile between sectors and all oil is imported.

In order to distinguish between expected and unexpected oil price disturbances, we again invoke the assumption that in date 1 all firms face a fixed coefficient technology. We also assume that in date 1 firms face an economy-wide wage indexed to final goods prices. Thus overall employment will vary in response to oil price disturbances. In date 2, firms can fully adjust their factor mix and labor is fixed in total supply and fully employed. The economy's revenue functions, which represent national product over the two periods, can be written as:

$$R^1(1, q^1, j^1, \ell^1, \bar{k}^1) + \delta R^2(1, q^2, j^2, \bar{\ell}^2, \bar{k}^1 + I^1)$$

$$\equiv \max_{\substack{z_T^1,\, z_N^1 \\ \ell_T^1,\, \ell_N^1 \\ z_T^2,\, z_N^2 \\ \ell_T^2,\, \ell_N^2 \\ I_T^1,\, I_N^1}} \quad x^1 + j^1 n^1 - q^1 z^1 + \delta(x^2 + j^2 n^2 - q^2 z^2)$$

subject to

$$x^1 = \min(f(\ell_T^1, \bar{k}_T^1), z_T^1); \; f_\ell > 0, \; f_{\ell\ell} < 0$$

$$n^1 = \min(h(\ell_N^1, \bar{k}_N^1), \alpha z_N^1); \; h_\ell > 0, \; h_{\ell\ell} < 0, \; \alpha > 0$$

$$x^2 = x^2(\ell_T^2, \bar{k}_T^1 + I_T^1, z_T^2)$$

$$n^2 = n^2(\ell_N^2, \bar{k}_N^1 + I_N^1, z_N^2)$$

$$\ell_N^1 = \ell^1 - \ell_T^1$$

$$\ell_N^2 = \bar{\ell}^2 - \ell_T^2$$

$$z^1 = z_T^1 + z_N^1$$

$$z^2 = z_T^2 + z_N^2$$

$$I^1 = I_T^1 + I_N^1$$

where subscripts T and N refer to the traded and nontraded sectors, respectively, and j^i represents the relative spot price at date i of nontraded goods (in terms of traded final goods) at date i. (The term $1/j^1$ is often called the real exchange rate.) Price j^i adjusts so as to maintain equilibrium in the market for nontraded goods in period i. The parameter $1/\alpha$ represents the input-output coefficient in the nontraded goods sector; it will generally differ from one, which is the assumed input-output coefficient in the traded goods sector.

Maximization of date 1 national output requires that

$$x^1 = f(\ell_T^1) = z_T^1$$

$$n^1 = h(\ell_N^1) = h(\ell^1 - \ell_T^1) = \alpha z_N^1$$

The following set of equations describes the intertemporal budget constraint, the nontraded goods market in dates 1 and 2, and the current account in date 1:

$$E(1, j^1, \delta, \delta j^2, u) + j^1 I^1$$
$$= R^1(1, q^1, j^1, \ell^1, \bar{k}^1) + \delta R^2(1, q^2, j^2, \bar{\ell}^2, \bar{k}^1 + I^1) \quad (4.1)$$

$$E_2 + I^1 = R^1_3 \quad (4.2)$$

$$E_4 = R^2_3 \quad (4.3)$$

$$b^1 = R^1 - E_1 - j^1 E_2 - j^1 I^1 \quad (4.4)$$

The four equations contain four unknowns: u, j^1, j^2 and b^1.

The determinants of the investment and employment functions can be derived from (4.1) and from information about labor supply.

