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Unification of Dual Exchange Markets

Prepared by José Saúl Lizondo

Approved by Donald J. Mathieson

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Summary

This paper examines some of the effects of unifying dual exchange markets. To this end, the paper develops the model of an economy under a dual exchange system, comprising of an official market in which the exchange rate is crawling at a constant rate and a free market in which the exchange rate is determined by market forces. The official market handles selected imports and exports, while the free market handles the remaining imports and exports, and capital flows. After analyzing the behavior of the economy under the dual system, it is assumed that the exchange markets are unified by the adoption of, alternatively, a floating exchange rate system and a crawling peg system. The paper examines the consequences that the unification of the markets has on the nominal exchange rate, the real exchange rate, and the overall balance of payments and its composition, between the moment of unification and the time the economy reaches the steady state under the new system.

I. Introduction

During the last decade, several countries have adopted dual exchange market systems comprising an official market in which the exchange rate is determined by central bank intervention, and a free market in which the exchange rate is determined by market forces. In the majority of cases, these countries were confronted with low levels of international reserves and balance of payments problems, and adopted dual exchange market systems as an alternative to uniform exchange rate adjustments that could be brought about by either devaluations of the official exchange rate or the adoption of a floating exchange rate system. Under the dual system, official reserves were used to provide foreign exchange at a relatively low price through the official market for certain priority imports, while other imports and private sector capital flows were usually settled at a more depreciated exchange rate in the free market. Foreign exchange proceeds from traditional exports were generally required to be surrendered at the official market, while proceeds from non-traditional exports were allowed to be sold in the free market.

The balance of payments relief obtained by the adoption of dual systems, however, has frequently been only transitory. Countries that failed to curb excessively expansionary policies were again confronted with foreign exchange demand pressures, which were reflected in balance of payments deficits in the official market and in large depreciations of the domestic currency in the free market. As a result, large differentials often arose between the free and the official exchange rates, with some undesirable consequences. First, they contributed to the pressure on international reserves by providing incentives for overinvoicing imports and underinvoicing exports in the official market, and, to the extent that large differentials raised doubts about the viability of the official exchange rate, they encouraged exporters in the official market to withhold shipments and importers in the official market to stockpile imported goods. In addition, efficiency and welfare losses were incurred since relative prices of traded goods faced by producers and consumers were different from international relative prices.

Since the use of dual exchange markets constitutes a multiple currency practice, the Fund often encourages these countries to adopt a unified exchange rate system. In considering this possibility, the authorities are often concerned about the consequences that the adoption of alternatives unified systems will have on some important macroeconomic variables. For example, although the adoption of a floating exchange rate system will eliminate immediately the differential between the exchange rates and the balance of payments deficit, the nominal exchange rate will be beyond the control of the authorities and it could depreciate sharply. On the other hand, the adoption of a unified system with central bank intervention in the exchange market will eliminate immediately the differential between the exchange rates and will keep the nominal exchange rate under the control of the authorities; but the effect on the balance of payments is uncertain, and large deficits could deplete the available international reserves. Furthermore, the adoption of any new system will also have consequences for the real exchange rate and the composition of the overall balance of payments. 1/ These issues have been virtually ignored in the literature on dual exchange markets. 2/

1/ We define the real exchange rate as the relative price between traded and non-traded goods.

2/ The exceptions are a brief mention in Macedo (1982) and in Dornbusch (1984) and some discussion in Nowak (1984).

This paper examines some of the consequences of unifying the exchange markets by adopting either a floating exchange rate system or a crawling peg system. To this end, the paper develops the model of an economy that uses dual exchange markets, comprising an official market in which the exchange rate is crawling at a constant rate and a free market in which the exchange rate is determined by market forces. The official market handles selected imports and exports, while the free market handles the remaining imports and exports, and capital flows. The private sector is assumed to allocate its wealth between two non-interest bearing assets, domestic money and foreign money, depending on the expected rate of depreciation of the free exchange rate. After analyzing the behavior of the economy under the dual system, it is assumed that the exchange markets are unified by the adoption of, alternatively, a floating exchange rate system and a crawling peg system. When analyzing the crawling peg system, we assume that the country chooses a rate of crawl that produces balance of payments equilibrium in the long run. The paper examines the consequences that the unification of the markets has on the nominal exchange rate, the real exchange rate, and the overall balance of payments and its composition, between the moment of unification and the time the economy reaches the steady state under the new system. Although other situations could be analyzed, we restrict our attention to the case in which, under the dual system, the economy is running a balance of payments deficit and the free exchange rate is above the official exchange rate.

The paper shows that the steady-state solution under both unified systems are the same, since for the crawling system to produce balance of payments equilibrium in the long run the rate of crawl must be equal to the steady-state rate of depreciation that would arise if a floating system were adopted. Under this condition, the model has the following implications regarding steady-state comparisions. First, the rate of depreciation of the exchange rate under the unified systems will be higher than the rate of depreciation of the exchange rates of the dual system, and as a result, the rate of inflation will also be higher under the unified systems. Second, the relative price of traded goods channeled through the official market with respect to nontraded goods will increase as a result of the unification of the markets. The relative price of traded goods channeled through the free market with respect to non-traded goods, however, may increase or decrease, depending on the share of imports and exports channeled through each of the markets. Finally, while the current account is in deficit and the capital account is in equilibrium under the dual system, both accounts will be in equilibrium under the unified systems.

The paper also shows that, under each of the unified systems, the economy can follow alternative paths from its initial position at the time of unification to its steady state equilibrium. Some of the immediate effects of unifying the markets, however, are unambiguous. If a floating exchange rate system is adopted, the floating exchange rate will depreciate immediately with respect to the official exchange rate of the dual system, and the current account of the balance of payments will improve. If a crawling peg system is adopted without a maxi-devaluation of the official exchange rate, there will be an immediate capital outflow. 1/ The magnitude of this capital outflow can be reduced by a maxi-devaluation of the official exchange rate. For the capital outflow to be completely eliminated, the maxi-devaluation must be higher than the differential between the free and the official exchange rates of the dual system.

The rest of the paper is organized as follows. Section II develops a model of an economy using dual exchange markets, discusses its dynamics, and derives the solution for the endogenous variables of interest. Section III examines the effects of adopting a floating exchange rate system, and Section IV examines the effects of adopting a crawling peg system. Section V summarizes the main results and presents some concluding remarks.

II. A Model of the Dual Exchange Market System

Consider a small economy with a dual exchange market system. Let some commercial transactions be settled in the official market at the official exchange rate e, which is depreciated at a rate π by central bank intervention. 2/ The rest of the commercial transactions and all the capital transactions are settled in the non-official market at the free exchange rate s, which is determined by market forces. Both exchange rates are defined in units of domestic currency per unit of foreign currency.

The economy is assumed to produce and consume traded and non-traded goods. Output of traded goods and non-traded goods in physical terms, y_T and y_N, respectively, are fixed. 3/ Total nominal expenditure is assumed to be a fixed proportion, a, of nominal financial wealth of the private sector, W. A fraction $(1-\alpha)$ of total expenditure is allocated to traded goods, and a fraction α is allocated to non-traded goods. 4/ In

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1/ A maxi-devaluation refers to a once-and-for-all large increase in the official exchange rate, as opposed to the continuous small increases, or mini-devaluations, that characterize a crawling peg system. Hence, the absence of a maxi-devaluation means that the exchange rate under the crawling peg system starts to crawl from the level at which the official exchange rate of the dual system is at the time of unification.

2/ The model allows for the case of a fixed official exchange rate by setting $\pi = 0$.

3/ Relative price effects on the supplies of traded and non-traded goods are ignored in order to simplify the analysis.

4/ This implies that the elasticity of substitution in consumption between traded and non-traded goods is equal to one.

order to simplify the model, it is assumed that there is no domestic expenditure on domestically produced traded goods; thus, total output of traded goods is exported and total consumption of traded goods is imported. The central bank decides which goods must be exported or imported through each of the markets. It is assumed that total production of traded goods, y_T, is evenly distributed across a continuum of goods indexed between zero and one. The central bank determines z, $0 \leq z \leq 1$, which is the boundary between goods that must be exported through the free market (those with index lower than or equal to z) and the goods that must be exported through the official market (those with index higher than z). Thus, out of the total exports of y_T, zy_T is exported through the free market and $(1-z)y_T$ is exported through the official market. Regarding imports, it is assumed that total expenditure on traded goods is evenly distributed across a continuum of goods indexed between zero and one. The central bank determines v, $0 \leq v \leq 1$, which is the boundary between goods that must be imported through the free market (those with index lower than or equal to v) and the goods that must be imported through the official market (those with index higher than v). Thus, out of a total expenditure in traded goods of $(1-\alpha)aW$, $v(1-\alpha)aW$ is spent on goods imported through the free market, and $(1-v)(1-\alpha)aW$ is spent on goods imported through the official market.

Foreign currency prices of traded goods are assumed to be fixed and are normalized at unity; thus, the domestic currency price of traded goods is equal to the official exchange rate e for goods imported or exported through the official market, and to the free exchange rate s for goods imported or exported through the free market. The domestic currency price of non-traded goods, p_N, adjusts instantaneously to clear the non-traded goods market.

Nominal financial wealth of the private sector, W, is comprised of holdings of two non-interest bearing assets, domestic money, M, and foreign money, F. Since capital transactions are settled in the free market, domestic money is exchanged for foreign money at the free exchange rate. Thus, nominal financial wealth is equal to holdings of domestic money plus the domestic currency value of holdings of foreign money, valued at the free exchange rate.

$$(1) \quad W = M + sF$$

The private sector allocates its wealth between the two available assets. Since those assets are exchanged at the free exchange rate, it is assumed that the fraction of wealth that the private sector wants to hold in domestic money, denoted by λ, is a decreasing function of the expected rate of depreciation of the free exchange rate. It is also assumed that the private sector possesses perfect foresight, thus λ is a decreasing function of the actual rate of depreciation of the free exchange rate. Assuming that the private sector can achieve its desired portfolio composition instantaneously, desired holdings of domestic money $\lambda(\dot{s}/s)W$ are equal to the actual stock of domestic money M. Using this condition to replace W in (1), we obtain

$$(2) \quad M = \frac{\lambda(\dot{s}/s)}{1 - \lambda(\dot{s}/s)} sF \qquad 0 < \lambda < 1 \qquad \lambda' < 0$$

Equation (2) is a portfolio relationship that links the rate of depreciation of the free exchange rate, $\dot{s}/s$, to the holdings of domestic money, M, and the domestic currency value of the holdings of foreign money, sF. The higher the rate of depreciation of the free exchange rate, the lower is the ratio of domestic money to the domestic currency value of foreign money.

