

Preliminary
COMMENTS WELCOME

EXPORT BOOM AND DUTCH DISEASE:
A DYNAMIC ANALYSIS

By

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1. Introduction

The purpose of this paper is to analyze the effects of an export boom in a small open economy with fixed exchange rates. In particular, we want to investigate the extent to which a boom in an export sector (oil, for example) affects competitiveness in the rest of the tradable goods sectors. This problem has sometimes been associated with the so-called Dutch-disease, where an increase in the price (or production) of a commodity export (oil) results in a real appreciation of the exchange rate, and in a loss of competitiveness of the traditional (non-oil) tradable goods sector.¹ This phenomenon has also been referred to as de-industrialization or tradables-squeeze effect (see Corden and Neary, 1981, and Corden, 1981).

From a policy point of view, the analysis of the Dutch-disease has important implications, since different governments have recently tried alternative measures to combat its main effects. In that respect, for example, the February 1982 Mexican devaluation can be viewed as an effort on behalf of the Mexican authorities to combat the real appreciation of the Mexican Peso, resulting from the booming oil and gas sector. Also, the Indonesian devaluation of 1978 responded to the notion that the increase in oil revenues had generated a domestic inflation higher than the world inflation, harming the competitiveness of traditional exports (palm oil, rubber). In both cases — Mexico in February 1982 and Indonesia in 1978 — by devaluing the domestic currency, the authorities attempted to restore the real exchange to its "equilibrium" value. This measure, however, would make sense only if the real appreciation of the domestic currency was indeed a short run phenomenon generated by the so-called "disease". However, if this appreciation is a real long run equilibrium consequence of a commodity export boom, a devaluation would have no lasting effect.

In this paper, we investigate the effect of commodity export boom on the rest of the economy under the assumption of a small economy with fixed exchange rates.² In this case, changes in the real exchange rate take place through changes in the nominal price of non-tradable goods. The fixed-rate assumption is made in order to focus the analysis on the case of oil exporting developing countries, most of which have a fixed rate with respect to the U.S. dollar (i.e., Indonesia, Ecuador, Venezuelas, and Mexico until recently). The extension of the model to the case of flexible rates, however, would not affect the main findings.

The main conclusion of the analysis is that the so-called "Dutch-disease" is not a disease in any clear sense. It is shown that as a consequence of a commodity exports boom, the equilibrium relative price of other tradables declines both in terms of non-tradables and in terms of the booming commodity. This long run decline in the equilibrium price of other tradables is a real effect of the export boom, and it is not clear in what sense it should be labelled a disease. As a consequence of this change in relative prices, resources move out of the traditional tradables sector into the other sectors of the economy.

However, as a result of the export boom, a short run excess supply of money can occur (see Harberger, 1981). In this case, in the short run the relative price of traditional tradables, with respect to non-tradables, will fall below its new long run equilibrium, further squeezing profitability in the non-tradables sector. (In this model, this short run fall in the relative price of traditional tradables results from an overshooting of the nominal price of non-tradables over and above their new run equilibrium.)³

In this paper we develop a general equilibrium dynamic model where we analytically investigate the conditions under which this short run

overshooting will result. We then discuss the policy measures that would eliminate this overshooting, allowing a smoother transition from pre-boom to post-boom relative prices.

The plan of the paper is as follows: In Section 2, a diagrammatical analysis is used to investigate the long run and short run effects of a commodity (oil) boom on the competitiveness of other tradables. The model assumes that the export boom is produced by an increase in the price of oil, but it could easily be adapted to the case of a boom generated by new oil discoveries. The model also assumes that there is perfect factor mobility in the short and long run. The introduction of short run restrictions to intersectoral capital mobility, as in Jones (1971), Corden and Neary (1981), and Neary and Purvis (1981) would provide additional sources for dynamic effects. In Section 3 the technique derived by Aoki (1980, 1981) is used to formally investigate the conditions under which a short run overshooting of the nominal price of non-tradables will result. It is found that this price will overshoot its long run equilibrium if the government spends more than a critical fraction of additional oil revenues on non-tradable goods. From here, it directly follows that by setting this proportion at a determined level, overshooting can be eliminated. Section 4 contains some discussion on the results derived in the variational analysis of Section 3, and some possible extensions of the model are discussed. In particular, it is noted that if downward wage rigidity is introduced in the analysis, an export boom can result in short run unemployment. Finally, the paper contains an Appendix where some of the derivations are presented in detail.

2. Exports Boom, Relative Prices and Competitiveness: A Diagrammatical Analysis

In this section, we use a diagrammatical analysis to discuss the effects of an increase in the price of the booming sector (oil) on the relative price of other (or traditional) tradables. The discussion distinguishes between the long run real effect of this external disturbance and the short run dynamics. The analysis is kept to a simple level in order to highlight the main issues without having to deal with side effects. Section 3, on the other hand, incorporates a number of complications ignored in the diagrammatical analysis.

2.1 Long Run Effects

Consider a small open economy that produces three goods: oil (O), other tradables (T) and non-tradables (N). Assume also that the oil sector is owned by the government, as is the case of most oil-producing developing countries. Further assume that the exchange rate is fixed and equal to one. The excess demand for non-tradables is assumed to depend on prices and income:

$$N = \tilde{N}(P_N, P_T, Y) = 0 \quad (1)$$

(-) (+) (+)

where P_N and P_T are nominal prices of non-tradables and traditional tradables, respectively. Y , on the other hand, is real income. The signs in parentheses below the function's arguments refer to the assumed signs of the partial derivatives. The positive sign of P_T stems from the assumption of gross substitutability between non-traded goods and tradable goods.

Equilibrium in the non-tradables sector requires that the excess demand for this type of good is equal to zero, both in the short run and the long run.

In (1) Y is expressed in terms of other tradable goods, and given by

$$Y = H_T^S + (P_N/P_T)H_N^S + (P_O/P_T)\bar{O} \quad (2)$$

where H_N^S , H_T^S and \bar{O} are supplies of the non-tradables, tradables and oil,

respectively. The supply of oil is held fixed for simpler analysis. The price index is denoted by P_I .

Equation (2) implies that

$$\frac{\partial N}{\partial P_0} = (\partial N/\partial Y)(\partial Y/\partial P_0) > 0$$

hence (1) may be written as

$$N = \tilde{N}(P_N, P_T, P_0) = 0 \quad (1')$$

(-) (+) (+)

Taking the price of non-tradables as the numeraire, we can write (1') as:

$$N = N(q_T, q_0, Y/P_N) = 0 \quad (1'')$$

where

$$q_T = \frac{P_T}{P_N} \quad \text{and} \quad q_0 = \frac{P_0}{P_N}$$

Our interest is to discover the effect of an increase in the price of oil on the relative price of traditional tradables.