For example, the investment that maximizes output yields the marginal condition

$$\delta R^2_K(1, q^2, j^2, \bar{\ell}^2, \bar{k}^1 + I^1) = j^1$$

which says that firms should invest up to the point where the value of the marginal product of capital in date 2 production equals the cost of capital. It follows that investment demand can be represented by:

$$I^1(j^1, \delta, j^2, q^2); \; I^1_j < 0, \; I^1_\delta, \; I^1_{j^2} > 0, \; I^1_{q^2} \gtreqless 0$$

It is a function of the cost of capital, j^1, the prices of date 2 final goods, δ and j^2, and the date 2 price of oil. Since $\delta \equiv 1/(1 + r)$, the investment function captures the familiar relationship between the real interest rate and investment demand. Changes in the date 1 price of oil affect investment demand indirectly through j^1 and j^2 by influencing the supply of investment goods.[7] The properties of the investment function can be obtained from information about the production technology. Given a convex production technology in date 2, it can be shown that an increase in the price of capital goods decreases investment demand while an increase in date 2 final prices raises the marginal product of capital and hence investment demand. An increase in date 2 oil prices lowers investment demand if capital and oil are complements in date 2 production and increases investment demand if the two factors are substitutes.[8]

The employment function, ℓ^1, can be derived from the labor-market equilibrium condition:

$$R^1_\ell(1,\ q^1,\ j^1,\ \ell^1,\ \bar{k}^1) = w^1(1,\ j^1,\ \ell^1)$$

It follows that

$$\ell^1(1,\ j^1,\ q^1);\ \ell^1_j \gtreqless 0,\ \ell^1_{q^1} < 0\ .$$

An increase in j^1 raises employment in the nontraded goods sector and lowers it in the traded goods sector, so there is an ambiguous impact on economy-wide employment in date 1. An increase in q^1 lowers the net marginal product of labor in both sectors and hence reduces overall employment in the current period.

Having discussed some of the properties of the model, we are now ready to analyze the effects of oil price increases on the current account when the economy produces both traded goods and nontraded consumer and/or investment goods.

First, totally differentiate (4.1)-(4.4). Equation (4.1) can be solved separately to obtain the welfare effects of oil price increases. Equations (4.2) and (4.3) must be solved simultaneously to obtain equilibrium values for the price of nontraded goods in dates 1 and 2. The solutions to (4.1)-(4.3) can then be used in (4.4) to obtain the current-account effects of oil price increases.

The welfare and current-account effects are as follows:

$$E_u du = \lambda_{11} dq^1 + \lambda_{12} dq^2 + \lambda_{13} d\delta + \lambda_{14} dj^1 \tag{4.5}$$

where

$$\lambda_{11} = R_2^1 + R_\ell^1 \ell_q^1 < 0$$

$$\lambda_{12} = \delta R_2^2 < 0$$

$$\lambda_{13} = b^2$$

$$\lambda_{14} = R_\ell^1 \ell_j^1 \gtreqless 0$$

$$db^1 = \lambda_{21} dq^1 + \lambda_{22} dq^2 + \lambda_{23} d\delta + \lambda_{24} dj^1 + \lambda_{25} dj^2 \tag{4.6}$$

where

$$\lambda_{21} = (R_2^1 + R_\ell^1 \ell_q^1)(1 - c_y^1) < 0$$

$$\lambda_{22} = -j^1 I_{q^2}^1 - c_y^1 \delta R_2^2 > 0 \quad \text{if} \quad I_{q^2}^1 \leq 0$$

$$\lambda_{23} = -(c_y^1 b^2 + E_{13} + j^2 E_{14} + j^1 E_{23} + j^1 j^2 E_{24} + j^1 I_\delta^1) \gtreqless 0$$

$$\lambda_{24} = R_\ell^1 \ell_{j^1}^1 (1 - c_y^1) - E_{12} - j^1 E_{22} - j^1 I_{j^1}^1 \gtreqless 0$$

$$\lambda_{25} = -\delta(E_{14} + j^1 E_{24} + (j/\delta) I_{j^2}^1) \gtreqless 0$$

Equations (4.5) and (4.6) have been written in the above form even though j^1 and j^2 are endogenous variables in order to highlight the channels through which oil price increases alter welfare and the current account. Clearly, oil price increases affect welfare and the current account both directly, through q^1 and q^2, as well as indirectly, through their influence on nontraded goods prices j^1 and j^2.

