Tax Buoyancy Estimates for Indian States

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With the introduction of a destination-based VAT in all but eight states starting April 2005, there is need for a good baseline indicator of tax buoyancies in states in the period immediately preceding. This paper attempts to provide such a base, with buoyancies estimated over a 23-year span starting in 1980-81. If estimated over a sufficiently long period of time, the buoyancy coefficient essentially estimates the underlying revenue-generating properties of the system with endogenised tax policy. A log linear trend fit over the entire period showed serial correlation, which is eliminated for all but one state, Assam, with the introduction of structural breaks. A third specification, including the log of the per cent share of industry in the domestic product, eliminates serial correlation for Assam, and improves the goodness-of-fit for some other states. In all but six states, the sign of the change in the buoyancy coefficient at the break is positive. Where the buoyancy-enhancing break occurs in the late 1990s, the spurt in tax effort might have been an endogenous response to the expenditure shock from implementation of the higher salary scales recommended by the Fifth Pay Commission.

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Tax buoyancy estimates, which measure the percentage response of tax revenue to a one per cent change in the tax base, usually proxied by the gross domestic product, are a routine requirement for fiscal projection purposes. The elasticity of tax revenue is more stringently defined as the underlying revenue response, holding constant all parameters of tax policy. In developing countries, where tax policy parameters are changed every year and sometimes in the course of the year, the elasticity of tax revenue is virtually impossible to estimate with any appreciable degree of accuracy.[1] In such a fiscal context, where tax policy parameters are in a state of constant flux, the buoyancy coefficient may provide the only feasible alternative to estimating the underlying revenue-generating properties of the system. If estimated over a sufficiently long period of time, the buoyancy coefficient essentially estimates the revenue response with endogenised tax policy. The problem with estimation over a long period of course is the possible presence of structural breaks due to regime changes in tax effort, which will lead to serial correlation in the residuals and thus a biased estimate of the buoyancy coefficient when a log linear trend is fitted over the entire sample period.

This paper estimates buoyancies for Indian states with respect to their own tax revenues for the period since 1980-81, not including tax revenues received from the centre, and not including their own non-tax revenues.[2] Non-tax revenues of states display high volatility, with spikes resulting from an assortment of accounting practices, which vary from state to state. Chief among these, but not the only one, is the practice with respect to the recording of non-tax revenues from lottery schemes.[3] Tax revenues display greater stability year-to-year, and are the dominant source of revenue, accounting for 80 per cent of own revenue collections in aggregate across states. Buoyancy estimates for tax revenues of states are estimated with respect to the gross state domestic product (GSDP). The GSDP estimates for states in India are available only at factor cost, not at market prices.[4]

Section I presents the specifications estimated. Section II presents the buoyancy coefficients themselves from the results of the best specification for each state, and compares these with the buoyancies projected in the report of the Twelfth Finance Commission for the period 2005-10. Section III concludes the paper.

I
The Specifications Estimated

The basic estimation procedure for tax buoyancies is through a double log specification of the type given in equation (1) below, which yields the buoyancy coefficient β_1.

$$\ln (OTR_t) = \alpha_1 + \beta_1 (\ln GSDP_t) + u_t \qquad ...(1)$$

where $\ln (OTR_t)$ = log of (nominal) revenue in year t

$\ln (GSDP_t)$ = log of (nominal) GSDP in year t

α_1 = intercept

β_1 = buoyancy estimate

The residuals from estimation of equation (1) showed serial correlation for most states. This could be on account of an incorrect functional form (fitting a linear specification to an underlying non-linear relationship, for example, or where there is a structural break), or because of omitted variables. The Cochrane-Orcutt two-step estimator is a commonly used mechanical way of correcting for autocorrelation, when the source of the problem is unknown. In the context of buoyancy estimation over a long period, clearly one source of the problem could be a kink in the underlying relationship, which would generate serial correlation in the residuals when fitting a log linear trend over the entire sample period. Allowing for a structural break serves three purposes: it solves one possible source of serial correlation, it avoids the degrees of freedom problem that would arise if the buoyancy is estimated for the several periods separately, and most importantly it brings out regime changes in tax effort.

