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"TRUE FINANCIAL OPENING UP": THE ANALYSIS OF CAPITAL ACCOUNT LIBERALIZATION IN A GENERAL EQUILIBRIUM FRAMEWORK

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I. INTRODUCTION

THERE is still an ongoing debate relating to the sequencing of structural reforms in LDCs. Although a large number of *empirical* studies have been carried out, especially on trade liberalization, the evidence with regard to the sequencing issue is not clear; "experience has been too meager to afford solid lessons, and we have to rely on a priori analysis" [29, p. 16]. At the *theoretical* level there are two basic conflicting opinions, which have been recently reviewed by Edwards [12].

The "capital account first" position is defended in a strong form by Lal [26] and in a moderate version by Bhandari [2] and Sell [34]. Lal finds that liberalizing the capital account first will "minimize the information required to set particular nominal values (of the exchange rate) at their optimal levels, and hence to avoid the risk of mistakes in the desirable extent and even the direction of changes of the nominal exchange rate" [26, p. 294].

Sell [34], on the other hand, argues for the benefits (in terms of external competitiveness, price level, and emloyment) that accrue when trade liberalization is implemented along with an already liberalized account. However, he claims that "the liberalization of the capital account with a given trade account, either liberalized $[CA(TA)]$ or still regulated $[CA(\overline{TA})]$, still has to be evaluated. As a 'rule,' the capital-account-first sequencing will be preferred whenever the benefits of $[TA(CA) - TA(\overline{CA})]$ exceed those of $[CA(TA) - CA(\overline{TA})]$."[1]

Only Bhandari has interpreted capital controls as a restriction of free currency convertibility by a dual exchange rate regime. In his sophisticated model, tariff liberalization leads to an appreciation of the real financial rate "coupled with price deflation and an increase in output" [2, p. 497] at existing capital controls. If policymakers' objectives are limited to domestic output-price targets, then a "current account first" sequence is preferable. "By contrast, if policymakers' sole concern were with external competitiveness or with the exchange rate spread [which

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[1] Sell [34, p. 648]. CA = liberalize capital account, (CA) = capital account already liberalized, $(\overline{CA})$ = capital account regulated, TA = liberalize trade account, (TA) = trade account already liberalized, and $(\overline{TA})$ = trade account regulated.

accrue better at relaxed capital controls], then the 'capital account first' scenario should be chosen" [2, pp. 509–10].

The (more recent) "trade account first" position is adopted by Edwards, and Edwards and van Wijnbergen. Edwards [13] developed an intertemporal equilibrium model in order to analyze the way in which the equilibrium real exchange rate reacts to a reduction in tariffs and to a capital account liberalization. He shows that "in a world with...exportables, importables and nontradeables...a reduction in tariffs can, in general result in either an equilibrium real exchange rate depreciation or appreciation" [12, p. 10–11]. In his model, capital account liberalization, however, will always result in a real exchange rate appreciation (at least, in the first of two periods). This "deprotects" the tradeables' sector and, hence, the capital account liberalization should be postponed until the tradeables' sector is "strong enough" to absorb the effects of a(nother) real exchange rate appreciation.

In an analysis based on the *transfer problem* framework, Edwards and van Wijnbergen [16] argue that if the capital account is liberalized in the presence of trade distortions, welfare will be negatively affected (sufficient condition) "if the funds obtained from abroad are (partially) used to increase investment" [16, p. 147], thus, they amplify the preexisting distortions.

Surprisingly, most contributions to the sequencing issue still assume that once the capital account is opened, the domestic economy will be able to borrow from abroad. This argument is supplemented also by the view that under "normal conditions"—with a reformed domestic capital market and a successful stabilization policy—real interest rates should be substantially higher in developing than in developed countries. This view seems to be rather theoretical,[2] as Edwards already pointed out in 1984: "since 1982...many countries have faced temporary credit rationing imposed in international capital markets. Under these circumstances, opening the capital account will probably not result in additional capital inflows" [10, p. 19].

It is, therefore, our aim in this paper to define firstly what are the "true circumstances" of a capital account liberalization (hereafter CAL) for highly indebted developing countries nowadays (Section II). Thereafter, we will make use of the analytical instruments which have revealed themselves to be so useful for the analysis of trade liberalization ("true exposure") to examine the effects of a CAL in a general equilibrium framework. By analogy, we will call this approach "true financial opening up" (Section III). The disadvantage of this procedure is that money and other financial assets are not explicitly considered. On the other hand, a similar analytical framework facilitates comparisons and enables us to find some new aspects for the sequencing debate. Then in Section IV, effects of a CAL on prices, exchange rate, and production are discussed along with the transition process. Special emphasis is placed on alternative trade regimes which suggest some answers to the sequencing of the liberalization debate. Finally, conclusions and a summary follow in Section V.

[2] For example, in a number of NICs *real* capital cannot be considered any longer to be scarce.

II. "TRUE CIRCUMSTANCES" OF CAL IN HIGHLY INDEBTED LDCs

Since the Mexico case in 1982, foreign debt of developing countries, especially in Latin America, has grown only slowly. While the experience of credit rationing started in the early 1980s, by the end of the 1980s most of the debtors became credit-constrained [21, p. 7]. As an extreme case, a debtor may be completely cut off from the international capital market. As Hofman and Reisen have shown [21, pp. 12–17], the inability to borrow as much as desired implies "that the shadow price of capital is higher than the world interest rate" [21, p. 14]. Of course, a relaxation of the credit constraint would lower the shadow price of capital, and increase investment. For the economy concerned there are basically two options: either the "inherited capital flight"[3] is lowered by repatriation (foreign sources) or domestic savings are increased (see [9, p. 35]). While the latter strategy would be difficult to adopt in the short and medium run, as the marginal and average propensities to save have proven to be rather rigid parameters, a country may find it easier to stop capital flight (*flows*) and to encourage domestic agents to repatriate parts of the existing *stock* of the capital.

One may argue that if the capital is in fact repatriated then foreign credits *and* foreign private investment may begin again to flow into the country as well. The actual Mexico case tends to support the view of more or less simultaneous inflows. Also, from an empirical point of view, it appears that the determinants for capital flows either in the form of bank credits, foreign private investment, or reflows of capital flight are very similar. However, it is likely that bank surveillance guidelines will make credit flows more difficult than investment capital. And for the latter, it can be assumed that there is an informational advantage in favor of *domestic* owners of capital compared to *foreign* investors.

Apart from the relaxation of the credit constraint, the repatriation of capital has some additional advantages. Contrary to the international transfer of capital it is *not* characterized by informational asymmetries [6, pp. 6–19]. The domestic principal, unlike the foreign principal, *does* know how much is effectively invested after the repatriation of capital. Then, the distinction between cooperative and noncooperative equilibria between agents and principals becomes irrelevant [6, pp. 11–15].

Also, as there is no reason to assume the existence of changes in the time preference, one can expect that almost every dollar repatriated by domestic residents will be invested and not consumed.[4] Where do the incentives to repatriate capital come from? One assumption which can be deduced from the literature is that the abolition of currency overvaluation, as a major source of earlier capital flight [8, p. 28], may be a necessary although not a sufficient condition. Sound macroeconomic policies (low fiscal deficits and inflation rates), appropriate struc-

[3] This may be the only form of *net* transfers available from outside the country.

[4] Hence this argument assumes that capital not invested *any longer* abroad would be invested domestically. This is a modification of the opinion shared by Gordon and Levine [18].

tural reforms, political stability [8, p. 29], and attractive growth prospects should be present as well [32, p. 14].[5]

A major indicator for currency overvaluation in developing countries is and has always been the black market premium. This premium serves as a proxy for "measuring the severity of capital controls" [15, p. 396]. Of course, the black market premium "will tend to capture a variety of factors, including the effect of actual and expected capital controls" [15, p. 396]. As Pinto [31] and others have shown, however, the rationing of the official foreign exchange market through capital controls (and possibly additional instruments) is a *sufficient* condition to give rise to a black market where the currency floats freely [31, p. 4]. If the government "abandons rationing and lets the market determine the rate of exchange and currency depreciation...all transactions are...at the market exchange rate so that the premium vanishes" [31, p. 12].

It is in this sense that we will analyze the impacts of a CAL under more or less severe trade restrictions in a typical highly-indebted LDC. The approach adopted is in a way parallel to a recent contribution by J. S. Bhandari, "Trade Reform under Partial Currency Convertibility" [2]. The technique selected, which draws on our earlier analysis (Sell [34]), will however be less sophisticated. The general equilibrium model presented in the following section resembles that on which we built "true exposure"; it is briefly outlined in the following section.