Changes in private sector holdings of foreign money and domestic money depend on the transactions carried out in both exchange markets and on the public sector budget. Since capital transactions are not allowed in the official market, changes in private sector holdings of foreign money, $\dot{F}$, are equal to the current account balance in the free market. Exports in the free market are equal to a fraction z of total output of traded goods y_T. Since foreign currency prices of traded goods are normalized at unity, the foreign currency value of exports in the free market is zy_T. Imports in the free market are equivalent to a fraction v of private sector expenditure in traded goods $(1-\alpha)aW$. Since the domestic currency price of goods imported through the free market is s, the foreign currency value of imports in the free market is $v(1-\alpha)aW/s$. Therefore,

$$(3) \quad \dot{F} = zy_T - \frac{v(1-\alpha)a(M+sF)}{s}$$

Abstracting from the banking system, the change in the stock of domestic money, $\dot{M}$, is equal to the change in central bank domestic credit, $\dot{D}$, plus the change in the domestic currency value of international reserves resulting from central bank intervention in the official foreign exchange market, $\dot{R}$. 1/

1/ It is assumed that the central bank does not monetize changes in the domestic currency value of international reserves arising from changes in the official exchange rate.

$$(4) \quad \dot{M} = \dot{D} + \dot{R}$$

It is assumed that changes in domestic credit reflect public sector deficits arising from transfer payments to the private sector, which are equal to a constant fraction, μ, of the stock of domestic money. 1/

$$(5) \quad \dot{D} = \mu M$$

Since capital transactions are not allowed in the official market, changes in international reserves are equal to the current account balance in the official market. Exports in the official market are equal to a fraction (1-z) of total output of traded goods y_T, and imports in the official market are equivalent to a fraction (1-v) of the private sector expenditure in traded goods $(1-\alpha)aW$. Since the domestic currency price of goods imported or exported through the official market is e, the current account balance in the official market in terms of domestic currency is equal to

$$(6) \quad \dot{R} = e(1-z)y_T - (1-v)(1-\alpha)a(M + sF)$$

Using equations (4), (5), and (6), we obtain equation (7), which describes the evolution of the nominal stock of domestic money.

1/ An alternative to equation (5) is to assume some fixed levels of real public sector expenditures and real taxes that result in a fixed real public sector deficit financed by domestic credit creation. However, this alternative may require fiscal policy to be explicitly modified after the exchange markets are unified, because the original real public sector deficit may be inconsistent with a steady state solution under the unified systems. In the model of this paper, a steady state solution under the unified systems requires the public sector deficit to be financed entirely with the inflation tax. The problem with postulating exogenously a given real public sector deficit is that there may be no rate of inflation that generates an inflation tax equal to the exogenous real public sector deficit. Thus, we chose to model domestic credit creation as a constant fraction of the stock of domestic money. Since the steady state real stock of domestic money under the unified systems will in general be different from the real stock of domestic money under the dual system, there is an implicit change in fiscal policy when the markets are unified and domestic credit creation is determined by equation (5). The advantage of this formulation is that the change in fiscal policy does not have to be modeled explicitly.

$$(7) \quad \dot{M} = e(1-z)y_T - (1-v)(1-\alpha)a(M + sF) + \mu M$$

Equations (2), (3), and (7) determine the evolution of the free exchange rate, the stock of foreign money, and the nominal stock of domestic money. Since the official exchange rate changes continuously for $\pi \neq 0$, it is useful to rewrite equations (2), (3), and (7) in terms of $m = (M/e)$ and $d = (s/e)$, to obtain

$$(8) \quad m = \frac{\lambda(\frac{\dot{d}}{d} + \pi)}{1 - \lambda(\frac{\dot{d}}{d} + \pi)} dF$$

$$(9) \quad \dot{F} = zy_T - v(1-\alpha)a(\frac{m}{d} + F)$$

$$(10) \quad \dot{m} = (1-z)y_T - (1-v)(1-\alpha)a(m + dF) + \mu m - \pi m$$

where m is the real stock of domestic money in terms of traded goods channeled through the official market and d measures the differential between the free and the official exchange rates. 1/ Equations (8), (9), and (10) describe the dynamics of d, F, and m. 2/

As is usual in models that assume perfect foresight, the system exhibits saddle point stability. 3/ Thus, the economy adjusts along a saddle path, and converges to a stationary equilibrium where the values of the real stock of domestic money, the stock of foreign money, and the differential between the exchange rates remain constant at the following levels. 4/

1/ For simplicity, $m = M/e$ will henceforth be referred to as the "real stock of domestic money".

2/ The dynamics of d, F, and m are independent of the price of non-traded goods, p_N. The determination of p_N is analyzed later.

3/ This is shown in the appendix.

4/ The stationary-equilibrium values of the variables under the dual system are denoted by an upper bar. We require that $(1-v)(1-\alpha)a + (\pi-\mu)\lambda(\pi)$ be positive, since otherwise there would not be a solution with a positive real stock of domestic money; see equation (11).

$$(11) \quad \bar{m} = \frac{(1-z)y_T\lambda(\pi)}{(1-v)(1-\alpha)a + (\pi-\mu)\lambda(\pi)}$$

$$(12) \quad \bar{F} = \frac{zy_T[1 - \lambda(\pi)]}{v(1-\alpha)a}$$

$$(13) \quad \bar{d} = \frac{(1-z)v(1-\alpha)a}{z[(1-v)(1-\alpha)a + (\pi-\mu)\lambda(\pi)]}$$

Since in stationary equilibrium the differential between the exchange rates is constant, the free exchange rate depreciates at the same rate π as the official exchange rate. In addition, since the stationary-equilibrium stock of foreign money is constant, the capital account is in equilibrium. This, together with the fact that all capital transactions take place in the free market, imply that the current transactions in the free market are also in equilibrium. Therefore, the overall current account is equal to the balance of current transactions in the official market, which is equal to the overall balance of payments.

The stationary-equilibrium balance of payments in terms of foreign currency can be obtained by replacing (11), (12), and (13) into (6), to obtain

$$(14) \quad \overline{(\dot{R}/e)} = \frac{(\pi-\mu)(1-z)y_T\lambda(\pi)}{(1-v)(1-\alpha)a + (\pi-\mu)\lambda(\pi)} = (\pi-\mu)\bar{m}$$

In stationary equilibrium, the balance of payments is equal to the difference between the inflation tax, $\pi\bar{m}$, and the public sector deficit in real terms, $\mu\bar{m}$. Thus, the balance of payments is in surplus or is in deficit depending on whether the rate of domestic credit creation μ is lower or higher than the rate of depreciation of the official exchange rate π. Clearly, a situation with $\mu > \pi$ is unsustainable in the long run since it implies a persistent loss of international reserves.

There are two relative prices between traded and non-traded goods under dual exchange markets, (e/p_N) and (s/p_N), for traded goods channeled through the official market and the free market, respectively. The "real official exchange rate" (e/p_N), and the "real free exchange rate" (s/p_N), are determined at each point in time by the condition of equilibrium in the non-traded goods market. Since nominal expenditure in non-traded goods is a fraction α of total nominal expenditure, aW, and the production of non-traded goods is equal to y_N, equilibrium requires

$$(15) \qquad p_N y_N = \alpha a(M + sF)$$

which is equivalent to

$$(16) \qquad y_N = \alpha a(m + dF)(e/p_N)$$

and

$$(17) \qquad y_N = \alpha a(\frac{m}{d} + F)(s/p_N)$$

Replacing (11), (12), and (13) into equations (16) and (17), we obtain the stationary-equilibrium real exchange rates

$$(18) \qquad \overline{(e/p_N)} = \frac{y_N[(1-v)(1-\alpha)a + (\pi-\mu)\lambda(\pi)]}{\alpha a(1-z)y_T}$$

$$(19) \qquad \overline{(s/p_N)} = \frac{y_N v(1-\alpha)}{\alpha z y_T}$$

Since in stationary equilibrium these relative prices are constant, the price of non-traded goods increases at the same rate π as the official and the free exchange rates; thus, the rate of inflation is π.

In summary, in stationary equilibrium the rate of depreciation of the free exchange rate and the rate of inflation are both equal to the rate of depreciation of the official exchange rate. The real exchange rates and the differential between the free and the official exchange rates are constant, and they are determined by the various policies followed by the authorities. The current account in the free market and the capital account are both in equilibrium. The current account in the official market (which is equal to the overall balance of payments), however, is in surplus or deficit depending on whether the rate of domestic credit creation is lower or higher than the rate of devaluation of the official exchange rate.

Therefore, countries with dual exchange markets that follow excessively expansionary policies will be faced with persistent balance of payments deficits, and most likely a large differential between the free and the official exchange rates. Both problems could be solved within the dual system by setting the rate of devaluation of the official exchange rate equal to the rate of domestic credit creation, in order to eliminate the balance of payments deficit, and by modifying the coverage of the exchange markets so as to eliminate any remaining differential between the free and the official exchange rates. 1/ These results would be obtained in the long run, after an adjustment period in which the balance of payments may be in disequilibrium and the free exchange rate may be different from the official exchange rate. Alternatively, these countries may decide to abandon the dual system and adopt a unified exchange rate system, in this way eliminating the differential between the exchange rates immediately. The effect on the balance of payments, however, depends on the exchange rate system that is adopted. While a floating exchange rate system guarantees immediate balance of payments equilibrium, the effect of any other system depends on the rules of intervention in the foreign exchange market. In addition, the behavior of the exchange rate will also depend on the exchange rate system that is adopted.

In the next sections, we consider the consequences of unifying the exchange markets by adopting either a floating exchange rate system or a crawling peg system. In each case we first examine the workings of the economy under the unified system, we then examine the steady-state solution under the unified system, and we finally discuss the path that the economy will follow as it moves from a stationary equilibrium under the dual system to its steady state equilibrium under the unified system.

III. Unification Under a Floating Exchange Rate System

1. The economy under a floating exchange rate system

The adoption of a floating exchange rate system introduces several changes into the workings of the economy. First, the same exchange rate, which will be denoted by x, applies to all current transactions and capital transactions. 2/ Second, since the central bank no longer intervenes in the foreign exchange market, the change in the stock of foreign money held by the private sector will be equal to the difference between total exports and total imports. Since nominal wealth is now equal to M + xF, and the price of all traded goods is equal to x, the evolution of the private sector holdings of foreign money is described by

$$(20) \quad \dot{F} = y_T - (1-\alpha)a(m+F)$$

1/ Lizondo (1984) discusses the effects of a variety of policies on the balance of payments and on the differential between the free and the official exchange rate for an economy under dual exchange markets.

