# l Capacity and Tax Performance in Selected Indian States: Panel Frontier Approach

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## Abstract

An efficient tax generating mechanism not only secures financing of government expenditure but it also leads to fiscal sustainability. To achieve this objective, it is crucial for examining tax collection capacity and tax effort among Indian states. This study aims to estimate the tax-capacity and tax effort or efficiency from 2001-02 to 2015-16 for a panel of 17 major states. For this purpose, the study incorporates several socio-economic factors (such as per capita income, literacy rate, agricultural GSDP, per capita power consumption, share of central transfer in aggregate revenue receipts, lag of total expenditure to GSDP ratio, lag of outstanding liabilities as share of GSDP etc.) which are affecting tax capacity as well as tax effort. Using Stochastic Frontier Analysis (SFA) model, time- variant inefficiency model has been executed to estimate efficiency of own tax revenue in order to measure inefficiency in tax collection. The results indicate that states' tax efforts fall short of their tax-capacity during 2001-15. This provides large budgetary room that states potentially enjoy for raising revenues from existing taxes.

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## 1. Introduction

An effective tax system will provide better financing of government expenditure and containing fiscal imbalances and thereby enhances economic development. . Taxable capacity and revenue capacity refers to maximum possible tax revenue a government can generate. On the other hand, tax effort refers to the comparison of actual tax collection and tax capacity. In the literature of public finance, there are four approaches for estimating a tax capacity of government such as Income approach**;** Aggregate Regression approach**;** Representative Tax System (RTS) and Frontier analysis. The existing literature on this subject is sparse and do not study states' tax efforts effectively.

Tax revenue across states depends on their tax base (or tax capacity) and tax effort (or tax efficiency). Indices of tax effort provide differences between sub-national governments in how effectively they are utilizing their potential tax bases. These indices help in making appropriate policy for dealing with fiscal imbalances. Countries with high tax effort index may need to look at reducing expenditure rather than raising taxes (Stotsky and WoldeMariam, 1997).

To achieve this objective, it is crucial for examining tax collection capacity and tax effort among Indian states. Going by literature, the study incorporates several socio-economic factors (such as per capita income, literacy rate, agricultural GSDP, per capita power consumption, per capita NSDP, share of central transfer in aggregate revenue receipts, lag of total expenditure to GSDP ratio, lag of outstanding liabilities as share of GSDP, FRBM dummy and VAT dummy) which are affecting tax capacity as well as tax effort.

The objective of this study is to analyse the revenue sources of the state governments in general and their own tax collection in particular. Being the major source of Aggregate Revenue Receipts for states, own tax revenue (OTR) is focus of our study. Stochastic Frontier Analysis (SFA) is used to estimate own tax capacity as well as own tax effort from 2001-02 to 2015-16 in a panel data framework More specifically, we investigate the determinants of own tax revenue of states.

The structure of this paper is organized as follows. Section 2 presents the brief overview of various revenue sources of the states. Section 3 depicts the review of literature. In section 4, we describe data and methodology of the study. Section 5 represents the computation of tax capacity and tax effort and Section 6 draws concluding remarks.

## 2. Revenue-generating Profile of Punjab: (2001-02 to 2015-16)

In this section, we provide scenario of revenue generation of Punjab state. This included share of each major tax in total tax revenue, followed by share of federal transfers and debt. Table 1 presents the relative share of various components of total revenue. These components include Punjab's own tax revenue**;** transfers from the central governments and various ministries**;** borrowings etc. Own tax revenue of Punjab contributed 43.01 percent in total revenue in 2015-16. Large part of the total tax revenue comes from the sales tax category. It contributed 17.36 percent of total revenue in 2001-02, which increased to 25.55 percent in 2015-16. Contribution of all other individual taxes is less than 9 percent in total revenue. The first two taxes along with sales tax cover nearly 77 percent of state's own tax revenue. Similarly, share of central transfers constituted 12.83 percent of total revenue in 2001-02, which is increased to 20.06 percent in 2015-16. So dependence of this state has increased over period of time. Among components of inter-governmental transfers, share of central transfers constitute the highest proportion followed by grants-in-aid and loans (Table 1).