Maintaining the assumption of gross substitutability, we can depict the equilibrium situation in the non-tradables market in Figure 1, which has been adapted from Dornbusch (1974). The NN schedule describes the combination of q_T and q_0 that is compatible with equilibria in the non-traded goods market. The slope of this curve is given by $-(\partial N/\partial P_0)/(\partial N/\partial P_T)$. Ray OT, on the other hand, measures the relative price of both tradable goods -- traditional tradables to oil (P_T/P_0). The initial equilibrium position is given by A with equilibrium relative prices being equal to q_T^0 and q_0^0 respectively.

Assume now that there is an exogenous increase in the price of oil. The OT ray will then rotate clockwise toward OT' in Figure 2. If the (nominal) price of non-tradables was constant, the new equilibrium would be given by B, with a constant relative price of traditional tradables with

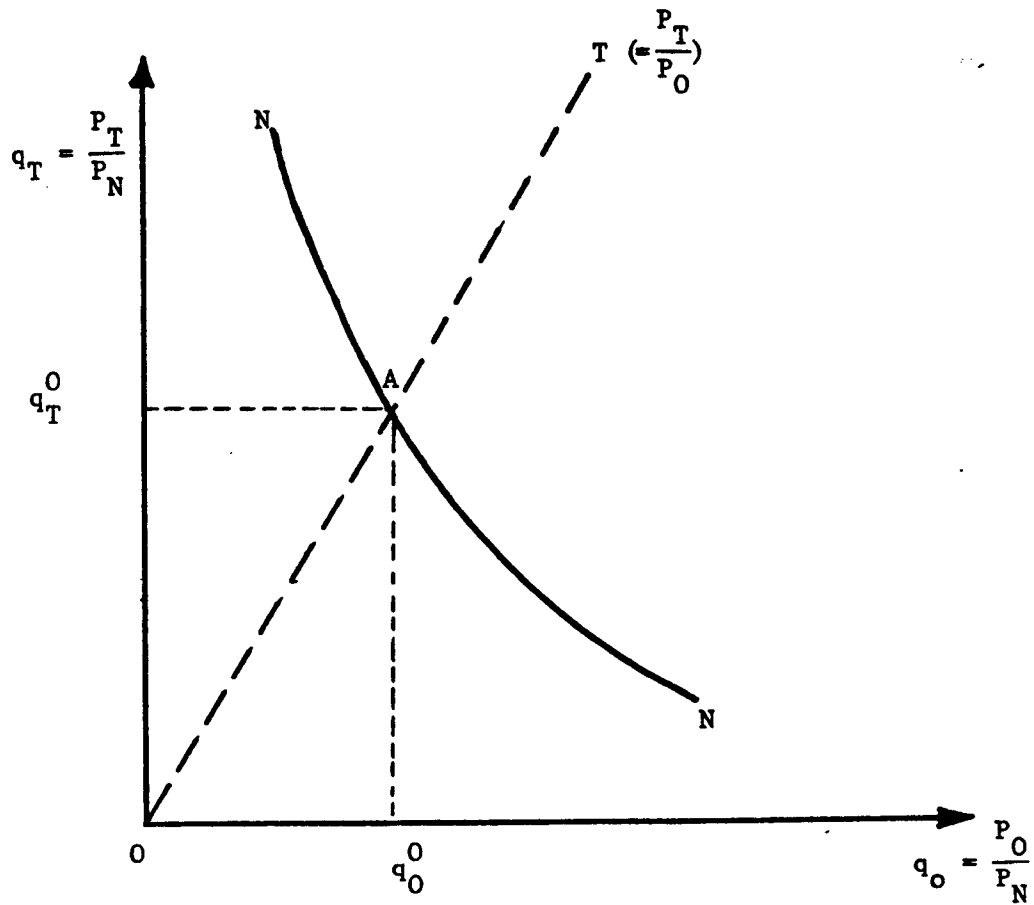


Figure 1

respect to non-tradables. However, as long as the slope of the NN is different from 0, at B there will be an excess demand for non-tradables that will require an increase of the relative price of these goods, both with respect to the price of oil and traditional tradables. The final equilibrium will then be attained at C. As a consequence of the increase of the price of oil, there has been a decrease of the relative price of traditional tradables both with respect to oil (i.e., $P_T/P_0^1 < P_T/P_0$) and with respect to non-tradables (i.e., $q_T^0 > q_T^1$). This reduction in the relative price of traditional tradables, of course, will encourage resources to move out of the traditional tradables sector into the other sectors of the economy. This phenomenon has been called by some authors the de-industrialization effect of an exports boom (see, for example, Corden and Neary (1981)).

It may be noticed from Figure 2 that the degree of reduction of $q_T (= P_T/P_N)$ will depend on the slope of the NN curve. At one extreme, if the NN curve is a vertical line — that is, if $\partial N/\partial P_T = 0$ — the negative effect on q_T of an exogenous increase in the price of oil will be maximum. On the other hand, if the NN curve is a horizontal line, there will be no effects of an increase of the price of oil on q_T . This will be the case if all the additional income generated by the higher price of oil is spent on tradables (i.e., $\partial N/\partial P_0 = 0$).

The movement from A to C in Figure 2 is a real phenomenon resulting from the increase in P_0 , and in that respect it can hardly be referred to as a "disease".⁴

2.2 Short Run Disequilibrium in the Money Market

The preceding analysis has focused on the real long run effect of an exogenous increase in the price of one export (oil) on the competitiveness of the rest of the tradable industries. The analysis, however, has abstracted

