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PERSPECTIVES ON OPTIMAL TAX-GDP RATIO USING LAFFER CURVE ANALYTICS: INDIA'S ANCIENT WISDOM ON TAXATION

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Abstract: This article looks at the issue of determining optimal tax-GDP ratio for a country both from an analytical and empirical viewpoint. It constructs an underlying analytical framework broadly following the logic of the Laffer curve to enunciate parametric assumptions under which the effective tax rate, that is, the tax-GDP ratio would lie in a narrow range of 16.67% to 25%. We reviewed the tax-GDP ratios of 192 countries to highlight that nearly 68% of the countries have, in modern times, an effective tax rate in the range of 10-25%. We have also brought together enunciated principles of taxation and prescribed tax rates from India's ancient literature to argue that in their case also the prescribed tax rate is in the range of 16.67% to 25%. Under certain parametric assumptions, the rate of 16.67% corresponds to a point of inflexion in the tax rate-revenue function and 25% is the base maximizing rate.

Keywords: Laffer Curve, tax-GDP ratio, optimal tax rate, revenue-maximizing tax rate, base-maximizing rate, government revenues, Kautilya's Arthashastra, India's ancient texts

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1. INTRODUCTION

The idea of an inverse relationship between tax rates and tax revenues beyond a threshold has been present in the literature from ancient times. Although in modern times, this idea is summarily referred to as the Laffer curve, its foundations are present in India's ancient literature as well as in Adam Smith's 'Wealth of Nations' (1776) and Dupuit (1844) which is cited in Fullerton (1982). Many attempts have been made in the literature to apply the idea of an inverse relationship between tax rate and tax base in the context of individual taxes as well as for the entire economy including developing a general equilibrium framework. In this paper, we attempt to generalise the ideas of a Laffer curve that can throw light on developing optimal schemes of taxation.

Section 1 makes introductory observations including the idea of a threshold while considering responses of tax revenues to tax rate changes generally referred to as the Laffer curve. Section 2 provides a survey of literature in terms both of analytical and empirical contributions regarding the trade-off between tax rates and tax revenues. Section 3 examines properties of a symmetric Laffer curve which may be called its textbook shape and compares its properties with those of a quadratic tax base function. It is argued in this section that the textbook shape of the Laffer curve does not give rise to a size of output that is higher than the output that can be produced in the absence of government implying that in these cases taxation is not required at all. Section 4 develops a general equilibrium framework using the quadratic tax base function and utilizes this framework to determine the total output, total tax revenues and the distribution of total output into public and private sectors along with the determination of an optimal tax rate in the presence of a community indifference curve. Section 5 gives some contemporary cross-country evidence as to the range of preferred tax-GDP ratios that characterise modern economies. Section 6 summarises some prescriptions drawn from India's ancient literature regarding the principles of taxation and a set of prescribed tax rates and their implications. These tax rates are interpreted in the framework for the rate revenue relationship analysed in section 4. Section 7 provides concluding observations.

2. LITERATURE SURVEY

The literature on the Laffer curve explores how tax rates shape revenue performance and economic growth across countries. Cross-country analyses highlight the impact of corporate and personal taxation on growth, while model-based studies estimate revenue-maximizing rates for labour, capital, and consumption taxes in advanced economies. More recent research extends these frameworks to incorporate informality, institutional quality, and compliance, explaining the limited fiscal capacity of emerging markets. In the Indian context, studies emphasize that administrative inefficiencies and narrow tax bases rather than high rates constrain revenues, suggesting that base broadening and stronger enforcement are more effective than simple rate adjustments. Findings of a set of selected studies are highlighted below.

Lee and Gordon (2005) empirically investigate how different types of taxes influence long-run economic growth across countries, using a panel dataset covering 70 nations from 1970 to 1997. The study distinguishes between the effects of corporate income taxes and personal income taxes on GDP growth. Employing both cross-sectional regressions and country fixed-effect models, they control for standard growth determinants such as initial income, education, openness, and inflation. The results show a strong and robust negative relationship between statutory corporate tax rates and average economic growth, even after accounting for other policy variables, whereas personal income tax rates display no consistent or significant effect. Quantitatively, they estimate that a 10% points reduction in the corporate tax rate is associated with a 1-2% point increase in the annual GDP growth rate.

Clausing (2007) examines cross-country variation in corporate income tax revenues relative to GDP among OECD countries over 1979-2002. Using a decomposition framework, the study relates revenue differences to statutory tax rates, tax-base breadth, profitability in the corporate sector, and the share of the corporate sector in GDP. The empirical results reveal a parabolic (inverted-U) relationship between statutory tax rates and corporate tax revenues, with an estimated revenue-maximising rate of about 33% for the full sample. Smaller, more globally integrated economies, however, show a lower optimal rate due to mobility and profit-shifting considerations.

Trabandt and Uhlig (2011) re-examine the shape and revenue implications of Laffer curves for the United States, the EU-14, and individual European economies using a neoclassical growth model with constant Frisch elasticity (CFE) preferences. The study introduces new, harmonized tax rate data for labour, capital, and consumption taxes and computes steady-state Laffer curves for each. The study finds that the U.S. could raise tax revenues by up to 30% through higher labour taxes and by 6% via higher capital taxes before reaching the revenue-maximizing peak, whereas the EU-14 economies could raise only 8% and 1%, respectively, indicating that Europe operates closer to the top of the curve. In contrast, consumption taxes show no revenue-maximizing peak, implying room for further increases without revenue loss. The analysis also shows that 54% of a labour tax cut and 79% of a capital tax cut in the EU-14 are self-financing, highlighting stronger behavioural responses than in the U.S. Further, the authors test model extensions and find that endogenous growth and human capital accumulation affect the magnitude of results, while household heterogeneity is less critical, but transition dynamics, that is, how economies adjust to new tax rates, play a major role.

Extending the work in 2011, Trabandt and Uhlig (2012) compares Laffer curves across the US and EU-14, incorporating monopolistic competition, refined tax data, and human capital accumulation to better capture fiscal dynamics. Using data from 1995 to 2010, the study shows that by 2010, most countries had moved much closer to the peak of their labour tax Laffer curves, leaving limited scope - only about one-third to one-half - for further tax-based revenue expansion. The authors also estimate the interest rate that these economies can sustain if only labour taxes are adjusted to service the additional government debt burden. The model estimates that, if only labour taxes were raised, the US could sustain real interest rates of 12-15.5%, Ireland about 11.2%, while many EU economies could sustain only 4.4-7.1%. Allowing both labour and capital taxes raises this modestly to around 6.5%. Once human capital effects are introduced, sustainable rates fall further to about 5.8-6.6% for the US and 4-4.9% for most EU countries. For consumption taxes, potential revenue gains shrink sharply from 40-100% of GDP in the baseline to 10-30% when accounting for human capital, indicating that while tax increases can still raise revenue marginally, the negative output and incentive effects sharply constrain long-term fiscal space.

