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Exchange Rate Reform and Structural Disturbances in a Dual Exchange Rate Economy

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Abstract

This paper analyzes the implications of devaluation and a variety of structural disturbances in a dual exchange rate economy. A key feature of the model developed is its explicit recognition of both private (fraudulent) and officially-sanctioned cross transactions between the two exchange markets. The principal lesson to be learned from the analysis is that popular notions as to the effects of devaluation or of other disturbances are to be viewed with considerable caution when the dual rate regime involves inter-market transactions.

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I. Introduction

There has been renewed interest recently on both the practical and theoretical levels in the operation of multiple exchange rate regimes. On the practical level, the International Monetary Fund reports that 47 member countries maintained some form of multiple currency practices at the end of March 1987 (see Annual Report on Exchange Arrangements and Exchange Restrictions, 1987) and that although "19 member countries either eliminated or simplified multiple currency practices" during 1986, "new multiple currency practices were introduced in seven countries" over this period. Of the 47 countries reported to be engaging in some form of multiple currency practices, at least 17 can be identified as maintaining widespread legally-sanctioned multiple exchange markets as of end-1986 (the rest employ parallel markets for only limited categories of transactions). 1/

On a theoretical level as well, there has been increasing attention devoted to the analysis of such exchange rate regimes. Thus, contributions to this literature within the last three years alone include Adams and Greenwood (1985), Aizenman (1985), Dornbusch (1986), Obstfeld (1986), Frenkel and Razin (1986), Kiguel and Lizondo (1986), Gros (1988), Pinto (1987), Blanco (1987), Gardner (1985), Guidotti (1987), Lizondo (1987), Bhandari and Decaluwe (1987), Delbecque (1988) and Guidotti and Vegh (1988), among others. 2/

With very few exceptions, a notable feature of these papers is the assumption that the dual exchange markets can be and are effectively segmented. 3/ Such an assumption is of course, analytically convenient in

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1/ Additional details may be obtained from the Annual Report.

2/ An earlier strand of literature includes Argy and Porter (1972), Fleming (1971), Decaluwe (1974), Decaluwe and Steinherr (1976) and Swoboda (1974). A somewhat later group of papers include Flood (1978), Marion (1981), Flood and Marion (1982, 1983), among others. To a large extent, the later literature may be viewed as an extension of models of earlier vintage with the replacement of static or adaptive expectations by the now-popular rational expectations hypothesis. Another distinction is that the newer models tend to be dynamic and/or stochastic as opposed to the generally static models of the earlier period. The most recent papers cited in the main text continue the examination of the same type of issues as previously (for example, efficacy of various policies, insulation from external disturbances etc.); however, the types of models utilized are more sophisticated in the sense of being of an optimizing nature rather than of the ad hoc type that characterized the earlier work.

3/ Papers that do recognize the possibility of leakage are Bhandari and Decaluwe (1987), Guidotti (1987), Gros (1987) and Lizondo (1987). These are considered separately below.

that a freely floating financial rate assures that the capital account is always zero. As a result, one channel of transmission of external disturbances (i.e., via foreign asset accumulation/decumulation) is completely eliminated. In point of fact, however, there is considerable "leakage" between the two exchange markets on account of two complementary reasons. First, illegal cross-operations between the commercial (official) and financial (parallel) exchange markets are widespread. The existence of such "black" market transactions has been noted in the earlier descriptive literature. Thus, Lanyi (1975) writes "... if the domestic currency is relatively depreciated in the financial market, there will be an incentive for under-invoicing exports, with the difference between the actual and invoiced export proceeds entering the country in the guise of a capital inflow at the more favorable financial exchange rate" (ibid. at p.720). Empirical work has also yielded results which are consistent with the fact that fraudulent transactions are extremely pervasive in both developing and industrial countries that have employed dual rate regimes. For example, Gulati (1985) reports that during the period 1977-83, under-invoicing of exports as a percentage of official exports was 34% for Mexico, 20% for Argentina and 13% for Brazil. 1/ Econometrically estimated trade balance functions for the Belgium-Luxembourg Economic Union (BLEU) also exhibit a significant response to the exchange rate spread, thus indicating the presence of fraudulent transactions (see Decaluwe (1975)).

A second and more important reason for the existence of movements between the two exchange markets is that certain cross transactions are legally compelled in every country that engages in multiple exchange rate practices. Thus, several important categories of current account transactions (involving both merchandise trade items as well as service account transactions) are assigned de jure to the financial external market. 2/ Examination of the actual institutional arrangements in these countries reveals that in most instances this is effected by requiring that specified proportions of export receipts be surrendered at the financial exchange rate (for example, in Costa Rica, Syria, Dominican Republic, Jamaica, Sierra Leone) or that only certain categories of imports ("priority imports") be financed via the commercial exchange market (Egypt, Dominican Republic, El Salvador, Sudan, Ecuador, Nicaragua,

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1/ Underinvoicing or overinvoicing of exports/imports may also occur quite apart from the maintenance of dual exchange rates; for example, if trade tariffs or subsidies are present.