**Table 1: Various Sources of Revenue: Punjab (1991-92 to 2015-16)**

| **Revenue Component: Punjab** | **(% of Total Revenue)** | | | |
|---|---|---|---|---|
| | 2001 | 2005 | 2010 | 2015 |
| 1. Own Tax Revenue | 31.17 | 40.77 | 46.64 | 43.01 |
| (i) Sales Tax | 17.36 | 20.98 | 27.76 | 25.55 |
| (ii) State Excise | 8.72 | 7.11 | 6.58 | 7.73 |
| (iii) Tax on Property & Cap. Transaction | 2.93 | 7.65 | 6.48 | 4.04 |
| (iv) Vehicle Tax | 2.06 | 1.96 | 1.81 | 2.38 |
| (v) Tax and duties on Electricity | 0.02 | 3.04 | 3.94 | 3.17 |

| | | | | |
|---|---|---|---|---|
| (vi) Tax on Goods and Passengers | 0.00 | 0.00 | 0.00 | 0.01 |
| (vii) Tax on Profession, Trades and Callings | 0.00 | 0.00 | 0.00 | 0.00 |
| (viii) Agriculture Income Tax | 0.00 | 0.00 | 0.00 | 0.00 |
| (ix) Entertainment Tax | 0.06 | 0.03 | 0.01 | 0.01 |
| 2. Total Transfers | 12.83 | 15.71 | 15.63 | 20.06 |
| (i) Transfers from Central Taxes | 3.95 | 5.57 | 8.46 | 12.91 |
| (ii) Grants | 3.48 | 10.04 | 6.65 | 6.73 |
| (iii) Loans from Centre | 5.40 | 0.11 | 0.53 | 0.44 |
| 3. Market Borrowings | 2.71 | 5.44 | 19.31 | 17.40 |

## 3. Review of Literature

Several scholars used the aggregate regression approach. This model is proposed by Bahl (1971) which is based on three determinants of taxable capacity: the stage of development, sectoral share of GDP and the size of the foreign trade sector. These are proxied by the agricultural share of income, the mining share of income and the export share of income respectively.

Reddy (1975) applied this approach to calculate the relative tax efforts of 16 Indian states for the period of 1970-72 and found some unanticipated results. This analysis found something which is against the argument that Bihar's tax effort made least and had enough space for tax potential.

Gupta (2007), in a country wise dynamic data model, found a significant effect or some structural variables such as per capita gross domestic product, the share of agriculture sector in GDP, trade openness and size of the foreign sector on the tax revenue of these countries.

There are few studies which used DEA or SFA to estimate tax capacity and tax efficiency in India. Rajaraman and Goyal (2005) used DEA to measure tax efficiency in 28 states during 2000-07. As per the results, subtle variation observed in tax inefficiency scores across Indian states.

Researchers have used SFA to measure tax-efforts of states in India (Jha et al., 1998; Karnik and Raju 2015; Garg et al., 2014). Jha et al. (1999) studied that for the period 1980-81 to 1992-93, composition of economic sector such as Gross State Domestic Product (GSDP), share of agriculture in GSDP are the factors which determining taxable capacity of state governments. The study adopts time variant Battese and Coelli (1995) and considers some fiscal variables influencing tax effort.

Garg et al. (2014) found that for the period 1992-93 to 2010-11, considers several economic, social and infrastructural variables affecting taxable capacity of the states. This study uses Battese and Coelli (1995) model for simultaneous estimation of taxable capacity and tax effort for Indian states.

Karnik and Raju (2015) found that for the period 2000-01 to 2010-11, sectoral share of manufacturing in GSDP and per capita consumption expenditure are major determinants of sales tax capacity for 17 Indian states. These variables have positive and significant impact on sales tax collection. This study used time invariant SFA model.

## 4. Database and Methodology

Variables can be classified into two sets. First set includes variables to estimate the tax capacity while second set incorporates variables which are affecting inefficiency in tax collection. Tax capacity variables are as follows: Economic variables (per capita GSDP), indicators of Infrastructure (Road Density, Per capita power consumption) and Demographic variables (Literacy Rate, share of urban population). Variables affecting tax effort are fiscal variables such as the share of Central transfers in total revenue receipts (CENT); lagged central transfer as a proportion of revenue receipts; lag of total expenditure as a proportion of GSDP (EXP) and lagged outstanding liabilities as a share of GSDP (DEBT). The coefficient on CENT is expected to have a negative sign. EXP is expected to be positively associated with tax effort. The sign of DEBT expected to positive on tax effort. Other factors that account for economic environment such as VAT and FRBM dummy which are fiscal policy change variable, it takes value one for years when FRBM or VAT Act is implemented and zero otherwise.

Data on these variables have been retrieved from RBI's Handbook of Statistics on State Government Finances, Economic and Political Research Foundation, Census Reports.

