TAX REVENUE IMPLICATIONS OF DEVALUATION: A CASE STUDY OF BANGLADESH

Nitai C. Nag*

A small macroeconomic model is used to estimate empirically the real tax revenue implications of devaluation. Overall effect of devaluation on tax revenue is found to be negative, which contrasts with the theoretical presumption that devaluation improves the government's revenue position. According to our estimation a 10 percent devaluation lowers equilibrium output by 1.04 percent and overall tax revenue by 4.2 percent. Import is dependent on output in the model. Contractionary output effect, it seems, lowers tax revenue via, among others, its negative effect on import demand, which in turn traditionally generates a very significant part of total tax revenue.

1. Introduction

It is relatively recently that economists began underscoring devaluation's likely impact on national budget. Since the issue of budget deficit lies at the core of stabilization and structural adjustment policies adhered to by most countries in the developing world, and since these policies almost invariably involve devaluation, an assessment of whether budget deficits would rise or fall consequent to a devaluation could be of immense importance, especially for the countries concerned. Since public expenditure is mostly exogenous in nature, an assessment of the impact on public revenue might be a proper method to proceed with. In this work, we explore the tax revenue implications of devaluation with the help of a macroeconomic model, estimated with empirical data. Tax revenue implications of devaluation can be seen as a function of price and output effects of devaluation.

2. Price and Output Effects

Price Effect

Barring other cases where a devaluation is also accompanied by such policies as reduction of tariffs, devaluation also leads to an increase in the prices of all goods. Cooper (1971a) uses data from 24 countries and finds consumer price index to have risen in all the cases following devaluation. Wages are to rise too. Cooper (op. cit.), of course, does not find evidence of wage-price spiral, which could have been due partly to the influence of the period, the Bretton-Woods Agreement, to which those data pertained. Under the flexible exchange rate system, the likelihood of wage-price spiral has remarkably risen as will be mentioned later.

Output Effect

Both demand and supply side factors are supposed to affect output.

The Demand Side Factors. Tinbergen (1946) found "surprisingly low" values for the elasticities in international demand. Machlup (1955) coined the term "elasticity pessimism" to describe the literature that followed Tinbergen's finding.

One implication of "elasticity pessimism" is that devaluation can reduce output. Non-fulfillment of Marshall-Lerner (M-L) condition (the probability of which was ruled out earlier by assumption) could, via expanding instead of narrowing trade deficit, lead to reduced employment and output.

Some studies (e.g., Hirschman, 1949; Cooper, 1971) argue that devaluation could lead to contraction in output despite satisfaction of M-L condition. Thus, even "successful devaluation" may generate unemployment and underutilization of capacity.

Diaz-Alejandro (1963) makes a theoretical case and also an empirical demonstration (1965) that devaluation can be deflationary despite positive effect on trade balance. According to this theory,

devaluation redistributes income toward capitalists and exporters, which may lower output by lowering aggregate demand.

Krugman and Taylor (1978), on the basis of the above studies, developed a formal model of contractionary effects of devaluation. In the presence of initial trade deficit, capitalists with higher propensity to save than wage earners, and ad valorem taxes on exports and imports, devaluation could reduce output through reduced aggregate demand.

The Supply Side Factors. Devaluation may lead to a fall in output through the economy's supply side. Dornbusch (1981) shows that the symmetry that devaluation acts simultaneously as a tariff on import and a subsidy on export is broken in the presence of export industries dependent upon imported intermediate imports. Devaluation under such circumstances acts as a tax on import, which has its usual demand side effect as described above. Only substitution toward domestic labor-intensive good under such a situation can help expand output.[1] Bautista (1982) points out that in the least developed countries of the world of generalized floating 80 percent of exchange rate changes gets added to domestic price level. Cost push effect and its contractionary implications are emphasized in other studies, too (e.g., Bruno, 1979).

Van Wijnbergen (1986) develops a set of channels via which devaluation lowers supply of domestic output. Devaluation-led higher price of imported intermediates raises requirement of working capital.

