

Can Pakistan Get Out of the Low Tax-to-GDP Trap?

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ABSTRACT

This paper explores possibilities of Pakistan getting out of the low-tax-to-GDP trap and coming close to achieving the target agreed upon with the IMF. Examining the trend and factors influencing the trend in total and individual tax-to-GDP ratios over a period of twenty years, the paper concludes that partially successful and/or inappropriate tax reforms have put Pakistan into this trap. While highlighting that a period of economic slowdown may not be the best time to make a big push on resource mobilization, the paper presents a strategy which aims at not only enhancing tax revenues but also making the taxation structure more progressive, broad based and balanced.

CAN PAKISTAN GET OUT OF THE LOW TAX-TO-GDP TRAP?

1. INTRODUCTION

Pakistan's overall tax-to-GDP ratio has remained stagnant at around 10-11% or so and, in fact, has shown a decline in recent years. Today Pakistan has a lower tax-to-GDP ratio compared to other Asian countries like Sri Lanka (13 percent), India (16 percent), Indonesia (15 percent), Malaysia (14 percent), Thailand (17 percent), Philippines (14 percent), and South Korea (16 percent).

In this backdrop, the country has committed, according to the macroeconomic framework agreed upon with the IMF, as a part of the Standby Agreement in 2008 to increase the tax-to-GDP ratio to 14.2 percent by 2013-14, which implies a jump of almost four percentage points in the ratio. This is expected to help in bringing the fiscal deficit down from over 7 percent of the GDP in 2007-08 to about 2 percent by 2013-14.

Greater emphasis is being placed on budget deficit reduction in order to contain the rate of inflation and restore a measure of fiscal sustainability. But the continuing fall in the tax-to-GDP ratio has made this task increasingly difficult, necessitating sharp cutbacks in public expenditure, especially on development, thereby affecting the growth momentum of the economy. Also, lack of development of basic economic infrastructure has manifested itself in critical shortages which have limited private economic sector activity also. A stark example of this is the increase in power outages which according to a recent study by IPP [2009] has cost the economy Rs. 210 billion in 2007. On top of this, the falling share of divisible pool taxes in the GDP has implied lower growth in intergovernmental transfers to the provincial governments, leading to a loss of dynamism in social sector expenditures.

The objective of this paper is to explore possibilities of Pakistan getting out of the low tax-to-GDP trap and coming close to achieving the target agreed with the IMF by 2013-14. We start by reviewing in Section 2 the overall and individual trends in tax-to-GDP ratio. This is followed in Section 3 by a decomposition of the factors contributing to the change in tax-to-GDP ratio in different periods. Section 4 presents estimates of the revenue potential and Section 5 highlights the key elements of the future resource mobilization strategy. Finally, Section 6 summarises the key conclusions.

2. TREND IN THE TAX-TO-GDP RATIO

The overall and individual tax-to-GDP ratios during the last twenty years are given in Table 1. The aggregate tax-to-GDP ratio has generally shown a declining trend, with a fall of over one percent of the GDP during the period. Simultaneously, there have been major changes in the taxation structure. The importance of customs and excise duties has declined while that of income and sales taxes has increased.

	Direct Taxes	Customs Duty	Sales Tax	Central Excise Duty	Indirect Taxes	Total FBR Taxes	Surcharges	Total Federal Taxes	Total Provincial Taxes	Total Taxes
1990-91*	1.49	4.89	1.50	2.07	8.46	9.95	1.01	10.96	0.51	11.47
1994-95*	2.74	3.45	1.94	1.94	7.33	10.07	0.92	10.99	0.50	11.49
1999-2000	2.95	1.61	3.05	1.46	6.12	9.07	1.02	10.09	0.47	10.56
2004-05	2.82	1.78	3.67	0.82	6.26	9.08	0.41	9.49	0.45	9.94
2006-07	3.85	1.52	3.57	0.82	5.91	9.76	0.74	10.50	0.42	10.92
2007-08	3.77	1.47	3.76	0.82	6.05	9.82	0.34	10.16	0.40	10.56
2008-09	3.47	1.16	3.55	0.91	5.62	9.09	0.99	10.08	0.36	10.44
2009-10	3.60	1.10	3.50	0.80	5.40	9.00	0.80	9.80	0.40	10.20

* The GDP has been increased by 20.6% following the rebasing of national income accounts
Source: FBR Year Book
Pakistan Economic Survey
IMF Staff Reports

Since the early 90s, Pakistan has been engaged in a process of trade liberalization as the emphasis in development strategy shifted from import substitution to export promotion. Consequently import tariffs have been scaled down gradually from initially very high levels to a maximum tariff of 25 percent currently, with a number of slabs reflecting cascading of the tariff structure. The average effective rate of duty on imports was 30 percent in 1990-91, which has fallen below six percent by 2009-10.