The stochastic frontier model was initially propounded by Aigner, Lovell, Schmidt (1977). Alfirman (2003) argued that, in production function, the relationship between output and inputs (such as capital and labour) are precise. However, it is ambiguous when it comes to stochastic tax frontier. But, there are many studies like Karnik and Raju (2011), Fenochietto and Pessino (2013), Garg et al (2017) taking into account more general analysis by incorporating much expected variables.

Stochastic frontier models in the framework of panel data are first proposed by Pitt and Lee (1981) and Schmidt and Sickles (1984). They employed this model to examine the performance of Indonesian weaving establishments and domestic airline industry in the USA. These models assumed technical inefficiency as time-invariant. Later, Cornwell et al (1990), Kumbhakar (1990) and Lee and Schmidt (1993) proposed time-varying technical inefficiency models. Battese and Coelli (1995) introduced another model to estimate the time-varying technical inefficiency model, which became standard model in the stochastic frontier analysis. Green (2005) subsequently introduced alternative models such as true fixed effect (TFE) true random effect (TRE) which are confronting the issue of time invariant heterogeneity problem.

A few studies have attempted to estimate tax-capacity and tax effort using stochastic and non-stochastic frontier models. As our study incorporates such socio- economic environmental factors, we used Stochastic Frontier Analysis (SFA) to obtain desired results. The standard econometric stochastic frontier model is proposed by Aigner, Lovell and Schmidt (1977). Several variant of this model have been applied in the literature with different structure of inefficiency term and different distributional assumptions. We apply the Battese and Coelli (1995) model where inefficiency term is assumed to be a truncated linear. Stochastic Frontier model for panel data is defined as:

$$Y_{it} = \exp (X_{it}\beta + v_{it} - u_{it}) \quad \text{.....} (1)$$

Where $Y_{it}$ denotes the own tax revenue for i-th (i= 1, 2,....., N) state at t-th (t=1, 2,….., T) time;

$X_{it}$ is (1×K) vector of inputs affecting tax revenue;

$\beta$ is a (k×1) vector of unknown parameters**;**

Error component is decomposed into two parts $v_{it}$ and $u_{it}$**:** $u_{it}$ is a non-negative error component which represents the time varying technical inefficiency term and $v_{it}$ is white noise term with symmetric distribution. It can take value negative or positive. Inefficiency term obtained from this model is assumed to be linear function of explanatory variables $Z_{it}$**,** which could be specified as**:**

$U_{it} = Z_{it}\delta + W_{it}$

Where $W_{it}$ is a random variable, assumed by truncation of normal distribution with zero mean and variance.

Within Panel data models, there are a few models which estimate time-varying random effect models (for example, Battese and Coelli, 1995; Green, 2005) (Belotti et al, 2012). For the estimation of inefficiency models, we have applied Battese and Coelli (1995) model. This model estimates parameters of the stochastic frontier and the inefficiency model simultaneously to avoid bias (Wang and Schmidt, 2002). This model also captures time-varying inefficiency that reflects heterogeneity using maximum likelihood estimation technique.

## 5. Results and Discussions

In this section, tax capacity and tax effort is computed for 17 major Non- Special category states during the period of 2001-02 to 2015-16. The estimated results for determinants of own tax revenue is reported by using stochastic frontier approach presented in Table 2. Further, this model has been used to compute tax effort indices of the states over the years.

**Table 2: Estimation of Tax Revenue and Technical Inefficiency: Stochastic Frontier Approach (2001-02 to 2015-16)**

| Ln OTR-GSDP ratio (Dependent Variable) | Coeff. | Std. Error | p-value |
|---|---|---|---|
| Ln real GSDP | 0.154640 | 0.016217 | 0.000 |
| Ln Literacy Rate | 0.477994 | 0.117758 | 0.000 |
| Ln Per Capita Power Consumption | 0.108523 | 0.026446 | 0.000 |

| | | | |
|---|---|---|---|
| FRBM dummy | -0.078362 | 0.046839 | 0.094 |
| Constant | -7.184993 | 0.541326 | 0.000 |
| Inefficiency Equation | | | |
| Ln real PCNSDP | -0.042005 | 0.019859 | 0.034 |
| Ln lag share of central transfers in total revenue | 0.104692 | 0.040664 | 0.010 |
| Ln lag share of total expenditure in GSDP | -0.920899 | 0.053783 | 0.000 |
| Ln lag share of outstanding debt in GSDP | 0.222204 | 0.046156 | 0.000 |
| vatdum | 0.007453 | 0.048278 | 0.877 |
| N | 253 | | |
| Log-Likelihood | 57.8721 | | |
| Sigma_u | 0.053856 | 0.091871 | 0.558 |
| Sigma_v | 0.184815 | 0.028135 | 0.000 |
| Lambda | 0.291404 | 0.118892 | 0.014 |

