Value Added Tax Efficiency across Indian States
Panel Stochastic Frontier Analysis

SACCHIDANANDA MUKHERJEE

In India, states may be induced to mobilise revenue through alternative channels by the growing demand for public expenditure, limitations in expanding fiscal space, and the limited scope to deviate from the common harmonised tax system, the goods and services tax regime. An assessment of existing tax efficiency and strengthening the tax administration could be one such alternative. The efficiency of tax administration varies across states. Given tax capacity, measuring tax efficiency is important to identify states where enhancing tax efficiency is likely to raise revenue gains considerably.

In augmenting state revenues, tax administration is as important as tax capacity. For developing countries like India, “tax administration is tax policy” (Casanegra de Jantscher 1990). The introduction of the goods and services tax (GST) from 1 July 2017\(^1\) has brought about major changes in India’s indirect tax structure. It has harmonised tax policy across states in India and left limited scope for deviation. Improving the efficiency of tax administration could help states to improve tax collection, given that the fiscal responsibility regulation adopted by states limits the budgetary deficits they can incur to augment the provision of public goods and services as required.

Sales tax or VAT (value added tax) is the most important source of revenue for states (Table 1). In India, VAT was introduced in 2003; most states adopted the VAT in April 2005 (the Economic Survey 2016–17 [GoI 2017] lists the year each state adopted the VAT). For General Category States, from 2001–02 to 2015–16, the VAT generated on average 65% own tax revenue (OTR) and 33% of total revenue receipts. Revenue from the VAT finances 27% of the states’ total expenditure (revenue and capital expenditure, excluding loans and advances) on average. The importance of VAT as a revenue source in state finances has been increasing (Table 1).

The efficiency of tax administration varies across states. State tax administrations face many constraints, and it is important to assess the present state of tax efficiency to identify the scope for tax administration reforms. An emerging strand in the literature goes beyond comparing tax–GDP ratios and seeks to measure differences in the efficiency of tax administration across countries and subnational governments in a country (Bird et al 2008; Brun and Diakité 2016; Davoodi and Grigorian 2007; Fenochietto and Pessino 2013; Mikesell 2007).

### Table 1: Importance of VAT* in State Finances for General Category States—2001–02 to 2015–16

<table>
<thead>
<tr>
<th>Description</th>
<th>Pre-VAT</th>
<th>Post-VAT</th>
<th>All Pre-VAT</th>
<th>All Post-VAT</th>
<th>All 2011–12</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average revenue from VAT as percentage of GSDP*</td>
<td>4.05</td>
<td>4.55</td>
<td>4.40</td>
<td>4.12</td>
<td>4.31</td>
</tr>
<tr>
<td>Average share of VAT in OTR (%)</td>
<td>63.40</td>
<td>65.12</td>
<td>64.62</td>
<td>63.55</td>
<td>64.91</td>
</tr>
<tr>
<td>Average share of VAT in total revenue receipts (%)</td>
<td>31.55</td>
<td>32.82</td>
<td>32.45</td>
<td>32.10</td>
<td>31.41</td>
</tr>
<tr>
<td>Average share of VAT in total expenditure (%)**</td>
<td>24.18</td>
<td>27.87</td>
<td>26.80</td>
<td>25.03</td>
<td>26.79</td>
</tr>
</tbody>
</table>

* includes CST and entry tax; ** revenue and capital expenditure, excluding loans and advances

Source: Compiled from Finance Accounts of States, various years.

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This article attempts to contribute to this discussion by asking whether variables could be influencing the tax collection efficiency of jurisdictions. Existing studies focus on the composition of government revenue but, perhaps, economic factors beyond government control play a role as well. In particular, this article explores whether the level of per capita income of the jurisdiction—a proxy for the level of purchasing power— influences revenue collection efficiency and whether, given inter-temporal variations in revenue collection efficiency, election cycles play any role in changes in efficiency.

Earlier studies on the efficiency of tax administration in Indian states consider OTR. Since OTR is composed of various taxes where tax bases are not uniform, it is difficult to capture the tax base or capacity perfectly in a single framework of analysis. This study looks into a comprehensive VAT, including central sales tax (CST) and entry tax, where the tax base is relatively well defined and, mostly, states have had a uniform taxation system since 1999–2000 (CAG 2010). It aims to estimate VAT efficiencies of General Category States for the 2001–16 period and understand the factors of VAT efficiency. The tax base of the VAT depends mostly on a state’s consumption base and tax collection on inputs for which input tax credit has not been claimed. Moreover, all states have a department to administer VAT (along with other taxes) and tax administration is more or less organised.

**Literature Review**

Tax collection differs across states depending on tax base (or taxable capacity) and tax efforts (or tax efficiency). Tax capacity is a government’s ability to raise tax revenues based on structural factors such as the level of economic development, the number of “tax handles” available, and the population’s ability to pay taxes (Chelliah 1971). Tax effort is a measure of how well a country is using its taxable capacity (Bahl 1971); it is the ratio of actual tax revenue to taxable capacity. Tax effort indices help measure differences in how effectively countries/subnational governments use their potential tax bases. These indices may indicate the appropriate policy for dealing with budget deficits. For example, the countries with a high tax effort index may need to look at reducing expenditure rather than raising taxes (Stotsky and WoldeMariam 1997).

Tax capacity and effort may be estimated by different approaches: income, representative tax system (RTS), regression, and stochastic frontier. The income approach assumes the national (or subnational) income as the tax base, and the ratio of tax collection to national (or subnational) income as the tax effort. This approach is based on the assumption that national income perfectly captures the tax base. Being a consumption-based tax, subnational income (or gross state domestic product [GSDP]) may not be the only indicator of tax base for VAT. Therefore, the income approach is not the right approach for the analysis in this article. Purohit (2006) ranks Indian states according to their tax effort based on this approach. Coondoo et al (2001) use a modified income approach where the ordinal position of the states in the tax–GSDP ratio is captured through quintile regression.