A second specification was therefore fitted, allowing for structural breaks in the tax series, marking points where there have been major alterations in the tax policy parameters, such that there is not merely a one-time change in levels, but also a change in the revenue-generating properties of the system. This is shown below in equation (2).

$$\ln(OTR_t) = \alpha_1 + (\alpha_2-\alpha_1)D + \beta_1 (\ln GSDP_t) + \{(\beta_2-\beta_1)D^*(\ln GSDP_t)\} + u_t \quad ...(2)$$

Equation (2) has a dummy variable D which takes the value one for years after the single structural break in the estimation period, zero otherwise. There is provision for both an intercept change in levels, as well as a change in the slope. The coefficients attached to the dummy variable terms give the difference between the coefficient for the period when the dummy variable carries the value zero, and the period for which it carries the value one. After the structural break, the buoyancy coefficient is β_2.

The introduction of a structural break took care of serial correlation in the residuals for most states, as measured by the LM test. The year of the structural break was chosen from all the possible break years within the estimation period based on the LM test, and the significance of the coefficients of the intercept and slope dummies. Where there was a break in the 1980s using the full sample period, as in the case of Karnataka, Kerala, Meghalaya, Rajasthan, Tamil Nadu and Tripura, the equations were re-estimated looking for another break in the second period using the same model. Among these six states, a second break was found in the case of Karnataka, Rajasthan and Tamil Nadu.

Where serial correlation remained even after testing, for all possible structural breaks, a third equation was estimated with sectoral shares in GSDP.[5] It is a well-known feature of the tax system in all developing countries that industry is more amenable to taxation than agriculture and services. The share of industry in domestic product would by prior expectation, increase steadily over time in such a setting, and therefore be serially correlated. The third specification tried, in cases where residual correlation persisted even in specification (2), is given below:

$$\ln(OTR_t)=\alpha_1+(\alpha_2-\alpha_1)D+\beta_1(\ln GSDP_t) +\{(\beta_2-\beta_1)D^*(\ln GSDP_t)\}+\gamma(\ln prcntindshare_t)+u_t \quad ...(3)$$

An alternative method by which to correct for systematic variations over time between the base used, GSDP in this case, and the true base, would be an error correction model, with the one-period lagged value of the dependent variable included as a regressor on the right hand side. That is difficult to do in the present case where, as will be seen, there are structural breaks in nearly all the states, which further occur typically in the 1990s, with short post-break estimation periods.

The data on own tax revenues of states are sourced from RBI publications, for the period 1980-81 to 2002-03, and on GSDP, including sectoral shares, from the Central Statistical Organisation.

Although the augmented specification actually improved the quality of the estimation in only a small number of states, it is a useful supplement to the simpler specifications normally used for buoyancy estimation. The sectoral share of industry in a developing country increases over time, and since industry in developing countries is the most tractable sector for taxation purposes, buoyancy estimation with respect to total domestic product alone could carry an omitted variable problem that gets reflected in the residuals. The alternative that is sometimes adopted is to estimate buoyancies with respect to industrial sector value added alone.

II
Estimated Buoyancy Coefficients

Table 1 lists the states, with the P-level of the LM test on the residuals with specifications (1) and (2), and the break year in the second specification. The LM test is performed for two lags. The null hypothesis in the LM test is that there is no serial correlation in the series tested for. A low P-value indicates that the null hypothesis can be rejected with a low probability of error, and so indicates the presence of serial correlation. A high P-value indicates that the null hypothesis cannot be rejected. Assam shows serial correlation in the residuals even with equation (2), with the LM test carrying a P-value of 0.12. When estimated with specification (3), the P-value improved to 0.65. This is shown in Table 2, along with some other states for which the P-value showed a reduction in serial correlation with specification (3) relative to specification (2), and the goodness of fit improved.