2/ A limited number of capital account transactions are often required to be settled in the commercial market in some countries. However, these items usually involve certain types of public sector capital account items and their empirical significance appears to be very limited; see also Lanyi (1975) in this regard.

Jamaica, Sierra Leone, Venezuela). Additional details regarding the precise institutional arrangements may be obtained from the Annual Report.

In light of these institutional factors, it is important and relevant to construct and analyze a model of dual exchange rates that properly accounts for both types of cross-transactions between the two exchange markets, i.e., both the de jure and the fraudulent variety. As indicated earlier however, with very few exceptions, the previous literature has ignored the phenomenon of leakage and has proceeded on the assumption that the two exchange markets are effectively segmented. However, a few papers have attempted to incorporate the stylized fact of incomplete market separation; these are Bhandari and Decaluwe (1987), Lizondo (1987), Gros (1987) and Guidotti (1987). Of these, the first two are unable to obtain analytical solutions at all and recourse to numerical methods was necessary. In part, the difficulty is due to the fact that the presence of inter-market transactions results in a non-zero capital account, despite the flexibility of the financial exchange rate. This additional source of dynamics causes the typical system to involve a set of three non-recursive differential equations with consequent problems of intractability. This is the case in Lizondo (1987) inspite of the fact that several simplifying assumptions are made, involving a fixed level of output, no capital assets and the total absence of fraudulent cross-transactions (see note 7, p.40, op cit). By contrast Bhandari and Decaluwe (1987) construct a much more elaborate model and incorporate both varieties of leakage. However, no analytical results were possible, owing not only to the third-order nature of the system but also because of the inherent non-linearities encountered. On the other hand, both Gros (1987) and Guidotti (1987) are able to derive analytical results. Both of these authors exclude the possibility of officially-sanctioned leakage and find it necessary to make several other simplifying assumptions in order to generate a recursive dynamic system which can then be solved. In Gros (1987) for example, the trade balance does not depend upon income at all and the price adjustment rule is independent of the spread. These assumptions, along with the absence of a money market, ensures recursiveness in the model. Similarly, in Guidotti (1987) recursiveness is the result of a specialized assumption relating to asset adjustment.

The present paper is able to advance on previous work in two principal ways. First, unlike Bhandari and Decaluwe (1987) and Lizondo (1987), analytical solutions are explicitly obtained. In part, the possibility of obtaining analytical solutions results from the fact that asset accumulation equations in the present paper are specified in beginning-of-period ex-ante equilibrium rather than in end-of-period ex-post terms. 1/ Second, unlike Gros (1987) and Guidotti (1987), the

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1/ This modification is not without costs however, in that the resulting model is of a short-run nature.

presence of both officially authorized leakage and fraudulent cross-transactions is properly recognized and modelled. At the same time, the framework involves a reasonably well-developed specification of both the real and financial sectors of the economy. The model we construct may be viewed, in some sense, as an extension of the Flood-Marion (1982) analysis amended to incorporate incomplete market separation. Alternatively, the present paper may be seen as a simplified version of Bhandari and Decaluwe (1987), to which an analytical solution has now been obtained.

The framework is utilized to analyze the implications of several disturbances in the home economy. Specifically, the effects of commercial devaluation, of an increase in foreign inflation, as well as of other domestic real and monetary (aggregative and allocative) disturbances are discussed. The severity of the domestically-induced effects of these disturbances is related to the degree of officially-sanctioned leakage (compulsory cross-transactions) and to the penalty costs associated with engaging in illicit transactions. For expositional purposes, the model presented is of the one-good variety wherein the domestic economy possesses no market power in trade. However, the essential results derived from this framework can be shown to hold in a more elaborate two-good setting.

In what follows, Section II specifies the analytical framework while Section III evaluates the macroeconomic responses associated with commercial exchange rate reform (devaluation) and other structural disturbances. A summary of the principal results is contained in the concluding section.

II. The Analytical Framework: A Model of Compulsory and Illicit Cross-Transactions

The hypothetical world of this model consists of an open economy whose authorities deploy a dual rate exchange regime--a commercial rate applying to certain current account transactions and a financial rate for capital account transactions and the remainder of current account items. Under this regime, the authorities intervene continuously in order to peg the level of the commercial exchange rate at a specific par value while the financial rate floats freely. No substantive differences result if the commercial rate were permitted to crawl systematically. Domestic output of the country in question is limited to a single final commodity which is perfectly substitutable with foreign output. The domestic economy is small in all international markets, i.e., the foreign currency price of output, as well as the foreign interest rate are taken as exogenous. Goods are perishable so that domestic residents must allocate their wealth between the available financial assets. These are domestically-issued money and a one-period, risk-free, internationally-issued

security. There is no currency substitution, no physical capital accumulation, and neither transactions nor transport costs.

