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TRANSMISSION CHANNELS OF REAL EXPENDITURE SHOCKS

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* - The leitmotive of this working paper was suggested by Professor J. Braga de Macedo as an extension of previous research published by David Meerschwam and himself in 1985 and 1987. Many fruitful remarks are owed to Professor J. Braga de Macedo but all remaining errors are the author's own responsibility.

ABSTRACT

This paper deals with the international transmission of real expenditure shocks. A two-country intertemporal model of flexible exchange rates is used to identify four transmission channels. They show how an expenditure jump at home or abroad in a particular period affects contemporaneous as well as past and future income levels in both countries.

1. INTRODUCTION

Economic interdependence has always benn growing and acquiring greater sophistication after world war II. Policy-makers soon realized its implications for the formulation and conduct of national economic policies. The instruments set became constrained, particularly for small open economies, and, moreover, awareness of policies international repercussion quickly spread out through the world. Not only can a domestic policy influence macroeconomic performance abroad but a foreign decision can also affect and even jeopardize economic aims at home.

Keynesian literature of the sixties adjusted the fixed price framework to understand the phenomenon of repercussion and offered the so-called locomotive models to study the international transmission of expenditure shocks: income expansion abroad pulls up income at home. This idea became very popular on policy debates, making everyone waiting for the neighbour's expansion.

However, the exchange rate and price flexibility after 1973 introduced considerable flaws into that argument. As the oil crisis show, foreign expenditure shocks are no longer fully transmitted in the short run and even a simple anticipation of a future external disturbance is sufficient to affect current income in many economies. Clearly, the conventional argument for transmission lacked a relevant intertemporal dimension.

In two path-breaking articles, Macedo and Meerschwam (1985, 1987) redefine the expenditure shock transmission problem in two important ways, by allowing for exchange rate flexibility and by introducing an explicit intertemporal context. Consideration of a single (foreign) financial instrument in a two-country model, where an intertemporal balance constraint is imposed on the trade account, allows the authors to derive new and more general predictions concerning expenditure shock transmissions. In particular, the standard locomotive argument is shown to be a mere possibility and not an inescapable phenomenon.

The present paper intends at providing additional theoretical support for the avenue opened up by Macedo and Meerschwam. We extend their analysis by introducing a second (domestic) financial instrument and by refining the budget function. The model focus on the case of a small open economy where a financial relationship between its government and its citizens is considered but where such relationship in the other economy is neglected. Four transmission channels are identified, as in Macedo and Meerschwam (1985, 1987), combining intertemporality with shock nationality.

Contemporaneous disturbances are transmitted across countries via both an income effect and an exchange rate effect working on opposite directions. It is shown that for large creditor economies the latter may outweight the former; so a foreign expenditure pull may cause recession at home, destroying the standard locomotive argument. The model

Macedo and Meerschwam's papers are used throughout as a benchmark to which we refer our model. That is why we retain their notation as well as their parameterization used for simulation purposes.

The paper proceeds as follows. Next section describes the atemporal or, more precisely, the contemporaneous macroeconomic relations for both countries while section 3 introduces intertemporality explicitly in the form of three balance constraints (trade account and budget deficits). The equilibrium exchange rate is determined in section 4, finally enabling the computation of equilibrium income. Section 5 derives the transmission channels of expenditure shocks (the central object of this paper) through comparative statics. A small simulation is conducted in section 6 to offer a crude comparative appraisal between our model and Macedo and Meerschwam's concerning the relative power of expenditure shocks to affect domestic income and the exchange rate. The main conclusions of this study and several suggestions for future research close the paper as section 7.

2. CONTEMPORANEOUS MACROECONOMIC RELATIONS

The fundamental macroeconomic equilibrium is defined by the equality between income and expenditure; for an open economy expenditure consists of absorption and the current account,

$$Y = A + C.$$

A similar equilibrium exists for the foreign country (denoted by a" *"),

$$Y^* = A^* + C^* ,$$

where

$Y(Y^*)$ – domestic (foreign) disposable income

$A(A^*)$ – absorption at the home (foreign) economy

$C(C^*)$ – domestic (foreign) current account balance expressed in domestic (foreign) currency.

Absorption is defined as

$$A = E + \mathfrak{T} + (1-s)\ Y$$

$$A^* = E^* + \mathfrak{T}^* + (1-s^*)\ Y^* ,$$

where

$E(E^*)$ – autonomous expenditure at home (abroad)

The trade balance and the interest on the international asset make-up the current account,

$$C = e\,B^* + e\,r^*\,F,$$

where

- e – exchange rate (price of foreign currency in terms of domestic monetary units)
- B^* – home country's trade balance expressed in foreign currency
- r^* – interest rate in the foreign capital market
- F – stock of the foreign asset at the beginning of the period.

The foreign asset is an interest-bearing financial instrument with an infinite maturity. It is denominated in foreign currency and has an international dimension since its accumulation is linked to transactions between the two economies for reasons to be spelled out in the next section. A positive (negative) value of F means the home economy has a creditor (debtor) position in the international capital market.