III. TRUE FINANCIAL OPENING UP: OUTLINE OF ITS DIMENSIONS

Consider a small open economy which produces and consumes nontradeables, importables, and exportables. The domestic prices of importables (P_M) and exportables (P_X) are determined by their international prices (P^*), the nominal exchange rate (E), and domestic import tariffs (t)/export subsidies (s):

$$P_M = EP_M^*(1 + t), \tag{1}$$

$$P_X = EP_X^*(1 + s). \tag{2}$$

The domestic terms of trade are then given by:

$$P_M/P_X = (P_M^*/P_X^*)(1 + t)/(1 + s), \tag{3}$$

and are independent of the nominal exchange rate (E).

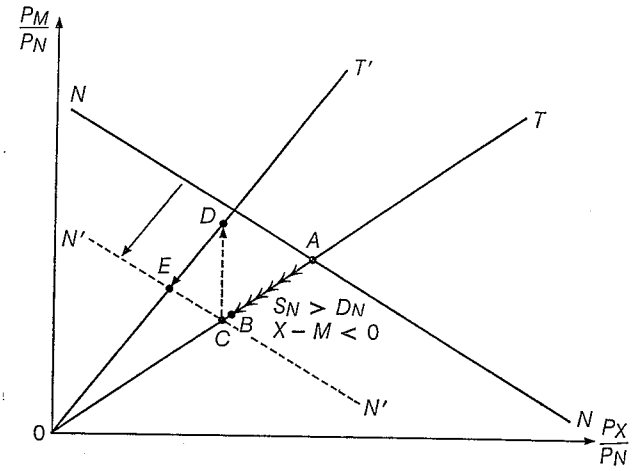
Prices of nontradeables (P_N) are in equilibrium, when the market for nontradeables clears. This, in turn, is associated with a balance of trade equilibrium, *when* income equals absorption [34, p. 636]. Demand for nontradeables (D_N) is assumed to be a function of relative prices *and* of income (Y):

$$D_N = D_N(P_M/P_N, P_X/P_N, Y). \tag{4}$$

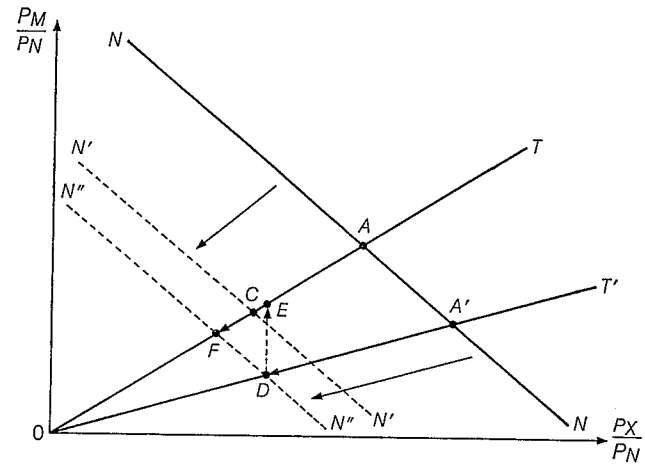
[5] "It has been argued that the stock of flight capital in Argentina declined in 1986 (implying repatriation) following the adoption in June 1985 of a comprehensive adjustment program which was initially successful in bringing down inflation" [32, p. 14].

Fig. 1. Impact of CAL in Three-Good Economy

A. Case 1



B. Case 2



If we assume that nontradeables can be substituted for exportables and/or importables in production as well and that the productive factor L remains constant, we obtain the supply of nontradeables (S_N); where K stands for the capital stock:

$$S_N = S_N(P_M/P_N,\ P_X/P_N,\ K,\ \overline{L}). \tag{5}$$

When the market for nontradeables clears, equation (4) equals equation (5) with the relative price of traded goods given exogenously by equation (3). The relative price of traded goods can be represented graphically by a ray through the origin (OT) in a (P_M/P_N, P_X/P_N) diagram (Figure 1-A). The market equilibrium

for nontradeables is a negatively sloped schedule (*NN*) whenever home goods are substituted for both tradeables. The short-run impact of a capital account liberalization within this framework is a move along the ray *OT* towards the origin (*B*), starting from the original equilibrium in *A*.

This move is due to the fact that the repatriation of capital induces a rightward shift in the supply curve of foreign exchange (capital import) and an appreciation of the nominal exchange rate. This appreciation is accompanied by a balance of trade *deficit* at lower domestic prices of both importables and exportables and a *supply surplus* on the market for nontradeables. This imbalance could, in principle, be matched by decreasing prices for nontradeables (move back to *A*). However, due to the effects of investment on income in the domestic economy, the *NN* schedule will shift to the left (*N'N'*).[6]

Usually, this shift will be strong enough (*C*) to turn the supply surplus on the market for nontradeables into an excess demand.[7] The income, or better absorption effects (of invested repatriated capital) increase the demand for nontradeables *and* for tradeables leading to an *additional* balance of trade deficit[8] and rising prices of nontradeables [35, pp. 402–3]. However, this downward shift will be stronger (*N"N"*) if trade liberalization has already occurred, i.e., if *OT'* gives the relevant domestic relative price of importables in terms of exportables (See Figure 1-B).[9] This fact has been implied by Bhagwati [1].

In developing countries capital controls often take the form of foreign exchange rationing. "In this case, firms will have the incentive to gain access to foreign exchange by underinvoicing their exports and overinvoicing their imports" [36, p. 66]. Assuming the presence of exchange controls, we can conclude that if the black market premium on foreign exchange is P per cent, the incentive to underinvoice for any exporter will exist only if $P > s$. If x is the percentage by which exports are underinvoiced, the exporter will enjoy a profit of $(P - s)x$ per cent. Correspondingly, a similar analysis is valid for the import side. If t stands for the import tariff, a representative importer will have the incentive to overinvoice when $t < P$. If y is the percentage by which imports are overinvoiced, the importer will enjoy a profit of $(P - t)y$ per cent [1, pp. 67–68].

Assuming that the amount of the past capital flight was primarily a function of the profits that could be earned, the repatriation of capital will, ceteris paribus, be larger, if trade liberalization took place beforehand. Thus, there is a *simultaneity problem* with capital account liberalization (linked to the sequencing issue) which, to my knowledge, has only been considered in the literature so far by Bhandari [2].

Whether the repatriation of capital can be treated as a net exogenous transfer depends among other things on whether the interest earnings on the capital were

[6] To allow the transfer of capital, "domestic output of non-traded goods *must* rise and that of traded goods fall" [25, p. 686].

[7] Which implies that the (direct+indirect) income effects of capital inflows for the benefit of a higher absorption of nontradeables dominate the substitution effects against the absorption of nontradeables.

[8] As absorption exceeds domestic income. This is reflected by the distance *BC*.

[9] Let us assume that t always exceeds s.

remitted previously to the domestic economy. If so, opportunity costs of the repatriation may arise. We here assume that this was not the case because owners of such capital *accumulated* interest earnings outside the country.

As can be seen from Figure 1-B, the decrease in *relative prices* of importables and exportables will, ceteris paribus, be larger, if the trade account has already been liberalized. It is important to realize that both C and D (as possible new equilibria on the market for nontradeables) are associated with a deficit of the balance of trade.[10] Rewriting equations (4) and (5) in percentage changes, when considering the market-clearing condition for nontraded goods, leads to the expression:

$$\eta_M(\hat{P}_M-\hat{P}_N)+\eta_X(\hat{P}_X-\hat{P}_N)+\eta_Y\hat{Y}=\varepsilon_M(\hat{P}_M-\hat{P}_N)+\varepsilon_X(\hat{P}_X-\hat{P}_N)+\varepsilon_{N,K}\hat{K},^{11} \tag{6}$$

where a circumflex mark ($\hat{}$) indicates a percentage change; the η's represent the demand elasticities for home goods with respect to real income (η_Y), the prices of importables (η_M), and exportables (η_X), and ε_M and ε_X are the corresponding supply elasticities [34, p. 638].

Rearranging equation (6) leads to:

$$\gamma_M(\hat{P}_M-\hat{P}_N)+\gamma_X(\hat{P}_X-\hat{P}_N)-\varepsilon_{N,K}\hat{K}+\eta_Y\hat{Y}=0, \tag{7}$$

where $\gamma_M=\eta_M-\varepsilon_M>0$ and $\gamma_X=\eta_X-\varepsilon_X>0$, as η_X, $\eta_M>0$ and ε_M, $\varepsilon_X<0$.