Kalra and Gupta (2025) develop a theoretical Laffer curve model to explain why emerging market and developing economies (EMDEs) collect less tax revenue relative to GDP than advanced economies. Using a closed-economy neoclassical growth framework with heterogeneous households and endogenous tax compliance, the study incorporates two key EMDE features namely, a large informal sector and weak institutional quality, to simulate revenue outcomes at the balanced growth path. Their results show that expanding the tax base by formalizing non-filing households could increase labour and capital tax revenues by over 50%, while improving institutional quality through stronger audit mechanisms could raise revenues by 17% and 23%, respectively. Increasing penalties on evasion yields smaller gains of 2% (capital tax) and 3.5% (labour tax) and fostering better tax compliance norms adds 11% and 14% respectively. The study concludes that EMDEs' fiscal weakness stems primarily from informality and poor enforcement, emphasizing that institutional reform and base broadening, rather than higher rates, are the most effective strategies for sustainable revenue enhancement.

Alba and McKnight (2022) examine how large informal sectors constrain fiscal capacity in developing countries. Using a two-sector neoclassical growth model incorporating both formal and informal production, the authors calibrate the model for Brazil, Chile, Colombia, Mexico, and Peru to quantify how informality shapes the Laffer curves for labour, capital, and consumption taxes. Results show that the elasticity of substitution between formal and informal goods critically determines fiscal potential. With realistic parameter values, informality sharply limits revenue gains: under labour taxation, Chile can increase revenues by only 11%, Brazil by 6% (through a tax cut), while Colombia, Mexico, and Peru have even narrower ranges. Under capital income taxation, the fiscal space is minimal—below 4% in all countries. For consumption taxes, Mexico and Chile can raise revenues by 8% and 3%, respectively, while others achieve less than 1%. An iso-revenue analysis further indicates that to maximize overall tax receipts, Latin American governments should prioritize higher labour and consumption taxes while reducing capital income taxes, reflecting the strong revenue constraints imposed by widespread informality.

In the Indian context, Bahl and Bird (2008) provide a historical account of India's tax reforms, noting that post-1991 liberalization base-broadening measures and rationalization of rates (particularly in income and corporate taxes) shifted the fiscal system toward greater buoyancy. Their analysis implied that India remained on the ascending segment of the Laffer curve, as moderate rate reductions were often accompanied by revenue gains through improved compliance. Chakraborty (1997) tests the Laffer curve hypothesis for India using time-series data from 1950-51 to 1994-95. Employing regression and elasticity analysis between statutory tax rates and revenue-to-GDP ratios, the study assesses whether tax cuts could raise revenues. The results show no evidence that India was on the downward-sloping side of the Laffer curve. Instead, weak revenue performance stemmed from administrative inefficiencies, exemptions, and a narrow tax base rather than high rates. The study concludes that rate reductions alone cannot enhance revenues without parallel improvements in tax compliance and base broadening. Ebrill (1987), considering the cases of Jamaica and India, finds that in developing countries with narrow tax bases and enforcement limits, the revenue-maximizing tax rate is relatively high, and rate reductions alone are unlikely to raise revenues without broader structural reforms.

As discussed above many of these studies relate to individual taxes. There are hardly any studies that address the question as to what should be the appropriate level of the overall effective tax rate that may be proxied by the overall tax-GDP ratio. In this analysis, we argue that the focus needs to be on the maximization of tax base, that is, the output and not on maximization of tax revenue. Optimal allocation of output between public and private sectors would be welfare improving. Cross country evidence covering 192 countries show an overwhelming preference for keeping the tax-GDP ratio well below the revenue maximizing point and close to the rate consistent with the tax base maximization. We compare analytical results with the prescriptions drawn from India's ancient literature on taxation and highlight that India's current tax-GDP ratio is aligned with the recommendations drawn from its ancient literature which seem to have timeless properties.

3. SYMMETRIC AND QUADRATIC TAX BASE FUNCTIONS

We start with consideration of a textbook kind of Laffer curve which is perfectly symmetrically shaped as an inverted parabola as depicted in Chart 1. The X-axis shows values of the tax rate (r), that is, tax revenues as a proportion of the tax base. It ranges from 0 to 1. On the vertical axis, tax revenues are given.

In general, the tax base is considered to be the overall output or GDP (Y) of the economy. If total revenues are represented by R, then it is the proportion R/Y that is represented on the X-axis while R is represented on the Y axis. Such a Laffer curve must show a zero revenue when the tax rate is zero (r=0) and also when the tax rate is 100% (r=1). This is so because when the tax rate is 100% there is no incentive to produce or earn income and the base goes down to

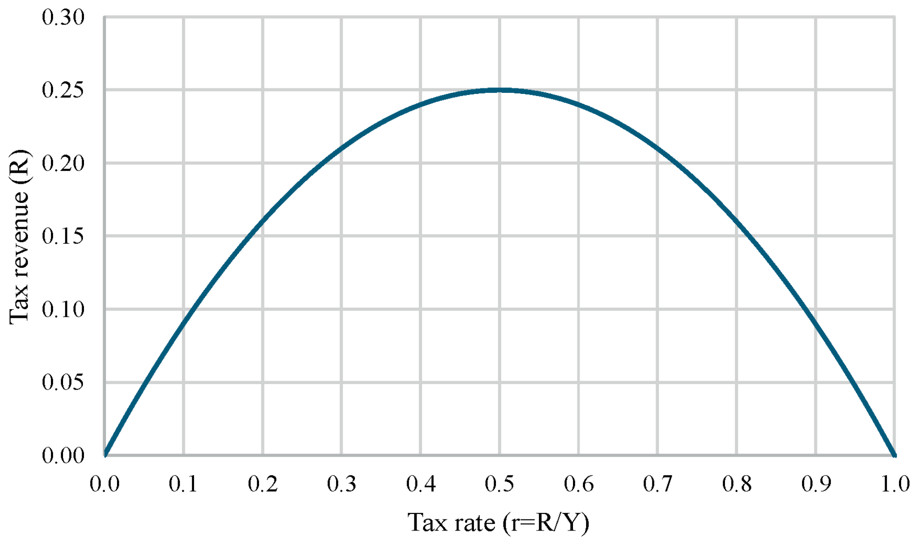

Chart 1: Symmetric Laffer curve

Source: Drawn by authors

zero. Conversely, when tax rate is 0, tax base is 1. The maximum revenue in a symmetric Laffer curve is at the tax rate of 50% and at this point tax revenues, that is, R is 0.25. The underlying production function in such a case can be specified as below.

Consider the production function.

$$Y' = A(1-r) \quad (1)$$

Here A can be considered as the output of the economy when r=0, that is in the absence of taxation which also implies the absence of government.

