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# CAPITAL CONTROLS AND THE REAL EXCHANGE RATE

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# CAPITAL CONTROLS AND THE REAL EXCHANGE RATE

## ABSTRACT

Using an intertemporal, two-country general equilibrium model, I demonstrate that international asymmetries in expenditure patterns determine the real exchange rate effects of capital controls. Capital import taxes lower world interest rates, but raise home interest rates. These changes in interest rates bring about a change in the composition of world expenditure, with a shift of home expenditure from the present ("today") to the future ("tomorrow"), and a shift of foreign aggregate expenditure from tomorrow to today.

If the pattern of expenditure across commodities is the same at home and abroad, the change in the composition of world expenditure has no effects on the (excess) demand for any particular commodity. Therefore, with identical expenditure patterns at home and abroad, the imposition of capital controls has no effect on the real exchange rate. However, when consumers have a preference for domestically produced goods, the shift in composition of world expenditure caused by interest rate changes implies a decline in demand today for home goods. In that case, capital controls lower the real exchange rate. Of course, in period two the reverse happens. This result is mitigated when the country imposing capital controls is a large debtor.

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## I. Introduction

Controls on international capital flows are often advocated in response to an appreciation of the real exchange rate. Thus, Dornbusch (1983) and Liviatan (1980) advocate capital controls in the early phase of monetary stabilization programs since restrictive monetary policy will lead to a real appreciation initially if domestic prices are anything less than perfectly flexible (Dornbusch (1976)). Similarly, Bergsten (1982), has called for what amounts to a capital import tax in response to the high real exchange value of the dollar.

Such advocacy implies a belief in the downward effect of capital controls on the real exchange rate, an effect for which theoretical support is as yet rather unconvincing. This is so because where the real exchange rate effects of capital controls have been analyzed, this has been done in the context of partial equilibrium (one country), and essentially static models (see Liviatan (1980). Since capital controls are interventions in intertemporal trade, a framework where the intertemporal allocation of consumption is based on static savings rules is not satisfactory; moreover, I will show in this paper that general equilibrium (2-country) effects are crucial determinants of the real exchange rate effects of capital controls, arguing against a one-country, partial equilibrium approach.

I will present a simple model explicitly set up to analyze the intertemporal and intratemporal aspects of capital controls. The explicit use of an intertemporal framework to analyze capital controls is in line with other recent work on capital controls (Adams and Greenwood (1985), Frenkel and Razin (1987), Greenwood and Kimbrough (1985), Marion and

Svensson (1985b), and van Wijnbergen (1985)). These authors either use a partial equilibrium one country approach (Adams and Greenwood (1985)), or employ a general equilibrium framework but one with one final commodity in each period (Greenwood and Kimbrough (1985), Marion and Svensson (1984), Frenkel and Razin (1987), and van Wijnbergen (1985)). Either set up rules out a satisfactory analysis of the real exchange rate effects of capital controls.

In contrast, the analysis to be presented below is a full general equilibrium one, an extension that will turn out to be important for the final results obtained. I will show that asymmetries in international expenditure patters are important determinants of the real exchange rate effects of capital controls.

In another departure of much of the literature (but in line with Marion and Svensson (1984), and van Wijnbergen (1985)), I will abstract from monetary aspects and use an entirely "real" model. Capital controls are an intervention in intertemporal trade; the question of how such controls affect the intratemporal terms of trade or real exchange rate therefore hinges on the interaction between intertemporal and intratemporal trade patters. It is not clear that monetary factors play an important role in these interactions. Of course, monetary factors would matter a great deal more if nominal price rigidities would introduce an impact of nominal on real exchange rates and the possibility of discrepancies between the actual and the equilibrium (i.e., home good market clearing) real exchange rate. We abstract from such poorly understood, although possibly important real world problems; the real effects of the intertemporal distortions introduced by capital controls are of sufficient interest by themselves to motivate this approach.

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Capital controls may drive a wedge between domestic and foreign discount factors $\delta$ and $\delta^*$ (or, equivalently, between $r$ and $r^*$). In the absence of capital controls there is perfect capital mobility ($\delta=\delta^*$). I will focus on price intervention (a capital import tax) rather than explicit quantity controls; this involves no loss of generality, since within the present context for any given quantity control a capital import tax rate can be chosen with exactly the same economic effect (Adams and Greenwood (1985)). I provide a qualification to this equivalence result for the case of asymmetric expenditure patterns at home and abroad at the end of the next sector. Also, as is well known from the literature on intervention in static commodity trade, equivalence between quota and tariffs may break down in the presence of uncertainty (Newbery and Stiglitz (1981)) or non- competitive market structure (Bhagwati (1965), Krishna (1985)).