The latter raises interest rates, which, in addition to lowering output from the demand side, also lowers supply, since higher inter-

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[1] But this could at the same time invite cost price spiral. In a world of floating exchange rates, an initial disturbance can set in motion a cumulative process (see Bond, 1980) of price inflation and exchange rate depreciation, through which the exchange rate effect is rapidly passed into domestic prices and costs and back again into exchange rate. In the case of small countries, the likely detrimental effect of devaluation on price of inputs, imported or home made, is remarkably larger. While large countries such as the USA and Japan experience only partial pass through the effect of devaluation on domestic prices, the small and medium countries experience almost complete pass through (Bond, op.cit).

out means higher cost of production.[2] A new dimension of the contractionary supply side effect appears in Lai and Chang (1996), which employs the notion of wage employment contract.[3]

A few empirical works (e.g., Gylfason and Risager, 1984; Gylfason and Radetzki, 1985) look at simultaneous interaction of both demand and supply side forces to show that devaluation improves trade balance deficits by reducing income, lowering wage, and raising profits in the short run.

3. The Model

We use a model developed originally by Fierro and Reisen (F-R) (1990), which is the first empirical attempt to compute tax revenue implications of devaluation. The appeal of F-R is that it enables one to isolate price and output effects of devaluation.

We build a small macroeconomic model, which includes regression equations on various categories of tax revenue. To test the model we use Bangladesh data.[4]

Aside from the tax revenue equations, our model also includes regression equations in various components of aggregate demand, most of which we use as proxies of bases of different categories of taxes.

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[2] Again, assuming that real wage is indexed to consumer price, which in turn is based on import price, a negative relation can be shown to exist between real product wage and international terms of trade. Higher real product wage reduces supply of output both directly and indirectly through raising working capital requirements. Also, as a result of indexing wages to prices, real wage remains unaffected following a nominal devaluation. Under such an arrangement, a nominal exchange rate change implies a reduction of real amount of bank credit and the monetary base. With the resulting reduction in the volume of real credit now going to the firms, the latter will be forced to borrow from the unofficial market at higher charges. Supply of output is to fall as a result.

[3] "...devaluation will definitely depress the supply of domestic goods when the union and the firm negotiate an efficient wage employment contract" (Lai and Chang, 1996).

[4] Bangladesh is chosen because the country, among others, has experienced the largest number of stabilization and structural adjustment programs in Asia during the last nearly three decades. Bangladesh has been under programs for seventeen out of twenty-five years of its independent existence. Her currency has been devalued most rapidly during the last two decades.

This also enables us to estimate output effect; the coefficients of the exchange rate term in the various tax equations on the other hand measure the direct or price effects.

We treat exchange rate as an exogenous variable in the model; this enables us to estimate its various impacts on tax revenue. We refrain from doing causality analysis between exchange rate and tax revenue.[5]

According to government accounting, total tax revenue is composed of four categories of tax revenues: (1) income tax, (2) customs duty, (3) excise and sales taxes, and (4) other taxes.[6] Although value-added tax (VAT) replaced sales tax altogether, excise tax continued to be collected, although at significantly reduced scale, alongside VAT during the period in question. We denote the sum of excise and sales taxes and VAT as domestic indirect taxes.

We choose gross domestic product (GDP) as proxy of tax-base for income tax. For Customs Revenue we use the total expenditure on imports (M) as tax base.

Private consumption spending (CP) serves as tax base for domestic indirect taxes. The fourth category of taxes, which is composed of miscellaneous sources of tax revenue such as registration fees, sale of non-judicial stamps, land revenue, wealth taxes, tax on motor vehicles, etc., contributes on average 7 percent of the total tax revenue. Investment demand (I) serves as proxy of base of Other Tax. It is assumed that the higher the level of investment, the higher is Other Tax revenue.

Aside from facilitating estimation, this also enables us to obtain the fraction of total impact of devaluation on Other Tax revenue attributable to what happens to output.

