

Elasticity and Buoyancy of Federal Taxes in Pakistan

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This paper focuses on the revenue-expenditure activities of the federal government and evaluates the performance of the fiscal system on the basis of estimates of revenue productivity. Two methodologies for the estimation of the short-run and long-run elasticity and buoyancy for tax revenue are evaluated. It is found that the Divisia Index method is superior on both theoretical and practical grounds and the results obtained are substantiated by the proportional – adjustment method. The study finds that the built-in elasticity of Pakistan's tax system was greater than unity.

INTRODUCTION

Growing expenditure in a country is considered a prerequisite for economic growth, due to which in most of the developing countries expenditure growth rate commonly exceeds the rate of national income growth. On the other hand, economic growth increases the taxable capacity of these countries and enables them to obtain a larger share of national income in the form of tax revenues. Therefore, developing countries usually depend on their tax system to generate adequate revenues in order to finance their ever-expanding expenditures. Generally, they find themselves in growing fiscal problems when their tax responsiveness remains below that of expenditures. So a great effort is needed in this area to analyse the sources of revenues and their responsiveness in order to maximize the revenues.

This paper focuses on the revenue-generating activities of the federal government of Pakistan and evaluates the performance of the fiscal system on the basis of estimates of revenue productivity. This is measured by tax elasticity and tax buoyancy, with the former taking account of the automatic response of revenue to income changes (i.e. revenue increase, excluding the effects of discretionary changes) and the latter measuring the total response of tax revenue to changes in income

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(including discretionary changes). A higher tax elasticity is always preferable in so far as it helps to plan for a higher level of current expenditure. However, for taxes with a lower elasticity, additional revenue may only be generated through discretionary changes, which is reflected in a higher buoyancy of the tax system.

In Pakistan, empirical investigations of tax elasticity and buoyancy have yielded varying results because of methodological problems. The elasticity coefficients for the years from 1950-51 to 1957-58 obtained by Chaudhry [1] on the basis of the "changing-base method" have limited policy relevance because of varying elasticity estimates for different years. The "dummy variable method" used by Khan [4] to eliminate the effect of discretionary changes took care of only those changes for which a dummy variable was used. But since the tax structure underwent frequent changes during this period, not all the discretionary changes were accounted for, which casts serious doubt on the reliability of the elasticity estimates. Jeetun [3], using the Prest formula to allow for the revenue effects of discretionary tax measures, calculated elasticities of Pakistan's tax system for the period from 1960-61 to 1975-76. These results were very different from those obtained by Khan even though the data set was the same.

Since revenue growth stems both from the growth in base and from new tax legislation, the built-in elasticity of the tax system has to be first adjusted for all discretionary tax measures. In a situation involving frequent changes in the tax structure, the most relevant and practically useful techniques for estimating elasticity of taxes are (i) the Divisia Index method, and (ii) the Proportional Adjustment method.

In this paper the elasticity and buoyancy of Pakistan's federal tax system have been estimated for the years from 1971-72 to 1982-83 by using the Divisia Index method and the Proportional Adjustment method. The size of the elasticity estimates of the total tax as well as its components has been analysed and compared with the buoyancy measures. The difference between the buoyancy and elasticity estimates for individual taxes has also been explained. Finally, the estimates of buoyancies with respect to individual taxes are compared with the corresponding expenditure buoyancies to evaluate the revenue performance of the fiscal system. All the data have been taken from [6], [10], [11] and [12].