An analytical convenient way of parameterizing price intervention in intertemporal trade (which is what capital controls come down to) starts by defining

$$(2) \quad b = \delta^* - \delta = \frac{(r-r^*)/(1+r^*)}{(1+r)}$$

b equals the discounted value of tax payments per unit transferred to foreigners (this approach of modeling capital controls follows Marion and Svensson (1984), and van Wijnbergen (1985)). The discounted value of tax revenue will then equal the unit tax rate b times the net resource transfer in period two, nca. nca is the non-interest current account surplus of the home country in period two. Hence tax revenue equals b.

nca. We assume that these tax revenues are rebated to consumers in random fashion (in particular not proportional to the amount borrowed), which leads to a home country budget constraint:

(3a) $PX + \delta px + b\ nca = E(\Pi(P,1), \delta\pi(p,1), U)$

Similarly, the intertemporal budget constraint for foreigners is:

(3b) $X^* + \delta^* x^* = E^*(\Pi^*(P,1), \delta^* \pi^*(p,1), U^*)$

There are three relative prices in the model: the real exchange rate today (P), the real exchange rate tomorrow (p), and the intertemporal terms of trade $\delta^*$ ($\delta$ at home in the presence of capital controls). These are jointly determined by three commodity market clearing equations. The market clearing equation for the fourth good is redundant vias Walras' Law (the four goods are home goods today and tomorrow, and foreign goods today and tomorrow).

Consider first equilibrium in the home goods market today [2]:

(4) $X = E_P + E_P{}^*$

$E_P$ is the domestic (Hicksian) demand function for period one home goods, using properties of the expenditure function (see Dixit and Norman (1980)). Similarly $E_P^*$ is foreign demand for first period home goods.

[2]Subscripts indicate partial derivatives: $E_P = \partial E/\partial P$. With some inconsistency, in our notation $\partial E_p/\partial p = (\partial E_p/\partial \delta p)(\partial \delta p/\partial p) = \delta E_{pp}$.

For given $\delta$, substituting out U and U* using the budget constraints (3a,b), this equilibrium condition can be represented as an upward sloping curve in P-p space (locus GMI in Figure 1):

$$(5) \quad \left.\frac{\partial P}{\delta \partial p}\right|_{\substack{GM1 \\ \delta=\bar{\delta}}} = - \frac{\Sigma_{Pp}}{\Sigma_{PP}} > 0$$

$\Sigma_{i,j}$ are elements of the world substitution matrix [3] with i and j indicating period numbers. Specific expressions are given in the appendix. The subscript $\delta=\bar{\delta}$ in (5) indicates that GM1 is drawn for given $\delta$.

The reason for the positive slope of GM1 is simple: an increase in p will lead to substitution away from future home goods. Since the WIHS utility structure rules out complementarity, some extra demand will fall on current home goods. To get back in equilibrium, the price of today's home good will need to go up.

A change in the discount factor $\delta$ (and $\delta^*$, for given b) will disturb period one home goods market equilibrium:

$$(6) \quad \left.\frac{\partial P}{\partial \delta}\right|_{GM1} = - \frac{\Sigma_{P\pi}}{\Sigma_{PP}} > 0 \quad ^{4/}$$

An increase in $\delta$ means a decrease in the price of current goods in terms of future goods and a corresponding increase in demand for current home goods. To restore equilibrium in the home goods market, p will need to increase (i.e. GM1 shifts up), hence the positive sign of (6).[4]

[3] Plus terms reflecting income effects.

[4] This shift could be reversed if net debtors have a much higher marginal

Second period home goods equilibrium implies:

$$(7)\quad x = E_p + E^*_p$$

(7) also corresponds to an upward sloping schedule in P-p space (locus GM2): a higher P leads to substitution away from current home goods, which, since there is no complimentarity, leads to excess demand for future home goods. To restore equilibrium in the period two home goods market, p needs to go up. Dominance of own substitution effects over cross-substitution effects guarantees that GM2 is steeper than GM1. An increase in the discount factor $\delta$ (and $\delta^*$, for given b) will shift expenditure towards today via pure substitution effects. This shift away from future expenditure will lead to downward pressure on the period two real exchange rate (GM2 shifts to the left) to restore home goods market equilibrium in that period:

$$(8)\quad \left.\frac{\partial p}{\partial \delta}\right|_{GM2} = -\frac{\Sigma_{p\pi}}{\Sigma_{pp}} < 0 \text{ 4/}$$

FIGURE 1 SOMEWHERE HERE

The final equilibrium is the market clearing condition for current foreign goods. The fourth and last goods market clearing condition, for second period foreign goods, is redundant via Walras' Law. Simple manipulation shows that first period foreign goods market equilibrium, when combined with current home goods market equilibrium, is equivalent to

