OIL SHOCK, SAVING, INVESTMENT AND TRADE BALANCE: THE ROLE OF SHORT RUN RIGIDITY VERSUS LONG RUN FLEXIBILITY. AN INTERTEMPORAL APPROACH.*

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The analysis of external shocks of real nature, such as the oil shock, requires an intertemporal framework to properly investigate through saving and investment decision the outcome of the balance of trade.

By now there are quite few works replying on such an approach, M. Obstfeld (1980), J. Sachs (1981, 1983), M. Bruno (1982), N. Marion (1984), N. Marion -L. Svensson (1984), yet they are far from explaining the large deficits of oil importing countries and the joint combination of trade deficits and fall in investment as the outcome of oil shocks .

Even more surprisingly they disprove the intuition, which can be traced back to the income-expenditure model of a strict correlation between the magnitude of trade deficits and real income losses.

M. Obstfeld's conclusion is that trade deficit, as consequence of the fall in saving, can occur only when there is a significant degree of substitution in the economy, when income losses tend to be at minimum.

For J. Sachs (1981, 1983) real income losses per se do not lead to trade deficit, they matter for the balance of trade performance only in so far the oil shock is of temporary nature. The fall in investment due to permanent oil stock will tend to give rise to trade balance surpluses and the poor performance of the oil importers trade balance can be explained only by replying on the reduction in the world interest rate (J. Sachs 1981).

When a non traded sector is added to the world price taker traded sector, M.Bruno (1981) and N.Marion(1984), the results are no more clear cuts, but the balance of trade worsening can be unambiguously explained only by rises in the investment, as a result not of exogeneous changes in the interest rates but rather of structural,technological, parameters ,N.Marion (1984).

Here again the trade balance outcome is indipendent on the welfare loss (1) and the framework cannot explain the fall in investment and the worsening of the trade balance as the joint outcome of the oil shock.

The objective of the paper is to show that these conclusions do not carry on for the generality of countries which are price makers of their internationally traded output, whose real exchange rate and intertemporal terms of trade are, as endogeneously determined,additional channels through which the external shocks affect saving and investment and therefore the trade balance.

Now the magnitude of the real income loss, due to both the degree of substitutability in production and the degree of wage flexibility, is a relevant factor in explaining the trade balance deterioration, inde pendently of the temporary or permanent nature of the disturbance. The negative correlation between investment and trade balance performance doesn't necessarily hold and the model can explain the joint outcome of trade balance deterioration and fall in investment for both permanent and temporary oil shock.

Moreover by explaining the real exchange rate and the intertemporal terms of trade and bringing out explicitely the implications of the asymmetry between the short and the long run on saving and investment, through real prices effects, the framework fully exploits the explanatory power of the intertemporal approach, whose interest relays on capturing short and long run phenomena simultaneously.

The paper is organized as follows. Section one reviews the small open economy intertemporal framework and the effects of oil shock in such an economy. Section two extends the analysis to the case of imperfect substitutability between domestic and foreign final goods. Here the real exchange rate at the two dates, the short and the long run, and the intertemporal terms of trade are endogenous variables. The effects on welfare and the real trade balance, deflated by an exact consumer price index, of real price shocks are analyzed. Section three introduces the real wage stickness as a short run phenomenon interacting with the deflationary disturbances on the determination of employment and investment decisions.

1. The small open economy model

The framework throughout the whole analysis is an intertemporal one allowing for two periods, indexed t=1 and 2. All rigidities, predetermination of the capital stock and possible price stickness, take place in the first period, the short run. Period two, the long run, is characterized by fully flexibility of prices and larger substitutability of inputs in production. the capital stock is the result of the investment taking place in the first period.

The benchmark model, reviewed in this section, deals with a small open economy (S.O.E.) for which prices of final goods (p) of raw materials (p_m) and interest rate (r) are exogeneously given in the international market.

The economy produces a tradable final good (Q) in each period using capital(K), labor (N) and imported raw materials(I_m). The period one final good can be consumed domestically, exported or used as a capital input in the second period. The capital stock in the first period is inherited by the past and it fully deprecia tes at the end of period, the second period capital stock is endo geneously determined by investment decision made at $t=1$.

1.1 Firms

Firms behave competitively by maximizing, for given la bor and capital endowments, prices and production function, $Q^t=Q(I_m^t, K^t, N^t)$, the present value of domestic product (GDP):

$$\max_{I_m^1, I_m^2} \left\{ p^1 Q^1(\cdot) - p_m^1 I_m^1 + D\left[p^2 Q^2(\cdot) - p_m^2 I_m^2\right]\right\} =$$

$$Y^1(p^1, p_m^1, K^1, N) + DY^2(p^2, p_m^2, K^2, N)$$

wher D is the discount factor, $D=1/(1+r)$, N is the labor endowment fixed at full employment in both periods.