4.1 <u>The role of nontraded investment goods</u>

In order to see clearly how these channels operate, consider first the case where the only nontraded goods produced are investment goods, and all investment takes place in date 1. This simplified case can be represented by equations (4.7)-(4.9), which are a modification of equations (4.1)-(4.4):

$$E(1,\ \delta,\ u) + j^1 I^1 = R^1(1,\ q^1,\ j^1,\ \ell^1,\ \bar{k}^1) + \delta R^2(1,\ q^2,\ \bar{\ell}^2,\ \bar{k}^1 + I^1) \quad (4.7)$$

$$I^1 = R^1_3 \quad (4.8)$$

$$b^1 = R^1 - E_1 - j^1 I^1 \quad (4.9)$$

The investment and employment functions are now given by:

$$I^1(j^1,\ \delta,\ q^2);\ I^1_j < 0,\ I^1_\delta > 0,\ I^1_{q^2} \gtrless 0$$

$$\ell^1(1,\ j^1,\ q^1);\ \ell^1_{j^1} > 0,\ \ell^1_{q^1} < 0\ .$$

Note that in this special case j^2 does not enter the investment demand function because there is no date 2 production of nontraded goods. Note, too, that $\ell^1_j > 0$. With wages indexed only to final goods, an increase in the price of the nontraded investment good increases employment because it raises the net marginal product of labor in the nontraded goods sector while leaving the supply price of labor unchanged.

Equations (4.7)-(4.9) can be solved for changes in u, j^1, and b^1. When the economy's only nontraded goods are investment goods, exogenous increases in world oil prices or the world interest rate have the following effects on nontraded goods prices and the current account:

$$dj^1 = \lambda_{31}dq^1 + \lambda_{32}dq^2 + \lambda_{33}d\delta \tag{4.10}$$

where

$$\lambda_{31} = -(R^1_{32} + R^1_{3\ell}\ell^1_q)\Delta^{-1} \gtrless 0$$

$$\lambda_{32} = I^1_{q^2}\Delta^{-1} < 0 \quad \text{if} \quad I^1_{q^2} < 0$$

$$\lambda_{33} = I^1_\delta\Delta^{-1} > 0$$

$$\Delta = -I^1_{j^1} + R^1_{33} + R^1_{3\ell}\ell^1_{j^1} > 0$$

$$db^1 = \lambda_{21}dq^1 + \lambda_{22}dq^2 + \lambda_{23}d\delta + \lambda_{24}dj^1 \tag{4.11}$$

where

$$\lambda_{21} = (R^1_2 + R^1_\ell\ell^1_q)(1 - c^1_y) < 0$$

$$\lambda_{22} = -j^1I^1_{q^2} - c^1_y\delta R^2_2 > 0 \quad \text{if} \quad I^1_{q^2} \leq 0$$

$$\lambda_{23} = -(c^1_y b^2 + E_{12} + j^1I^1_\delta) < 0 \quad \text{if} \quad b^2 > 0$$

$$\lambda_{24} = R^1_\ell\ell^1_{j^1}(1 - c^1_y) - j^1I^1_{j^1} > 0$$

A _temporary_ increase in oil prices affects the supply of investment goods but not the demand. The disturbance can either raise or lower nontraded goods prices, depending on the relative oil intensity of production in the two sectors of the economy. Technically, the response of j^1 depends on the sign and size of R^1_{32} in λ_{31}. The term represents the supply response in the nontraded goods sector to an increase in date 1 oil prices for a given economy-wide level of employment. If a temporary increase in date 1 oil prices reduces the supply of nontraded investment goods ($R^1_{32} < 0$), then j^1 will _rise_. The resulting drop in investment demand helps improve the current account ($\lambda_{24} > 0$). Note that the current account is also helped by the small drop in household absorption induced by the oil shock. But since temporary oil price increases also have a direct negative effect on GNP ($R^1_2 < 0$ in λ_{21}), their net impact on the current account is _ambiguous_. Only if temporary oil price increases reduce the relative price of nontraded goods will the current account clearly deteriorate. Recall that in the absence of nontraded goods, temporary oil shocks always led to a current-account deterioration.

