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Capital Controls and Trade Liberalization in a Monetary Economy

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Abstract

This paper reexamines Aizenman's (1985) results on the effects of capital controls during unanticipated trade liberalization using an intertemporal optimizing monetary model. Unlike in Aizenman's model, which is based on the currency substitution model, foreign money is an interest-bearing asset in this paper, and its major role is to smooth intertemporal consumption. With this modification, Aizenman's results are reversed, thus showing that the effects of capital controls during trade liberalization would vary greatly depending on the role of foreign money in a country. The effects of an anticipated trade liberalization are also studied.

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Contents

I. Introduction

For many years, the order and speed of economic liberalization have been discussed, for example, by Corden (1987), Frenkel (1982), Edwards (1984 and 1989b), and McKinnon (1973 and 1982). The liberalization policy consists of setting the sequence of trade and capital account liberalization. Interest in this issue was stimulated by the experiences of Argentina, Chile, and Uruguay in the 1970s where some liberalization of both kinds took place in various orders. In Argentina and Uruguay capital account liberalization came first and in Chile trade liberalization.[2] To understand the impact of various liberalization policies, it is important to address the question of the effects of capital controls during trade liberalization.[3]

Aizenman (1985) studies an unanticipated trade liberalization in a currency substitution model. Aizenman (1985) specifically examines how restrictions on capital mobility affect adjustment to a tariff liberalization policy. He shows that the reduction in import tariffs induces, through the decrease in domestic price levels, a drop in the demand for nominal wealth, which, in turn, induces a decline in the demand for domestic and foreign money. The decline in the demand for foreign money generates a drop in the equilibrium financial exchange rate under capital controls. The instantaneous appreciation of the financial exchange rate after trade liberalization substitutes partially for the quantity adjustment needed via the current account. Therefore, the current account adjustment is smaller under capital controls than under perfect capital mobility.

This paper reexamines Aizenman's (1985) results on the effects of capital controls during an unanticipated trade liberalization in an intertemporal optimizing monetary model. Aizenman's model is based on the currency substitution model, in which foreign money is generally held for liquidity services. Unlike in Aizenman (1985), foreign money is an interest-bearing asset in this paper, and its major role is to smooth intertemporal consumption. This modification leads to an important change: corresponding to individuals' desires to adjust money balances after unanticipated trade liberalization, the demand for foreign money increases rather than decreases as in Aizenman (1985). Therefore, the financial exchange rate increases in the short run in a regime of capital controls after unanticipated trade liberalization. In addition, the unanticipated trade liberalization is shown to yield a larger current account adjustment under capital controls than under perfect capital mobility--a reversal of Aizenman's results.

The effects of an anticipated trade liberalization under the two regimes are also studied. The announcement of future trade liberalization is shown to yield a current account surplus under both regimes until the trade liberalization actually occurs, owing to intertemporal consumption substitution. When trade is liberalized, the economy jumps to a

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[2]See Edwards (1984)

[3]For a survey of capital controls in developing countries, see Quirk and Evans (1995) pp. 34-7.

new steady state in a regime of perfect capital mobility. Owing to the accumulation of foreign assets, the consumption level of tradables in the new steady state is higher than in the initial steady state. Meanwhile, corresponding to individuals' desires to adjust money balances, there is a current account deficit after trade liberalization in a regime of capital controls. In addition, the consumption level of tradables in the new steady state is lower than in the initial steady state. Also, under capital controls, the financial exchange rate is shown to follow a hump-shaped dynamic path after future trade liberalization is announced.

The model to be presented is an intertemporal optimizing monetary model that is an extension of Obstfeld (1986).[4] In Section II, the benchmark model of perfect capital mobility will be developed to study the effects of unanticipated and anticipated[5] trade liberalization. Section III modifies the benchmark model by adding an official prohibition on private capital movements. Individuals are still allowed to hold a fixed pool of financial foreign exchange under this modification, and the price of this asset defines the financial exchange rate. Section IV investigates the effects of capital controls during trade liberalization by comparing the dynamic paths under perfect capital mobility and capital controls. The appendix includes technical matters.

II. THE BASIC MODEL: PERFECT CAPITAL MOBILITY

This section develops a simple optimizing model with capital mobility. This model is a benchmark for the discussion to follow, which examines how the imposition of capital controls affects the economic adjustment of trade liberalization.

Consider a small, open economy in which there are three goods: exportables, importables, and nontradables. Outputs are given in terms of exportables and nontradables and do not change over time. The only two assets held by individuals are domestic money not held by foreigners and internationally traded, consol-type bonds paying r units of the exportable good per unit time in perpetuity. Both the foreign prices of exportables and importables and the world real bond price, Q^*, are given and assumed to be constant over time. There are no restrictions on international capital movements, which, combined with a fixed exchange rate policy, implies that the government has no direct control over the money supply. The lack of restrictions also implies that the real interest rate, $q^* \equiv r/Q^*$, is given by the world capital market and is constant.

A representative individual is assumed to derive utility from consumption of importables, c_I, and nontradables, c_N, and from real money balances, where the latter variable is defined as nominal money holdings, M, divided by the prices of nontradables, P_N. His objective function is

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[4]Obstfeld (1986) examines the effect of devaluation under capital account restrictions.