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propensity to save than net creditors. I assume this not to be the case.

an equilibrium condition requiring a zero net intertemporal trade condition for the world as a whole in period one:

$$(9)\quad PX - E_{\Pi}\Pi + X^{*} - E_{\Pi}{}^{*}\Pi^{*} = 0$$

or

$$NCA + NCA^{*} = 0$$

NCA (nca) is the first (second) period home country non-interest current account. NCA* and nca* are the corresponding foreign variables. (9) represents a negative locus in p - $\delta^{*}$ space (locus NCA in Figure 1): a higher relative price of period two home goods (an anticipated future appreciation) increases the relative price of aggregate future consumption goods in terms of current aggregate consumption goods, the consumption discount factor $\delta_c = (\delta^{*} - b)\pi/\Pi$. This in turn leads to a shift towards current expenditure.[5]/ To restore equilibrium, the relative price of all future goods in terms of current goods needs to fall or $\delta^{*}$ declines. Formally:

$$(10)\quad \left.\frac{\partial\delta^{*}}{\partial p}\right|_{\substack{NCA\\ P=\bar{P}}} = -\frac{\Sigma_{\Pi p}}{\Sigma_{\Pi\pi}} < 0 \quad 4/$$

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[5]An alternative way of presenting this effect uses the concept of the consumption rate of interest CRI, defined as $\delta_c = 1/(1+CRI)$. An increase in $\delta_c$ implies a lower consumption rate of interest and hence more current expenditure for given utility U. If consumption is optimally allocated over time, the CRI equals the rate at which the marginal utility of consumption (discounted by the rate of time preference) declines over time (Little and Mirrlees (1974).

The slope would once again be reversed if income effects are very asymmetric, with debtors saving much more on the margin than creditors (cf FN 4).

## III. Capital Controls, Interest Rates and the Real Exchange Rate

Consider now the imposition of a capital import tax: $db > 0$, evaluated at $b = 0$ since we discuss an imposition of new capital controls rather than an increase in an existing tax. Imposing a capital import tax $(db > 0)$ is equivalent to subsidizing current production (taxing investment) and taxing current consumption in the country imposing the tax. Since we work in an exchange economy, we can focus on the intertemporal allocation of consumption.

An increase in b, by taxing current consumption in the home country, leads to a shift from current to future consumption at home and so disturbs world current account equilibrium. By shifting home consumption to the future, global excess savings would develop at given interest rates. To restore global equilibrium, world interest rates will therefore fall (the discount factor $\delta^*$ rises):

$$(11)\quad \left.\frac{\partial \delta^*}{\partial b}\right|_{\substack{NCA \\ P,p}} = \frac{E_{\Pi\pi}\Pi\pi}{E_{\Pi\pi}\Pi\pi + E^*_{\Pi\pi}\Pi^*\pi^* + (C_{IE}\Pi - C^*_{IE}\Pi^*)nca} > 0$$

$C_{IE}$ $(C^*_{IE})$ is the domestic (foreign) marginal propensity to spend on (aggregate) current goods out of wealth:

$$C_{IE} = \frac{E_{\Pi U}}{E_U}, \quad C^*_{IE} = \frac{E^*_{\Pi U}}{E^*_U}$$

Similar marginal propensities can be defined for disaggregate goods. For example for first period expenditure on home goods, one has $C_{PE} = E_{PU}/E_U$ etc.

(11) represents an outward shift of the locus NCA (see Figure 2). The sign of (11) could potentially be reversed if income effects are large and negative, particularly if:

$$(C_{IE}\Pi - C^*_{IE}\Pi^*)nca < -(E_{\Pi\pi}\Pi\pi + E^*_{\Pi\pi}\Pi^*\pi^*) < 0$$

However, capital controls are typically imposed in countries with current account deficits, which, through the intertemporal budget constraint implies $nca > 0$:

$$NCA<0,\ NCA+\delta^* nca=0 \rightarrow nca>0$$

Also, at least in the present context, with homothetic preferences, without investment and with constant endowments over time, $NCA < 0$ implies $C_{IE}\Pi > C^*_{IE}$. We can therefore ignore such reversals and assume that the denominator of (11) is positive.