Temporary oil price increases are more likely to increase the supply of nontraded goods and reduce their price the lower the oil——value-added ratio (the greater the α) in the nontraded goods sector relative to the traded goods sector.[9] That is because under such circumstances an increase in oil prices will induce a movement of labor from traded to nontraded goods. Temporary oil price increases which are _unexpected_ also generate additional employment effects in both sectors when there is real-wage resistance.

Permanent oil price increases alter both the demand and the supply of nontraded investment goods and have an ambiguous effect on their price. As in the previous case, the supply of investment goods will rise or fall depending on the relative oil intensity of capital goods production. A permanent increase in oil prices will also reduce (increase) the demand for investment goods if oil and capital are complements (substitutes) in date 2 production.

Permanent oil price increases have an ambiguous effect on the current account as well. For given prices of nontraded goods, they reduce GNP and employment ($R^1_2 + R^1_\ell \ell^1_q < 0$ in λ_{21}), which worsens the current account. They lead to a cut in absorption, which improves the current account; the expressions $(R^1_2 + R^1_\ell \ell^1_q)(-c^1_y)$ in λ_{21} and $\delta R^2_2(-c^1_y)$ in λ_{22} indicate that consumer expenditures fall and the term $-j^1 I^i_{q^2}$ in λ_{22} shows that investment demand drops if capital and oil are complements in date 2 production. But prices of nontraded goods do not remain fixed. As we have seen, permanent oil price increases can either raise or lower nontraded goods prices. If j^1 should increase, we see from λ_{24} that employment is stimulated and investment demand is further reduced. The spur to output and the fall in absorption help improve the current account. If j^1 should fall, there is instead an additional negative effect on the current account.

An anticipated future increase in oil prices reduces (increases) the demand for investment goods if capital and oil are complements (substitutes) in date 2 production, but has no effect on their current supply. Consequently, the expected future disturbance reduces (increases) today's relative price of nontraded goods.

When oil and capital are complements in date 2 production, an anticipated future increase in oil prices improves the date 1 current account. It can be shown that when $I^1_{q^2} < 0$, the expression $[\lambda_{22}dq^2+\lambda_{24}\lambda_{32}dq^2]$

in (4.11) is unambiguously positive.[10] The anticipated future increase in oil prices reduces permanent income, leading households to cut their expenditures in both periods. The expected increase also lowers the relative price of capital goods, j^1, with a resulting drop in employment. This additional welfare loss also induces households to reduce their spending. Finally, since the drop in j^1 triggers a contraction of employment in the nontraded goods sector, there is a concomitant drop in the demand for oil imports, given the fixed coefficient technology in place in date 1. All of these responses contribute to an improved current account.

Recall that anticipated future oil price increases always led to an improved current account when the economy produced just traded goods. The introduction of nontraded investment goods, however, permits oil price increases to influence the current account through additional channels. As we have seen, anticipated future oil price increases unambiguously improve the current account if capital and oil are complements in date 2 production.

The inclusion of nontraded goods highlights the importance of the oil—value-added ratio in the nontraded goods sector relative to the traded goods sector in determining the current-account response to current oil price increases. The relative oil intensity of production will also be an important determinant of the current-account response to anticipated future oil price increases once we introduce nontraded consumer goods and hence nontraded goods production in both periods.