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[5] Such causality analyses are complex (see Jacobs, et al.,1979); also, some studies (e.g., Fierro and Reisen, 1990) reject the hypothesis of unidirectional causality running from taxes to exchange rates.

[6] Excise and sales taxes were sought to be replaced by value added tax (VAT) since 1992. Since our estimation covers the period between 1973 and 1996, we had to add together excise tax revenue and VAT revenue for the years between 1992 and 1996.

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All the four tax bases are endogenous variables, of which import, private consumption, and investment are behavioral; GDP is used as the equilibrium identity. Two other behavioral equations of the model are government consumption (CG) and export (X). In addition, the model includes three definitions. In all, there are 13 equations in the model. The model equations, shown in table 1, are assumed to be multiplicative in form.

Table 1 - Model Equations

(a) The Behavioral Equations

1. ITx = f(GDP, Exr, Gdfl, Dit)
            (+)   (+/−) (−)   (+/−)
2. CUST = f(M, Exr, Gdfl)
            (+) (+/−) (−)
3. INDTx = f(CP, Exr, Gdfl, DINDTx)
            (+)   (+/−) (−)   (+)
4. OTx = f(I, Exr, Gdfl)
           (+) (+/−) (−)
5. CP = f(GDP, CP1, Gdfl)
           (+)   (+)   (−)
6. CG = f(R, CG1)
          (+) (+)
7. I = f(GDP, I1, i)
          (+) (+) (−)
8. X = f(Exr, X1, Xdum)
          (+/−) (+) (+)
9. M = f(GDP, M1)
          (+) (+)

(b) Defnitions

10. TxR = ITx + CUST + INDTx + OTx
11. R = TxR + NTxR
12. C = CP + CG

(c) Equilibrium Condition

13. GDP = C + I + X − M

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Aside from the tax base and exchange rate variables, the tax equations also have an explanatory price variable.

Two dummy variables, DIT and DINDTx are put in the income tax and indirect tax equations, respectively. DITx is meant to capture the probable impact on ITx of economic reforms, which started in the late 1980's and involved, among others, significant reductions in income tax rates. DINDTx is supposed to capture impact of introducing VAT in the early 1990's.

Private consumption expenditure (CP) is assumed to depend on GDP, a lagged value of CP, and the price level. Investment is assumed to depend on GDP, past value of investment, and interest rate. Government consumption is assumed to be dependent on revenue, R, and a lagged value of the dependent variable. Revenue, R, is the sum of tax revenue and non-tax revenue, NTxR.

Import is a function of GDP and import lagged one period. And export depends on exchange rate, lagged value of export, and a dummy variable, Xdum, which is supposed to capture the importance of non-traditional exports in total export. Import, like the other tax bases, has not been regressed on exchange rate. The purpose is to devise routes via which to compute the direct and indirect effects of exchange rate reduction.

Data Description

The assumed multiplicative form of the model equations enables us to exploit the advantage of showing price and output effect of devaluation explicitly. Time series data gathered[7] from various sources are deflated by annual GDP deflator. The deflated series are then transformed into logarithms. TSP and LOTUS 123 have been used to compute the model.

Exchange rate is measured as the exchange rate of US dollar per unit of the local currency, Taka. Any fall in the said rate means a devaluation. So, a positive sign of the exchange rate variable in a tax equation will suggest that devaluation on average lowers tax revenue.

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[7] Sources of data are described in the appendix to the mimeograph of the work available at Department of Economics, University of Chittagong.

4. Estimation of the Model

Annual data for the years between 1973 and 1996 have been used in the estimation, which is based on Two Stage Least Squares (TSLS) method. In each of the nine behavioral equations, the list of instruments include, aside from the lagged values of both dependent and independent variables,[8] such variables as are actually found to be highly correlated with the endogenous variables of the right hand side. We also correct most of the behavioral equations for first order auto regression. For a couple of equations which have lagged dependent variables on the right hand side, we have not applied correction for autoregression to avoid having an inconsistent estimate of the autoregression parameter.[9] In addition to GDP deflator, inflation also has served as a price variable in some of the equations. Dummy variables on indirect tax and export have been dropped for not behaving well. Table 2 shows the estimated equations.