The foreign current account is obviously tied to the domestic one by

The home country's trade balance gives net exports of goods,

$$B^* = M^* - \frac{M}{e},$$

where

$M(M^*)$ – gross imports made by the home (foreign) country expressed in domestic (foreign) currency.

Imports are simply modellized as an increasing function of the relevant disposable income,

$$M = my$$

$$M^* = m^* y^*,$$

where

$m(m^*)$ – marginal propensity to import at home (abroad).

The above relations are conveniently summarized by the following equations giving the equilibrium levels of income in each country and the trade balance:

$$(1) \qquad y_i = \frac{1}{\Delta}\left[(s^*+m^*)(E_i+\mathcal{T}_i+e_i r^* F_i)+e_i m^*(E_i^*+\mathcal{T}_i^*-r^*F_i)\right]$$

$$(2) \qquad y_i^* = \frac{1}{\Delta}\left[(s+m)(E_i^*+\mathcal{T}_i^*-r^*F_i)+\frac{m}{e_i}(E_i+\mathcal{T}_i+e_i r^* F_i)\right]$$

where

$$\Delta = ss^{*}+s^{*}m+sm^{*}.$$

A subscript i indexes time, showing the observation period of each variable. It had been omitted in the previous exposition to avoid cumbersome writing. Marginal propensities and the interest rate are assumed constant over time and thus parameterize equations (1)-(3). Since all variables in these equations are referred to the same period we say that such relations are contemporaneous definitions of equilibrium. They are not the reduced-form equations for income at home and abroad and the trade balance because the right-hand sides do not involve only exogenous variables and parameters. Clearly the exchange rate, the fiscal deficits and the foreign asset stock need to be explained.

We can interprete the model in terms of expectations formed in the base (zero) period. Under these circunstances, E_i is the autonomous expenditure economic agents expect in the base period to prevail in period i and similarly for the other variables. Variable e_i is thus the spot exchange rate expected in the base period to prevail i periods ahead and so, under conditions of efficient speculation, is the i-period forward exchange rate.

Under a fixed exchange rates regime an expenditure pull abroad has unambiguous positive consequences on contemporaneous domestic income. Such pull is multiplied by is just the first impact of foreign expansion since we must also consider the influence of the expenditure shock on the exchange rate and allow for the effect of this variable on domestic income. Although the first impact[1] is positive, an eventual exchange rate appreciation may be strong enough to more than compensate that benefit. The following analysis determines an intertemporal equilibrium for our model and will highlight this issue, as well as the transmission of non-contemporaneous shocks.

3. INTERTEMPORAL CONSTRAINTS

Under flexible exchange rates it is the role of the exchange rate to bring an automatic adjustment to any balance of payments disequilibrium. To model this behaviour we must force the current account into line with the capital account,

$$(4) \qquad B_i^* + r^* F_i = F_{i+1} - F_i \ .$$ [2]

The left-hand side, i.e., the current account, can be interpreted as the excess flow supply of foreign exchange in period i while the right-hand side, i.e., (the symmetrical value of) the capital account, shows the change in the international financial position of the home economy or the stock demand for foreign exchange. This is the kind of equilibrium in the foreign exchange market analysed by Kouri (1978) in his path-breaking article concerning the interaction between the current and the capital accounts[3] in the determination of the equilibrium exchange rate.

2- Recall that F is measured at the beginning of each period.

3- To be precise, our equation (4) corresponds to equation (10) of Kouri (1978, p.18).

Since the foreign interest rate is constant over time, the difference equation (4) can be solved by sequential backward substitutions, as in Macedo and Meerschwam (1987), to give

$$(5) \qquad \sum_{i=0}^{\infty} \left(\frac{1}{1+r^*}\right)^i B_i^f = -(1+r^*)F_o \ .^4$$

Equation (5) states an intertemporal balance constraint. The present value of initial and all expected future trade balances must exactly match the value of initial external debt. As Macedo and Meerschwam (1985, p.6) stress,

> "(...) foreign asset holdings represent purchasing power over foreign goods: their ultimate use lies in consumption. The balance of trade is a vehicle for intertemporal saving and consumption. Current output claims on the future consumption of foreign goods are thus accumulated through savings."

Fiscal deficits were introduced in the absorption equations of the previous section but were not explained at all. The time has come to do it.

Assume an international asset exists in the home economy, being issued by the government to finance its deficit and

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4-Use of $\lim_{n\to\infty} \left(\frac{1}{1+r^*}\right)^n F_{n+1} = 0$ as terminal condition has been made.

held by domestic residents only.[5] Therefore,

$$(6) \qquad \mathbf{T}_i = D_{i+1} - D_i ,$$

where

D_i – stock of the domestic asset at the beginning of period i (a positive value means a government debt).

According to this rule, the domestic debt stock grows up through the accumulation of fiscal deficits.

As D is an interest-bearing asset at rate r (constant over time), the government budget contains an interest component every period and can be apropriately defined as

$$(7) \qquad \mathbf{T}_i = T_i + r\, D_i ,$$

where T denotes the excess of government consumption over tax collection, the so-called "primary" deficit. Solving (6) like (4), by sequential backward substitutions, and using definition (7), we get

$$(8) \qquad \sum_{i=0}^{\infty} \left(\frac{1}{1+r}\right)^i T_i = -(1+r)D_o .$$

5- This corresponds to the special case discussed by Kouri (1978, pp.16-19) where foreign residents do not hold domestic assets. The home economy is called "small" by Obstfeld and Stockman (1985, p.948) whenever this situation occurs.