2/ The exchange rate x will be referred to as "the floating exchange rate" to distinguish it from the "free exchange rate", s, of the dual system.

where $m = M/x$ is the real stock of domestic money in terms of traded goods. 1/ Third, since the central bank no longer intervenes in the foreign exchange market, the stock of international reserves is constant. Thus, the change in the nominal stock of domestic money is equal to the change in domestic credit.

$$(21) \quad \dot{M} = \dot{D} = \mu M$$

The rate of growth of the real stock of domestic money, $m = M/x$, is equal to the rate of growth of the nominal stock, μ, minus the rate of depreciation of the exchange rate, $\dot{x}/x$. Thus,

$$(22) \quad \dot{m} = [\mu - (\dot{x}/x)]m$$

Finally, since there is only one exchange rate, x, that applies to both current and capital transactions, the condition for portfolio equilibrium is now

$$(23) \quad m = \frac{\lambda(\dot{x}/x)}{1 - \lambda(\dot{x}/x)} F$$

The system of three differential equations formed by (20), (22) and (23), which describe the evolution of the stock of foreign money, the real stock of domestic money and the exchange rate, can be reduced to a system of two equations by eliminating $(\dot{x}/x)$. Using equation (23), $(\dot{x}/x)$ can be expressed as a decreasing function of (m/F).

$$(24) \quad (\dot{x}/x) = h(m/F) \qquad h' < 0$$

Using (24) to replace $(\dot{x}/x)$ in (22), we obtain

$$(25) \quad \dot{m} = [\mu - h(m/F)]m$$

1/ For simplicity, $m = M/x$ will henceforth be referred to as the "real stock of domestic money".

Equations (20) and (25) describe the dynamics of F and m, which can be analyzed in terms of Figure 1. The $\dot{F} = 0$ curve indicates the combinations of m and F that are consistent with equilibrium in the current account. To the left of this curve $\dot{F}$ is positive, because a lower real stock of domestic money implies lower financial wealth, and therefore lower expenditure and a current account surplus. To the right of this curve $\dot{F}$ is negative. The $\dot{m} = 0$ curve indicates the combinations of m and F that, being consistent with portfolio equilibrium, imply a rate of depreciation of the exchange rate equal to the rate of growth of the nominal stock of domestic money. To the left of this curve $\dot{m}$ is negative, because a lower real stock of domestic money requires a higher rate of depreciation of the exchange rate in order to be consistent with portfolio equilibrium. To the right of this curve $\dot{m}$ is positive. Since the system exhibits saddle-point stability, it is assumed that in the absence of anticipated disturbances the variables adjust along the convergent path TT. 1/

2. Steady-state solution under the floating exchange rate system

The steady state values of the rate of depreciation of the exchange rate, $(\dot{x}/x)^*$, the real stock of domestic money, m^*, and the stock of foreign money, F^*, are the following.

$$(26) \qquad (\dot{x}/x)^* = \mu$$

$$(27) \qquad m^* = \frac{y_T \lambda(\mu)}{(1-\alpha)a}$$

1/ Linearizing the system around the steady state, $m = m^*$ and $F = F^*$, we obtain

$$\begin{vmatrix} \dot{m} \\ \dot{F} \end{vmatrix} = \begin{vmatrix} -(m^*/F^*)h' & (m^*/F^*)^2 h' \\ -(1-\alpha)a & -(1-\alpha)a \end{vmatrix} \begin{vmatrix} m-m^* \\ F-F^* \end{vmatrix}$$

where the argument of the function $h'(m^*/F^*)$ is omitted to simplify the notation. Since $h'(m^*/F^*)$ is equal to $[1 - \lambda(\mu)]^2/\lambda'(\mu)$, the determinant of the system is equal to $(1-\alpha)a\lambda(\mu)/\lambda'(\mu)$, and it is negative. This implies that the system exhibits saddle-point stability.

$$(28) \quad F^* = \frac{y_T[1 - \lambda(\mu)]}{(1-\alpha)a}$$

In steady state, the rate of depreciation of the exchange rate $\dot{x}/x$, and hence the rate of growth of traded goods prices, is equal to the rate of growth of the nominal stock of money, μ. Since in steady state the stock of foreign money is constant, the current account as well as the capital account are in equilibrium.

The real exchange rate, x/p_N, is determined at each point in time by the condition of equilibrium in the non-traded goods market.

$$(29) \quad y_N = \alpha a(m + F)(x/p_N)$$

Replacing (27) and (28) into (29), we obtain the steady state real exchange rate

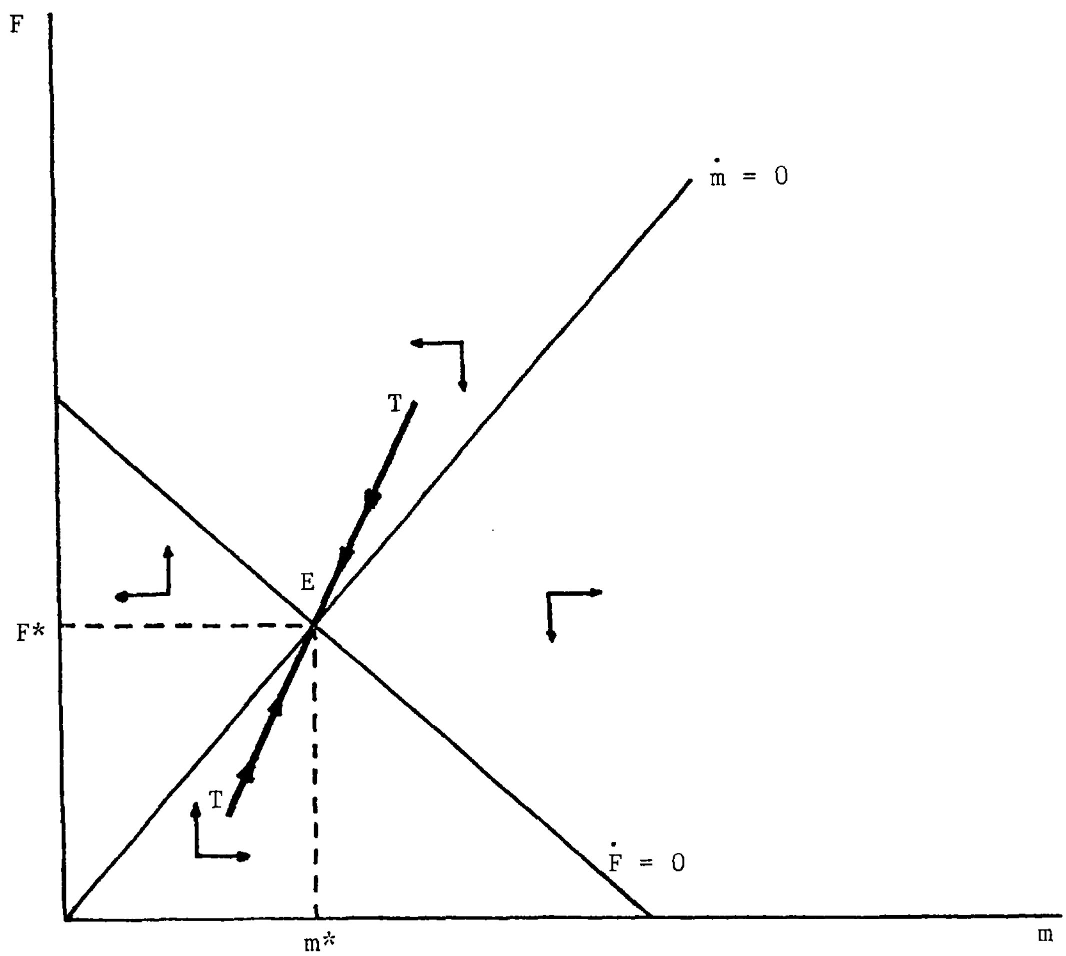
$$(30) \quad (x/p_N)^* = \frac{y_N(1-\alpha)}{y_T\alpha}$$

Since the real exchange rate in steady state is constant, the price of non-traded goods increases at the same rate, μ, as the exchange rate; hence, the rate of inflation if also μ.

The comparison of the steady state equilibrium under the floating system with the stationary equilibrium under the dual system depends on the various policies followed by the country, which include the rate of devaluation of the official exchange rate, π, the rate of domestic credit creation, μ, and the proportion of exports, z, and imports, v, channeled through the free market under the dual system. To focus our analysis, we consider the case of a country under the dual system which has a balance of payments deficit (implying $\mu > \pi$) and a free exchange rate which is above the official exchange rate ($\bar{d} > 1$). Under these conditions, we have the following implications. First, the rate of inflation under the floating system, μ, will be higher than the rate of inflation under the dual system, π. Under the dual system the rate of inflation is determined by the rate of depreciation of the official exchange rate, with any excess in domestic credit creation being reflected in a balance of payments deficit rather than in additional inflation. Under the floating system, however, the full amount of domestic credit creation will be reflected in the rate of inflation because the central

Figure 1

Dynamics Under the Floating Exchange Rate System



bank will no longer offset part of the additional domestic credit through the sale of foreign exchange. Second, while the current account is in deficit under the dual system, it will be in equilibrium under the floating system. Since total exports are equal to y_T under both systems, the difference is associated with lower imports under the floating system, which in turn reflect a lower level of real wealth. 1/ Third, the real exchange rate under the floating system will be depreciated (appreciated) with respect to the real free exchange rate of the dual system if the share of imports in the free market, v, is lower (higher) than the share of exports in the free market, z. 2/ Finally, the real exchange rate under the floating system will be depreciated with respect to the real official exchange rate of the dual system. 3/

3. Dynamics upon unification under a floating exchange rate system

This section examines the behavior of the current account of the balance of payments, the nominal exchange rate, and the real exchange rate, as the economy moves from a stationary equilibrium under the dual system to its steady-state equilibrium under the floating system. The behavior of these variables depend on the stationary-equilibrium values of the real stock of domestic money, the stock of foreign money, and the differential between the free and the official exchange rates under the dual system, which in turn, depend on the various parameters of the model.

As noted earlier, our attention is focused on the case where, under the dual system, the country is running a balance of payments deficit ($\mu > \pi$) and the free exchange rate is above the official exchange rate

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1/ In this model, the relevant concept of "real wealth" for the determination of imports is real wealth in terms of traded goods. Under the dual system, this is equal to a weighted average of real wealth in terms of goods imported through the official market and real wealth in terms of goods imported through the free market, the weights being the share of imports in the respective markets, (1-v) and v, (see equations (3) and (6)). Using equations (11), (12), (13), (27) and (28), and the assumption that $\pi < \mu$, it can be shown that the steady state real wealth is lower under the floating system than under the dual system.

2/ This follows from (19) and (30).

3/ From (18) and $\pi < \mu$, it follows that $\overline{(e/p_N)} < y_N(1-v)(1-\alpha)/(1-z)\alpha y_T$. This, together with (30), implies that, if $v > z$, $\overline{(e/p_N)} < (x/p_N)^*$. If $v < z$, we know that $\overline{(s/p_N)} < (x/p_N)^*$, which, together with $\bar{d} > 1$, implies $\overline{(e/p_N)} < (x/p_N)^*$.