If A is used as unit of measurement we may write

$$\frac{Y'}{A} = Y = 1 - r \quad (2)$$

In this case total revenue $R = \frac{Y'}{A}.r = Y.r = r.(1-r)$ (3)

Revenue is maximized when the first order condition

$\frac{dR}{dr} = 0$ that is when

$\frac{dR}{dr} = 1 - 2r = 0$, that is when

$r = 0.5$ (4) as shown in Chart 1.

At that point tax base or output

$$Y = (1 - 0.5) = 0.5 \quad (5)$$

This is what gives rise to the symmetric laffer curve. The right hand side of this symmetric laffer curve is called its inefficient side and its left hand side is referred to as its efficient side since when the tax rate changes from 0 to 0.5, the tax revenues keep increasing and when the tax rate increases beyond 0.5, revenues start to fall (Chart 1).

A more general representation of the production function of this family can be written as

$$Y = (1 - r)^k \tag{6}$$

And correspondingly

$$R = r.(1 - r)^k \tag{7}$$

This equation will also satisfy the basic condition that

$$R = 0 \text{ when } r = 0 \text{ or when } r = 1 \tag{8}$$

Chart 2 shows simulated values of the tax base and tax revenues, depicted on the Y-axis, with respect to tax rates shown on the X-axis, that are varied

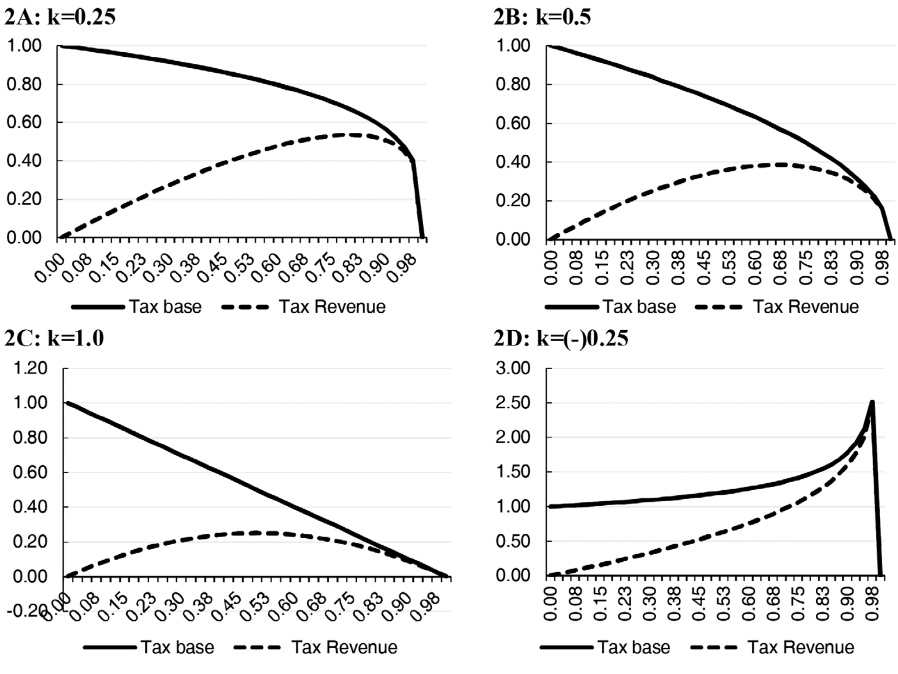

Chart 2: Tax base and tax revenue functions simulated for values of 'k' in equations (6) and (7)

Source: Author's estimates

from 0 to 1. For the purpose of simulation, we have varied the tax rates in increments of 0.025, starting from 0 going upto 1.

In Chart 2A tax base continuously falls and the tax revenue continuously rises as the tax rate increases. Tax revenue reaches a peak at a tax rate of about 0.8 (80%) after which both tax revenue and tax base fall sharply to become zero at tax rate=1 (100%).

In Chart 2B the tax base falls from 1 to 0 and tax revenue rises first, reaches a peak and then falls to 0. The peak of tax revenue occurs at r=0.675. The sharpness of the fall of the tax base is moderate compared to the case when k=0.25.

In Chart 2C the tax base falls from 1 to 0 and tax revenue rises first, reaches a peak at r=0.5 and again falls to 0 at r=1.0. At r=0.5, tax revenue is maximized and is equal to 0.25. This revenue curve is symmetric on both sides of the revenue maximizing point and provides an illustration of the textbook laffer curve as discussed earlier.

In Chart 2D, the value of k is negative. As the tax rate increases, the tax base also increases. Further, the tax base increases at a very high rate after it has reached a high level of 0.80. After it reaches a tax rate close to 1.0, the base suddenly drops to 0 from a level of 2.5. This is a case of discontinuity. The possibility of discontinuity is discussed at length in Gahvari (1988, 1989). This case may, at best apply to very selected situations and for individual taxes. It is not relevant for a discussion with reference to the aggregate tax-GDP ratio.

This family of functions is quite unrealistic since in all cases where k>0, the tax base, that is, aggregate output, never rises above the value of 1 which is the value of output in the absence of taxation, that is, in the absence of government. Such a situation involves willingness of people to pay taxes and settle for supply of public goods even if total output is less than what can be provided by the private sector under market forces. For this case there is only a theoretical possibility where due to the problem of free riders the market by itself may underprovide market services. Within this family the case of k<0 is even more unlikely as it involves sharp discontinuities close to tax rates when they reach a level of 100%.

We need more general tax base functions. Consider now, a quadratic function defined as below.

4. A GENERAL EQUILIBRIUM FRAMEWORK: DIAGRAMMATIC REPRESENTATIONS AND SIMULATIONS

Tax base is a quadratic function of r and other variables

$$Z = A + Br - Cr^2 \tag{9}$$

where A, B, C >0

Dividing throughout by A, we get

$$\frac{Z}{A} = 1 + \frac{B}{A}r - \frac{C}{A}r^2 \tag{10}$$

The use of A as a unit of measurement reduces the parameters to two namely β and γ. 'A' can be interpreted as the value of Z when tax rate is 0 from equation (9). This means A is the size of GDP in the absence of taxes, that is, in the absence of government. This may be referred to as the non-government maximum output produced entirely by the private sector under market forces.

$$Y = 1 + \beta r - \gamma r^2 \tag{11}$$

Where $Y = \frac{Z}{A}$, $\beta = \frac{B}{A}$, $\gamma = \frac{C}{A}$

When r = 1 (tax rate = 100%), Y = 0 (tax base = 0). (12)

It can be shown that the output function Y will keep shifting up as the value of β increases.