The implication of the tariff reforms is a major decline in the tax-to-GDP ratio of import duty from almost five percent to just over one percent of the GDP over the last twenty years. This was bound to exert a strong downward pressure on the overall tax-to-GDP

unless complementary reforms were undertaken to raise the tax-to-GDP ratio of other taxes.

Major reforms have, in fact, been undertaken in direct taxes. During the early to mid-90s an elaborate withholding /presumptive tax regime was put in place. Beyond the typical deductions at source of wage /salary income, unearned capital income was brought into the tax net. Deductions at source were introduced on income from bank deposits, securities, national saving schemes, dividends, house rentals, etc. In addition, withholding taxes in the form of advance taxes were introduced on proxies of income like electricity, telephone and gas bills, cash withdrawals from banks, car sales, etc. Today, as many as eleven sections of the Income Tax Ordinance relate to withholding taxes.

This regime of withholding/presumptive taxes has not only simplified the tax system and eliminated the discretion of tax officials, it has also contributed significantly to higher revenues. The direct tax-to-GDP ratio has increased by over two percent of the GDP. Although some of the impositions like the presumptive taxes on importers and contractors have been considered as regressive in character, there is no doubt that deductions at source from capital income have contributed to a more progressive tax system by reducing the extent of tax evasion.

The other area of reform is in the sales tax. The Sales Tax Act of 1990 embodied elements of value added tax. The tax base was broadened initially to cover more goods like petroleum products, electricity and gas. Subsequently, a number of large and rapidly growing services like telecommunications were brought into the tax net. The standard tax rate has also been enhanced from 12.5 to 15 percent and then to 16 percent. The result is that over the last two decades the sales tax-to-GDP ratio has increased by two percentage points.

Surcharges on petroleum products and natural gas have been a variable source of revenue. In the case of the former they have acted as a cushion between domestic and international prices. Therefore, when the global oil prices have risen the yield from the surcharge has been less. In good years with relatively low import prices of POL products the overall revenue from surcharges has approached one percent of the GDP. In an effort to reduce variability, the Government in 2008-09 has introduced the concept of the 'carbon tax'. Fixed specific taxes per litre have been levied on each petroleum product.

Overall, it is clear from the above description that the loss of revenue from the process of trade liberalization involving reduction in import tariffs has only been partly compensated for by reforms in direct and sales taxes. This raises the fundamental question about the sequencing and pace of tax reforms in the country. It also raises the question of partial success of tax reform in Pakistan.

While the above examples illustrate success in the reform effort, there have also been some failures. From 1998-99 onwards, under the ESAF program emphasis was placed on development of Agricultural Income Tax to extend the income base to agricultural sector and thereby reduce horizontal inequity. It was expected that the move will yield revenue of about 0.3 percent of GDP, equivalent to Rs. 40 billion at current GDP. Legislation was drafted accordingly. However, the tax was imposed in a half hearted manner which now yields revenue of about Rs.1.5 billion only. The tax reform has been a victim of lack of political will to tax the big landowners in the country.

Another such reform was introduced in the IMF standby facility of 2000-01, which involved efforts at extending the general sales tax to retailers (about the threshold level of Rs 5 million). A Tax Survey was undertaken but the exercise was abandoned due to street protest by traders. Effective broad basing was also rendered difficult by the absence of adequate documentation in the economy. In another effort under the Poverty Reduction and Growth facility (PRGF) for 2001-02 to 2003-04, the tax-to-GDP ratio was to be raised from 10.5% in 2000-01 to 14.3% by 2003-04. The actual ratio in 2003-04 was, in fact, somewhat lower at 10.3%.

Pasha (1997) while analyzing the factors behind the success and failure of tax reforms in the 90s states that the political economy of reforms alongwith governance capacity play a key role. He demonstrates that while a government can meet with exceptional success in some areas it can fail in others, depending primarily on the political will and governance capacity displayed in implementing each reform. For example, the first Nawaz Sharif government achieved notable success in extending the network of withholding and presumptive taxes within the income tax system because a number of favorable factors came together. These included the projection of the particular reform as an integral part of the government's vision of change, demonstration of superiority of the reform over the available actions, building of a strong and diversified coalition of support, strong leadership from the top, by passing of and credible threats to losers, lack

of homogeneity of losers and spectacular initial success of the reforms in raising revenue.