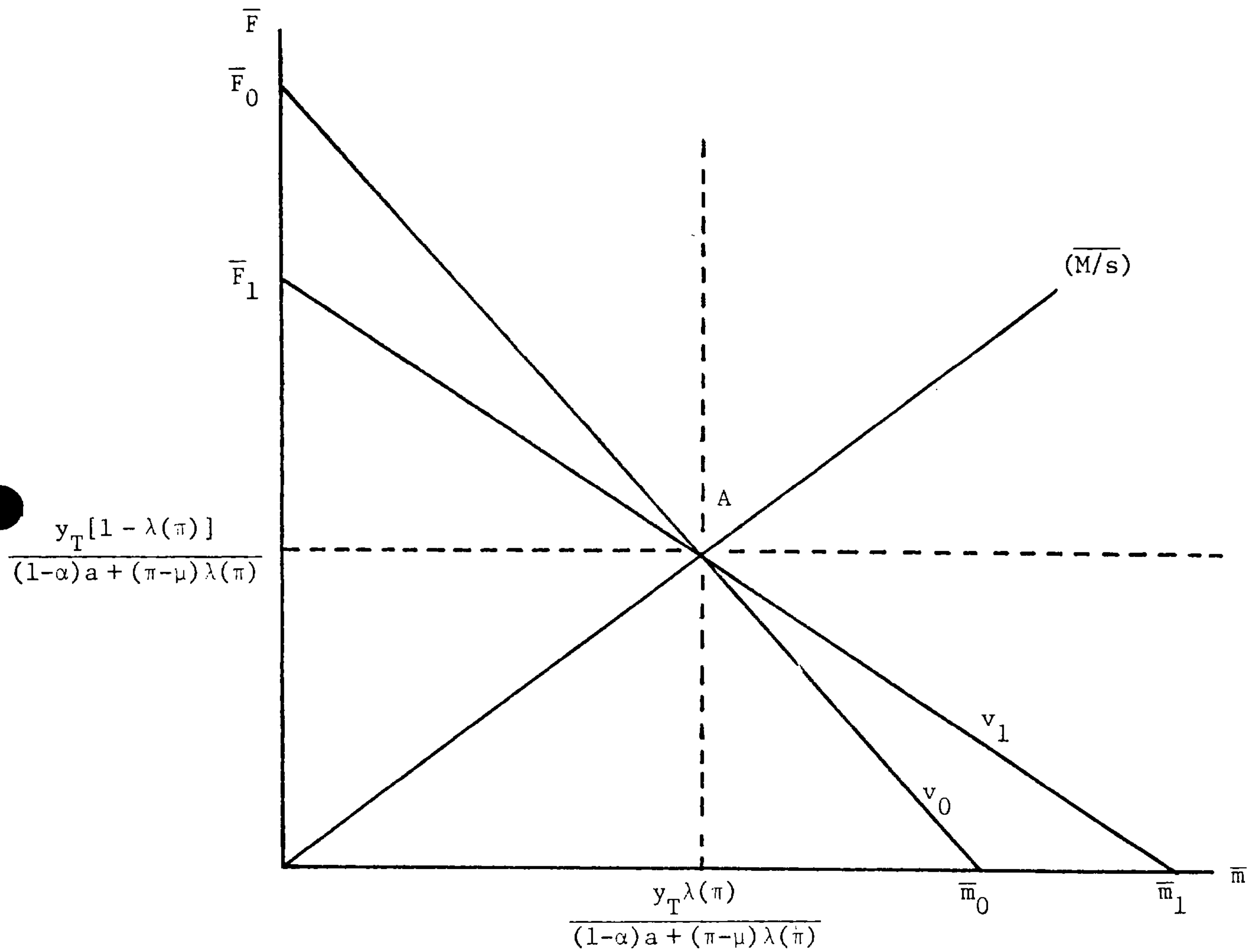
($\bar{d} > 1$). The assumptions that $\mu > \pi$ and $\bar{d} > 1$, together with equations (11), (12), and (13), can be used to define the range of possible stationary-equilibrium values of the real stock of domestic money and the stock of foreign money under the dual system in Figure 2, which shows $\bar{m}$ on the horizontal axis and $\bar{F}$ on the vertical axis. Given the rate of devaluation, π, and the rate of domestic credit creation, μ, equations (11) and (12) indicate that $\bar{m}$ and $\bar{F}$ are functions of the share of goods exported through the free market, z, and the share of goods imported through the free market v. For a given $v = v_0$ and z varying between zero and one, equations (11) and (12) define a linear relationship between $\bar{m}$ and $\bar{F}$, which is represented by the curve v_0 in Figure 2. If $z = 0$, $\bar{F} = 0$ and $m = \bar{m}_0$, and if $z = 1$, $\bar{m} = 0$ and $\bar{F} = \bar{F}_0$. Thus, the curve v_0 depicts all the possible combinations of $\bar{F}$ and $\bar{m}$ for $v = v_0$ and z varying from zero to one; the higher the proportion of goods exported through the free market, z, the higher is $\bar{F}$ and the lower is $\bar{m}$. The same procedure can be followed for each admissible value of v. 1/ For example, the curve v_1 shows the possible combinations of $\bar{F}$ and $\bar{m}$ for $v = v_1$, with $v_1 > v_0$. From equations (11) and (12), for $v_1 > v_0$ the maximum possible value of the real stock of domestic money, $\bar{m}_1$, is higher than $\bar{m}_0$, and the maximum possible value of the stock of foreign money, $\bar{F}_1$, is lower than $\bar{F}_0$. Once again, as z varies from zero to one, the stationary equilibrium of the economy under the dual system moves upward and to the left along the v_1 curve. As can easily be shown, the curve v_1 intersects the curve v_0 at point A, which is defined by $\bar{m} = y_T\lambda(\pi)/[(1-\alpha)a + (\pi-\mu)\lambda(\pi)]$ and $\bar{F} = y_T[1 - \lambda(\pi)]/[(1-\alpha)a + (\pi-\mu)\lambda(\pi)]$. Repeating the same procedure for every admissible value of v, we define two areas where the stationary equilibrium of the economy under the dual system could in principle be located. These two areas comprise all the points to the south-east and to the north-west of point A. However, if the differential between the free and the official exchange rate is to be higher than one, the economy can only be located to the south-east of point A. The proof is the following. From equation (8),

$$(31) \quad \overline{m/d} = \frac{\lambda(\pi)}{1 - \lambda(\pi)} \bar{F}$$

1/ The maximum admissible value for v is $[(1-\alpha)a + (\pi-\mu)\lambda(\pi)]/(1-\alpha)a$, since otherwise $\bar{m}$ and $\bar{d}$ would become negative; see equations (11) and (13).

Figure 2

Stock of Foreign Money and Real Stock of Domestic Money in Stationary Equilibrium Under Dual Exchange Markets



Equation (31) defines the $(\overline{M/s})$ curve in Figure 2, which starts in the origin and passes through point A. 1/ If $\bar{d} > 1$, $(\bar{m}/\bar{d}) < \bar{m}$ and thus the real stock of domestic money must be located to the right of the $(\overline{M/s})$ curve. Therefore, under the assumption that $\bar{d} > 1$, the position of the economy under the dual system can only be located to the south-east of point A.

We have defined an area that shows the range of possible stationary equilibrium values of the real stock of domestic money and the stock of foreign money under the dual system. This area depends on the rate of devaluation of the official exchange rate, π, and the rate of domestic credit creation, μ. 2/ The particular position of the economy within this area depends on the share of exports channeled through the free market, z, and on the share of imports channeled through the free market, v. The higher the share of exports, z, and the lower the share of imports, v, in the free market, the higher is the stock of foreign money, $\bar{F}$, and the lower is the real stock of domestic money, $\bar{m}$.

In order to discuss the short-term effects of unifying the markets, we can combine the possible stationary equilibriums of the economy under the dual system, illustrated in Figure 2, with the dynamics of the economy under the floating system, described in Figure 1. This combination is represented in Figure 3. The curve $(\overline{M/s})$, defined by equation (31), is to the right of the curve $\dot{m} = 0$, defined by (32), since $\pi < \mu$ and $\lambda' < 0$. 3/

$$(32) \qquad m = \frac{\lambda(\mu)}{1 - \lambda(\mu)} F$$

Point A is located to the east of point E, which shows the steady state position under the floating system, since

$$(33) \qquad m^* = \frac{y_T \lambda(\mu)}{(1-\alpha)a} < \frac{y_T \lambda(\pi)}{(1-\alpha)a + (\pi - \mu)\lambda(\pi)} = \text{first coordinate of point A}$$

because $\pi < \mu$ and $\lambda' < 0$. Point A can be located either to the south or to the north of point E, depending on whether the lefthand side of (34) is higher or lower than the righthand side.

1/ Remember that $m = (M/e)$ and $d = (s/e)$, so $(m/d) = (M/s)$.
2/ Since both π and μ determine the coordinates of point A.
3/ Equation (32) follows from (23), (24), and (25).

$$(34) \quad F^* = \frac{y_T[1 - \lambda(\mu)]}{(1-\alpha)a} \gtrless \frac{y_T[1 - \lambda(\pi)]}{(1-\alpha)a + (\pi-\mu)\lambda(\pi)} = \text{second coordinate of point A}$$

In Figure 3 we assume that point A is located to the north of point E.

After defining the range of possible stationary-equilibrium values of m and F under the dual system (all the points to the south-east of A), and after locating this area with respect to the steady state equilibrium under the floating system (point E), we can examine the short-term effects of unifying the markets. Assume that the economy is in stationary equilibrium under the dual system in point B, with $\overline{F} = \overline{F}_0$, $m = (\overline{M/e})_0$, and $(\overline{M/s}) = (\overline{M/s})_0$, and the exchange market is unified by adopting a floating exchange rate system. Since the stock of foreign money is predetermined and the economy must be on the curve TT under the floating system, the point of equilibrium at the time of unification is C, with a real stock of domestic money equal to $(M/x)_0$. From point C, the economy adjusts along the TT curve toward the steady-state equilibrium, E.

