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Macroeconomic policies and the food supply

- Exchange rate effects in a model with non-tradables -

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I Introduction

In this paper, we attempted to develop a framework to study effects of exchange rate movements on the food supply. The real exchange rate was used as a proxy for macroeconomic policy to explain the effects of depreciations – appreciations of the currency on the food supply in each studied country. The results of the econometric model indicate that food supply decreases but trade surplus increases after a devaluation. Schuh (1974) introduced explicitly the link between macroeconomic variables (through the exchange rate) in an agricultural economic analysis. Moreover, Schiff and Valdés (1998) indicate that the most important form of indirect intervention in the agricultural sector in developing countries is the over/sub-valuation of the exchange rate. The exchange rate plays a crucial role in determining the resources available for different sectors, and as showed by Derevajan, Lewis and Robinson (1993), non-tradable products define the adjustment of a change in real exchange rate in the short and long run, especially in developing countries. Some recent studies have pointed that macroeconomic policy is fundamental in the determination of food supply and that the new liberalization process might affect this sector, especially in developing countries (Aboagye and Gunjal, 2000; Davis, Thomas and Amponsah, 2001).

There are some indications that, in many instances, agricultural exports are undertaken at the expense of production for domestic consumption, which is mostly food (Aboagye and Gunjal, 2000 and Lamb, 2000). A similar analysis was reported by Jaeger (1992) who found that there was no evidence of substitution of domestic production by production of export-oriented crops in Sub-Saharan countries.

II The theoretical model

Following Dornbusch (1973), it is possible to show that a devaluation of the domestic currency will depress prices of non-tradables in a model with two goods. Assuming that the production takes place along a concave transformation curve, that demand depends on money prices and nominal expenditure, and that real expenditure is real income less real hoarding, it is possible to show that the price in the non-tradable sector will fall in the country that is carrying out the devaluation and rise in the foreign country in the short run (Eq. (1)).

$$\hat{q} = -\delta\beta\gamma\theta\hat{e} \text{ and } q^* = \delta^*\beta^*\gamma^*(1-\theta)\hat{e} \quad \text{Eq. (1)}$$

$$\begin{aligned} &\left(Q^{NT} + Q^{X} + Q^{MS}\right) + Q_M + Q_{ST} - Q_{TX} = FS \\ &\left(Q^{NT} + Q_{ST}\right) + \left(Q^{MS} + Q_M\right) + \left(Q^{X} - Q_{TX}\right) = FS \end{aligned} \quad \text{Eq. (2)}$$

This result is supported by Derevajan, Lewis and Robinson (1993). Stamoulis and Rausser (1988) extended Dornbusch's model including the effects of money supply, assuming that international prices were fixed. If these theories are translated to the food supply relation (FS), it should be easy to see that the logical result of a devaluation of the domestic currency may end up

in a decrease in the FS (Eq. 2). Devaluation of exchange rate tends to cause domestic consumption of Exportable foods (Q_E) and imports (Q_M) decrease and non-tradables production falls (Q_{NT}). Therefore, the FS also falls.

III Econometrical model

The model on Equation (3) was developed based on the theories described in the previous sections. Lamb (2000) and Jaeger (1992) constructed their models in a country-by-country basis; those models assume that the real exchange rate (RXR) and income are exogenous variables. In this paper, it was assumed that these variables (RXR and income) are endogenous, assuming that the agricultural sector is small compared with the rest of the economy and that international prices are fixed (small country assumption).