In the RTS approach, “[T]axable capacity is defined … as the total tax amount that would be collected if each country applied an identical set of effective rates to the selected tax bases, that is, as the yield of a representative tax system” (Bahl 1972). However, universal effective tax rate across commodities is a very strong assumption. In addition, tax base may also vary for a representative tax across states due to the differences in exemption list, thresholds, and abatements. In this approach, the ratio of actual tax collection to the yield of the RTS is taken as tax effort. Given the difficulties involved in the estimation of effective tax rate and tax base, this approach is not suitable for the analysis in this article. Rao (1993) used a modified RTS approach for the estimation of tax effort across Indian states.

In the regression approach, the actual tax revenue-to-income ratio is regressed on a set of independent variables, to capture the tax base, and the residual of the regression model, which is the difference between the actual tax revenue-to-income ratio and the estimated tax revenue-to-income ratio, is considered the tax effort. In this method, the regression error (or disturbance), which may contain a random component, is also considered as the tax effort. This method is adopted by many studies specific to Indian states (Oommen 1987; Rao 1993; Sen 1997; Thimmaiah 1979).

The stochastic frontier approach (SFA), an extension of the regression approach, simultaneously estimates tax capacity and tax inefficiency. Since tax capacity is not observable, the SFA estimates a production frontier based on the observable variables having significant influence on tax capacity (or tax base). Given the cross-sectional and time series variations in the observed data, and their relationship with the observed output (say tax revenue), the SFA estimates a frontier (maximum achievable output or tax revenue) of tax capacity. The difference between these estimates could be due to tax inefficiency and other factors that are stochastic in nature. There are several variants of the SFA model (Belotti et al 2012).

Three studies based on the SFA approach estimate tax capacity and tax efficiency for Indian states. These studies vary in methodology adopted, capturing indicators for estimating tax capacity and effort, time period for analysis, selecting states, and selecting taxes. Jha et al (1999) find that in 17 major Indian states from 1980–81 to 1992–93 tax capacity was determined majorly by state domestic product (SDP) or GSDP; proportion of agricultural income to total SDP (AGY); and time series trend (captured through year or time variable). Jha et al (1999) find a positive relationship between SDP and OTR and a negative relationship between share of agriculture in GSDP and OTR. The study adopts a time-variant SFA, as developed by Battese and Coelli (1995), and considers some factors influencing tax effort (central government grants in total state government expenditure (GTOE); interaction term of GTOE and SDP; interaction term of GTOE and AGY; and household consumption expenditure).

Garg et al (2014) find for 14 major states that, from 1992–93 to 2010–11, OTR (as a percentage of GSDP) capacity was influenced by per capita real GSDP, share of agriculture in GSDP, literacy rate, labour force, road density, and urban Gini
(a measure of consumption inequality). All independent variables—except square of per capita real GSDP and share of agriculture in GSDP—have a positive and significant relationship with states’ OTR. Garg et al (2014) use Battese and Coelli’s (1995) methodology for simultaneous estimation of tax capacity and efficiency across Indian states.

Karnik and Raju (2015) find for 17 major Indian states from 2000–01 to 2010–11 that the major determinants for sales tax (as percentage of GSDP) capacity are sectoral share of manufacturing in GSDP and annual per capita consumption expenditure. Both variables have a positive and significant relationship with a state’s sales tax collection. Karnik and Raju (2015) estimate time-invariant SFA models and do not incorporate efficiency factors into the model.

In estimating the tax efficiency function, Jha et al (1999) find that the factors influencing tax inefficiency significantly are GTOE, interaction terms of GTOE and GSDP, GTOE and AGY, per capita real rural household consumption expenditure and time series trend. All factors except consumption expenditure influence tax inefficiency positively.

Garg et al (2014) find that tax inefficiency is significantly influenced by the one-year lag value of ratio of transfers net of loan to revenue receipts, ratio of total expenditure to GSDP, ratio of outstanding liabilities to GSDP, ratio of debt repayment to total revenue, and governance index. Tax inefficiency is significantly influenced by the years after the implementation of the Fiscal Responsibility and Budget Management (FRBM) Act in the state (FRBMA dummy) and the effective number of political parties at the state level (ENP). All factors except ratio of transfers net of loan to revenue receipts influence tax inefficiency negatively.

Given the fiscal capacity of states, the system of intergovernmental fiscal transfers is expected to encourage subnational governments to intensify their tax effort to mobilise own revenue (resources) to fulfil their public expenditure commitments. Earlier studies show that central transfers—comprising grants-in-aid from the centre and state’s share in central taxes—significantly and positively influence tax inefficiency (Garg et al 2014). In other words, central transfers are higher for states where tax inefficiency is high.

Taking a cue from earlier studies, this article tests the relationship between tax efficiency and central transfers in the context of state VAT collection. Successive central finance commissions recommended establishing an incentive structure within the intergovernmental fiscal transfer framework to encourage states to intensify their own tax mobilisation effort, but their effectiveness in achieving convergence in tax effort across states is not well assessed in the literature. This article assesses the effectiveness of the finance commissions’ recommendations by considering a 15-year period that covers three finance commissions: Eleventh Finance Commission (2000–05), Twelfth Finance Commission (2005–10), and Thirteenth Finance Commission (2010–15).

States richly endowed with natural resources such as minerals and fossil fuels receive non-tax revenues in terms of royalty. It is expected that states where these royalties finance a large share of total expenditure will invest less effort in mobilising revenue from other sources. This phenomenon has some bearing with the natural resource curse hypothesis—countries with higher endowment of natural resources are likely to have less economic growth; an economy’s tax base is influenced positively by its size (as measured by GSDP) and GSDP growth rate. The term “resource curse” was first used by Richard M Auty in 1993 to describe how countries rich in mineral resources were unable to use that wealth to boost their economy and, counter-intuitively, experienced lower economic growth than countries without an abundance of natural resources (Auty 1993). Though this phenomenon is an established hypothesis in the literature of environmental economics, it has not been tested in the taxation literature. This study aims to test whether states where royalty revenues financed a large share of total expenditure made a lower tax effort.