Let us now examine the evolution of the various variables, starting with the nominal exchange rate. Since the nominal stock of domestic money is also predetermined at the time of unification, the variable that adjusts to make $(M/x) = (M/x)_0$ is the floating exchange rate, x. This floating exchange rate lies between the official exchange rate e, and the free exchange rate s, because $(M/s)_0 < (M/x)_0 < (M/e)_0$ implies $e < x < s$. During the process of adjustment to the steady state the real stock of domestic money increases, which implies that the rate of depreciation of the floating exchange rate $(\dot{x}/x)$ is lower than the rate of growth of the nominal stock of domestic money, μ. The evolution of the real exchange rate can be obtained from equations (16), (17), and (29). Since at the time of unification $e < x < s$, these equations imply that, at point C, $(e/p_N) < (x/p_N) < (s/p_N)$. 1/ Thus, the real exchange rate under the floating system at the time of unification lies between

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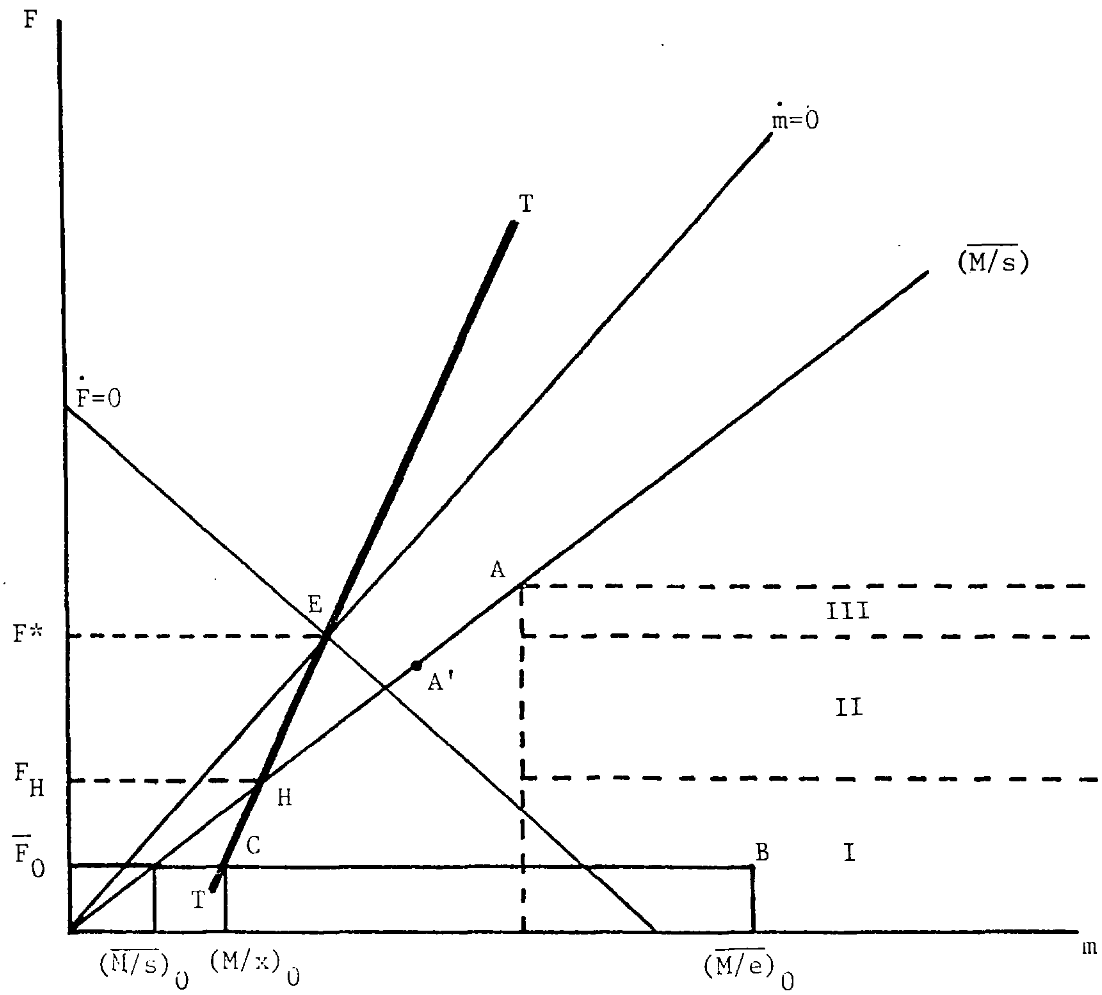
1/ It would be incorrect to go directly from $e < x < s$ to $(e/p_N) < (x/p_N) < (s/p_N)$, without using equations (16), (17), and (29), because the domestic currency price of non-traded goods, p_N, is not the same for the three ratios that are compared above. Since p_N is determined by nominal wealth (as described in equation (15)), and nominal wealth declines at the time of unification (because $x < s$), p_N declines at the time of unification. However, the decline in p_N is proportionally smaller than the difference between x and s, so that the inequality $(x/p_N) < (s/p_N)$ holds.

Figure 3

Unification of the Exchange Markets Under
A Floating Exchange Rate System



the real official exchange rate and the real free exchange rate of the dual system; the relative price of traded goods with respect to non-traded goods increases for the traded goods that were channeled through the official market and declines for the traded goods that were channeled through the free market. From point C, as the economy adjusts along the TT curve with m and F increasing, the demand for non-traded goods increases, causing the real exchange rate to appreciate gradually toward its steady state level, which is higher than the stationary equilibrium level of the real official exchange rate. 1/ During the process of adjustment, as the private sector accumulates foreign money, the capital account is in deficit and the current account is in surplus. The evolution of the nominal exchange rate, the real exchange rate, and the current account balance are shown on panels (a) in Figure 4.

The results described above regarding the evolution of the nominal exchange rate, the real exchange rate, and the current account balance hold for a country whose stationary equilibrium position under the dual system lies on region I of Figure 3, such as point B. If the stationary equilibrium position under the dual system lies in either region II or III, some of the results described above have to be modified. The various regions are defined according to the stationary equilibrium stock of foreign money under the dual system. Region I comprises the points for which $\bar{F}$ is lower than F_H, which corresponds to point H where the TT curve intersects the $\overline{(M/s)}$ curve. Region II comprises the points for which $\bar{F}$ is higher than F_H but lower than the stationary equilibrium level of foreign money under the floating system, F^*. Region III comprises the points for which $\bar{F}$ is higher than F^*.

If the economy adopts a floating exchange rate system starting from a stationary equilibrium position under the dual system that lies on region II, the qualitative effects on the current account are the same as the ones described for region I but some of the results regarding the exchange rates have to be modified. First, at the time of the adoption of the floating system the floating exchange rate will be above both the official and the free exchange rates of the dual system, $e < s < x$, since (M/x) would be lower than both $\overline{(M/e)}$ and $\overline{(M/s)}$. Second, at the time of the adoption of the floating system the real exchange rate under the floating system will be above both the real official exchange rate and the real free exchange rate. 2/ Finally, although the steady state

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1/ This was shown before when we compared the stationary equilibrium of the dual system with the steady-state equilibrium of the floating system.

2/ This follows from equations (16), (17), and (29).

real exchange rate under the floating system will certainly be higher than the real official exchange rate, it can be either higher or lower than the real free exchange rate. The evolution of the nominal exchange rate, the real exchange rate, and the current account balance when the floating system is adopted starting from region II are shown on panels (b) in Figure 4. 1/

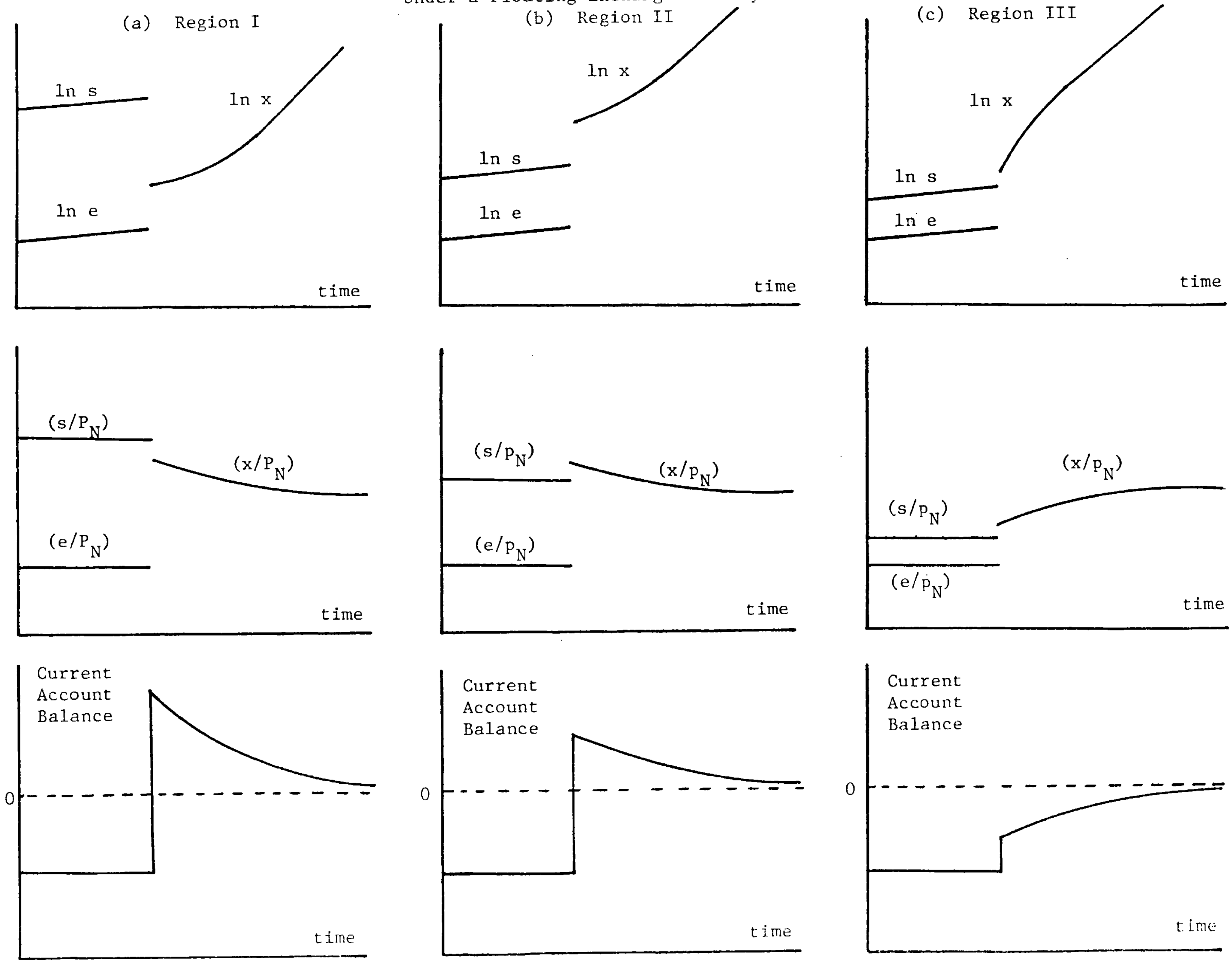
If the economy adopts a floating exchange rate system starting from a steady state position under the dual system that lies on region III, the main results regarding the exchange rates and the current account balance are the following. First, at the time of the adoption of the floating system the floating exchange rate will be above both the official and the free exchange rates of the dual system. Second, since in the process of adjustment toward the steady state the real stock of domestic money gradually declines, the rate of depreciation of the exchange rate, $(\dot{x}/x)$, will be higher than the rate of growth of the nominal stock of domestic money, μ. Third, at the time of adoption of the floating exchange rate system the real exchange rate under the floating system will be above both the real official exchange rate and the real free exchange rate. Fourth, since in the process of adjustment toward the steady state the real stock of domestic money and the stock of foreign money decline, the real exchange rate will depreciate due to the gradual reduction in real wealth. Finally, in the process of adjustment toward the steady state the capital account is in surplus, as the private sector reduces its stock of foreign money, and the current account is in deficit. Panels (c) in Figure 4 show the evolution of the exchange rates and the current account balance when the floating system is adopted starting from region III. 2/ It must be noticed, however, that it is possible that no region III exists. For certain values of the various parameters the maximum admissible value of $\bar{F}$ could be lower than F*, as indicated by one of the inequalities in (34). In such a case, the range of possible values of $\bar{m}$ and $\bar{F}$ would be determined by a point such as A' in Figure 3, and there would be no region III.