By imposing this condition (12) we can reduce equation (11) to one parameter, namely β as shown below.

$$0 = 1 + \beta - \gamma \tag{13}$$

Thus,

$$\gamma = 1 + \beta \tag{14}$$

Tax base is redefined as

$$Y = 1 + \beta r - (1 + \beta)r^2 \text{ , } \beta > 0 \tag{15}$$

It can be shown as explained in end note (1) that[1]

$$Y = (1 - r)(1 + r + \beta r), \text{ where } \beta > 0 \tag{16}$$

This shows that when $r = 1$, $Y \text{ (tax base)} = 0$

When $\beta = 0$, equation (16) reduces to:

$$Y = 1 - r^2 \tag{17}$$

In this case Y will always be lower than its maximum value of 1 for any positive values of 'r' which is in the range of 0 to 1, a case that we have already considered as unrealistic since the level of output is less than what can be produced in the absence of government. This is why a condition $\beta > 0$ is relevant so as to enable a level of output even in the presence of government, that is higher than that in its absence, that is, Y>1 even when r>0.

For different values of tax rates, we can simulate equation (15) for given values of β. It would be useful to show the tax base below the X axis and tax revenues above the X axis so that points of interest can be juxtaposed.

Tax revenue is tax rate multiplied by tax base

$$\mathrm{R} = r.Y \tag{18}$$

Using equations (18) and (15) we can write

$$\mathrm{R} = r + \beta r^2 - (1+\beta)r^3 \tag{19}$$

Using equations (18) and (16), equation (19) can also be written as

$$\mathrm{R} = (1 + r + \beta r)(1 - r).r \tag{20}$$

This ensures that $\mathrm{R}\ (\text{tax revenue}) = 0$ when $r = 0\ or\ 1$

Tax base is maximum when (differentiating equation (15))

$$\frac{dY}{dr} = \beta - 2(1+\beta).r = 0 \tag{21}$$

Or,
$$r = \frac{\beta}{2(1+\beta)} \tag{22}$$

and
$$\frac{d^2Y}{dr^2} < 0$$

When $\beta = 1$, the tax rate $r\ (Y_{\max}) = \frac{1}{4}$

The tax revenue maximizing tax rate can be derived by differentiating equation (19) and using the first order condition

$$\frac{dR}{dr} = R' = 1 + 2\,\beta\, r - 3(1+\beta)\, r^2 = 0 \tag{23}$$

Equation (23) can be rewritten as:

$$3(1+\beta)\, r^2 - 2\,\beta\, r - 1 = 0 \tag{24}$$

$$r = \frac{\beta \mp \sqrt{\beta^2 + 3(1+\beta)}}{3(1+\beta)} \tag{25}$$

Negative sign after β in the numerator is not relevant. Therefore

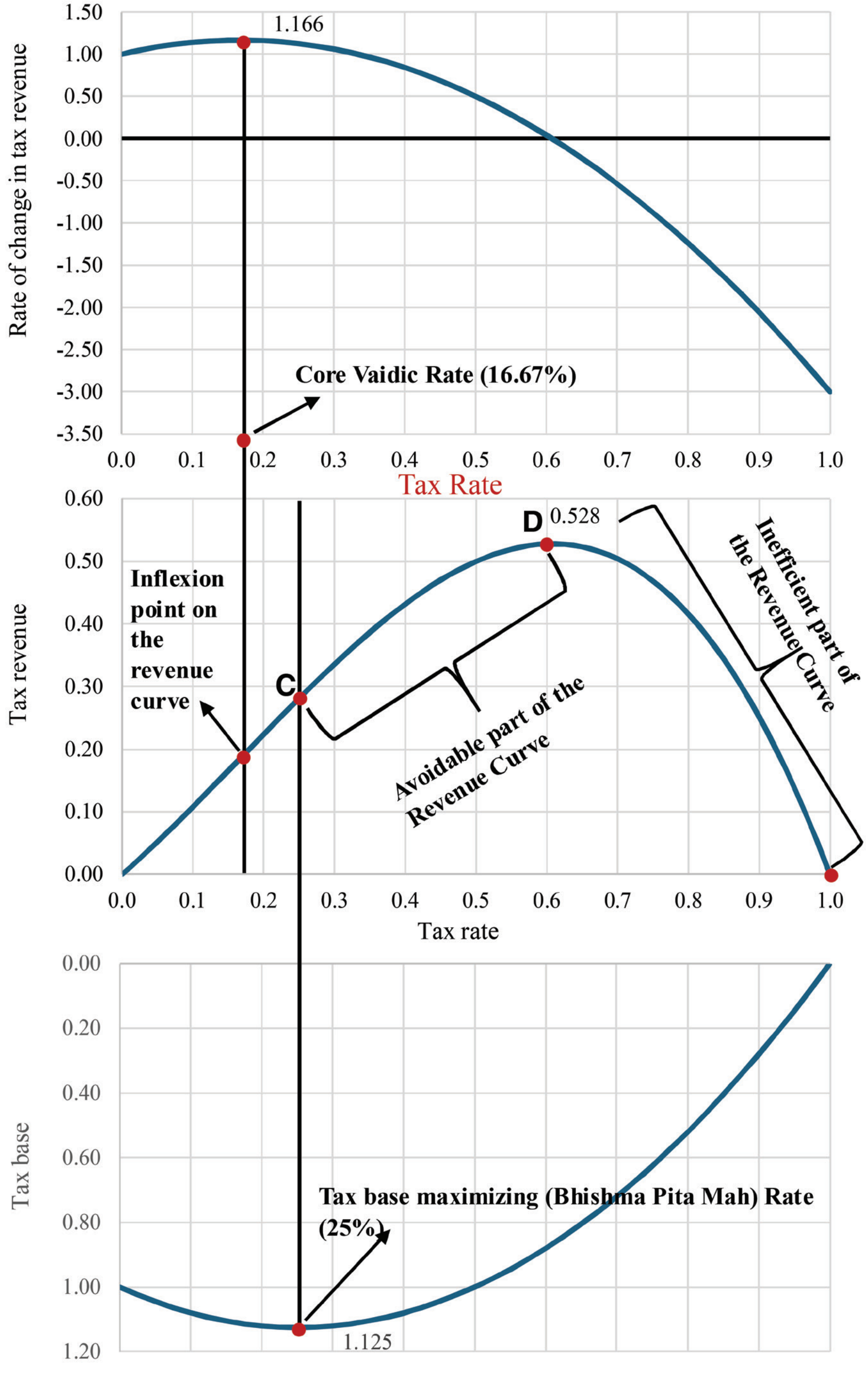

Chart 3: Simulations of tax base and tax revenue functions for $\beta = 1$

$$r\ (R_{\max}) = \frac{\beta + \sqrt{\beta^2 + 3(1+\beta)}}{3(1+\beta)} \tag{26}$$

However, to arrive at the revenue maximizing tax rate, the second order condition is

$$\frac{d^2 R}{d r^2} < 0 \tag{27}$$

Differentiating equation (23)

$$\frac{d^2 R}{d r^2} = \frac{dR'}{dr} = 2\,\beta - 6(1+\beta)\,r \tag{28}$$

This gives a point of inflexion on the revenue curve when

$$2\,\beta - 6(1+\beta)\,r = 0 \tag{29}$$

$$r\ (inflexion) = \frac{\beta}{3(1+\beta)} \tag{30}$$

When $\beta = 1, r\ (inflexion) = \frac{1}{6}$

As discussed in section 6 of this article, this is the special value of the tax rate highlighted in India's ancient texts. We refer to it as the Vaidic rate.