In contrast to this, elimination of tax concessions and exemptions, to make the income tax system more neutral and fair, floundered because of a low level of commitment to the reform on the part of agents of state, state capture by special interest groups, lost opportunities for bargaining with potential losers, strong organization and lobbying power of losers, lack of information with gainers and launching of a successful campaign by potential losers that the status quo is actually in everybody's interest.

Similarly, the partial retreat from implementation of reforms in the general sales tax reveals how an effective coalition of potential losers can be organized (with street agitation) in the presence of weak support for the reforms due to the dispersed, uncertain nature and uneven distribution of gains and agents of state with some lack of vision, commitment and preparedness for the reforms. These lessons are important to remember before the country embarks on the impending reform process.

3. DECOMPOSITION OF CHANGES IN THE TAX-TO-GDP RATIO

We attempt now to decompose the change observed in the tax-to-GDP ratio for individual taxes collected by the FBR and in the tax system as a whole. We are interested, in particular, in isolating the 'base' and 'rate' effects respectively. The former essentially identifies to what extent the change in tax-to-GDP ratio is due to change in the ratio of the tax base to the GDP. That is, if the tax base of a tax is stagnant / buoyant in relation to the GDP then the 'base' effect will be negative/positive, implying other things being equal, a fall/rise in the tax-to-GDP ratio.

The 'rate' effect is meant to primarily capture the change in the 'effective' tax rate on the tax base. Effective rates can change either if statutory tax rates are altered or if, given unchanged statutory rates, there is an increase in exemptions or a change in the efficiency of tax collection. For example, if statutory rates fall, as happened in the case of import duty then the 'rate' effect will be negative.

The methodology for attributing any change in the tax-to-GDP ratio to the 'base' and 'rate' effects respectively is described below.

We designate the following:

T = actual tax revenue
t = effective tax rate
B = tax base
Y = GDP

That is, $T = tB$

Subscripts 0 and 1 designate the base and terminal years respectively

The change in the tax-to-GDP ratio is given by

$$\begin{aligned} \frac{T_1}{Y_1} - \frac{T_0}{Y_0} &= \frac{t_1 B_1}{Y_1} - \frac{t_0 B_0}{Y_0} \\ &= \frac{t_1 B_1}{Y_1} - \frac{t_0 B_0}{Y_0} + \frac{t_1 B_0}{Y_0} - \frac{t_0 B_0}{Y_0} \end{aligned}$$

That is,

$$\frac{T_1}{Y_1} - \frac{T_0}{Y_0} = t_1 \left[\frac{B_1}{Y_1} - \frac{B_0}{Y_0} \right] + \frac{B_0}{Y_0} [t_1 - t_0] \text{ ----- (1)}$$

← *base effect* → ← *rate effect* →

Equation (1) gives the expressions for the base and rate effects respectively.

Results of the decomposition analysis are presented in Table 2. The striking conclusion is that during the last two decades the overall ‘rate’ effect has been negative while the ‘base effect’ has been positive. It appears that the tax-to-GDP ratio of Pakistan has not been held back by slow growing tax bases but more by a policy of reduction in statutory tax rates and/or by exemptions on existing tax bases.

As highlighted in the previous section, the decade of the 90s witnessed a substantial scaling down in import tariffs. Table 2 indicates that this alone is responsible for a fall of over four percentage points in the tax-to-GDP ratio. The contribution of direct tax reforms described above appears to be substantial in terms of contributing to a positive ‘rate’ effect of almost two percent of GDP.

The sharp contrast between the large negative ‘rate effect’ and positive ‘base effect’ is vividly illustrated for the last decade. This was a period of relatively fast growth and the primary tax bases of the economy, viz., manufacturing, banking and insurance, transport and communications and imports, showed extraordinarily rapid growth. This should have led to an increase in the tax-to-GDP ratio, but this did not happen because of the policy of bringing down statutory tax rates and granting of more exemptions.