In principle, VAR replaces the state sales tax system, though the state sales tax system continues for items such as petrol, diesel, aviation turbine fuel, crude petroleum, natural gas, and alcoholic beverages for human consumption. Given data constraints, it is beyond the scope of the present study to differentiate state tax revenues on account of taxes on sales, trade, etc., into two separate baskets—VAT and non-VAT.

The relationship between per capita income and tax efficiency is not established in the literature. This article attempts to establish it by considering comprehensive state VAT collection from 2001–02 to 2015–16 as a case in point. The period of the analysis covers the pre- and post-VAT periods. To bring about parity in the tax base, this article considers state sales tax, central sales tax, and entry tax for the pre-VAT period; for the post-VAT period, it considers state VAT, state sales tax (for out-of-VAT items), CST, and entry tax. The period is selected with a view to determine whether the introduction of the VAT has had any impact on tax capacity and/or tax effort. In 2000, three new states were formed—Chhattisgarh (formerly a part of Madhya Pradesh [MP]), Jharkhand (Bihar), and Uttarakhnad (Uttar Pradesh [UP]). For these states, full financial year data on state finances are available only from 2001–02. Therefore, 2001–02 is used as the starting year of the analysis.

Except Garg et al (2014), the literature does not adequately explore the impact of the enactment of the FRBM Act on states or the adoption of rule-based fiscal management practices in states’ tax effort. The FRBM Act requires state governments to eliminate their revenue deficit and contain fiscal deficit to less than 3% of GSDP. These constraints are expected to compel state governments to increase revenue mobilisation and/or contain expenditure to meet the deficit targets. Increasing tax efficiency after the enactment of FRBM Act could be one possible way to increase revenue mobilisation.

The present study attempts to understand the impact of the statewide adoption of FRBM Act on tax effort. The relationship between tax effort and state legislative assembly election cycle is not well established in the literature; Garg et al (2014) studied it, but did not find a significant relationship. Using the state assembly election database during the period of this study, an
attempt is made to understand the relationship between the state assembly election cycle and the tax effort.

**Methodology**

Following Battese and Coelli (1995), the stochastic production function for panel data can be written as:

\[ Y_{it} = \exp(x_{it}'\beta + V_{it} - U_{it}) \]  ... (1)

where,

- \( Y_{it} \) denotes the production of the ith firm (\( i = 1, 2, 3, ..., N \)) for the t-th year (\( t = 1, 2, ..., T \)),
- \( x_{it} \) is a \((1 \times k)\) vector of values of known function of inputs of production and other explanatory variables associated with the ith firm at the t-th year;
- \( \beta \) is a \((k \times 1)\) vector of unknown parameters to be estimated;
- \( V_{it} \) is a \((1 \times k)\) vector of unknown coefficients, \( \delta \) and \( u_{it} \) being a non-negative and significant. The value of \( \sigma_u^2 \) must lie between zero and one with values of \( \gamma \) indicating the deviations from the frontier are entirely due to noise (idiomatic), and values of \( \epsilon \) indicating that all deviations are due to technical inefficiencies.

The technical efficiency of production for the ith firm at the \( t \)-th year is defined by equation (3), where all variables are taken in natural logarithm,

\[ \tau_{it} = E[\exp(-U_{it} | \epsilon_i)], \]  ... (3)

and \( \epsilon_i \) is the composite error term (for a detailed derivation of the technical efficiency term see Mastromarco 2008).

The prediction of the technical efficiencies is based on its conditional expectation, given the model assumptions. Following the above methodology, equation (1) is tax capacity estimates and equation (2) is tax inefficiency estimates.

**Conceptual Framework**

Being a consumption-based tax, the tax base of a comprehensive VAT (including CST and entry tax) is dependent on the consumption base of the state. In the absence of representative annual consumption data for states, this article takes the GSDP (at factor costs, current prices) as a proxy for consumption base. Though interstate sales attract CST, and due input tax credit (ITC) is adjusted against CST liability, states having a comparatively larger share of CST sales (as compared to domestic sales) are expected to collect lower VAT revenue, as applicable tax rates for VAT and CST sales differ.

The shift from an origin-based tax system to a destination-based tax system under the GST system will result in a larger erosion of tax base for exporting states. States having a larger share of mining, manufacturing, or industry in GSDP are expected to have a larger share of export as compared to domestic sales. Not being under VAT, the share of services in export is not important in eroding the tax base. However, it will be an issue in the GST regime.

Agricultural commodities do not attract VAT. Except a few states where purchase tax is levied on foodgrains, erosion of tax base due to the export of agricultural produce is very limited. In the absence of statewide figures of exports (both interstate and international), this article takes the relative share of mining, manufacturing (or industry) vis-à-vis agriculture (excluding livestock, forestry and logging, and fishing and aquaculture) to capture the state's potential to export.

The framework may be presented as follows:

\[ \text{VAT Revenue} = tC-tX = t(GSDP-I-G-X+M)-t\text{X} = tGSDP-tA-\text{X}(t-t_1) = tGSDP-tA-f()\text{(t-t_1)} \]

where,

- \( C \) is the private final consumption expenditure;
- \( X \) is the export;
- \( t \) and \( t_1 \) are the tax rates on consumption and export, respectively;
- \( I \) is the investment;
- \( G \) is the government final consumption expenditure; and
- \( M \) is the import.

\[ X = f \left( \frac{\text{mining mfg service}}{\text{agri} \cdot \text{agri} \cdot \text{agri}} \right) = f() \]

\[ A=I+G-M \]
Revenue mobilisation through indirect taxes involves dealing with a large number of individual economic agents, and the political cost associated with revenue generation is expected to be higher than direct taxes. Political cost increases with rising revenue. In states where tax collection is higher (say, the tax-to-GSDP ratio is higher), any additional tax collection is expected to generate a larger political cost compared to the states where the tax-to-GSDP ratio is lower. Political cost could result in increasing resistance to tax—in terms of harbouring anti-government sentiments among businesses (or anti-incumbency), higher resistance to donation to political parties, or increasing number of litigations.