By standard properties of the GDP function (2) the profit maximizing supply of final goods, raw material input demand and the wage rate associated to the labor endowment are expressed by:

$$Q^t = Y^t_{p^t}(p^t, p_m^t, K^t, N) \qquad [1']$$

$$I_m^t = -Y^t_{p_m^t}(p^t, p_m^t, K^t, N) \qquad [2']$$

$$w^t = Y^t_N(p^t, p_m^t, K^t, N) \qquad [3']$$

denoting with w the nominal wage rate and with $Y^t_{p^t}$ ...... the deriva tive of GDP...., at time t, relatively the subscript variable.

The optimum value of the capital stock in the second period will be such to maximize the difference between the present value of GDP at period 2 and the cost of investment at date one.

The investment function will satisfy the first order condition:

$$Y_K^2\,(p^2, p_m^2, I^1, N) = p^1/D \qquad [4']$$

totally differentiating [4'] and recalling its homogeneity property of degree one:

$$dI^1 = a(\hat{p}^1 - \hat{p}^2) - a\hat{D} - aY^2_{K,p_m}(Dp_m^2/p^1)(\hat{p}_m^2 - \hat{p}^2) - (Y^2_{K,N}/Y^2_{K,K})dN^2 \qquad [4'']$$

$a = Y_K^2/Y^2_{K,K} < 0$, from the concavity property of the production function; $Y^2_{K,p_m} < 0$ for oil and capital complementary inputs in production.

Given the small open economy assumption, whenever the wage rate is flexible in the long run so to keep labor fixed at full employment ($dN^2=0$), investment decision is completely determined by the exogeneous parameters: p^1, p_m^2, p^2, D.

1.2 Households

Consumer preferences are represented by an intertemporal utility function defined over consumption of final goods at the two dates:

$U = U(C^1, C^2)$

associated to this there will be the expenditure function, defining the minimum present value of expenditure required to reach the level of uti lity u:

$$E(p^1, p^2, u) = \min\{p^1C^1 + Dp^2C^2 \;|U(\cdot) \geq u\}$$

Assuming firms distribute profits to the households so to satisfy their intertemporal budget constraint, and the government budget balance over the two periods, the intertemporal budget constraint which should be satisfied by households:

$$E(p^1, Dp^2, u) = Y^1(p^1, p_m^1, N, K^1) + DY^2(p^2, p_m^2, N, K^2) - p^1I^1(p^1, p^2, p_m^2) - (p^1G^1 + Dp^2G^2)$$

defines at the same time the intertemporal Walrasian equilibrium for the S.O.E.

Recalling the homogeneity property of degree one of the expenditure and GDP functions we can deflate by p^1 and rewrite the intertemporal equilibrium condition as:

$$E(1,R,u)=y^1(1,(p_m/p)^1,N,K^1)+Ry^2(1,(p_m/p)^2,N,I)-I(\circ)-G^1-RG^2 \qquad [5']$$

where small letters y^1,y^2 define real GDP, as deflated by the price of final goods at the two dates (p^1,p^2); $R=Dp^2/p^1$ is the intertemporal terms of trade.

By standard properties of the expenditure function:
$E_1=C^1(R,u)$; $E_R=C^2(R,u)$; $C^1_R>0$, $C^2_R<0$, $C^1_u/E_u=C^1_W$, $C^2_u/E_u=C^2_W$
denoting with E_u the inverse of the marginal utility of wealth, the lattest given by the right hand side of [5'] .

The real balance of trade at two dates is given by:
$t^1=y^1-(C^1+I^1+G^1)$
$t^2=y^2-(C^2+G^2)$
from [5'] $t^1+Rt^2=0$, trade is balanced in present value terms over the two periods.

Totally differentiating [5'] , recalling the properties of the expenditure function, $E_R=C^2$, and the definition of the trade balance ,we get:

$$E_u du=-(I^1_m\tau^1)\hat{\tau}^1+t^2R(\hat{D}+\hat{p}^2-\hat{p}^1)-R(I^2_m\tau^2)\hat{\tau}^2-(dG^1+RdG^2) \qquad [5'']$$

where $\tau=p_m/p$ defines the international terms of trade between raw materials and final goods and at the same time, given the S.O.E. assumption, the relative price of raw material for the economy under study. The ^ over a variable denotes the percentage rate of change.

The following propositions hold for the S.O.E.:

1) the welfare effect of an increase in the international terms of trade $\bar{\tau}$, at both dates is indipendent of the degree of substitution between raw materials, capital and labor, whenever the wage rate is flexible so to satisfy [3'] .

2) Short run real wage rigidity, oil shock taking place in the first period and government policy are irrilevant for investment decisions.

3) A current temporary oil shock unambiguously deteriorates the trade balance as a result of the falling in saving at a constant level of investment.

4) Starting from a position where the state of the economy in the first period is replicated in the second period, output, real prices and production factors are the same at t=1,t=2, a permanent oil shock unambiguously improves the current balance of trade whenever the pro pensity to consume out of wealth in the second period doesn't exceed the propensity to consume at date one. If they are equal the trade balance improves as a result of the fall in investment taking place at a con stant level of saving.