[5]For an analysis involving policy discontinuities, see Calvo (1989) and Drazen and Helpman (1986 and 1987).

$$\int_0^\infty [u(c_I(t),\ c_N(t)) \ + \ v(\frac{M(t)}{P_N(t)})]e^{-\delta t}dt, \tag{1}$$

where the parameter δ is a fixed, subjective rate of time preference. The functions u(.) and v(.) are increasing and concave. Under a fixed exchange rate, E, goods market arbitrage guarantees

$$P_X \ = \ EP_X^* \ = \ 1, \quad P_I \ = \ (1+\tau)EP_I^* \ = \ 1+\tau, \tag{2}$$

where P_X (P_I) represents the domestic price of exportables (importables), τ is the import tariff, and * denotes the foreign variables. The foreign prices of exportables and importables and the exchange rate are normalized to one. The individual budget constraint is written using exportable goods as the numeraire, as

$$\int_0^\infty [P_N(t)c_N(t) \ + \ P_I(t)c_I(t) \ + \ q^*M(t)]e^{-q^*t}dt \ \leq \ M_0 \ +$$

$$Q^*b_0 \ + \ \int_0^\infty [y_X \ + \ P_N(t)y_N \ + \theta(t)]e^{-q^*t}dt, \tag{3}$$

where b_0 is the initial stock of bonds and θ(t) represents transfer payments in terms of exportable goods expected from the government at time t.[6]

The market equilibrium condition for nontradable goods requires

$$c_N(t) \ = \ y_N \qquad for\ all\ t. \tag{4}$$

The government, which consists of a fiscal and monetary authority, faces the following consolidated budget constraints:

$$\theta(t) \ = \ rf(t) \ + \ \tau(t)c_I(t) \qquad for\ all\ t. \tag{5}$$

where $f(t)$ is the central bank's stock of foreign exchange reserves. Implicit in (5) is the assumption that foreign exchange reserves bear interest at the rate r.

The optimization problem faced by the representative individual is to maximize equation (1) by choosing the paths of c_I, c_N, and M, subject to equation (3). The individual is assumed to possess perfect foresight regarding the future paths of P_N and θ. It is assumed that

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[6]As E and P^*_X are normalized to one, the nominal balance is equal to the real balance measured in terms of exportable goods.

the time-preference rate δ is equal to the world interest rate, q^*. This assumption is commonly made as a way of guaranteeing a steady state in a small, open economy with perfect capital mobility. The first-order conditions for this problem imply

$$u_I(c_I(t),\, y_N) = \lambda_0 P_I(t) \quad \textit{for all } t, \tag{6}$$

$$\frac{u_N(c_I(t),\, y_N)}{u_I(c_I(t),\, y_N)} = \frac{P_N(t)}{P_I(t)} \quad \textit{for all } t, \textit{ and} \tag{7}$$

$$v'\left(\frac{M(t)}{P_N(t)}\right)\frac{1}{P_N(t)} = \lambda_0 q^* \quad \textit{for all } t, \tag{8}$$

where λ_0 is the multiplier of budget constraint (3). Equation (7) represents the standard equality of the marginal rate of substitution to relative prices.

As long as no devaluation occurs, the money stock is

$$M_t = Q^* f_t + D_0 \quad \textit{for all } t, \tag{9}$$

where D_0, assumed to be constant, is the nominal supply of domestic credit.

The flow budget constraints faced by an individual are

$$\dot{M} + Q^*\dot{b} = rb + y_X + P_N y_N + \theta - P_I c_I - P_N c_N \quad \textit{for all } t, \tag{10}$$

where a dot over the variable denotes the variable's time derivative. Using (4), (5), and (9), we obtain in equilibrium

$$Q^*[\dot{f} + \dot{b}\ ] = r[f + b] + y_X - c_I \quad \textit{for all } t, \tag{11}$$

where the right-hand side represents the surplus in the current account. That is, the rate of change of the net credit of the domestic economy equals the balance of payments on the current account.

A. The Effect of Unanticipated Trade Liberalization

In this subsection, the effect of a permanent unanticipated change in the import tariff is examined.

To derive the shadow price of wealth, λ_0, associated with an individual optimization problem, c_I(t), M(t), and P_N(t) can be expressed as a function of λ_0, P_I, y_N, and q^*, using equations (6), (7), and (8). The substitution of these relationships into (3) with (4), (5), and (9) yields the equation

$$\int_0^{\infty} c_I(\lambda_0,\ P_I(t),\ y_N) e^{-q^* t} dt \ = \ Q^*(b_0 + f_0) \ + \ \frac{y_X}{q^*}. \tag{12}$$

The equilibrium shadow price of wealth, λ_0, is the solution to equation (12), and it can be expressed as a function of exogenous and predetermined variables only:

$$\lambda_0 \ = \ \lambda_0(b_0 + f_0,\ y_N,\ y_X,\ \{p_I(t)\}_{t=0}^{t=\infty},\ q^*). \tag{13}$$

This may be interpreted as the shadow price of wealth consistent with both the individual optimization condition and aggregate intertemporal constraints.

The effects of unanticipated trade liberalization at time 0 can now be analyzed. Consider the case in which the economy is initially in a steady state equilibrium. After trade liberalization, that is, a reduction in tariffs, there is a jump in multiplier from λ_0 to λ_1 ($\lambda_1 > \lambda_0$)[7], after which the multiplier remains constant at a new level; this behavior implies the constancy of c_I after trade liberalization. It follows from (11) that there is no change in the new steady state level of c_I after trade liberalization because neither the sum of $f+b$ nor y_X changes.[8] Consequently, an unanticipated trade liberalization has no effect on the current account. In addition, (7) implies that, as the constancy of c_I after trade liberalization induces no change in P_N/P_I, P_N jumps down and remains constant. Furthermore, (8) implies that M/P_N is constant since $\lambda_0 P_N q^*$ remains unchanged after trade liberalization.[9] The trade liberalization occasions

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[7]From (12), we get

$$\frac{d\lambda_0}{dP_I} \ = \ - \ \frac{\dfrac{\partial c_I}{\partial P_I}}{\dfrac{\partial c_I}{\partial \lambda_0}} \ < \ 0, \quad since \ \frac{\partial c_I}{\partial P_I} \ < \ 0 \ and \ \frac{\partial c_I}{\partial \lambda_0} \ < \ 0.$$

[8]If the individual consumes exportable goods, it can be shown that the consumption of exportables, c_X, will decrease and the consumption of importables, c_I, will increase after trade liberalization. But the sum $c_X + c_I$ will remain unchanged after trade liberalization. Therefore, there is no effect on the current account. No change in c_I may therefore be interpreted as having no effect on the current account of the unanticipated trade liberalization under perfect capital mobility.