This equation states the domestic budget constraint. The government can choose "primary" deficits or surpluses over time but the discounted value of present and all expected future "primary" budgets must meet initial internal debt. This variable sets a ceiling to the expenditure capacity of the domestic government over time. For instance, assume $D_o=0$. In this case, if public consumption exceeds taxes (a deficit) in a particular year, the government must show up an overall discounted surplus in the other years in order to satisfy the intertemporal budget constraint.

Under a small country assumption, we can neglect the financial links between the foreign government and foreign residents. In particular, we assume no internal debt abroad, which amounts to say that

$$(9) \qquad \mathcal{T}_i^* = 0 \ ,$$

where we define the foreign (total) budget deficit as

$$(10) \qquad \mathcal{T}_i^* = T_i^* + r^* F_i \ .$$

T* denotes the foreign government "primary" deficit.

We could have defined the foreign total budget deficit exclusive of interest payments ($\mathcal{T}_i^*=T_i^*$) but, given the impossibility of accumulating debt ($\mathcal{T}_i^*=0$), this would correspond to impose a permanent balance on the "primary" deficit. Instead of fixing T_i^* at the zero level, we prefer to peg the "primary" deficit to the interest account in such a way that

$$T_i^*=-r^*F_i \qquad \forall\ i.$$ [6]

We can rationalize this procedure by assuming that the foreign government acts as a financial intermediary between its citizens and the home economy, collecting taxes when the interest payment accruing to domestic residents is positive and transferring income when such payment is negative.

Accumulating (9) along the lines already developed for (4) and (6), we derive the intertemporal foreign budget constraint:

$$(11) \qquad \sum_{i=0}^{\infty} \left(\frac{1}{1+r^*}\right)^i \mathcal{T}_i^* = 0 .$$

Its interpretation is similar to equation (8) above.

6- Macedo and Meerschwam (1987) used the same budget definition but they pegged the total deficit, not the "primary" one. They assumed (using our notation)

$$\mathcal{T}_i^*=r^*F_i \qquad \forall\ i,$$

and, as a result, they balanced the "primary" deficit in every period,

$$T_i^*=0 \qquad \forall\ i.$$

With perfectly integrated capital markets, efficient arbitrage will lead to interest parity which, in an intertemporal context, means that the i-period forward exchange rate, e_i, is in line with the current or (base period) spot exchange rate, e:

(12) $$e_i = \left(\frac{1+r}{1+r^*} \right)^i e \; .$$

This condition is directly borrowed from Macedo and Meerschwam (1987) who derive and extend it from popular asset market models.[7]

It is usual in corporate finance theory to define the base period market value of a particular bond as the present value of the cash flow stream it generates from that moment onwards. In our model both domestic and foreign assets are perpetuities so that their face value is never paid back. According to this sound theoretical foundations, as reviewed in Brealey and Myers (1985, section 4.1), we expect domestic residents to allocate their initial wealth to both assets in the following way:

7- See Grauwe (1984, ch.12) for an explanation of interest parity in the context of a simple asset market model. On the practical relevance of interest parity see, for instance, Macedo (1988,sct. 2) who uses (real) interest differentials as a measure of capital mobility among EC 12 member states.

$$(13) \qquad D_o = \sum_{i=0}^{\infty} \left(\frac{1}{1+r}\right)^i r\, D_i$$

$$(14) \qquad F_o = \sum_{i=0}^{\infty} \left(\frac{1}{1+r^*}\right)^i r^*\, F_i \quad .$$

Home residents allocate their initial wealth to existing perpetuities according to expected returns in such a way that D_o and F_o equal the present value of current and all expected future interest bearing on domestic and foreign assets ($r\, D_i$ and $r^*\, F_i$), respectively.

4. THE EQUILIBRIUM SPOT EXCHANGE RATE

The equilibrium value of the spot exchange rate is such that the balance of payments is permanently cleared, i.e., the trade accounts satisfy the intertemporal balance contraint. As the contemporaneous relations are valid whatever the period while budget constraints and interest parity hold and investors set their initial asset holdings according to the discounted value of their expected interest stream, we introduce (3) into (5) and make use of (8), (11), (12), (13) and (14) to derive the equilibrium exchange rate:

$$(15) \qquad e = \frac{s^* m (E_\infty - r D_o)}{s m^* E^*_\infty + (\Delta r^* + s s^*) F_o},^{8}$$

8- If we had adopted the Macedo and Meerschwam (1987)'s assumption regarding the foreign fiscal deficit pegging instead of our own (see footnote 6) the current exchange rate would not be qualitatively affected; in fact, expression (15) would be

$$e = \frac{s^* m (E_\infty - r D_o)}{s m^* E^*_\infty + [\Delta(1+r^*) - s^* m] F_o}$$

and the term associated to F_o (the only difference between the two expressions) presents the same signal as the one in (15).