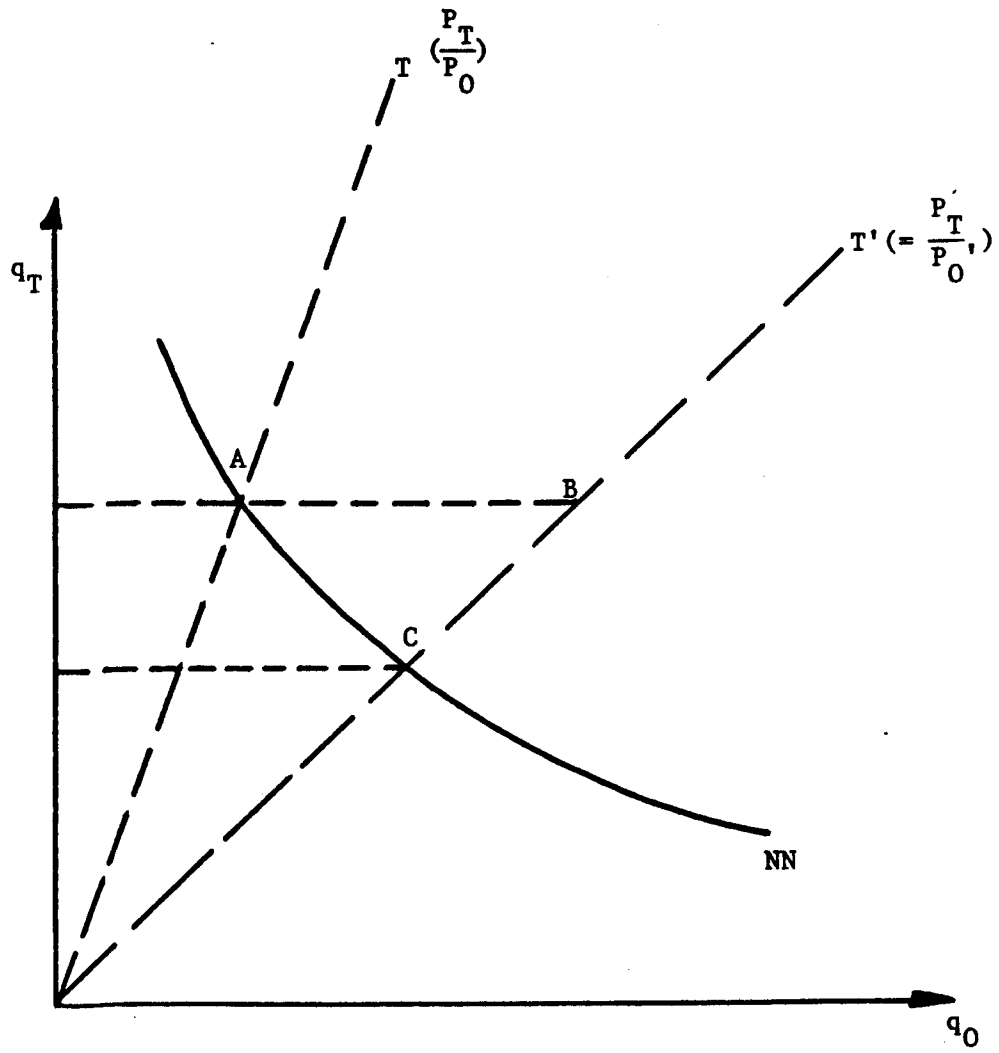


Figure 2

from any dynamic considerations. In this section we motivate the formal dynamic analysis of Section 3 by introducing some dynamic considerations into our diagrammatical analysis. To accomplish this, we explicitly introduce a slowly-clearing monetary sector. We posit that the excess supply for money function is given by:

$$M^E = M^S - M^D \quad (3)$$

Assuming that the demand for money equation M^D (in nominal terms) depends on the usual arguments -- real income, and the price level -- we can write M^E as:

$$M^E = M^E (M^S, P_N, P_O, P_T, Y) \quad (3')$$

(+) (-) (-) (-) (-)

We further assume that M^E is equal to zero only in the long run. In particular, an increase of M^S will result in a short run excess supply of money. It is further assumed that an excess supply of money will be reflected in an excess demand for non-tradables and an excess demand for traditional tradables. Then, equation (1') has to be modified to incorporate the assumption that in the short run, an excess supply of money is partially translated into an excess demand for non-tradables.

$$N = N(q_T, q_O, M^E, Y/P_N) = 0 \quad (3'')$$

(+) (+) (+) (+)

In terms of Figure 1, an increase in M^E will result in a downward shift of schedule NN. The model is completed by specifying the balance of trade and the money supply equations.

The balance of trade is defined as:

$$B = q_O \bar{O} - E_T \quad (4)$$

where E_T stands for excess demand for traditional tradables, and where \bar{O} is the amount of oil exported. It is also assumed that $\partial B / \partial q_O > 0$; an

increase of the price of oil will result in an improvement of the balance of trade.

In a small open economy with fixed exchange rates the quantity of money will be endogenous in the long run. However, in the short run it is plausible to think that the actual quantity of money can differ from the amount of money demanded. This process will be modelled by differential equations in Section 3 to facilitate the analysis.

For the purpose of the diagrammatic analysis only, we will assume that, under certain circumstances, an increase in the price of oil will also result in a short run excess supply of money. The reason for this is that an increase in P_0 will result, through (4), in a balance of trade surplus and this, in turn, will positively affect the supply of money. (See Harberger, 1981).⁵ Assuming that this increase in M^S is greater than the increase in M^D resulting from the income and price effects, an excess supply of money will result. This disequilibrium in the money market will be slowly eliminated through the trade account.

Under these assumptions, the short run effects an exogenous increase in the price of oil can be depicted in Figure 3. The exogenous increase in the price of oil simultaneously results in a downward shift of the NN curve to $N'N'$ and in a rotation of the OT ratio to OT' . The new short run equilibrium is attained at S . Final equilibrium is obtained, as before, in C . The dynamics are characterized by shifts of the $N'N'$ curve to the right towards the NN curve. The speed of this adjustment depends on how fast the excess supply of money is eliminated. As may be seen, in this case relative price of traditional tradables undershoots its final equilibrium level. This means that in this particular case, the loss of competitiveness of the traditional tradables sector (as measured by the decline of q_T) is greater

