Frontier analysis for State Excise in India

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1. Trends in excise

Article 246 (Seventh Schedule) of the Constitution contains the legislative powers of the Union and State Government. These powers include making of law with respect to goods and services. The schedule includes three lists- Union, Centre and Concurrent. Items listed in the State List are those on which states have the power to make the law. State excise duty is Entry number 51[1] in the State List. Thus all alcoholic liquors for human consumption and opium, Indian hemp and other narcotic drugs and narcotics are subject to state excise duty. Further, medicinal and toilet preparations with alcohol content are also subject to such levy[2]. Since alcohol is a demerit good and its consumption has health implications, states regulate consumption through licensing of production and sale[3] as well as with the levy of state excise[4].

Broadly, the alcoholic beverages subject to state excise are classified under the heads- Country Spirits, Country fermented Liquors, Malt Liquor, Liquor, Foreign Liquors and Spirits, Commercial and denatured spirits and medicated wines. The rate applicable on each of these varies. Thus state excise is a tool to regulate consumption[5] as well as an important source of revenue. Except for Gujarat, Nagaland, Mizoram and Manipur where liquor has been prohibited, excise is an important source of revenue for states. Table 1 shows that the share of state excise in own tax revenues (OTR) is substantial for most

[1] Duties of excise on the following goods manufactured or produced in the State and countervailing duties at the same or lower rates on similar goods manufactured or produced elsewhere in India:-
(a) alcoholic liquors for human consumption;
(b) opium, Indian hemp and other narcotic drugs and narcotics, but not including medicinal and toilet preparations containing alcohol or any substance included in sub-paragraph (b) of this entry.

[2] Medicinal and Toilet Preparations (Excise Duties) Act, 1955

[3] https://blog.ipleaders.in/liquor-laws/

[4] As per entry 84 in 7th schedule of the Constitution, the central government can impose duties of excise on tobacco and other goods manufactured or produced
in India except—
(a) alcoholic liquors for human consumption;
(b) opium, Indian hemp and other narcotic drugs and narcotics, on alcohol.

[5] Para 4.4, Page 156, Final Report of the Tax Reforms Commission (2001)

states. However, the share of excise has changed dramatically, over the period 2001-15, for some of the states. In 2001-02, Punjab, Haryana and Karnataka were among the top three states in terms of the share of excise in own tax revenues. Followed by Rajasthan, Tamil Nadu and Chattisgarh. In fact, a quarter of Punjab's revenues were on account of excise. In 2014-15, the contribution of excise to own tax revenues nearly halved for Punjab and Tamil Nadu and registered a decline for Rajasthan and Haryana.

As a source of revenue for states, excise duty remained "unpredictable and fluctuating revenues"[6] in the 1990s owing to fairly regulated consumption. Even in recent times, volatility has been observed in the state excise revenues, not just in terms of the share in revenue but also in proportion to GSDP. Note than for some of the states there has been a decline in the excise to GSDP ratio in the years following 2010 (Figure 1). The excise collections have declining steadily for states such as Haryana and Punjab. The share of excise revenues in GSDP has declined sharply for Tamil Nadu and Andhra Pradesh. The decline in share for Tamil Nadu has been attributed to the change in the liquor order process favouring local players[7].On the flip side, states such as Karnataka, Madhya Pradesh, Odisha and Bihar witnessed an increase over 2001 to 2016.