[9]From the first-order condition, we get

$$u_N(c_I,\ y_N) \ = \ \lambda_0 P_N.$$

(continued...)

an incipient excess supply of domestic real balances, but this excess is immediately eliminated as individuals sell the central bank domestic money to adjust their money holdings. This process of portfolio adjustment changes the mix of b and f, but leaves the sum b_0+f_0 unchanged. Individuals can instantaneously adjust their real balances under perfect capital mobility and maintain their previous consumption levels of importable goods because the lower levels of transfers that they receive from the government are compensated by the increase in foreign interest payments that they receive by adjusting real balances.

B. The Effect of Anticipated Trade Liberalization

Consider the situation in which the domestic prices of importable goods satisfy

$$\begin{aligned} P_I &= EP_I^*(1+\tau) = (1+\tau) && 0 \leq t < T, \\ P_I &= EP_I^* = 1 && t \geq T, \end{aligned} \tag{14}$$

where E and P_I^* are normalized to one. That is, at time 0 the government announces the intention to liberalize trade at time T.

In these circumstances, (6) becomes

$$u_I(c_I(t), y_N) = \lambda_2(1+\tau) \qquad 0 \leq t < T, \tag{15a}$$

$$u_I(c_I(t), y_N) = \lambda_2 \qquad t \geq T. \tag{15b}$$

Equation (15a) implies the constant consumption of importable goods before T. In the previous subsection, it was shown that the shadow price of wealth, λ, is a function of the domestic prices of importables. The announcement of trade liberalization causes the shadow price of wealth to jump from λ_0 to $\lambda_2(>\lambda_0)$. The domestic prices of importables remain unchanged before T. It follows immediately from (15a) that the consumption of importables jumps down from the initial steady state level, A, after trade liberalization is announced (Figure 1). Therefore, a surplus on the current account takes place before time T. Equation (15b) implies the constant consumption of importables after time T. Thus c_I reaches a new steady state level, B, after liberalization. The new steady state level of c_I is higher than the initial steady state level because, with the current account in surplus between time 0 and time T, the sum b_T+f_T is larger than the sum b_0+f_0. The change in the time path of c_I is due to the intertemporal consumption substitution taking place after the announcement of trade liberalization. The motion of the system is fully described by (11) and (15), which may be represented in a phase diagram in the c_I - $(b+f)$ space, as in Figure 1.

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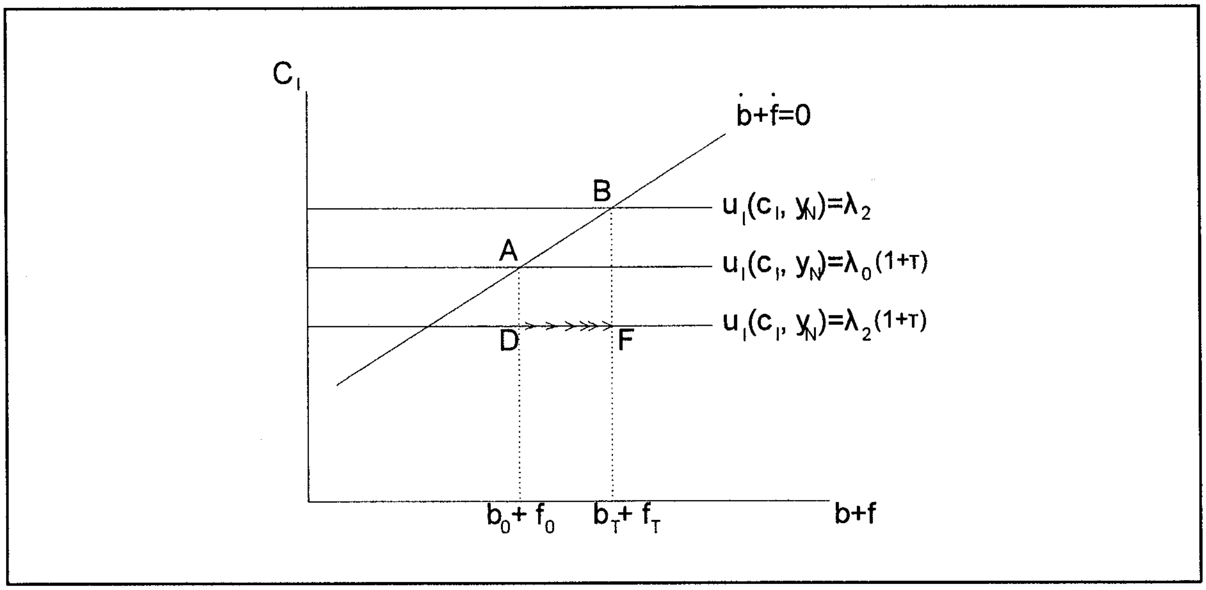
[9](...continued)
After trade liberalization, there is no change in c_I. Thus $\lambda_0 P_N$ remains unchanged, even though the shadow price of wealth, λ_0, and P_N are changed. Therefore, $\lambda_0 P_N q^*$ remains unchanged.

Figure 1. Anticipated Trade Liberalization with Perfect Capital Mobility



Under the assumption that both importables and nontradables are normal,[10] the demand for nontradables will decrease when trade liberalization is announced at time 0. Thus the price of nontradables will fall. When trade liberalization takes place at time T, the effect on P_N will depend on the sign of u_{IN}. If $u_{IN}>0$, the demand for nontradables will increase as c_I increases after a reduction in import tariffs; thus P_N will increase. If $u_{IN}<0$, then P_N will decrease. If $u_{IN}=0$, then P_N will remain unchanged.[11]

With changes in the shadow price of wealth, λ_0, and P_N, money balances, M, must adjust. The announcement of trade liberalization triggers an increase in λ_0 and a decline in P_N. The increase in λ_0 will lower M. The effect of a change in P_N on M will depend upon the elasticity of money demand with respect to the interest rate. If the elasticity of money demand is equal to 1, then no adjustment is required. If it is higher (lower) than 1, then M increases (declines). Thus, for a standard case where the interest elasticity of money demand is lower than 1, the money balance declines as a result of the announcement of trade liberalization. At time T, the change in P_N depends on the sign of u_{IN}. With an interest-inelastic demand function for money, M declines (increases) if $u_{IN} <$ (>) 0.[12]

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[10]We assume that utility function $u(.)$ satisfies $u_I u_{NN} - u_N u_{IN} < 0$ and $u_N u_{II} - u_I u_{IN} < 0$.