TABLE 2 DECOMPOSITION OF CHANGES IN TAX-TO-GDP RATIO (Taxes Collected By FBR)			
Tax	Change in Tax-to- GDP Ratio	Base* Effect	Rate Effect
1989-90 to 2000-01			
Direct Tax	1.9	0.2	1.7
Excise Duty	-1.1	-0.4	-0.7
Customs Duty	-4.0	0.1	-4.1
Sales tax	2.6	1.3	1.3
Total	-0.6	1.2	-1.8
1999-2000 to 2009-10			
Direct Tax	0.6	1.0	-0.4
Excise Duty	-0.7	0.2	-0.9
Customs Duty	-0.5	0.3	-0.8
Sales tax	0.5	1.0	-0.5
Total	-0.1	2.5	-2.6
<p>* The tax bases for individuals tax are as follows: Direct taxes: non-agricultural GDP Excise Duty: large-scale manufacturing Customs Duty: Imports Sales Tax: Imports + Custom Duty + large-scale manufacturing +transport and communications+ electricity and gas Source: Pasha et al [2009]</p>			

From 2001-02 to 2007-08, as more fiscal space was created by larger aid inflows and debt rescheduling, there appears to have been a visible slackening of the fiscal effort and resort to the ‘supply-side economics’ of stimulating growth by tax cuts. The first step was the abolition of the wealth tax. This was followed by sharp reductions in tax rates. The corporate income tax rate was brought down for private limited companies from 40 percent to 35 percent and for banks from 58 percent to 35 percent. The maximum personal income tax rate for salaried earners was reduced from 35 to 20 percent and for the self-employed to 25 percent. Some withholding tax rates, for example, on importers were also scaled down.

Simultaneously, a number of significant exemptions were also granted. The entire domestic sales of six export oriented sectors, including textiles, were zero rated from sales tax. Agriculture inputs and machinery were also given sales tax exemption. Excise duties were withdrawn from a number of industries. The jump in private investment was not reflected in higher revenues due primarily to the presence of accelerated depreciation allowances and tax holidays. The boom in the stock market and the enormous capital gains realized were not translated into revenues due to the continued exemption of the capital gains tax on shares.

The slackening in the quality of tax administration is indicated by the lack of growth in the number of tax payers, which remained at about two million. The introduction of the universal self-assessment scheme was not accompanied by a strengthening of the audit process. During the 90s, collections from demand following audit used to account for over 20 percent of revenues, which fell to below 10 percent by 2004-05.

A similar story is repeated in the case of provincial governments. Their combined tax-to-GDP ratio has languished at below 0.5 percent of the GDP. Given the overwhelming dependence on transfers from the federal governments, they have had little or no incentive to develop their own tax system. During the last decade there was an explosion in property values but this did not yield a rapid growth in provincial revenues from stamp duty and the property tax.

Overall, during the last decade a historic opportunity for achieving a significant jump in tax revenues in a period of fast economic growth was lost. The above analysis shows that if somehow the negative 'rate' effects could have been avoided Pakistan's tax-to-GDP ratio could have been almost 2.5 percentage points higher, at close to 13 percent of the GDP. In the same period, with fast economic growth, India's tax-to-GDP ratio increased by over 3 percentage points, with income and corporation taxes contributing 71 percent of this increase.

4. ESTIMATES OF REVENUE POTENTIAL

The Minh Lee [2008] has applied the 'representative tax system' approach to estimate the tax revenue potential in a sample of developing countries, including Pakistan. The taxable capacity of a country is estimated on the basis of the per capita GDP, age dependency ratio, degree of trade openness, share of agriculture in the GDP, and institutional structure, measured by the corruption index and quality of the bureaucracy.

The authors classify countries into four categories on the basis of the level of taxable capacity and actual fiscal effort. Pakistan is in the category of countries with relatively low taxable capacity and moderate tax effort. As such, the study concludes that with its present structure the tax-to GDP ratio of Pakistan could be about 2.5 percentage points higher. Interestingly, this gap could have been eliminated if, as highlighted above, there had been no negative 'rate' effects on the tax-to-GDP ratio.