From equation (7), it follows that:

$$\hat{P}_N=\frac{\gamma_M}{\gamma_M+\gamma_X}\hat{P}_M+\frac{\gamma_X}{\gamma_M+\gamma_X}\hat{P}_X-\frac{\varepsilon_{N,K}}{\gamma_M+\gamma_X}\hat{K}+\frac{\eta_Y}{\gamma_M+\gamma_X}\hat{Y}.^{12} \tag{8}$$

For the following discussion the subsequent definitions shall hold:

$$\omega=\frac{\gamma_M}{\gamma_M+\gamma_X},\ (1-\omega)=\frac{\gamma_X}{\gamma_M+\gamma_X},\ \theta_N=\frac{-\varepsilon_{N,K}}{\gamma_M+\gamma_X},\ \text{and}\ \psi=\frac{\eta_Y}{\gamma_M+\gamma_X}.$$

Contrary to our earlier analysis [34, pp. 639, 644–45], however, the price elasticities cannot be treated any longer as compensated elasticities, for income turns out to be one explicit variable determining the demand for nontradeables.

Equation (8) implicitly introduces a nontradeables' investment function into the model; capital inflows increase domestic income which is invested in nontradeables according to the income elasticity (η_Y). If investment goods were entirely imported, then the η_Y value would be zero here and there need be no change in domestic

[10] As recommended by Dornbusch [7], we abstract from purchasing power effects due to the collection/redistribution of tariff proceeds. See Sell [34, p. 638].

[11] The additional income ($\hat{Y}$) is treated as exogenous, stemming from new investment due to a repatriation of capital by domestic residents. The elasticity ($\varepsilon_{N,K}$) denotes the extent (in percentages) to which the production of nontradeables increases when the stock of national capital grows by 1 per cent.

[12] Hence, an increase in the national capital stock ($\hat{K}$) will lower the absolute and relative price of nontradeables, ceteris paribus.

relative prices in the *short run.* In the *long run,* the nontradeables' market equilibrium is altered by both the spending ($\psi\hat{Y}$, the author) and the capacity effects ($\theta_N\hat{K}$, the author) of investment.

IV. TRUE FINANCIAL OPENING UP: NEW ANSWERS TO OLD QUESTIONS?

A. *Effects of CAL on Prices*

As equation (8) shows, there are three factors that determine the evolution of the prices of nontradeables in the course of a capital account liberalization: (i) in the *short* run the appreciation of the exchange rate ($\hat{E} = \hat{P}_M = \hat{P}_X < 0$)[13] tends to lower the prices of nontradeables; (ii) in the *medium* run, the income effects ($\hat{Y} > 0$) tend to increase the prices of nontradeables; and (iii) in the *long* run the newly installed capacities ($\hat{K} > 0$) will tend to dampen the prices of nontradeables, ceteris paribus. In this section we will concentrate on (ii), as the effects of a CAL on exchange rate and production shall be later discussed in detail.

The shift in the *NN*-curve due to the effects of a CAL on income is characterized by two aspects: one is the *size* of the income elasticity of demand for nontradeables (η_Y), and the second is concerned with the *slope* of *NN*. As a number of empirical studies have shown, the level of the income elasticity of the demand for nontradeables is primarily a function of income per head. In LDCs such as Bangladesh η_Y is approximately 0.4 wheras in newly industrializing countries such as South Korea η_Y is close to one [33, p. 292].

The slope of *NN,* on the other hand, depends on the substitutability between the three goods (nontradeables, importables, and exportables) with regard to consumption *and* production [34] [7]. As we have discussed previously, there are six possible cases, of which cases 1, 3, and 6 are particularly relevant for LDCs / newly industrializing countries [34, pp. 639–42].

Figure 2 shows relevant situations; increases in the prices of nontradeables tend to be the highest[14] when there is a weak/semi-strong substitutability of X and N or a weak/semi-strong complementarity of M and N (Case 4) and also when there is a weak/semi-strong substitutability of M and N or a weak/semi-strong complementarity of X and N (Case 6).[15] Cases 3 and 5 are associated with "medium" price effects, compared to cases 1 and 2, where the lowest price effects are, ceteris paribus, to be expected. Thus, whenever home goods are substituted for *both* tradeables, the income induced increases of prices of nontradeables after a CAL will be relatively small.

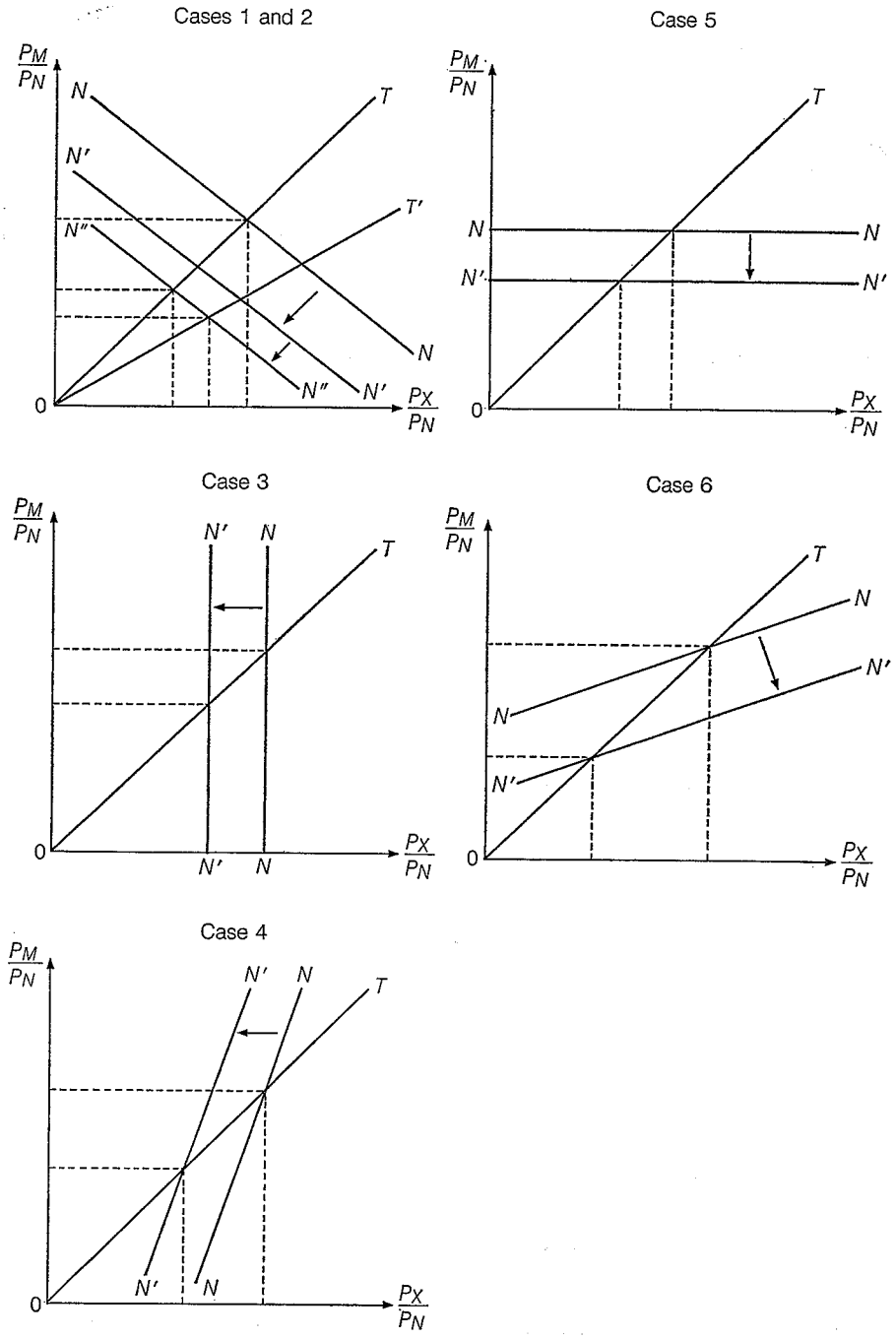
[13] Equation (8) can be simplified to:

$$\hat{P}_N = \hat{E} + \frac{\eta_Y}{\gamma_M + \gamma_X}\hat{Y} - \frac{\varepsilon_{N,K}}{\gamma_M + \gamma_X}\hat{K}.$$

[14] At a given income elasticity of demand for nontradeables.

[15] For a further distinction of cases with regard to factor intensities and substitutability in consumption and production, see Sell [34, Table 1].

Fig. 2. Effects of CAL on Prices: Cases 1 through 6



B. *Effects of CAL on Exchange Rate*

Since the very beginning of the sequencing debate [27] [19] [20] [10], it has been generally recognized that whenever a CAL leads to capital inflows and whenever "a fraction of these additional foreign funds is spent on nontradeable goods, their absorption will require an increase in the relative price of nontradeables and a real appreciation of the domestic currency" [10, pp. 5–6].