Measurement of Elasticity

Two methods, viz. the Divisia Index method and the Proportional Adjustment method, have been used to isolate the effect of discretionary changes on aggregate tax revenue. The first method utilizes time-series data on various taxes and is particularly helpful where reliable information about discretionary changes is not available. On the other hand, when data on discretionary change are available, the Proportional

Adjustment method yields better estimates of elasticity [2]. In Pakistan, however, precise data on the discretionary changes introduced so far are not always available, given the complexity of the tax rate structure (in particular that pertaining to international trade) which is made even more intricate by changes in the tax base.¹ By using the two methods together, the effect of 'non-tangible' factors like tax evasion, tax exempting investments, etc., on the tax effort can also be accounted for.²

Divisia Index Method (DIM)

The DIM of measuring the revenue effects of discretionary changes is widely used for measuring technical change and isolating the effect of exogenous factor on a variable. In this paper, the DIM has been used to estimate tax elasticity by isolating the automatic growth of revenue from its total growth. Following Choudhry [2], we estimate tax elasticity as follows.

The starting point is an aggregate tax function.

$$T(t) = f[x_1(t), \dots, x_k(t); t] \quad \dots \quad \dots \quad (1)$$

where T denotes the aggregate tax yield, x_i denotes the proxy tax base for the K categories of taxes and the time variable t is a proxy for discretionary tax measures. The effect of discretionary tax changes at time t are obtained by taking the logarithm of the tax function. Differentiating with respect to time and rearranging the terms, we get the following equation:

$$\frac{\dot{f}_t(t)}{f(t)} = \frac{\dot{T}(t)}{T(t)} - \sum_{i=1}^k \frac{f_i(t) x_i(t)}{f(t)} \frac{\dot{x}_i(t)}{x_i(t)} \quad \dots \quad \dots \quad (2)$$

$$\text{setting } \frac{f_i(t) x_i(t)}{f(t)} = \beta_i(t) \text{ and } \frac{\dot{f}_t(t)}{f(t)} = \frac{\dot{D}(t)}{D(t)},$$

where $D(t)$ is the Divisia Index of discretionary tax changes, we can rewrite equation (2) as follows:

$$\frac{\dot{D}(t)}{D(t)} = \frac{\dot{T}(t)}{T(t)} - \sum_{i=1}^k \beta_i(t) \frac{\dot{x}_i(t)}{x_i(t)} \quad \dots \quad \dots \quad (3)$$

¹ The estimates of discretionary changes are available only from Budget Speeches [9] and Annual Budget Statements [8] from 1971-72 to 1982-83. Although it is possible that these estimates are biased because of political or other considerations, we are constrained to use these data in the absence of data from other sources.

² For a detailed exposition of the two methods, see Choudhry [2], Mansfield [5] and Prest [13].

Integrating equation (3) over the interval (o, n) we get the index of discretionary tax revenue.

$$\frac{D(n)}{D(o)} = \left[\frac{T(n)}{T(o)} \right] \exp - \left[\sum_{i=1}^k \int_o^n \beta_i(t) \frac{\dot{x}_i(t)}{x_i(t)} dt \right] \dots \dots (4)$$

When equation (4) is normalized by setting $D(o) = 1$, $D(n)$ can be viewed as the index of revenue growth stemming from discretionary tax measures at time (n) . Replacing $\beta_i(t)$ with a $\hat{\beta}_i(t)$, which is a form of the weighted average of $\beta_i(t)$, where weights are the ratios of the instantaneous rates of growth of the bases to their average rates of growth in the time interval (o, n) , and taking the logarithm, we get

$$\log D(n) = \log \left[\frac{T(n)}{T(o)} \right] - \sum_{i=1}^k \hat{\beta}_i \log \left[\frac{x_i(n)}{x_i(o)} \right] \dots \dots \dots (5)$$

where $\log D(n)$ is the index of discretionary tax measures. To obtain the elasticity estimates, the index of discretionary tax measures is adjusted by using the following formula:

$$r = b - \frac{\log D(n)}{\log x(n)/x(o)} \dots \dots \dots (6)$$

where

r = Tax elasticity;

b = Tax buoyancy,³ obtained by regressing actual tax revenue on GDP using logarithmic form of the equation;

$\log D(n)$ = Divisia Index of discretionary tax revenues; and

$\log x(n)/x(o)$ = Index of automatic growth of proxy tax base.

