

An investigation in the theory of foreign exchange controls

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Abstract. A choice-theoretic cash-in-advance model is constructed to examine foreign exchange controls. While foreign exchange controls improve the trade balance and the balance of payments (or exchange rate) they reduce welfare for a distortion-free small open economy. This is because foreign exchange controls essentially place a quota on imports. Shocks to the terms of trade are shown to be transmitted negatively to the domestic economy when exchange controls are in effect. Devaluations are found not to have real effects. Finally, it is argued that foreign exchange controls are not the optimal policy for attaining trade balance objectives.

Un examen de la théorie des contrôles de changes étrangers. Les auteurs développent un modèle théorique de choix où l'agent économique doit avoir des espèces sonnantes en main pour effectuer ses transactions. A l'aide de ce modèle, les auteurs analysent les contrôles de changes étrangers. Si ce genre de contrôles améliore la balance commerciale et la balance des paiements (ou le taux de change), ils réduisent le niveau de bien-être dans une petite économie ouverte libre de distorsions. La raison en est que ces contrôles imposent *de facto* un contingentement des importations. On peut montrer que des chocs affectant les termes d'échange se réverbèrent négativement sur l'économie domestique quand ce genre de contrôle est en place. De même les dévaluations n'ont pas d'effets réels. Finalement, les auteurs suggèrent que ce genre de contrôle ne constitue pas la politique optimale pour atteindre des objectifs de balance commerciale.

INTRODUCTION

The use of foreign exchange controls is widespread in the world economy today. As the figures presented in table 1 indicate, 43 per cent of all IMF member countries had exchange controls throughout the six-year period from 1978–83, while 68 per cent of all IMF member countries had exchange controls at some time during the period. It can also be seen from table 1 that, as has been true for quantitative restrictions generally, the use of exchange con-

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TABLE 1

Exchange controls in IMF member countries, 1978-83

	Per cent with foreign exchange controls	Per cent of countries with controls during the six- year period that had them for		Per cent with foreign exchange controls
All six years	43	63	1978	50
Five years	6	9	1979	50
Four years	4	5	1980	54
Three years	7	8	1981	58
Two years	7	11	1982	65
One year	3	4	1983	65
No years	32			

SOURCE: Entries are based on the summary tables at the back of the IMF's *Annual Report on Exchange Arrangements and Exchange Restrictions*, 1979-84 issues.

TABLE 2

Multiple exchange rate systems in IMF member countries, 1978-83

	Per cent with multiple rate systems	Per cent of countries with multiple rate systems during the six- year period that had them for		Per cent with multiple rate systems
All six years	7	25	1978	15
Five years	4	15	1979	17
Four years	2	7	1980	12
Three years	3	10	1981	15
Two years	6	20	1982	20
One year	7	23	1983	20
No years	71			

SOURCE: See table 1.

trols has been rising in recent years. Half of all IMF members had exchange controls in 1978, and by 1983 the figure had risen to about two-thirds. It is also apparent that there is a strong tendency for foreign exchange controls, once enacted, to become a permanent part of the economic environment. Additionally, in the formal analysis that comprises the body of this paper it is shown that under certain conditions multiple exchange rate systems entailing different rates for imports and exports are equivalent to exchange controls. Table 2, therefore, provides some evidence on the use of multiple exchange rate systems. As can be seen, multiple exchange rate systems are not nearly as popular a means of intervening in foreign exchange markets as are exchange controls. It should be noted, however, that there is a much stronger tendency

for multiple exchange rate systems to be enacted for only a short period of time, that is, to be a temporary policy.

In the light of the widespread use of exchange controls it is important for economists to have a clear understanding about how such controls affect national economies. This paper examines foreign exchange controls from the perspective of positive economics. The analysis is conducted within the context of a choice-theoretic general equilibrium model which Helpman (1981) proposed as a framework for evaluating alternative exchange rate regimes. This modelling strategy is chosen because it highlights how the adoption of foreign exchange controls limits the opportunity sets facing individuals and alters the incentive structure facing them. Once the effect of foreign exchange controls on agents' decision rules is established, it is then easy to infer their ramifications for an economy's general equilibrium.

It is shown that foreign exchange controls effectively place a quota on imports, thus raising their domestic relative price in the same manner as a tariff would. While the adoption of foreign exchange controls may improve both the trade balance and the balance of payments (or exchange rate), these controls tend to reduce welfare for a distortion-free small open economy. Imposing foreign exchange controls, in a sense, transforms the imported goods market into a non-traded goods market, and it is shown that this results in terms of trade shocks being transmitted *negatively* to the domestic economy. The paper also examines the effects of devaluation in a foreign exchange control setting. It is shown that unlike the situation with capital controls, the presence of foreign exchange controls is not a sufficient condition for a devaluation to have real effects. Finally, the question of whether foreign exchange controls are the optimal instrument to obtain trade balance and balance of payments objectives is addressed. It is argued that they are not the optimal tool for obtaining either of these non-economic objectives.