[11]See Appendix I (Section A).

[12]See Appendix I (Section B).

III. Capital Controls and Trade Liberalization

Under a regime of capital controls, the central bank buys and sells foreign exchange only for commercial transactions, pegging the commercial exchange rate at E. Domestic residents cannot buy or sell bonds abroad, and any foreign exchange earnings must be converted into domestic money at the commercial exchange rate, E. The stock of foreign bonds held by the domestic residents is fixed at b_0. The price of bonds, Q, need no longer equal the world price, Q^*, and can be thought of as a financial exchange rate. Therefore, the domestic real interest rate $i=(r+\dot{Q})/Q$ is determined endogenously in the model and can differ from the world rate, q^*.

The representative individual's objective is to maximize equation (1) subject to the budget constraint

$$\int_0^\infty [P_N(t)c_N(t) + P_I(t)c_I(t) + i(t)M(t)]\exp(-\int_0^t i(s)ds)dt \le M_0 +$$

$$Q_0 b_0 + \int_0^\infty [y_X + P_N(t)y_N + \theta(t)]\exp(-\int_0^t i(s)ds)dt. \tag{16}$$

The first-order conditions imply

$$u_I(c_I(t), y_N) = \lambda_0 P_I(t)\exp(\delta t - \int_0^t i(s)ds) \quad \textit{for all } t, \tag{17}$$

$$\frac{u_N(c_I(t), y_N)}{u_I(c_I(t), y_N)} = \frac{P_N(t)}{P_I(t)} \quad \textit{for all } t, \textit{ and} \tag{18}$$

$$v'(\frac{M(t)}{P_N(t)})\frac{1}{P_N(t)} = \lambda_0 i(t)\exp(\delta t - \int_0^t i(s)ds) \quad \textit{for all } t. \tag{19}$$

Differentiation of (17) yields the relationship:

$$u_{II}(c_I(t), y_N)\dot{c}_I(t) = u_I(c_I(t), y_N)\times(\delta - i(t)). \tag{20}$$

From (17) and (19), the following is obtained:

$$u_I(c_I(t), y_N)i(t) = v'(\frac{M(t)}{P_N(t)})\frac{P_I(t)}{P_N(t)}. \tag{21}$$

From (18), P_N can be expressed as a function of c_I and P_I:[13]

$$P_N = \underset{(+)\ \ (+)}{P_N(c_I, P_I)}. \tag{22}$$

After substituting (21) and (22) into (20), one obtains

$$\dot{c}_I(t) = \frac{1}{u_{II}}[u_I(c_I(t), y_N)\delta - \frac{P_I(t)}{P_N(c_I(t), P_I(t))}v'(\frac{M(t)}{P_N(c_I(t), P_I(t))})]. \tag{23}$$

The flow budget constraint becomes

$$\dot{M} + Q\dot{b} + \dot{Q}b = rb + \dot{Q}b + y_X + P_N y_N + \theta - P_I c_I - P_N c_N \quad \textit{for all } t. \tag{24}$$

By the market-clearing condition for nontradable goods (equation (4)), the government budget constraint (equation (5)), and the central bank balance sheet relation (equation (9)), (24) becomes

$$\dot{M} + Q\dot{b} = rb + y_X + q^*(M - D_0) - c_I \quad \textit{for all } t. \tag{25}$$

In perfect-foresight equilibrium, one obtains $b(t)=b_0$ and $\dot{b}=0$ for all t. In equilibrium, we obtain

$$\dot{M} = rb_0 + y_X + q^*(M - D_0) - c_I \quad \textit{for all } t. \tag{26}$$

The money supply is a predetermined variable in the aggregate. Equations (23) and (26) together give the equilibrium motion of c_I and M. By linearizing the system of equations (23) and (26) in the neighborhood of a steady state, the dynamics of this economy can be analyzed.

By (18), (20), (23), and (26), a steady state $(\bar{c}_I, \bar{M}, \bar{P}_N, \bar{Q})$ of the economy is given by the following set of equations:

$$\bar{c}_I = rb_0 + y_X + q^*(\bar{M} - D_0), \tag{27a}$$

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[13]From the differentiation of (18) and the assumption that both importables and nontradables are normal goods, we obtain

$$\frac{\partial P_N}{\partial c_I} = \frac{(u_{NI}u_I - u_N u_{II})P_I}{(u_I)^2} > 0, \textit{ and}$$

$$\frac{\partial P_N}{\partial P_I} = \frac{P_N}{P_I} > 0.$$

$$\bar{i} = \delta \Rightarrow \bar{Q} = \frac{r}{\delta}, \tag{27b}$$

$$u_I(\bar{c}_I, y_N)\delta = \frac{P_I}{P_N(\bar{c}_I, P_I)} v'(\frac{\bar{M}}{P_N(\bar{c}_I, P_I)}), \text{ and} \tag{27c}$$

$$\frac{u_N(\bar{c}_I, y_N)}{u_I(\bar{c}_I, y_N)} = \frac{\bar{P}_N}{P_I}. \tag{27d}$$

By integrating (20) forward, we obtain

$$Q(0) = \int_0^\infty r[\frac{u_I(c_I(t), y_N)}{u_I(c_I(0), y_N)}]e^{-\delta t}dt. \tag{28}$$

Equation (28) is considered as an asset pricing equation for foreign bonds. It implies that financial exchange rate Q is the sum of future physical yields weighted by marginal rates of substitution between present and future consumption of importables.