Proportional Adjustment Method (PAM)

By this method, elasticity has been calculated, as in Mansfield [5], by first preparing a preliminary series of adjusted tax yield obtained by subtracting from the

³Two estimates of buoyancies have been calculated, viz. short-run buoyancy and long-run buoyancy, as follows:

$$\log T_t = \delta_0 + \delta_1 \log GDP + \delta_2 \log T_{t-1}$$

where δ_1 is the short-run buoyancy, and $\frac{\delta_1}{1-\delta_2}$ is the corresponding long-run buoyancy.

By using these two estimates in equation (6), the corresponding short-run and long-run tax elasticities have been calculated (as reported in Table 3).

actual yield the estimated effect of discretionary tax changes.⁴ The series is further adjusted by excluding the continuing impact of each discretionary change on future year's tax yields as given in equation (7).

$$T_{ij} = T_{j-1,j} \times \frac{T_{j-2,j}}{T_{j-1,j}} \times \dots \times \frac{T_{23}}{T_2} \times \frac{T_{12}}{T_2} \dots \quad (7)$$

where

T_1, T_2, \dots, T_n represent actual tax yields for a series of n years; and
 T_{ij} indicates the j th year's actual tax yield adjusted to the tax structure that existed in the year i .

In equation (7), the adjusted tax yield is obtained by multiplying the actual tax yield by a factor sequence, each element of which represents the effect of automatic tax changes. Finally, T_{ij} is regressed on GDP and the lag value of adjusted tax to yield the short-run elasticity and long-run elasticity as follows:

$$\log T_t = \delta_0 + \delta_1 \log \text{GDP} + \delta_2 \log T_{t-1}$$

where δ_1 is the short-run elasticity, and $\frac{\delta_1}{1 - \delta_2}$ is the long-run value.

DISCRETIONARY AND AUTOMATIC GROWTH OF TAX REVENUE

To measure the revenue effect of discretionary changes on different taxes, we use the following equation, derived earlier.

$$\log D(n) = \log \left[\frac{T(n)}{T(o)} \right] - \sum_{i=1}^k \hat{\beta}_i \log \left[\frac{x_i(n)}{x_i(o)} \right] \dots \dots \dots (5')$$

where $\hat{\beta}$ is the weighted average of β_i defined as $\frac{f_i(t) x_i(t)}{f(t)}$.

The left-hand side of equation (5') measures discretionary tax growth. The first component of the right-hand side measures total tax growth and the second represents automatic growth of taxes.

⁴ Discretionary changes are defined, for the purposes of this method, as legal changes in the rates or in the tax base, the introduction of new taxes, and certain administrative efforts. The yield effects of normal (trend) improvements in administration unaccompanied by legal changes are thus included in this measurement of elasticity (PAM).

Table 1
*Decomposition of Total Growth into Discretionary
 and Automatic Growth (1971-72 to 1982-83)*

Tax Category	Total Growth of Tax Revenues	Growth in Tax Revenue due to	
		Discretionary Change	Change in Base
All Taxes	2.154	-0.177	2.331
Indirect Taxes	2.207	-0.171	2.378
Excise Tax	1.807	-0.147	1.954
Sales Tax	1.956	-0.126	2.082
Import Duties	2.692	-0.109	2.801
Export Duties	-0.869	3.341	-4.21
Direct Taxes	1.955	-0.023	1.978
Corporation Tax	2.805	0.249	2.556
Income Tax	1.233	-0.205	1.028

The results reported in Table 1 show that, with a few exceptions, almost all the growth in the various taxes stemmed from endogenous factors. This is reflected in the overwhelming contribution of automatic tax growth to total growth.

On the other hand, the revenue effect of discretionary changes in various taxes has either been extremely small, as in the case of corporation taxes, or negative. The only exception is that of export duties in whose case discretionary tax changes yielded substantial additional revenue, thanks both to upward revision of tax rates and to the introduction of some new taxes. This result would hold even when allowance is made for the over-estimation of discretionary growth by the Divisia Index Method arising from excessive statutory tax changes.⁵ However, because of the adverse movement of automatic factors, the total growth of export duties was negative.