THE REPRESENTATIVE AGENT'S OPTIMIZATION PROBLEM

Imagine a small open economy with either a fixed or flexible exchange rate and with a system of foreign exchange controls in place. The economy is inhabited by a representative agent who lives for two periods and desires to maximize his lifetime utility, U , as given by

$$U = \sum_{t=1}^2 \rho^{t-1} [U(X^t) + V(Z^t + \bar{Z}^t)], \quad (1)$$

where ρ is his subjective rate of discount, and X^t and $Z^t + \bar{Z}^t$ are his consumption of exportables and importables in period t .¹

The representative agent has two sources of income. In each period t he is endowed with a certain quantity of the exported good, \bar{X}^t , and the imported

1 It is assumed that the utility function is a strictly quasi-concave class C^2 function. The term \bar{Z}^t in $V(\cdot)$ is a constant and merely serves to simplify the analysis. This will be readily apparent later on.

good, \bar{Z}^t . The exported good can be freely sold in world markets, and its price is thus subject to the arbitrage condition

$$P^t = e^t P^{*t}, \quad t = 1, 2,$$

where $P^t (P^{*t})$ is the domestic (foreign) currency price of exportables and e^t the exchange rate. Owing to the presence of foreign exchange controls, a similar arbitrage condition does not hold for importables. Also, in each period t the agent receives from the domestic government a nominal transfer payment, T^t .

The sequencing of the economy's monetary transactions is crucial for determining the constraints facing the representative agent. However, since the sequencing of transactions is similar to that adopted by Helpman (1981), only a brief description will be given here. The representative agent enters period t with a certain amount of domestic and foreign money to spend left over from the previous period. At the beginning of period t the individual receives domestic currency from his sales of goods during period $t - 1$ and a nominal transfer payment of T^t . The agent then enters the asset market and redeems the bonds he purchased during the previous period, which are now worth $(1 + r^*)b^{t-1}$ in terms of the exported good, where r^* is the world real interest rate (denominated in terms of the export good), purchases new bonds of amount b^t , and allocates his holdings of cash between domestic and foreign currency in the amounts M^t and M^{*t} . The agent's budget constraints can thus be written as

$$m^1 + m^{*1} + b^1 = \tau^1, \quad (2)$$

$$m^2 + m^{*2} = (P^1/P^2)[\bar{X}^1 + (P_I^1/P^1)\bar{Z}^1] + \tau^2 + (P^1/P^2) \cdot [m^1 - X^1 - (P_I^1/P^1)\bar{Z}^1] + (P^{*1}/P^{*2})[m^{*1} - p^{*1}Z^1] + (1 + r^*)b^1, \quad (3)$$

where $m^t \equiv M^t/P^t$, $m^{*t} \equiv M^{*t}/P^{*t}$, $\tau^t \equiv T^t/P^t$, $p^{*t} \equiv P_I^{*t}/P^{*t}$, and $P_I^t (P_I^{*t})$ is the domestic (foreign) currency price of importables. Since foreign exchange controls are in effect, the maximum amount of foreign exchange the agent can acquire is $\tilde{m}^{*t} \equiv \tilde{M}^{*t}/P^{*t}$. Therefore, the agent also faces the constraints

$$m^{*t} \leq \tilde{m}^{*t}, \quad t = 1, 2. \quad (4)$$

During the remainder of the period the agent uses the domestic currency he has acquired to purchase domestically produced goods and the foreign currency he has acquired to purchase foreign produced goods. It is assumed that the agent satisfies his demand for goods from domestic sources first, so that his consumption choices must satisfy the cash-in-advance constraints

$$X^t + (P_I^t/P^t)\bar{Z}^t \leq m^t, \quad p^{*t}Z^t \leq m^{*t}, \quad t = 1, 2. \quad (5)$$

The agent then enters period $t + 1$ with any money he has left over and the process begins again.

The agent's goal in life is to choose X^t , Z^t , m^t , m^{*t} for $t = 1, 2$, and b^1 to maximize (1) subject to (2)–(5). In the framework used here money is required by the exchange mechanism in order to effect consumption purchases but agents can choose whether or not to hold money as a store of value. This portfolio decision will be made so as to maximize wealth, and hence the asset (or assets) with the highest real return will serve as a store of value. It is straightforward to show (see Helpman, 1981) that if nominal interest rates at home and abroad are positive bonds will dominate money as a store of value. This condition is assumed to hold in the remainder of the analysis and hence the cash-in-advance constraints (5), are treated as equalities.

The upshot of the above maximization is summarized by the following marginal conditions:

$$V_1(Z^t + \bar{Z}^t) = [1 + (\lambda^t/\alpha^t)]p^{*t}U_1(X^t), \quad t = 1, 2, \quad (6)$$

$$U_1(X^1) = (1 + r^*)\rho U_1(X^2), \quad (7)$$

where α^1 and α^2 represent the Lagrange multipliers associated with the first- and second-period budget constraints (2) and (3), and λ^1 and λ^2 are the multipliers associated with the foreign exchange controls as given by (4). Equation (6) describes how the agent optimally divides his period- t expenditure between importables and exportables. Note that the presence of foreign exchange controls drives a wedge in the amount $[1 + (\lambda^t/\alpha^t)]$ between the agent's marginal rate of substitution, $V_1(Z^t + \bar{Z}^t)/U_1(X^t)$, and the terms of trade, p^{*t} . Thus, with foreign exchange controls in place the effective cost of an extra unit of imports in the first period can be thought of as being made up of two components. The first component is the p^{*1} units of exports (or bonds) one must sell on world markets in order to purchase the import good. The second component derives from the value of the foreign exchange needed to purchase a unit of imports.² To see this note that λ^t is the utility value of an extra real unit of foreign exchange and α^t the utility value of extra period- t real income. Hence $(\lambda^t/\alpha^t)p^{*t}$ is the shadow value of the additional foreign exchange needed to purchase a unit of imports. Therefore, as with a tariff, when foreign exchange controls are in effect, the domestic relative price of imports, $P_I^1/P^1 = (1 + (\lambda^1/\alpha^1))p^{*1}$, will be above the world level, p^{*1} . Equation (7) is the familiar intertemporal efficiency condition characterizing the agent's consumption-savings decision.³

2 Formally, the Kuhn-Tucker conditions associated with the foreign exchange restrictions are $\bar{m}^{*t} - m^{*t} \geq 0$, $\lambda^t \geq 0$, and $\lambda^t(\bar{m}^{*t} - m^{*t}) = 0$, $t = 1, 2$. Thus whenever the multiplier, λ^t , is greater than zero, the period- t exchange controls are binding. The converse, however, is not generally true. For simplicity, it will be assumed that if the foreign exchange constraint is binding, then the multiplier, λ^t , is strictly positive in value.