It is assumed that the use of the Lucas supply function is no longer contentious. Specifically, output supply is governed by: 1/

$$y_t = \bar{y} + b(p_t - E_{t-1}p_t) + u_t \tag{1}$$

where y_t is the current level of output in logarithmic units, $\bar{y}$ is trend output and p_t is the logarithm of the domestic price level. The operator E is an expectations operator and the subscript indicates the time period in which the expectation is formed. Finally, u_t is a log-additive, serially uncorrelated, zero-mean disturbance term intended to capture temporary supply innovations. It is possible to motivate (1) from a variety of standpoints; for example, on the basis of profit maximization behavior on the part of a firm, assuming that wages are tied to the expected price level. In this case, it can easily be shown that the slope parameter is $b = a/(1-a)$ when a is the share of labor in the productive process. 2/

Given the absence of transportation and transaction costs, the elimination of profitable arbitrage possibilities necessitates that the domestic currency price of output is determined via a purchasing power parity relationship:

$$p_t = s_t + p_t^* \tag{2}$$

where p_t^* is the logarithm of the foreign currency price of the commodity, while s_t is defined as the logarithm of the aggregate commercial exchange rate. Because of the fact that certain commercial transactions are settled in the financial market, the actual exchange rate relevant for commercial transactions is not the official commercial exchange rate, but instead, the aggregate commercial rate, where the latter is defined as a function of the actual commercial and financial rates. A logarithmic linear approximation to this function is assumed to be given by

$$s_t = \alpha\bar{e}_t + (1 - \alpha)x_t \tag{3}$$

1/ All parameters are defined positively in what follows.

2/ If contemporaneous wage indexation were incorporated, then as shown by Flood and Marion (1982) among others, the form of the supply function is not altered. However, the slope parameter b is now given by $b = (a/(1-a)(1-\theta)$ where θ is the degree of contemporaneous wage indexation.

where $\bar{e}_t$ and x_t are logarithms of the commercial and financial exchange rates respectively, while α is defined as the initial share of trade transactions settled in the commercial market relative to total trade transactions. 1/ It is this parameter that we identify as (the inverse of) the legally-compelled degree of leakage. Thus, the official "coverage" of the commercial market is determined by the parameter α. All financial transactions are settled in the financial market. In addition, a proportion $(1-\alpha)$ of all trade transactions are also required to be settled in this market. Government decree, however, is not the only reason why certain merchandise trade items are settled in the financial exchange market. To the extent that the financial exchange rate is relatively depreciated compared with the commercial rate, private exporters have an incentive to circumvent government regulations by illegally surrendering their export receipts at the more favorable financial rate. By contrast, with the financial rate at a premium (i.e., relatively appreciated) relative to the commercial rate importers attempt to fraudulently use the financial market. The widespread presence of such black market transactions was noted above. Thus, the actual coverage of the financial market is broader than the official coverage on account of fraudulent transactions.

It is necessary at the outset to first specify the total trade balance. Ignoring the physical investment component of domestic expenditure, the real trade balance (in natural units) is given definitionally by income less consumption. In the interest of analytical simplicity we assume that consumption is determined solely by income. Most of our substantive results however, are not affected if a wealth effect were included in the consumption function (and hence in the trade balance or savings function). Thus, the total trade surplus is

$$T_t = Y_t - C(Y_t) \qquad (4)$$

$$0 < C_1 < 1$$

A logarithmic approximation to (4) is assumed to be given by:

$$\ln T_t = \bar{T} + \beta y_t \qquad (5)$$

1/ Technically, α represents the value share of trade transactions settled at the commercial exchange rate to the total value of trade transactions. However, provided that the initial spread between the two exchange rates is small, α can also approximate the relevant real share, i.e., $\alpha \approx T^{e\circ}/(T^e + T^x)^\circ$, where $T^{e\circ}$ and $T^{x\circ}$ denote initial volumes of transactions settled in the commercial and financial markets respectively.

where $\bar{T}$ represents an autonomous component of the trade balance. 1/ 2/ Total real exports, i.e. T_t, are composed of two components: one component (denoted by T^e) is settled at the commercial exchange rate, while the other (T^x) is settled in the financial exchange market. The component T^x subsumes both compulsory and illicit commercial transactions in the financial market. We hypothesize the following functional forms for the logarithms of T^e and T^x

$$\ln T^e = \bar{T}^e + \beta^e y_t - \gamma^e (x_t - \bar{e}_t) - \eta_t \tag{6a}$$

$$\ln T^x = \bar{T}^x + \beta^x y_t + \gamma^x (x_t - \bar{e}_t) + \xi_t \tag{6b}$$