Table 2 - Estimated Version of the Model

(a) Behavioral Equations		

(1) $ITx = -0.90\ EXR_1 + 1.08\ GDP - 0.45\ dit + 0.39\ AR_{(1)}$ R2   D.W
        (0.38)   (0.19)   (0.36)   (0.11)   0.75   1.28

(2) $CUST = 0.34\ EXR_1 + 0.76\ M - 0.17\ INF + 0.49\ AR_{(1)}$
        (0.12)   (0.05)   (0.08)   (0.17)   0.83   1.79

(3) $INDTx = -29.67 + 0.8\ EXR_1 + 2.85CP - 0.33\ INF_1 + 0.22\ AR_{(1)}$
        (10.83) (0.39)   (.70)   (.08)   (0.22)   0.88   1.94

(4) $OTx = -0.90\ EXR_1 + 1.18\ I + 0.35\ AR_{(1)}$
        (0.13)   (0.07)   (0.08)   0.94   1.78

(5) $CP = 1.34 + 0.91\ GDP - 0.06\ GDfL_1 + 0.67\ AR_{(1)}$
        (1.85) (0.17)   (0.09)   (0.20)   0.98   2.11

(6) $CG = -1.01 + 0.31\ REV + 0.79\ CG_1$
        (3.64) (0.64)   (0.32)   0.96   1.42

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[8] Which are required in order to have consistent estimates of the parameters (see, Fair, 1970).

[9] See Pindyck and Rubinfeld (1981).

Table 2 (continued)

(7)	$I = -2.14 + 1.01\ GDP + 0.44\ AR_{(1)}$		
	(2.80) (0.21) (0.14)	0.90	2.26
(8)	$X = -2.20 + 0.24\ EXR_1 + 1.09\ X_1$		
	(4.5) (0.33) (0.25)	0.92	1.37
(9)	$M = -6.32 + 1.35\ GDP + 0.35\ AR_{(1)}$		
	(1.82) (0.14) (0.15)	0.94	1.43

(b) Definitions and the Equilibrium Condition

(10) $TxR = 0.16\ ITx + 0.35\ CUST + 0.41\ INDTx + 0.07\ OTx$
(11) $R = 0.81\ TxR + 0.19\ NTxR$
(12) $C = 0.88\ CP + 0.12\ CG$
(13) $GDP = 0.95\ C + 0.14\ I + 0.10\ X - 0.18\ M$

In terms of generating expected signs, as well as reasonable size of the parameters, the model seems to perform very well. Also, despite being small in size, the model also performs well at simulation.

In equations (1) to (4), each of the coefficients of EXR_1, the exchange rate variable lagged one period, is at least twice as large as the standard error.

The overall impact of devaluation on tax revenue is found by getting the sum of the weighted impacts on the four categories of tax revenue. Average share of a tax in total tax revenue served as the weight.

Devaluation, according to this model, lowers both customs revenue and domestic indirect tax. Income tax and Other Tax are found to have been positively affected. Since revenues from import tax and indirect tax sum to around 80 percent of total tax revenue, our finding remains as a cautionary signal for Bangladesh's policymakers. Our result about import tax is also consistent with the results obtained by F-R for Mexico.

Our result, however, contrasts with the theoretical presumption (e.g., Tanzi, 1989) that a devaluation would likely increase the real local currency value of import taxes.

The positive and statistically significant coefficient of EXR1 in equation (3) suggests that domestic indirect taxes also decrease following devaluation.

Output Effect

A significant proportion of the total effect on tax revenue as a result of devaluation depends on what happens to output. Appendix 1 shows how price and output effects are computed. Table 3 presents the total, price, and output effects of devaluation on different categories of real tax revenue. These are calculated on the basis of the coefficients of the exogenous variables obtained by solving the entire model. The said coefficients are presented in table 4.