In Eq. (3) FS is included in per capita basis, without livestock products. RXR is the real exchange rate as defined by the World Bank[1)] and GDP is real per capita income with the base year 1995. MS is import substitutes. The equations for the RXR and GDP include the same variables for all countries. WY, is the per capita income of commercial partners weighted by trade shares and AW is the aggregated GDP (also weighted); AP is the average of real international prices of agricultural commodities; IR is the domestic interest rate; L is the LIBOR rate for 90 days deposit; PI is public investment as a share of GDP; WR is the RXR of commercial partners of the country weighted by trade shares (same as in WY); TI is total investment; TT is total trade as a percentage of GDP; INF is the rate of inflation measured by the CPI growth; HK is the human capital accumulation measured by the gross rate of secondary school enrolment; TB is the total trade balance; GC is government consumption as a percentage of GDP; P is commodity price, ***j*** is country-specific products and ***i*** represents Argentina, Bolivia, Brazil and Venezuela. The econometric procedure used was seemingly unrelated regression (SUR) tests; series run from 1980 to 1999 in all cases which generate 139-150 (unbalanced) total system observations.

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\begin{aligned}
X_{it} &= f\left(RXR_{it-1}, X_{it-1}, GDP_{it-1}, AW_{it-1}, TAX_{it-1}, P^{j}_{it-1} AP_{it-1} BP_{it-1}\right)\\
M_{it} &= f\left(RXR_{it-1}, M_{it-1}, GDP_{it-1}, P^{j}_{it-1}, WY_{it-1}\right)\\
NT_{it} &= f\left(RXR_{it-1}, NT_{it-1}, GDP_{it-1}, AW_{it-1}, AP_{t-1}, TAX_{it-1}\right)\\
TP_{it} &= f\left(RXR_{it-1}, TP_{it-1}, GDP_{it-1}, AW_{it-1}, TAX_{it-1}, AP_{it-1}\right)\\
FS_{it} &= f\left(RXR_{it-1}, FS_{it-1}, GDP_{it-1}\right)\\
MS_{it} &= f\left(RXR_{it-1}, M_{it-1}, GDP_{it-1}, AW_{it-1}, AP_{t-1}, P^{j}_{it-1} TAX_{it-1}\right)\\
RXR_{it} &= f\left(AV_{it}, IR_{it}, L_{it}, PI_{it}, WR_{it}\right)\\
GDP_{it} &= f\left(TI_{it}, TT_{it-1}, INF_{it-1}, HK_{it-1}, TB_{it-1}, GC_{it-2}\right)
\end{aligned}
\qquad \text{Eq. (3)}
$$

1) That is: $RXR=CPI_{dom}/(CPI_{USA}*\boldsymbol{e})$, where ***e*** is the nominal exchange rate and CPI is the consumer price index. This allows us to understand "devaluation" as a negative sign and "appreciation" as a positive sign. A negative sign in the exports equation, for example, means that exports increased after the devaluation.

IV Results and discussion

1 Country analysis

Results for Argentina show that, everything else constant, when there is a devaluation of the exchange rate, the food availability diminishes by 0.12% for each 10% of devaluation, basically due to the increase in exports (4.9%) and the rise in the production of MS (6.88%). The production of NT also falls but only by 0.21%. In the case of Argentina, as a result of devaluations, resources seem to move towards more production of MS rather increases in the exports sector, keeping in mind that MS is basically tropical fruits. Results described in Table 1 indicate that devaluations are not highly important in the determining process of the FS and that they basically redistribute resources among tradables, highlighting the big share of tradables in the Argentinean agriculture.

The short run coefficients estimated from the analysis show that devaluations are especially important for the Bolivian food export sectors (dominated by soybeans and sugar) and for the import substitutes (wheat). A 10% devaluation in the domestic currency will increase exports by 38.02% and MS production by 20.2%. At the same time, NT production (mostly tubers and vegetables) falls by 3.28% mostly due to lower relative prices in this sector compared with export-crop's prices. Imports diminish by 7.79%, resulting in a total fall in the FS by 1.20%. This result shows that in some way the increase in MS has the same magnitude of the increase in the production of NT. The reduction in NT production will be the result of migration of resources towards the tradables sector, more profitable than the NT sector after the devaluation.

Brazilian imports and MS have the highest coefficients for the RXR where wheat is in both cases the most important product by far (60% and 85%, holding respectively). Therefore movements in the FS comes mostly from the adjustment in the importables' market rather than from the rise in export which increase only by 1.93% for a 10% devaluation of the exchange rate with everything else constant. In the case of Brazil, the FS falls marginally by 1.27%. The small coefficient of the RXR for the NT might be indicating that, as pointed by Dornbusch (1973), if NT are not affected by exchange rate devaluations, then trade surpluses are sustainable in the long run.