One should be very specific on this topic, as there are at least three different exchange rate concepts: the nominal exchange rate (E); the real exchange rate (e), which gives us the internal price of tradeables and nontradeables; and finally the purchasing power parity real effective exchange rate (ep) which reflects the degree of external competitiveness of a country. In order to evaluate the impact of capital inflows on these key exchange rates we will rely on the following macroeconomic equilibrium model:[16]

$$ep=EP_F/P_D; \quad \text{purchasing power parity real effective exchange rate (PPP-REER)} \tag{9a}$$

$$ep=E/P_D; \quad \text{with } P_F=1,$$

$$e=P_T/P_N; \quad \text{real exchange rate,} \tag{10a}$$

$$P_N=P_M{}^{\omega}P_X{}^{(1-\omega)}Y^{\psi}K^{\theta N}; \quad \text{nontradeables' price equation,} \tag{11a}$$

$$P_T=P_M{}^{\alpha}P_X{}^{(1-\alpha)}; \quad \text{tradeables' price equation,} \tag{12a}$$

$$P_D=P_T{}^{\beta}P_N{}^{(1-\beta)}; \quad \text{domestic price equation,} \tag{13a}$$

$$P_M=EP_M{}^*(1+t); \quad \text{importables' price equation,} \tag{14a}$$

$$P_X=EP_X{}^*(1+s); \quad \text{exportables' price equation,} \tag{15a}$$

$$E=CI^{*\delta}, \ \hat{E}=\delta\hat{CI}^*, \ \delta<0; \quad \text{exchange rate equation,} \tag{16a}$$

$$CI=CI^*E; \quad \text{capital inflow equation,} \tag{17a}$$

$$\overbrace{Y=S_XP_X+S_MP_M+S_NP_N}^{\text{Nominal income}} + \overbrace{CI}^{\text{Nominal capital transfer}}, \tag{18a}$$

with

$$S_M=S_M(P_N/P_M, \ P_X/P_M, \ K, \ \bar{L}) \text{ and}$$
$$S_X=S_X(P_N/P_X, \ P_M/P_X, \ K, \ \bar{L}).$$

Endogenous: $e, ep, P_M, P_N, P_T, P_D, P_X, E, CI, Y.$
Exogenous: $P_X{}^*, P_M{}^*, P_F, s, t, CI^*, K.$

The following parameter restrictions should hold:

[16] This model can be taken as a considerable extension of an approach adopted by Edwards and Edwards in 1987 [14, pp. 74–77].

$$\varepsilon_{N,K}+\varepsilon_{M,K}+\varepsilon_{X,K}=1,^{17} \tag{19}$$

$$W_X+W_M+W_N+W_{CI}=1, \tag{20}$$

with

$$W_X=\frac{S_XP_X}{Y},\quad W_M=\frac{S_MP_M}{Y},\quad W_N=\frac{S_NP_N}{Y},\quad \text{and } W_{CI}=\frac{CI}{Y},$$

$$\text{and } \omega=\frac{\gamma_M}{\gamma_M+\gamma_X},\quad \gamma_M=\eta_M-\varepsilon_M{}^N,\quad \gamma_X=\eta_X-\varepsilon_X{}^N,\quad \text{and } \varepsilon_j{}^i<0,\ i\neq j. \tag{21}$$

The model consists of ten independent equations and three parameter restrictions / definitions. In order to simplify our analysis, we treat capital inflows in foreign currency as exogenous in a sense that once the capital account and the foreign exchange market are liberalized, in *each* following period a fraction of capital is repatriated.

Two scenarios have to be distinguished: (i) if the trade account had been liberalized earlier ($t, s=0$) one may expect the capital inflow ($\hat{CI}^*$) in each period to be higher, ceteris paribus; and (ii) if there are still tariffs and subsidies ruling ($t, s\neq 0$), the stock of capital to be repatriated is lower and so are the inflows ($\hat{CI}^*$) in each period, ceteris paribus.

Figure 3 depicts the dynamic evolution of the real exchange rate in the course of a CAL. The *first impact* (t_0, t_1) is an appreciation of the *nominal exchange rate* (E) in response to the capital inflow (see equation 16a) which is equivalent to the *real exchange rate* (e) appreciation in the short run, where prices of nontradeables are rigid. Thereafter, the *second impact* (t_1, t_2) reflects the *substitution and income effects* of the CAL which lead to a higher absorption of all goods and most likely to rising prices of the nontradeable goods.[18] The magnitude of this impact depends on a range of parameter values as can be seen from equation (10b) in the mathematical appendix.[19] *Finally* (t_2, t_3) as this further trend in appreciation is dampened (*third impact*) by the *capacity effects* of the CAL, the long-run equilibrium of the real exchange rate is higher than that of previous rounds (see equation 10b in the mathematical appendix). As a result, the CAL may lead to the well-known overshooting effects of the (real) exchange rate; all in all we have to distinguish, however, *three* impacts or phases, i.e., one more than what the overshooting model traditionally consisted of.

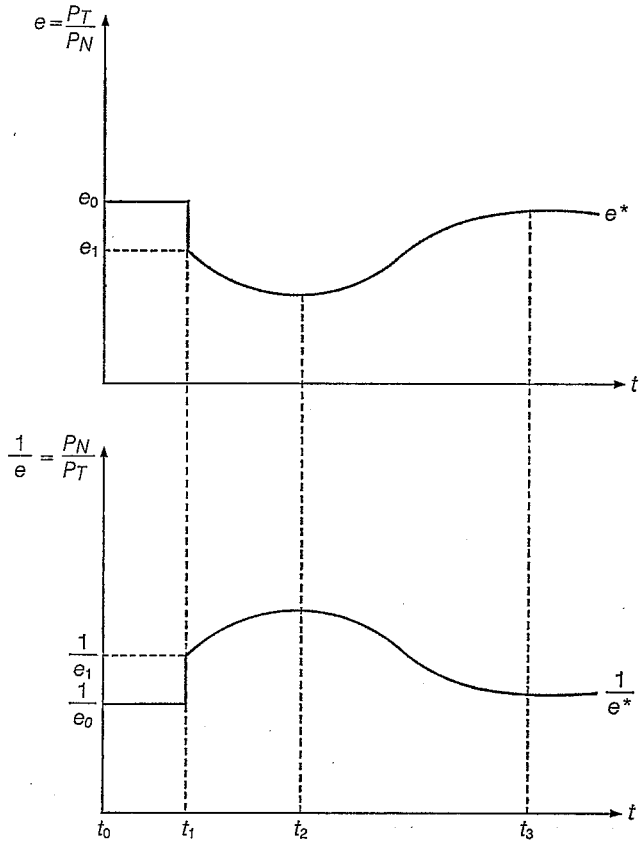
Figure 3, incidentally corresponds to S. Edwards's observation that "opening the capital account could result in a short-run appreciation of the domestic currency that exceeds the long-run appreciation. One such reason is related to the differences

[17] This assumption implies that $\hat{K}=\hat{Y}$, i.e., a constant capital coefficient. As we also assumed that the value of $\hat{L}$ was zero (see above), it is considered that the rise in the overall capital intensity of production is matched by an equivalent drop in the labor coefficient.

[18] See the discussion of Figure 1-A.

[19] According to Figure 3 the coefficient of $\hat{CI}^*$ should exceed δ. Thus, the second term in the braces that accompanies $\hat{CI}^*$ in equation (10b) should be negative!

Fig. 3. Overshooting Effects in Real Exchange Rate (e) in the Course of CAL



between short- and long-run elasticities of supply in the nontradeables-goods sector" [10, p. 7].[20]

As far as the PPP-REER (ep) is concerned, the effects are very similar to those on the real exchange rate (e). The coefficients of $\hat{CI}^*$ only differ (at $s = 0$) by a constant factor $(1 - \beta)$, the share of nontradeables in domestic absorption (see equation 9b in the mathematical appendix). Hence, the long-run deterioration of the external competitiveness due to a CAL is less pronounced than that in the short and medium run.

[20] The repatriation of transferred capital in our sense can be analyzed within the monetary setting put forward by Bruno as well. In his framework a change in exogenous capital flows causes a shift in the basic balance; "the only channel by which this may have an effect on the economy is the asset market, through a possible impact effect on expectations and a long-run effect on the total supply of foreign exchange assets" [4, p. 145].

C. *Effects of CAL on Production*

Even in the most recent literature there is still some ambiguity (sometimes even confusion) about what happens to the production of nontraded goods when the capital account is liberalized. This is primarily due to the often lacking systematic discussion of the *three* relevant criteria: (i) which time horizon is considered? (short/medium/long?); (ii) how will the capital inflows be utilized? (consumption/investment?); and (iii) do we allow for the possibility of an overshooting of the level of capital inflows in the short run? (presence/absence of overshooting?)