3 An interesting area for future research would be to modify the monetary mechanism of exchange so that foreign exchange needed to service any outstanding debt is also subject to foreign exchange controls. In this case foreign exchange controls would also impinge on the intertemporal efficiency condition (7) by driving a wedge between the domestic and world real interest rates in the same manner as do capital controls.

The first-order conditions for the agent's optimization problem imply that his compensated demand functions are given by

$$\left. \begin{aligned} Z^t &= Z^t(p^{*1}(1 + \eta^1), p^{*2}(1 + \eta^2)/(1 + r^*), 1/(1 + r^*), U) \\ \text{and} \\ X^t &= X^t(p^{*1}(1 + \eta^1), p^{*2}(1 + \eta^2)/(1 + r^*), 1/(1 + r^*), U) \end{aligned} \right\} \quad (8)$$

for $t = 1, 2$, where $\eta^t \equiv \lambda^t/\alpha^t$ is the implicit tariff on period- t imports imposed by exchange controls.⁴ The form of the utility function guarantees that substitutability and normality prevail. Thus, for example, $Z_1^1 < 0$, and $Z_2^1, Z_3^1, Z_4^1 > 0$ where Z_j^1 is the derivative of $Z^1(\cdot)$ with respect to its j th argument. The agent's level of welfare, U , of course depends on his endowment of exportables and importables, the terms of trade, the world real interest, and the severity of exchange controls. The nature of this dependence is discussed in fuller detail below.

In passing it should be noted that foreign exchange controls are equivalent to certain types of multiple exchange rate systems. To see this suppose that e^t is the exchange rate used for export transactions in period t and s^t the exchange rate used for import transactions. Under this system the representative agent would set the period- t marginal rate of substitution between import and export goods equal to $[1 + (s^t - e^t)/e^t]p^{*t}$, where $(s^t - e^t)/e^t$ represents the effective tariff on imports that the multiple exchange rate system imposes. This type of multiple exchange rate system is identical to exchange controls in the same sense that Bhagwati (1965) has argued that tariffs and quotas are equivalent.

THE ECONOMY'S GENERAL EQUILIBRIUM

The economy under consideration is inhabited not only by the representative agent but also by a government. The government's budget constraints are

$$m_s^1 = \tau^1 + b_R, \quad (9)$$

$$m_s^2 = \tau^2 + m_s^1/(1 + \pi) - b_R(1 + r^*), \quad (10)$$

where m_s^t is the real supply of money in period t , b_R is the government's acquisition of interest-bearing reserves in the first period, and $\pi = (P^2 - P^1)/P^1$ is the domestic rate of inflation.

Equilibrium in the domestic money market requires that the demand and supply for money must be equal in each period. Thus

$$m^t + m_F^t = m_s^t, \quad t = 1, 2. \quad (11)$$

where m_F^t is the foreign country's period- t real holdings of domestic cash

4 Actually note that the agent's demand for the period- t imported good should have been written as $Z^t + \bar{Z}^t = \hat{Z}^t(\cdot)$ for $t = 1, 2$. Since the agent's period- t endowment of the imported good, \bar{Z}^t , is a constant that is never varied in the model, one can think of $-\bar{Z}^t$ as having been subsumed for convenience in the function $Z^t(\cdot) \equiv \hat{Z}^t(\cdot) - \bar{Z}^t$.

balances. Recall that the cash-in-advance constraints hold as strict equalities so long as nominal interest rates are positive; so from (5) $m^t = X^t + (P_t^t/P^t)\bar{Z}^t$. Foreign residents are taken to be solving an analogous optimization problem, except without foreign exchange restrictions, and hence $m_F^t = X_F^t$, where X_F^t is the foreign consumption of the domestic exported good. Hence, (11) can be rewritten as

$$\bar{X}^t + (P_t^t/P^t)\bar{Z}^t = M_s^t/(P^{*t}e^t), \quad t = 1, 2, \quad (12)$$

with M_s^t defined as the period- t nominal supply of domestic money. The left-hand side of (12) follows from the fact that the exportables market clears in each period, so $X^t + X_F^t = \bar{X}^t$. Under a flexible exchange rate system, and given the economy's general equilibrium, (12) determines the equilibrium value of the exchange rate. Under fixed exchange rates (12) determines the supply of money compatible with the specified value of the fixed exchange rate.