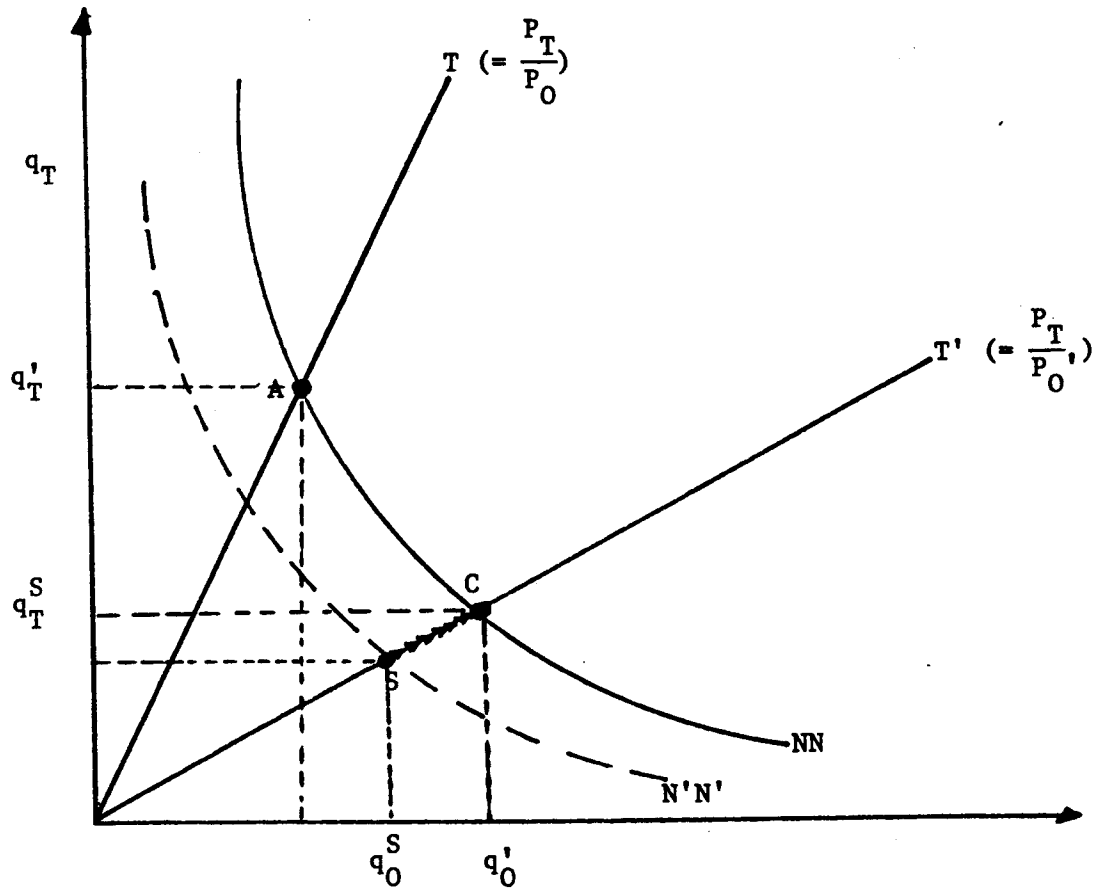


Figure 3

in the short run than in the long run. In the next section we rigorously analyze the characteristics of this undershooting of q_T (or overshooting of P_N). Our results indicate that an undershooting of q_T is not a necessary outcome of the dynamic analysis. Quite the contrary, as shown in Section 3, in order to obtain this result, a set of specific conditions are required. An alternative dynamic effect is obtained, for example, if it is assumed that the balance of trade surplus resulting from the increase in P_0 is not monetized. In this case, the initial increase in P_0 will generate an excess demand for money. This may be seen from equation (3), where

$\partial M_E / \partial P_0 < 0$. Under these circumstances, then, the increase of P_0 will result in a simultaneous shift of the NN curve to the right and a downward rotation of the OT ray. This situation is captured by Figure 4. In this case, the short run equilibrium situation will be obtained at R, where q_T falls short of its final equilibrium value of q_T^1 .

2.3 The Behavior of P_N .

The preceding analysis focused on the behavior of q_T in order to discover the extent to which an increase in the price of oil affects the competitiveness of the traditional tradables sector. However, in a small open economy with a fixed exchange rate, the nominal price of traditional tradables (P_T) is given, and the adjustment of relative prices is obtained through changes in the nominal price of non-tradable goods (P_N).

Our discussion in the previous section reveals that there are (at least) three different paths that P_N can take following an increase in P_0 . These alternative paths are summarized in Figure 5, and are rigorously investigated in the next section. If monetary considerations are ignored, P_N will jump from A to C. Alternatively, if the increase in P_0 results in a short run excess supply of money, the price of non-traded goods will jump from A to