One may add that the results obtained depend further on the assumptions made with regard to the order of factor intensities (including or excluding the possibility of changes) and the likelihood of economies of scale. As a matter of fact the "trade account versus capital account first" literature has placed emphasis on predicting the effects when a *consumptive* utilization of capital inflows is considered (see Table I). If one adds the possibility of an *investitive* utilization in the picture, the results will neither differ in the short nor in the medium run; as in the consumptive case only the absorption effects of a higher disposable income will take place. In order to simplify the discussions we disregard the Keynesian "multiplier lemma" stating that it makes a difference whether the households receive the total amount of the increase in income out of which they increase consumption (into an extent determined by the marginal propensity to consume) or if the increased income is spent fully in the first round in the form of investment. In the (very) long run, however, one may argue that since relative prices at the output as well as at the input level are constant, the Rybczynski effect can be applied.

As we can see from Table I, here there are discrepancies in the opinions presented in the literature—in contrast to the sample of "consumptive cases" where S. Edwards represents the majority of authors. The only consensus reached by all authors is that (given the "orthodox" factor intensities' ordering)[21] the production of *exportables* should definitely decline in the long run (see Table I), if economies of scale are neglected. Furthermore, this effect will be more pronounced than in the short run.

The results obtained by Ethier and Hoon are both correct while those of Nowak are inaccurate. In the three-good case one must be aware of the fact that nontradeables are of a "special nature":

> a rise in the level of capital stock implies a rise in national income. Now, the rise in national income raises the demand for all products including the non-traded good. To match the rise in demand the output of the non-traded good must rise to some extent.[22] In other words, a part of the additional factor supply *must*[23] be employed in the non-traded good sector. [22, p. 108]

As we have seen earlier, there is no reason why altering factor intensities should not be considered in the analysis. The results are depicted in Figure 4,[24] which

[21] $(K/L)_X < (K/L)_N < (K/L)_M$.

[22] Depending on the *size* of the income elasticity of demand.

[23] Emphasis by the author.

[24] Our analysis is based on Ethier's "normal case" with regard to the income elasticity of demand for nontradeables [17].

TABLE I

EFFECTS OF CAPITAL INFLOWS ON PRODUCTION IN A THREE-GOOD ECONOMY

	Utilization of Capital Inflows				
	Investitive			Consumptive	
Short run (capital sector specific)	Without Overshooting $X_N\uparrow$ $X_M\downarrow$ $X_X\downarrow$ (Hoon [22])			Without Overshooting $X_N\uparrow$ $X_M\downarrow$ $X_X\downarrow$	With Overshooting $X_N\uparrow\uparrow$ $X_M\downarrow\downarrow$ $X_X\downarrow\downarrow$
				(Edwards [11, p. 203])	
Medium run (transition; capital mobile)	$X_N\uparrow$ $X_M\downarrow$ $X_X\downarrow$ (Hoon [22])			Without Overshooting $X_N\uparrow$ $X_M\downarrow$ $X_X\downarrow$	With Overshooting $X_N\downarrow$ $X_M\uparrow$ $X_X\uparrow$
				(Edwards [11, pp. 204, 206])	
Long run (capital mobile)	$X_N\uparrow\uparrow$ $X_M\uparrow$ $X_X\downarrow\downarrow$[a] (Ethier [17])	$X_N\uparrow$ $X_M\uparrow$-$\downarrow$ $X_X\downarrow\downarrow$ (Hoon [22])	$X_N\uparrow$-$\downarrow$ $X_M\uparrow$ $X_X\downarrow\downarrow$ (Nowak [30])	Without Overshooting $X_N\uparrow\uparrow$ $X_M\downarrow\downarrow$ $X_X\downarrow\downarrow$	With Overshooting $X_N\uparrow$ $X_M\downarrow$ $X_X\downarrow$
				(Edwards [11, p. 205])	

Sources: [11] [17] [22] [30].

Notes: 1. Assumed factor intensities: $(K/L)_M > (K/L)_N > (K/L)_X$.

2. Two arrows pointing downwards (upwards) indicate that production is lower (higher) in the long (short) than in the short (long) run.

[a] As long as the marginal propensity to consume nontradeables (m) satisfies $0 \leq m < 1$ and the terms of trade are constant.

is based on Melvin's report [28]. The diagrams are standard Edgeworth-Bowley production boxes, whose dimensions equal the economy's total endowment of capital and labor. Assuming that the stock of capital increases in the long run by investment, the boxes' capital line is extended. Initial equilibria are denoted by the points R, new equilibria by points S. We obtain the following main results: (i) when home goods are substituted for both tradeables (cases 1 and 2) the production of nontradeables and importables (exportables) will rise, and the production of exportables (importables) will decline; (ii) the expansion of the production of either exportables (case 6) or importables (case 3) will be most pronounced when nontradeables show the lowest capital intensity in production; and (iii) mutatis mutandis, when nontradeables are produced with highest capital intensity, the expansion of the relatively capital intensive tradeable goods is comparatively moderate (cases 4 and 5).[25]

Obviously, the results indicated in Figure 4 predict possible outcomes only in the (*very*) *long run*. If we concentrate on the production of nontradeables, differences between short-, medium-, and long-run effects can be demonstrated in a rather simple market diagram (Figure 5). In the *short run* price increases (P_{N1}) overshoot the medium-run equilibrium of prices (P_{N2}), and production increases (X_{N1}) undershoot the medium-run equilibrium of production (X_{N2}). In the *medium run* there will be a shift in the supply schedule ($S_N \rightarrow S_N'$) due to capacity effects of investment accompanied by a reduction in prices ($P_{N1} \rightarrow P_{N2}$) and a rising production ($X_{N1} \rightarrow X_{N2}$). In the (*very*) *long run* as all relative prices are constant, nontradeables' prices reach their original equilibrium level (P_{N0}) and production increases along a fully horizontal supply curve S_N''. The extent of the increase has been previously depicted in Figure 4.

D. *Means of Adjustment after CAL*

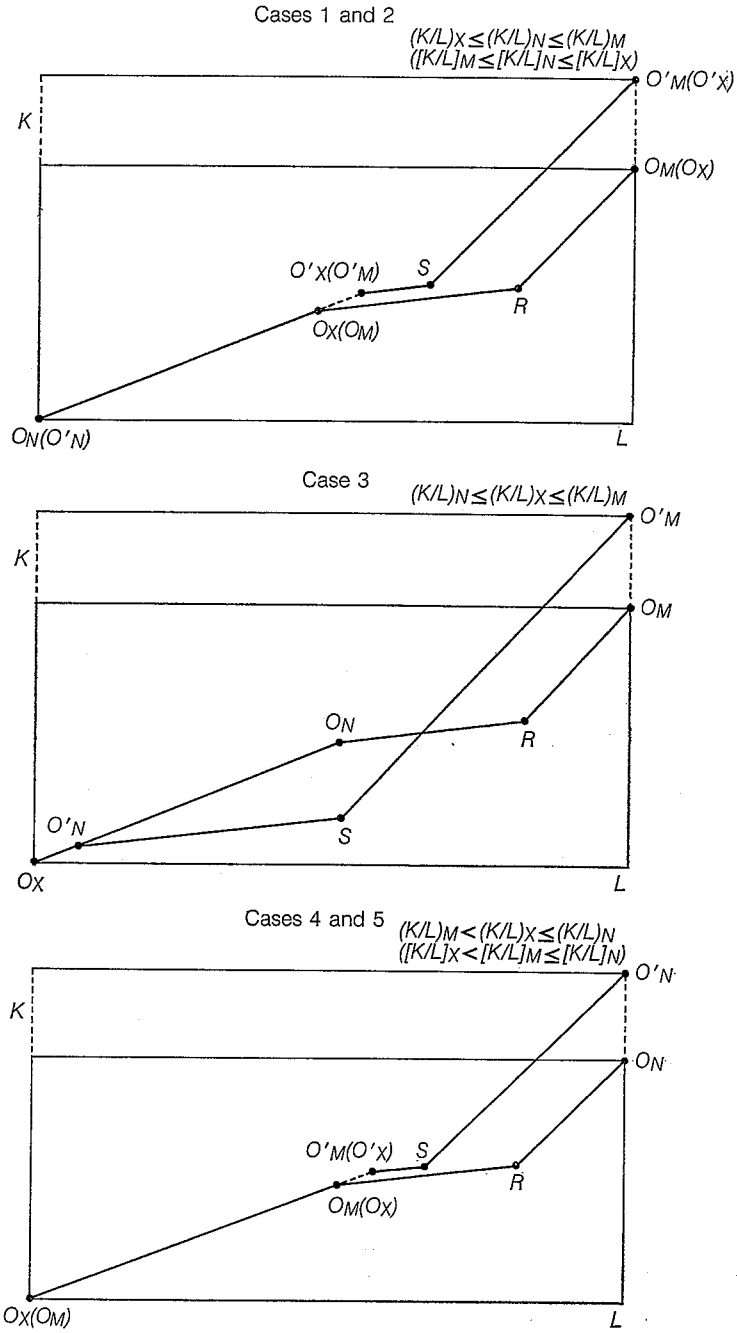
In order to allow the transfer of capital (in the *short* and *medium* run) "domestic output of non-traded goods must rise and that of traded goods fall" [25, p. 686]. The process of adjustment after a CAL (movement from A to C in Figure 1-A) is accompanied by a rise in the real exchange rate which can be achieved by (i) an appreciation of the nominal exchange rate alone or (ii) combined with a rise in the nominal price of nontraded goods [25, p. 687]. At first glance it seems to be, from a theoretical point of view, totally "irrelevant" whether the required rise in the *real* exchange rate is associated with an appreciation of the nominal exchange rate alone or in combination with rising prices of nontradeables.