where

$$E_{\infty} = \sum_{i=0}^{\infty} \left(\frac{1}{1+r}\right)^{i} E_{i}$$

$$E_{\infty}^{*} = \sum_{i=0}^{\infty} \left(\frac{1}{1+r^{*}}\right)^{i} E_{i}^{*} \quad .$$

Future levels of autonomous expenditure are expected with certainty while the other exogenous variables (marginal propensities to save and to import and interest rates) parameterize our solution and therefore remain constant over time. Hence, equation (15) gives the reduced form value of the exchange rate given the initial stocks of domestic and foreign assets. But domestic investors are not free to choose them independently, they have to face a portfolio constraint. Initial wealth is given them by their past saving accumulation so that their decision regarding D_o and F_o must meet the portfolio constraint

(16) $\quad W_o = D_o + e\, F_o$. [9,10]

9- The appropriate exchange rate to be shown in (16) would be e_o but $e_o = e$ by mere inspection of (12).

10-This is the simplest way to consider a portfolio balance condition but it prooves adequate enough for our modelling purposes. The interested reader may consult Branson and Henderson (1985) for a comprehensive analysis of portfolio balance models emphasyzing their microeconomic foundations.

Independence of D_o and F_o would result on exchange rate overidentification; equations (15) and (16) would determine e in two autonomous ways. In order to avoid this problem the ultimate equilibrium value of the current exchange rate must meet conditions (15) and (16) simultaneously. This means D_o and F_o are, in fact, dependent; according to (16) and given such equilibrium value, once investors choose D_o they immediately decide upon the amount of F_o . Therefore, inserting (16) into (15) we finally derive the equilibrium current or spot exchange rate:

$$(17) \qquad e = \frac{s^* m(E_\infty - rD_o) - (\Delta r^* + ss^*)\,(W_o - D_o)}{sm^*\,E^*_\infty} \quad ,$$

where $W_o - D_o$ is the domestic currency value of initial external credit extended to foreigners.

It can be shown that positiveness of the equilibrium exchange rate arises only when

$$(18) \qquad (W_o - D_o)\left[(1+r^*) - \frac{sm^*}{\Delta}\right] < M_\infty \ ,$$

where

$$M_\infty = \frac{s^* m}{\Delta}\left[E_\infty + W_o - (1+r)D_o\right] \quad .$$

The right-hand side of inequation (18)- M_∞ - is the discounted domestic currency value of foreign exports [11].

11-This point can be seen by applying the present value formula to the domestic currency value of our imports in equation (3) and using statements (8), (12), (13), (14) and (16) to simplify the above present value.

For a moment assume foreigners import nothing ($m^* = 0$). In this case, M_∞ represents their largest potential accumulation of payment capacity over time; in order to be repayable, initial domestic lending to foreigners cannot exceed M_∞. Consider now the case where they are allowed to consume over time our initial credit $W_o - D_o$; if their import path is limited to this revenue source, our external credit ceiling is increased through repercussion, being given by

$$(19) \qquad \overline{W_o - D_o} = \frac{\Delta M_\infty}{\Delta(1+r^*) - sm^*} .$$

So we may conclude that the exchange rate is positive [12] whenever our initial external credit does not exceed the ceiling dictated by (19).

5. COMPARATIVE STATICS: TRANSMISSION CHANNELS

We are finally able to analyse the transmission of expenditure shocks. The model developed in the three previous sections can be used to identify four transmission channels, using the Macedo and Meerschwam's classification. The performance of these channels derives from the operation of two effects, an income effect and an exchange rate effect.

Consider a foreign autonomous expenditure expansion at period j, $\Delta E_j^* > 0$. As this shock is immediately perceived (under perfect foresight expectations), it gives rise to those two effects. The income effect is already standard in the literature and runs as follows: higher foreign autonomous expenditure in period j calls for higher foreign income in that period whenever prices are absent (as is the case in this model); this tends to improve the home country contemporaneous trade account and so stimulates domestic income of the shock period. Hence considering only the income effect, a foreign expenditure pull causes a contemporaneous boom at home and abroad.

But under flexible exchange rates with intertemporal trade account balance, expenditure expansion abroad forces the current exchange rate to appreciate since that expansion leads to an improvement in the (home country) trade account of period j; as the intertemporal balance constraint must hold and the exchange rate is the external account adjusting which operates in the following way: the drop in e appreciates all expected exchange rates, given the constant interest rate differential, and so tends to deteriorate all trade accounts, thus reducing (increasing) all expected incomes at home (abroad). Therefore, considering the exchange rate effect only, an expenditure expansion in period j abroad causes recession (boom) at home (abroad) in all periods, before, after and in j.

While the income effect is contemporaneous, the exchange rate's has an intertemporal dimension. It is the intertemporal linkage of exchange rates that enables a particular expenditure shock to be transmitted to both economies across time.

The next paragraphs present an informal discussion on the transmission of real expenditure shocks. It will highlight operation of the income and exchange rate effects.

The contemporaneous transmission of a domestic (foreign) expenditure shock to income at home (abroad) is called own transmission channel. Both income and exchange rate generate a positive influence upon domestic (foreign) income.