Table 3 - Price and Output Effect

	Total Effect	Price Effect	Output Effect
Income Tax	−0.79	−0.9	0.11
Customs Duty	0.45	0.34	0.11
Indirect Tax	1.07	0.80	0.27
Other Tax	−0.78	−0.90	0.12
Total Tax	0.42	0.25	0.17

Table 4 - Matrix of the Reduced Form
Coefficients $II_1 = A^{-1}B$

Const	EXR_1	$GDFL_1$	INF	INF_1	Dit	NTxR
4.68	−0.78	−0.19	−0.006	−0.01	−0.45	0.02
−0.34	0.44	−0.18	−0.18	−0.01	−0.01	0.02
−14.59	1.07	−0.63	−0.01	−0.36	−0.02	0.06
2.64	−0.77	−0.21	−0.01	−0.02	−0.01	0.03
5.29	0.09	−0.22	−0.01	−0.01	−0.01	0.02
−2.26	0.1	−0.1	−0.02	−0.04	−0.02	0.07
2.24	0.11	−0.12	−0.01	−0.01	−0.01	0.02
−2.2	0.24	00	00	00	00	00
−0.46	0.14	−0.24	−0.01	−0.02	−0.01	0.03
−5.16	0.41	−0.37	−0.07	−0.16	−0.08	0.04
−4.18	0.33	−0.29	−0.06	−0.13	−0.07	0.22
4.38	0.10	−0.20	−0.01	−0.01	−0.01	0.03
4.34	0.104	−0.18	−0.01	−0.01	−0.01	0.02

According to our model, devaluation is indeed contractionary. A 10 percent devaluation, other things remaining unchanged, would reduce output by 1.04 percent as can be seen from Table 4, column 2 of which shows the comparative static results of devaluation.[10]

We have seen earlier that import tax revenue is negatively affected by devaluation. It seems that contractionary output effect lowered import, which in turn lowered import tax revenue. Capital formation suffered accordingly. One may have observed, most of the 1980's has actually been marked by such a scenario. Similar outcomes are noticeable in other studies (see Taylor, 1988).

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[10] Appendix 2 shows the technique of solving the estimated model.

Again, a 10 percent devaluation would reduce overall tax revenue by 4.2 percent, of which 2.5 percent is due to price effect and 1.7 percent due to output effect. Of this overall effect, it is noteworthy that the share of domestic indirect tax is the highest. Total effect on indirect tax revenue is 1.07, of which price effect amounts to 0.80, and the rest, output effect.

Domestic indirect tax, whose tax base in the model is private consumption (CP), has the highest average share, 41 percent in total tax revenue. As can be seen from table 3, CP has a statistically significant coefficient of as high as 2.85. This attests to the excessive dependence of the government on this category of tax in an environment marked by a pre-modern tax system.

Contractionary output effect also reduces import tax revenue by 1.0 percent. Due mainly to the relative smallness of the two other kinds of taxes in total tax revenue, their output effects on overall tax revenue sum to just 0.3 percent.

Since indirect taxes are levied mostly from consumers' essentials, our estimation suggests that every dose of devaluation is but a signal of an additional dose of regressive tax leviable from among the deprived section of the community. It is no wonder that one will find all-pervasive poverty amidst fanciful shopping malls, frequented by the lucky few of the community, whom devaluation presumably made luckier.[11]

It is no wonder, too, that by pushing out of the market place more and more of the community's marginal humans, devaluations, as have been occurring every now and then, could be rendering the tax base narrower. The latter in turn could be a reason why the government of late has become increasingly dependent on the so called supplementary duty.[12]

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[11] A UNICEF report published in 1997 points out that 92 percent of Bangladesh's under-five children are malnourished as against 67 percent in 1992. The same report also warns about the alarming rapid growth of malnutrition among children. Early childhood malnutrition hinders government efforts to educate children. Iodine deficiency lowers IQ of students, which cannot be reversed. Among others, average height and average weight of people in Bangladesh are declining.