As for the impact of a CAL on the overall price level of the country (P_D) concerned, however, the two mechanisms mentioned above differ substantially; while the first one will definitely lead to a fall of P_D, the effect of the second is complex. P_D may still fall (but less than before), remain constant, or even rise [25, p. 687].[26]

[25] Or, put it this way: if nontradeables are capital intensive, the relative prices of nontradeables will be a decreasing function of the national capital stock.

[26] For an explicit discussion of the determinants of $\hat{P}_N/\hat{P}_D$, see equations (11b) and (13b) in the mathematical appendix.

Fig. 4. Capital Accumulation in a Small Open Economy with Nontraded Good Sector



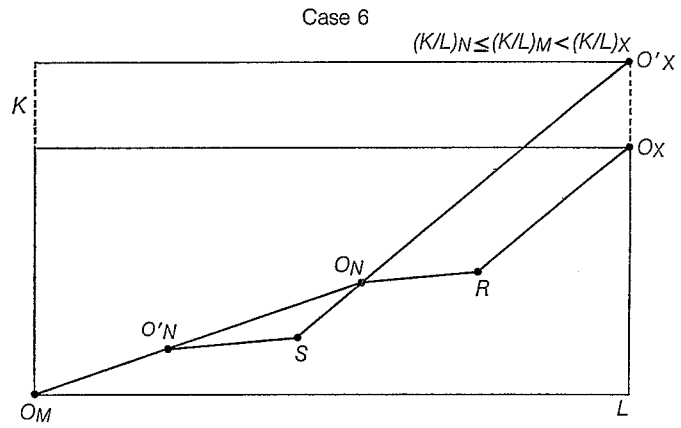
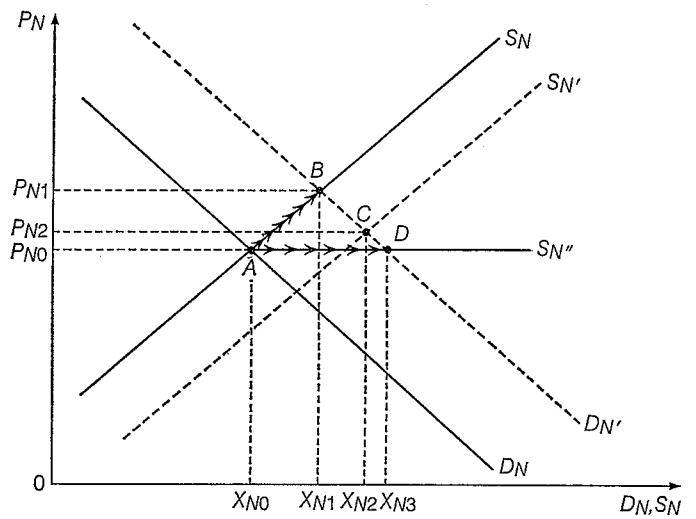


Fig. 5. Short-, Medium-, and Long-run Effects of CAL on the Production of Nontradeables



If the net effect results in an increase in the general price level (P_D) an excess demand of money and a rise in the domestic interest rate will take place, which in turn will slow expenditures and, ceteris paribus, dampen the trade balance effect. Mutatis mutandis, if the net effect results in a reduction in the general price level the trade balance effect will be *reinforced* [24, p. 37].

Assuming now that "the authorities wrongly consider the trade deficit. . . to be a problem and attempt to 'cure' it through" [25, p. 687] (i) the imposition or (ii) the elevation of a tariff; while (i) would take place in an environment where trade had already been liberalized, (ii) would occur in an economy with still distorted

prices. In both cases as the prices of importables in terms of both exportables and nontradeables are likely to rise by the amount of the tariff, the economy may find itself at point *D* (Figure 1-A) or at point *E* (Figure 1-B) respectively. Both points are associated with a smaller trade deficit (in comparison to *C* or *D*, respectively) and a matching excess demand for nontraded goods [7, p. 180]. Hence neither *D* nor *E* is *sustainable*. Rising prices will result in the equilibration of demand and supply on the market for nontraded goods and in a less profitable production of both exportables and importables; the trade deficit reaches its original level and the economy will find itself at point *E* (Figure 1-A) or point *F* (Figure 1-B) respectively.

Thus, as Lal puts it, "directional errors in the movement of [tariffs and/or subsidies] . . . could lead to an excessive rise in the domestic price level" [25, p. 687]. Hence, the external competitiveness of the country concerned will deteriorate further (see equation 9b in the mathematical appendix).

When comparing the two scenarios (i) and (ii) one may state that it is easier for a government to raise existing tariffs than to impose new tariffs.[27] From this point of view, it is preferable to liberalize the capital account, in case of an already liberalized trade account.

In the *long run* we have to consider the capital accumulation induced by the repatriation of capital. In comparing a CAL with a trade account already liberalized and a CAL under persisting trade restrictions, Johnson has shown "that if there are tariffs and the importable good is capital intensive, capital accumulation may reduce welfare" as the "production of the capital-intensive (importable) sector will increase, and the negative welfare effect of the pre-existing distortion will be reinforced" (cited in [10, p. 9]). Johnson's results have been reinforced by the contribution of Brecher and Diaz Alejandro [3] in demonstrating that direct foreign investment is necessarily immiserizing in a small tariff-imposing country that remains incompletely specialized and where capital is intersectorally mobile and export production is relatively labor intensive. More recently (1985), Buffie has shown that it makes a difference whether imports are either tariff-ridden or quota-restricted. "In the latter case it is found that. . . a capital inflow is welfare improving regardless of the relative factor-intensity of import-competing production" [5, p. 292]. When imports are subject to a tariff the same considerations indicate that foreign capital inflows "must be welfare improving if export production is relatively capital intensive" [5, p. 295].

Thus there is another argument (considering importables to be very likely capital intensive) in favor of an environment with a liberalized trade account. However, much depends on the credibility of the trade reform. If those agents who are willing to repatriate their capital consider that the trade reform sooner or later will be reversed, they might even invest today in (possibly capital-intensive) import-competing industries, expecting gains tomorrow [10, p. 10].

There is a *third* aspect which does not necessarily have to be assigned to a short- or long-run category. It deals with the notion of "nontradeables." As

[27] Normally, the reimposition of trade barriers should erode the credibility of a government.

McKinnon already pointed out in 1976, a considerable part of these goods may be a sort of pseudo-nontradeable.[28] He mentions as an example highly protected domestic manufacturing industries, whose prices are determined domestically. A CAL as discussed above would then, in an environment of trade restrictions, lead to an additional protection of these pseudo-nontradeables and (according to the Stolper-Samuelson theorem) increase the rewards of those factors which are intensively used in the production of pseudo-nontradeables. These effects could be avoided ceteris paribus if the trade account had been previously liberalized. By definition, then, pseudo-nontradeables would not exist any longer and, hence, they could not deserve any protection by a CAL. As discussed above, all three aspects of the adjustment process that occurs after a CAL had been carried out lead to the conclusion that it is preferable to liberalize the trade account beforehand.

V. SUMMARY AND CONCLUSIONS

The concept of "true financial opening up" is an application of the "true exposure" setting to the analysis of capital account liberalization under varying trade regimes in developing countries.

The present paper has put forward the "true circumstances" (high external debt, liquidity constraints, capital flight, and black market premium) of a CAL in LDCs, occurring nowadays. Price, exchange rate, and production effects of a CAL have also been analyzed revealing the conditions under which:

—prices of nontradeables will rise, decrease, or even stay constant,
—the real exchange rate will overshoot its long-run equilibrium level (in three phases), and
—production of the three sectors (nontradeables, importables, and exportables) will be affected in the long run by capacity effects.