The contemporaneous transmission of a domestic (foreign) expenditure shock to income abroad (at home) is termed horizontal channel of transmission. This cross-country channel has, a priori, an ambiguous outcome since the income and exchange rate effects run in opposite senses: the former calls for expansion (is the traditional locomotive argument) while the latter calls for recession. As we will see in our formal discussion below, the likelihood of a depressive outcome is higher the higher is the initial credit extended to foreigners.

Consider now non-contemporaneous shocks. Imagine a domestic (foreign) expenditure pull at any time i, with $i \neq j$ (past or future "vis-à-vis" j).

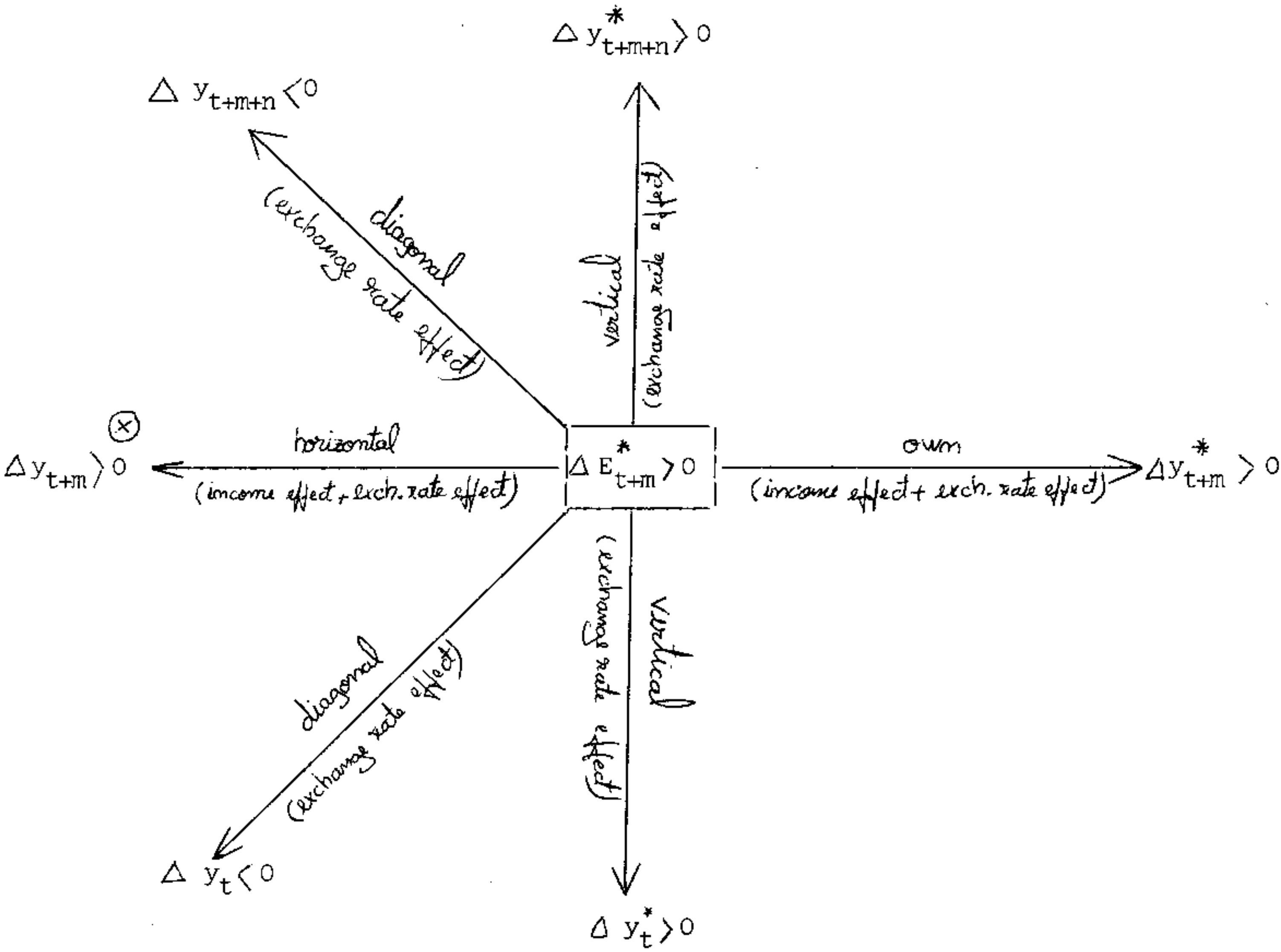
If we want to study the influence of this shock on incomes of period j it is useful to distinguish two additional transmission channels. The vertical one gives the transmission of the above shock to domestic (foreign) income of period j. Only the exchange rate effect operates under this channel; therefore, appealing to our previous discussion, we expect that shock to cause a boom in both economies in period j.

The influence of a domestic (foreign) expenditure pull at any time i ($i \neq j$) in period j foreign (domestic) income carries under the diagonal transmission channel. As in the previous channel, the income effect does not operate. Therefore, such cross-country influence is negative.