Therefore, states will always look for opportunities to raise revenue through alternative “tax handles,” which are politically less costly. If states could finance a larger share of their committed expenditures through central transfers, which are politically less costly, they will put lower effort in their own tax collection. This issue has relevance for federal countries like India, where constitutionally assigned taxation powers and expenditure responsibilities allow states to decide the level of revenue generation and expenditure according to their political interests.

The states that are higher up the development ladder, as measured by per capita income, are better at delivering public goods than states where per capita income is low. High-income states enjoy economies of scale in the provision of public goods and services; each rupee these states spend may result in better delivery of public goods and services. In other words, the unit cost of provisioning the same level of public goods/services is less for high-income states than for low-income states. Lack of peer pressure to improve achievement and efficiency in public goods delivery may make high-income states complacent with their existing expenditure and revenue level. Being laggards, low-income states set their revenue targets aggressively to catch up with high-income states in delivery of public goods and services. Therefore, the need for additional revenue generation may be less for high-income states than low-income states.

In a state, tax administration is the outcome of a political decision. In the absence of any estimate of potential tax collection of a state, a government’s revenue needs to determine its revenue targets. Tax evasion may lead to revenue leakage, though; total annual indirect tax collection is constant, but only a part of the total tax collected is deposited to the government exchequer as revenue. Taxpayers evade paying a part, and they use another part to cover up tax evasion by paying bribes and donations.

The relative size of these components varies across states depending on the interest of the political parties in power, tax effort, political interventions in tax administration, compliance behaviour (tax morale) of taxpayers, and the strength of fraud detection infrastructure. In an election year, when a new political party or coalition forms the government, it is likely to strengthen the tax administration to deter businesses and understand the relative size of the components of tax proceeds, but this tax effort is likely to taper off. The tax efficiency function may be presented as follows:

\[ \text{Tax Efficiency} = f(\text{political cost of raising revenue, economies of scale in public service provision, FRBM dummy, VAT dummy, anti-incumbency}) \]

**VAT Capacity Estimation:**

Model 1: \[ \lnvat = \beta_{0} + \beta_{1}\lnGSDP + \beta_{2}\lnind\text{agri} + \beta_{3}\lnserv\text{agri} + \beta_{4}\lnmowpi + \beta_{5}\lnport + \beta_{6}\lnrefinery + V_{it}U_{it} \]

Model 2: \[ \lnvat = \beta_{0} + \beta_{1}\lnGSDP + \beta_{2}\lnmine\text{agri} + \beta_{3}\lnmfg\text{agri} + \beta_{4}\lnserv\text{agri} + \beta_{5}\lnmowpi + \beta_{6}\lnport + \beta_{7}\lnrefinery + \beta_{8}\lnvatdum + V_{it}U_{it} \]

where \( \lnvat \) is natural logarithm of sales tax/\( \text{VAT} \) (including CST and entry tax) collection (in \( \text{r} \) crore) (current prices); \( \lnGSDP \) is natural logarithm of GSDP (in factor cost, current prices, 2004–05 series) (in \( \text{r} \) crore); \( \lnind\text{agri} \) is share of mining and quarrying vis-à-vis agriculture (excluding the shares of livestock, forestry and logging, and fishing and aquaculture in GSDP); \( \lnmfg\text{agri} \) is share of manufacturing vis-à-vis agriculture in GSDP; \( \lnserv\text{agri} \) is share of industry vis-à-vis agriculture in GSDP (industry includes mining and quarrying, manufacturing, construction, electricity, gas, and water supply); \( \lnmowpi \) is natural logarithm of wholesale price index (wpi) of mineral oil; \( \lnport \) is sea port dummy, 1 if any sea port is located in the state, 0 otherwise; \( \lnrefinery \) is petroleum refinery dummy, 1 if any refinery is located in the state, 0 otherwise; and \( \lnvatdum \) is VAT dummy, 1 for the year of introduction of VAT in the state and thereafter, 0 otherwise.

**VAT Inefficiency Estimation:**

Model 1: \[ U_{it} = \delta_{0} + \delta_{1}\lnpcgsdp + \delta_{2}\lnpcgsdp^{2} + \delta_{3}\lncentranstotex + \delta_{4}\lnroyaltytotex + \delta_{5}\lnvatdum + \delta_{6}\lnantiincumbency + W_{it} \]

Model 1: \[ U_{it} = \delta_{0} + \delta_{1}\lncentranstotex + \delta_{2}\lnroyaltytotex + \delta_{3}\lnfrbmdum + \delta_{4}\lnantiincumbency + W_{it} \]

where \( \lnpcgsdp \) is natural logarithm of per capita GSDP (in factor cost, current prices, 2004–05 series) (in \( \text{r} \)); \( \lnpcgsdp^{2} \) is square of natural logarithm of per capita GSDP (in factor cost, current prices) (in \( \text{r} \)); \( \lncentranstotex \) is central transfers (total of grants-in-aid and state’s share in central taxes) to a state as percentage of total expenditure (revenue and capital, excluding loans and advances) of the state; \( \lnroyaltytotex \) is state’s collection of royalty from petroleum, coal, and lignite, and non-ferrous mining and metallurgical industries as percentage of total expenditure (revenue and capital) of the state; \( \lnfrbmdum \) is FRBM dummy, 1 for the years of introduction of FRBM Act in the State and thereafter, 0 otherwise; \( \lnantiincumbency \) is anti-incumbency dummy, 1 for the state legislative election year if new political party (or alliance of parties) forms the government, 0 otherwise.