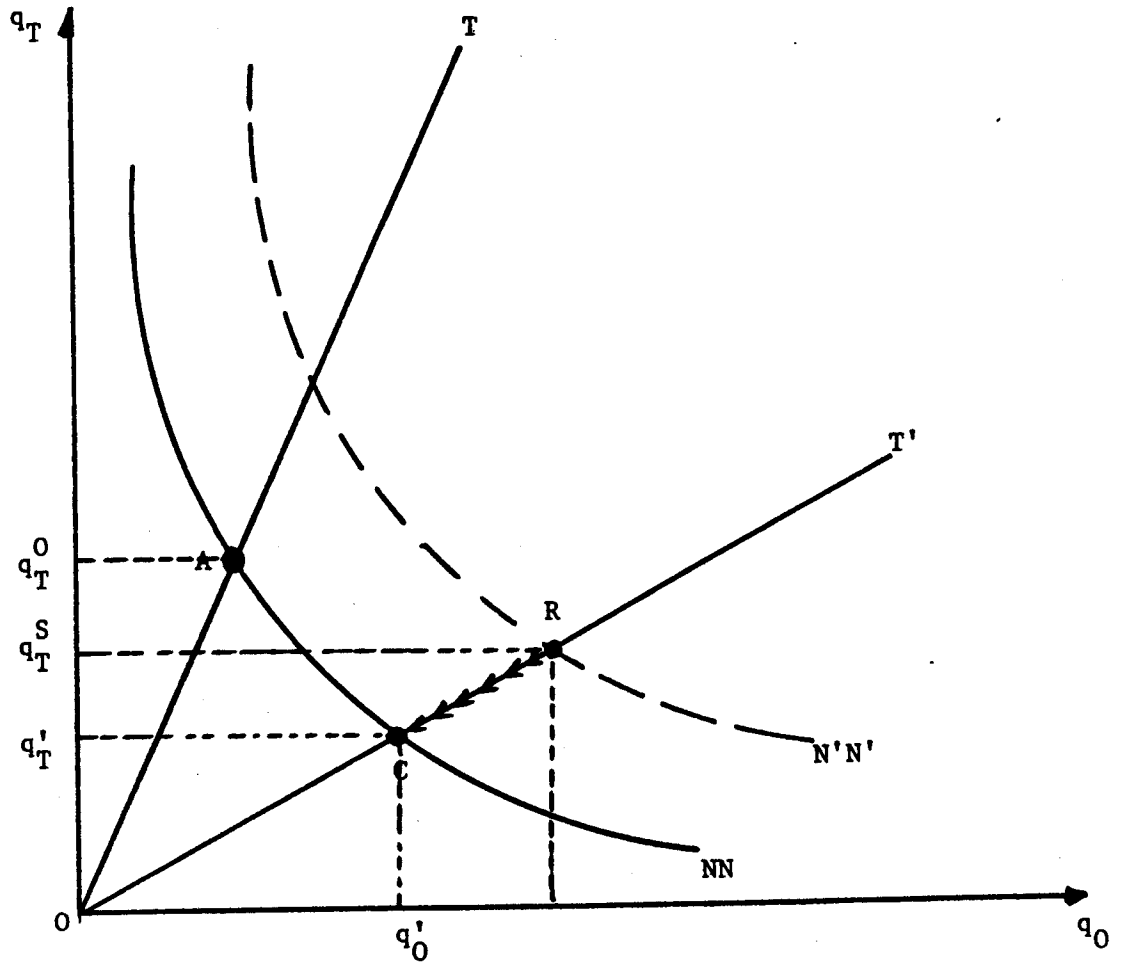


Figure 4

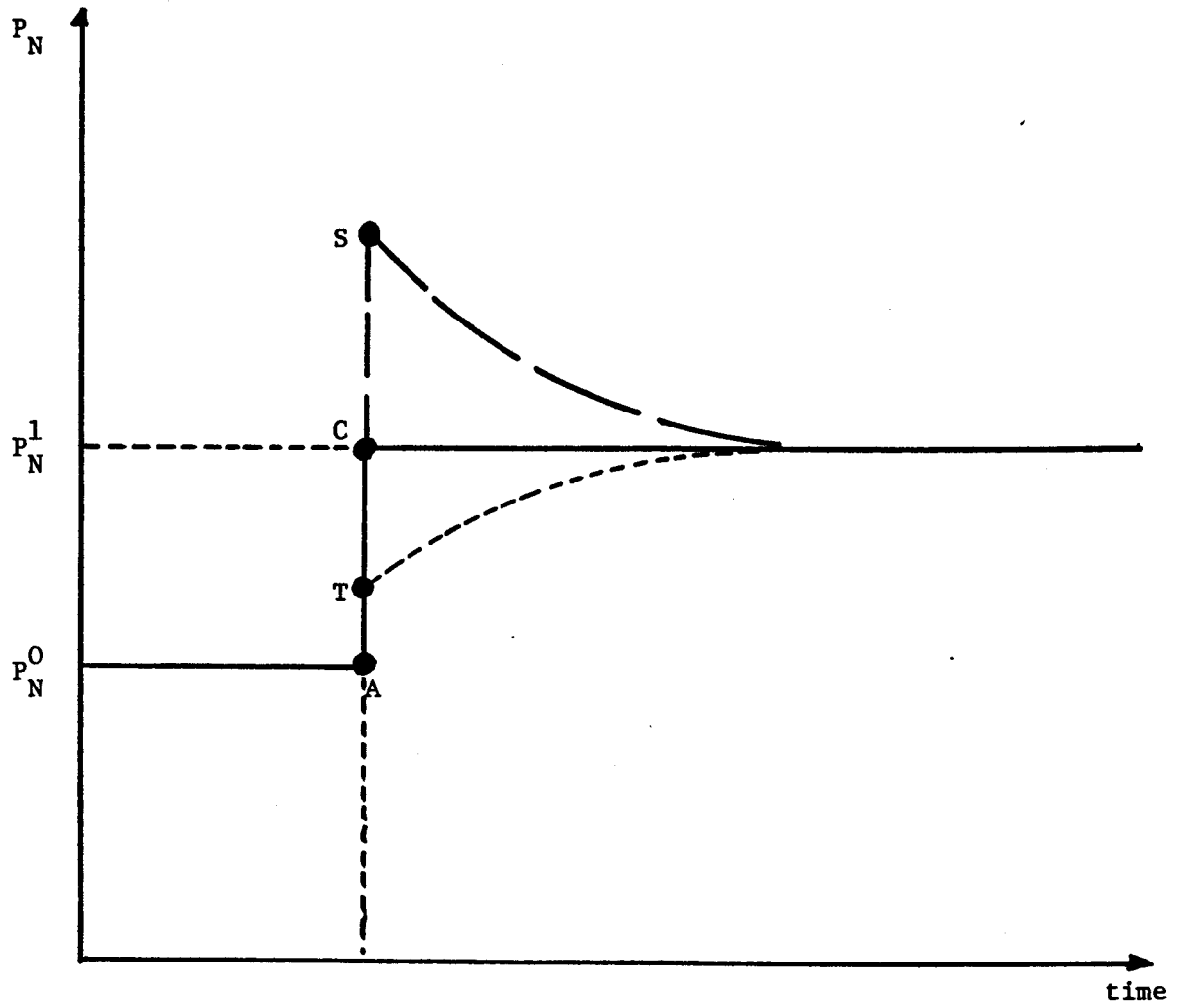


Figure 5

S, and will slowly return to its long run equilibrium. Finally, if immediately after the increase in P_0 there is an excess demand for money, P_N will only jump to T, undershooting its final equilibrium, and will subsequently move towards P_N^1 . As discussed in Section 3, the adjustment towards P_N^1 in these two latter cases can also be oscillatory if additional sources of dynamics are included in the analysis, such as changing wage rates or expectations on inflation.

The simple diagrammatical discussion in this section has been presented in order to motivate the analytical investigation of the next section. Additionally, from this diagrammatical analysis, it is apparent that it is not clear in what way, if any, we can refer to the effects of an increase in P_0 on the rest of the economy as a "disease".

3. Comparative Dynamics Analysis

In this section the discussion presented in the diagrammatical analysis is formalized using a dynamic general equilibrium model. We investigate conditions under which the alternative paths of P_N depicted in Figure 5 are obtained. In particular, we derive conditions for P_N to overshoot its long run equilibrium value, generating what might be called a short run "disequilibrium" loss of competitiveness in the traditional tradable goods sector. The analysis is carried out in terms of two alternative assumptions regarding the formation of inflationary expectations: static expectations and perfect foresight.

3.1 Structural Equations

We summarize the model in structural form:

Non-tradable sector:

$$H_N^S = H_N^S(W/P_N) \quad \text{supply} \quad (5)$$

(-)

$$H_N^d = H_N^d(P_N/P_T, Y, M^S - M^d) + G_N \quad \text{demand} \quad (6)$$

(-) (+) (+)

Tradable sector:

$$H_T^S = H_T^S(W/P_T) \quad \text{supply} \quad (7)$$

(-)

$$H_T^d = H_T^d(P_N/P_T, Y, M^S - M^d) + G_T \quad \text{demand} \quad (8)$$

(+ (+) (+)

National Income:

$$Y = H_T^S + (P_N/P_T) H_N^S \quad (9)$$

in terms of tradables

Balance of Trade:

$$B = H_T^S - H_T^d + (P_O/P_T) \bar{O} \quad \text{in terms of tradables} \quad (10)$$

Labor Sector:

$$L_N = L_N(W/P_N) \quad \text{demand for non-traded goods sector} \quad (11)$$

(+)

$$L_T = L_T(W/P_T) \quad \text{demand for traded goods sector} \quad (12)$$

(+)

$$L_T + L_N = L - \bar{L}_O \quad \text{equilibrium condition.} \quad (13)$$

Monetary Sector:

$$M^d/P_I = kYe^{-\pi^e} \quad \text{demand} \quad (14)$$

where

$$P_I = P_N^\alpha P_T^{1-\alpha} \quad (15)$$

$0 < \alpha < 1$

and where

$$\pi^e = (\dot{P}_I/P_I) \quad \text{expected inflation} \quad (16)$$

$$M^S = D + R \quad \text{supply} \quad (17)$$

where

$$\dot{R} = P_T B \quad (18)$$

Government Sector:

$$G_T = (1-\theta)B \quad \text{in terms of tradables} \quad (19)$$

$$P_N G_N = \dot{D} + \theta P_T B - P_T T_X \quad (20)$$

In (5) and (7), W is the nominal wage rate. In (6) G_N is the government expenditure on non-tradables. Equations (11) and (12) are labor supply schedules. Equation (13) is the market clearing condition for the labor sector where the oil sector employment is assumed constant. In (14), P_I is the consumer price index. The ratio α of the consumption bundle of the residents of the small open economy falls on non-tradables and the remainder, $1 - \alpha$, on tradables. This formulation of the price index assumes that oil is not consumed in this economy. This assumption turns out to be critical in the analysis of the overshooting of P_N as is shown below. The expected rate of inflation of the consumer price index is given by (16). Equation (17) describes the supply of money. Equation (18) describes the rate of increase of foreign exchange in the economy. Equation (19) shows that the government spends $(1-\theta)$ of the trade balance on the foreign goods. The government budget constraint equation implies that G_N is given by (20), where T_X is the real tax receipt in terms of the tradables.