FIGURE 2 SOMEWHERE HERE

Figure 2 Capital Import Taxes, Interest Rates and the Real Exchange Rate

Of course tax-inclusive interest rates go up rather than down, or, in terms of discount factors, $\delta = \delta^* - b$ falls:

$$(12)\quad \frac{\partial\delta}{\partial b} = \frac{\partial\delta^*}{\partial b} - 1$$

$$< - \frac{E^*_{\Pi\pi}\Pi^*\pi^* + (C_{IE}\Pi - C^*_{IE}\Pi^*)nca}{E_{\Pi\pi}\Pi\pi + E^*_{\Pi\pi}\Pi^*\pi^* + (C_{IE}\Pi - C^*_{IE})nca} < 0$$

(11) also explains the welfare consequences of a capital import tax given intratemporal relative prices. Net creditors will lose, because of lower world interest rates, and net debtors gain, for the same reason:

$$(13)\quad E_U \left.\frac{dU}{db}\right|_{P,p} = nca\,\frac{\partial\delta^*}{\partial b}$$

$$E^*_U \left.\frac{dU^*}{db}\right|_{P,p} = -\,nca\,\frac{\partial\delta^*}{\partial b}$$

(13) shows the analogy with tariffs on intratemporal trade. A country can gain from taxing intertemporal trade to the extent that it is large enough to influence, through such interventions, the intertemporal terms of trade (world interest rates).

The consequences for the real exchange rate are more complicated. Commodity markets in each period are subject to two conflicting impulses after imposition of a capital import tax. Consider the market for home goods in period one. The first impulse is a direct consequence of the effect of capital import taxes on the consumption discount factor for given world prices. The consumption discount factor $\delta_c=(\delta-b)\pi/\Pi$ is lowered directly by an increase in b. This shifts home consumption from today to tomorrow, thus lowering home demand for home goods in period one. Such a shift puts downward pressure on the period one real exchange rate P:

$$(14)\quad \left.\frac{\partial P}{\partial b}\right|_{GM1} = \frac{E_{P\pi}\pi}{E_{PP}+E^*_{PP}+(C_{IE}-C^*_{IE})E^*_P} < 0$$

(14) corresponds to shift "A" of locus GM1 in Figure 2.
The second impulse is caused by the change in world interest rates triggered by the higher capital import tax. Lower world interest rates shift both home and foreign consumption from the future towards today through substitution effects, some of which fall on first period home goods. This will put upward pressure on the real exchange rate:

$$(15)\quad \left.\frac{\partial P}{\partial \delta^*}\right|_{GM1} \left.\frac{\partial \delta^*}{\partial b}\right|_{NCA} = \left(-\frac{\Sigma_{P\pi}}{\Sigma_{PP}}\right)\cdot\left(\frac{E_{\Pi\pi}\Pi\pi}{\Sigma_{\Pi\pi}}\right)$$

$\Sigma_{PP}$, $\Sigma_{\Pi\pi}$ etc. are elements of the world substitution matrix; precise expressions are in the appendix. (15) corresponds to shift "B" of the locus GM1 in Figure 2.

The net effects, and therefore the impact of the imposition of the capital import tax on the real exchange rate, depends on whether the direct effect (14) outweighs the indirect effect (15). The sign of the net effect is straightforward and intuitive; the rather forbidding expression for it can be simplified a great deal:

$$(16)\quad \left.\frac{\partial P}{\partial b}\right|_{GM1} + \left.\frac{\partial P}{\partial \delta^*}\right|_{GM1} \left.\frac{\partial \delta^*}{\partial b}\right|_{NCA} =$$

$$= \frac{\sum_{P\pi}\pi}{\sum_{PP}} - \frac{\sum_{P\pi}}{\sum_{PP}} \cdot \frac{E_{\Pi\pi}\Pi\pi}{\sum_{\Pi\pi}}$$

$$= \left.\frac{\partial P}{\partial b}\right|_{GM1} \left(1 - \frac{\sum_{P\pi}}{\sum_{\Pi\pi}} \frac{\Pi}{\Pi_P}\right) \text{[6]}$$

$$= \left.\frac{\partial P}{\partial b}\right|_{GM1} \frac{1}{\sum_{\Pi\pi}} \left(E^*_{\Pi\pi}\Pi^*\pi^* . \left(1 - \frac{\Pi}{\Pi_P P} \frac{\Pi^*_P P}{\Pi^*}\right)\right. \qquad (A)$$

$$\left. - C^*_{IE}\Pi^* \text{ nca } \left(1 - \frac{\Pi}{\Pi_P P} \frac{\Pi^*_P P}{\Pi^*}\right)\right) \qquad (B)$$

The first result is immediately obvious after inspection of (16): if

$$(17)\quad \frac{\Pi_P P}{\Pi} = \frac{\Pi^*_P P}{\Pi^*} \rightarrow \frac{\partial P}{\partial b} = 0$$

This condition is readily interpreted after use of standard properties of the expenditure function. Since $\Pi$ and $\Pi^*$ are unit expenditure functions, $\frac{\Pi_P P}{\Pi}$ is the share of current expenditure by home country residents falling on home goods. Similarly, $\frac{\Pi^*_P P}{\Pi^*}$ is the share of current expenditure by foreigners that falls on home country goods. (17)

[6]To derive this, use: $E_P = E_{\Pi}\Pi_P$ and $\Pi_{P\pi} = 0$.

therefore states that if expenditure patterns are the same across countries, i.e., if foreigners spend the same proportion of total expenditure on home country goods as home country residents themselves, then a capital import tax has no effect at all on the real exchange rate.

