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Numerical Exercises on Devaluation and Debt Repudiation

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The paper extends the Gylfason and Schmid model to analyze the effects of devaluation and debt repudiation on a post-crisis economy. Simulation experiments were conducted using this model. The numerical results indicate that devaluation can be contractionary but repudiation can dampen the negative effects of a devaluation. Devaluation can be expansionary in the model depending on the amount of imported intermediate input use and/or on the value of the substitution elasticity.

This paper describes an economy in the post-crisis period where interest payments on foreign debt play a significant role and the pressure to devalue gets to be strong. The paper makes use of a macroeconomic general equilibrium model toward this end.

The post-crisis economy is modeled in the spirit of Gylfason and Schmid (1983) and Gylfason and Risager (1984). The modelling technique allows the subject of interest to be expressed in terms of parameters. In this paper, the main interest is the effect of devaluation on income when interest payments on foreign debt are large and the share of imported inputs in production is significant. This method is quite useful when data limitations do not permit a fuller examination of the problem at hand. To make the analysis manageable, it is assumed that the economy does not incur more debts so that the capital account of the BOP can be ignored.

The first section presents a highly simplified model of the economy. The second section shows the results of counterfactual experiments using Philippine data.

1. A Macroeconomic Model

Aggregate Supply

The economy is assumed to produce one output, q, using labor, l,

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and an imported input, n, under constant returns to scale. The production function in growth rate form is:

(1) $q' = (1 - \theta)\, l' + \theta n'$

where θ is the share of the imported input in output; variables with primes indicate their growth rates (e.g., $v' = dv / v$).

The elasticity of substitution between labor and imported inputs may be defined as $\sigma = -(n' - l') / (E' - w')$. E is the exchange rate and w is the wage rate. Using this in equation (1) gives the import demand function:

(2) $n' = q' - (1-\theta)\, \sigma\, (E' - w')$

The real income of the economy, y, is simply equal to the gross output less imported inputs and interest payments:

(3) $y = q - En / p - a$

where E is, in effect, the domestic price of the input after setting its foreign price to one; p is the price of the output; and a is the interest payment in domestic output units.

The ability to pay of the country depends on the amount it is able to sell in the world market. It is therefore assumed that a takes a fraction of export earnings or $a = \alpha x$. In normal periods, α may be unimportant. However, this becomes a policy parameter in post-crisis periods as in Peru.

Suppose export demand takes the form $x' = \eta\, (E' - p')$ where η is the export demand elasticity. Using this together with equation (2) and assuming marginal cost pricing so that the price equation takes the form $p' = (1 - \theta)\, w' + \theta E'$, aggregate supply in growth rate form can then be expressed as:

(4) $y' = (1 + \alpha\mu) q' - [(1+\alpha\mu)\ \theta\, (1 - \sigma) + (1 - \theta)\ \alpha\mu\eta]\ (E' - w')$

where μ is the export to income ratio. It is shown in (4) that a substitution elasticity less than one restricts supply growth when a devaluation occurs. The ratio of interest payments to GNP shows how interest payments affect income growth for a given η.

Aggregate Demand

The aggregate demand equation in level form is written as:

(5) $y = e + [x - (z + En/p + \alpha x)]$

where e is aggregate expenditures and z is competitive imports. The expression in brackets is the current account. To simplify matters considerably, assume as in Gylfason and Schmid that the trade account is initially in balance. This means that the deficit in the current account is solely due to the real interest payments, αx. Aggregate demand can then be expressed as:

(6) $y' = (1+\alpha\mu)e' + \mu[(1-\alpha)x' - (1-\phi)z' - \phi(E' + n' - p')]$

where $\phi = (1 + \alpha\mu)\,\theta/(1-\theta)\,\mu$ is the share of imported inputs in total imports.

To complete the specification of the demand side, assume the following:

(7) $e' = \delta y' + (1 - \delta)(m' - p')$

(8) $z' = e' - \pi(E' - p')$

(9) $x' = \eta\,(E' - p')$

Equation (7) shows that expenditures depend on income and real money balances. δ is the income elasticity. Equation (8) is the competitive import demand function. Imports are assumed to have unitary expenditure elasticity and π is the price elasticity. Equation (9) is the export demand equation as in the above.

Using (4) and the price equation, the imported input demand equation (2) can be rewritten as:

(10) $n' = y'/(1+\alpha\mu) + [(1-\sigma) + \theta\alpha\eta\,\varnothing]\,(E' - w') - (E' - p')$

Since the main interest here is the effect of devaluation on output, assume that the nominal money stock and the wage rate are fixed ($m' = w' = 0$. This assumption seems reasonable since tight money and wage controls are in place during this period. Substituting equations (7) to (10) in equation (6) gives the effect of devaluation on income:

$$(11)\quad y'/E' = [\mu(1-\theta)\, M - N\theta]/\Phi$$

$$\Phi = 1 - \delta[1 - \mu(1 - \alpha - \theta)]$$

$$M = [(1 - \varnothing)\, \pi - \varnothing(1 - \sigma) - \eta(\alpha + \theta - 1)]$$

$$N = [(\delta + \pi - 1)(1 - \theta)\mu + (1 - \delta - \theta\pi)(1 + \alpha\mu)]$$

$1/\Phi$ is the multiplier. Note that if there are no imported inputs, $1/\Phi$ reduces to $1/[(1\text{-}\delta) + \delta\mu(1\text{-}\alpha)]$. The first term in brackets is the savings propensity while the second term is an analogue of the marginal propensity to import after accounting for interest payments.

M is this paper's version of the Marshall-Lerner condition which is composed of appropriately weighted elasticities. $\varnothing(1\text{-}\sigma)$ is the factor substitution effect. This set of parameters represents the supply effects of devaluation. N is the full price or demand effect of devaluation. Notice that $N\theta$ can be written as $(y'/p')\,p/E'$ since $p' = \theta E'$ by virtue of the fixed wage assumption.

The effect of devaluation on income depends on the relative strengths of the supply and demand effects. Note also that the parameter α enters in all sets of parameters. Thus, the effects of α if it is considered as a policy parameter cannot be readily determined.

2. Empirical Implementation

This section is a tentative test of the model in section 1. The model requires only seven extraneous parameters – α, η, δ, π, σ, μ, θ. The elasticity parameters used were those used by Gylfason and Schmid for the Philippines. The new parameters are $\mu = 0.17$ which was computed from the 1979 national accounts and θ which came from the 1979 social accounting matrix of the Philippines. α is treated as a policy parameter. These parameter values were used in equation (11).

Table 1 shows the contractionary effects of devaluation for the given set of parameters. The nominal depreciation rate was allowed to vary from 5 to 20 percent. As shown, the higher the depreciation rate, the greater is the decline in output. For this set of simulations, α was fixed at 0.40.

The results of the next set of simulations are given in Table 2. These experiments fix the depreciation rate at 10 percent and the only