The negative effect of discretionary changes on revenue, particularly in the case of indirect taxes, led to relatively low values of tax revenue buoyancy and elasticity. These are analysed in greater detail in the next section. Before discussing the elasticities and buoyancies of different taxes, the percentage share of each tax category in total tax revenue is presented in Table 2, which gives information about

⁵ Due to this factor the efficiency of estimation of the DIM is not affected because, during the Seventies, the discretionary changes for export duties were not many, even though the impact on aggregate revenue was substantial.

Table 2

Percentage Share of Individual Tax in Total Taxes

Year	Total Taxes	Indirect Taxes	Excise Tax	Sales Tax	Import Duties	Export Duties	Direct Taxes	Corporation Tax	Income Tax
1971-72	100	76.94	38.57	8.76	19.38	7.08	23.06	6.26	16.24
1982-83	100	81.11	28.23	7.18	39.41	0.70	18.89	12.01	6.46

the proportion of each individual tax in the total tax bill. Indirect taxes contributed almost three times as much as direct taxes, which increased from 76.94 percent in 1971-72 to 81.11 percent in 1982-83. In individual categories of indirect taxes, only the share of import duties showed a marked increase from 19.38 percent in 1971-72 to 39.41 percent in 1982-83, while other three categories reduced their contribution to total tax revenue. A major decline from 7.08 percent in 1971-72 to 0.70 percent in 1982-83 is recorded by export duties, reflecting the impact of international market situation and a sharp decline in exportable surplus.

In direct taxes, corporation tax increased substantially from 6.26 percent in 1971-72 to 12.01 percent in 1982-83, while income tax reduced its contribution to total taxes from 16.24 percent to 6.46 percent during the same period.

ELASTICITY AND BUOYANCY OF TAX REVENUE

Estimates of the elasticity of tax revenue are obtained by eliminating the effects of discretionary changes on buoyancy estimates, using a discretionary change Divisia Index transformation. It follows that the larger is the element of discretionary change in tax revenue the greater will be the difference between elasticity and buoyancy. In case discretionary changes add to total revenue, the difference between the total and automatic growth of tax revenue will be positive but the opposite will be the case if new tax legislation reduces tax revenue.

We have calculated the long-run estimates of elasticities and buoyancies,⁶ using the PAM and DIM, as well as the short-run estimates for various taxes. Since discretionary changes produce long-run effects on the tax system and responsiveness of a system can be analysed with the help of a set of observations on both tax revenues and discretionary changes, we have therefore discussed only the long-run estimates, although the short-run estimates have been reported in the Table 3. All the regression results are significant at the 95-percent confidence level. The long-run results show that for total tax the elasticity was greater than unity and greater than

⁶ Buoyancy estimates are similar for the two methods.

buoyancy.⁷ This explains that while a growing proportion of incremental income has been transferred to the government in the form of tax revenues with the growth of the tax base, the role of discretionary changes in raising additional revenue was not very substantial. In fact, discretionary changes had an adverse effect on the growth of aggregate tax revenue as reflected in the tax elasticity exceeding buoyancy. Except for corporation tax and export duties, this was true for all the other components of the total tax revenue.

A number of other observations can be made on the basis of the figures in Table 3. Firstly, the low buoyancies of the income tax and export duties have adversely affected the overall buoyancy of the total tax whose other components are fairly buoyant. Secondly, the higher buoyancy of direct taxes despite the less-than-unity income tax buoyancy was due to the extremely high buoyancy of the corporation tax which was also the largest contributor to the overall tax buoyancy. Thirdly, the negative buoyancy of export duties shows that the effect of automatic growth factors was negative and exceeded the effect caused by positive discretionary changes. This is also reflected in the higher buoyancy of export duties as compared