Venezuelan agricultural exports (basically sugar and tropical fruits) and imports (grains) have the right RXR coefficients, the bigger exports and the smaller imports (6.29% and 3.60% for a 10% devaluation of the domestic currency) plus the reduction in the production of the NT with a decrease in the FS by 1.63%. The high dependence of Venezuela on petroleum exports (more than 75% of total exports) diminish the importance of agricultural exports for the balance of the economy, but at the same time it creates enough financial resources for the support of domestic production (fixed prices and tariffs) which distort the relative profitability of each group. Although the elasticity of the RXR of the MS is almost as big as imports, the fall in the FS comes from the rise in exports.

Table 1. Exchange rate short-run coefficients[1]

	Argentina	Bolivia	Brazil	Venezuela
Exports	-0.490 *(2.07)	-3.802 **(0.19)	-0.193 *(2.27)	-0.629 (8.17)
Imports	0.703 **(0.11)	0.779 (23.84)	1.040 **(0.08)	0.360 **(0.31)
Non-tradables	0.021 (29.63)	0.328 **(0.15)	0.043 (21.21)	0.100 **(0.55)
Total Production	-0.383 (16.74)	-0.831 **(0.07)	-0.093 *(2.94)	-0.176 **(0.07)
Food Supply	0.012 (25.86)	0.120 **(0.30)	0.127 **(0.51)	-0.163 (5.65)
Imports Substitutes	-0.688 **(0.01)	-2.022 **(0.07)	-1.295 **(0.00)	-0.518 **(0.25)

[1]Numbers in parenthesis indicate probability values for a one-tale test. Variables were introduced in their logarithmic form, hence, coefficients represent elasticities. * indicates 5% and ** 1% confidence, respectively.

2 Country comparison

Countries with a more diversified and technical (capital intensive) agriculture like Argentina and Brazil have smaller coefficients of RXR for the FS than the other two countries where agriculture is less developed and labor intensive, mostly oriented for the domestic market. The export oriented agriculture of Brazil and Argentina creates a great surplus in agricultural products, reducing the effect of devaluations on the agricultural sector. Bolivia is a good example of how the RXR affects the agricultural sector; its agricultural exports are less diversified than Brazil and Argentina, consisting mainly in soybeans and their products.

Production of NT has bigger coefficients for Bolivia and Venezuela where these crops represent more than 85% of total production and is smaller for Argentina and Brazil where production is more oriented to international markets. This result also shows the potential resources available for the production of tradables in

the short run (where more land can not be developed). The NT sector holds labor and capital which can be used for the production of tradables. However, the speed of conversion from non-tradables to tradables will depend on climate restrictions, topographical characteristics of the land used in the production of NT and financial systems for NT producers in these countries. Finally, countries with a weak (small) tradable sector have bigger RXR coefficients for the FS, showing that the development of the tradables sector is fundamental to achieve the desired level of food production. It is also important to note that exports and imports are concentrated on grains and oil crops and that they are directly (food) and indirectly (feed) more important for food supply than non-tradable products.

V Concluding remarks

The RXR rate plays an important role in the determination process of agricultural supply, as mentioned in the literature. The exchange rate is a principal variable used by the governments of developing countries to influence the performance of the economy in the short run distorting producer's decisions. In South America, the results show that the RXR can accelerate the growth of exports and imports substitutes' production but in some cases this production crowd out domestic production, at least in the short run where resources are fixed. In this scenario, rural development policies and investment should encourage the production of more exportables and import substitutes in order to maintain the trade surplus and let non-tradables production to diminish in the future, which is the historical trend. Schuh (2000) argues that "… an important feature of economic growth and development is that large amounts of labor will inevitably have to leave agriculture. Public resources might better be invested in education and training programs that would facilitate that shift."

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