Finally, international trade must balance intertemporally. This fact is easily deduced by first discounting equation (3) by $(1 + r^*)$ and subsequently adding it to (2). Next, eliminate the money terms on both sides of the resulting equation by using the fact that the cash-in-advance constraints given by (5) hold as strict equalities. Last, the transfer payment terms on the right-hand side of the new equation can be removed by using (9), (10), and (12). This yields the desired result,

$$p^{*1}Z^1 + X^1 + [(p^{*2}Z^2 + X^2)/(1 + r^*)] = \bar{X}^1 + [\bar{X}^2/(1 + r^*)]. \quad (13)$$

THE IMPACT OF EXCHANGE CONTROLS

Exchange controls can be used to achieve a variety of objectives but one of the most common is to restrict the volume of imports to some target level. Assume, therefore, that the government desires to limit the physical volume of imports in period one to \tilde{Z}^1 units and attempts to accomplish this by setting $\tilde{m}^{*1} = p^{*1}\tilde{Z}^1$. In order for the market for importables to clear in the first period the following condition must hold:⁵

$$Z^1(p^{*1}(1 + \eta^1), p^{*2}/(1 + r^*), 1/(1 + r^*), U) = \tilde{m}^{*1}/p^{*1}. \quad (14)$$

As can be seen, in response to various shocks the first-period domestic relative price of importables, $p^{*1}(1 + \eta^1)$, must adjust to equate the domestic demand for imports and the governmentally determined supply of imports, \tilde{m}^{*1}/p^{*1} . The imported goods market in an economy with exchange controls thus behaves in much the same manner as do markets for non-traded goods.⁶ Note

5 The case where foreign exchange controls can be partially circumvented at a cost in terms of real resources is taken up in the seventh section below.

6 For an analysis of non-traded goods see Jones (1974) or, more recently, Greenwood (1984) and Kimbrough (1985). That controls on international transactions can be analyzed from the perspective of a competitive market generating (implicit) market-clearing prices for the controlled quantity has been discussed, for the case of capital controls by Obstfeld (1986), Adams and Greenwood (1985), and Greenwood and Kimbrough (1985a).

that with exchange controls in place in the first period, \tilde{Z}^1 replaces Z^1 in the economy's intertemporal budget constraint, (13).

To aid in understanding the impact of exchange controls on the economy, consider the impact of relaxing first-period exchange controls.⁷ This move will allow the agent to purchase additional imports amounting to $d\tilde{Z}^1/d\tilde{m}^{*1} = 1/p^{*1}$. In the light of this, the impact on the agent's welfare level, U , from relaxing exchange controls can be shown from (1), (6), (7), (13), and, (14) to be

$$dU/d\tilde{m}^{*1} = \eta^1 U_1(X^1). \quad (15)$$

This expression is easy to interpret. A unit relaxation in first-period exchange controls allows the agent to purchase an additional $1/p^{*1}$ units of first-period imports. The cost of these additional imports is a unit of forgone export consumption. But, as is evident from (6), $1/p^{*1}$ units of extra import consumption is worth $(1 + \eta^1)$ units of export consumption to the agent. Thus, by relaxing the exchange restrictions by a unit, the individual realizes a net welfare gain worth the equivalent of η^1 units of first-period exports which is converted into utility by multiplying it by the marginal utility of first-period exports, $U_1(X^1)$.

From (14) and (15) it can be shown that the drop in the first-period domestic relative price of importables following the loosening of controls is

$$d[p^{*1}(1 + \eta^1)]/d\tilde{m}^{*1} = [1 - (\eta^1/(1 + \eta^1))\mu_Z^1]/p^{*1}Z_1^1 < 0, \quad (16)$$

where $0 < \mu_Z^1 \equiv (1 + \eta^1)p^{*1}Z_4^1U_1(X^1) < 1$ represents the marginal propensity to consume importables in period one. Note that the decrease in the price of current imports, $p^{*1}(1 + \eta^1)$, is inversely related to the size of the marginal propensity to consume importables, μ_Z^1 , to the size of the existing distortion, reflected by $\eta^1/(1 + \eta^1)$, and to the extent of substitution in consumption as captured by Z_1^1 .

The current trade balance, tb^1 , is defined as $tb^1 = \bar{X}^1 - [X^1 + p^{*1}Z^1]$. Thus the response of the trade balance to a loosening of exchange controls is

$$dtb^1/d\tilde{m}^{*1} = -1 - \eta^1\mu_X^1 - X_1^1d[p^{*1}(1 + \eta^1)]/d\tilde{m}^{*1} < 0, \quad (17)$$

where $\mu_X^1 \equiv X_4^1U_1(X^1)$ is the marginal propensity to consume first-period exportables. The sign of the above expression is unambiguously negative, as demonstrated in the appendix. The first term illustrates the worsening in the trade balance generated by the increased volume of imports permitted with the new higher quota for foreign exchange. The loosening of exchange controls also raises welfare and thus stimulates the domestic demand for exportables, which, as the second term shows, causes a deterioration in the trade balance. The last term indicates the positive impact on the trade balance arising

⁷ Results of related interest concerning the impact of temporary trade restrictions have been derived for non-monetary economies by Razin and Svensson (1983) and Djajic (1985).

from the fall in the effective price of current imports and the associated decline in domestic consumption of exportables.

The current balance of payments deteriorates in a fixed exchange rate system when first-period exchange controls are relaxed, while under a flexible exchange rate regime the domestic currency depreciates. These results are straightforward. For instance, for the fixed exchange rate case (9) and (12) imply that the current balance of payments, b_R , can be written as $b_R = \bar{X}^1 + p^{*1}(1 + \eta^1)\bar{Z}^1 - \tau^1$. Since a liberalization in first-period exchange controls causes the domestic relative price of imports, $p^{*1}(1 + \eta^1)$, to decline, the demand for domestic money falls, implying a worsening of the balance of payments. It should be noted that while a relaxation (tightening) of exchange controls causes a deterioration (improvement) of both the trade balance and balance of payments (or exchange rate), it has a beneficial (deleterious) impact on economic welfare. This last point should be kept in mind by policy-makers who, as mentioned by McKinnon (1979), often impose exchange controls to improve the balance of payments. In general, policy-makers should recognize that stabilizing arbitrary economic statistics, such as the balance of payments or the trade balance, is not necessarily the same thing as maximizing economic welfare. As a further word of caution to policy-makers, it should be noted that the above line of reasoning can also be employed to show that the anticipation of a future tightening of foreign exchange controls worsens the trade balance and reduces welfare while a permanent tightening of exchange controls also reduces welfare but has an ambiguous impact on the trade balance. Therefore, in manipulating exchange controls to attain trade balance objectives policy-makers must be careful to specify the appropriate intertemporal pattern of controls.