5) The trade balance worsens if when the oil shock takes place the world interest rate falls as well: $\hat{D}>0$. In this case the trade balance outcome is the result of the mitigated fall in investment and the fall in saving due to the substitution effect arising from the increase in the intertemporal terms of trade: $\hat{R}=\hat{D}>0$.

Propositions 3), 4) also imply that only for transitory shock the largest the income loss the gratest is the deficit in the trade balance(3). With permanent shock the trade balance outcome is indipendent on the country's income loss.

Propositions 3), 4) follow from the definition of the change in the balance of trade:

$$dt^1 = dy^1 - dC^1 - dI$$

for $\hat{\tau}^1 > 0$, and constant levels of D, p^t, G^t, with wage flexibility so that [3'] holds, one gets:

$$dt^1 = -(I_m^1 \tau^1)\hat{\tau}^1 (1 - C_W^1) < 0$$

where the right hand side measures the fall in current saving due to the consumption smoothing of the income loss over the two periods life span.

When the worsening of the international terms of trade is permanent, $\hat{\tau} = \hat{\tau}^1 = \hat{\tau}^2 > 0$,

$$dt^1 = -(I_m^1 \tau^1)\hat{\tau}(1 - C_W^1) + C_W^1 R(I_m^2 \tau^2)\hat{\tau} - dI$$

where $dI = -aY^2_{k,p_m}(Dp_m^2/p^1) < 0$ for $Y_{K,p_m} < 0$.

Considering a stationary state as the initial situation, so that $I_m^1 = I_m^2$, $\tau^1 = \tau^2$:

$$dt^1 = -(I_m^1 \tau^1)\hat{\tau}(1 - C_W^1 - C_W^1 R) - dI$$

recalling the restiction imposed by the budget constraint: $C_W^1 + RC_W^2 = 1$,

$$dt^1 = -(I_m^1 \tau^1)\hat{\tau} R(C_W^2 - C_W^1) - dI$$

For equal propensities to consume at the two dates, saving is unaffected and the trade balance improvement is exactly equal to the fall in investment.

Only by relying on a simultaneous fall in the world interest rate one can explain the trade balance deterioration as the outcome of a permanent oil shock. With the fall in the interest rate, $\hat{D} > 0$, one has to add the following effect on the trade balance:

$$dt^{1} = -(C^{1}_{R}R)\acute{D} + a\hat{D} < 0$$

where $C^{1}_{R} > 0$, $a < 0$

as the result of the fall in saving and the rise in investment.

2. Endogenizing real prices

We will now relax the assumption of exogeneity of the relative price between raw materials and final goods, by allowing for imperfect substitutability between domestic and international gross output.

The real exchange rate, defined as the price ratio between foreign and domestic final goods, the terms of trade between raw materials and domestic final goods and the intertemporal terms of trade are now endogeneously determined. External shocks will affect the economy through these additional real prices channels.

The scope of the analysis is to investigate how the previous listed propositions are modified by the endogeneous response of investment and saving decisions to external shocks. The lattest being the result of both consumption smoothing and substitution effect induced by changes in the intertemporal terms of trade. In particular we wont to show how the structure of the economy, degree of substitution among factors in production and the asymmetry of such substitution in the two dates, the short and the long run, affect the welfare level and through the muvement in the intertemporal terms of trade, the flow of saving, of investment and therefore the trade balance response to real shocks .

Once we allow for imperfect substitutability between domestic and foreign final goods, the previous analysis should be modified by reformulating the household choice problem and by introducing the output market clearing condition at the two dates.

2.1 The model

Consumption of domestic final goods (A) and foreign final goods(I_f) will now enter as separate variables in the utility function defined over the two periods:

$$U=U[z^1(A^1,I_f^1),z^2(A^2,I_f^2)]$$

The utility function is written as weakly homothetically sepa rable between the two dates, and the subutility function z^t for each da te are linearly homogeneous of degree one.

Under these assumption to each subutulity function z^1,z^2 can be associated an expenditure function defined over the corresponding time period prices only, which is linearly homogeneous of degree one in prices(4):

$$\pi^t(p^t,p_w^t)z^t=\min(p^tA^t+p_w^tI_f^t)|\,z^t(A^t,I_f^t)\geq z^t$$

where p_w is the unit price of foreign final goods; $\pi^1(\cdot)$, $\pi^2(\cdot)$ define respectevely the minimum cost per unity of subutility z^1,z^2. The two functions will be the same if the subutulity functions are the same in the two periods, which we henceforth assume.

Under the above assumptions, the expenditure function associated to the intertemporal utility function U, can be written:

$$E(\pi^1,D\pi^2,u)\ =\min(\pi^1z^1+D\pi^2z^2)|\,U(z^1,z^2)\geq u$$

By standard properties of the expenditure functions the following hold :

$$z^1=z^1(R,u)=E_{\pi^1}(R,u);z^2=z^2(R,u)=E_{D\pi^2}(R,u)$$

$$A^t=A(\sigma^t,z^t)=\pi_{p^t}(\sigma^t)z^t$$

with $z_W^t=z_u^t/E_u$ and $R=D\pi^2/\pi^1$, the lattest defining the intertemporal terms of trade.