Another way of looking at the revenue potential is to quantify the revenue foregone due to tax exemptions and concessions, sometimes also referred to as 'tax expenditures'. These expenditures are usually justified on the grounds that they promote particular social or economic goals. They include special tax relief (through deductions, credits, exemptions, etc.) to encourage certain types of behavior by tax payers on support tax payers in special circumstances. Of course, some such concessions find their basis not only in economic rationale but are offered under pressure from strong local lobbies and vested interest groups. The most dramatic example of this is the continued exemption of capital gains from income taxation especially at a time when massive unearned incomes were accruing in the economy to the relatively well-off, due to the exceptional buoyancy of the stock market and of property values. The Pakistan Economic Survey [2006-07] has shown that the exemption of capital gains on stocks from income taxation and other concessions cost the economy over Rs 123 billion, as shown in Table 3. Other exemptions include import duty exemptions on import of sugar, machinery and other items like pharmaceuticals and tractors etc. The table shows the sharp increase in the cost of these exemptions to the economy.

	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07
Income Tax	11.20	10.20	6.80	6.15	4.60	4.65	123.07
Sales Tax	13.20	8.60	10.39	9.25	7.85	8.65	12.00
Custom Duties	6.20	5.42	4.71	4.40	12.38	8.21	50.52
Central Excise	0.50	0.50	0.01	0.00	0.02	0.40	0.50
Total	31.20	24.72	21.91	19.80	24.85	21.91	186.09
* Only a partial coverage of exemptions/concessions, reported by the Government Source: Pakistan Economic Survey, 2006-07							

The list of exemptions can be extended to include accelerated depreciation allowances, lack of coverage of sales tax on wholesale and retail trade, effective exemption of a large number of services from GST, zero-rating of domestic sales of export-oriented sectors, etc. If all these concessions and erosions of the tax base are accounted for then the aggregate tax expenditure in the federal tax system could reach a whopping Rs 450 billion or so according to Pasha [2010]. This equals to almost 3 percent of the economy and over one-thirds of revenues actually collected. In particular, extension of the GST to comprehensively cover services could raise revenues by 1.5 percent of the GDP, as estimated by Ghaus-Pasha [2010].

Therefore, we have the basic conclusion that the tax-to-GDP ratio could be raised by upto three percentage points by reforms in tax administration and changes in tax policy, particularly related to the withdrawal of exemptions and concessions. The next section describes the key elements of the future resource mobilization strategy.

5. RESOURCE MOBILIZATION STRATEGY

What should be the resource mobilization strategy that Pakistan should follow to boost its revenues given the current state of the economy and political setup. While the principal objective of the strategy should be to mobilize more resources for the public exchequer, it is essential that the design of reform be such that revenues are generated in a way that the burden of taxes is not on the lower income groups and do not significantly add to the inflationary pressures already burdening the common man in the country. Also, the objective of the resource mobilization strategy should be to eliminate the horizontal inequities prevailing in the taxation structure. This will be achieved if hitherto 'untaxed' or 'undertaxed' sectors are brought into the tax net.

We believe that the design of such a strategy should have three pillars:

1. Reform of the current general sales tax (GST)
2. Improvement of direct/ income tax administration
3. Enhancement in the provincial tax-to-GDP ratio

Reform of Current GST: The linchpin of the reform effort should be the introduction of a comprehensive and integrated VAT to cover goods and services, replacing the current GST in existence in Pakistan since 1990. This is expected to not only raise substantial additional revenues but also distribute the tax burden more evenly across sectors. Also,

contrary to general perceptions, this will contribute towards greater progressivity of the tax system of Pakistan.

VAT is currently operating in over 130 countries, including developing countries like Sri Lanka and Bangladesh. Its popularity is due to its non-discretionary character and high revenue productivity. In virtually all countries it covers both goods and services. In the Pakistani context VAT or reformed GST will essentially be an expansion of current GST to cover services and exempt and zero-rated sectors. Therefore, it will broaden the tax base while reducing the burden on the goods and services which are currently taxed at a rate ranging from 16 ½% to 21% down to the standard VAT rate of 15%.

The regressivity of VAT will be minimized by exempting basic items, particularly those consumed by the lower income segments of the population, like unpackaged cereals, dairy products vegetables, etc. Also, the major revenue gain from the tax would be from the expansion in coverage of services. Analysis undertaken by Ghaus-Pasha (2010) of the distribution of consumption expenditure on services by households reveals an increase from about 19 percent in the case of the lowest income quintile to about 27 percent for the highest quintile. There is no break in this pattern for households in the middle income quintiles also. Therefore, it can be concluded that the incidence of VAT on services is likely to be mildly progressive. To the extent that bulk of the additional burden of VAT is due to its extension to the services sector, clearly the additional incidence of the tax is not likely to be regressive, as argued by its opponents Major revenue contribution is likely to come from communications, retail trade, railways and scheduled and cooperate banks.