Consider, for the analysis under asymmetric expenditure patterns, the benchmark case of negligible intertemporal income effects first. This implies setting the term (B) equal to zero. Then (16) simplifies to:

$$(18) \quad \frac{\Pi_p P}{\Pi} \gtrless \frac{\Pi_p^* P}{\Pi^*} \rightarrow \frac{\partial P}{\partial b} \lessgtr 0$$

Capital import taxes lead to a real depreciation in the country imposing them if $\frac{\Pi_p P}{\Pi} > \frac{\Pi_p^* P}{\Pi^*}$, i.e., if home country residents spend more on home country goods than foreigners, as a proportion of their total expenditure.

The similarity with the Metzler condition for an undereffected transfer (Metzler (1942)) is of course no coincidence. Capital import taxes at home will switch aggregate home expenditure towards the future. This disturbs global current account equilibrium. Lower world real interest rates then become unavoidable, to provide an offsetting shift of foreign and domestic expenditure from the future to today until global current account equilibrium is restored and world expenditure again equals world output. We are then left with the same level of first period world expenditure, but a changed composition: less domestic but more foreign expenditure. This explains why capital import taxes have no effect on the real exchange rate when expenditure patterns at home and abroad are the same. What matters for the relative price of home goods is total demand for them, not whether buyers live at home or abroad. But, under symmetric expenditures, a shift in the composition of total expenditure (more by foreigners and less by domestic residents) will not affect total demand for any given commodity.

Empirically, it is more likely that home residents consume relatively more home goods than foreigners do; this is certainly the case in the presence of non-traded goods, which, by definition, are only consumed by home country residents. If this is the case, if $\frac{\Pi_P P}{\Pi} > \frac{\Pi_P^* P}{\Pi^*}$, imposition of capital import taxes will lead to a decline in world demand for first period home goods and therefore to a real depreciation of the exchange rate.

Of course in period two, the reverse change takes place, with less foreign and more domestic expenditure. When, therefore, after the imposition of a capital import tax expenditure pattern asymmetries are such that a capital import tax causes a real depreciation today, it will cause a real appreciation tomorrow (period two). The proof of this proposition closely follows the analysis of first period real exchange rate effects of a capital import tax that was just presented, and is therefore not given here.

The discussion so far used the simplifying assumption of negligible income effects after imposition of the tax. This will be the case if nca is small, for example. That may be an unrealistic assumption; capital controls are often imposed during periods of payments imbalances, in particular of current account deficits. Incorporating such initial deficits is straightforward. Expression (16) shows first of all that the first proposition, that capital import taxes have no effects on the real exchange rate when intra- and intertemporal expenditure patterns are identical across countries, is independent of the current account starting position. This should not be surprising, since a non-zero current account starting position only matters for the income effects caused by the changes in world interest rates that an imposition of a capital import tax leads to. Such income effects are pure transfers in that creditors' gains equal debtors' losses; under symmetric expenditure patterns such a redistribution of course has no effect on relative prices.

If expenditure patterns are not symmetric, in particular in the empirically plausible case where home consumers have a preference for home goods and foreigners for foreign goods ( $\frac{\Pi_P P}{\Pi} > \frac{\Pi^*_P P}{\Pi^*}$ ), exchange rate effects of a capital import tax will be mitigated if there is a large initial (non-interest) current account deficit ($NCA = -\delta\, nca < 0$ ):

$$(19)\quad \frac{\Pi_P P}{\Pi} > \frac{\Pi^*_P P}{\Pi^*} \rightarrow \left.\frac{dP}{db}\right|_{nca=0} < \left.\frac{dP}{db}\right|_{nca>0}$$

(19) follows directly from (16). A large first period CA deficit implies large income gains for the debtor country due to the depressing effect of imposing capital controls on world interest rates. The implied income transfer from creditor to (controls imposing) debtor will reduce the shift in world expenditure and therefore will mitigate the real exchange rate effects of imposing capital controls. [7]

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[7] In fact with sufficiently large income effects (because of, for example, a large first period CA deficit implying nca >> 0) and sufficiently small substitution effects ( the term (A) in (16) the real exchange rate effects

These results do not depend on the simplifying assumption of complete specialization. Even if both goods are produced in each country, intratemporal relative prices will not be affected by capital controls if expenditure patterns are symmetric across countries. If there is a home bias towards the home export goods, imposing capital controls will lead to a term of trade deterioration in the country imposing them.[8]/ Further results can easily be derived and are similar to the ones presented in this paper.