We can illustrate these four transmission channels using figure 1 which is borrowed, with minor adjustments, from Macedo and Meerschwam (1987, p.10). For simplicity, only a foreign expenditure shock is considered. If it occurs at period t+m then Δy^*_{t+m} and Δy_{t+m} are the income changes arising from own and horizontal transmissions, respectively. Vertical transmissions give rise to foreign income changes in any future (Δy^*_{t+m+n}) or past (Δy^*_t) period. Finally, diagonal transmissions concern domestic income changes in any future (Δy_{t+m+n}) or past (Δy_t) period.

All these transmission channels can be shown formally. We will concentrate the discussion on home income but precisely the same conclusions could be derived using foreign income.

FIGURE 1 – TRANSMISSION CHANNELS



⊗ $\Delta y_{t+m} > 0$ if the exchange rate effect is dominated by the income effect.

Consider equation (1) referred to period j and totally differentiate it, as well as equations (12) and (17), to introduce a contemporaneous domestic and foreign autonomous expenditure shock. The result is

$$(20)\quad dy_j = \underbrace{\frac{1}{\Delta}\left[s^* + m^*\left(1 + \frac{s^* m}{s m^*}\,\mathcal{E}_j^*\right)\right] dE_j}_{\text{own channel}} + \underbrace{\frac{m^*}{\Delta}\,(1-\mathcal{E}_j^*)\, e_j}_{\text{horizontal channel}}\; dE_j^* \;,$$

where

$$\mathcal{E}_j^* = \frac{E_j^*/(1+r^*)^j}{E_\infty^*} \;.$$

The own transmission channel is unambiguously positive [13]; thus an unexpected increase in domestic autonomous expenditure at period j rises contemporaneous domestic income.

Since $1-\mathcal{E}_j^* > 0$ is an universal condition (because $0 < \mathcal{E}_j^* < 1$), the horizontal transmission channel is positive whenever the initial credit extended by domestic lenders to foreign

13-The own transmission channel is ambiguous in Macedo and Meerschwam (1987). A positive current exchange rate is a sufficient condition to make such channel positive and the authors keep that assumption throughout.

borrowers is below its ceiling (19). Only if that ceiling is violated can we observe an expansion abroad causing contemporaneous recession at home (perverse locomotive effect) [14].

As noted in the last footnote, sign ambiguity concerning horizontal transmission is smaller in this paper than in Macedo and Meerschwam (1987). The reason lies in our inclusion of an additional asset, the domestic asset, leading to a weaker exchange rate effect. As explained before, a positive foreign shock in period j forces the current and the whole path of expected exchange rates to appreciate in order to deteriorate all trade balances in the amount required to restore intertemporal equilibrium. But consider the balance of period j, the one that suffers both income and exchange rate effects. It is the only balance to improve; otherwise the others would not need to deteriorate. So the home economy accumulates in period j additional foreign bonds, by equation (4). With a fixed wealth stock the drop on the exchange rate required to restore portfolio balance is exactly proportional to the rise on foreign asset holding if this is the only financial instrument available.

14-This result sharply contrasts with Macedo and Meerschwam (1987) where the condition $e > 0$ is not sufficient to assure a positive locomotive effect. In their paper, a further condition - inequation (13) - relating ε_j^* to the initial stock of the foreign asset is required in order to avoid a perverse horizontal transmission.

But suppose now that an alternative asset exists (the domestic asset); then, domestic investors may sell it to acquire a stronger foreign asset position and so the exchange rate fall does not need to be so pronounced for the portfolio balance to be restored. Thus the exchange rate effect is weaker when a domestic asset exists [15].

15-The size of the exchange rate drop depends on the initial portfolio composition, as the following analysis shows. Given the initial wealth stock (zero subscripts omitted)

$$W = D + eF$$

we have

$$de = -\left(\frac{dD}{F} + \frac{e}{F}\, dF\right).$$

Computing $\frac{e}{F}$, we get:

$$\frac{e}{F} = \frac{s^{*}m\left(\frac{E_{\infty}}{F} - r\,\frac{D}{F}\right)}{sm^{*}E^{*}_{\infty} + (\Delta r^{*} + ss^{*})F}.$$

It is now clear that the larger the initial domestic asset holding "vis-à-vis" the initial amount of foreign assests held (ceteris paribus) the smaller is e/F and so the weaker is the exchange rate change required to restore portfolio balance. This weakening of the exchange rate effect prevails even if no change in D occurs. The weakening is reinforced, i.e., |de| is even smaller when dD (partially) offsets dF, that is, when investors sell part of D to buy more F.

Therefore, there is no perverse locomotive effect (i.e., a backward push of the locomotive) provided the initial credit extended to foreigners is not large enough. A normal locomotive effect or positive horizontal transmission means the exchange rate effects is dominated by the income effect.

