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Devaluation, Investment and the Trade Balance

Søren Bo Nielsen
Institute of Economics, University of Copenhagen

SUMMARY: *This article provides an analysis of the implication of the investment response for the overall effect of a devaluation on output, real income and the trade balance. We use a model of a small open economy in which investment is guided by changes in the net rate of profit and show that not only conventional Marshall-Lerner terms, but also the possibilities for capital-labour substitution in production and the sensitivity of investment to variations in profitability determine whether a devaluation will in fact improve the trade balance in the short run.*

1. Introduction

During more than a decade, there has been a fair amount of discussion in the literature about the effects of devaluations, notably devaluations in developing countries. Various authors have considered whether devaluations could lead to a contraction in output and a worsening of the trade balance, cfr. Krugman and Taylor (1978), Gylfason and Schmid (1983), Edwards (1986), and Nielsen (1987) among others.

Several reasons why a devaluation might contract domestic output have been proposed. One way is through a reduction in real balances which leads domestic agents to cut back in demand in order to replenish real balances. Another works through different propensities to save on the part of workers and capital owners combined with income redistribution after a devaluation. And a third one is the existence of imported intermediate goods for which there are only moderate substitution possibilities. While the former two factors tend to make the output effect less positive, but the trade balance effect more positive, the latter tends to deteriorate as well output as the trade balance impact of a devaluation.

As Edwards notes, however, »most theoretical models on contractionary devaluations have used a framework without capital accumulation« (Edwards (1986, p. 501)). Indeed, it is difficult to find theoretical analyses of devaluations that explicitly take into account the effects on domestic investments and capital accumulation. (Some exceptions are Korkman (1978), Kouri (1979) and Risager (1988); none of these analyze the trade balance effect of a devaluation, however).

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The object of the present note is to shed some light on the importance of the investment response for the overall output, employment and trade balance effects of a devaluation. This will be done by constructing a simple model of a small, open economy that produces one aggregate good which it partly exports, partly consumes and partly uses for investment at home. It imports one good from abroad which is used solely for domestic consumption. Investment demand is described by a crude version of Tobin's q-approach in which instantaneous profitability (rather than long-term profitability) is guiding investments. Hence, we refrain from a full-scale optimization approach to investment modelling and instead utilize a specification that seems to proxy the more elaborate formulation well within the context of our simple model.

We set up the model in section 2, first in an ordinary version and then in a loglinear version. In section 3 we analyze the effects of the devaluation on, chiefly, output, income and the trade balance. It turns out that the traditional Marshall-Lerner condition plays its usual role in determining the outcome of output, income and the trade balance. In addition, the scope for substitution between labour and capital as well as the sensitivity of gross investments to changes in profitability (the net profit rate) appear in the relevant formulas.

To counter one possible argument against the set-up we discuss in section 4 a version of the model in which all investment goods are imported. It turns out, however, that the implication of shifting the origin of investment goods is rather modest.

Concluding remarks in section 5 end the note.

2. The model

We consider a small open economy which takes prices on imports as given from the outside but faces a downward-sloping demand schedule for its exports. From abroad it imports a finished good for consumption purposes. It produces one aggregate good, which is used for consumption *and* investment at home besides being exported.

Our model consists of the following relations:

$$Q = (H(\overset{+}{Y})\ (E/P)^{\nu} - M(\overset{+}{Y},\ E\bar{/}P)\ (E/P)) + X(\overset{+}{E}/P) + KV(\overset{+}{R}) \tag{1}$$

$$Y = (Q - KV(R^{\circ}))\ (E/P)^{-\nu} \tag{2}$$

$$Q = Q(W\bar{/}\ P),\ \overset{+}{K}) \tag{3}$$

$$L = L((\bar{W}/P),\ \overset{+}{K}) \tag{4}$$

$$R = (PQ - WL - PKV(R^{\circ}))\ /\ (KP) \tag{5}$$

$$B = PX - EM \tag{6}$$

Total demand for the domestic good is modelled in (1). It consists of domestic demand for consumption, exports demand and investment demand. The former is found as total domestic consumption measured in units of the domestic good minus imports of finished goods, likewise in domestic goods units. *H(Y)* denotes domestic real consumption, derived by deflating nominal consumption expenditures by the consumer price index given by $P_c = P^{(1-\nu)} E^{\nu}$, in which ν represents the share of imported finished goods in domestic absorption. P is the price of the domestic product, E is the exchange rate, and the constant price of the import good, measured in units of foreign currency, is equal to one. It is assumed that domestic real consumption H depends solely on real net income, denoted by Y and derived from nominal net income also by deflating by P_c. The amount of goods imported, M, depends on real net income and the relative price of the import good. With these definitions, domestic consumption demand for the home product is contained in the parenthesis on the right hand side of (1).