We have simulated equations (15), (19) and (23) for alternative values of β. In the first case (β = 1) shown in Chart 3, we depict the tax revenue and tax base curves and identify the revenue and base maximizing tax rates. When tax rates are increased initially, the tax base increases above 1. This implies that in the presence of public sector, initially total output increases above a situation when no public goods are supplied. The supply of public goods such as infrastructure increases the productivity even of the private sector. However, as the level of taxation rises, the tax base eventually falls below the value of 1 beyond r=0.5.

A base maximizing tax rate is reached when the tax rate is 25%, that is, one-fourth of 100%. At this point, the level of the base is 1.125. It may be noted that base maximization occurs at a rate which is lower than the rate at which tax revenue is maximized (r=0.6). Tax revenue, at its peak, is 0.528, that is, 52.8% of A, that is, the measurement unit. It may be noted that r which is equal to 0.6 is higher than the threshold of 0.5 beyond which output starts to fall below the value of 1. In fact, the range of tax rates from 0.5 to 0.6 already leads to inferior choices since the same output can be produced without taxation. There is another point of interest, however, which is the point of inflection. This occurs at a tax rate of r=0.1667 or 16.67%. At this point tax revenues start to increase but at a falling rate. Table 1 gives a summary of these important threshold values of the tax rate and corresponding values of the tax base and tax revenues.

Table 1: Base and revenue maximizing tax rates and points of inflexion for alternative value of β

	Tax rate (r)	*Level of base (Y)*	*Level of revenue (R)*
(1)	(2)	(3)	(4)
$\beta = 0.75$			
Base maximizing tax rate	0.2143	1.0804	0.2315
Revenue maximizing tax rate	0.6021	0.8172	0.4920
Point of inflection	0.1429	1.0714	0.1531
$\beta = 1$			
Base maximizing tax rate	0.2500	1.1250	0.2813
Revenue maximizing tax rate	0.6076	0.8692	0.5282
Point of inflection	0.1667	1.1111	0.1852
$\beta = 1.25$			
Base maximizing tax rate	0.2778	1.1736	0.3260
Revenue maximizing tax rate	0.6123	0.9218	0.5644
Point of inflection	0.1852	1.1543	0.2138
$\beta = 1.5$			
Base maximizing tax rate	0.3000	1.2250	0.3675
Revenue maximizing tax rate	0.6163	0.9748	0.6008
Point of inflection	0.2000	1.2000	0.2400
$\beta = 2.0$			
Base maximizing tax rate	0.3333	1.3333	0.4444
Revenue maximizing tax rate	0.6228	1.0819	0.6738
Point of inflection	0.2222	1.2963	0.2881

Source: Authors' calculations

Based on Table 1, as the value of parameter β is increased from illustrative values of 0.75 to 2.0, we observe the following:

1. The tax rate for the point of inflexion increases from 0.1429 to 0.2222.
2. The base maximizing rate increases from 0.2143 to 0.3333.
3. The revenue maximizing tax rate changes by very small margins as the value of β increases. It ranges from 0.6021 to 0.6228 as β increases from 0.75 to 2.0.
4. The base maximizing tax rate is always lower than the revenue maximizing tax rate for all values of β.

Associated with maximum revenue values, the base value falls below 1 in all cases except when β = 2. This means that as long as the base is below the value of 1, revenue maximization will be an inferior choice, because it reduces output to below the desired threshold, that is, the level of non-government maximum output. Rational choices appear to lie between the point of inflexion and the base maximizing rate.

Relative sizes of public and private sectors

Chart 4 shows the response of output to changes in the tax rate for alternative values of β**.** It shows a base output when the tax rate is 0. This base output is

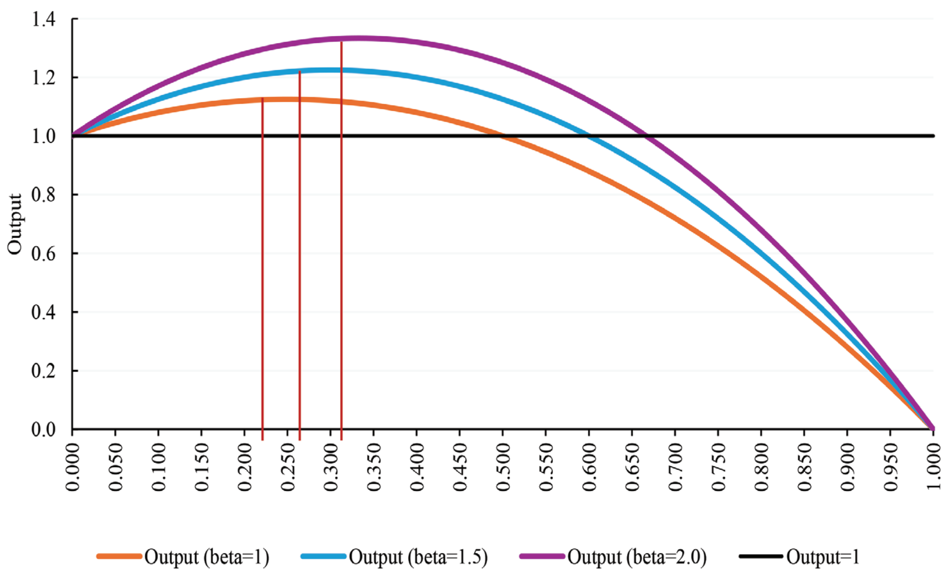

Chart 4: Tax rate-output function for alternative values of β

Source: Author's simulations

used as a unit of measurement and given a value of 1. It also implies that it is the level of output when there is no taxation and no government. It reaches a peak with a suitable combination of government and private sector. Beyond a certain point, this output starts to fall and reaches a value of zero when tax rate is increased to 100% resulting in zero tax revenues and no output either from the public sector or the private sector.

Total resources are shared between these two sectors and their output can be divided. Assuming a balanced budget, the share of the public sector is equal to the tax-GDP ratio. The implicit assumption is that government fully recovers the cost of publicly provided services through taxation. The context is that tax revenues are generated by taxing the private sector and the provision of public and merit goods financed by taxation increases the output above the non-government maximum output threshold. There is a trade-off between the private sector output and the tax financed public sector output. This may be depicted through production possibility curves as shown in Chart 5.

Samuelson also establishes that markets by themselves can not achieve this outcome due to freeriding and their inability to provide an efficient amount of public goods which requires government intervention. The production possibility curve between public and private goods gives the optimal combination of public and private goods. This occurs when the sum of the marginal rate of substitution (MRS) of consumption is equal to the marginal rate of transformation (MRT). This is a trade-off between production optimality and consumption optimality which occurs at the point at which the MRS curve is tangential to the production possibility curve (Stolper, Wolfgang F., and Paul A. Samuelson (1941)) as shown in Chart 5.