According to equations (5) and (6), an increase in aggregate income increases total exports (savings), which is allocated to each component as determined by the elasticities β^e and β^x. 3/ By contrast, an increase in the spread between the exchange rate (i.e. $(x_t - \bar{e}_t)$), is assumed to have no scale effect upon total exports and leads only to compositional changes. 4/ Specifically, private exporters find it more favorable to illegally divert some of their trade transactions from the commercial market to the financial market. Thus, the component $\gamma^x (x_t - \bar{e}_t)$ in (6b) can be associated strictly with fraudulent transactions. The component $\beta^x y_t$ however, consists of both legal and illegal transactions since an increase in total exports (due to an increase in income) legally requires additional settlements in the financial market, as well as encouraging certain traders to under-invoice exports at the given spread. The magnitudes of the relevant elasticities γ^e and γ^x are clearly (inversely) related to the perceived implicit and explicit penalty costs of engaging

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1/ At this stage it is useful to recall that owing to the one-good nature of the model, the trade surplus ($T_t > 0$) is synonymous with total exports. Throughout this paper, we assume without consequence, that the domestic economy is a net exporter (so that aggregate savings are positive). If the country in question were a net importer (i.e., $T_t < 0$), then equation (5) is replaced by a function that associates the trade deficit (negatively) with income. Our results are not altered by this modification.

2/ If a real wealth effect is included in the consumption (savings) function, then the total trade surplus (or savings) responds negatively to an increase in real wealth, i.e. (5) would be replaced by $\ln T_t = \bar{T} + \beta_1 y_t - \beta_2 (w_t - p_t)$.

3/ If the wealth effect were included in (5), then an increase in total real wealth increases both T^e and T^x.

4/ This is a parameter restriction which is stated more formally in equation (7b) below.

in illicit transactions and to the degree of enforcement of exchange regulations. In addition to the systematic reallocation implied by an increase in the spread, the above equations also incorporate the random terms ξ_t and η_t which are intended to characterize unsystematic compositional shifts between the two exchange markets. In the context of this model, these random terms may be interpreted as subsuming all factors other than the exchange rate spread that impinge upon the allocation of trade transactions between the two markets (such as the degree of risk aversion of traders etc.).

It can be demonstrated that the parameters (and disturbances terms) in (5) and (6) are interrelated via the following "adding-up" conditions: 1/

$$\alpha\beta^e + (1 - \alpha)\ \beta^x = \beta \tag{7a}$$

$$-\alpha\gamma^e + (1 - \alpha)\ \gamma^x = 0 \tag{7b}$$

$$-\alpha\eta_t + (1 - \alpha)\ \xi_t = 0 \tag{7c}$$

The next stage in the development of the model involves the specification of asset market relationships. It can be shown that the logarithm of the expected opportunity cost of holding domestic money (as opposed to international securities) can be approximated by: 2/

$$i_t = \bar{i}^*_t + (E_t, x_{t+1}) - x_t) + \bar{i}^*\omega E_t(\bar{e}_{t+1} - x_{t+1}) \tag{8}$$

where $\bar{i}^*$ is the mean value of the foreign nominal yield and ω is the proportion of foreign interest receipts repatriated at the commercial exchange rate. Thus $(1 - \omega)$ measures the degree of service account leakage.

1/ These conditions can be derived by recalling that $T = T^e + T^x$ and that $\alpha \equiv [T^e/(T^e + T^x)]^\circ$, where the superscript '°' refers to an arbitrary linearization point.

2/ This expression may be derived by a procedure similar to that in Flood and Marion (1982), extended to incorporate leakage.

Domestic money market equilibrium is described by

$$m_t - p_t = -\lambda i_t + \phi y_t \qquad (9)$$

Equation (9) is entirely conventional and needs no further comment. The next two equations define the logarithms of domestic money and wealth respectively:

$$m_t = d^\circ d_t + (1 - d^\circ)(\bar{e}^\circ + r_t) \qquad (10)$$

$$w_t = d_1 m_t + (1 - d_1)(x_t + k_t) \qquad (11)$$

where

$$d^\circ \equiv (D/M)^\circ \text{ and } d_1 \equiv (M/W)^\circ$$

are arbitrary linearization points corresponding respectively to the ratios of domestic credit to money and domestic money to wealth around the linearization points. Note that international reserves (r_t) are evaluated at a specific fixed exchange rate ($\bar{e}^\circ$) in order to rule out valuation effects while domestically-held foreign assets (k_t) are evaluated at the current financial rate (x_t). 1/

The final ingredient of the model is the specification of consistency relationships between planned saving and expected wealth accumulation. Specifically, the model involves two sources of accumulation, i.e. money (or reserves) accumulation and foreign asset accumulation. 2/ It is to be emphasized that changes in the stock of

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1/ Note that the principal on foreign securities is always acquired (by assumption) at the financial exchange rate. However, interest proceeds (a current account item) may be repatriated via either market. It is not difficult (in principle) to model leakage from the financial to the commercial market: essentially, this requires the use of a suitably defined aggregate financial rate in the definition of wealth. As pointed out earlier however, the empirical significance of such cross transactions is minimal compared with leakage from the commercial to the financial market (as incorporated in this paper).