The demand for exports, X, is simply a function of the relative price E/P. Investment demand, *KV(R)*, is proportional to the stock of capital K in the economy and furthermore varies with the net profit rate on ownership of capital, denoted by R. The level of R that yields no net investments, only reinvestsments, is called R°. Hence, when R is greater than R°, capital is accumulated in the economy and vice versa. $V(R) - V(R^{\circ})$ can then be said to represent the rate of net investments.

Equation (2) explains real net income. Nominal net income is found by subtracting outlays for reinvestment, $PKV(R^{\circ})$, from total factor income, PQ. Deflating by the consumer price index we obtain (2).

The supply of the domestic product is written as a declining function of the relative wage, W/P, and an increasing function of the stock of capital, as in (3). The demand for labour in (4) is of the same qualitative form as output supply. Underlying output supply we assume a constant returns to scale production function.

The net rate of profit is given in equation (5). The profit sum, net of reinvestments, is equal to $PQ - WL - PKV(R^{\circ})$, while the replacement value of capital is equal to PK in the denominator. Hence, R can be interpreted as a contemporaneous (and myopic) measure of profitability in domestic production. When this measure deviates from its »target level« R° – which could be the international rate of return on investments - this generates capital accumulation or decumulation.

The above way of modelling investment demand can be thought of as a proxy to a more elaborate »*q*-theory« in which the entire future profitability of extra capital would be compared to the replacement cost of capital and not just the contemporaneous rate of profit. Actually, however, the future and the contemporaneous profit rate will tend to move together after a devaluation. Since, moreover, also employment and output movements are governed by the same forces as the rate of profit, our investment specifications seems like a reasonable short-cut. Kouri (1979) and Branson (1986) use

a similar formulation of investment demand; as noted by Kouri, this investment function can be derived from a model of profit maximizing firms by assuming that it is costly to adjust the stock of capital and that expectations are stationary.

The last equation (6) is defining the trade balance in an obvious way.

It turns out to be convenient to utilize a loglinear approximation to the above model. This approximation is made around an initial equilibrium point with balanced trade, all prices equal to one, and the net profit rate at the level R^o. Suppressing constant terms, when necessary, the following equations obtain with the original values of the variables all equal to zero:

$$q = \beta(1-\delta)y + (\gamma_x+\gamma_m)\,(1-\delta)v(e-p) + \delta(k+\eta r) \tag{7}$$

$$y = (1-\delta)^{-1}q - \delta(1-\delta)^{-1}k - v(e-p) \tag{8}$$

$$q = k - \alpha(1-\alpha)^{-1}\,\sigma\,(w-p) \tag{9}$$

$$l = k - (1-\alpha)^{-1}\,\sigma\,(w-p) \tag{10}$$

$$r = -\alpha(1-\alpha-\delta)^{-1}(w-p) \tag{11}$$

$$B/PQ = (1-\delta)\varphi y - \delta\eta r \tag{12}$$

All small non-greek letters denote logarithms of variables introduced earlier. New symbols are:

α : output elasticity and factor share of labour
β : marginal propensity to consume the domestic product
δ : share of reinvestments in output
σ : substitution elasticity for capital-labour substitution
φ : marginal propensity to save
γ_x : price elasticity of exports
γ_m : price elasticity of imports
η : the elasticity of the gross investment rate V with respect to the net profit rate R.

We may point out that the trade balance as a proportion of gross output in (12) reflects national savings minus national investments, the former basically governed by real net income and the latter dependent on the net profit rate.

3. The effects of a devaluation

By substituting (8) and (11) into (7) we get a two-equation system in (7) and (9). Predetermined variables are k and w, the (logs of the) capital stock and nominal wage rate, while the exchange rate e is exogenous. Endogenous variables are p and q.