The underlying assumption in the present analysis is that public or government sector is financed by the tax revenues. Accordingly, the share of the private sector gets determined by deducting the share of tax revenues from the overall output. Thus, we can write the two relevant equations pertaining to the tax base (output, Y) and the tax revenues (R). From equation (16) we have,

$$Y = (1 + r + \beta r)(1 - r),\ \beta > 0$$

And from equation (18) we have

$$R = r.Y$$

Indicating the size of the private sector by X, we have

$$X = Y - R = Y - r.Y = (1 - r).Y \quad (31)$$

Using equations (31) and (16) we have

$$X = (1 - r).(1 + r + \beta r)(1 - r) \quad (32)$$

$$X = (1 - r)^2.(1 + r + \beta r) \quad (33)$$

Both X and Y are written as a function of the tax rate (r) and one parameter which is β. When r=1, X=0 and when r=0, $X = 1 + \beta r = 1$. Thus, X also varies between 0 and 1. These are also the values of Y, when r=1 and r=0.

$$R = Y - X \quad (34)$$

$$R = (1 + r + \beta r)(1 - r) - X \quad (35)$$

These combinations of private and public sectors can be depicted for alternative values of β showing corresponding production functions.

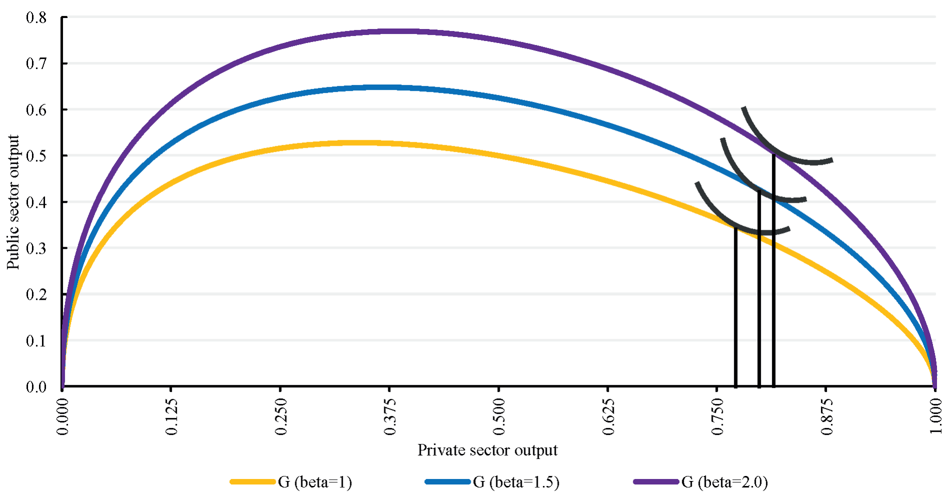

Chart 5: Production possibility frontiers for alternative shares of public and private sectors for different values of β

Source: Author's simulations

The government or public sector is financed by taxation.

Chart 5 shows production possibility frontiers for alternative combinations of public and private sectors for different values of β. As β increases, the curve shifts upwards. It is touched by higher and higher community indifference curves as β increases. The points of tangent indicate combinations preferred by the consumers of public and private outputs. As these tangent points shift outwards, it is indicated that the community is able to access higher and higher levels of public and private sector outputs since the overall output also increases.

We can now bring all the key elements of the macro system in a general equilibrium framework where the optimal tax rate is determined using the production possibility frontier, the community indifference curve, the rate revenue curve and the rate base relationship. This is shown in Chart 6. This chart is made with reference to a value of β = 1. The northeast quadrant shows the rate revenue relationship. The southeast quadrant shows the rate-base or the rate output relationship. The northwest quadrant shows the allocation of

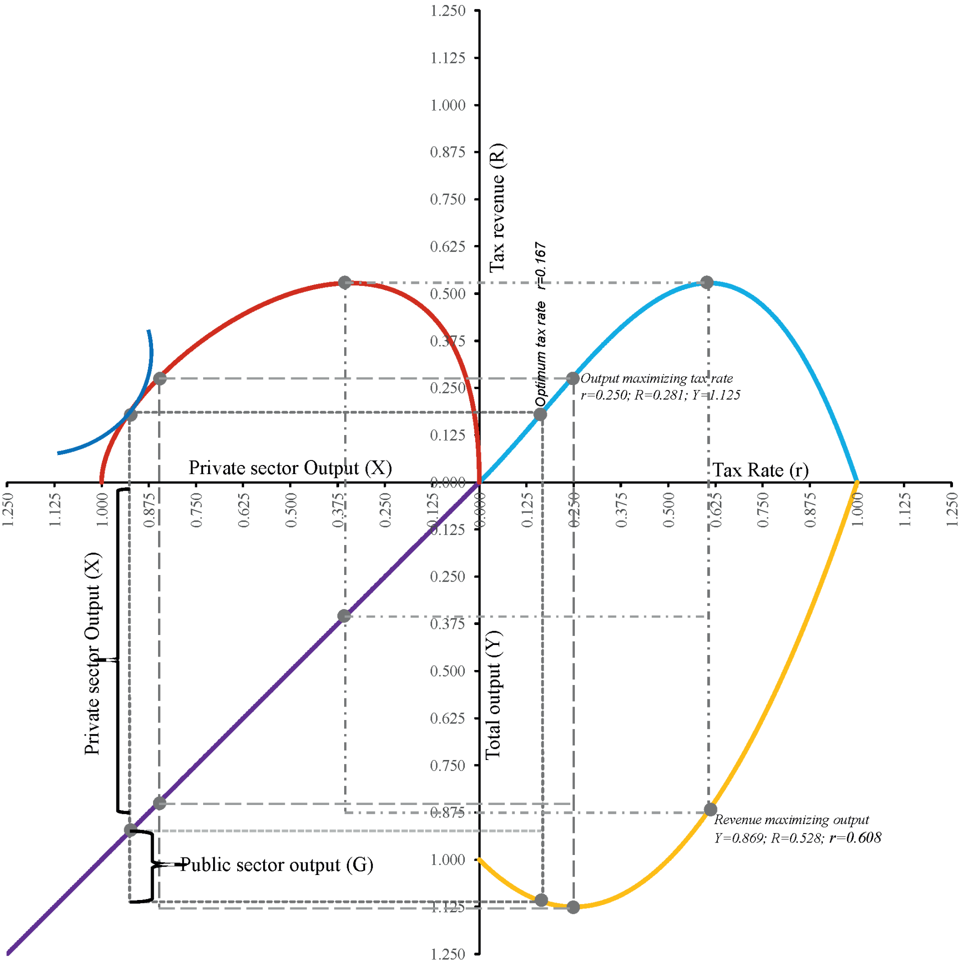

Chart 6: Optimal tax rate and relevant macro-aggregates

Source: Authors' simulations

the total output between public and private sector outputs through a 45 degree line that is drawn in the southwest quadrant.