This estimates the maximum likelihood random-effects time-varying inefficiency effects model as developed by Battese and Coelli (1995) using spanel command in STATA (version 13.1).
(as developed by Belotti et al 2012). Battese and Coelli (1995) estimate the parameters of the stochastic frontier and the inefficiency model simultaneously to avoid bias (Wang and Schmidt 2002). Using the maximum likelihood estimation technique, this method captures time-varying inefficiency that reflects observable heterogeneity. Time-variant tax efficiency is estimated across states by using methodology developed by Battese and Coelli (1988), using the predict command in Stata (as developed by Belotti et al 2012).

**Sources of Data**

For state-level public finance statistics, this article relies on the finance accounts of the respective state governments. State government finance accounts are statements of state accounts audited by the Comptroller and Auditor General (CAG) of India. The data on GSDP at factor cost by industry of origin (at current prices) are taken from the Economic and Political Weekly Research Foundation (EPWRF) India Time Series database. However, for GSDP in 2011–12 series, the data on gross state value added (GSA) at basic prices are taken from the National Institute for Transforming India (NITI) Aayog State Statistics Database (NITI Aayog undated).

To bring parity across GSDP databases across series, the entire period of analysis (2001–16) is converted into 2004–05 series (at current prices) by using statewise GSDP deflator for the common year across series.4 Similar series conversion is also made for sectoral GSDP. A large part of sales tax is collected from mineral oils (petrol, diesel, and aviation turbine fuel (ATF)). The price of most of these oils is volatile, as it depends on the international price of crude oil, exchange rate volatility, and tax rates on these commodities. Therefore, the WPI of mineral oils (in 2004–05 base) is taken as the explanatory variable in estimating tax capacity. Since statewise WPI for mineral oils is not available, the same data are used for all the states. The data on WPI of mineral oils (in 2004–05 base) are taken from the EPWRF India Time Series database.

The EPWRF compiles GSDP data from the publications of the Central Statistics Office (CSO), Ministry of Statistics and Programme Implementation, and WPI data from the publications of Ministry of Commerce and Industry, Government of India. The statewise names of petroleum refineries and their year of establishment are taken from Indian Petroleum and Natural Gas Statistics 2016–17 (MoPNG 2017). The statewise list of ports and their year of establishment is taken from Wikipedia. For construction of VAT and FRBM dummies, this article relied on the Economic Survey 2016–17. The state legislative election-related indicators have been compiled based on the Election Results—Full Statistical Report of the Election Commission of India (ECI undated).

**Results and Discussion**

The estimated results (Table 2) show that in determining states’ VAT capacity, apart from the scale of economic activity of a state, as measured by lnGSDP, structural composition of the economy, as measured by the ratio of mining, manufacturing, industry, and services vis-à-vis agriculture in GSDP, is an important factor. The structure of the economy is found significantly influenced by the scale of economic activity of a state. To avoid the problem of multicollinearity, in the regression models, this article takes the share of mining, manufacturing (or industry), and services vis-à-vis agriculture in GSDP. Being a consumption-based tax, VAT capacity is influenced by the sectoral composition of an economy. VAT capacity is positively influenced by sectors where the share of compensation to employees and operating surplus/mixed income constitutes a significant share in value addition vis-à-vis that of agriculture.

For 2012–13, at current prices, the share of compensation to employees and operating surplus/mixed income in gross value added was 92.4% for agriculture, 77.8% for mining, 76.4% for manufacturing, 80.2% for industry, and 92.3% for services, according to the National Accounts Statistics (NAS) 2014 (CSO 2014). A relatively large share of value addition in agriculture and services goes back to employees and farmers/entrepreneurs as income available for consumption. Therefore, the VAT base is likely to be larger in states where the share of agriculture and services in GSDP is higher than in states where mining and manufacturing (or industrial activities) are located. Since almost a third of VAT/sales tax is collected from petroleum products, the prices of mineral oils influence VAT collection.

<table>
<thead>
<tr>
<th>Table 2: Estimated Results of VAT Capacity and VAT Efficiency</th>
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<tbody>
<tr>
<td>Description</td>
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<tr>
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</tr>
<tr>
<td><strong>Stochastic Frontier</strong></td>
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<tr>
<td>lnGSDP</td>
</tr>
<tr>
<td>mine/AGRI</td>
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<tr>
<td>ind/AGRI</td>
</tr>
<tr>
<td>serv/AGRI</td>
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<td>lnMOWPI</td>
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<td>port</td>
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<td>refinary</td>
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<tr>
<td>vatdum</td>
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<td><strong>Inefficiency Function</strong></td>
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<td>constant</td>
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<tr>
<td>lnPCGSDP</td>
</tr>
<tr>
<td>lnPCGSDP2</td>
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<tr>
<td>centranstotex</td>
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<tr>
<td>royltytotex</td>
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<td>frbmdum</td>
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<tr>
<td>lambda</td>
</tr>
<tr>
<td>gamma</td>
</tr>
</tbody>
</table>

| Basic Information | | |
|---------------------------------------------------------------|
| Number of observations | 255 | |
| Number of groups | 17 | 17 |
| Wald chi2 | 21192.72 | 14582.11 |
| prob>chi2 | 0.000 | 0.000 |
| Log Likelihood | 147.27 | 151.84 |
| Mean Efficiency | 0.83 | 0.85 |

***, **, and * imply estimated z-statistics are significant at 0.01, 0.05, and 0.10 level, respectively.
positively. As expected, the states having a petroleum refinery have larger capacity to collect VAT/sales tax, including CST and entry tax. As compared to landlocked states, the states having sea ports are expected to see value addition related to trade (exports and imports), which helps the state to expand the tax base. The square term of lngsdp is introduced in one of the alternative models to understand the non-linearity of the capacity function, but no significant relationship is found between the square of lngsdp and tax capacity. The VAT dummy is introduced in the capacity equation in Model 2; it is found significant. This implies that the introduction of VAT enhanced the tax capacity of states. The allowance of rrc against output tax liability may have encouraged businesses to take registration under VAT. Taking a cue from Jha et al (1999), time series trend is introduced as an explanatory variable in the capacity function, but no significant relationship was found. The results support our conceptual framework.