If we solve for these, we get

$$p = (d_e + d_w)^{-1} (d_e e + d_w w + d_k k) \tag{13}$$

with

$$d_e \equiv (1-\beta)^{-1} \nu (1-\delta)(\gamma_x + \gamma_m - \beta) \quad , \quad d_k \equiv -(1-\delta)$$

$$d_w \equiv \alpha(1-\alpha)^{-1}\sigma - \delta\eta\alpha(1-\beta)^{-1}(1-\alpha-\delta)^{-1}$$

and

$$q = (1-\alpha)^{-1}(d_e+d_w)^{-1}(\sigma\alpha d_e(e-w) + ((1-\alpha)(d_e + d_w) + \alpha\sigma d_k)k) \tag{14}$$

We require the market for the domestic good to be at least Walrasian stable, i.e. that $(d_e + d_w) > 0$. With nominal wages fixed in the short run, the effects of the devaluation then is

$$\frac{\partial p}{\partial e} = d_e(d_e + d_w)^{-1} > 0 \tag{15}$$

$$\frac{\partial q}{\partial e} = \sigma\alpha(1-\alpha)^{-1} d_e (d_e + d_w)^{-1} > 0 \tag{16}$$

Both of these are taken to be greater than zero, since the term $\gamma_x + \gamma_m - \beta$ in d_e, being the two trade price elasticities minus the marginal propensity to consume the domestic good, cannot fail to be positive. Accordingly, as well the price as the quantity of the domestic good rise following the devaluation.

The term d_w, representing the effect of an increase in wages on excess demand for the home good, has, by the way, a neat interpretation. On one hand, the rise in wages leads to a fall in the domestic output supply, but on the other it implies a lower rate of profit which hurts investment demand. The sign of d_w, and hence the sign of the effect of a higher wage level on the level of output prices, depends on which of these effects is the stronger one.

We can now calculate the effects of a devaluation on the net rate of profit and employment; these are

$$\frac{\partial r}{\partial e} = \alpha(1-\alpha-\delta)^{-1}\,(d_e + d_w)^{-1}\,d_e > 0 \tag{17}$$

$$\frac{\partial I}{\partial e} = \sigma(1-\alpha)^{-1}\,(d_e + d_p)^{-1}\,d_e > 0 \tag{18}$$

So in this simple model, output, the output price, the rate of profit and employment move together and all increase right after the devaluation.

Next, let us calculate the effect on real net income. We obtain from (8)

$$\frac{\partial y}{\partial e} = (d_e + d_w)^{-1}\,(1-\alpha)^{-1}\,(1-\beta)^{-1}\cdot\alpha\cdot v\cdot \tag{19}$$

$$[\sigma\,(\gamma_x + \gamma_m - 1) + (1-\alpha)\,\delta\eta(1-\alpha-\delta)^{-1}] > 0$$

What determines the outcome for real net income is the term in the square bracket. It consists of two parts: one is the Marshall-Lerner term $\gamma_x+\gamma_m-1$ times the substitution elasticity σ, which is probably positive. It stems from the usual substitution and terms of trade effects of a devaluation. The second expression in the bracket represents the investment effect and is strictly positive; since the effect of the devaluation on the rate of return is positive, investment demand will go up, increasing the demand for the home good and driving up domestic income. Accordingly, in this »real« model where monetary factors, income redistribution or intermediate goods play no role, the devaluation cannot be contractionary with respect to neither output and employment nor real net income.

The *trade balance effect* of the devaluation may be negative in the short run, if the expansionary effect on investment is sufficiently strong. We derive

$$\frac{\partial B/\partial e}{PQ} = (d_e+d_w)^{-1}\,(1-\delta)(1-\beta)^{-1}\,v\alpha\cdot \tag{20}$$

$$[(\gamma_x + \gamma_m - 1)\,((1-\alpha)^{-1}\,\varphi\sigma - \delta(1-\alpha-\delta)^{-1}\eta) - \delta(1-\alpha-\delta)^{-1}\eta(1-\varphi-\beta)]$$

We first note that the last term in the bracket is negative, $(1-\varphi-\beta)$ being the marginal propensity to consume the imported good. Assuming that the Marshall-Lerner term $\gamma_x+\gamma_m-1$ is greater than zero, we see that a sufficient condition for the devaluation to actually deteriorate the trade balance is that

$$\eta > \varphi\sigma \frac{(1-\alpha-\delta)}{(1-\alpha)\delta} \qquad 21)$$

Hence, if the sensititivy of investments to variations in the real net profit rate is sufficiently large (relative to the substitution elasticity in production), the powerful investment response to a devaluation will lead to a worsening in the trade balance.