The equilibrium of the economy is now given by the intertemporal budget constraint [1] , where nominal variables are deflated by the current price index π^1, and the market clearing conditions [2] , [3] :

$$E(1,R,u)=W=\left\{y^1\left[(p/\pi)^1,(p_m/\pi)^1,K,N\right]-(p/\pi)^1G^1-(p/\pi)^1I\right\}+ R\left\{y^2\left[(p/\pi)^2,(p_m/\pi)^2,I,N\right]-(p/\pi)^2G^2\right\} \qquad [1]$$

$$X^1+G^1+A^1=Q^1-I \qquad [2]$$

$$X^2+G^2+A^2=Q^2 \qquad [3]$$

$$X^t=X(\sigma^t,W_d^t) \qquad (a)$$

$$A^t=A^t(\sigma^t,z^t) \qquad (b)$$

$$z^t=z^t(R,u) \qquad (c)$$

where X defines exports, W_d world demand of manufactures , $\sigma^t=(p_w/p)^t$ is the real exchange rate at date t. Q^t,I are defined by [1'] and the first order condition [4'] .

The real trade balance in the two dates are expressed by:

$$t^1=y^1-z^1-(p/\pi)^1(G^1+I) \qquad [4]$$

$$t^2=y^2-z^2-(p/\pi)^2G^2 \qquad [5]$$

For given levels of the exogeneous variables, G^t,W_d^t,D,K,p_w^t,p_m^t, the solution of the model is characterized by a couple of real exchange rates values (σ^1,σ^2) (5) which simultaneously satisfy the current and future full employment goods market equilibria conditions [2] ,[3] . Such an equilibrium is in fact Walrasian having incorporeted the hypothesis of full flexibility of wages by assuming [3'] holds in both periods.

The effect of external shocks on the welfare level, investment and trade balance, associated to the Walrasian equilibrium can be traced back to the warranted changes in the real exchange rates at both dates so to clear the goods market at full employment.

Differentiating [1] -[3] taking into account (a)-(c) and the following definitions:

$dR=R\{\hat{D}+\alpha(\hat{\sigma}^1-\hat{\sigma}^2)\}$

$d(p/\pi)^t=-(p/\pi)^t(1-\alpha)\hat{\sigma}^t$

$d(p_m/\pi)^t=(p_m/\pi)^t(\hat{\tau}^t+\alpha\hat{\sigma}^t)$

$\alpha=p^tA^t/\pi^tz^t$, is the share of expenditure on domestic goods assumed to be equal in both periods; $\tau=p_m/p_w$ defines the international terms of trade of oil.

We get (6) :

$$E_u du=-T_1\hat{\sigma}^1-RT_2\hat{\sigma}^2-T_3\hat{\tau}^1-RT_4\hat{\tau}^2+t^2R\alpha(\hat{\sigma}^1-\hat{\sigma}^2) \qquad [6]$$

$$dI=-a(\hat{\sigma}^1-\hat{\sigma}^2)-ab(\hat{\tau}^2+\hat{\sigma}^2) \qquad [7]$$

with $a=Y^2_K/Y^2_{K,K}<0$; $b=Y^2_{K,p_m}(Dp^2_m/p^1)<0$ if $Y^2_{K,p_m}<0$

$$dz^1=z^1_R R\alpha(\hat{\sigma}^1-\hat{\sigma}^2)+z^1_W E_u du \qquad [8]$$

$$dt^1=-T_1\hat{\sigma}^1-T_3\hat{\tau}^1-dz^1-(p/\pi)^1 dI \qquad [9]$$

where :

$$T_t=(p/\pi)^t X^t(1-\alpha)+\alpha\sigma^t(I^t_m\tau^t+I^t_f) \qquad [10]$$

$t=1,2$

T_t define, in absolute value, the real static terms of trade effects due to increases in the real exchange rates at the two dates. They are measured by the net export weighted real price changes (7). T_3, T_4 measure the welfare loss due to the "pure" increase in the international real price of raw materials:

$$T_3=(p_m/\pi)^1 I^1_m \quad ; \quad T_4=(p_m/\pi)^2 I^2_m \qquad [11]$$

By assuming as the initial situation one of stationary state, the export-import vectors, real prices and the propensity to consume out of wealth are equal at the two dates:

$T_1=T_2$; $T_3=T_4$; $t_2=0$

the change in the current trade balance can be semplified as follows:

$$dt^1 = -T_1Rz_W^1(\hat{\sigma}^1-\hat{\sigma}^2)-T_3Rz_W^1(\hat{\tau}^1-\hat{\tau}^2)-z_R^1R\alpha(\hat{\sigma}^1-\hat{\sigma}^2)-(p/\pi)^1dI \qquad [12]$$

The first term in expression [12] measure the change in national saving. More precisely the first and second term identify the effect on current saving due to consumption smoothing of the welfare loss associated with rises in the real exchange rates and in the international raw material final goods terms of trade. The third term identifies the fall in saving due to the substitution of future consumption with current consumption which takes place whenever there is a positive increment of the intertemporal terms of trade, $\hat{R}=\alpha(\hat{\sigma}^1-\hat{\sigma}^2)>0$.