A non-linear relationship is found between per capita income (lnpcsgdp) and tax efficiency. As per capita income rises, tax efficiency increases, but it plateaus; if per capita income rises further, tax efficiency falls. Tax efficiency is high in states where per capita income is high; after per capita income reaches a threshold, tax efficiency starts falling. This trend may be due to constraints in understanding the potential tax capacity of high per capita income states and/or lack of peer group to follow/compete with in terms of tax efficiency. In other words, there is no competition for a high per capita income state to improve performance in tax efficiency. Moreover, setting tax targets lacks an understanding of the potential tax base and potential growth rate in income; the tax effort often depends on discretionary decisions, which may not always result in an optimum tax effort. This is especially true in the case of high per capita income states, where there are no peers or competitors to follow/compete. However, middle and low per capita income states see high-income states as their peers and set their tax targets (in terms of the tax-to-gsdp ratio) aggressively; there is a rising relationship between VAT collection (as a percentage of gsdp) and tax efficiency. High-income states need to set their own tax target judiciously, given the depth of their economic activities and variety of administrative jurisdictions.

The result shows that intergovernmental fiscal transfers do not increase tax efficiency. In other words, the states where a large part of expenditures is financed through central transfers put less tax effort. The states where royalty from petroleum, coal and lignite, and non-ferrous mining and metallurgical industries finance a significant share of total expenditures have larger efficiency in tax collection. Minerals are inputs for industries (petroleum refineries and metallurgical industries, for example); therefore, the extracted minerals could be used either in the state where minerals are extracted or in other states, where industries are located. When minerals are sold within a state, it attracts sales tax/VAT; when it is sold to other states, it attracts CST. Since state government authorities—the state commercial tax department or geology and mining department—closely monitor the activities of miners and often collect royalties/taxes at the exit points of mines (in Rajasthan, for example, the commercial tax department collect taxes on marble at the exit point), state tax authorities will likely monitor further value addition in the production chain. This result shows that capturing information at the input stage is important for efficient tax administration. Therefore, monitoring of upstream sector(s) is important for capturing value addition at downstream sector(s).

The introduction of VAT is found to result in a fall in tax effort as the VAT dummy is significant in Model 2. The FRBM dummy is found to influence tax efficiency positively. This implies that after the enactment of FRBM Act, the tax effort of states has improved.

It cannot be concluded unequivocally that tax efficiency is dependent on the election cycle. No significant impact is found in any of the three election dummies (election year, one year preceding the election, and one year following the election year) introduced in alternative specifications of the inefficiency function. However, tax efficiency is found to depend on anti-incumbency. In states where anti-incumbency is observed in the state legislative assembly election, tax efficiency improves in the election year. The influence of election and political outcome of a state on tax efficiency is a new finding of this article.

Alternative models are estimated to capture variables that influence states' tax capacity and inefficiency. The best models are selected based on values of gamma and lambda (Table 2). Model 1 is selected for estimating tax efficiency as diagnostic statistics (lambda and gamma) have larger values for Model 1 than Model 2.

### Changing VAT Efficiency across States

Compared to 2001–06, substantial improvement is observed in VAT efficiency during 2006–11 in Chhattisgarh, MP, Odisha, and UP (Table 3), and a considerable fall in Haryana, Kerala, Maharashtra, and Tamil Nadu. From 2006–11 to 2011–16, a dramatic fall in VAT efficiency is observed in Goa, Haryana, MP, and Madhya Pradesh. The result shows a considerable improvement in Tamil Nadu, and the state has improved.

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<td>0.84</td>
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* including Telangana. Figures in the parenthesis show the rank.
and Maharashtra, and a commendable improvement in low per capita income states such as Bihar, Odisha, UP, and West Bengal. The analysis of state ranking shows that VAT efficiency in relatively high-income states such as Goa and Haryana has been falling over the years, whereas tax efficiency is improving in low-income states such as Chhattisgarh and Odisha. However, there are exceptions; for example, Gujarat, instead of becoming a high-income state, is witnessing a consistent improvement in tax efficiency. The experience of MP and Rajasthan shows that continual effort is required to improve tax efficiency. States such as Bihar and West Bengal require major reforms in tax administration to improve tax efficiency. As compared to 2006–11, an improvement in VAT efficiency of Tamil Nadu during 2011–16 helped the state to regain the top position in the ranking. There is no sign of convergence in VAT efficiency across states.5 This analysis shows that VAT efficiency changes over time. Some states try consistently to improve VAT efficiency, which reflects in their relative rankings.

For the period of analysis (2001–16), out of 17 states, average tax efficiency (or effort) was above 90% in AP (including Telangana), Chhattisgarh, Karnataka, Punjab, Rajasthan, and Tamil Nadu, and above 80% but below 90% in Goa, Gujarat, Haryana, Jharkhand, Kerala, MP, Odisha, and UP (Table 3). In Maharashtra, average tax efficiency was 76%, not at par with other high-income states. Tax efficiency was the lowest in Bihar and West Bengal. The performance was commendable in relatively low per capita income states such as Chhattisgarh, Jharkhand, MP, and Odisha.