Before concluding, a final remark: within the model structure used, quantity controls on capital flows can be mimicked by price interventions of the type analyzed in this paper. However, care should be taken to establish who (home or foreign residents) captures the rents created by quantity controls on intertemporal trade. This is because, as I have shown in this paper, the changes in the composition of world expenditure triggered by the imposition of capital controls are the main determinants of the real exchange rate effects of these controls. Different ways of distributing the rents created by quantity controls could therefore, in a predictable manner, lead to different real exchange rate effects.

## IV. Concluding Comments

Capital controls are interventions in intertemporal trade. The effect

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of capital controls could even be reversed.

[8]In this incomplete specialization production structure set-up, our concept of the real exchange rate (relative price of "our" goods in terms of "their" goods is not helpful, since both goods are produced in each country. The concept "terms of trade" (export over import prices) would in this case be more useful, since no cross-hauling would take place in such a model. With the complete specialisation assumption used in the paper, the concepts coincide.

of the imposition of capital controls on the real exchange rate (an intratemporal relative price), therefore hinges on the interaction of inter- and intratemporal trade. Models used to analyze such exchange rate effects of capital controls should therefore, in contrast to the existing literature on these real exchange rate effects, explicitly incorporate intertemporal considerations. That is the purpose of this paper.

Using a full intertemporal, general equilibrium (2 country) model, I demonstrate that international asymmetries in expenditure patterns are the main determinants of the real exchange rate effects of capital controls. Capital import taxes are shown to cause lower world interest rates but raise home interest rates, of course not a surprising result. As a consequence, the composition of world expenditure changes, although the level has to remain equal to the level of world output. Higher real rates at home and lower real rates abroad imply a shift of home expenditure from today to tomorrow and a shift of foreign aggregate expenditure from the future to today. Therefore, the composition of current world expenditure has shifted, with less home and more foreign expenditure.

If, however, the pattern of expenditure is the same at home and abroad, this change in composition has no consequence for the (excess) demand for any particular commodity. Therefore, with identical expenditure patterns at home and abroad, imposing capital controls has no effects on the real exchange rate.

If consumers have a preference for domestically produced goods (the standard Metzler condition for an undereffected transfer), the shift in composition of world expenditure from expenditure by domestic to expenditure by foreign consumers, implies a decline in demand for home goods. In that case, capital controls lower the real exchange rate; of course, in period two the reverse happens.

This outcome is mitigated when the country imposing capital controls is a large debtor (runs a large first period current account deficit, in our framework). A large first period CA deficit implies large income gains for debtor countries due to the downward impact of imposing capital controls on world interest rates. The implied income transfer from creditor to (controls imposing) debtor will reduce the shift in world expenditure and therefore will mitigate the real exchange rate effects of imposing capital controls.

These results have some bearing on the discussion of sequencing of commodity and capital markets (see Edwards (1987), and Edwards and van Wijnbergen (1987)). There a concern is often expressed that the impact of capital market liberalization on the real exchange rate threatens the sustainability of trade reform. Postponing capital market liberalization according to our results would, in the normal case of a home bias for home goods, postpone the appreciation, thus allaying fears for a reversal of the trade regime.

Similarly, capital controls are often advocated when disinflation policies lead to costly unemployment on account of transitory real appreciation. Again, our base case results suggests this argument is not without merit. On the other hand, many countries impose controls because of downward pressure on the exchange rate. But, the base case result indicates that controls, while hampering possible speculative attacks, will in fact exacerbate downward pressure on the real exchange rate.