The change in the real exchange rate at the two dates, will be the solution of the following system:

$$a_{11}\hat{\sigma}^1+a_{12}\hat{\sigma}^2=b_{11}dW_d^1+b_{12}\hat{\tau}^1+b_{13}\hat{\tau}^2$$
$$a_{21}\hat{\sigma}^1+a_{22}\hat{\sigma}^2=b_{21}dW_d^2+b_{22}\hat{\tau}^1+b_{23}\hat{\tau}^2$$

where:

$a_{11}=\eta_{e,\sigma}e-Q_{\sigma\tau}(\sigma\tau)-a+A_zz_R^1R\alpha-A_zz_W^1T_1$; $a_{12}=a(1-b)-A_zz_R^1R\alpha-A_zz_W^1RT_1<0$

$a_{21}=Q_K^2a+A_zz_R^2R\alpha-A_zz_W^1T_1<0$; $a_{22}=\eta_{e,\sigma}e-Q_{\sigma\tau}(\sigma\tau)-Q_K^2a(1-b)-A_zz_R^2R\alpha-A_zz_W^1RT^1$;

with $e=A+X$.

$b_{11}=b_{21}=-X_{W_d}<0$; $b_{12}=Q_{\sigma\tau}(\sigma\tau)+A_zz_W^1T_3\gtrless 0$; $b_{22}=A_zz_WT_3>0$; $b_{13}=ab+A_zz_WRT_3>0$;

$b_{23}=Q_{\sigma\tau}(\sigma\tau)-Q_K^2ab+A_zz_WRT_3\gtrless 0$.

We shall assume the determinant (det) of matrix $A(\delta)$, whose ele ments are $a_{11},a_{12},a_{21},a_{22}$, is positive, or also Walrasian price tatônnement stability, by imposing: $a_{11}+a_{12}=F>0$ ($\mathcal{S}$). The lattest also implying: $a_{22}+a_{21}=F+ab(1+Q_K^2)>0$, whenever capital and imported inputs are complements, a,b being both negative.

This amounts to assume a positive excess demand for domestic goods generated at the two dates as a result of an equal proportio - nal fall of domestic prices at t=1,2, that is leaving constant the intertemporal terms of trade. The induced excess demand is the result of both the substitution of domestic for foreign goods, measured by $\eta_{e,\sigma}$, and the fall in supply (Q^1-I), Q^2, due to the increase in imported inputs real price $(\sigma^t \tau)$. With capital and imported inputs complementarity the long run flexibility of the capital stock explains, through the fall in investment, the larger excess demand generated in the second period by equal proportional rises in the two dates real exchange rates.

2.2 Oil shock

Given the endogeneity of the real exchange rate, the welfare loss due to an increase of the international terms of trade does now depend upon the degree of substitutability between raw materials, or oil, and domestic inputs.

The higher the welfare loss the higher the fall in sa ving taking place unambiguously for both temporary and per manent shock and the higher the induced trade deficit.

Investment unambiguously falls with a permanent shock, for temporary shocks the trade deficit will emerge jointly with a fall in investment for a sufficient degree of substitu tability between domestic and foreign final goods.

For a temporary current oil shock: $\hat{\tau}^1 > 0$

$$\hat{\sigma}^1 = [(a_{22}b_{12}-a_{12}b_{22})/\det]\hat{\tau}^1$$
$$\hat{\sigma}^2 = [(a_{11}b_{22}-b_{12}a_{21})/\det]\hat{\tau}^1$$

The lower the degree of substitutability between raw mater ials and domestic inputs the lower the value of the denominator in the above expressions, and more likely the shock induces a po sitive excess supply, $b_{12}>0$, thus requiring a rise in the real exchange rate at both dates. The maximum welfare loss will be associated with a technology requiring a fixed input coefficient for oil ($Q_{\sigma\tau}=0$), where we have the maximum warranted fall in domestic prices at the two dates, the maximum rise in the inter temporal terms of trade:

$$\hat{R} = \alpha(\hat{c}^1-\hat{c}^2)=(\alpha/\det)\left\{b_{22}\left[ab(1+Q_K^2)\right]+Q_{\sigma\tau}(\sigma\tau)(a_{22}+a_{21})\right\}\hat{\tau}^1$$

and therefore the maximum fall in current saving.

A positive current excess supply generated at the initial level of prices, $b_{12}>0$, is a sufficient condition for a worsening of the trade balance.