2/ The banking sector is suppressed in this model, i.e. reserves accumulation is equivalent to money accumulation.

domestically-held foreign securities is a direct consequence of inter-market transactions. If it is assumed (as in the previous literature) that the two exchange markets are completely segmented, then the floating financial rate ensures that no net investment in foreign asset stocks can occur. Given incomplete market separation however, it is the sum of the capital account plus the leakage that is now zero. This process has been noted in the previous descriptive literature (see for example, Lanyi (loc.cit)). Thus, total wealth accumulation occurs via two distinct components of saving in this model. One component of saving is the commercially-settled trade surplus (T^e) which results in money (reserve) accumulation. 1/ The other component of saving is the financially-settled trade balance (T^x), the counterpart of which is foreign asset accumulation. Hence, the relations that express the equality of planned saving (of each type) with the appropriate component of expected real wealth accumulation are given by: 2/

$$d_1[(E_t,m_{t+1} - m_t) - (E_t,p_{t+1} - p_t)] = \psi^e [\beta^e y_t - \gamma^e (x_t - \bar{e}_t) - (\frac{1-\alpha}{\alpha})\xi_t] \quad (12)$$

$$(1-d_1)[(E_t,x_{t+1} - x_t) + (E_t,k_{t+1} - k_t) - (E_t,p_{t+1} - p_t)] = \psi^x [\beta^x y_t + \gamma^x (x_t - \bar{e}_t) + \xi_t] \quad (13)$$

where the random term η_t has been replaced in (12) using (7c) and where ψ^e and ψ^x are stock-flow conversion factors defined as:

$$\psi^e \equiv \frac{T^{e^\circ}}{(W/P)^\circ} \; ; \; \psi^x \equiv \frac{T^{x^\circ}}{(W/P)^\circ}$$

1/ Strictly speaking, reserve accumulation corresponds to the commercially-settled trade balance plus the commercially-settled component of the service account. The service account component has been disregarded in the following accumulation equations on the grounds of maintaining analytical tractability.

2/ Details as to the derivation of these accumulation equations are provided in the Appendix.

Similar conversion factors also appear in Flood and Marion (1982). These equations are consistent with the requirement that total planned saving equals expected aggregate wealth accumulation. Thus, equation (2) asserts that real money (or reserve) accumulation (i.e., the left-hand side of (12)) equals the commercially-settled real trade balance, while in equation (13), the real adjustment in domestically-held foreign assets is equated to the financially-settled trade account. The sum of the left-hand sides of these equations is expected wealth accumulation, while the right-hand sides sum to total planned saving, as required for aggregate consistency.

The final ingredient in the formulation of the model is the specification of the stochastic processes involved. Specifically, the commercial exchange rate evolves according to:

$$\bar{e}_t = \bar{e} + \nu_t \tag{14}$$

$$\nu_t = \nu_{t-1} + n_t$$

Thus, a change in $\bar{e}$ signifies a fully perceived and permanent commercial devaluation, while a positive value of n_t indicates an unanticipated and permanent commercial devaluation. 1/

Foreign prices are governed by:

$$p^*_t = p^*_{t-1} + q_t \tag{15}$$

where q_t is an unperceived, permanent foreign price innovation. Each of the random terms u_t (productivity shocks), ξ_t (allocational trade balance shifts), n_t (commercial rate disturbances) and q_t (foreign price innovations) are serially (and mutually) uncorrelated and are centered about zero. All expectations are formed rationally in the sense of Muth and all variables are currently observable upon realization. 2/ This completes the specification of the model. For later purposes however, it is useful to note that the complete separation analog of this model involves the

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1/ Formally, E_{t-1}, $\bar{e}_t = \bar{e}$, i.e., E_{t-1}, $\nu_t = 0$.

2/ In reality of course, certain variables (for example, financial market variables) are more readily observable than others (eg. real sector variables). In addition, domestic variables may be more easily observed (by domestic agents) than foreign variables. These issues (relating to differential information availability) are not treated here; see however, Bhandari (1985).

following modifications. First, officially-sanctioned leakage can be ruled out by setting α, $\omega = 1$, while private, fraudulent cross-transactions are eliminated if the penalty costs associated with the latter are infinitely high, i.e., if $\gamma^e = 0$. Next, when exchange markets are completely segmented, no trade transactions occur in the financial exchange market, i.e., $T^x = 0$, so that the total trade balance T_t is synonymous with the commercially-settled component T^e. Finally, since $T^x = 0$, $\gamma^x = 0$ as well, so that the right-hand side of equation (13) reduces to zero. This of course, is a mere restatement of the fact that under complete separation of exchange markets, no net accumulation of foreign assets can occur. In what follows, the results obtained in the presence of inter-market transactions will be compared with those in the corresponding no-leakage economy.

III. Macroeconomic Effects of Structural Disturbances

The solution to the model described above is found by the methods of Muth and Lucas. Since the details of this procedure are well-known, we simply state and discuss the results. Table 1 lists the effects of various disturbances (n_t, ξ_t, u_t and q_t) upon the nominal financial rate, the price level, level of reserves and both real exchange rates.