3.2 Variational Equations

We now employ the technique for comparative dynamic analysis as expounded in Aoki (1980, 1981) to evaluate consequences of unexpected exogenous shifts in P_0 . Roughly speaking, we postulate a reference time path along which this small open economy is moving. The reference path can be a long run equilibrium (or a steady-state path in the case of a growing economy) or any

other "planned" time path, so long as the time path for the exogenous variables (such as P_0 , T_X or D) and the resulting time paths for the endogenous variables satisfy the model equations (5) through (20). Unforeseen movements in P_0 not included in the reference time path then would cause the time paths for all the endogenous variables to deviate from their respective time paths.⁶ These deviations are governed by the variational dynamic equations, derivations of which we now describe. It is convenient to derive the variational equations without explicit specification of the reference path. Different choices of reference paths modify (generally) time-varying coefficients of the variational equation. By treating these coefficients as generally time-varying, and specifying them later, if necessary, we can treat a variety of reference paths.

In all the reference paths, T_X and P_T are held fixed; T_X because of a simplifying assumption that the effects of changing P_N and Y do not affect T_X , and P_T because it is equal to P_T^* by price arbitrage.

Notation

We use δ to denote deviation from the reference path values, e.g., $\delta M^S(t) = M^S(t) - M_0^S(t)$ where the subscript 0 denotes a reference path variable. Lower case letters are used to denote relative deviation, e.g., $m^S(t) = \delta M^S(t)/M_0^S(t)$ so that perturbed path $M^S(t)$ is related to the reference path $M_0^S(t)$ by $M^S(t) = M_0^S(1+m^S(t))$. Other lower case variables, such as $w(t)$ and $p_N(t)$ are similarly defined, i.e., $w(t) = \delta W(t)/W_0(t)$ and $p_N(t) = \delta P_N(t)/P_N^0(t)$. Here superscript 0 is used to denote a reference path for $P_N(t)$.

From (17) and (18), then

$$\dot{\delta M^S}(t) = \dot{\delta D}(t) + P_T \delta B(t). \quad (21)$$

From (20)

$$\delta(P_N G_N) = P_N G_N (p_N + g_N) = \delta \dot{D}(t) + \theta P_T \delta B(t) \quad (22)$$

where

$$g_N = \delta G_N / G_N^0(t).$$

Variational Reduced Forms and Dynamics

Details of derivations are found in the Appendix. The price of non-tradables deviates according to

$$p_N = \pi_0 p_0 + \pi_1 (m^s - \mu m^d) + \pi_2 g_N \quad (23)$$

where $\pi_0 \sim \pi_2$ are the elasticities of no immediate concern (they are defined in the Appendix). The balance of trade deviates from the reference path according to

$$P_T^0 \delta B(t) / M^S(t) = \beta_0 p_0 - \beta_1 p_N - \beta_2 (m^s - \mu m^d) \quad (24)$$

where $\beta_0 \sim \beta_2$ are defined in the Appendix.

The money supply deviates according to

$$\dot{m}^s = -\lambda_0 m^s + \beta_0 p_0 - \beta_1 p_N - \beta_2 (m^s - \mu m^d) + x \quad (25)$$

where

$$\lambda_0 = (\dot{M}^S / M^S)_0$$

is the rate of growth of the money supply along the reference path (which could be zero), and

$$x = (\delta \dot{D} / M^S)_0$$

is another instrument of the government.

In (23) and (24), m^d is given by

$$m^d = \xi_0 p_0 + \xi_1 m^s - \xi_2 \delta \pi^e + \mu_2 \xi_2 x \quad (26)$$

$$g_N = \xi_0 p_0 - \xi_1 m^s - \mu \xi_1 \delta \pi^e + \gamma_2 x. \quad (27)$$

The exact expressions of the parameter ξ_0 , ξ_1 , ξ_2 , and ξ_3 are given in the Appendix.

Static Expectations

Under static expectations assumption, $\delta\pi^e$ in (26) and (27) is zero.

Equation (25), on substituting m^d out by (26) becomes

$$\dot{m}^s = -v_1 m^s + v_0 p_0 + v_2 x \quad (28)$$

where

$$v_1 = \lambda_0 + (1-\mu\xi_1)\beta_2 - [\pi_2\xi_1 - (1-\mu\xi_1)\pi_1]\beta_1$$

and

$$v_0 = \beta_0 - \beta_1\pi_0 + \mu\xi_0(\beta_2 + \beta_1\pi_1) - \pi_1\beta_1\xi_0,$$

v_2 is some constant of no immediate concern. To have a stable variational dynamic, we assume that v_1 is positive. Later we choose θ to eliminate overshoot which renders v_1 unambiguously positive. The reduced form expression for P_N is obtained from (23), (26), and (27)

$$P_N = \rho_0 P_0 + \rho_1 m^s + \rho_2 x \quad (29)$$

where

$$\rho_0 = \pi_0 - \mu\xi_0\pi_1 + \xi_0\pi_2$$

$$\rho_1 = (1-\mu\xi_1)\pi_1 - \pi_2\xi_1$$

and

$$\rho_2 = (\pi_2 - \mu\xi_2\pi_1)\xi_2.$$

We later show that a non-zero coefficient ρ_1 in (29) produces overshooting.