Connecting horizontal and vertical lines show consistent combinations where starting from the point of tangent of the CIC with the PPC in the northwest quadrant, we can mark the corresponding tax rate, the total output and its allocation between public and private sectors. One illustration pertains to when the tax rate is 0.167. If the CIC is to touch the PPC at the point slightly to the right to be consistent with the tax rate of 0.25, total output is maximized at 1.125, with size of public sector output at 0.281 and private sector output at 0.844.

5. CONTEMPORARY TAX-GDP RATIOS: CROSS-COUNTRY EVIDENCE

In this section, we look at the contemporary tax-GDP ratios which are also indicative of the effective tax rate of a country. Data relates to the average during the period 2017 to 2019. Table 2 shows that the maximum number of tax-GDP ratios lie in the range of 10-25%. Effective tax rates higher than 25% are preferred only by a limited number of countries, that is, 31 out of 192. A rate higher than 30% is preferred only by 8 countries.

Table 2: Frequency distribution of number of countries according to tax rate ranges

Tax to GDP %	Number of countries	% share in total
0-5	11	5.7
5-10	20	10.4
10-15	50	26.0
15-20	47	24.5
20-25	33	17.2
25-30	23	12.0
30+	8	4.2
Total	192	100.0
Share of countries in the range from 10-25		67.7

Source (basic data): IMF

Chart 7 shows the number of countries according to the tax rate ranges. It is clear that the preference is for keeping overall tax rates below 25% and above 10%.

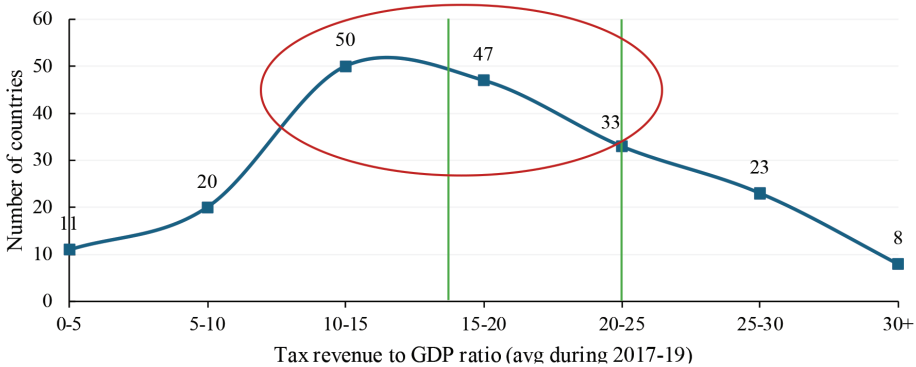

Chart 7: Modal class of tax rates according to number of countries

Source (basic data): IMF

Note: The vertical green coloured lines depict the inflexion point at 16.7% and the output maximization tax rate of 25%.

In the next section we consider the tax rate recommendations prescribed in India's ancient texts which ranges between 16.67% to 25%. It is shown in Chart 7 that the modal preference range of effective tax rate even in contemporary times is consistent with this prescription.

6. INDIA'S ANCIENT WISDOM ON TAXATION

India's ancient texts starting from Rig Ved encompassing Manu Samhita, Valmiki Ramayan, Ved Vyas Mahabharat, and Kautilya's Arthashastra, all enunciate desirable principles of taxation and in many instances prescriptions for actual tax rates. There is a clear instruction of keeping the tax rate low and the tax base high. They discuss at length the underlying principles which should be used and the conditions that should be kept in mind if and when the tax rate is to be increased. Although a number of rates have been mentioned, the core rate of taxation can be considered as one-sixth (16.67%) and with an upper limit of one-fourth (25.0%). Some of the relevant texts in Sanskrit along with translation in English with discussion are given below.

Mantra 10/173/6 ध्रुव आंगिरसः। राजा। अनुष्टुप्।

ध्रुवं ध्रुवेण हविषाभि सोमं मृशामसि ।
अथो त इन्द्रः केवलीर्विशो बलिहृतस्करत् ॥ 10/173/6

This Rig Ved Mantra translates to: "By mixing the inexhaustive havi, we obtain the inexhaustible Soma; in the same way, may Indra make your subjects ready to pay taxes on their own accord for you". Taxation is equated to the offering of havi in the performance of the Yajna where the Yajna performed by the King is for the sustenance of the kingdom. As havi ensures sustenance of the Yajna, taxation ensures sustenance of the kingdom.

आददीताथ षड्भागं द्रुमान् समधुसर्पिषाम् ।
गन्धौषधिरसानां च पुष्पमूलफलस्य च ॥ Manusmriti ॥ 7.131॥
पत्रशाकतृणानां च चर्मणां वैदलस्य च ।
मृन्मयानां च भाण्डानां सर्वस्याश्ममयस्य च ॥ Manusmriti ॥ 7.132॥

In these two shlokas from Manusmriti, a number of commodities are specified where the prescribed rate is one-sixth, that is 16.67%. In Shloka 131 of chapter 7, it is said that 'He (the King) may also take the sixth part (16.67%) of trees, meat, honey, clarified butter, perfumes, (medical) herbs, substances used for flavouring food, flowers, roots, and fruit.' Similarly specifying various other commodities, the prescribed rate was indicated at 16.67%. This is indicated in the next Shloka from Manu Samhita.

In Shloka 132 of chapter 7, on other goods such as '…leaves, pot-herbs, grass, (objects) made of cane, skins, of earthen vessels, and all (articles) made of stone', the rate of 16.67% applies. Thus, 16.67% is the core tax rate recommended by Manu.

In Kalidas's Raghuvansham, describing the stand of King Dilip, an ancestor of Shri Ram, on the matter of what portion of the output of subjects belongs to the King, it is clarified that it is only the one-sixth portion that rightfully belongs to him.

वत्सस्य होमार्थविधेश्च शेषं गुरोरनुज्ञामधिगम्य मातः ।
ऊधस्यमिच्छामि तवोपभोक्तुं षष्ठांशमुर्व्या इव रक्षितायाः ॥

Kalidas's Raghuvansham॥ 2-66॥

The context is that after being pleased by the service rendered by King Dilip, the divine cow asks him to take her milk for begetting a progeny. King Dilip says that he would do so but it is only one-sixth part of the milk that he is entitled to. The Shloka translates as follows: "O, mother, I am desirous of taking your milk, out of whatever remains after your calf has had its drink, and whatever may be used in the performance of yajnas, as if it is the **sixth part** of the levy on produce of land under my charge, for the protection of that land, that too on getting the permission of my Guru."