Let us now look at the transmission of non-contemporaneous expenditure shocks. Imagine autonomous expenditure changes at home and abroad in all periods but j. Their effects on domestic income are assessed by

$$(21)\quad dy_j = \underbrace{\frac{s^* m}{s\Delta}\mathcal{E}_j^*(1+r)^j \sum_{\substack{i=0\\ i\neq j}}^{\infty}\left(\frac{1}{1+r}\right)^i dE_i}_{\text{vertical channel}} + \underbrace{\left[-\frac{m^*}{\Delta}\mathcal{E}_j^*(1+r)^j \sum_{\substack{i=0\\ i=j}}^{\infty}\left(\frac{1}{1+r}\right)^i e_i dE_i^*\right]}_{\text{diagonal channel}},$$

having differentiated equations (1), (12) and (17). Non-contemporaneous expenditure shocks can only affect income through changes on the exchange rate and equation (21) prooves the results informally discussed above. Both vertical and diagonal transmission channels have unambiguous signs: the former is positive while the latter is negative [16]. Hence any higher than expected expenditure at home (abroad) improves (damages) domestic income in all periods where such shock did not occur.

16-The diagonal transmission channel is unambiguously negative provided the forward exchange rate e_i is positive. As explained before, this is always the case whenever initial external credit is below its ceiling (19). A similar condition of "well-behaved" exchange rate is required by Macedo and Meerschwam (1987) to avoid sign ambiguity in both non-contemporaneous channels.

6. SIMULATION

Several simulation exercises were carried through to provide at least some crude idea about the relative power of expenditure shocks to affect domestic income and the exchange rate.

The exercises differ in the parameterization of initial conditions (T_o , W_o and D_o). In choosing such parameterization we tried to reproduce, as close as possible, the initial conditions selected by Macedo and Meerschwam (1985, 1987), so as to enable the reader to compare those relative powers in the two models. Shock outcomes in Macedo and Meerschwam's are conditional upon a single initial condition, F_o , since the foreign asset is the only financial instrument available and both primary deficits are zero in every period.Their model was simulated for three different values of F_o :2000, 0 and -2000. Thus we also considered three variants in our initial conditions. In all of them we made T_o =0 and D_o =3000 (making domestic government an effective debtor in the initial period) and chose W_o so as to get the above F_o values. The variants were:

a) $$\left\{\begin{array}{l} T_o = 0 \\ W_o = 4564.77 \\ D_o = 3000 \end{array}\right\} \Longrightarrow F_o = 2000$$

b) $$\left.\begin{cases} T_o = 0 \\ W_o = 3000 \\ D_o = 3000 \end{cases}\right\} \Longrightarrow F_o = 0$$

c) $$\left.\begin{cases} T_o = 0 \\ W_o = 614.18 \\ D_o = 3000 \end{cases}\right\} \Longrightarrow F_o = -2000.$$

The condition $F_o = 0$ corresponds in Macedo and Meerschwam's model to the absence of financial sphere. The analogous situation in our model is not represented by b) because we have also to eliminate the domestic asset. Hence a fourth variant was simulated:

d) $$\left.\begin{cases} T_o = 0 \\ W_o = 0 \\ D_o = 0 \end{cases}\right\} \Longrightarrow F_o = 0.$$

To keep similarities between both models we adopted the same numerical values for the parameters and the exogenous variables. Thus

$$
\begin{aligned}
s &= s^* = 0.05 \\
m &= m^* = 0.15 \\
r &= r^* = 0.1 \\
E_i &= E_i^* = 500 \qquad \forall i.
\end{aligned}
$$

The expenditure shocks considered were

$$dE_o = dE_o^* = dE_{1o} = dE_{1o}^* = 50$$

and we analyzed their impact on the current exchange rate and initial domestic income.

As in Macedo and Meerschwam, a 50-period time horizon version of our model exhibits almost the same results as the infinite time horizon version, the differences being negligible [17]. Therefore, we use the finite time horizon as an accurate approximation to the exact infinite time horizon structure because this was the simulation procedure used by those authors.

17-Initial income and the current exchange rate are exactly

The results are exhibited in tables 1 and 2. The former contains the base case, presenting the pre-shock equilibrium values of the initial spot exchange rate and domestic income inherent to the four variants discussed above. The 10% expenditure shocks outcomes are assessed in terms of elasticities in table 2; for each transmission channel the four variants are considered.

Both the own and vertical shocks devalue domestic currency in all variants, thus always generating a positive exchange rate effect. The devaluation is, in relative terms, lower the smaller is financial wealth (ceteris paribus), i.e., the smaller is credit extended to foreigners (independently of the currency in which such credit is measured).

Not surprisingly, both domestic shocks expand income at home, its rise being smaller the smaller is external credit, i.e., the weaker is the exchange rate effect. Initial income, as well as the exchange rate, is more strongly affected by a present shock than by a future one of the same absolute amount; the relative change in y_o (e) caused by the 50 units increase in E_{1o} is only 2.48% (38.55%) of that called for the same rise in E_o, whatever the initial conditions are [18].

The exchange rate and income elasticities drop as we go from a) to c) variant. However, the absolute changes in e and y_o (not shown) determined by shocks at home are independent of initial conditions [19]. Therefore, the decline of elasticities as external credit is shrunken results exclu-

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18-The reason is obvious: the present value of dE_{1o} is only 19.28 while that of dE_o is 50.

19-As can be seen from equations (20) and (21), both own and vertical transmission are independent of T_o, W_o and D_o.