Finally, the adjustment process itself (in the course of a CAL) has been reviewd. From here it is concluded that a liberalized current account is most suitable when the policy aims at:

—stabilizing domestic (and nontradeables') prices in the *short run,*
—avoiding negative welfare effects of capital accumulation in the *long run,* and
—minimizing the protection of pseudo-nontradeables.

Hence, these are the advantages of an already liberalized trade account accompanying a capital account liberalization.

With regard to the *sequencing issue* it follows that a "current account first" sequence, provided that $[CA(TA) - CA(\overline{TA})]$ is positive, is preferable if the policymakers' objectives concentrate on the above-mentioned targets. By contrast, if the policymakers are concerned with external competitiveness in the *short run,* a *long-run* equilibrium of domestic prices and the avoidance of unemployment in an environment characterized by rigid prices and nominal wages downwards, then

[28] Buffie states that "a nontraded good can be treated as an importable whose quota is zero" [5, p. 292].

the "capital account first" sequence, provided that $[TA(CA) - TA(\overline{CA})]$ is positive, should be selected. These have proven to be the main advantages of a "capital account first" strategy (see [34, p. 649]).

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MATHEMATICAL APPENDIX

$$\hat{E}=\delta\hat{CI}^{*}. \tag{16a}$$

Introducing (16a) in (17a) gives:

$$\hat{CI}=\hat{CI}^{*}+\delta\hat{CI}^{*}=(1+\delta)\hat{CI}^{*}. \tag{17b}$$

Introducing (16a) in (15a) gives:

$$\hat{P}_{X}=\delta\hat{CI}^{*}+\hat{P}_{X}^{*}+(1\hat{+}s). \tag{15b}$$

Introducing (16a) in (14a) gives:

$$\hat{P}_{M}=\delta\hat{CI}^{*}+\hat{P}_{M}^{*}+(1\hat{+}t). \tag{14b}$$

Introducing (14b) and (15b) in (12a) gives:

$$\hat{P}_{T}=\alpha[\delta\hat{CI}^{*}+\hat{P}_{M}^{*}+(1\hat{+}t)]+(1-\alpha)[\delta\hat{CI}^{*}+\hat{P}_{X}^{*}+(1\hat{+}s)]. \tag{12b}$$

$$\hat{Y}=\frac{S_{X}P_{X}}{Y}(\hat{S}_{X}+\hat{P}_{X})+\frac{S_{M}P_{M}}{Y}(\hat{S}_{M}+\hat{P}_{M})+\frac{S_{N}P_{N}}{Y}(\hat{S}_{N}+\hat{P}_{N})+\frac{CI}{Y}\hat{CI}$$

$$=W_{X}(\hat{S}_{X}+\hat{P}_{X})+W_{M}(\hat{S}_{M}+\hat{P}_{M})+W_{N}(\hat{S}_{N}+\hat{P}_{N})+W_{CI}\hat{CI}. \tag{18b}$$

Rearranging (18b) leads to:

$$\hat{Y}=W_{X}\hat{P}_{X}+W_{X}[\varepsilon_{X}{}^{N}(\hat{P}_{N}-\hat{P}_{X})+\varepsilon_{X}{}^{M}(\hat{P}_{M}-\hat{P}_{X})+\theta_{X}\hat{K}]+W_{M}\hat{P}_{M}+W_{M}[\varepsilon_{M}{}^{N}(\hat{P}_{N}-\hat{P}_{M})+\varepsilon_{M}{}^{X}(\hat{P}_{X}-\hat{P}_{M})\theta_{M}\hat{K}]$$
$$+W_{N}\hat{P}_{N}+W_{N}[\varepsilon_{N}{}^{M}(\hat{P}_{M}-\hat{P}_{N})+\varepsilon_{N}{}^{X}(\hat{P}_{X}-\hat{P}_{N})+\theta_{N}\hat{K}]+W_{CI}\hat{CI}.$$

Introducing (15b), (14b), and (17b) in (18b) gives:

$$\hat{Y}=[\delta\hat{CI}^{*}+\hat{P}_{X}^{*}+(1\hat{+}s)](W_{X}-W_{X}\varepsilon_{X}{}^{N}-W_{X}\varepsilon_{X}{}^{M}+W_{M}\varepsilon_{M}{}^{X}+W_{N}\varepsilon_{N}{}^{X})$$
$$+[\delta\hat{CI}^{*}+\hat{P}_{M}^{*}+(1\hat{+}t)](W_{M}-W_{M}\varepsilon_{M}{}^{N}-W_{M}\varepsilon_{M}{}^{X}+W_{X}\varepsilon_{X}{}^{M}+W_{N}\varepsilon_{N}{}^{M})$$
$$+(W_{N}-W_{N}\varepsilon_{N}{}^{M}-W_{N}\varepsilon_{N}{}^{X}+W_{X}\varepsilon_{X}{}^{N}+W_{M}\varepsilon_{M}{}^{N})\hat{P}_{N}+(W_{X}\theta_{X}+W_{M}\theta_{M}+W_{N}\theta_{N})\hat{K}+(W_{CI}+W_{CI}\delta)\hat{CI}^{*}. \tag{18c}$$

Introducing (15b), (14b), and (18c) in (11a) and solving for $\hat{P}_N$ gives:

$$\hat{P}_N = \frac{\{(1\hat{+}t)[\omega+\psi(W_M - W_M\varepsilon_M{}^N - W_M\varepsilon_M{}^X + W_X\varepsilon_X{}^M + W_N\varepsilon_N{}^M)] + (1\hat{+}s)[(1-\omega)+\psi(W_X - W_X\varepsilon_X{}^N - W_X\varepsilon_X{}^M + W_M\varepsilon_M{}^X + W_N\varepsilon_N{}^X)]\}}{[1-\psi(W_N - W_N\varepsilon_N{}^M - W_N\varepsilon_N{}^X + W_X\varepsilon_X{}^N + W_M\varepsilon_M{}^N)]}$$

$$+\left\{\frac{[\delta+\psi\delta(W_X - W_X\varepsilon_X{}^N - W_X\varepsilon_X{}^M + W_M\varepsilon_M{}^X + W_N\varepsilon_N{}^X + W_M - W_M\varepsilon_M{}^N - W_M\varepsilon_M{}^X + W_X\varepsilon_X{}^M + W_N\varepsilon_N{}^M + W_{CI})+\psi W_{CI}]}{[1-\psi(W_N - W_N\varepsilon_N{}^M - W_N\varepsilon_N{}^X + W_X\varepsilon_X{}^N + W_M\varepsilon_M{}^N)]}\right\}\hat{CI}^*$$

$$+\left\{\frac{[\psi(W_X\theta_X + W_M\theta_M + W_N\theta_N)+\theta_N]}{[1-\psi(W_N - W_N\varepsilon_N{}^M - W_N\varepsilon_N{}^X + W_X\varepsilon_X{}^N + W_M\varepsilon_M{}^N)]}\right\}\hat{K}$$

$$+\left\{\frac{[\omega+\psi(W_M - W_M\varepsilon_M{}^N - W_M\varepsilon_M{}^X + W_X\varepsilon_X{}^M + W_N\varepsilon_N{}^M)]}{[1-\psi(W_N - W_N\varepsilon_N{}^M - W_N\varepsilon_N{}^X + W_X\varepsilon_X{}^N + W_M\varepsilon_M{}^N)]}\right\}\hat{P}_M{}^*$$

$$+\left\{\frac{(1-\omega)+\psi(W_X - W_X\varepsilon_X{}^N - W_X\varepsilon_X{}^M + W_M\varepsilon_M{}^X + W_N\varepsilon_N{}^X)}{[1-\psi(W_N - W_N\varepsilon_N{}^M - W_N\varepsilon_N{}^X + W_X\varepsilon_X{}^N + W_M\varepsilon_M{}^N)]}\right\}\hat{P}_X{}^*. \tag{11b}$$