A. Capital Controls and Unanticipated Trade Liberalization

In order to analyze the dynamics of c_I and M, the system consisting of (23) and (26) will be linearized around the steady state.[14] Linearizing this pair of equations around the steady state yields

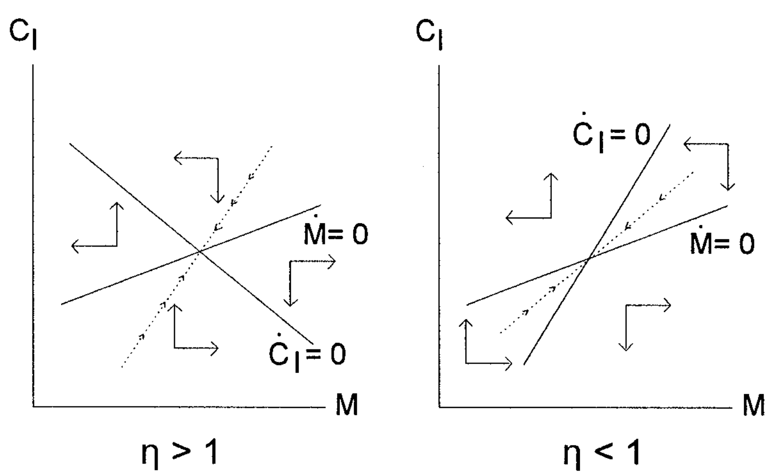
$$\begin{pmatrix} \dot{c}_I \\ \\ \dot{M} \end{pmatrix} = \begin{pmatrix} \frac{1}{u_{II}}[\delta u_{II} + \frac{v'P_I P_N'}{P_N^2} + \frac{v''MP_I P_N'}{P_N^3}] & -\frac{v''P_I}{P_N^2 u_{II}} \\ \\ -1 & q^* \end{pmatrix} \begin{pmatrix} c_I - \bar{c}_I \\ \\ M - \bar{M} \end{pmatrix} \tag{29}$$

$$\text{where} \quad P_N' \equiv \frac{\partial P_N}{\partial c_I}, \text{ and}$$

[14]Financial exchange rate Q does not enter equations (23) and (26). Thus the dynamics of c_I and M can be analyzed without reference to movement in Q.

where $\bar{c}_I$ and $\bar{M}$ denote the steady state values of c_I and M. The condition for saddle path stability of (29) is that the system has real characteristic roots of the opposite sign. Since the determinant of the matrix of coefficients in (29) is the product of these characteristic roots, the stability condition requires that the determinant be negative.[15] Figure 2 illustrates two cases of the system (29) under the assumption that the stability condition holds.[16] The stability condition implies that the slope of the $\dot{c}_I$=0 locus exceeds that of the $\dot{M}$=0 locus when the slope of the $\dot{c}_I$=0 locus is positive.

Figure 2. The Dynamics of the Economy



We will first examine the effect of an unanticipated trade liberalization on an economy in a steady state equilibrium. Around the steady state, the horizontal shift of the $\dot{c}_I$=0 locus is

$$\left.\frac{dM}{dP_I}\right|_{\dot{c}_I=0} = \frac{M}{P_I} > 0, \tag{30}$$

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[15]The stability condition is

$$q^*\left[\delta u_{II} + \frac{v'P_IP_N'}{P_N^2} + \frac{v''MP_IP_N'}{P_N^3}\right] < \frac{v''P_I}{P_N^2}.$$

For the interpretation of this condition, see Obstfeld (1986) pp. 12-13.

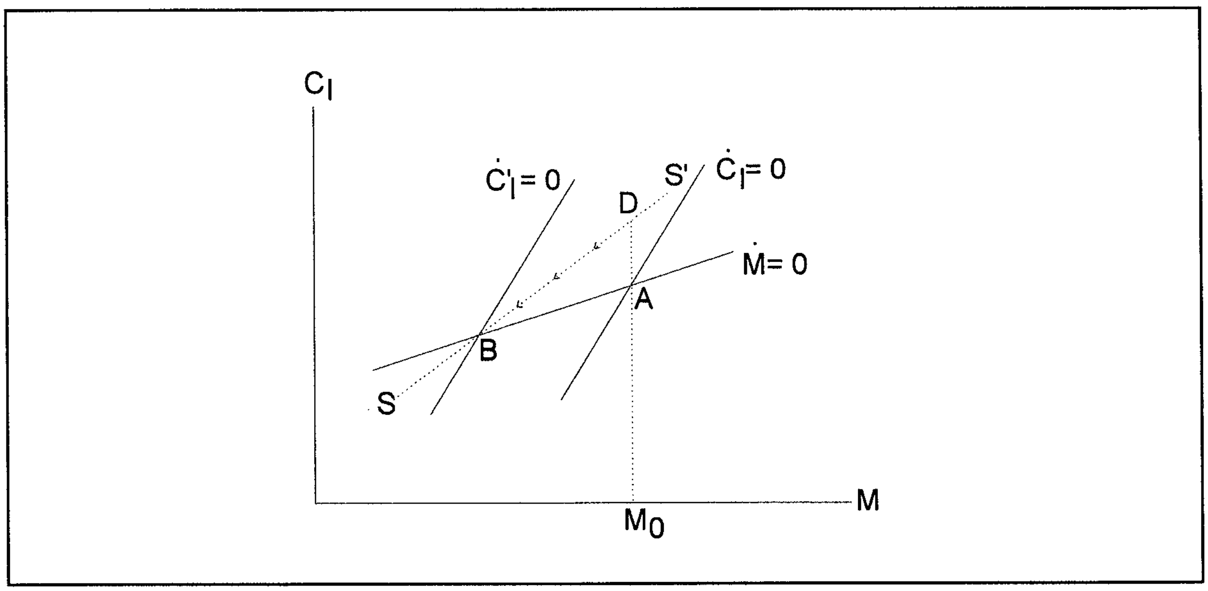
[16]η denotes the interest elasticity of money demand. From now on, it is assumed that money demand is interest inelastic, that is, η<1, which is the standard case. For example, see Drazen and Helpman (1986).

while that of the $\dot{M}$=0 schedule is

$$\left.\frac{dM}{dP_I}\right|_{\dot{M}=0} = 0. \tag{31}$$

The dynamics of the system in response to an unanticipated trade liberalization is illustrated in Figure 3. A change in import tariff from τ>0 to 0 shifts the $\dot{c}_I$=0 schedule to the left and leaves the $\dot{M}$=0 schedule unchanged. In the short run, c_I jumps up from A to D on the new saddle path SS' and then declines gradually toward the new steady state B along the saddle adjustment path. Corresponding to the adjustment of the real balances, the current account is in deficit. As money balances decline over time, central bank foreign reserves decline. And, as central bank reserves earn interest at rate q^*, national income declines as well. Therefore, at the new steady state equilibrium B, c_I and M are lower than before trade liberalization.