Equation (28) is solved as:

$$m^s(t) = \phi(t,0)m^s(0) + \int_0^t \phi(t,\tau) \{v_0 p_0(\tau) + v_2 x(\tau)\} d\tau \quad (30)$$

where

$$\phi(t,\tau) = \exp\left(-\int_{\tau}^t v_1(u) du\right).$$

Let $x(t) \equiv 0$ and $p_0(t) \equiv \bar{p}_0$ to illustrate a simple case. We further assume that v_1 is a constant. Then, from (29) and (30)

$$P_N(t) = (\rho_0 + \rho_1 v_2/v_1) \bar{p}_0 + \rho_1 (m^s(0) - \bar{p}_0 v_0/v_1) e^{-v_1 t}.$$

Initially, $p_N(0)$ equals $\rho_0 \bar{p}_0 + \rho_1 m^s(0)$. As time goes to infinity, $p_N(t)$ approaches $(\rho_0 + \rho_1 v_2/v_1) \bar{p}_0$. Thus, $p_N(t)$ exhibits an initial overshoot if and only if:⁷

$$\rho_1 (m^s(0) - \bar{p}_0 v_0/v_1) > 0.$$

Since $m^s(0)$ is zero unless the domestic credit is discontinuously changed at the time of the oil price increase, i.e., $\delta D(0) \neq 0$, this condition becomes, noting that $\bar{p}_0 > 0$

$$\rho_1 v_0/v_1 < 0. \quad (31)$$

Thus, an overshoot is eliminated by choosing θ -- the proportion of oil revenue spent by the government on non-tradable goods -- such that $\rho_1 v_0$ is zero.⁸ It turns out that v_0 is not zero, but ρ_1 can be made zero as follows: From (29), where π 's and ξ 's are substituted out, the coefficient ρ_1 vanishes if $\pi_1 + \gamma_1 \pi_2$ is set to zero. From its defining relation of γ_1 , the value of θ given by

$$\theta = \kappa (P_N G_N / M^S)_0 \quad (32)$$

where

$$\kappa = \left(\frac{1}{H_N^d} \frac{\partial H_N^d}{\partial M^S} M^S \right)_0 \{ g_N / (H_N^d + G_N) \}_0^{-1} (P_T M^S \frac{\partial H_T^d}{\partial M^S})_0$$

no overshoot occurs.

More generally,

$$p_N(t) = \rho_0 \bar{p}_0 + \rho_1 \phi(t,0) m^s(0) + \rho_1 \left(\int_0^t \phi(t,\tau) v_2(\tau) d\tau \right) \bar{p}_0.$$

Assuming that (28) is stable, i.e., $\phi(t,0) \rightarrow 0$ as $t \rightarrow \infty$, the condition of overshoot becomes $\lim_{t \rightarrow \infty} \rho_1(t) \{ m^s(0) - \int_0^t \phi(t,\tau) v_0(\tau) d\tau \} > 0$ or assuming $m_s(0) = 0$ as before, (31) is replaced with

$$\lim_{t \rightarrow \infty} \rho_1(t) \int_0^t \phi(t,\tau) v_0(\tau) < 0. \quad (31')$$

A sufficient condition for no overshoot then is $\rho_1(t) \equiv 0$. A θ which varies with time according to (32) still eliminates the unnecessary overshoot

in the price of non-tradables.

Perfect Foresight

Under perfect foresight we have:

$$\begin{aligned}\dot{\delta\pi}^e &= \dot{p}_I \\ &= \alpha \dot{p}_N\end{aligned}\tag{36}$$

To (28) and (29) are added terms depending on $\delta\pi^e$

$$\dot{m}^s = -v_1 m^s + v_0 p_0 + v_2 x - v_3 \delta\pi^e\tag{37}$$

and

$$p_N = \rho_0 p_0 + \rho_1 m^s + \rho_2 x + \rho_3 \delta\pi^e\tag{38}$$

where

$$v_3 = \mu \{ \beta_2 \xi_2 + (\pi_1 \xi_2 - \pi_2 \xi_1) \beta_1 \}$$

and

$$\begin{aligned}\rho_3 &= \mu (\pi_1 \xi_2 - \pi_2 \xi_1) \\ &= \mu \rho_1.\end{aligned}$$

Note that our choice of θ given by (32) additionally renders ρ_3 zero. With ρ_1 and ρ_3 zero, (36) through (38) yield

$$\dot{m}^s = -v_1 m^s + v_0 p_0 + v_2 x - \alpha v_3 \dot{p}_N,$$

and

$$p_N = \rho_0 p_0 + \rho_2 x.$$

With $x = 0$ and $p_0 = \bar{p}_0$, $\dot{p}_N = 0$; hence, except for the initial jump in p_N , the differential equation reduces to (28). Thus, θ in (32) still produces no overshoot! See Appendix for further explanations.

4. Discussion and Extensions

In the preceding section, the conditions under which P_N will overshoot its new long run equilibrium value were found, assuming both static expectations and perfect foresight. It was found that in both cases overshooting will occur if the proportion of oil revenues spent by the government or non-tradable goods (θ) exceeded a specific value. From this finding it is trivial to find the value of θ — given by equation (32), will be the same under static expectations and under perfect foresight. The reason for this apparently odd result is that in this model the price level (equation (15)) only includes the prices of traditional tradable and non-tradable goods, and this excludes the price of oil.

Alternatively, overshooting of P_N can be eliminated through a devaluation of the domestic currency. A devaluation will produce an increase in the domestic price of traditional tradable goods, and of the price level P_I . This increase in the price level, in turn, will tend to eliminate the excess supply of money initially generated by the increase of the price of oil, eliminating the source of the overshooting of P_N .

Until now the discussion has been carried under the assumption that by elimination of overshooting of P_N would produce a smoother (and more desirable) transition from pre-boom relative prices to post-boom relative prices. The analysis, however, has not dealt in an explicit way with reasons why the avoiding of an overshooting of P_N might be desirable. Real costs associated with the overshooting of P_N can be introduced in many ways. One way to assume that there are real resource costs associated with movements of factors of production from one sector to another. Alternatively, we can assume that wages are rigid downward. In this case, the overshooting of P_N will also result in an overshooting of nominal wages. However, once P_N

begins to decline after having reached the overshoot peak, wages will also have to decline. However, if wages are inflexible downward, they will go up with P_N , but then will not decline. This wage rate inflexibility will then be associated with unemployment as a consequence of the overshooting of P_N .

Finally, it is important to stress that, as pointed out in Section 2, the overshooting of P_N is not a necessary condition of a commodity export boom. Quite on the contrary, as is implicit in equation (32), the overshooting, undershooting or step-change of P_N as a result of the boom will depend on the value of θ -- the proportion of foreign exchange earnings that the government spends on non-tradables. If $\theta < \kappa(P_N G_N / M^S)_0$, then P_N will undershoot its final equilibrium value.

FOOTNOTES

¹On Dutch Disease see, for example, Buiter and Purvis (1982), Corden (1981), Corden and Neary (1983), Harberger (1981), and Bruno and Sachs (1982).

²Most studies dealing with Dutch Disease have assumed flexible exchange rates. Corden and Neary (1981), however, discuss the merits of alternative exchange rate regimes as ways to deal with the disease. Harberger (1981) uses a model of a fixed rate economy.