TABLE 1 - BASE CASE

VARIABLE / VARIANT	e	y_o
a)	0.7824	12943.0
b)	0.9450	13192.8
c)	1.1929	13573.7
d)	1.0000	10000.0

TABLE 2 - EXPENDITURE SHOCKS:TRANSMISSION CHANNELS

i) OWN CHANNEL			ii) HORIZONTAL CHANNEL	
	$\frac{\Delta e/e}{\Delta E_o/E_o}$	$\frac{\Delta y_o/y_o}{\Delta E_o/E_o}$	$\frac{\Delta e/e}{\Delta E_o^*/E_o^*}$	$\frac{\Delta y_o/y_o}{\Delta E_o^*/E_o^*}$
a)	0.1172	0.4719	a) -0.0917	0.2353
b)	0.0970	0.4629	b) -0.0917	0.2788
c)	0.0769	0.4499	c) -0.0917	0.3421
d)	0.0917	0.6107	d) -0.0917	0.3893
iii) VERTICAL CHANNEL			**iv) DIAGONAL CHANNEL**	
	$\frac{\Delta e/e}{\Delta E_{1o}/E_{1o}}$	$\frac{\Delta y_o/y_o}{\Delta E_{1o}/E_{1o}}$	$\frac{\Delta e/e}{\Delta E_{1o}^*/E_{1o}^*}$	$\frac{\Delta y_o/y_o}{\Delta E_{1o}^*/E_{1o}^*}$
a)	0.0452	0.0117	a) -0.0354	-0.0092
b)	0.0374	0.0115	b) -0.0354	-0.0109
c)	0.0269	0.0112	c) -0.0354	-0.0133
d)	0.0354	0.0152	d) -0.0354	-0.0152

sively from increases in base case values. The situation is quite different in the horizontal and diagonal channels (to be considered below) where all absolute changes vary with initial wealth. Moreover, the exchange rate elasticities are all the same under both horizontal and diagonal transmission. In Macedo and Meerschwam (1985, 1987) the absolute changes in e and y_o are conditional upon initial conditions (F_o) whatever the transmission channel; however, exchange rate elasticities are independent of F_o under both own and vertical transmission.

Turning now to foreign expenditure shocks, we notice a domestic currency appreciation independent of initial conditions (9.17% for the present shock and 3.54% for the future one). As expected, the exchange rate exerts a negative influence in the home country income through deterioration of all trade balances. Nevertheless, the income response under horizontal transmission is positive because the external credit ceiling is respected in all variants; therefore, the wagon follows the locomotive. The proportional income gap between own and horizontal transmission is smaller the smaller is the creditor position of the home economy (it shrinkes from 100.53% when F_o = 2000 to 31.52% when F_o = -2000) because the latter transmission declines with the credit size. Diagonal transmission is negative, as one should expect, since it emanates exclusively from the exchange rate effect, which was already seen to be negative. Moreover, it rises, in absolute value, with the external indebtedness of the home economy.

The contemporaneous foreign shock is more powerful to affect both the exchange rate and income than the future one whatever the variant: the reason is the same we argued before for the case of domestic disturbances.

As stated above, our variant d) corresponds exactly to the F_o =0 case in Macedo and Meerschwam papers. Making $D_o=W_o=0$, our model reduces to the one of those authors with $F_o=0$; hence the base case and the elasticities are precisely the same in both models. This similarity naturally vanishes for the other variants; in particular, the elasticities fluctuation as initial external credit decreases (from 2000 to -2000) is much softer in our model (at least in the other three variants considered).

7. CONCLUDING REMARKS

The international transmission of real expenditure shocks has been the leitmotive of this essay. We used an intertemporal flexible exchanges rates framework developed by Macedo and Meerschwam (1985, 1987). Their analysis was generalized here by the introduction of an additional financial asset and a simple portfolio constraint and by the elimination of the primary deficit balances assumption in every period.

Four transmission channels were identified. A domestic expenditure upturn in period i induces a clear boom at home in every period j, being larger the closed are i and j. A foreign expenditure pull in period i causes recession at home in every period other than i and expansion at home in period i provided the foreign economy is not a large debtor. These results are basically those derived by Macedo and Meerschwam, thus stressing their robustness (and reinforcing these authors' intuition), but are less sign ambiguous. In fact, both own and vertical transmissions are definitely positive and independent of the exchange rate and the level of initial credit, which is not the case in those authors' model. A "well-behaved" exchange rate, i.e., initial credit extended to foreigners below its ceiling, is sufficient (in fact, necessary and sufficient) to get a clearly positive horizontal transmission. That same condition alone is not sufficient to deduce this unambiguous outcome in Macedo and Meerschwam's model–reread footnote 14.

The transmission channels were analytically derived and simulated for domestic income only but exactly the same procedure could be applied to foreign income. Since the conclusions would be analogous we omitted such analysis from this paper.

Research on the international transmission of real expenditure shocks still has a large scope for future development. For example, further thought may be addressed to eliminate the small country assumption by avoiding the zero foreign government budget and bringing into explicit consideration the financial relationship between that government and its citizens.

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