1/ This illustration assumes that the steady state real exchange rate under the floating system is lower than the real free exchange rate.

2/ The current account improves at the time of unification, although it still remains in deficit, as illustrated in Figure (4), panel (c). The improvement in the current account follows from a decline in real wealth; at the time of unification, (m+F) under the floating system is lower than $v\left(\frac{\bar{m}}{\bar{d}} + \bar{F}\right) + (1-v)(\overline{m+dF})$ under the dual system.

Figure 4

Nominal Exchange Rates, Real Exchange Rates and Current Account Balance
Under a Floating Exchange Rate System



The results of this section indicate that the economy can follow alternative paths from its initial position at the time of unification to its steady state equilibrium under the floating exchange rate system, depending on the policies followed with respect to the rate of depreciation of the official exchange rate, the rate of domestic credit creation, and the coverage of the exchange markets regarding imports and exports. These policies determine the initial position of the economy at the time of unification, and hence its dynamics during the process of adjustment toward the new steady state. Some of the immediate effects are unambiguous. At the time of unification the floating exchange rate will be above the official exchange rate, the real exchange rate will be above the real official exchange rate, and the current account of the balance of payments will improve. All the other results, however, cannot be generalized. Thus, at the time of unification the floating exchange rate could be below or above the free exchange rate, the real exchange rate could be below or above the real free exchange rate, and the current account of the balance of payments could be in surplus or in deficit. In addition, during the process of adjustment the rate of depreciation of the floating exchange rate could be lower or higher than the rate of domestic credit creation, the real exchange rate could be falling or rising, and the current account of the balance of payments could be in surplus or in deficit.

IV. Unification Under a Crawling Peg System

1. The economy under a crawling peg system

The workings of the economy under a crawling peg system will be characterized by the following conditions. First, the same exchange rate, which will be denoted by c, applies to all current transactions and capital transactions. The rate of crawl of the exchange rate will be denoted by ε. Second, since the rate of depreciation of the exchange rate is ε, the condition for portfolio equilibrium is now

$$(35) \qquad m = \frac{\lambda(\varepsilon)}{1-\lambda(\varepsilon)} F$$

where $m = M/c$ is the real stock of domestic money in terms of traded goods. 1/ Since this condition must hold at each point in time, the changes in the real stock of domestic money and in the stock of foreign money are related by

1/ For simplicity, $m = M/c$ will henceforth be referred to as the "real stock of domestic money."

$$(36) \qquad \dot{m} = \frac{\lambda(\varepsilon)}{1-\lambda(\varepsilon)} \dot{F}$$

Third, since nominal wealth is equal to M + cF and the price of all traded goods is equal to c, the current account of the balance of payments in terms of foreign currency is equal to $y_T - (1-\alpha)a(m+F)$. Fourth, since both current and capital transactions are carried out in the official market, the change in the nominal stock of domestic money is equal to

$$(37) \qquad \dot{M} = c[y_T - (1-\alpha)a(m+F)] - c\dot{F} + \mu M$$

where the first term is the current account, the second term is the capital account, and the third term represents domestic credit creation. Using (36) to replace $\dot{F}$ in (37) we obtain

$$(38) \qquad \dot{m} = \lambda(\varepsilon)\{[y_T - (1-\alpha)a(m+F)] + (\mu-\varepsilon)m\}$$

Equations (35) and (38) describe the dynamics of F and m, which can be analyzed in terms of Figure 5. Curve P represents equation (35), and thus indicates the combinations of m and F that are consistent with portfolio equilibrium. Since portfolio equilibrium is obtained at each point in time, the economy is always on curve P. The $\dot{m} = 0$ curve, obtained by replacing $\dot{m}$ by zero in equation (38), indicates the combinations of m and F that are consistent with a constant real stock of domestic money. 1/ To the left of this curve $\dot{m}$ is positive, because a lower real stock of domestic money implies lower financial wealth, and therefore lower expenditure and a higher current account surplus (or lower current account deficit). To the right of this curve $\dot{m}$ is negative. Thus, the economy adjusts along the P curve towards the stationary equilibrium point E.

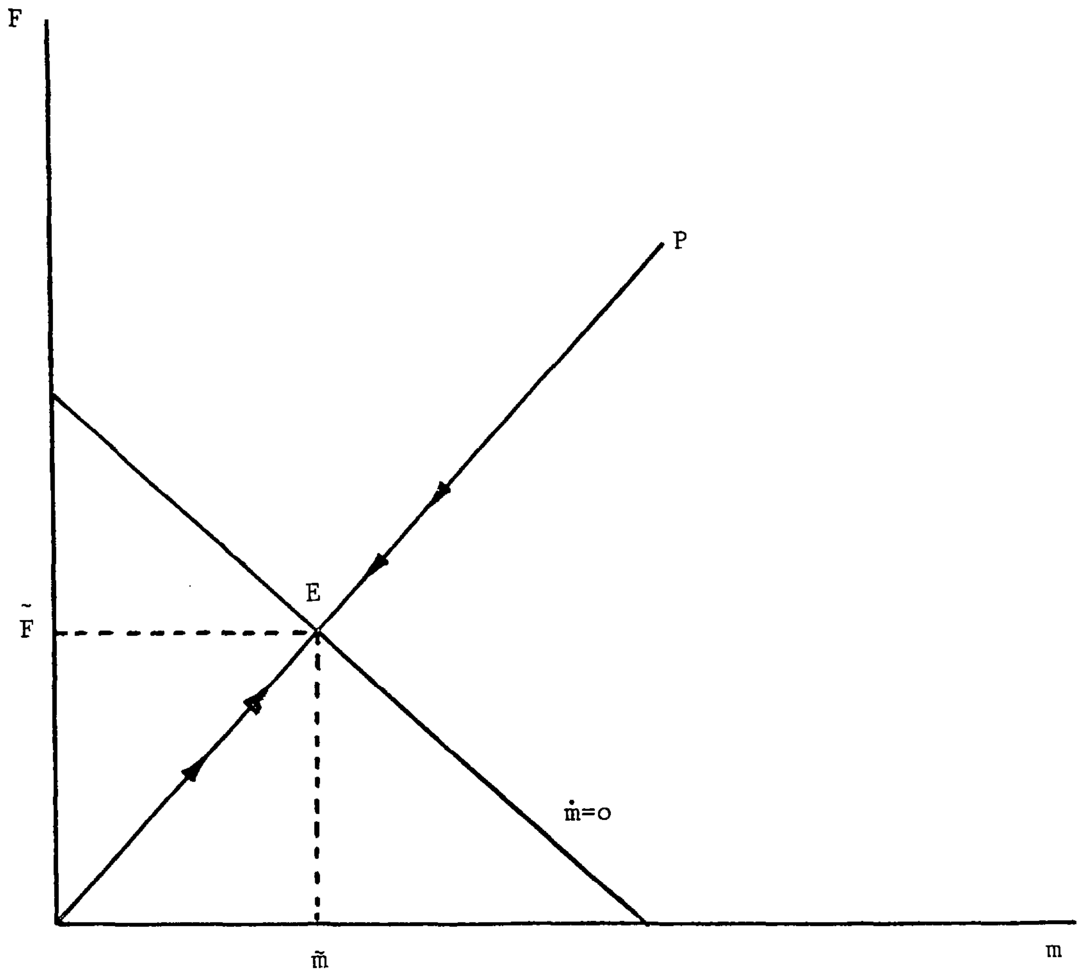
2. Steady-state solution under the crawling peg system

The stationary-equilibrium values of the real stock of domestic money, $\tilde{m}$, and the stock of foreign money, $\tilde{F}$, are the following.

1/ Although the $\dot{m} = 0$ curve could also be positively sloped if μ were sufficiently higher than ε, we rule out the case of $\mu > \varepsilon$ because, as shown below, under this condition the crawling system would be unsustainable in the long run.

Figure 5

Dynamics Under the Crawling Peg System



$$(39) \qquad \tilde{m} = \frac{y_T \lambda(\varepsilon)}{(1-\alpha)a + (\varepsilon-\mu)\lambda(\varepsilon)}$$

$$(40) \qquad \tilde{F} = \frac{y_T[1-\lambda(\varepsilon)]}{(1-\alpha)a + (\varepsilon-\mu)\lambda(\varepsilon)}$$

Since in stationary equilibrium the stock of foreign money is constant, the capital account of the balance of payments is in equilibrium. The current account, and thus the overall balance of payments, are obtained by setting $\dot{m} = 0$ in equation (38) to obtain

$$(41) \qquad y_T - (1-\alpha)a(\tilde{m}+\tilde{F}) = (\varepsilon-\mu)\tilde{m}$$

In stationary equilibrium the balance of payments is equal to the difference between the inflation tax, $\varepsilon\tilde{m}$, and the public sector deficit in real terms $\mu\tilde{m}$. Thus, the balance of payments is in surplus or in deficit depending on whether the rate of domestic credit creation μ is lower or higher than the rate of crawl ε. This implies that for the crawling peg system to be sustainable in the long run, the rate of crawl should be higher than, or equal to, the rate of domestic credit creation. We assume that when switching to a crawling peg system the country wants to attain balance of payments equilibrium in the long run, thus we assume $\varepsilon = \mu$. Using this assumption to replace ε in (39) and (40) we obtain the steady state values for m and F.

$$(42) \qquad \tilde{m} = \frac{y_T \lambda(\mu)}{(1-\alpha)a}$$

$$(43) \qquad \tilde{F} = \frac{y_T[1-\lambda(\mu)]}{(1-\alpha)a}$$

The steady-state solution under the crawling peg system is the same as the steady-state solution under the floating system, $\tilde{m} = m^*$, $\tilde{F} = F^*$ and $(\dot{x}/x) = (\dot{c}/c) = \mu$. 1/ Therefore, all the steady-state implications of switching from a dual system to a floating system also hold for a switch from a dual system to a crawling peg system provided that the rate

1/ See equation (26), (27) and (28).

of crawl is consistent with balance of payments equilibrium in the long run. Thus, the rate of inflation under the crawling peg system, μ, will be higher than the rate of inflation under the dual system, π. Second, while the current account is in deficit under the dual system, it will be in equilibrium under the crawling peg system. Third, the real exchange rate under the crawling peg system will be depreciated (appreciated) with respect to the real free exchange rate of the dual system if the share of imports in the free market, v, is lower (higher) than the share of exports in the free market z. Finally, the real exchange rate under the crawling peg system will be depreciated with respect to the real official exchange rate of the dual system.

3. Dynamics upon unification under a crawling peg system

Although the steady-state implications of unifying the exchange markets under either a floating or a crawling peg system are the same, *the paths that the economy follows before reaching the steady state are* different. The short-term effects of unifying the exchange markets under a crawling peg system will be illustrated in Figure 6, which reproduces Figure 5 and the relevant parts of Figure 3. Curves $\dot{m} = 0$ and P determine the steady-state equilibrium at point E. 1/ When the economy is out of steady-state equilibrium, it adjusts along the P curve. Curve TT shows the path of adjustment under a floating exchange rate system.