Introducing (12b) and (11b) in (13a) gives:

$$\hat{P}_D = \alpha\beta(1\hat{+}t) + (\beta-\alpha\beta)(1\hat{+}s)\left\{\frac{(1-\beta)(1\hat{+}t)[\omega+\psi(W_M - W_M\varepsilon_M{}^N - W_M\varepsilon_M{}^X + W_X\varepsilon_X{}^M + W_N\varepsilon_N{}^M)]}{[1-\psi(W_N - W_N\varepsilon_N{}^M - W_N\varepsilon_N{}^X + W_X\varepsilon_X{}^N + W_M\varepsilon_M{}^N)]}\right\}$$

$$+\frac{(1-\beta)(1\hat{+}s)[(1-\omega)+\psi(W_X - W_X\varepsilon_X{}^N - W_X\varepsilon_X{}^M + W_M\varepsilon_M{}^X + W_N\varepsilon_N{}^X)]}{[1-\psi(W_N - W_N\varepsilon_N{}^M - W_N\varepsilon_N{}^X + W_X\varepsilon_X{}^N + W_M\varepsilon_M{}^N)]}$$

$$+\left\{\beta\delta+\frac{(1-\beta)[\delta+\psi\delta(W_X - W_X\varepsilon_X{}^N - W_X\varepsilon_X{}^M + W_M\varepsilon_M{}^X + W_N\varepsilon_N{}^X + W_M - W_M\varepsilon_M{}^N - W_M\varepsilon_M{}^X + W_X\varepsilon_X{}^M + W_N\varepsilon_N{}^M + W_{CI})+\psi W_{CI}]}{[1-\psi(W_N - W_N\varepsilon_N{}^M - W_N\varepsilon_N{}^X + W_X\varepsilon_X{}^N + W_M\varepsilon_M{}^N)]}\right\}\hat{CI}^*$$

$$+\left\{\frac{(1-\beta)[\psi(W_X\theta_X + W_M\theta_M + W_N\theta_N)+\theta_N]}{[1-\psi(W_N - W_N\varepsilon_N{}^M - W_N\varepsilon_N{}^X + W_X\varepsilon_X{}^N + W_M\varepsilon_M{}^N)]}\right\}\hat{K}$$

$$+\left\{\beta\alpha+\frac{(1-\beta)[\omega+\psi(W_M - W_M\varepsilon_M{}^N - W_M\varepsilon_M{}^X + W_X\varepsilon_X{}^M + W_N\varepsilon_N{}^M)]}{[1-\psi(W_N - W_N\varepsilon_N{}^M - W_N\varepsilon_N{}^X + W_X\varepsilon_X{}^N + W_M\varepsilon_M{}^N)]}\right\}\hat{P}_M{}^*$$

$$+\left\{\beta-\beta\alpha+\frac{(1-\beta)[(1-\omega)+\psi(W_X - W_X\varepsilon_X{}^N - W_X\varepsilon_X{}^M + W_M\varepsilon_M{}^X + W_N\varepsilon_N{}^X)]}{[1-\psi(W_N - W_N\varepsilon_N{}^M - W_N\varepsilon_N{}^X + W_X\varepsilon_X{}^N + W_M\varepsilon_M{}^N)]}\right\}\hat{P}_X{}^*. \tag{13b}$$

Introducing (12b) and (11b) in (10a) gives:

$$\hat{e}=\alpha(1\hat{+}t)+(1-\alpha)(1\hat{+}s)\frac{(1\hat{+}t)[\omega+\psi(W_M-W_M\varepsilon_M{}^N-W_M\varepsilon_M{}^X+W_X\varepsilon_X{}^M+W_N\varepsilon_N{}^M)]}{[1-\psi(W_N-W_N\varepsilon_N{}^M-W_N\varepsilon_N{}^X+W_X\varepsilon_X{}^N+W_M\varepsilon_M{}^N)]}\cdot$$

$$-\frac{(1\hat{+}s)[(1-\omega)+\psi(W_X-W_X\varepsilon_X{}^N-W_X\varepsilon_X{}^M+W_M\varepsilon_M{}^X+W_N\varepsilon_N{}^X)]}{[1-\psi(W_N-W_N\varepsilon_N{}^M-W_N\varepsilon_N{}^X+W_X\varepsilon_X{}^N+W_M\varepsilon_M{}^N)]}$$

$$+\left\{\delta-\frac{[\delta+\psi\delta(W_X-W_X\varepsilon_X{}^N-W_X\varepsilon_X{}^M+W_M\varepsilon_M{}^X+W_N\varepsilon_N{}^X+W_M-W_M\varepsilon_M{}^N-W_M\varepsilon_M{}^X+W_X\varepsilon_X{}^M+W_N\varepsilon_N{}^M+W_{CI})+\psi W_{CI}]}{[1-\psi(W_N-W_N\varepsilon_N{}^M-W_N\varepsilon_N{}^X+W_X\varepsilon_X{}^N+W_M\varepsilon_M{}^N)]}\right\}\hat{CI}^*$$

$$-\left\{\frac{[\psi(W_X\theta_X+W_M\theta_M+W_N\theta_N)+\theta_N]}{[1-\psi(W_N-W_N\varepsilon_N{}^M-W_N\varepsilon_N{}^X+W_X\varepsilon_X{}^N+W_M\varepsilon_M{}^N)]}\right\}\hat{K}$$

$$+\left\{\alpha-\frac{[\omega+\psi(W_M-W_M\varepsilon_M{}^N-W_M\varepsilon_M{}^X+W_X\varepsilon_X{}^M+W_N\varepsilon_N{}^M)]}{[1-\psi(W_N-W_N\varepsilon_N{}^M-W_N\varepsilon_N{}^X+W_X\varepsilon_X{}^N+W_M\varepsilon_M{}^N)]}\right\}\hat{P}_M{}^*$$

$$+\left\{(1-\alpha)+\frac{(1-\omega)+\psi(W_X-W_X\varepsilon_X{}^N-W_X\varepsilon_X{}^M+W_M\varepsilon_M{}^X+W_N\varepsilon_N{}^X)}{[1-\psi(W_N-W_N\varepsilon_N{}^M-W_N\varepsilon_N{}^X+W_X\varepsilon_X{}^N+W_M\varepsilon_M{}^N)]}\right\}\hat{P}_X{}^*. \tag{10b}$$

Introducing (16a) and (13b) in (9a) gives:

$$\hat{ep}=-\alpha\beta(1\hat{+}t)-(\beta-\alpha\beta)(1\hat{+}s)-\frac{(1-\beta)(1\hat{+}t)[\omega+\psi(W_M-W_M\varepsilon_M{}^N-W_M\varepsilon_M{}^X+W_X\varepsilon_X{}^M+W_N\varepsilon_N{}^M)]}{[1-\psi(W_N-W_N\varepsilon_N{}^M-W_N\varepsilon_N{}^X+W_X\varepsilon_X{}^N+W_M\varepsilon_M{}^N)]}$$

$$-\frac{(1-\beta)(1\hat{+}s)[(1-\omega)+\psi(W_X-W_X\varepsilon_X{}^N-W_X\varepsilon_X{}^M+W_M\varepsilon_M{}^X+W_N\varepsilon_N{}^X)]}{[1-\psi(W_N-W_N\varepsilon_N{}^M-W_N\varepsilon_N{}^X+W_X\varepsilon_X{}^N+W_M\varepsilon_M{}^N)]}$$

$$+\left\{\delta-\beta\delta-\frac{(1-\beta)[\delta+\psi\delta(W_X-W_X\varepsilon_X{}^N-W_X\varepsilon_X{}^M+W_M\varepsilon_M{}^X+W_N\varepsilon_N{}^X+W_M-W_M\varepsilon_M{}^N-W_M\varepsilon_M{}^X+W_X\varepsilon_X{}^M+W_N\varepsilon_N{}^M+W_{CI})+\psi W_{CI}]}{[1-\psi(W_N-W_N\varepsilon_N{}^M-W_N\varepsilon_N{}^X+W_X\varepsilon_X{}^N+W_M\varepsilon_M{}^N)]}\right\}\hat{CI}^*$$

$$-\left\{\frac{(1-\beta)[\psi(W_X\theta_X+W_M\theta_M+W_N\theta_N)+\theta_N]}{[1-\psi(W_N-W_N\varepsilon_N{}^M-W_N\varepsilon_N{}^X+W_X\varepsilon_X{}^N+W_M\varepsilon_M{}^N)]}\right\}\hat{K}$$

$$-\left\{\beta\alpha+\frac{(1-\beta)[\omega+\psi(W_M-W_M\varepsilon_M{}^N-W_M\varepsilon_M{}^X+W_X\varepsilon_X{}^M+W_N\varepsilon_N{}^M)]}{[1-\psi(W_N-W_N\varepsilon_N{}^M-W_N\varepsilon_N{}^X+W_X\varepsilon_X{}^N+W_M\varepsilon_M{}^N)]}\right\}\hat{P}_M{}^*$$

$$-\left\{\beta-\beta\alpha+\frac{(1-\beta)[(1-\omega)+\psi(W_X-W_X\varepsilon_X{}^N-W_X\varepsilon_X{}^M+W_M\varepsilon_M{}^X+W_N\varepsilon_N{}^X)]}{[1-\psi(W_N-W_N\varepsilon_N{}^M-W_N\varepsilon_N{}^X+W_X\varepsilon_X{}^N+W_M\varepsilon_M{}^N)]}\right\}\hat{P}_X{}^*. \tag{9b}$$