4.2 The role of nontraded consumer goods

Consider next the case where the small economy's only nontraded good is a consumer good. Then the general model represented by equations (4.1)-(4.4) can be modified as follows:

$$E(1, j^1, \delta, \delta j^2, u) = R^1(1, q^1, j^1, \ell^1, \bar{k}^1) + \delta R^2(1, q^2, j^2, \bar{\ell}^2, \bar{k}^1) \qquad (4.12)$$

$$E_2 = R_3^1 \qquad (4.13)$$

$$E_4 = R_3^2 \qquad (4.14)$$

$$b^1 = R^1 - E_1 - j^1 E_2 \qquad (4.15)$$

The employment function is now given by:

$$\ell^1(1, j^1, q^1); \; \ell_j^1 \gtrless 0, \; \ell_q^1 < 0$$

Its properties are identical to the employment function of the general model. There is no investment function.

Equations (4.12)-(4.15) can be solved for changes in u, j^1, j^2 and b^1. When the economy's only nontraded good is a final good, exogenous increases in world oil prices or interest rates[11] have the following effects on nontraded goods prices and the current account:

$$dj^1 = \lambda_{31}dq^1 + \lambda_{32}dq^2 + \lambda_{33}d\delta \qquad (4.16)$$

where

$$\lambda_{31} = \{[R_{32}^1 + R_{3\ell}^1\ell_q^1 - c_{yN}^1(R_2^1 + R_\ell^1\ell_q^1)][E_{44} - R_{33}^2]$$
$$+ c_{yN}^2(R_2^1 + R_\ell^1\ell_q^1)E_{24}\}\nabla^{-1} \gtrless 0$$

$$\lambda_{32} = \{-\delta c_{yN}^1 R_2^2(E_{44} - R_{33}^2) + \delta(-R_{32}^2 + c_{yN}^2 R_2^2)E_{24}\}\nabla^{-1} \gtrless 0$$

$$\lambda_{33} = \{-(E_{23} + j^2E_{24} + c_{yN}^1 b^2)(E_{44} - R_{33}^2)$$
$$+ (-R_3^2 + E_{43} + j^2E_{44} + c_{yN}^2 b^2)E_{24}\}\nabla^{-1} \gtrless 0$$

$$\nabla = (E_{44} - R^2_{33})(E_{22} - R^1_{33} - R^1_{3\ell}\ell^1_j + c^1_{yN}R^1_\ell\ell^1_j)$$

$$- E_{24}(E_{42} + c^2_{yN}R^1_\ell\ell^1_j) > 0$$

$$dj^2 = \lambda_{41}dq^1 + \lambda_{42}dq^2 + \lambda_{43}d\delta \tag{4.17}$$

where

$$\lambda_{41} = \{-(E_{22} - R^1_{33} - R^1_{3\ell}\ell^1_j + c^1_{yN}R^1_\ell\ell^1_j)\, c^2_{yN}(R^1_2 + R^1_\ell\ell^1_q)$$

$$- (E_{42} + c^2_{yN}R^1_\ell\,\ell^1_j)(R^1_{32} + R^1_{3\ell}\ell^1_q - c^1_{yN}(R^1_2 + R^1_\ell\,\ell^1_q))\}(\delta\nabla)^{-1} \gtrless 0$$

$$\lambda_{42} = \{(E_{22} - R^1_{33} - R^1_{3\ell}\ell^1_j + c^1_{yN}R^1_\ell\,\ell^1_j)(R^2_{32} - c^2_{yN}R^2_2)$$

$$+ (E_{42} + c^2_{yN}R^1_\ell\,\ell^1_j)c^1_{yN}R^2_2\}\nabla^{-1} \gtrless 0$$

$$\lambda_{43} = \{(E_{22} - R^1_{33} - R^1_{3\ell}\ell^1_j + c^1_{yN}R^1_\ell\ell^1_j)(R^2_3 - E_{43} - j^2E_{44} - c^2_{yN}b^2)$$