Figure 3. Unanticipated Trade Liberalization with Capital Controls



If u_{NI}≤0, the reduction in import tariff induces a drop in P_N in the short run. However, if u_{NI}>0, the effect of trade liberalization on P_N is indeterminate.[17] Subsequently, under the assumption that both importables and nontradables are normal goods, the price of nontradables declines gradually toward its new steady state level as c_I declines.

[17]An unanticipated trade liberalization effects P_N through two channels, that is, the change in λ_0 and P_I, in the short run. If u_{NI}>0, these two channels have an opposite effect on P_N. See equations (A3) and (A4) in Appendix I.

The sudden increase in real wealth increases the demand for foreign bonds. The equilibrium requires an immediate increase in the price of foreign bonds, that is, the financial exchange rate, which exceeds its long run level, r/δ. Q declines toward r/δ over time as the economy converges to the new steady state.[18] Therefore, a balance of payments deficit is accompanied by a falling financial exchange rate Q.[19]

If we compare the adjustment to an unanticipated trade liberalization under the two regimes, corresponding to individuals' desires to adjust money balances after unanticipated trade liberalization, the demand for foreign money increases in this paper rather than decreases as in Aizenman (1985). Therefore, the financial exchange rate increases in the short run in a regime of capital controls after unanticipated trade liberalization. In addition, the unanticipated trade liberalization yields a larger current account adjustment under capital controls than under perfect capital mobility--a reversal of Aizenman's (1985) results. This outcome suggests that the effects of capital controls during trade liberalization would vary greatly depending on the role of foreign money in a country.

B. Capital Controls and Anticipated Trade Liberalization

Consider--under a regime of capital controls--the situation that was examined under a regime of perfect capital mobility in the previous section: the government announces at time 0 its intention to liberalize trade at time T.

Figure 4 shows the dynamics of the system (29) in response to an anticipated trade liberalization, assuming an interest-inelastic money demand function. In the short run, c_I jumps down from A to D and then declines gradually from D to E between time 0 and time T. When trade is liberalized at time T, c_I jumps up from E to F on the new saddle path SS' before declining gradually toward the new steady state B along the saddle path. Corresponding to the adjustment of the real balances, the current account is in surplus between time 0 and time T and then moves into a deficit. As money balances rise between time 0 and time T, central bank reserves increase. As money balances subsequently decline along the saddle path, central bank reserves also decline. Because central bank reserves earn interest at rate q^*, national income declines along the saddle path as well. Therefore, at the new steady state equilibrium B, c_I and M are lower than before trade liberalization. The levels of c_I and M at the new steady state equilibrium are independent of the timing of liberalization, T.

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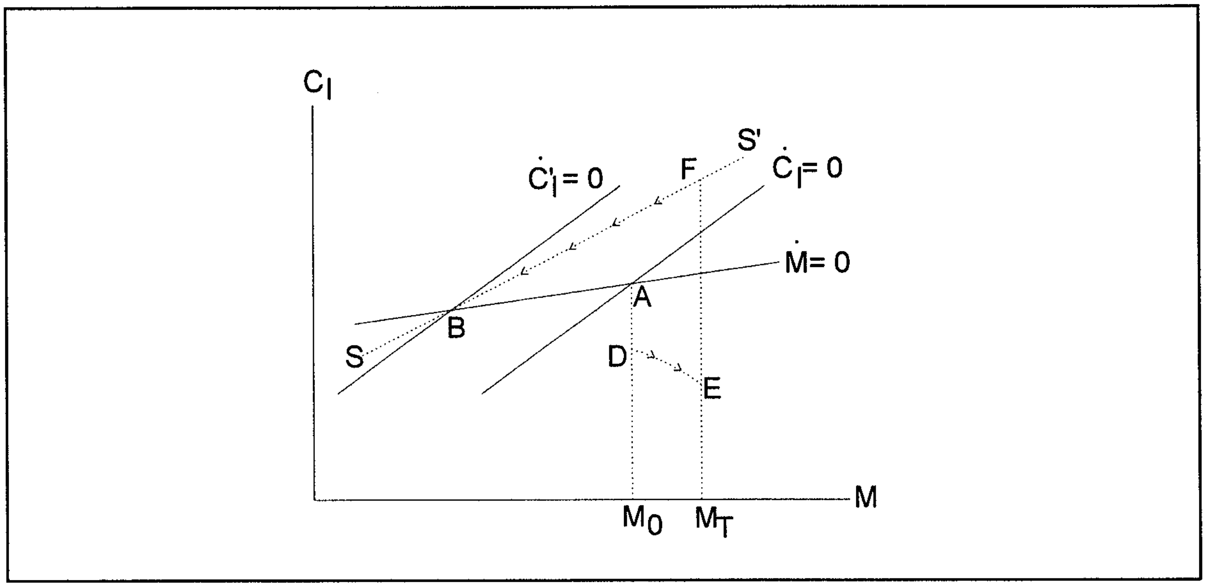
[18]The behavior of Q can also be analyzed using (28). After trade liberalization, c_I is higher than its new steady state level, and marginal utility is lower than its new steady state level. Hence, (28) implies that Q exceeds its long run level, r/δ, and falls toward r/δ as c_I converges to its new steady state level.

[19]See Appendix I (Section C).