Assume that the economy is in stationary equilibrium under the dual system at point B, and that the exchange markets are unified under a crawling peg system with a rate of crawl equal to the rate of domestic credit creation μ. In addition, assume that the exchange rate at the time of unification is set equal to the official exchange rate prevailing under the dual system at that moment, i.e., there is no maxi-devaluation of the exchange rate at which the central bank intervenes in the foreign exchange market; thus $c = e$, and $(M/c) = (\overline{M/e})$. Once the markets are unified, the economy is out of portfolio equilibrium at point B since the desired ratio of foreign money to domestic money under the new conditions is given by curve P. Therefore, the private sector shifts its portfolio out of domestic money and into foreign money and the economy moves immediately from B to D. This increase in private sector holdings of foreign money is matched by a decline in the international reserves of the central bank. Thus, the immediate effect of unifying the markets without devaluing the official exchange rate is a deficit in the balance of payments brought about by a sudden capital outflow. Once at point D, the economy moves

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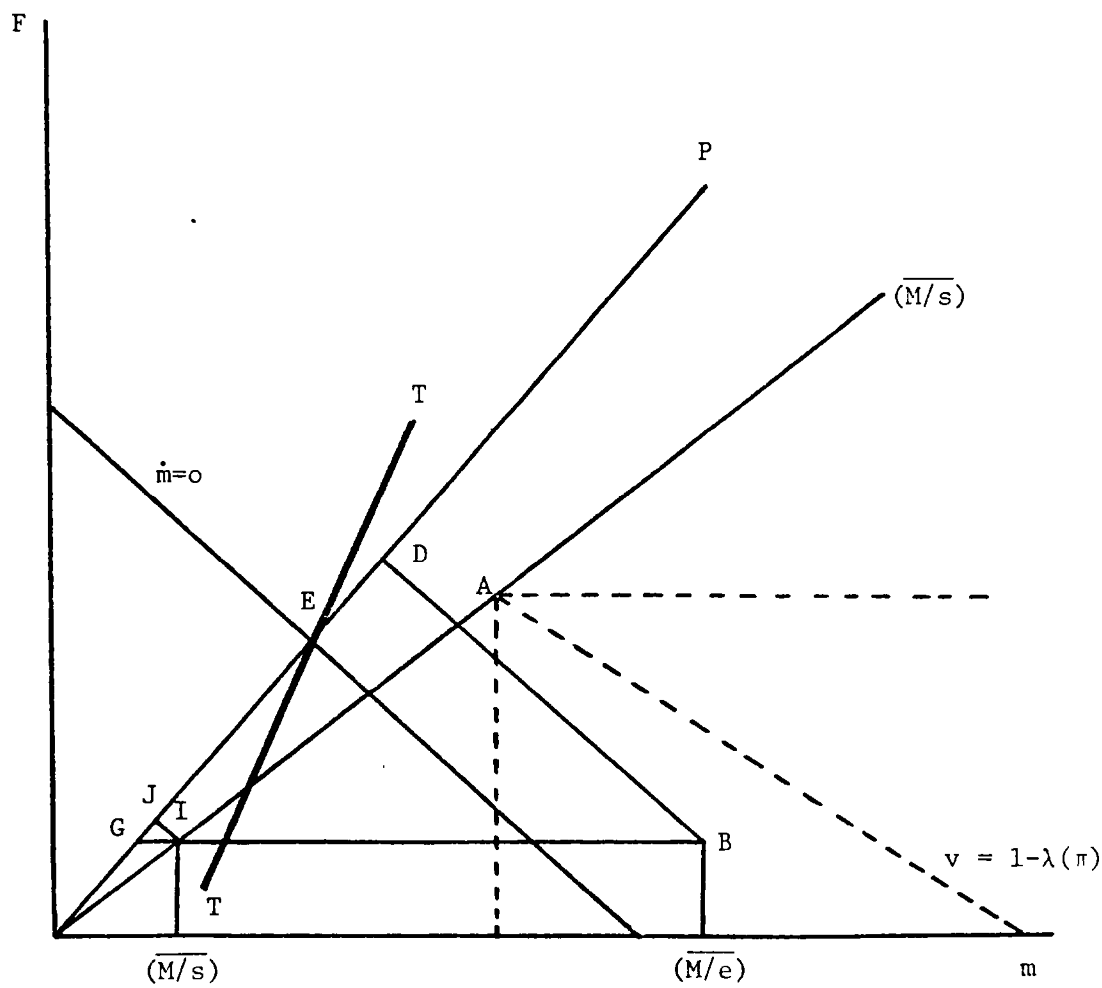
1/ Although labelled differently, these are the same curves that determine the steady-state equilibrium under the floating system. After setting $\dot{F} = \dot{m} = 0$ and $\varepsilon = \mu$, compare (20) with (38), and (32) with (35).

Figure 6

Unification of the Exchange Markets Under
a Crawling Peg System



gradually along the P curve towards its steady state equilibrium at point E. During the process of adjustment the balance of payments is in deficit, with a capital account surplus more than compensated by a current account deficit. Once the economy reaches steady state, both accounts of the balance of payments are in equilibrium. Regarding relative prices, at the time of unification the real exchange rate lies between the real official and the real free exchange rates of the dual system. 1/ Thus, the relative price of traded goods with respect to non-traded goods increases for traded goods that were channeled through the official market and declines for the traded goods that were channeled through the free market. As the economy adjusts from D to E with wealth declining due to the current account deficit, the real exchange rate depreciates towards its steady-state level. The evolution of the nominal exchange rate, the real exchange rate and the current account of the balance of payments are shown on panels (a) in Figure 7.

The results illustrated on panels (a) in Figure 7 are subject to some qualifications. First, as mentioned previously, the steady-state real exchange rate under the crawling peg system could be above the real free exchange of the dual system. Second, the current account does not necessarily improve at the time of unification. It is possible to show that, if $v > 1-\lambda(\pi)$, the current account worsens due to an increase in real wealth. 2/ The condition $v = 1-\lambda(\pi)$ defines the curve $v = 1-\lambda(\pi)$ in Figure 6. For points above that curve the current account worsens, and for points below that curve the current account improves. Third, the current account could turn into surplus at the time of unification. This happens for

1/ This follows from (16) and (17), since (m+F) does not change at the time of unification, and d=1 under the crawling peg system.

2/ As mentioned before, the relevant concept of "real wealth" for the determination of imports is real wealth in terms of traded goods. Under the dual system, this is equal to a weighted average of real wealth in terms of goods imported through the free market and real wealth in terms of goods imported through the official market, the weights being the shares of imports in the respective markets, v and (1-v). At the time of unification nominal wealth declines since the exchange rate that is relevant for converting foreign money into domestic money falls from s to c=e. The decline in nominal wealth is proportional to the share of foreign money in total wealth, $[1-\lambda(\pi)]$. Since the price of goods that were imported through the free market falls from s to c, real wealth in terms of these goods increases. Since the price of traded goods that were imported through the official market remains constant at c=e, real wealth in terms of these goods falls. The net result of these two opposite effects on real wealth depends on the share of imports in the free market, v, and on the magnitude of the decline in nominal wealth, which is proportional to $[1-\lambda(\pi)]$.

points below the curve $\dot{m} = 0$, because the initial level of real wealth would be sufficiently low for the level of imports to be lower than the level of exports. For this case, the behavior of the nominal exchange rate, the real exchange rate and the current account of the balance of payments are shown on panels (b) in Figure 7.

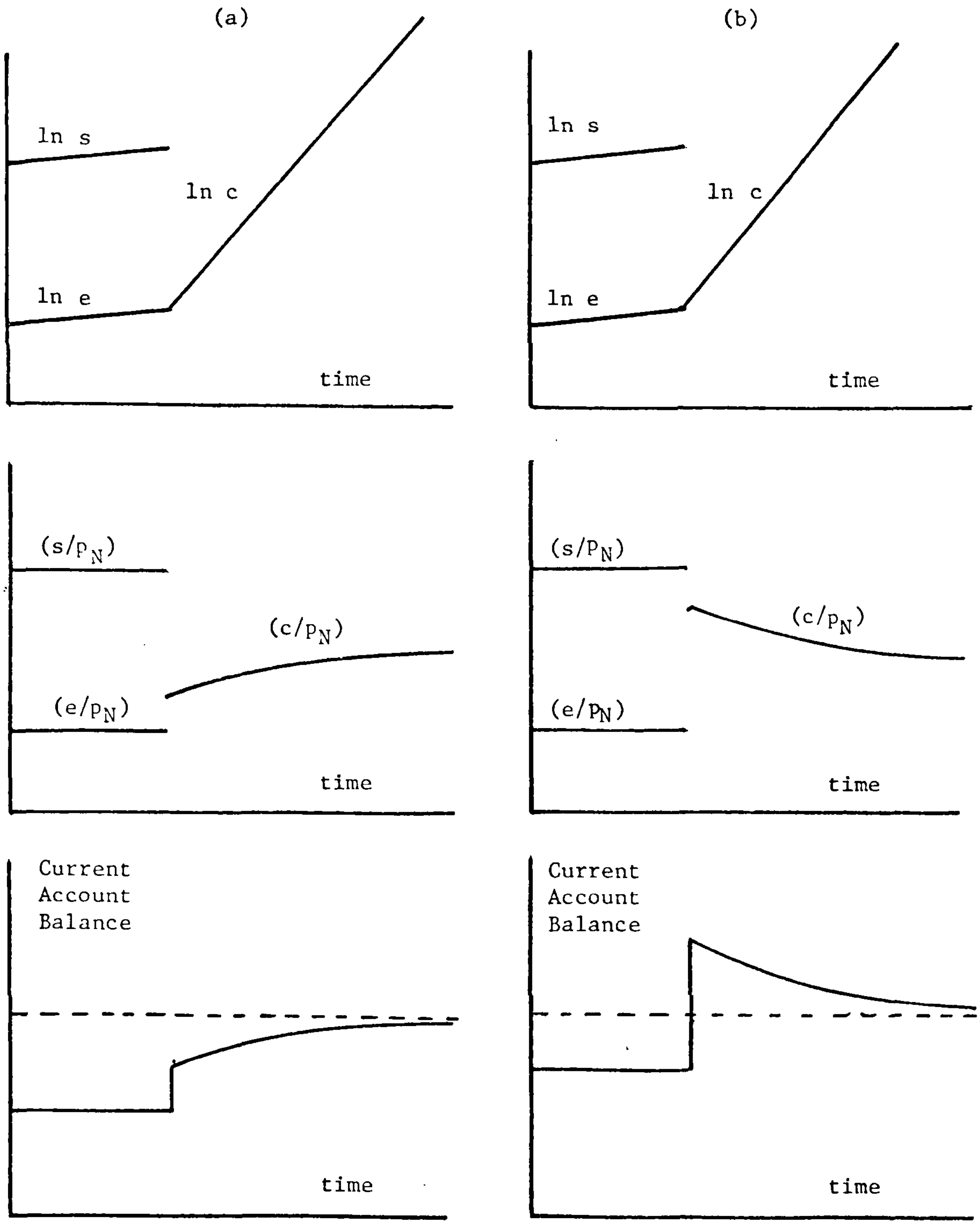
The initial capital outflow that takes place when the exchange markets are unified without a maxi-devaluation of the official exchange rate is due to an excess of domestic money in the portfolio of the private sector. This excess of domestic money arises from two sources. First, the desired ratio of domestic money to foreign money declines due to the higher rate of depreciation of the domestic currency under the crawling peg system. Second, the actual ratio of domestic money to foreign money increases at the time of unification since the exchange rate that is relevant for determining portfolio composition declines from s to c = e; in other words, for the purposes of capital transactions the domestic currency is revalued. A maxi-devaluation of the exchange rate at the time of unification would reduce the real stock of domestic money, and thus would reduce or eliminate the initial capital outflow. In addition, the reduction in the real stock of domestic money reduces the initial level of real wealth and therefore implies a lower deficit (or a higher surplus) than otherwise in the current account during the process of adjustment towards the steady state.