The trade balance response to a current rise in the interna tional terms of trade can be expressed as:

$$dt^1 = \psi(-\hat{\tau}^1)$$

where :

$$\psi = C_o F^2 + C_1 F + C_2$$

$$C_o = T_3 R z_W^1 > 0$$

$b_{12}>0$ is a sufficient condition for both C_1, C_2 being positive. By admitting two negative rooths the ψ function will be positive for any positive value of F. The initial assumption of a posi tive determinant is consistent with an unambiguous deteriora tion of the balance of trade. In contrast with the S.O.E. framework a fall in investment can occur jointly with the trade balance deterioration whenever the degree of substitutability between domestic and foreign goods is such to induce a sufficie ntly small decrease in the relative price of capital (p^1/p^2) so not to offset the deflationary stimulus due to the long run fall in output profitability. The lattest being the result of the second period rise in the oil real price due to the real exchange rate devaluation $(\hat{\sigma}^2 > 0)$.

$$dI=-a\left[\hat{\sigma}^1-\hat{\sigma}^2(1-b)\ \hat{\tau}^1\right]<0$$

if the following is satisfied

$$F\left[|Q_{\sigma\tau}| \quad +|b|\, b_{22}\right]+b_{22}|b|\ |a_{12}+a_{21}| > ab(1+Q_K^2)b_{12}+\ |ba_{21}Q_{\sigma\tau}(\sigma\tau)|$$

For a permanent increase in the international terms of trade, $\hat{\tau}^1=\hat{\tau}^2=\hat{\tau}>0$, we have:

$$\hat{\sigma}^1=\left\{\left[a_{22}(b_{12}+b_{13})-a_{12}(b_{22}+b_{23})\right]/det\right\}\hat{\tau}$$

$$\hat{\sigma}^2=\left\{\left[a_{11}(b_{22}+b_{23})-a_{21}(b_{12}+b_{13})\right]/det\right\}\hat{\tau}$$

The lower the degree of substitutability between home inputs and oil, the higher the excess supply generated in the first period, $b_{12}+b_{13}>0$, more likely the shock induces an excess supply at t=2, $b_{22}+b_{23}>0$, thus generating with a perma nent price deflation $(\hat{\sigma}^1,\hat{\sigma}^2>0)$ the maximum welfare loss in the economy.

Whatever the degree of substitutability among inputs in production, the long run flexibility of the capital stock is a sufficieht condition for an increase in the intertemporal terms of trade:

$$\hat{R}=(\alpha/det)\left\{(b_{12}+b_{13})(a_{22}+a_{21})-(b_{22}+b_{23})(a_{11}+a_{12})\right\}\hat{\tau}>0$$

where $a_{22}+a_{21}-(a_{11}+a_{12}) = (b_{12}+b_{13})-(b_{22}+b_{23})=ab(1+Q_K^2)>0$

and therefore, in contrast with the S.O.E. model, for an unambiguous fall in current saving. The lattest as a result of both consumption smoothing and intertemporal substitution effect.

Whenever the initial condition of a positive determinant is satisfied, $F>0$, a positive current excess supply at the initial level of prices, $b_{12}+b_{13}>0$, is a sufficient condition for an unambiguous fall in investment.

With both investment and saving falling, the trade bala nce outcome is not clear cut.

The degree of substitutability in the economy, that is the amplitude of both the income loss and the rise in the intertemporal terms of trade, is rilevant in defining the size of the fall in saving, whether it exceeds the investment fall thus generating a trade balance deficit.

The analysis of the trade balance response (10) to the permanent oil shock shows that for a sufficient degree of openess of the economy (11), provided the sufficient condi tion for a fall in investment is satisfied, a trade deficit will emerge whenever the degree of substitutability in the economy does not exceed a ceiling value.

Being this condition compatible with the fall in inve stment, the model now allows for a trade deficit and slow down in capital growth as the joint outcome of a permanent oil shock.

3. The role of short run price rigidities

The model discussed in the previous section is an ade guate framework to capture the implications of the most pre minent asymmetry between the short and the long run, such as the different degree of substitutability between domestic and imported inputs, due to the short run rigidity versus long run flexibility of the capital stock.

Nevertheless, given the full employment market clea ring assumption extended over the two time periods, the fra mework fails to recognize a relevant issue such as the short run wage stickiness versus long run flexibility.

Having imposed labor endowment fixed at full employment we in fact assumed perfect current downward wage flexibility.

With labor and oil complementary inputs in production, the standard case, a positive current excess supply genera ted by the oil shock at full employment, is a sufficient condition for a fall in the full employment real wage rate:

$$\hat{w}^1-\hat{p}^1=Y_{N,p_m}(p_m/w)^1(\hat{\sigma}^1+\hat{\tau}^1)<0$$

for both temporary and permanent shocks.

If the current real wage is sticky $w^1-p^1=0$, labor in puts decrease and the analysis of the oil shock's induced effects has to be extended to the implications on saving-investment and trade balance arising from the employment fall.

These can be identified through the endogeneous real price's response to the decrease in N^1.