No pattern exists in the relationship between percentage change in average VAT efficiency and average VAT buoyancy (Figure 1)—VAT buoyancy is measured by the ratio of annual growth rate in VAT collection to annual growth rate in GSDP—but there is an inverse relationship in 2002–03 to 2006–07, 2008–09, 2011–12, and 2015–16. This article cannot conclude unequivocally that discretionary practices exist in tax administration, but these cannot be ruled out.

There is a falling relationship between per capita income and tax efficiency (Figure 2). In three relatively high-income states, tax efficiency falls as per capita income rises beyond a threshold. The phenomenon is much more prominent in Maharashtra, where tax efficiency started falling in 2004–05 and reached 61% in 2015–16. From 2004–05 to 2015–16, tax effort fell 24 percentage points, though per capita income went up 3.8 times. Tax efficiency fell similarly in Tamil Nadu up to 2008–09, 2011–12, and 2015–16. This article cannot conclude unequivocally that discretionary practices exist in tax administration, but these cannot be ruled out.

In the relatively low-income states of Odisha and UP, tax efficiency improved with rising per capita income (Figure 3). In Odisha, from 2004–05 to 2015–16, tax efficiency improved by 24 percentage points and per capita income increased three-and-a-half times. In UP, tax efficiency improved by 18 percentage points though per capita income increased three-and-a-half times. This shows that tax efficiency in low-income states is improving.

The experience of MP and Rajasthan demands special mention here (Figure 4). Tax efficiency increased with rising per capita
income; it fell after reaching a particular per capita income. Tax efficiency fell by 15 percentage points in Rajasthan from 2007–08 to 2012–13, but per capita income doubled. In Rajasthan, tax efficiency has been rising gradually since 2013–14. MP is a low-income state, but its experience mimics that of Rajasthan—tax efficiency fell by a dramatic 19 percentage points from 2010–11 to 2014–15, though per capita income increased 1.6 times.

The analysis shows that tax efficiency is definitely not a developmental issue and cannot be solved with rising economic development (per capita income) of a state; special, continual measures and programmes are needed to improve tax efficiency. What causes tax administrations in high-income and middle-income states to reduce tax effort as the per capita income rises? What kinds of reforms (administrative, institutional, and infrastructural) are required in tax administration so that they raise the tax effort as the per capita income rises?

**Estimation of VAT Gap**

Based on the estimated tax efficiency across states, an attempt is made to estimate the potential VAT–GSDP ratio that a state could achieve by raising tax efficiency to the maximum tax efficiency achieved by a General Category State in a particular year during the period of analysis.

The process of estimation of VAT Gap is presented as follows:

$$PVAT_i = \frac{1}{n} \sum_{j=1}^{n} \left[ \frac{VAT_{ij}}{VATE_{ij}} + \left( \frac{VATE_{ij} - VATE_{ij}}{VATE_{ij}} \right) \times \left( \frac{VATE_{ij}}{VATE_{ij}} \right) \right] / GSDP_{ij}$$

where $VAT_{ij}$ is the VAT efficiency of the $i$th state in the $j$th year; $VATE_{ij}$ is the maximum VAT efficiency that has achieved by a state (among the sample states) in the $j$th year; $VAT_i$ is the collection of comprehensive VAT in the $i$th state for the $j$th year; $GSDP_{ij}$ is the GSDP (at factor cost, current prices, 2004–05 series) for the $i$th state and $j$th year; $PVAT_i$ is the average potential VAT–GSDP ratio for the $i$th state, if the state achieves tax efficiency to the level equivalent to maximum tax efficiency that has achieved by a state (among the sample states) for a year; and $n$ is the number of years of our analysis ($n=15$).

Bihar and West Bengal have the potential to increase VAT (as a percentage of GSDP) by more than 2.6% by increasing tax efficiency (Figure 5). Potential gains could be considerable for Maharashtra (1.2%), UP (0.8%), Haryana and Odisha (each 0.72%), and Kerala (0.71%). Increasing VAT efficiency could raise the VAT–GSDP ratio in Bihar and West Bengal (Figure 5).

Since 2005–06, tax efficiency of Bihar has grown continually, except in 2008–09, 2010–11, and 2014–15 (Figure 6). Prior to 2004–05, tax efficiency in West Bengal was higher than Bihar. Tax efficiency in West Bengal has been growing since 2008–09, but at a slower pace than Bihar. From 2010–11 to 2012–13, the growth rate in VAT collection was higher than that in GSDP in West Bengal, which helped the state to increase VAT (as a percentage of GSDP) from 2.63% in 2009–10 to 3.29% in 2012–13. Continual effort is required to increase VAT efficiency in West Bengal to achieve the potential VAT–GSDP ratio.

In Bihar, from 2006–07 to 2015–16, GSDP grew at 17% per annum on average and VAT at 22%, and VAT efficiency improved consistently since 2007–08; this helped the state to increase VAT (as a percentage of GSDP) from 2.84% in 2006–07 to 4.16% in 2015–16. In West Bengal, during the same period, the average annual growth rate of GSDP was 15%, of which VAT was 16%; as a result, VAT (as a percentage of GSDP) increased from 2.71% in 2006–07 to only 2.92% in 2015–16. Since 2008–09, VAT efficiency has improved in both states, but the improvement in tax efficiency needs to be accelerated for them to catch up with other General Category States. Initiating reforms in tax administration could help them raise tax efficiency.

**Conclusions**

The results show that the tax capacity of states is a function of the scale of economic activity and of the structural composition of the economy. Tax capacity is lower in states that have a larger share of manufacturing and mining or industry vis-à-vis agriculture in GSDP and larger in states that have a larger share of services in GSDP vis-à-vis agriculture. A large share of value addition in agriculture and services goes back to employees and farmers/entrepreneurs as income (as compensation to employees and operating surplus/mixed income) available for consumption (CSO 2014). Therefore, VAT capacity is likely to be larger in states where the share of agriculture and services in GSDP is higher.