Another elaborate discussion is given in the Mahabharat when, after winning the battle, King Yudhishthir goes to Bhishma Pitamah, his grandfather, to seek instructions as to how to run his kingdom. He specifically says that although the kingdom is prosperous, he needs to increase its resources. This discussion happens in the Shanti Parva (Chapter 12) of Mahabharat.

यदा राजा समर्थोऽपि कोशार्थी स्यान्महामते |

कथं प्रवर्तेत तदा तन्मे ब्रूहि पितामह ||12/89/1

This Shlok from Ved Vyas Mahabharat from the Shanti Parva refers to the question that Yudhishthir, the victorious king of the Mahabharat war asks Bhishm Pitamah, his grandfather, in the matter of taxation as follows: 'Tell me, O grandsire, the one who is known to have great views, how should the king endeavour, notwithstanding his already great wealth, to increase it further.' Here the question is about raising the tax (to GDP) ratio for a nation which is already quite prosperous and has been taxing according to the prescribed rules and principles in the past. This implies that the tax-GDP ratio is already one-sixth. King Yudhishthir has in mind the performance of a Rajasuya yajna after the end of the Mahabharat war for which he needs additional resources. In the next Shloka, Bhishma Pitamah advises that implicitly for such purposes, tax rate can be increased but only gradually. This is indicated in the next Shloka.

न चास्थाने न चाकाले करान एभ्यो ऽनुपातयेत

आनुपूर्व्येण सान्त्वेन यथाकालं यथाविधि। 11

[Vedvyas Mahabharata, Shanti Parva, Shloka 11, Chapter 12]

According to this Shloka, Bhishma Pitamah advises that 'the King should impose taxes gradually and with conciliation, in proper season and according to due forms (ratios or rates). He should never impose taxes unseasonably and on persons unable to bear them.'

The broad principle of raising taxation is further enunciated in the next shloka.

मधुदोहं दुहेद्राष्ट्रं भ्रमरान्न विपातयेत् |

वत्सापेक्षी दुहेच्चैव स्तनांश्च न विकुट्टयेत् ||12/89/4

[Vedvyas Mahabharata, Shanti Parva, Shloka 4, Chapter 12]

This Shloka translates to: A king should milk his kingdom like a bee gathering honey from flowers and plants without harming the plants; or like the keeper of a cow who gently draws milk from her, after duly providing for the calf, without hurting her in any way.

The next shloka indicates that by following these principles the king can go raising taxes upto 25% of output.

प्रभुर्नियमने राजा य एतान्न नियच्छति |

भुङ्क्ते स तस्य पापस्य चतुर्भागमिति श्रुतिः ||12/89/17a

तथा कृतस्य धर्मस्य चतुर्भागमुपाश्नुते ||12/89/17b

[Vedvyas Mahabharata, Shanti Parva, Shlokas 17a and b, Chapter 12]

That king who does not restrain his subjects (from sin) earns a fourth part of the sins committed by his people (in consequence of the absence of royal protection). This is the declaration of the *Srutis*.

This Shloka means that since the king shares the sins of his subjects like their merits, he should, therefore, O monarch, restrain those subjects of his that are sinful. The king that neglects to restrain them becomes sinful himself. He earns (as already said) a fourth part of their sins as he does a fourth part of their merits.

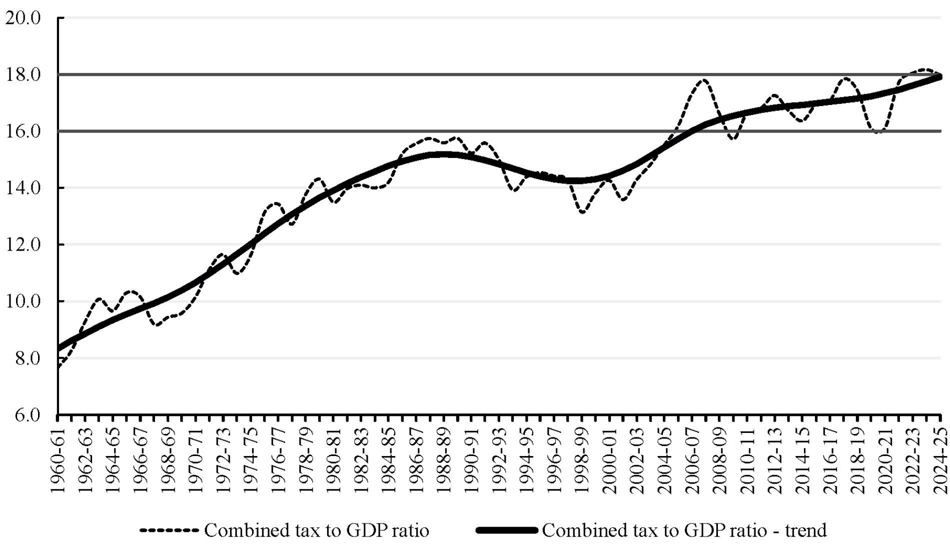

Chart 8: Combined tax-GDP ratio (%)

Source (basic data): IPFS, RBI, CGA, CAG

Thus, in India's ancient texts, prescribed tax rates, at least core tax rates range from 16.67% to a maximum of 25%. These prescriptions compare well with the choices given by modern nations as discussed in section 5. Chart 8 shows that even in the post Constitution modern India, for most years, India has managed to increase its tax-GDP ratio (combined for centre and states) to a range of 16-18% on trend basis since 2006-07.

7. CONCLUDING OBSERVATIONS

In this article, we have examined the question of determining a suitable overall tax-GDP ratio for a country using the underlying tools for Laffer curve analytics. The literature on Laffer curve largely deals with individual taxes. The determinants of the overall tax-GDP ratio using an analytical framework have not been discussed much in the literature. We develop an analytical framework for examining this question and argue that under certain parametric assumptions there is only a narrow range in which tax-GDP ratio should optimally lie. This range is 16.67% to 25%. We have examined the evidence from 192 countries to show that this is the modal range within which the tax-GDP ratios of most countries lie. In fact, nearly 68% of the countries have tax-GDP ratios in the range of 10-25%. We have brought together the principles and prescribed rates drawn from India's ancient literature on the subject of taxation where also the prescribed effective tax rates lie between 16.67% and 25%. The rates of 16.67% and 25% correspond to the point of inflexion in the tax rate-revenue function and the base maximizing rate respectively under certain parametric assumptions.

Disclaimer: ***Views or perspectives in this article are solely those of the authors and do not necessarily reflect the views, policies, or positions of any organization, employer, or affiliated group.***

Notes

1. $Y = 1 + \beta r - (1+\beta) r^2, \beta > 0$

$$Y = 1 + \beta r - r^2 - \beta r^2$$

$$Y = 1 - r^2 + \beta r - \beta r^2$$

$$Y = (1-r)(1+r) + \beta r(1-r)$$

$$Y = (1-r)(1+r+\beta r), \text{ where } \beta > 0$$

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