[12] This is a new head of tax, introduced a few years ago, but has already become a significant *ad hoc* source of public revenue.

It may be noted that both the government and the World Bank acknowledge the adverse impact on growth prospect of the demand management policies.[13] This prompted the World Bank (1992) to admit that poor infrastructure caused the failure of adjustment policies to bring the desired results in poor countries. An expert[14] felt like saying, "we told you so."

The observed sorry state of the social infrastructures, such as ports, power, telecommunications, etc., could thus in part be explained by government's revenue constraints caused, in turn, by mindless devaluations.

The irony of the Bangladeshis is that the government, despite such admissions, continues to rely on tools of the orthodox stabilization programs, including devaluation, while asking[15] at the same time the subjects of such programs to be ready to fix the likely damage thereof.

5. Conclusion

In the orthodox stabilization and structural adjustment policies, the government is generally required to reduce budget deficit. Devaluation is almost always a part of such policies. But one aspect of devaluation that the architects of these policies seem to have forgotten is its budgetary implications. The findings of our study suggest that devaluation, could, given other things, raise budget deficits. Imprudent devaluations could not only foil the very objectives of a stabilization package, but could also destabilize the macroeconomy.

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[13] "... tight fiscal policy was pursued ... faced with revenue shortfalls ... the government diverted investment resources into current consumption ... which forced public investment rates to drop significantly" (Fourth Five Year Plan, p. iv-2). The World Bank (1992) admits that poorer countries barely grew in per capita terms (as a result of the adjustment programs) and holds underdeveloped infrastructure responsible for their bad luck.

[14] Toye (1993).

[15] The government of Bangladesh, in addition to the supplementary duties mentioned above, also had to introduce a so called infrastructure development surcharge in fiscal year 1999.

Appendix 1 - Price and Output Effect

The coefficient of the exchange rate term in an equation measures the direct or price effect of a devaluation. Output effect is measured, following F-R, as follows:

Let certain tax category be denoted by $T0$.

For simplicity, let us write,

(1) $T0 = a1B + b1e$

and (2) $B = c1Y$

where B is the respective tax base, e, exchange rate, Y, output. $a1$, $b1$, and $c1$ are parameters.

The direct and indirect effects are found by differentiating (1) with respect to exchange rate, e:

i.e., (3) $dT0/de = a1 \, \delta B/\delta e + b1.$

where $b1$ is the measure of the direct effect of devaluation on $T0$ and $a1(\delta B/\delta e)$ the indirect effect which results through devaluation's impact on the tax base.

Total impact, which consists of the price and output effect of devaluation on $T0$ is found by substituting (2) in (3) and differentiating with respect to e.

That is,

(4) $\delta T0/\delta e = a1c1 \, \delta Y/\delta e + b1$

where $a1c1(\delta Y/\delta e)$ is the output effect of devaluation on $T0$.

Appendix 2 - Model Solution

The matrix of the reduced form coefficients, found by solving the estimated model, provides direct and indirect impact of the exogenous variables on the endogenous variables. The model can be written in matrix form as

$$(4.4.1) \quad AY_t = BX_t + CY_{t-n}$$

where A, B, and C are the matrices of the estimated coefficients of the current endogenous, current exogenous, and lagged endogenous variables, respectively. Y_t, X_t, and Y_{t-1} are column vectors with dimensions G, K, and Z, respectively.

Let the dimensions of A, B, and C respectively be $G*G$, $G*K$, and $G*Z$.

Assuming that A is non-singular, equation (4.4.1) can be solved for Y_t as follows

$$(4.4.2) \quad Y_t = \pi_1 X_t + \pi_2 Y_{t-n}$$

where $\pi_1 = A^{-1} B$, a $G*K$ matrix of reduced form coefficients, and $\pi_2 = A^{-1}C$, a $G*Z$ matrix of reduced form coefficients. The total impact of the exogenous variables on the endogenous variables is given by the elements of matrix π_2.

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