Figure 4: Anticipated Trade Liberalization with Capital Controls



Since both importables and nontradables are assumed to be normal, the price of nontradables, P_N, jumps down at time 0 as the consumption of importables, c_I, jumps down at time 0. Subsequently, P_N declines gradually between time 0 and time T. When trade is liberalized at time T, the effect on P_N depends on the sign of u_{IN}. If $u_{IN} > (<) \ 0$, P_N increases (decreases). If u_{IN}=0, then P_N will be unchanged. And then P_N declines gradually toward its new steady state level as c_I decreases.[20]

By (17), (19), and (22), the following is obtained:

$$i(t) = \frac{v'(\frac{M(t)}{P_N(c_I(t),\ P_I(t))})P_I(t)}{u_I(c_I(t),\ y_N)P_N(c_I(t),\ P_I(t))}. \tag{32}$$

Assuming that the interest elasticity of money demand is less than 1, the following is obtained:

$$\frac{\partial i}{\partial M} = \frac{v''P_I}{u_I P_N^2} < 0,\ and$$

$$\frac{\partial i}{\partial c_I} = \frac{1}{[u_I P_N]^2}\left[(-\frac{v''M}{P_N} - v')P_I u_I P_N' \ - \ v'P_I P_N u_{II}\right] > 0. \tag{33}$$

[20]See Appendix I (Section A).

When the future trade liberalization is announced, the interest rate *i(t)* therefore jumps down from its steady state level δ and declines gradually between time 0 and time T. If u_{NI}<0 and the interest elasticity of money demand is less than 1, then the reduction in import tariff at time T induces a drop in *i(t)*.[21] Subsequently, *i(t)* rises along the saddle path toward the steady state level δ. As a result, the financial exchange rate Q jumps up from the steady state level at time 0 and rises gradually between time 0 and time T as *i(t)* declines. However, there is no discrete jump in the financial exchange rate Q at time T, even though *i(t)* jumps down at that time. Subsequently, Q declines gradually toward its steady state level r/δ along the saddle path, thus following a hump-shaped dynamic path.[22]

IV. Conclusion

This paper has used an intertemporal optimizing model to examine a small, open economy's response to unanticipated and anticipated trade liberalizations under the regimes of perfect capital mobility and capital controls.

The role of capital controls during trade liberalization can be studied by comparing the adjustment paths under the two regimes. After an unanticipated trade liberalization, the economy jumps to a new steady state equilibrium with perfect capital mobility. In the new steady state equilibrium, there are no changes in either the consumption of tradables or the current account as there is no change in the economy's foreign assets. And there is a fall in both the price of nontradables and money balances, compared with the initial steady state equilibrium. However, an unanticipated trade liberalization with capital controls generates in the short run an increase both in the consumption of tradables and in the financial exchange rate, corresponding to individuals' desires to adjust money balances. Therefore, there is a current account deficit, as well as a fall in the price of nontradables, if $u_{NI} \leq 0$. The consumption of tradables in the new steady state is lower than in the initial steady state equilibrium, owing to the decrease in the economy's holdings of foreign assets. Thus the unanticipated trade liberalization yields a larger current account adjustment under capital controls than under perfect capital mobility--a reversal of Aizenman's (1985) results. This outcome suggests that the effects of capital controls during trade liberalization would vary greatly depending on

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[21]The anticipated discrete fall in *i(t)* at time T does not violate the condition of asset price continuity since the interest rate *i(t)* is the nominal return on a bond of instantaneous maturity. The asset price continuity condition requires that there be no anticipated discrete jump in the financial exchange rate Q. The other type of solution for Q is

$$Q(t) = \int_t^{\infty} r \, e^{-\int_t^k i(s)ds} dk \quad by \quad i(t) = \frac{r+\dot{Q}}{Q}.$$

Hence, Q does not jump when an anticipated discrete jump in *i(t)* occurs at time T. For further discussion, see Obstfeld and Stockman (1985).

[22]See Appendix I (Section C) for a proof.

whether, as in Aizenman's (1985) model, foreign money is held for liquidity services or, as in this paper, it is used to smooth intertemporal consumption.

This study has also examined anticipated trade liberalization under the two regimes. In the short run, the announcement of future trade liberalization yields a current account surplus, as well as a fall in the consumption of tradables under both regimes, owing to intertemporal consumption substitution. When trade is liberalized, the economy jumps to a new steady state equilibrium in a regime of perfect capital mobility. The consumption level of tradables in the new steady state is higher than in the initial steady state, owing to the accumulation of foreign assets. However, the current account is in deficit after trade liberalization in a regime of capital controls. The consumption level of tradables in the new steady state is lower than in the initial steady state, because of the decrease in the economy's holding of foreign assets. Also, under capital controls, the financial exchange rate follows a hump-shaped dynamic path after future trade liberalization is announced. Hence, capital controls have several major effects on the adjustment of the economy.

In view of the other important issues that are not addressed in this model--output, employment, and real wage changes, for example--it would be interesting to extend the analysis to account for these factors.

A. In this appendix, the effect on P_N of an anticipated trade liberalization is examined. From the first-order conditions, one gets

$$u_I(c_I, y_N) = \lambda_0 P_I, \; and$$
$$u_N(c_I, y_N) = \lambda_0 P_N. \tag{A1}$$

The total differentiation of (A1) yields

$$\begin{pmatrix} u_{II} & 0 \\ u_{NI} & -\lambda_0 \end{pmatrix} \begin{pmatrix} dc_I \\ dP_N \end{pmatrix} = \begin{pmatrix} P_I \\ P_N \end{pmatrix} d\lambda_0 + \begin{pmatrix} \lambda_0 \\ 0 \end{pmatrix} dP_I. \tag{A2}$$

It has already been shown that the announcement of future trade liberalization will increase the shadow price of wealth, λ_0, at time 0. Thus the effect on P_N of the announcement of trade liberalization will be obtained from (7) and the normality assumption:

$$\frac{dP_N}{d\lambda_0} = \frac{P_I u_{NI} - P_N u_{II}}{\lambda_0 u_{II}} = \frac{u_I u_{NI} - u_N u_{II}}{\lambda_0 u_{II}} < 0. \tag{A3}$$

The effect on P_N of trade liberalization at time T is

$$\frac{dP_N}{dP_I} = \frac{u_{NI}}{u_{II}} \overset{<}{\underset{>}{=}} 0 \;\; iff \;\; u_{NI} \overset{>}{\underset{<}{=}} 0. \tag{A4}$$