Two types of "direct" effects arise from a reduction in N^1:

(a) a fall in current output measured by $Q_N^1 dN^1$, Q_N^1 being the derivative of final output to current employment.

(b) a fall in the welfare level given, at the initial values of the real exchange rates, by $y_N^1 dN^1$. Where y_N^1, the derivative of real GDP to N^1, can be expressed as:

$y_N^1 = \theta Q_N^1 \quad ; \ \theta = (p/\pi)^1 \left[1 - m(\cdot)\sigma^1 \tau^1 \right], \quad 0 < m < 1$

m being the oil input coefficient, itself function of the given capital stock and relative prices $(\sigma\tau)^1, (w/p)^1$.

The induced effects on the real exchange rates at the two dates and the intertemporal terms of trade are given by:

$$\hat{\sigma}^1 = \left[(a_{22}k_1 + a_{12}k_2)/\det \right] dN^1$$

$$\hat{\sigma}^2 = \left[(-a_{11}k_2 - a_{21}k_1)/\det \right] dN^1$$

$$\hat{R} = \alpha \left\{ \left[k_1(a_{22}+a_{21}) + k_2(a_{11}+a_{12}) \right] /\det \right\} dN^1 < 0$$

where:

$k_1 = Q_N^1(1 - A_z z_W^1 \theta) > 0 \quad ; \quad k_2 = A_z z_W^1 Q_N^1 \theta > 0 \quad ; \quad dN^1 < 0$

The intertemporal terms of trade unambiguously falls for $dN^1 < 0$.

The decrease in current saving generated at the initial level of the real exchange rates by the employment fall will then be mitigated by the switch in consumption from the first to the second period, due to the substitution effect and by consumption smoothing of the welfare gain due to real prices effect:

$$dS^1 = R z_W^1 \theta Q_N^1 dN^1 + (R z_W^1 T^1 (1/\alpha) + z_R^1 R) |\hat{R}|$$

where S^1 is current real saving.

The higher the degree of substitution among inputs in pro duction and between home and foreign final goods, the lower, in absolute value, the intertemporal terms of trade fall. The lower will then be the increase in saving induced by prices effect thus leaving the possibility of current dissaving as a result of the unemployment income loss.

The strict connection between substitutability degree in the economy and dissaving also holds for the investment response to the employment fall.

The decrase in the intertemporal terms of trade also implies a real price of capital (p^1/p^2) increase. A reduction in the second period output profitability, $\hat{\sigma}^2 > 0$, will then be a sufficient condition for investment decreasing. This occurs if the fall in domestic absorption at t=2 due to the unemployment welfare loss dominates the substitution effect arising from current price inflation. The condition relying on a sufficiently high degree of substitutability so to require for output market clearing a contained reduction in the current real exchange rate.

With saving and investment moving in the same direction the trade balance response to the unemployment generated by wage stickiness is not self evident.

The analysis of the function expressing the trade balance response to the employment fall shows that the dissaving effect will prevail, so inducing a trade deficit, for a significant degree of substitution among inputs in production and between domestic and foreign final goods (12).

Here Obstfeld's proposition of positive correlation between trade deficit and the degree of substitutability in the economy holds when price rigidities are allowed for the short run. Moreover the trade deficit outcome of the oil shock's induced unemployment will be associated with a fall in investment.

4. Conclusion

The paper has extended the analysis of the small open economy intertemporal framework to the more general case of imperfect substitutability between home and foreign final goods and to the empirical relevant case of short run wage stickiness. The real exchange rate and the intertemporal terms of trade are now endogeneously determined.

The effects on welfare and on the real trade balance, deflated by an exact consumer price index, of temporary and permanent rises in the international oil-manufactures terms of trade have been examined taking into account the changes in saving, investment and employment, due to the endogeneous real prices's response to such external shocks.

In contrast with the previous intertemporal analysis's results the model allows for trade balance deterioration and investment fall as the joint outcome of oil shocks. The magnitude of the welfare loss, due to both the degree of substitutability in the economy and the degree of wage flexibility, is a relevant factor for international borrowing. Real income losses do in fact matter for trade balance deterioration for both temporary and permanent oil shocks.

The asimmetry between the degree of substitution in production, due to the short run predeterminacy of the capital stock versus long run flexibility, gives rise to an unambiguous fall in the intertemporal terms of trade as a response to oil shocks and therefore, through consumption smoothing and substitution effect,to an unambiguous fall in saving taking place with temporary and permanent oil disturbances. With sufficiently low degree of substitutability in the economy current dissaving will exceed the investment fall giving rise to a deterioration in the trade balance.

Only if wage rigidity is allowed for the short run we observe the positive correlation between trade deficit and the degree of substitutability in the economy claimed by M. Obstfeld's analysis (1984). The trade deficit outcome of the oil shock's induced output fall will be associated with a decrease in investment thus indicating the degree of wage flexibility as a further explanatory variable of the differences in trade balance and capital growth performances among the oil importing countries.