1. Unanticipated devaluation

First consider the effects of an unanticipated devaluation of the commercial exchange rate as represented by $n_t > 0$. 1/ Such a devaluation could be undertaken as an interim measure pending eventual exchange rate re-unification in order to bring the member country in compliance with Article VIII, Section 3 of the Articles of Agreement of the Fund. Several countries did in fact devalue the commercial exchange rate prior to final abolition of the dual market regime. 2/ 3/

1/ An anticipated devaluation of the commercial exchange rate is fully neutral in that the price level and the financial exchange rate increase equiproportionately with no effect upon output.

2/ See Pinto (1987) for details regarding country experiences with re-unification in Africa.

3/ At this juncture it should be noted that in the long-run, commercial devaluation--anticipated or unanticipated-leads to equiproportionate financial depreciation, thereby leaving the spread unaffected. It is clear therefore, that permanent re-unification cannot be achieved by attempting to eliminate the spread via commercial devaluation. Rather, the abolition of dual rate markets requires the judicious use of policy instruments in addition to the commercial exchange rate. This point has also been noted by other authors, for example, Lizondo (1987). It should also be noted that the persistence of a long-run spread is attributable to

Table 1. Effects of Structural Disturbances upon the Domestic Economy

Variable Disturbance	Nominal Financial Rate and Spread	Price Level	Reserves
Unanticipated commercial devaluation (n_t)	$\frac{[\psi^e\gamma^e - d_1\lambda + \alpha b(d_1\phi + \psi^e\beta^e)]}{\Omega}$	$\frac{(\psi^e\gamma^e - d_1\lambda)}{\Omega}$	$\frac{(\psi^e\gamma^e - d_1\lambda) + \psi^e b(\gamma^e\phi + \lambda\beta^e)}{\Omega}$
Allocative trade balance disturbance (ξ_t)	$-\frac{(\frac{1-\alpha}{\alpha})\ \psi^e}{\Omega}$	$-\frac{\frac{(1-\alpha)^2}{\alpha}\ \psi^e}{\Omega}$	$\frac{\psi^e\ (\frac{1-\alpha}{\alpha})\ [\lambda + (1-\alpha)(1+\phi b)]}{\Omega}$
Domestic output supply innovation (u_t)	$\frac{(d_1\phi + \psi^e\beta^e)}{\Omega}$	$\frac{(1-\alpha)(d_1\phi + \psi^e\beta^e)}{\Omega}$	$\frac{\psi^e(\beta^e\lambda + \phi\gamma^e) + (1-\alpha)[\psi^e\beta^e + d_1\phi]}{\Omega}$
Foreign price level shock (q_t)	$\frac{b(d_1\phi + \psi^e\beta^e)}{\Omega}$	$\frac{(\psi^e\gamma^e - d_1\lambda)}{\Omega}$	$\frac{(\psi^e\gamma^e - d_1\lambda) + \psi^e b(\gamma^e\phi + \lambda\beta^e)}{\Omega}$

$\Omega \equiv [\psi^e\gamma^e - d_1\lambda - (1 - \alpha)b(\psi^e\beta^e + d_1\phi)] \gtrless 0$

real money supply, thus necessitating an increase in the domestic asset yield i_t to re-equilibrate this market. Finally, it is clear from equation (8) that the increase in domestic asset yields occasions expected financial depreciation, which in turn, implies current financial depreciation in view of the permanent nature of the disturbance.

It is also readily verified that (provided the interest semi-elasticity of money demand, i.e., λ, is large enough) the coefficient attached to the effect of commercial devaluation on the financial exchange rate is decreasing in both α and γ^e. Since an enhanced degree of financial repression is characterized by lower values of α and γ^e (representing a high degree of compulsory cross-transactions as well as high penalty costs associated with fraudulent cross-transactions), it follows by necessary implication, that commercial devaluation is expected to cause greater financial depreciation in an economy that is already subject to pervasive external financial repression. By contrast, the domestic price level is more insulated in the same circumstances. It is apparent, therefore, that variations in the extent of financial repression imply a tradeoff between the resulting price-output and financial exchange rate movements associated with commercial devaluation.

Finally, it should be noted that the effects noted above apply in the "normal" case wherein the parameter λ is sufficiently large. On the other hand, if the parameter γ^e is large enough, it may be verified that $\Omega > 0$ so that commercial devaluation leads to greater-than-proportionate financial exchange rate and price level adjustments, i.e. to "over-shooting" in both of these variables. 1/ Over-adjustment of the financial rate implies that commercial devaluation leads in fact, to an <u>increase</u> in the exchange rate spread. In these circumstances, therefore, a policy of commercial devaluation would not succeed in achieving even temporary diminution of the exchange rate spread and would be extremely ill-advised. However, this type of situation is concededly unlikely to occur.