The change in prices of mineral oils as measured by the WPI of mineral oils (liquefied petroleum gas, petrol, kerosene, ATF, high speed diesel, naphtha, bitumen, furnace oil, lube oils, and...
Middle- and low-income states see high-income states as peers where there are no peers or competitors to follow/compete. This is especially true in the case of high tax effi ciency states, growth rate; as a result, tax effort often depends on discretionary lacks an understanding of the potential tax base and potential performance in tax effi ciency. Moreover, setting tax targets there is no competition for high-income states to improve follow/compete in terms of tax effi ciency. In other words, tax capacity of high-income states and/or lack of peer group to trend may be due to constraints in understanding the potential tax income, tax effi ciency falls. High per capita income states to stay outside the tax system, to register under the VAT.

The introduction of VAT enhanced the tax capacity of states. The incentives of ITC on raw materials and capital goods perhaps encouraged economic activities, which earlier preferred to stay outside the tax system, to register under the VAT.

Per capita income is found to have a non-linear relationship with tax efficiency. With rising per capita income, tax efficiency increases and reaches a plateau; with a further rise in per capita income, tax efficiency falls. High per capita income states have high tax efficiency; after reaching a threshold per capita income, tax efficiency starts falling. The reason for such a trend may be due to constraints in understanding the potential tax capacity of high-income states and/or lack of peer group to follow/compete in terms of tax efficiency. In other words, there is no competition for high-income states to improve performance in tax efficiency. Moreover, setting tax targets lacks an understanding of the potential tax base and potential growth rate; as a result, tax effort often depends on discretionary decisions, which may not always result in optimum tax effort. This is especially true in the case of high tax efficiency states, where there are no peers or competitors to follow/compete. Middle- and low-income states see high-income states as peers and set their tax target (in terms of tax–GSDP ratio) aggressively. High-income states need to set their own tax target judiciously given the depth of their economic activities and varsity of administrative jurisdictions.

The results show that intergovernmental fiscal transfers do not increase tax efficiency. In other words, less tax effort is made by states where a large part of the expenditure is financed by central transfers. This confirms that the intergovernmental fiscal transfer mechanism suggested by successive finance commissions does not provide states an adequate incentive to increase tax efficiency. The tax effort is higher in states where a large part of the expenditure is financed through the revenue from royalties. Royalties are collected from miners of crude petroleum (onshore), coal and lignite, and non-ferrous metallic minerals; state government departments (either the state commercial tax department or the geology and mining department) closely monitor the activities of miners and often collect taxes at exit points. It is likely that state tax authorities will monitor further value addition in these activities in the production chain. This result shows that capturing information at the input stage is important for efficient tax administration, and monitoring upstream sector(s) is important for capturing value addition in downstream sector(s).

The introduction of VAT has resulted in a fall in the tax effort across states. In the VAT regime, it is mandatory to inform the tax assesse prior to field audit. The lack of the element of surprise has weakened tax administration. Moreover, the workload of tax administrators has gone up after the introduction of VAT, but there has not been a commensurate increase in the deployment of manpower.

The enactment of the FRBM Act has positively influenced tax efficiency. The importance of meeting deficit targets by containing expenditure and increasing revenue is the logical response for states. Therefore, increasing tax revenue by increasing tax efficiency is as expected.

The results show that tax efficiency is dependent on the election cycle of the state legislative assembly. Increasing tax efficiency in the face of anti-incumbency is a new finding of this study. In other words, tax efficiency goes up in the year of election when a new government is formed by a different political party or alliance. This demands an in-depth analysis of political influence in tax administration.

An attempt is made to estimate the potential gap in VAT collection across states. There is scope for improving VAT collection by increasing tax efficiency. The largest gain from VAT efficiency improvement would be in states such as Bihar and West Bengal. Other gainers would be Maharashtra, Goa, Jharkhand, and Haryana. An effort to strengthen tax administration and increasing tax efficiency could help these states mobilise more resources.

Successive finance commissions aimed to harmonise the tax effort in Indian states, but this study does not see any sign of convergence of tax efficiency during the 2001–16 period. To strengthen tax administration, an objective, in-depth, state-specific assessment of tax administration is required. This study shows that the gains from such assessment could help low-income states such as Bihar, West Bengal, and UP. Even for high-income states such as Maharashtra and Haryana, an objective assessment of tax administration could help to understand the reasons for the fall in tax efficiency in recent years.

The results of this article are relevant even for the GST regime, since VAT and GST differ only in coverage. To reduce compliance burden on taxpayers, the GST network centralises some basic functions of tax administration, like registration, acceptance of returns, and tax payments. However, a dual GST administration system prevails between the union and state tax administrations for other functions of tax administration, like assessment, enforcement, scrutiny, and audit.
NOTES

1  The introduction of the GST has resulted in the centralisation of some functions of tax administration, such as registration, return filing, and payment, but other functions, such as assessment, audit, and recovery, still remain within the domain of the respective tax administrations.

2  In most General Category States, the VAT was introduced in April 2005, but it was enacted in Haryana in April 2003; in Chhattisgarh, Gujarat, Rajasthan, Jharkhand, and Madhya Pradesh in April 2006; in Tamil Nadu in January 2007; and in Uttar Pradesh in January 2008 (Gol 2017).

3  In most General Category States, the FRBM Act was enacted in 2005–06, but it was enacted in Karnataka in September 2002; in Tamil Nadu, Kerala, Punjab, and Uttar Pradesh in 2003–04; and in Bihar, Goa, and Jharkhand in 2006–07 (Gol 2017).

4  For 2001–02 to 2003–04, GSDP and sectoral GDP data correspond to the 1999–2000 series; for the same data during 2004–05 to 2011–12, the 2004–05 series is taken; and for 2001–12 to 2015–16, the GSAV at basic prices is taken for the 2011–12 series.

5  A beta convergence test (for standard deviation of tax efficiency) is conducted; except constant term, year and square of year terms are insignificant.

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