Table 1: Results of LM Test on Residuals for Alternative Specifications

State	Period	P-value for LM Test on Residuals (2 Lags)		Break Year
		Equation (1)	Equation (2)	
Andhra	1981-03	0.00	0.23	1994-95
Arunachal	1987-03	0.01	0.30	1994-95
Assam	1981-03	0.00	0.12	1995-96
Bihar	1981-03	0.99	No break	
Goa	1987-03	0.17	No break	
Gujarat	1981-03	0.03	0.96	1994-95
Haryana	1981-03	0.01	0.59	1995-96
Himachal	1981-03	0.05	0.37	1991-92
Jammu and Kashmir	1981-03	0.07	0.97	1994-95
Karnataka	1988-03	0.15	0.82	1997-98
Kerala	1981-03	0.02	0.24	1986-87
Madhya Pradesh	1981-03	0.24	0.27	1993-94
Maharashtra	1981-03	0.02	0.21	1997-98
Manipur	1981-03	0.76	0.95	1996-97
Meghalaya	1981-03	0.01	0.78	1986-87
Mizoram	1988-03	0.66	No break	
Nagaland	1981-02	0.04	0.72	1992-93
Orissa	1981-03	0.17	0.56	1997-98
Punjab	1981-03	0.09	0.42	1997-98
Rajasthan	1987-03	0.07	0.29	1996-97
Sikkim	1981-03	0.02	0.35	1997-98
Tamil Nadu	1988-03	0.00	0.18	1997-98
Tripura	1981-03	0.03	0.53	1988-89
Uttar Pradesh	1981-03	0.18	0.82	1994-95
West Bengal	1981-03	0.00	0.46	1996-97

Notes: The estimation period does not start at 1980-81 for six states: Arunachal, Goa and Mizoram on account of data unavailability for earlier years; Karnataka, Rajasthan and Tamil Nadu, because the truncation at what was clearly the earlier of two structural breaks improved the goodness of fit. The estimation period ends at 2001-02 for Nagaland for data reasons. The R-bar Squared values are not reported, but were uniformly high even for equation (1).

Source: Own tax revenue from RBI, *State Finances*, assorted issues; GSDP figures from Central Statistical Organisation. The data for Bihar, Uttar Pradesh and Madhya Pradesh are inclusive of the figures for Jharkhand, Uttaranchal and Chhattisgarh for the post-partition years (2000-03).

The final set of state own tax buoyancy coefficients, as estimated here for the post-break period up to 2002-03, is shown in Table 3. The break year in many cases is in the late 1990s, 1996-97 or 1997-98, with a positive and statistically significant change in the buoyancy coefficient at the break. This spurt in tax effort is a plausibly endogenous response to the enhanced expenditure on salaries starting in the year 1996-97, with implementation of the salary scales recommended by the Fifth Pay Commission.

The advantage of identifying structural breaks rather than a mechanical solution like the Cochrane-Orcutt two-step estimator, to correct for serial correlation, is that it yields a handle on the timing of changes in tax policy effort.

The direction of change at the structural break is not, however, positive in all cases. West Bengal, Gujarat and Kerala among the major states, and Himachal, Meghalaya and Tripura, in the special category, saw a decline in the buoyancy, at break years ranging between the late 1980s and late 1990s.

Table 2: Results for Specification Inclusive of Industry Share in Domestic Product

	P-value for LM test on Residuals		Goodness of Fit – AIC; SBC	
	Equation (2)	Equation (3)	Equation (2)	Equation (3)
Assam	0.12	0.65	-2.03;-1.83	-2.26;-2.02
Madhya Pradesh	0.27	0.36	-2.31;-2.12	-2.69;-2.44
Rajasthan	0.29	0.64	-2.13;-1.93	-2.26;-2.01
Tripura	0.53	0.73	-2.49;-2.29	-2.62;-2.37

Notes: Equation (3) is estimated over the same periods and for the same break years as equation (2).

Source: Ibid. The set of states is confined to those for which equation (3) reduced serial correlation in the residuals, and improved goodness of fit, relative to equation (2).