Another important feature of exchange controls can be illustrated by supposing, for variety, that the exchange controls are permanently in place and by considering the impact of an anticipated deterioration in the future terms of trade. It is straightforward to show that domestic welfare declines by

$$dU/dp^{*2} = -U_1(X^1)\bar{Z}^2/(1 + r^*). \tag{18}$$

The impact of this temporary deterioration in the terms of trade on domestic relative prices can be determined by undertaking the appropriate comparative statics exercise on (14) and its second-period analog, $Z^2(\cdot) = \bar{Z}^2$, while making use of (18), to obtain

$$\begin{aligned} d[p^{*1}(1 + \eta^1)]/dp^{*2} &= [Z_4^1 Z_2^2 - Z_4^2 Z_2^1]U_1(X^1)\bar{Z}^2/[(1 + r^*)\Delta] < 0, \\ d[p^{*2}(1 + \eta^2)/(1 + r^*)]/dp^{*2} &= [Z_1^1 Z_4^2 - Z_1^2 Z_4^1]U_1(X^1) \\ &\quad \cdot \bar{Z}^2/[(1 + r^*)\Delta] < 0, \end{aligned}$$

where $\Delta \equiv Z_1^1 Z_2^2 - Z_2^1 Z_1^2 > 0$, which follows from the negative semidefiniteness of the substitution matrix arising from the agent's optimization problem.

Thus, an anticipated deterioration in the future terms of trade causes the domestic price of imports to fall in both periods. That is, with foreign exchange controls in place, shocks to world relative prices are *negatively* transmitted to the domestic economy.⁸ The intuition underlying this result is straightforward. When the future terms of trade deteriorate welfare declines as (18) illustrates. At the original set of relative prices the agent cuts back on his consumption of both goods in both periods. With the supply of imports fixed, this leads to a drop in their relative price. It should be noted that while the negative transmission of shocks to world relative prices is a characteristic of exchange controls, it is not a necessary characteristic of multiple exchange rate systems such as those discussed near the end of the second section. The logic behind this result is that the quantitative limits imposed by exchange controls sever the link with world markets, causing the domestic market for importables to behave like a market for non-traded goods, while multiple exchange rate systems, like tariffs, drive a fixed wedge between domestic and world relative prices. As a consequence, under multiple exchange rate systems the home country's direct link to world markets is left intact and shocks to world relative prices will be positively transmitted. Of course in practice policy-makers may manipulate import and export exchange rates to achieve certain quantitative targets. In such cases multiple exchange rate systems will function in exactly the same manner as exchange controls.

Finally, the response of today's trade balance to an anticipated fall in the relative price of exports can be analysed for the case of permanent exchange controls. This response is determined by the simple differentiation of the current trade balance definition. This yields

$$dtb^1/dp^{*2} = -X_1^1 d[p^{*1}(1 + \eta^1)]/dp^{*2} \\ - X_2^1 d[p^{*2}(1 + \eta^2)/(1 + r^*)]/dp^{*2} + \mu_X^1 \tilde{Z}^2/(1 + r^*) > 0.$$

As can be seen, in response to an anticipated deterioration in the future terms of trade the current trade balance improves. Since the volume of imports is being controlled, all the impact on the trade balance occurs through adjustment in the export market. The last term in the above expression illustrates the beneficial impact on the trade balance arising from the drop in welfare and the associated reduction in export consumption. The first and second terms show the improvement in the trade balance resulting from the decline in the current and future domestic prices of imports which leads to a contraction in current export consumption. It should be noted that without exchange controls the effect on the trade balance of an anticipated drop in the future terms of trade is ambiguous. On the one hand, the associated fall in welfare causes current import and export consumption to be cut. On the other hand, the rise in the relative price of future imports tends to stimulate current

8 See Greenwood and Kimbrough (1985a) for a discussion of negative international transmission under capital controls.

import and export consumption. The overall change in the trade balance would thus be ambiguous in the absence of exchange controls.⁹

NOMINAL EXCHANGE CONTROLS

In practice nations often set ceilings on the amount of foreign exchange that domestic residents can hold in nominal terms rather than in terms of imports as was assumed in the previous section. This is probably because nominal targets are less costly to administer. It is not difficult to show that this policy renders the physical volume of imports prone to movements in the world price level and to fluctuations in the terms of trade. To this end assume that the government temporarily imposes a limit, \tilde{M}^* , on the nominal amount of foreign exchange agents can hold during period one.

To begin with, consider the impact of a general increase in first-period world nominal prices (i.e., let $dP^*/P^* = dP_I^*/P_I^*$ so that $dp^* = 0$). In the first period the amount of imports, Z^1 , that the agent can purchase is given by $Z^1 = \tilde{M}^*/P_I^* (= \tilde{m}^*/p^*)$. Thus, a rise in the first-period nominal price of imports resulting from an increase in the world price level represents an effective tightening of controls in the amount $dZ^1/dP_I^* = -\tilde{M}^*/(P_I^*)^2 = -(Z^1/P^*)d\tilde{Z}^1/d\tilde{m}^*$. By recalling expressions (15)–(17) it can be immediately seen that a general increase in the world price level causes a drop in domestic welfare, a rise in the first-period domestic relative price of imports, and a tendency toward a trade balance surplus.¹⁰ The key result here is that foreign nominal shocks are no longer neutral as a consequence of the nominal rigidity introduced by exchange controls.