$$+ (E_{42} + c^2_{yN}R^1_\ell\,\ell^1_j)(E_{23} + j^2E_{24} + c^1_{yN}b^2)\}(\delta\nabla)^{-1} \gtrless 0$$

$$db^1 = \lambda_{21}dq^1 + \lambda_{22}dq^2 + \lambda_{23}d\delta + \lambda_{24}dj^1 + \lambda_{25}dj^2 \tag{4.18}$$

where

$$\lambda_{21} = (R^1_2 + R^1_\ell\ell^1_q)(1 - c^1_y) < 0$$

$$\lambda_{22} = -c^1_y\delta R^2_2 > 0$$

$$\lambda_{23} = -(E_{13} + j^2E_{14} + j^1E_{23} + j^1j^2E_{24} + c^1_yb^2) \gtrless 0$$

$$\lambda_{24} = R^1_\ell\ell^1_j(1 - c^1_y) - E_{12} - j^1E_{22} \gtrless 0$$

$$\lambda_{25} = -\delta(E_{14} + j^1E_{24}) \gtrless 0$$

One can see that the expression (4.18) is identical to the current-account expression (4.6) in the general model except that investment effects are now absent. The term c_{yN}^{i} in (4.16) and (4.17) represents the date i marginal propensity to consume nontraded goods out of total present-value income.

Happily, the cumbersome expressions (4.16)-(4.18) have a ready economic interpretation.

From examination of (4.18), it is clear that a <u>temporary</u> increase in oil prices has an <u>ambiguous</u> effect on the current account. The term λ_{21} indicates that temporary increases have a direct negative effect on production, a negative employment effect and a smaller positive income-consumption effect.

Temporary oil price increases also influence the current account by altering the price of nontraded goods in dates 1 and 2. Inspection of λ_{31} in (4.16) and λ_{41} in (4.17) shows that temporary oil price increases can either raise or lower nontraded goods prices in dates 1 and 2. The expression $R_{32}^{1} + R_{3\ell}^{1}\ell_{q}^{1}$ in λ_{31} represents the supply effect in the date 1 nontraded goods market in response to an increase in date 1 oil prices. If the oil—value-added ratio in the nontraded goods sector is large (if α is small) relative to that in the traded goods sector, an increase in today's oil price will reduce the supply of nontraded goods for a given level of employment in the economy, and $R_{32}^{1} < 0$. Combined with the negative employment effect ($R_{3\ell}^{1}\ell_{q}^{1} < 0$), the supply of date 1 nontraded goods will fall. If the oil intensity of production in nontraded goods is relatively small, then the supply can actually rise. The term $(-c_{yN}^{1}(R_{2}^{1} + R_{\ell}^{1}\ell_{q}^{1}))$ in λ_{31} represents the date 1 demand deflationary effect of the oil price rise. The term $c_{yN}^{2}(R_{2}^{1} + R_{\ell}^{1}\ell_{q}^{1})E_{24}$ represents an intertemporal substitution effect in consumption. If the static and intertemporal consumption effects are strong and if nontraded goods are not very oil intensive, then j^1 will fall.

What is the effect of such a fall in j^1 on the current account? In general, any drop in j^1 worsens the current account. This can be seen from examination of λ_{24} in (4.18), which may be positive when nontraded and traded goods are imperfect substitutes and own-substitution effects dominate cross-substitution effects. The current account worsens when j^1 falls because production drops while net absorption by households increases.[12]

Temporary oil price increases also affect the current account through their influence on date 2 nontraded goods prices. Price j^2 can rise or fall depending on the relative strengths of the supply effects, income-consumption effects, and static and intertemporal consumption substitution effects. Suppose j^2 should fall. If all goods are net substitutes, then λ_{25} in (4.18) is negative and a fall in j^2 will improve the current account. This is because the drop in j^2 triggers an intertemporal consumption substitution effect away from date 1 goods, reducing current absorption.