These results can be illustrated in Figure 6. For example, starting from B, a maxi-devaluation that moves the economy to G at the time of unification of the markets will eliminate the initial capital outflow. Furthermore, during the process of adjustment the current account and the overall balance of payments will be in surplus. Notice that, in order to completely eliminate the initial capital outflow, the maxi-devaluation must be higher than the differential between the free and the official exchange rate of the dual system. If the crawling exchange rate were initially set at the same level as the free rate of the dual system, c = s, the economy would immediately move from B to I due to the devaluation, and from I to J due to the reallocation of private sector portfolio. Clearly, the shift from I to J implies a capital outflow. A maxi-devaluation to the level of the free rate is insufficient to bring about portfolio equilibrium by itself because the desired ratio of foreign money to domestic money under the crawling peg system, represented by curve P, is higher than the desired ratio under the dual system, represented by curve $\overline{(M/s)}$, due to the higher rate of depreciation under the crawling peg system. It is also clear from Figure 6 that a maxi-devaluation large enough to move the economy to the left of point G would produce a capital inflow instead of a capital outflow.

The results of this section indicate that the economy can follow alternative paths from its initial position at the time of unification to its steady-state equilibrium under the crawling peg system, depending

Figure 7

Nominal Exchange Rates, Real Exchange Rates and Current Account Balance Under a Crawling Peg System



on the various policies followed under the dual system and on the magnitude of the maxi-devaluation at the time of the unification. These factors determine the initial position of the economy under the crawling peg system, and hence its dynamics during the process of adjustment toward the steady state. If there is no maxi-devaluation, there is an immediate capital outflow, and an increase (decline) in the relative price of traded goods that were channeled through the official (free) market with respect to non-traded goods. Some of the other effects, however, cannot be generalized. Thus, at the time of unification the current account could improve or worsen. In addition, during the process of adjustment, the real exchange rate could be falling or rising, and the current account and the overall balance of payments could be in surplus or in deficit. A maxi-devaluation reduces the magnitude of the initial capital outflow and improves the current account.

V. Concluding Remarks

Countries that use dual exchange markets and have a rate of domestic credit creation that is excessive with respect to the rate of crawl of the official exchange rate, will experience balance of payments problems and most likely a large differential between the free and the official exchange rates. In order to solve both problems in the context of a unified exchange system, these countries could stop intervening in the official market, and thereby adopt a floating exchange rate system. Alternatively, they could adopt a unified system with a rule of intervention in the exchange market that is consistent with balance of payments equilibrium, at least in the long run.

This paper examines some of the consequences of adopting a floating exchange rate system and a crawling peg system. It shows that, in order to produce balance of payments equilibrium in the long run, the rate of crawl must be equal to the steady-state rate of depreciation that would arise from a floating system. Under this condition, both alternative ways of unifying the exchange markets have the same steady state implications. First, the rate of depreciation of the unified exchange rate will be higher than the rate of depreciation of the two exchange rates of the dual system, and thus, the rate of inflation will also be higher. Second, the real exchange rate of the unified system will be depreciated with respect to the real official exchange rate. Third, the real exchange rate of the unified system will be depreciated (appreciated) with respect to the real free exchange rate if the share of imports in the free market is lower (higher) than the share of exports in the free market. Finally, the current account of the balance of payments, in deficit under the dual system, will be in equilibrium under the unified systems.

The paper also shows that the path that the economy follows from the time of unification until it reaches the steady state differ between the two alternative unified systems. Under a floating system, the exchange rate adjusts immediately in order to produce continuous balance of payments equilibrium, while under the crawling peg system the exchange rate is set by the authorities, and international reserves adjust in response to the excess demand for (or excess supply of) foreign currency at the given exchange rate. The adoption of a floating system will be accompanied by an immediate depreciation of the floating exchange rate with respect to the official exchange rate of the dual system, and by an improvement in the current account of the balance of payments. Whether the floating exchange rate will also be depreciated with respect to the free exchange rate of the dual system depends on the policies that were followed while the economy was under the dual system. In particular, given all the other parameters, the higher the share of exports in the free market, the lower the share of imports in the free market, and the higher the rate of domestic credit creation, the more likely it is that at the time of unification the floating exchange rate will be depreciated with respect to the free exchange rate of the dual system. 1/ The path of adjustment of the economy after the initial impact also depends on the various policies under the dual system.

The adoption of a crawling peg system, without a maxi-devaluation of the official exchange rate, will be accompanied by an immediate capital outflow. Given all the other parameters, the larger the share of imports in the free market, the lower the share of exports in the free market, and the higher the rate of domestic credit creation, the larger the size of the initial capital outflow. 2/ The initial effect on the current account, and the path of adjustment of the economy after the initial impact also depend on the various policies under the dual system. A maxi-devaluation of the official exchange rate at the time of adoption of the crawling peg system reduces the size of the initial capital outflow and improves the initial effect on the current account. For the initial capital outflow to be completely eliminated, the maxi-devaluation must be higher than the differential between the free and the official exchange rate of the dual system.

1/ The higher the share of exports in the free market, z, and the lower the share of imports in the free market, v, the higher is the steady state stock of foreign money under the dual system, and therefore the more likely it is that the economy would be on regions II or III instead of region I. The higher the rate of domestic credit creation, μ, the more to the left would be the curve TT on Figure 3, and therefore the smaller would region I become.

2/ The size of the capital outflow is $[1-\lambda(\mu)]\overline{m} - \lambda(\mu)\overline{F}$. The results in the text can be shown by using (11) and (12) to replace $\overline{m}$ and $\overline{F}$ in this expression.

Finally, the results of the paper also imply that these short-term effects will be present even if the country follows a gradual approach to the unification of the markets, in which the differential between the free and the official exchange rate is first eliminated, and then a unified system is adopted. 1/ Even if the differential is eliminated while the economy is under the dual system, the portfolio of the private sector will be out of equilibrium when the markets are unified due to the higher rate of depreciation of the exchange rate under the unified systems. Thus, at the time of unification the private sector will shift its portfolio composition out of domestic money and into foreign money, causing an upward jump in the exchange rate if a floating system is adopted, and a capital outflow if a crawling peg system is adopted. These effects could be avoided by eliminating the balance of payments deficit, in addition to the differential between the exchange rates, before the markets are unified. This would entail an increase in the rate of depreciation of the official exchange rate under the dual system to the level of the rate of domestic credit creation. 2/ Since under this condition the rate of depreciation of the exchange rate would not change with the unification of the markets, the private sector has no incentives to shift its portfolio composition, and thus there would be no jump in the exchange rate if a floating system is adopted, and there would be no capital outflow if a crawling peg system is adopted.

1/ In terms of Figures 3 and 6, if the differential between the free and the official exchange rates is eliminated, the economy would be in point A under the dual system.

2/ In terms of Figures 3 and 6, point A would coincide with point E.

Appendix

This Appendix shows that the system formed by equations (8), (9), and (10) exhibits saddle-point stability. 1/ In order to simplify the notation, the argument of the function $\lambda(\pi)$ is omitted. Linearizing the system around the stationary equilibrium, $d = \bar{d}$, $F = \bar{F}$ and $m = \bar{m}$, we obtain

$$\begin{vmatrix} \dot{d} \\ \dot{F} \\ \dot{m} \end{vmatrix} = \begin{vmatrix} E & G & -H \\ I & -J & -K \\ -L & -N & -P \end{vmatrix} \begin{vmatrix} d - \bar{d} \\ F - \bar{F} \\ m - \bar{m} \end{vmatrix}$$

where E, G, H, I, J, K, L, N, and P are positive constants defined as follows:

$$E = \frac{-\lambda(1-\lambda)}{\lambda'} \qquad G = \frac{-\lambda(1-\lambda)\bar{d}}{\lambda'\bar{F}} \qquad H = \frac{-(1-\lambda)^2}{\lambda'\bar{F}}$$

$$I = \frac{v(1-\alpha)a\bar{m}}{\bar{d}^2} \qquad J = v(1-\alpha)a \qquad K = \frac{v(1-\alpha)a}{\bar{d}}$$

$$L = (1-v)(1-\alpha)a\bar{F} \qquad N = (1-v)(1-\alpha)a\bar{d} \qquad P = (1-v)(1-\alpha)a + (\pi-\mu)$$

The characteristic equation of the system is given by

(A1) $x^3 + Bx^2 + Cx + D = 0$

where

(A2) $B = J + P - E \gtrless 0$

1/ The proof assumes $\pi < \mu$, which is the case considered in the text. This assumption is implicit in inequality (A3). However, with a slight modification in the argument, it can be shown that the system also exhibits saddle-point stability for $\pi > \mu$.

(A3) $C = PJ - EP - EJ - LH - NK - GI < 0$

(A4) $D = NKE - EJP - LHJ - GIP - GKL - HIN < 0$

To obtain a unique perfect foresight path, the dimension of the convergent subspace must be equal to the number of predetermined variables. 1/ Since we have two predetermined variables, F and m, one characteristic root must be real and positive and the other two must have negative real parts.

The signs of the real parts of the characteristic roots can be obtained from the following two conditions:

(A5) $x_1 x_2 x_3 = -D$ (> 0 from (A4))

(A6) $x_1 x_2 + x_2 x_3 + x_1 x_3 = C$ (< 0 from (A3))

where x_1, x_2, and x_3 are the roots of equation (A1). 2/

From (A5) it follows that there is at least one positive real root and that the real parts of the other two additional roots must have the same sign. From (A6) it follows that the sign of the real part of the two additional roots cannot be positive. Therefore, there is one positive real root and the other two roots have negative real parts; the system exhibits saddle-point stability.

1/ See Begg (1982).
2/ See Allen (1960).

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