Also, it can be shown that changes in the terms of trade, p^* , will be transmitted to the domestic economy through an additional channel when nominal rather than real exchange controls are in effect. In this case, movements in the terms of trade are transmitted to the domestic country directly through the traditional welfare effect exemplified by (18). However, under nominal exchange controls terms of trade changes are also transmitted to the domestic economy via any change in the volume of imports, $Z^1 =$

9 If, alternatively, the world real interest rate was denominated in terms of the imported good, an anticipated deterioration in the terms of trade would unambiguously improve the trade balance in the absence of foreign exchange controls. Thus whether or not the world real interest rate is denominated in terms of the exported or imported good appears to be important. To understand the nature of the difference between the results obtained using the two different specifications note that the import denominated gross real interest rate, $1 + r^{**}$, is given by $1 + r^{**} = (p_1^*/p_2^*)(1 + r^*)$. Clearly, then, an anticipated deterioration in the terms of trade holding the import (export) denominated real interest rate constant implies a rise (fall) in the export (import) denominated real interest rate. In the current setting this rise in the export denominated real interest rate works to improve the current trade balance, since it encourages intertemporal substitution towards the consumption of future exports and imports, reconciling the result mentioned at the beginning of this footnote. See Obstfeld (1983) for a related discussion.

10 The desired comparative statics results are obtained by multiplying (15)–(17) by the factor of proportionality $-Z^1/P^*$.

\tilde{M}^{*1}/P_T^{*1} , induced by changes in the world nominal price of importables. This latter channel of transmission, of course, depends on the underlying cause of the shift in the terms of trade and the associated foreign monetary response.

DEVALUATION UNDER FOREIGN EXCHANGE CONTROLS

Devaluations are often undertaken in environments where foreign exchange or capital controls are present. McKinnon (1979, 440) notes that 'devaluation in the presence of exchange controls and other QRS (quantitative restrictions) has not been well worked out in the formal theoretical literature.' Despite the lack of formal general equilibrium analysis, many economists feel that the nature of devaluation in settings with quantitative restrictions is fundamentally different from settings where they are absent. For instance, Krueger (1983) appears to argue that in economies with foreign exchange controls the level of the nominal exchange rate influences domestic relative prices, and consequently a devaluation will have real effects.

To examine formally the effects of devaluation under foreign exchange controls, consider the fixed exchange rate version of the model with temporary first-period exchange controls and suppose that the government undertakes a devaluation at the beginning of the first period. To begin with, note that the real side of the economy is completely independent of monetary factors, except for the government's target level for foreign exchange holdings. Technically, equations (8), (13), and (14) [or its equivalent under nominal exchange controls $Z^1(\cdot) = \tilde{M}^{*1}/P_T^{*1}$] completely specify the economy's real general equilibrium or the determination of $p^{*1}(1 + \eta^1)$, X^1 , Z^2 , X^2 , and U . Thus, in contrast to Aizenman (1981), the only effect of a devaluation under foreign exchange controls is a proportional rise in all domestic nominal prices and a tendency towards a balance of payments surplus. The invariance of real activity with respect to a devaluation occurs for two basic reasons.¹¹ First, domestic (and foreign) residents are free immediately to adjust their holdings of bonds and domestic currency. Second, the extent of the government's holdings of interest-bearing reserves is irrelevant for consumption allocations, since Ricardian equivalence holds. With capital controls in place, Ricardian equivalence fails to hold, since the domestic and foreign interest rates differ, a fact that Obstfeld (1986), Adams and Greenwood (1984), and Greenwood and Kimbrough (1985a) all emphasize. Hence, as outlined by Obstfeld (1986), changes in the monetary authorities' holdings of interest-bearing reserves induced by a devaluation have implications for real allocations in the economy arising from their wealth effects. Unlike capital controls, the presence of foreign exchange controls does not seem to constitute a sufficient condition for a devaluation to have real effects.¹²

11 For more detailed analyses, in cash-in-advance setting, of some of the issues involved here see Helpman (1981), Persson (1984), and Aschauer and Greenwood (1983).

12 However, if the foreign exchange quota were expressed in domestic currency units, rather

BLACK MARKETS FOR FOREIGN EXCHANGE

It is easy to introduce a black market for foreign exchange into the modelling apparatus. Only a capsule summary of such an extension will be given here – the formal details are provided in Greenwood and Kimbrough (1985b). Again focus on the temporary exchange control case and assume that there exists a black market in the economy that can divert foreign exchange away from legal to illegal uses at an increasing real resource cost, ϕ . Specifically, let ϕ be a convex function of $m^*/p^* - \tilde{m}^*/p^*$ so that $\phi(.1) = \phi(m^*/p^* - \tilde{m}^*/p^*)$ with $\phi_1(.1), \phi_{11}(.1) > 0$. The inclusion of this black market into the economy involves three alterations to the description of the model's general equilibrium: (i) η^1 is now equal to $\phi_1(.1)/p^*$ which represents the proportionate black market premium for foreign exchange; (ii) the additional supply of first-period imports now available via black market activity, or $\phi_1^{-1}(\eta^1 p^*)$, should be added to the right-hand side of (14); and (iii) the real resource cost involved with running a black market in the first period, $\phi(.1)$, should be subtracted from the right-hand side of (13). As can be clearly seen, the spirit of the earlier analysis is essentially retained. The foreign exchange controlled economy with a black market is in a sense a hybrid economy representing a cross between the pure cases of a free trade economy and a perfectly foreign exchange controlled one. To see this, imagine that the agent realizes an improvement in his future endowments of the imported and exported goods. In the free trade case the agent would increase his current consumption of imports at the going terms of trade, while in the foreign exchange controlled case his consumption of imports would remain unaffected while the domestic price of imports rises. In the black market economy both the current price and the quantity of import consumption rise, the former providing the incentive for a larger amount of black market activity.