³The problem of short run movements of the real exchange rate as a consequence of an increase in capital inflows, has recently been analyzed in a similar way. See, for example Harberger (1982) and Edwards (1982).

⁴The problem of temporary vs. permanent booms remains, of course. If wage rigidities and slow factor movements (specific capital a la Jones-Mayer-Mussa, for example) are introduced into the model, even these equilibrium changes in relative price might result in unnecessary unemployment when the booms are only transitory.

⁵In order to simplify the exposition we are assuming a closed capital account. The relaxation of this assumption will not affect the final results.

⁶In stochastic models various exogenous shocks also move the economy off the reference path.

⁷Note that an overshoot here is defined relative to the reference path along which v_1 is constant. If the initial equilibrium state is chosen as the reference path, the overshoot here is the same as the usual notion of overshoot.

⁸Assume a constant v_1 with non-zero $x = \bar{x}$ in (28). With $m^S(0) = 0$, the solution is

$$m^S(t) = \frac{(v_0 \bar{p}_0 + v_2 \bar{x})}{v_1} (1 - e^{-v_1 t}).$$

Hence $p_N(t) = \rho_0 \bar{p}_0 + (\rho_1 v_1)(v_2 \bar{p}_0 + v_2 \bar{x})(1 - e^{-v_1 t}) + \rho_2 \bar{x}$ from (29).

The condition for no overshoot now becomes

$$(\rho_1/v_1)(v_0 \bar{p}_0 + v_2 \bar{x}) = 0$$

Even with $\rho_1 \neq 0$, $\bar{x} = -v_0 \bar{p}_0/v_2$ can eliminate an overshoot.

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APPENDIX

Derivation of (23)

The variational expressions of (11) ~ (13) are solved for w

$$w = f P_N \quad (\text{A.1})$$

where

$$0 < f = L'_N(W/P_N)_0 / \{L'_N(W/P_N)_0 + L'_T(W/P_T)_0\} < 1.$$

Variation of (5) yields, in view of (A.1)

$$\begin{aligned} h_N^S &= -s(w - p_N) \\ &= s(1-f)p_N \end{aligned} \quad (\text{A.2})$$

where

$$s = -\frac{1}{H_N^S} \frac{\partial H_N^S}{\partial (W/P_N)} > 0.$$

We also need variation of national income. From (9)

$$\begin{aligned} y &= -\tilde{\eta}_1 w + \tilde{\eta}_2 p_N + \eta_2 p_0 \\ &= \eta_1 p_N + \eta_2 p_0 \end{aligned} \quad (\text{A.3})$$

where

$$\begin{aligned} \eta_1 &= \tilde{\eta} - \tilde{\eta}_1 f \\ \tilde{\eta}_1 &= (\sigma H_T^S / Y) > 0, \quad \tilde{\eta}_2 = [(P_N/P_T) H_S / Y]_0 \{1 + s(1-f)\} > 0, \\ \eta_2 &= (P_0/P_T) \bar{0} / Y > 0. \end{aligned}$$

where σ appears in the variational supply relation obtained from (7)

$$h_T^S = -\sigma w, \quad \sigma = -\left[\frac{1}{H_T^S} \frac{\partial H_T^S}{\partial (W/P_T)} \right]_0 > 0.$$

Equate variations of (6) with (A.2) and solve them for p_N . The expression

for p_N is given by

$$p_N = \pi_0 p_0 + \pi_1 (m^S - \mu m^d) + \pi_2 g_N$$

where

$$\pi_0 = a_2 \eta_2 / \text{Den}, \quad \pi_1 = a_3 / \text{Den}, \quad \pi_2 = a_4 / \text{Den},$$

$$\text{Den} = a_1 + s(1-f) \{ 1 - a_2 (P_N/P_T) H_N^S / Y \} + a_2 \{ -(P_N/P_T) H_N^S + \sigma f H_T^S \},$$

$$a_1 = - \left[\frac{1}{H_N^d} \frac{\partial H_N^d}{\partial (P_N/P_T)} \right]_0 > 0, \quad a_2 = \left[\frac{1}{H_N^d} \frac{\partial H_N^d}{\partial Y} \right]_0 > 0,$$

$$a_3 = \left[\frac{1}{H_N^d} \frac{\partial H_N^d}{\partial M^E} \right]_0 > 0, \quad 0 < \mu = (M^d/M^S)_0 < 1,$$

$$0 < a_4 = [G_N / (H_N^d + G_N)]_0 < 1.$$

Coefficients of (24)

$$\beta_0 = (P_0 \bar{0} / M^S)_0 (1 - \partial H_T^d / \partial Y)_0 > 0,$$

$$\beta_1 = P_T^0 \{ \sigma f H_T^S - (b_1 - b_2 \eta_1) H_T^d \} / M_0^S,$$

with

$$b_1 = - \left[\frac{1}{H_T^d} \frac{\partial H_T^d}{\partial (P_N/P_T)} \right]_0 > 0,$$

$$b_2 = \left[\frac{1}{H_T^d} \frac{\partial H_T^d}{\partial Y} \right]_0 > 0,$$

$$\beta_2 = P_T^V (\partial H_T^d / \partial M^S)_0 > 0.$$

Coefficients of (26) and (27)

$$\xi_0 = (\mu_0 + \mu_2 \gamma_0) / (1 - \gamma \mu \mu_2), \quad \xi_1 = (\mu_1 - \mu_2 \gamma_1) / (1 - \gamma \mu \mu_2),$$

$$\begin{aligned} \xi_2 &= \mu_3 / (1 - \gamma_1 \mu \mu_2), & \xi_0 &= (\tau_0 + \gamma_1 \mu \mu_0) / (1 - \gamma_1 \mu \mu_2), \\ \xi_1 &= \gamma_1 \mu_3 / (1 - \gamma_1 \mu \mu_2), & \xi_2 &= \gamma_2 / (1 - \gamma_1 \mu \mu_2) \\ \gamma_0 &= \{\theta \beta_0 - \pi_0 (\theta \beta_1 + \tilde{\gamma})\} / D_g, & \gamma_1 &= \{\theta \beta_2 + \pi_1 (\tilde{\gamma} + \theta \beta_1)\} / D_g \\ \gamma_2 &= 1 / D_g, & D_g &= \tilde{\gamma} (1 + \pi_2) + \theta \beta_1 \pi_2 \end{aligned}$$

and

$$\tilde{\gamma} = (P_N^G / M^S)_0.$$

No Overshooting Under Perfect Foresight

Generally, the value θ , which suppresses overshooting under static expectations, would produce overshooting under perfect foresight. Because the price of oil is not included in the consumer price index in this paper, the CPI inflation rate is proportional to \dot{P}_N . This special circumstance causes the same θ to work for both types of expectations in eliminating overshooting.