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Figure 1

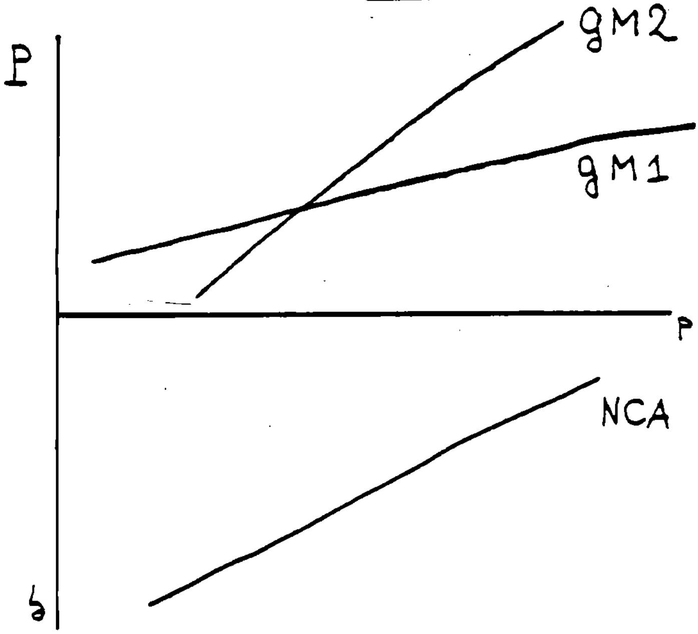
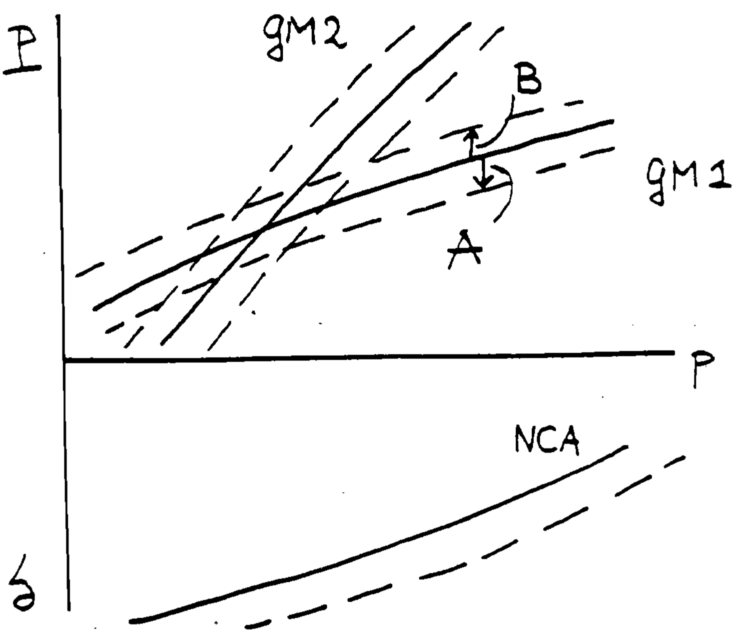



Figure 2



CAPITAL CONTROLS AND THE REAL EXCHANGE RATE

APPENDIX

## I The Basic Model

The model consists of intertemporal budget constraints at home (ITBC) and abroad ($ITBC^*$), market-clearing equations for the home goods market today (GM1) and tomorrow (GM2), and a world current account balance equation (NCA). In equation form:

ITBC $$PX + \delta px + b.nca = E(\Pi(P,1),\delta\pi(p,1),U)$$

$ITBC^*$ $$X^* + \delta x^* = E^*(\Pi^*(P,1),\delta^*\pi^*(p,1),U^*)$$

GM1 $$X = E_P + E_P^*$$

GM2 $$x = E_p + E_p^*$$

NCA $$PX - E_\Pi\Pi + X^* - E_\Pi^*\Pi^* = 0$$

Upper case (lower case) letters correspond to period 1 (period 2) variables. X ($X^*$) is home (foreign) output. P is the relative price of home goods in terms of foreign goods. $\delta^*$ is the relative price of future foreign goods in terms of current future goods prevailing in world markets, and $\delta$ the same price but prevailing at home. b is the wedge between the two induced by capital controls.

Differentiation of ITBC and ITBC* gives the first-order welfare effects of relative price changes on respectively U and $U^*$. Consider the impact on foreign welfare first:

A.1 $$-(X-E_P)dP - (x-E_p)\delta dp - (px-E_\pi \pi)d\delta^* = E_U^* dU^*$$

For home welfare, the corresponding expression is:

A.2 $$(X-E_P+b\frac{\partial nca}{\partial P})dP + (x-E_p+b\frac{\partial nca}{\partial p})\delta dp + (px-E_\pi \pi+b\frac{\partial nca}{\partial \delta^*})d\delta^* + b\frac{\partial nca}{\partial b}db = (1-bC_{IIE}\pi)E_U dU$$

The expressions for $\frac{\partial nca}{\partial P}$ etc. are straightforward:

$$\frac{\partial nca}{\partial P} = -E_{\pi P}\pi, \quad \frac{\partial nca}{\partial p} = x - E_\pi \pi_p - E_{\pi\pi}\pi\pi_p, \quad \frac{\partial nca}{\partial \delta^*} = -E_{\pi\pi}\pi\pi,$$
$$\frac{\partial nca}{\partial b} = E_{\pi\pi}\pi\pi.$$

$C_{IIE}$ is the marginal propensity to spend on second period goods (in volume terms), and by home consumers: $C_{IIE}=E_{\pi U}E_U^{-1}$. The corresponding expression for foreign consumers is $C_{IIE}^*$. Similarly, $C_{PE}=E_{PU}E_U^{-1}$, the marginal propensity to spend on first period home goods by home consumers.