The somewhat complex nature of these results may be compared with those obtaining in cases where the exchange markets are effectively segmented. As will be recalled, this case is generated by setting $\alpha,\omega = 1$ along with $\gamma^e = 0$ and $T^x = 0$. Inspection of Table 1 under these constrained values makes it clear that the price level increases equiproportionately when exchange markets are perfectly segmented with no effect

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1/ A high value of γ^e implies low penalty costs associated with cross-transactions. This may occur for example, if enforcement of exchange regulations is extremely lax or if private cross transactions are of a permissive character. Permissive cross-transactions have in fact, been authorized in the past by the BLEU by granting certain traders an "option" to transact in the exchange market of their choice (subject to certain mandatory eligibility requirements).

upon the real commercial rate. At the same time the nominal financial rate undergoes less-than-proportionate depreciation. There is, however, no possibility of financial exchange rate or price level overshooting, or of an increase in the spread following commercial devaluation, if exchange markets are effectively separated. In conclusion then, it is the presence of inter-market leakage that admits of the possibility of unconventional results.

2. Allocative trade balance disturbance

Consider next the implications of an unsystematic increase in the financially-settled trade balance which is matched (in natural units) by an equivalent decrease in the commercially-settled trade balance. 1/ Such an allocational disturbance is represented by the random term ξ_t taking on a positive value.

Inspection of the results in the Table indicates that an unsystematic shift in favor of the financial market leads, in the normal case, to financial depreciation coupled with price inflation and reserve decumulation. At the same time, the financial real exchange rate depreciates while the commercial real rate undergoes appreciation. Additional settlements in the financial market cause "pressure" in this market and hence occasion financial depreciation in the normal case. The effect upon domestic prices follows from the "effective" purchasing power parity relationship stated in (3). The latter equation makes it clear that the price effect falls short of the extent of financial depreciation, leading thereby, to financial real depreciation as stated above. 2/

3. Domestic supply innovations

A domestic supply innovation (as represented by $u_t > 0$) leads in the usual case to price deflation coupled with financial nominal appreciation. Because the commercial rate is pegged, the price deflation necessarily implies commercial real depreciation, while on the other hand, the financial real exchange rate undergoes appreciation. It is clear, of course, that the adjustment in the price level is directly attributable to the presence of compulsory cross-transactions. If there were no leakage for example, then the domestic price level is set with reference to the commercial exchange rate and foreign price level and is consequently

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1/ By contrast a change in α is a systematic change in the allocation of current account transactions between the two exchange markets that is attributable to administrative fiat.

2/ As noted previously, these effects are contingent upon reasonable values of the underlying parameters such that Ω is negative. A sufficiently high value of γ^e however, could lead to Ω being positive, in which case all the qualitative results are reversed.

unaffected by domestic supply disturbances. With cross transactions, however, the re-alignment of the financial rate impinges directly upon the price level (via the definition of the "aggregate" exchange rate). The appreciation of the nominal financial rate is explained by noting that the increase in domestic output supply causes excess demand in the money market, necessitating a corresponding increase in domestic asset yields. As a consequence, the financial nominal rate appreciates in order to maintain uncovered asset yields in line.

4. Foreign price disturbances

In the absence of cross-transactions an increase in the foreign price level would lead to an equiproportionate rise in the domestic price level and, therefore, to an unchanged commercial real rate. In the present case (i.e., with leakage), however, the effect upon the domestic price level is less than equiproportionate. This is due to the partial offset provided by the financial appreciation attendant upon such a disturbance, operating via the "aggregate" exchange rate in (3). In this sense, the presence of inter-market transactions operates as a "shock-absorber" and partially insulates the home economy against externally-occurring inflation. This cushioning effect is, as expected, directly related to the degree of leakage, as measured by $(1-\alpha)$. Finally, it is seen that (in the usual case), the commercial real exchange rate depreciates in response to the external inflation while the financial real rate undergoes appreciation.

The caveats noted earlier are equally applicable in the present instance. Specifically, the above properties are to be considered "normal" results that are expected to obtain in the usual case. However, two other possibilities also exist. Thus, for γ^e sufficiently high so that both $(\psi^e\gamma^e - d_1\lambda)$ and Ω are positive, the financial exchange rate depreciates on impact of the foreign price increase. Consequently, the domestic price level increases more than proportionately, i.e. magnified transmission can be said to have occurred. Higher values of α now dampen these observed price-exchange rate effects. A third (and seemingly perverse) outcome is also possible. For moderate values of γ^e especially in conjunction with low α, it is possible that $(\psi^e\gamma^e - d_1\lambda) > 0$ while $\Omega < 0$. In this case, external inflation leads to declining financial exchange rate and price levels, i.e., the domestic economy experiences negative transmission. By contrast, as pointed out above, none of these results would occur in the absence of cross-transactions. Specifically, the domestic price level would increase equiproportionately with the foreign price level with a less-than-proportionate financial appreciation.

It is clear, therefore, that the transmission properties of such an economy are heavily dependent upon the existing degree of leakage and the penalty costs associated with fraudulent cross-operations between the two

exchange markets (which in turn affect the responsiveness of exports to the exchange rate spread).