We may note, though, that if there is no net investment response at all after the devaluation, i.e. $\eta \equiv 0$, then the condition for the exchange rate adjustment to lead to an improvement in the real net income and in the trade balance *is* the Marshall-Lerner condition. With investments in the picture, this condition is no longer in itself sufficient for the improvement in the trade balance.

4. Introducing imports of investment goods

Above, we deployed the extreme assumption that none of the investment goods in the economy was imported from abroad. We now want to relax this assumption; for simplicity we do so by considering the opposite extreme with all investment goods being imported. Aside from this change and a consequent increase in the export flow, the economy will be specified in the same way as in section 2 above. Equations (3) and (4) stay the same, and in (1) the $KV(R)$-term drops out. Moreover, (2), (5) and (6) are modified to

$$Y = Q(E/P)^{-v} - KV(R^{\circ})\ (E/P)^{(1-v)} \qquad (2')$$

$$R = (PQ - WL - EKV(R^{\circ}))/(EK) \qquad (5')$$

$$B = PX - EM - EKV(R), \qquad (6')$$

where account is taken of the fact that E now is the relevant replacement price for capital.

Without going into too many details we should note that the net rate of profit will now vary with not only the relative wage but also the relative price of imported goods (E/P).

The impact effects of a devaluation on the quantity produced and on the price of the domestic good are positive as before, as they are proportional to the term $\gamma_x + \psi\gamma_m - \beta$, in which ψ stands for the share of consumption goods in total imports, drawing attention to the fact that the import price elasticity only operates on part of imports.

When investment goods are imported it becomes more expensive to install new capital after the exchange rate adjustment, compared to when investment goods are produced at home. Therefore, the prtofit rate and investment effects of the devaluation

will be less pronounced. For real net income we derive, that the effect will be proportional to the modified Marshall-Lerner term $\gamma_x + \psi\gamma_m - 1$, whereas for the *trade balance* it turns out that the impact effect becomes proportional to the expression

$$(\gamma_x + \psi\gamma_m - 1)\,(\varphi\sigma(1-\alpha)^{-1} - \delta\eta(1-\alpha-\delta)^{-1}) \qquad (22)$$

$$- \delta\eta\,(1-\alpha-\delta)^{-1}\,(1-\beta+\sigma\,/\,(\nu(1-\delta)+\delta))$$

Taking for granted that the modified Marshall-Lerner term is positive, we again require (21) to be fulfilled for the trade balance to be negatively affected by the exchange rate adjustment, just as in the first version of the model.

On the whole, then, introducing imports of investment goods in full does not dramatically change qualitative results for the trade balance or the quantity and price of output, whereas the real net income effect will be decoupled from incentives to invest after the devaluation.

5. Concluding remarks

The purpose of the present article was to incorporate the investment response in the analysis of an economy that carries out a devaluation of its currency. By introducing a simple investment function in which the net investment rate depended on the net rate of profit (as an approximation to a full-fledged q-theoretic approach) in a »real« model of a small open economy we were able to derive conditions for improvement in real net income, output and the trade balance following the devaluation.

In these conditions, the Marshall-Lerner terms showed up as usual, but in addition the investment response was found to further support an increase in real net income (when investment goods were produced domestically), while at the same time threatening the short run improvement in the balance of trade. If the sensitivity of net investment to changes in the net rate of profit was high and the elasticity of substitution between capital and labour low, then the devaluation could actually hurt the trade balance.

The analysis in this paper could rightly be criticized for being »ad-hoc«. This was inevitable precisely because we wanted to extend the conventional analysis of the effects of devaluations to take the investment response into account. Elsewhere, cfr. Nielsen (1991), we have analyzed the current account impact of a devaluation in a model, in which as well consumers as firms engage in intertemporal optimization. While similarities between these two articles can certainly be found, the framework in Nielsen (1991) in addition allows stressing the duration of the period of nominal wage stickiness as being important for the current account response.

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