Table 3
Elasticities and Buoyancies of Federal Taxes

	Elasticity				Buoyancy	
	DIM		PAM			
Total Taxes	1.26	(0.83)	1.22	(0.71)	1.17	(0.74)
Indirect Taxes	1.24	(1.41)	1.33	(0.91)	1.16	(1.32)
Excise Tax	1.21	(0.83)	1.16	(0.99)	1.13	(0.75)
Sales Tax	1.24	(1.31)	1.36	(0.91)	1.18	(1.24)
Import Duties	1.27	(0.52)	1.19	(0.69)	1.21	(0.46)
Export Duties	-2.69	(-2.38)	-1.57	(-0.95)	-0.83	(-0.63)
Direct Taxes	1.44	(0.76)	1.48	(1.01)	1.42	(0.75)
Corporation Tax	2.12	(0.84)	1.91	(1.72)	2.25	(0.97)
Income Tax	0.93	(0.71)	0.87	(0.54)	0.82	(0.61)

Note: Values in brackets are short-run values.

⁷ It is interesting to note that the two methods give roughly similar results. Although this could be taken as an indication of the validity of the methods, it is important to bear in mind that, given the poor quality of data on discretionary tax changes in Pakistan, the results from the DIM approach are likely to be more reliable.

with their elasticity. The negative buoyancy of export duties is due to the fact that during the Seventies export duties have been progressively reduced and withdrawn with a view to boosting exports by increasing the competitiveness of Pakistani products in international markets. Although, after the devaluation in 1972, export duties showed a sharp increase, soon after this, they declined markedly in response to the international market situation and sharp decline in exportable surplus. Fourthly, the contribution of additional revenue to total tax generated through discretionary changes (through increased tax rates and the broadening of the tax base) was not enough to offset the decline in revenue due to export duties and the adverse effect on revenue of an income tax elasticity of less than unity (which implies an adverse effect on the income tax ratio over time). In other words, the rise in the tax ratio during the years from 1971-72 to 1979-80 would have been faster had it not been for the negative influence of the discretionary changes (see [7]). Fifthly, the higher-than-unity elasticity of import duties, excise taxes and sales taxes are explicable in terms of the rapid growth in the base variables of these taxes, viz. the value of imports of goods (M), the value added in large-scale manufacturing sector (LSY) and $M + LSY$, respectively.

DECOMPOSITION OF ELASTICITIES

To obtain a closer picture of the performance of the fiscal system, tax elasticity can be evaluated as the weighted average of the elasticities of its various components, viz. the tax elasticity to the base and base elasticity to income.

$$\left[\frac{\Delta T_k}{\Delta Y} \cdot \frac{Y}{T_k} \right] = \left[\frac{\Delta T_k}{\Delta \beta_k} \cdot \frac{\beta_k}{T_k} \right] \left[\frac{\Delta \beta_k}{Y} \cdot \frac{Y}{B_k} \right] \dots \quad (8)$$

where

T = tax revenue;

Y = GDP; and

B_k = is proxy base related to individual categories of taxes.

The composition of tax elasticities helps to identify the dynamic as well as lagging components of the tax system. The division of each elasticity estimate into its two elements, viz. tax elasticity to base and base elasticity to GDP, also has important policy implications. In so far as the tax-to-base element is controlled by the government, it can be influenced to impart greater elasticity to a particular tax.

The results of decomposition⁸ for five major types of taxes are given in Table 4. Again, the long-run estimates of elasticities have been decomposed into two components.

Table 4 shows that the low elasticity of income tax stemmed primarily from the low value of the tax-to-base elasticity since the base-to-GDP elasticity of 1.18 was fairly high, pointing to a relatively faster income base growth with respect to GDP. The impact on the income tax elasticity would have been positive and substantial if tax revenue from this source had grown at least in the same proportion as the base. For a variety of reasons, which may include loss of revenue due to tax evasion, the growth in tax collection was less than proportionate to the expanding base which is reflected in the lower tax-to-base elasticity.