Improvement in Direct/Income Tax Administration: Improvement in tax administration to achieve a more functional and integrated tax system, for detecting under-filers and non-filers of tax returns, is essential. In 2009-10 it is estimated that from companies registered with FBR, half filed a tax return and from among those who filed returns, two-thirds declared either negative or zero taxable income. Therefore, only one-sixth declared a positive taxable income. As an interim measure, an alternative minimum tax under Section 113 of the income tax ordinance 2001 has been introduced.

The report of the Panel of Economists (2008) has also made a strong case for conversion of presumptive to minimum tax and for extension of capital gains tax to include shares and properties. Some movement on both these fronts has already been

initiated by the governments, in the last two Finance Bills. However, it remains to be seen how serious an effort will ultimately be made to bring these two sectors effectively into the tax net.

Enhancement in Provincial tax-to-GDP Ratio: Currently, the four provinces combined are generating less than half a percent of GDP as own revenues. This ratio has remained stagnant for a number of years and, in fact, has fallen down from one percent of the GDP in the early 80s. There is a real danger of further slackening of the provincial fiscal effort following the 7th National Finance Commission Award, which has increased the share of provincial transfers to 57 ½% of the total divisible pool. It is important that the provinces fully exploit their revenue potential to improve the level of service provision and to not substitute own revenue by federal transfers.

Given the current allocation of fiscal powers, provinces have two promising revenue sources under their fiscal jurisdiction---agricultural income tax (AIT) and urban immovable property tax. Currently, the AIT generates less than Rs 1.5 billion in revenues. Today, major crops (wheat, rice, cotton etc) receive world prices with subsidized inputs like fertilizer, water and electricity. Therefore, the conventional argument given against the levy of agricultural income tax of disguised taxation is no longer valid. It is important to realize that the inability of government to effectively tax agricultural income symbolizes a major source of horizontal inequity in the tax system, resulting in overall lower tax compliance. A case can be made for the levy of a presumptive tax at the marketing stage of crops at a small rate of 2 to 3 percent. In addition, the AIT can be collected as a presumptive income tax on land holding.

Likewise, proper development of the property tax can also yield significant revenues. Currently the tax mobilizes only about one-fifths of its potential. Proper assessment of rental values, broadening of the tax base through withdrawal of exemptions and expansion of rating areas are among the measures which need to be taken. Our estimates indicate that the above reforms can almost double the rate of revenue mobilization at the provincial level.

Overall, the resource mobilization proposals recommended in this paper can potentially enhance the tax-to-GDP ratio significantly in the medium run. The proposals will not be significantly inflationary in character and will contribute to the progressivity of current taxation structure making it more broad-based and balanced.

6. KEY CONCLUSIONS

Pakistan's low tax-to-GDP ratio is a story of some success and some failure in tax reform. It appears that the country has been able to only partially compensate for the loss of revenue resulting from the trade liberalization process initiated almost two decades ago. In particular, the country lost an historic opportunity for achieving a significant jump in tax revenue in a period of fast economic growth during the last decade. While arguing that a breakthrough in tax mobilization until and unless we achieve a high GDP growth rate is ambitious the paper concludes that continued effort at resource mobilization can yield some success even in a period of economic slowdown.

The way forward presented in the paper is the implementation of a resource mobilization strategy which has three pillars: expansion of the current GST to cover services and exempt and zero-rated sectors; improvement of direct/income tax administration; and enhancement in the provincial tax- to-GDP ratio. These measures will constitute the first step at bringing the country out of low tax-to-GDP trap. However, the success will crucially hinge on the political will to bring improvements in tax administration, adopt rational tax policies and promote higher tax compliance.

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MATHEMATICAL EQUATIONS

$$\begin{aligned}\frac{T_1}{Y_1} - \frac{T_0}{Y_0} &= \frac{t_1 B_1}{Y_1} - \frac{t_0 B_0}{Y_0} \\ &= \frac{t_1 B_1}{Y_1} - \frac{t_0 B_0}{Y_0} + \frac{t_1 B_0}{Y_0} - \frac{t_0 B_0}{Y_0}\end{aligned}$$

That is,

$$\frac{T_1}{Y_1} - \frac{T_0}{Y_0} = t_1 \left[\frac{B_1}{Y_1} - \frac{B_0}{Y_0} \right] + \frac{B_0}{Y_0} [t_1 - t_0] \text{ ----- (1)}$$