As with temporary shocks, a _permanent_ increase in oil prices has an _ambiguous_ effect on the current account. In addition to the negative production and employment effects and the positive income-consumption effect, there are static and intertemporal consumption-substitution effects and static production effects represented by the last two terms in (4.18).

An _anticipated_ future increase in oil prices also has an _ambiguous_ effect on the current account. In addition to the positive income-consumption effect, λ_{22}, in (4.18), expected future increases in oil prices may raise or lower nontraded goods prices in dates 1 and 2, making the last two terms in (4.18) of either sign.

Again, the response of nontraded goods prices depends crucially on the relative oil intensity of nontraded goods production. The term R^2_{32} in both λ_{32} and λ_{42} represents the supply effect in the nontraded goods market in date 2 following an increase in date 2 oil prices. The smaller the oil intensity of production in the nontraded goods sector relative to the traded goods sector, the more likely that R^2_{32} will be positive. Indeed, if the nontraded good uses no oil inputs in date 2 production, and given that labor is fixed in supply and fully employed in date 2, an expected future oil price increase will only induce a movement of labor from traded to nontraded goods. R^2_{32} will be positive. Consequently λ_{32} in (4.16) is negative, λ_{42} in (4.17) is likely to be negative, and we can say that expected future oil price increases will lower the relative price of nontraded goods in dates 1 and 2.

We know that a fall in j^1 tends to worsen the current account while a fall in j^2 tends to improve it. Consequently, we cannot ascertain the net impact on the current account of anticipated future oil price increases without knowledge of specific parameter values, including the relative oil intensity of production in the traded and nontraded sectors.

Comparing the results in Section 4.2 with those in Section 3, we see that the current-account response to various types of oil price increases are much less clear cut once we introduce nontraded goods and the possibility of intertemporal and static substitution effects in consumption.

5. Conclusions

A small-country model has been used to examine the current-account response to temporary oil price increases, permanent oil price increases, and future anticipated oil price increases. The analysis has been conducted using a two-period model with maximizing agents. This framework allows us to work with aggregates which are consistent with micro behavior and permits us to capture explicitly the intertemporal nature of net international saving. It also offers a useful way of distinguishing between unexpected and expected price changes and permits the calculation of welfare effects. Moreover, the model is analytically tractable.

The model of Section 3 demonstrates that a temporary oil price shock worsens the current account, a permanent oil price shock can improve or worsen the current account, and a purely anticipated oil price increase improves the current account. All oil price increases reduce welfare for the small economy that is a net importer of oil.

When the analysis is extended to include a nontraded investment and consumption good, we introduce substitution effects in production and consumption which are static and intertemporal in nature. These substitution effects modify the current-account response to oil price increases in important ways. The relative oil—value-added ratio in the traded and nontraded sectors also becomes a crucial determinant of the current-account response.

Since the small-country model is a simple one and amenable to easy economic interpretation, it is a convenient place to start when trying to determine the differential response to various types of oil price increases. However, the small-country model is limiting in some respects. For instance, its partial-equilibrium nature ignores the feedback effects of higher oil prices on traded goods prices and world interest rates that have been stressed in the two-country model of Sachs (1980) and the three-country model of Marion-Svensson (1981). The model described here should be seen as offering a useful way to analyze the effects of expected versus unexpected disturbances on important macro variables, but should be viewed as a first step in developing a more complete general equilibrium analysis.

Footnotes

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[1] A similar intertemporal framework that employs the dual approach can be found in Svensson and Razin (1981). See also Dixit and Norman (1980).

[2] For a model where prices of traded goods and world interest rates are determined endogenously as part of a general equilibrium system, see Marion and Svensson (1981).

[3] δ is the present-value price of date 2 final goods in terms of the date 1 price of final goods.

[4] By assumption there is no foreign debt initially, so there are no interest payments in the current account at date 1. The current account at date 1 is equal to the trade balance.