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(1) The only exception is the link between dissaving and the income loss due to the fall in employment associated with real wage predeterminacy, N.Marion-L.Svensson(1984).

(2) See as reference A.Dixit-V.Norman(1980).

(3) This remark is explicitely made by J.Sachs(1983,p.106). Only temporary income losses matter for trade deficit. The lattest is due to consumption smoothing of the current income loss generated by temporary shocks. The largest the current income loss, the largest the fall in saving and therefore given the invariance of investment, the size of the trade deficit.

(4) See W.Gorman(1975), C.Blackorby-D.Primont-R.Russell(1978), W.Diewert(1974) on separability and price indices, and L.Svensson-A.Razin (&983) for an application of such properties in an intertemporal framework. For an application of such properties to the shadow prices associated with quantity rationing see G.Chiesa(1983), Appendix I-II.

(5) We can observe that the intertemporal **terms of trade** is in fact a function of the real exchange rate at the two dates: $R=D\pi^2/\pi^1=Dp^2\pi(1,\sigma^2)/[p^1\pi(1,\sigma^1)] =$

$$D(p_w^2/p_w^1)(\sigma^1/\sigma^2)\left[\pi(1,\sigma^2)/\pi(1,\sigma^1)\right]$$

(6) We assume a constant level of the world interest rate, $\hat{D}=0$.

(7) $T_1=(Q-G-I)^1 d(p/\pi)^1 - I_m^1 d(p_m/\pi)^1$; $T_2=(Q-G)^2 d(p/\pi)^2 - I_m^2 d(p_m/\pi)^2$

can be replaced by [10] by using the definitions of $d(p/\pi)^t$, $d(p_m/\pi)^t$ and subtracting from T_1 the expression: $A^1 d(p/\pi)^1 + I_f^1 d(p_w/\pi)^1$ and from T_2: $A^2 d(p/\pi)^2 + I_f^2 d(p_w/\pi)^2$.
where: $A^t d(p/\pi)^t + I_f^t d(p_w/\pi)^t =$

$$(1/\pi^t)\{A^t dp^t + I_f^t dp_w^t - [A^t p^t + I_f^t p_w^t](1/\pi^t)[\pi_{p^t} dp^t + \pi_{p_w^t} dp_w^t]\} = 0$$

since:

$$\pi_{p^t} = (A/z)^t ; \ \pi_{p_w^t} = (I_f/z)^t$$

and, $A^t p^t + I_f^t p_w^t = \pi^t z^t$

(8) In the definition of the A matrix elements we made use of the assumption: the subutility functions z and real prices are equal at the two dates so that $A_z = A_z^1 = \alpha(\pi/p)^1 = A_z^2 = \alpha(\pi/p)^2$.

(9) The determinant of matrix A (det) can be expressed as: $det = F^2 + c_1 F + c_2$; where F^2 is the square of F. The lattest is itself an increasing function of the degree of substitutability between home and foreign final goods and between domestic and imported inputs. Given the positive value of c_1, c_2: $c_1 = ab(1+Q_K^2) - (a_{21} + a_{12}) > 0$; $c_2 = -a_{12} ab(1+Q_K^2) > 0$ the determinant admits two negative rooths. A positive value of F is therefore a sufficient condition for a positive determinant, thus ensuring the stability of the Walrasian price tatônnement.

(10) $dt^1 = \psi \hat{T} < 0$, for $\psi < 0$; $\psi = c_0 F^2 + c_1 F + c_2$, where $c_0 > 0$ the quadratic function ψ admits two opposite sign rooths for:

$c_2=(b_{12}+b_{13})(h_1+vab)<0$

with: $v=(p/\pi)^1$; $h_1=[R(1+Q_K^2)-vA_z(1+R)](-T_1z_w^1-z_R^1\alpha)<0$

since, $(R/1+R)(1+Q_K^2)>1$; $vA_z=\alpha<1$.

For $c_2<0$ there will be an interval of F values, compatible with the Walrasian tatonnement of prices stability, for which the function admits negative values,thus implying trade balance deterioration.

(11)The degree of openess is measured by the size of the import-export vector T_1.

(12) $dt^1=\psi\, dN^1$; for $dN^1<0$, $dt^1<0$ for $\psi>0$

where: $\psi=c_0F^2+c_1F+c_2$; $c_0=Rz_w^1>0$; $c_2<0$, for a sufficiently high degree of openess of the economy.

$c_2=ab[-av(S_1-1)-S_2S_3(z_R^1\alpha+T_1z_w^1)]$

where:

$v=(p/\pi)^1$; $S_1=z_w^1\theta(1/v)[(1-b)R(1+Q_K^2)+b\alpha]>0$, but not necessarily higher than one; $S_2=R(1+Q_K^2)-\alpha>0$; $S_3=[1-\theta z_w^1(\alpha/v)(1+R)]>0$.

For $c_2<0$, the function will admit one negative and one positive rooth and it will be positive for any level of F exceeding the positive rooth.

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