Table 3: Post-Break Own Tax Buoyancies and TFC Projected Buoyancies

State	Post-Break Period	Change of Sign at Break	Estimated Buoyancy Coefficient	TFC Projected Coefficient
Goa	1987-03	No break	1.05	1.35
Punjab	1998-03	plus	1.61	1.35
West Bengal	1997-03	minus	0.76	1.35
Gujarat	1995-03	minus	0.95	1.30
Himachal	1992-03	minus	1.07	1.30
Karnataka	1998-03	plus	1.23	1.30
Kerala	1987-03	minus	1.02	1.30
Haryana	1996-03	plus	1.35	1.25
Maharashtra	1998-03	plus	1.44	1.25
Andhra	1995-03	plus	1.51	1.20
Assam	1996-03	plus	1.54	1.20
Bihar	1981-03	No break	1.12	1.20
Jammu and Kashmir	1995-03	plus	1.55	1.20
Madhya Pradesh	1994-03	plus	1.09	1.20
Meghalaya	1987-03	minus	0.96	1.20
Orissa	1998-03	plus	1.36	1.20
Rajasthan	1997-03	plus	1.44	1.20
Sikkim	1998-03	plus	1.81	1.20
Tamil Nadu	1998-03	plus	1.29	1.20
Uttar Pradesh	1995-03	plus	1.36	1.20
Arunachal	1995-03	plus	1.73	1.10
Manipur	1997-03	plus	2.00	1.10
Mizoram	1988-03	No break	1.03	1.10
Nagaland	1993-02	plus	1.01	1.10
Tripura	1989-03	minus	1.04	1.10

Notes: In states where there is no break, the start of the estimation period is dictated by data availability (see Table 1 and notes). The series in all states terminates at 2002-03, except for Nagaland. For the four states listed in Table 2, the coefficients reported here are for specification (3).

Source: Ibid.

The post-break buoyancies for the majority of states which experienced an increase in buoyancy in recent years, falls in a fairly high range, between 1.01 for Nagaland, and as high as 2.00 for Manipur. It is only the states which have seen a post-break decline where the coefficient has dipped below one. In states with no discernible break, like Goa, Bihar and Mizoram, the coefficient is above one.

The states are grouped by the assigned values for own tax buoyancies in the report of the Twelfth Finance Commission. The median buoyancy assigned by the TFC is 1.20, whereas the median buoyancy as estimated here is 1.30. There is some question as to whether the post-break surge in estimated buoyancies, which in many states has held for only a five-or six-year period going up to 2002-03, can be sustained going into the future. This might be the reason for the more conservative buoyancies projected in the TFC report. There was also a fear that the switch to a VAT might be revenue-reducing, but preliminary indications are that the VAT has been revenue-enhancing.[6]

However, the TFC projected buoyancies are not uniformly lower than the estimated buoyancies for all states. The highest TFC buoyancies of 1.35 and 1.30 have been assigned to seven states, whose buoyancies as estimated here are well below the projected values in all but one case. These seven states include two with estimated buoyancies below one, Gujarat and West Bengal. At the other extreme, the TFC buoyancies of 1.10 have been assigned to five special category states, some of which, like Arunachal and Manipur, have experienced among the highest buoyancies, albeit starting from a low level.

III
Conclusion

With the introduction of a destination-based VAT in all but eight states starting April 2005, there is need for a good baseline indicator of tax buoyancies in states in the period immediately preceding. This paper attempts to provide such a base.

When buoyancies are estimated over a 23-year span starting in 1980-81, there is serial correlation in the residuals. The structural breaks fall in the 1990s for the most part, and eliminate serial correlation for all but one state. A specification including the log of the sectoral share of industry in GSDP eliminates serial correlation in that one exception, and improves the goodness of fit for a few other states.

The sign of the change in the buoyancy coefficient at the break is positive in all but six states. The set of six where there was a negative change at the break includes the three states with (post-break) buoyancy coefficients below one: Gujarat, Meghalaya and West Bengal. In all the rest, the post-break coefficients are comfortably above one. In states which experienced a buoyancy-enhancing structural break in the late 1990s, the spurt in tax effort might have been an endogenous response to the implementation of the higher salary scales recommended by the Fifth Pay Commission, starting in the year 1996-97. There is some question as to whether these enhanced buoyancies, which have prevailed typically for a post-break period of only five or six years going up to 2002-03, can be sustained into the future.