ENDOGENOUS PRODUCTION

It is also straightforward to extend the analysis to allow for endogenous production. In particular, let the economy's output of the exported and imported goods be modelled in standard Heckscher-Ohlin fashion. The model's main conclusions are unaffected by such an extension. For instance, the

than in foreign ones, the devaluation would be associated with an effective tightening in first-period exchange controls in the amount $d\tilde{m}^*/d\bar{e} = -\tilde{m}^*/\bar{e}$. Following the analysis of the previous sections, this would tend to lead to an increase in the relative price of imports, a trade balance surplus, and a further improvement in the balance of payments. In this situation a devaluation has real effects only to the extent that it alters the quantitative incidence of the exchange controls. In practice, devaluations are often purposefully coupled with a liberalization of foreign exchange controls and other quantitative restrictions. This makes it difficult for the economist to discriminate empirically between the effects of a devaluation and the lifting of quantitative restrictions.

imposition of temporary exchange controls still increases the domestic price of imports, improves the balance of payments/exchange rate, can have a beneficial impact on the trade balance, and reduces welfare.¹³ Note that domestic production of the imported good will be encouraged and that of the exported good discouraged by the upward movement in the domestic relative price of imports. Also, the return to the factor used intensively in the import-competing sector rises, and this may provide an explanation for the presence of foreign exchange controls. Indeed, suppose that the home country is inhabited by a large number of individuals with identical and homothetic tastes but endowed with different ratios of the two factors. This extension leaves intact most of the results derived earlier, but if the home country has majority voting, it can provide a rationale for the enactment of exchange controls. As shown by Mayer (1984), under these conditions the median voter will determine the policy outcome, and if the distribution of individual factor endowments is skewed towards the factor used intensively in the *export* industry (i.e., if ownership of that factor is highly concentrated) then application of the Stolper-Samuelson theorem implies that tariffs, or related policies such as exchange controls, will characterize the political equilibrium.

OPTIMAL ATTAINMENT OF NON-ECONOMIC OBJECTIVES

Foreign exchange controls are enacted for a variety of reasons. Often they are implemented or adjusted during times of economic crisis so that a target level for the trade balance or balance of payments can be attained. It seems, however, that foreign exchange controls are likely to achieve these objectives at an unnecessarily high welfare cost. To see this, let \tilde{t}^1 denote the government's target level for the first-period trade balance. This target is fulfilled when¹⁴

$$\bar{X}^1 - X^1 - p^*Z^1 \cong \tilde{t}^1. \quad (19)$$

The 'first-best' policy for attaining this goal maximizes the agent's lifetime utility, (1), subject to the economy's intertemporal budget constraint, (13), and the trade balance target, (19). By carrying out the prescribed maximization routine the following set of first-order conditions – in addition the constraints

- 13 Starting from an initial position of free trade, a slight restriction in the level of foreign exchange domestic residents can hold *unambiguously* improves the trade balance. In general this result is ambiguous, since foreign exchange controls, by forcing the economy to specialize in a direction counter to its comparative advantage, *reduce* (increase) the value of first-period national income evaluated at *world* (domestic) prices. This fall in first-period income, if strong enough, can (in fact) result in foreign exchange controls having a perverse impact on the trade balance.
- 14 To see that first-period exchange controls are a feasible tool for attaining a trade balance target note that (6), (13), and the trade balance definition imply a unique solution for X^2 which is given by $V_1(\bar{X}^2 + p^{*2}\bar{Z}^2 + (1 + r^*)\tilde{t}^1 - X^2)/p^{*2} = p^{*2}U_1(X^2)$. This solution for X^2 used in conjunction with (7) provides a unique value for X^1 . Finally, a unique solution for $Z^1 (= \tilde{m}^{*1}/p^{*1})$ is then obtained from (19).

(13) and (19) – emerge (the government's choice variables are X^1 , Z^1 , X^2 , and Z^2):

$$U_1(X^1) = (1 + r^*)[1 + (\theta/\alpha)]\rho U_1(X^2), \quad (20)$$

$$V_1(Z^t + \bar{Z}^t) = p^{*t}U_1(X^t), \quad t = 1, 2, \quad (21)$$

where α is the marginal utility of wealth associated with the constraint (13), and θ is the marginal welfare cost of tightening the trade balance target (19). In order to attain optimally the trade balance target the government must adopt a policy that generates a general equilibrium replicating the set of conditions (13), (19), (20), and (21).

First, note from (21) that in each period the marginal rate of substitution between importables and exportables, $V_1(Z^t + \bar{Z}^t)/U_1(X^t)$, should equal the terms of trade, p^{*t} . Thus the optimal attainment of the trade balance target does *not* involve driving a tariff-like wedge between the domestic and international relative prices of imports. Therefore, exchange controls, while able to attain a trade balance target are not a part of the optimal policy for doing so. Second, as can be seen from (20), in order efficiently to attain the first-period trade balance target, a wedge of $[1 + (\theta/\alpha)]$ should be driven between one plus the domestic real rate of interest, $U_1(X^1)/\rho U_1(X^2)$, and one plus the world real rate of interest, $1 + r^*$. The optimal policy involves implicitly taxing the principal and interest on borrowing from abroad at the rate θ/α . Such a policy can be implemented by explicitly taxing international borrowing, by imposing quantitative restrictions on capital flows in the amount \tilde{b}^1 , or by instituting a dual exchange rate system with different exchange rates for current account and capital account transactions.¹⁵ The essential idea is that a trade balance target is primarily a means of achieving a given intertemporal pattern of consumption and therefore is best attained by policies that directly discriminate against consumption across periods by striking at intertemporal relative prices rather than by policies which discriminate against consumption within periods by striking at intratemporal relative prices.