[5] Alternatively, c_y^1 is the partial derivative with respect to present-value income of the Marshallian uncompensated demand for goods at date 1.

[6] The distinction between temporary, permanent and future expected disturbances has been made by Svensson and Razin (1981) in their intertemporal analysis of the Harberger-Laursen-Metzler effect.

[7] In Sachs (1981), investment is determined solely by the exogenously-given world interest rate (our δ, where $\delta \equiv 1/(1 + r)$), and by date 2 oil prices. Consequently, temporary oil price disturbances have no effect on investment. Further, domestic variables cannot influence investment. In our model, by contrast, temporary oil price increases indirectly alter the demand for investment goods by changing their price. In addition, exogenous or policy-induced domestic disturbances, though not explicitly modeled, can alter the relative price of nontraded goods and thereby influence investment behavior. Moreover, foreign disturbances influence investment demand not only directly, through δ, q^1 and q^2, but indirectly, through j^1 and j^2.

[8]See Berndt and Wood (1979) for a discussion of the complementarity/substitutability between oil and primary factors.

[9]Specifically, $R^1_{32} \gtrless 0$ as $\alpha \gtrless (1/j^1)$. The proof is as follows. By the properties of the revenue function,

$$R^1_{32} = h_\ell \left(\frac{d\ell^1_N}{dq^1}\right) \tag{A.1}$$

Choice of the optimal ℓ^1_N to maximize national output in date 1 leads to the marginal condition

$$(1 - q^1) f_\ell = (j^1 - \frac{q^1}{\alpha}) h_\ell \tag{A.2}$$

When we differentiate (A.2) with respect to q^1 and substitute the expression $w^1/(1 - q^1)$ for f_ℓ and the expression $w^1/(j^1 - \frac{q^1}{\alpha})$ for h_ℓ, we find that

$$\text{sign } \left(\frac{d\ell^1_N}{dq^1}\right) = \text{sign } (\alpha j^1 - 1)$$

Hence

$$R^1_{32} \gtrless 0 \quad \text{as} \quad \frac{d\ell^1_N}{dq^1} \gtrless 0 \quad \text{as} \quad \alpha \gtrless \frac{1}{j^1} .$$

[10]The simplest way to prove this is to rewrite equation (4.9) as:

$$b^1 = R^1_1 - E_1 + q^1 R^1_2 \tag{A.3}$$

Differentiating (A.3) with respect to q^2 gives

$$\frac{db^1}{dq^2} = (R^1_{13} + R^1_{1\ell}\ell^1_j + q^1 R^1_{23} + q^1 R^1_{2\ell}\ell^1_j)\frac{dj^1}{dq^2} - c^1_y E_u \frac{du}{dq^2} \tag{A.4}$$

Making use of the fact that $\frac{dj^1}{dq^2} < 0$ and $\frac{du}{dq^2} < 0$, we substitute into the bracketed expression in (A.4) the functional equivalents of the second partials of the revenue function. This substitution gives:

$$\frac{db^1}{dq^2} = \left(\frac{-q^1}{\alpha} h_\ell \ell^1_j\right)\frac{dj^1}{dq^2} - c^1_y E_u \frac{du}{dq^2} > 0 \tag{A.5}$$

[11] When there are two final goods in date 1 and two final goods in date 2, there are actually four real discount rates: (1) the present-value price of date 2 final goods in terms of date 1 final goods (δ), (2) the present-value price of date 2 final goods in terms of date 1 nontraded goods (δ/j^1), (3) the present-value price of date 2 nontraded goods in terms of date 1 traded goods (δj^2), and (4) the present-value price of date 2 nontraded goods in terms of date 1 nontraded goods ($\delta j^2/j^1$).

[12] If ℓ_j^1 is significantly negative, then λ_{24} might be negative. In this case, a fall in j^1 improves the current account; the fall in j^1 increases economy-wide employment, and this positive production effect dominates the absorption effect.

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