B. We will examine the effect on money balances of the announcement of trade liberalization. By differentiating (8), we obtain

$$v''(\frac{M}{P_N})\frac{1}{P_N}dM = P_N q^* d\lambda_0 + \left[v''(\frac{M}{P_N})\frac{M}{P_N^2} + \lambda_0 q^*\right]dP_N. \tag{A5}$$

From (A5), we get

$$\frac{dM}{d\lambda_0} = \frac{P_N^2 q^*}{v''(\frac{M}{P_N})} < 0, \; and \tag{A6}$$

$$\frac{dM}{dP_N} = \frac{v''(\frac{M}{P_N})M + \lambda_0 P_N^2 q^*}{v''(\frac{M}{P_N})P_N} \begin{matrix} > \\ = \\ < \end{matrix} 0 \quad iff \quad \eta = -\frac{d\log M}{d\log q^*} \begin{matrix} < \\ = \\ > \end{matrix} 1, \tag{A7}$$

$$where \quad \eta = -\frac{\lambda_0 P_N^2 q^*}{v''M}.$$

C. We will prove that, around the steady state, a balance-of-payments deficit (surplus) is accompanied by a falling (rising) financial exchange rate Q. From (17) and (19) of the first-order conditions, we get

$$\frac{v'(\frac{M(t)}{P_N(t)})\frac{1}{P_N(t)}}{u_I(c_I(t),\, y_N)} = \frac{i(t)}{P_I(t)} \quad where \quad i(t) = \frac{r+\dot{Q}}{Q}. \tag{A8}$$

By (22) and the definition of *i(t)*, (A8) becomes

$$\dot{Q} = \frac{v'(\frac{M}{P_N(c_I,\, P_I)})P_I}{u_I(c_I,\, y_N)P_N(c_I,\, P_I)}Q - r. \tag{A9}$$

By linearizing (A9), (23), and (26) around the steady state, we get

$$\begin{pmatrix} \dot{Q} \\ \dot{c}_I \\ \dot{M} \end{pmatrix} = \begin{pmatrix} \delta & A & \frac{v''P_I}{u_I P_N^2} \\ 0 & B & -\frac{v''P_I}{P_N^2} \\ 0 & -1 & q^* \end{pmatrix} \begin{pmatrix} Q - \bar{Q} \\ c_I - \bar{c}_I \\ M - \bar{M} \end{pmatrix}, \tag{A10}$$

$$\text{where} \quad A = \frac{1}{(u_I)^2}\left[-\frac{v'P_IP_N'u_I}{P_N^2} - \frac{v''P_IMP_N'u_I}{P_N^3} - \frac{v'P_Iu_{II}}{P_N} \right],$$

$$B = \frac{1}{u_{II}}\left[\delta u_{II} + \frac{v'P_IP_N'}{P_N^2} + \frac{v''MP_IP_N'}{P_N^3} \right].$$

If the stability condition (see footnote 15) is assumed, the system (A10) has one negative root and two positive roots (one of which is δ). Let α denote the negative root and $\pi=(\pi_1,\pi_2,\pi_3)$ an eigenvector corresponding to α. The saddle path solution is

$$Q(t) - \bar{Q} = \frac{\pi_1}{\pi_3}[M_0-\bar{M}]e^{\alpha t},$$

$$c_I(t) - \bar{c}_I = \frac{\pi_2}{\pi_3}[M_0-\bar{M}]e^{\alpha t}, \tag{A11}$$

$$M(t) - \bar{M} = (M_0-\bar{M})e^{\alpha t}.$$

The differentiation of (A11) yields

$$\dot{Q}(t) = \frac{\pi_1}{\pi_3}[M_0-\bar{M}]\alpha e^{\alpha t} = \frac{\pi_1}{\pi_3}\dot{M}(t),$$

$$\dot{c}_I(t) = \frac{\pi_2}{\pi_3}[M_0-\bar{M}]\alpha e^{\alpha t} = \frac{\pi_2}{\pi_3}\dot{M}(t),$$

$$\dot{M}(t) = (M_0-\bar{M})\alpha e^{\alpha t}.$$

Because $\pi_2/\pi_3=q^*-\alpha>0$, c_I and M rise or fall together during the transition to a steady state. To show that a falling financial exchange rate is accompanied by a balance-of-payments deficit, we need to show that $\pi_1/\pi_3>0$. From (A10),

$$\frac{\pi_1}{\pi_3} = -\frac{1}{(\delta-\alpha)}\left[A(q^*-\alpha) + \frac{v''P_I}{u_IP_N^2} \right] \quad \text{since} \quad \frac{\pi_2}{\pi_3} = q^*-\alpha.$$

Hence, π_1/π_3 is positive if and only if

$$A(q^* - \alpha) + \frac{v''P_I}{u_I P_N^2} < 0,$$

$$where \quad \alpha = \frac{B+q^*}{2} - \left[\frac{(B+q^*)^2}{4} - Bq^* + \frac{v''P_I}{P_N^2 u_{II}}\right]^{1/2}.$$

$$\Leftrightarrow \quad A\frac{(q^* - B)}{2} + \frac{v''P_I}{u_I P_N^2} < -A\left[\frac{(B-q^*)^2}{4} + \frac{v''P_I}{P_N^2 u_{II}}\right]^{1/2}. \qquad \text{(A12)}$$

By squaring both sides of (A12) and using the relationship (27c), it can be shown that (A12) is equivalent to

$$q^* v'\left[\frac{P_N'}{P_N} + \frac{v''MP_N'}{v'P_N^2} + \frac{u_{II}}{u_I}\right] < \frac{v''}{P_N}.$$

$$\Leftrightarrow \quad q^*\left[\frac{v'P_I P_N'}{P_N^2} + \frac{v''MP_I P_N'}{P_N^3} + \delta u_{II}\right] < \frac{v''P_I}{P_N^2} \quad since \quad \delta = \frac{P_I v'}{u_I P_N} \quad by \ (27c). \qquad \text{(A13)}$$

(A13) is exactly the stability condition. Thus $\pi_1/\pi_3 > 0$ if the stability condition holds.

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