Regarding balance of payments targets, it is easy to see that the first-best policy for attaining them is a devaluation or a reduction in nominal transfers. This follows directly from the neutrality of money. However, when the government is committed to a certain monetary policy, it can be shown using the above methods that exchange controls alone do not constitute the optimal policy for meeting a balance of payments target (see Kimbrough, 1986 for a detailed treatment of this and other related issues).¹⁶

It is not being argued here that enforcing a target level for the trade balance or the balance of payments is a laudable goal; in general it is not. This is easy

15 In more general settings than the one adopted here such policies can have an additional channel of impact on the economy via their impact on the nominal interest rate. For an example of this, see Adams and Greenwood (1985).

16 Note that foreign exchange controls are an optimal instrument for restricting the volume of imports to some target level, \bar{Z}^1 . Formally this can be seen by noting that the marginal con-

to see in the above problem, since the government is maximizing the agent's lifetime utility subject to a budget set that is artificially restricted owing to the trade balance constraint (19). Thus in this set-up the economy is at least as well off without a trade balance target as it is with one. What is being argued here, however, is that if the government desires to achieve certain policy goals relating to the various balance of payments accounts, it should pick the policy best suited to attain this goal directly, a point recognized by Johnson (1965). Those advocating foreign exchange controls should precisely outline the policy objectives of such controls, justify why these goals are desirable, and explain why foreign exchange controls are the best available policy for attaining these ends.

CONCLUSIONS

To summarize, foreign exchange controls effectively place a quota on imports. As a result, they drive the domestic price of imports above the world price in exactly the same fashion as a tariff would. While foreign exchange controls improve both the trade balance and the balance of payments (or exchange rate), they reduce the welfare of a distortion-free small open economy. The first two implications of exchange controls may be a reason that they are so popular. It was also noted that if a standard Heckscher-Ohlin production paradigm is appended to the model, then the factor used intensively in import production benefits from the imposition of such controls. In a political world this may provide an explanation for the presence of foreign exchange controls. Another possibility, and one beyond the scope of this paper, is that exchange controls are imposed as part of an optimal (or non-optimal) public finance expenditure and taxation package. Such controls can expand the base for inflation tax by reducing the degree of currency substitution (see Hercowitz and Sadka, 1984). In many respects, when foreign exchange restrictions are imposed, the imported goods market behaves in the same manner as a non-traded goods market would. In particular, in the presence of such restrictions shocks to the world terms of trade will be negatively transmitted to the domestic economy. This occurs because the non-traded goods nature of the import market renders only the wealth effect from the world terms of trade shock operational. Also, unlike capital controls, the presence of foreign exchange controls does not constitute a sufficient condition for a devaluation to have real effects. Finally, it has been shown that foreign exchange controls are not the appropriate tool for obtaining a trade balance objective. This is because the trade balance primarily reflects agents' intertemporal decision-

ditions obtained from maximizing (1) subject to (13) and the import constraint $\bar{Z}^1 - Z^1 \geq 0$ are $V_1(Z^1 + \bar{Z}^1) = [1 + (\lambda/\alpha p^*)]p^*U_1(X^1)$, $V_1(Z^2 + \bar{Z}^2) = p^*U_1(X^2)$, and (7), where α is the marginal utility of wealth and λ is the marginal welfare gain from relaxing the import constraint.

making about how much to consume and save, while foreign exchange controls impinge mainly on agents' intratemporal decision-making about how to allocate their within-period consumption spending between importables and exportables.

APPENDIX

From the representative agent's optimization problem it follows that for the case of temporary first-period exchange controls $p^{*1}(1 + \eta^1)$, X^1 , X^2 and Z^2 are determined by the system of equations (6), (7), and (13) (note that $Z^1 = \bar{m}^{*1}/p^{*1}$ and $\eta^2 = 0$). By performing the specified comparative static exercise it is easy to see that

$$\frac{dX^2}{d\bar{m}^{*1}} = -\frac{U_1(X^1)U_{11}(X^1)V_{11}(Z^2 + \bar{Z}^2)p^{*1}}{\Pi} < 0$$

and

$$\frac{dZ^2}{d\bar{m}^{*1}} = -\frac{U_1(X^1)p^{*2}U_{11}(X^2)U_{11}(X^1)p^{*1}}{\Pi} < 0,$$

so that

$$\frac{dtb^1}{d\bar{m}^{*1}} = \frac{1}{1 + r^*} \left[\frac{dX^2}{d\bar{m}^{*1}} + p^{*2} \frac{dZ^2}{d\bar{m}^{*1}} \right] < 0$$

with

$$\begin{aligned} \Pi \equiv U_1(X^1)p^{*1} \{ & V_{11}(Z^2 + \bar{Z}^2)[U_{11}(X^1)/(1 + r^*) + \rho(1 + r^*)U_{11}(X^2)] \\ & + U_{11}(X^2)U_{11}(X^1)(p^{*2})^2/(1 + r^*) \} > 0. \end{aligned}$$

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