IV. Conclusion

This paper has analyzed the macroeconomic implications of various structural disturbances in an economy that maintains a multiple-tier exchange regime. A key feature of the model presented is its explicit recognition that both compulsory and fraudulent cross-transactions between the exchange markets are pervasive in reality. The framework is utilized to discuss the effects of commercial devaluation, allocative disturbances between exchange markets, domestic supply innovations, and of external inflation upon certain domestic macro variables of interest such as price-output levels, real exchange rates and the exchange rate spread. It is seen that the degrees of compulsory cross-transactions and the penalty costs associated with illicit trade transactions substantially influence both the qualitative and quantitative nature of the results obtained. For example, it is possible for commercial devaluation to lead, in the short-term, to a widening of the exchange rate spread and for external price disturbances to lead to magnified or even negative effects upon the domestic price level. While these results have been obtained in the context of a simple one-good model, they can be shown to be robust to an extension incorporating a more elaborate two-good framework.

The principal lesson to be learned from this exercise is that popular notions as to the effects of commercial devaluation or of other disturbances in a dual exchange rate economy are to be accepted with very considerable caution when the regime involves inter-market transactions. Consequently, the authorities should only embark upon any program of exchange rate reform or stabilization when sufficient information is available in order to evaluate the probability of its success. Such information is necessarily more detailed than is commonly supposed to be relevant, in that it includes values of parameters such as the penalty costs associated with illicit trade transactions and the existing degree of officially-authorized settlements of current account items in the financial market.

APPENDIX

The purpose of this Appendix is to provide a derivation of the accumulation equations (12) - (13) contained in the text.

First note that expected accumulation of real wealth in natural units is:

$$E_t \left[\frac{W_{t+1}}{P_{t+1}} - \frac{W_t}{P_t} \right]$$

which may be approximated by $[(E_t, w_{t+1}) - (E_t, p_{t+1} - p_t)].\frac{W_t}{P_t}$. Next, the logarithms of the two savings functions T^e and T^x are stated in (6a) and (6b) and are:

$$\ln T^e = [\beta^e y_t - \gamma^e (x_t - \bar{e}_t) - \eta_t]$$

$$\ln T^x = [\beta^x y_t + \gamma^e (x_t - \bar{e}_t) + \xi_t]$$

We now hypothesize the forms of the savings functions in natural units per-unit real wealth. The per-unit-wealth functions depend upon the same arguments as the logarithmic functions but involve different coefficients, i.e.,

$$\tilde{T}^e \equiv \frac{T^e}{(W/P)} = [\beta'^e y_t - \gamma'^e (x_t - \bar{e}_t) - \eta'_t]$$

$$\tilde{T}^x \equiv \frac{T^x}{(W/P)} = [\beta'^x y_t + \gamma'^x (x_t - \bar{e}_t) + \xi'_t]$$

It is straightforward to verify that the coefficients of T^e and T^x (when evaluated at the initial point) are related to those of $\ln T^e$ and $\ln T^x$ via $\beta'^e = \psi^e \beta^e$, $\gamma'^e = \psi^e \gamma^e$, $\beta'^x = \psi^x \beta^x$, $\gamma'^x = \psi^x \gamma^x$. In addition, $\eta'_t = \psi^e \eta_t$ and $\xi'_t = \psi^x \xi_t$. It may also be noted that ψ^e and ψ^x are themselves interrelated via:

$$\frac{\psi^e}{\psi^x} = \frac{\alpha}{1 - \alpha}$$

The next step is to equate T^e and T^x with the appropriate components respectively, of total expected wealth accumulation. In order to preserve log-linearity of the model, it is convenient to assume a special form of the process governing the allocation of wealth between money accumulation and foreign asset accumulation. Specifically, the savings components T^e T^x (in natural units) result in accumulation of money and foreign assets according to:

$$T^e = E_t \left[\frac{M_{t+1}}{P_{t+1}} - \frac{M_t}{P_t} \right]^{d_1} \cdot \frac{M_t/P_t}{(M_t/P_t)^{d_1}}$$

$$T^x = E_t \left[\frac{X_{t+1} K_{t+1}}{P_{t+1}} - \frac{X_t K_t}{P_t} \right]^{1-d_1} \cdot \frac{W_t/P_t}{(X_t K_t/P_t)^{1-d_1}}$$

These processes are indeed special; however, other allocation processes would involve additional linearizations. Accordingly, the per unit wealth functions $\tilde{T}^e$ and $\tilde{T}^x$ may be approximated by:

$$\tilde{T}^e = d_1[(E_t, m_{t+1} - m_t) - (E_t, p_{t+1} - p_t)]$$

$$\tilde{T}^x = (1 - d_1)[(E_t, x_{t+1} - x_t) + (E_t, k_{t+1} - k_t) - (E_t, p_{t+1} - p_t)]$$

Equations (12) and (13) in the text result from equating the above relations with the behavioral forms of $\tilde{T}^e$ and $\tilde{T}^x$ previously stated.

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