In the case of corporation tax, the expansion in the tax base was only slightly faster than the growth of GDP, and almost all the contribution to the higher tax-to-GDP elasticity was provided by the tax-to-base elasticity, which reflects an upward revision in the tax rates for these commodities. For excise taxes, both components

Table 4
Decomposition of Long-Run Tax Elasticities
(Divisia Index Method)

Tax	Related Base	Tax-to-GDP Elasticity	Base-to-GDP Elasticity	Tax-to-Base Elasticity
Income Tax	Value-added in Non-agriculture Sector	0.93	1.12	0.72
Corporation Tax	Value-added in Large-scale Manufacturing Sector	2.12	1.16	1.73
Excise Tax	Value-added in Large-scale Manufacturing Sector	1.21	1.16	1.13
Import Duty	Value of Imports	1.27	1.26	1.17
Export Duty	Value of Exports	-2.69	0.95	-1.44

⁸ This equality is strictly true when equation (8) is perfectly estimated, i.e. when the R^2 level of each component of the equation is 1.00. Since the elasticities of decomposed elements were obtained separately, there are differences in the overall elasticities of taxes and the product of the decomposed elements due to this factor as follows: income tax (0.93 vs 0.85), corporation tax (2.12 vs 2.01), import duty (1.27 vs 1.47), export duty (-2.69 vs -1.34), excise tax (1.21 vs 1.31).

contributed almost equally to the tax-to-GDP elasticity. For import duties, the base-to-GDP elasticity was the major contributor to the higher total elasticity even though the tax-to-base elasticity was also quite substantial. The negative elasticity of export duty was due both to a relatively low growth of the export base and to the adverse effect of the negative tax-to-base elasticity.

Table 5

Buoyancies of Revenues and Expenditure of the Federal Government

Dependent Variable and Base	Buoyancy	t-Value	R ²
Tax revenue-GDP	1.16	43.86	0.99
Total expenditure-GDP	1.10	57.45	0.99
Capital expenditure-GDP	1.17	46.76	0.99
Current expenditure-GDP	0.99	18.19	0.97

REVENUE PRODUCTIVITY

A comparison of tax and expenditure buoyancies in Table 5 shows that during the years from 1971-72 to 1982-83 revenue productivity was not a major problem in Pakistan in so far as the expenditure buoyancies have been lower than revenue buoyancies. This is an interesting result as it implies that some measure of success was attained in limiting the growth of current expenditure below that of tax proceeds. The higher overall expenditure buoyancy was, therefore, attributable to the faster growth of capital expenditure. This is, to an extent, substantiated by the fact that the buoyancy of capital expenditure exceeded that of current expenditure and of aggregate tax, even though the difference between the buoyancies of capital expenditure and aggregate tax was extremely small.

The fact that the buoyancy of revenue during the period from 1971-72 to 1982-83 exceeded that of expenditure does not necessarily mean that the country would have registered continuous budget surpluses if there was fiscal equilibrium at the beginning of the period for the simple reason that the study covers the revenue-expenditure activities of the federal government and does not include the consolidated fiscal activities which could lead to an inverse situation.

CONCLUSION

The DIM was used to assess the impact of discretionary changes on tax revenue and the results were compared with those obtained through PAM. Analysing the two

estimates of elasticity, we found that they did not vary substantially and gave similar trends. The little observed difference can be explained by the fact that the DIM accounts for the 'production effects' of tax changes through tax base adjustment, while the PAM adjusts tax yields against the base year tax-rate structure only. Secondly, the PAM uses estimates of discretionary tax changes obtained from annual budget speeches, which can vary from the actual figures owing to a number of reasons, like tax evasion, tax exempting investments, etc. It was noted, however, that during the Seventies, except in the case of export duties the effect of these factors was only minimal.

The decomposition of elasticity into its various components showed an expansion in the tax base for nearly all the categories of taxes along with positive discretionary changes. The low income tax elasticity with respect to GDP points to the need for a stronger effort for tax collection at the existing rates and for preventing tax evasion as well as minimizing tax exemptions.

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