The median buoyancy assigned to states for the period 2005-10 is 1.20 in the report of the Twelfth Finance Commission, whereas the median buoyancy as estimated here is 1.30. The projections of the TFC for the period 2005-10 are clearly conservative relative to the realised buoyancies in recent years. However, the cross-sectional pattern of TFC projected buoyancies does not accord with the cross-sectional pattern of buoyancies estimated in this paper. The highest TFC buoyancies of 1.35 and 1.30 have been assigned to seven states, where in all but one case, the buoyancies estimated here are well below the projected values. This set includes two of the three states which have estimated buoyancies below one, Gujarat and West Bengal. The TFC projected buoyancies underlie the deficit grants awarded to states, and therefore carry a normative component. What these comparisons show is that the sign and quantum of the normative component is not uniform, but varies across states. EPW

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Notes

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1 The classical procedure for cleaning out the incremental impact of changes in tax policy parameters through the proportionate adjustment method is provided in Prest (1962) and Mansfield (1972). Sen (2003) offers a possible method of correcting for projection errors in budget estimates of total tax receipts, but the procedure remains dependent on official estimates of the impact of rate and base changes, which are mechanically drawn. Tanzi (1969 and 1976), provided an ingenious method by which cross-sectional data from sub-national regions could be used to estimate the elasticity of a nationally-levied tax. Clearly, this method can be extended to state-level taxes, provided data are available by administrative subdivision within each state, which is not presently the case.

2 The Shome Committee (Government of India, 2001) provides buoyancy estimates in aggregate across all states for the same period. Estimates for earlier periods, either in aggregate or for individual states, are in Purohit (1979), Rao (1979), Khadye (1981) and Bhat and Kannabiran (1992). There are very many other studies of elasticity and buoyancy of tax revenues in India, but most relate to income taxes, which are levied only by the national government at the centre. State-specific estimates are among the background estimation exercises performed for all finance commissions, but the reports carry only projected buoyancies, which are often unrelated to the historical values, and carry varying normative elements.

3 Non-tax revenues from state lotteries are often reported gross, with payment of prize money reported separately in revenue expenditure and not netted out of receipts. Other spikes result from the episodic routing through the budget of notional receipts on account of bunched interest and dues from parastatals, against offsetting subsidies and other expenditures to parastatals. Finally, loan waivers on state debt owed to the central government enter non-tax receipts as an accounting entry.

4 This will impart a slight upward bias to state-level buoyancy estimates, if the share of indirect taxes in total tax collections (nationally) increases steadily over time.

5 In its estimates of aggregate buoyancy across states, the Shome Committee report (Government of India, 2001) attributes the fall from 1.12 in the 1980s to 1.04 over the period 1990-1999 to the sectoral shift towards services.

6 This could be a one-time enhancement, and may not translate into a buoyancy enhancement.

References

Bhat, K Sham, G Kannabiran (1992): 'Measuring Elasticity and Buoyancy of Tax Revenue in Tamil Nadu: A Divisia Index Approach', *Prajnan,* 21:2, p 195.

Government of India (2004): *Report of the Twelfth Finance Commission (2005-10).*

– (2001): *Report of the Advisory Group on Tax Policy and Tax Administration for the Tenth Plan* (Shome Committee), Planning Commission, New Delhi.

Khadye, I K (1981): 'The Responsiveness of Tax Revenues to National Income in India (1960-61 to 1978-79)', *RBI Occasional Paper,* 2:1.

Mansfield, Charles Y (1972): 'Elasticity and Buoyancy of a Tax System: A Method Applied to Paraguay', *IMF Staff Papers,* XIX:2.

Prest, A R (1962): 'The Sensitivity of the Yield of Personal Income Tax in the United Kingdom', *Economic Journal,* LXXII, pp 576-96.

Purohit, M C (1979): 'Buoyancy and Income-Elasticity of State Taxes in India', *Artha Vijnana,* 20:3, p 244.

Rao, V G (1979): *The Responsiveness of the Tax System in India,* Allied Publishers, Mumbai.

Reserve Bank of India *State Finances: A Study of Budgets,* assorted issues.

Sen, Pronab (2003): 'A Note on Estimating Tax Elasticities', Planning Commission, mimeo.

Tanzi, Vito (1969): 'Measuring The Sensitivity of the Federal Income Tax from Cross-Section Data: A New Approach', *The Review of Economics and Statistics,* pp 206-09.

– (1976): 'The Sensitivity of the Yield of the US Individual Income Tax and the Tax Reforms of the Past Decade', *IMF Staff Papers;* pp 441-54.