In Table 2, signs of coefficients of variables are in line with the reasoning of theoretical perspectives. Real GSDP was positively and significantly associated with own tax to GSDP ratio. This indicates that share of economic activity is an important factor in determining capacity of own tax revenue. Literacy rate and per capita power consumption found to be positive and significant impact on tax capacity. In tax inefficiency model, the results are robust in this specification. The lambda parameter is statistically significant, which means presence of technical inefficiency in model. The negative sign of coefficient on variables indicates positive impact on tax-effort. Share of Central transfers in total revenue, one year lag of central transfer as a proportion to total revenue and outstanding liabilities with one year lag found to be positively and significantly associated with tax-inefficiency which indicates negatively associated with tax-effort. Proportion of total expenditure in GSDP reported negative sign and significant at 1 percent level indicates positive impact on tax-effort.

Table 3 reveals that wide variation in tax effort scores obtained from the inefficiency equation. The table represents state wise tax effort scores for financial years 2001-02, 2005-06, 2010-11 and 2015-16. The tax-effort ranking which is based on the efficiency scores reported that tax effort of Punjab declined over the reference years. During this period, tax-effort ranking of Punjab declined from the 5th position in 2001-02 to 9$^{th}$ in 2010-11 and slipped to 15th position in 2015-16. This indicates that Punjab made low tax-effort to reach potential tax base. Andhra

Pradesh, Bihar and Goa were found to be top three states with highest efficiency scores over a reference period. Against this background, states need to improve their tax-effort in order to reach their potential tax base. This will help states to achieve their fiscal sustainability.

**Table 3: Tax Effort Index and Rank of States: SFA Approach (2001-02 to 2015-16)**

| State | 2001 | Rank | 2005 | Rank | 2010 | Rank | 2015 | Rank |
|---|---|---|---|---|---|---|---|---|
| Andhra Pradesh | 0.636 | 2 | 0.661 | 1 | 0.624 | 1 | 0.670 | 3 |
| Bihar | 0.878 | 1 | 0.410 | 13 | 0.481 | 3 | 0.728 | 2 |
| Chattisgarh | - | - | 0.361 | 16 | 0.388 | 11 | 0.732 | 1 |
| Goa | 0.610 | 3 | 0.572 | 2 | 0.573 | 2 | 0.631 | 7 |
| Gujarat | 0.524 | 4 | 0.405 | 14 | 0.353 | 14 | 0.425 | 16 |
| Haryana | 0.421 | 9 | 0.430 | 11 | 0.425 | 7 | 0.4654 | 13 |
| Jharkhand | - | - | 0.488 | 6 | 0.457 | 4 | 0.546 | 10 |
| Karnataka | 0.442 | 6 | 0.517 | 3 | 0.398 | 8 | 0.524 | 11 |
| Kerala | 0.406 | 12 | 0.415 | 12 | 0.340 | 17 | 0.547 | 9 |
| Madhya Pradesh | 0.426 | 8 | 0.511 | 5 | 0.454 | 5 | 0.643 | 5 |
| Maharashtra | 0.435 | 7 | 0.4374 | 9 | 0.3494 | 16 | 0.411 | 17 |
| Odisha | 0.403 | 13 | 0.397 | 15 | 0.390 | 10 | 0.638 | 6 |
| Punjab | 0.454 | 5 | 0.514 | 4 | 0.394 | 9 | 0.451 | 15 |
| Rajasthan | 0.413 | 11 | 0.447 | 8 | 0.369 | 13 | 0.575 | 8 |
| Tamil Nadu | 0.414 | 10 | 0.463 | 7 | 0.386 | 12 | 0.503 | 12 |
| Uttar Pradesh | 0.379 | 15 | 0.4372 | 10 | 0.449 | 6 | 0.644 | 4 |
| West Bengal | 0.384 | 14 | 0.350 | 17 | 0.3495 | 15 | 0.4651 | 14 |

## 5. Conclusion

This paper investigates the tax-capacity and tax-effort during the period 2001-02 to 2015-16 for a panel of 17 Indians states through Stochastic Frontier Approach. Andhra Pradesh found to be most efficient in tax-effort and West Bengal was found to be least efficient on the basis of ranking on tax-effort. The results of empirical analysis of tax-capacity and tax-effort revealed that Punjab did not utilize effectively its potential tax base. Overall, it can be concluded

that Punjab had a low tax capacity and low tax effort. It requires more effort to tap its untapped tax potential. This enables Punjab to correct fiscal imbalance and attain fiscal sustainability.

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