The analysis in the text is set up around the free capital market equilibrium (b=0). In that case the terms involving b in equ. (A.2) drop out:

A.3 $$(X-E_P)dP + (x-E_p)\delta dp + (px-E_\pi \pi)d\delta^* = E_U dU$$

Differentiation of GM1 and substituting out terms involving $E_U dU$ and

$E_U^* dU^*$ using (A.1) and (A.3) yields:

GM1 $$(E_{PP}+E_{PP}^*+(C_{PE}-C_{PE}^*)(X-E_P))dP +$$
$$(E_{Pp}+E_{Pp}^*+(C_{PE}-C_{PE}^*)(x-E_p))\delta dp$$
$$(E_{P\pi}+E_{P\pi}^*+(C_{PE}-C_{PE}^*)nca)d\delta^* - E_{P\pi}\pi db = 0$$

Define, for notational convenience, $\sum_{i,j}$, with i equal to either p or P, and j equal to either P, p or Π, as follows:

A.4 $$\sum_{i,j} = (E_{i,j}+E_{i,j}^*+(C_{iE}-C_{jE}^*)E_U U_j)$$

$U_j$ is the derivative of U with respect to variable j; for example, $E_U U_P = (X-E_P)$ when evaluated around b=0. [1]/ With this definition, A.4 becomes:

A.5 $$\sum_{PP}dP + \sum_{Pp}\delta dp + \sum_{P\pi}d\delta^* - E_{P\pi}\pi db = 0$$

Similarly, differentiating GM2 and NCA yields, respectively:

A.6 $$\sum_{pP}dP + \sum_{pp}\delta dp + \sum_{p\pi}d\delta^* - E_{p\pi}\pi db = 0$$

and

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[1]When b≠0, both the expressions for $U_j$ and for $\sum_{i,j}$ itself change. For the changes in $U_j$, see equations (A.1-2). $\sum_{i,j}$ becomes:

$$b\neq 0 \rightarrow \sum_{i,j} = (E_{i,j}+E_{i,j}^*+(C_{iE}-C_{jE})E_U U_j+b.\frac{\partial nca}{\partial j})$$

A.7 $$\sum_{\Pi P} dP + \sum_{\Pi p} \delta dp + \sum_{\Pi\pi} d\delta^{*} - E_{\Pi\pi}\pi db = 0$$

$\sum_{\Pi P}$ is defined as:

$$\sum_{\Pi,P} = -X + (E_{\Pi\Pi}\Pi + E_{\Pi})\Pi_P + (C_{IE} - C_{IE}^{*})E_U U_P$$

$\sum_{\Pi j}$ for $j = p, \delta^{*}$ is defined as:

$$\sum_{\Pi,j} = E_{\Pi,j}\Pi + E_{\Pi,j}^{*}\Pi^{*} + (C_{IE} - C_{IE}^{*})E_U U_j$$

## II Welfare Effects

Equ.(13) in the main text evaluates the welfare effects of db>0 for given intra-temporal terms of trade. The paper then proceeds to discuss the impact of capital controls on the real exchange rate (the intra-temporal terms of trade in this complete specialization model). These effects will clearly influence the welfare effects of the change in b that initiated the real exchange rate effects to begin with. The complete expression ( still evaluated at b=0) is:

A.8 $$E_U dU = nca\frac{d\delta^{*}}{db} + (X - E_P)\frac{dP}{db} + (x - E_p)\delta\frac{dp}{db}$$

For symmetrical expenditure patterns $\frac{dP}{db} = \frac{dp}{db} = 0$; A.8 then collapses into equation (13):

$$\frac{\Pi_P P}{\Pi} = \frac{\Pi_P^* P}{\Pi^*} \Rightarrow E_U dU = E_U dU\big|_{P,p}$$

This equality does not necessarily obtain for asymmetrical expenditure patterns, but the sign of the difference is unclear since real exchange rate effects are of opposite sign in each period. For example, when $\frac{\Pi_p P}{\Pi} > \frac{\Pi_P^* P}{\Pi^*}$, $\frac{dP}{db} < 0 < \frac{dp}{db}$; hence static terms of trade effects cause welfare losses today but welfare gains tomorrow, and the other way around for $\frac{\Pi_P P}{\Pi} > \frac{\Pi_P^* P}{\Pi^*}$.