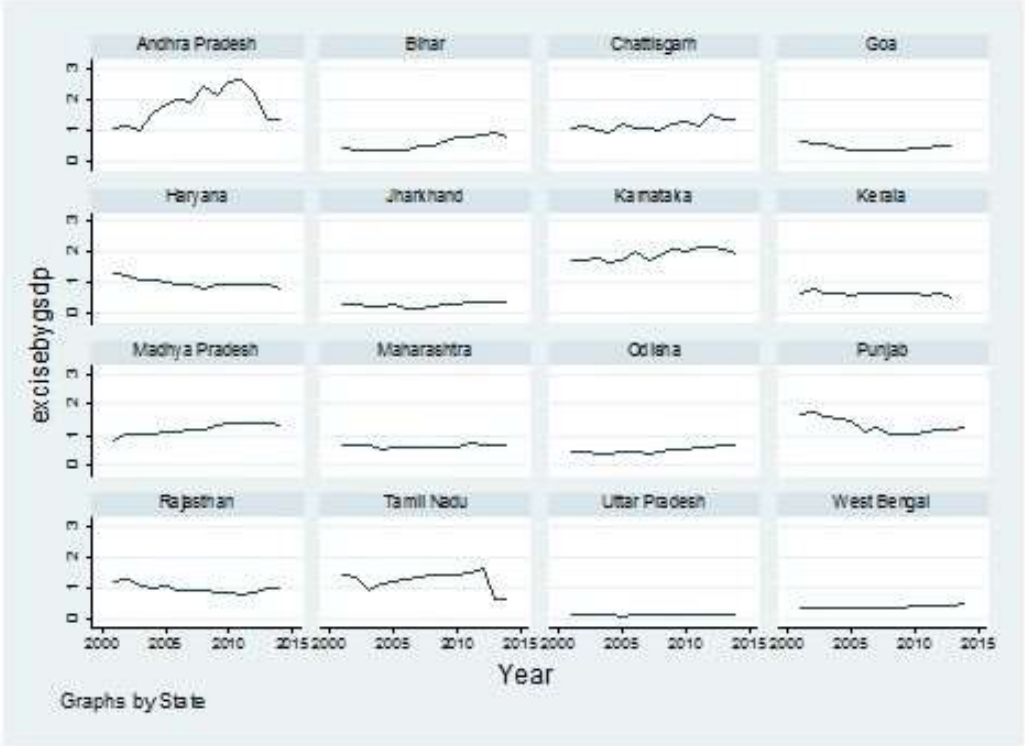
[6] para 4.2, page 155,Final Report of the Tax Reforms Commission (2001)
[7]http://www.thehindubusinessline.com/news/national/tns-liquor-policy-hits-spirits-industry/article6416607.ece

Table 1 Share of state excise in own tax revenue

State	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16
Andhra Pradesh	11.2	11.4	10.7	9.9	10.8	11	10.7	13.5	13.1	14.4	14.2	12	7.7	8.1	7.8
Bihar	3.3	3	2.8	2.8	2.9	2.9	3.2	3.8	5.8	6.2	6.7	6.6	7.4	7.2	5.3
Chattisgarh	10.5	10.7	10.8	10	10.8	9.8	10.1	10.2	12.2	12.2	11	14.1	13	13.7	12
Goa	7.1	6.8	6.6	5.7	4.3	3.8	4.7	4.5	5.2	5.6	6.1	6.2	5.7	6	
Gujarat	0.5	0.4	0.4	0.3	0.3	0.2	0.2	0.2	0.2	0.2	0.1	0.1	0.2	0.2	0.2
Haryana	16.5	14.2	13.5	12.9	11.1	10.3	10.8	11.1	14.4	13	12.9	12.7	13.3	11.6	12.6
Jharkhand	3.5	3.2	2.8	3.6	3.2	2.2	2.3	2.8	4.2	4.1	4	4.3	4.1	4.5	4.1
Karnataka	16.6	16.6	15.6	15.1	15.7	16.7	15.6	17.7	19.9	18.7	18.4	17.9	17.9	17.3	16.7
Kerala	7.6	7.7	6.9	7	7.2	6.7	7.1	7.4	7.5	6.8	6.4	6.7	5.3	4.4	4.1
Madhya Pradesh	9.6	9.8	11	10.5	10	9.6	9.8	11	12.4	11.6	11.4	11.6	12.1	12.8	11.9
Maharashtra	7.7	7.9	8.4	6.7	7.6	7.5	7.5	7.7	7.9	7.3	9	8.2	8.4	9	8.5
Odisha	4.5	4.9	4.5	4.4	4.6	4.2	4.3	4.9	6.1	6.2	6.6	6.2	6.6	6.7	6.6
Punjab	25.5	23	21.8	19.6	15.9	13.6	16.6	14.4	15.8	12.7	13.1	13.2	13.9	14.8	14.9
Rajasthan	14	13.2	11.8	11.1	11.1	9.8	9.5	10.3	10.5	10	9.5	9.6	10.9	10.8	10.9
Tamil Nadu	13.5	12.6	8.9	11.4	11.8	12.4	13.6	14.6	16.2	14.9	14.8	15.1	6	6.4	6.2
Uttar Pradesh	10.7	12	10.5	10.2	9.6	9.1	8.8	9.5	10.8	9.9	9.8	10.3	10.8	11.5	9.8
West Bengal	5.2	5.3	4.9	4.6	4.9	4.7	4.6	4.9	6.1	5.8	5.8	5.6	5.9	6.5	

Source: Estimated from state finance statistics

Figure 1: Share of Excise in GSDP 2001-2016



Source: Estimated from state finance statistics

Among the focus states of this paper (Tamil Nadu, Rajasthan, Gujarat and Bihar) inspite of the decline in the share of excise, it still accounts for more than 10 per cent of Rajasthan's OTR. Note that since Gujarat has banned the sale of alcohol, the share of excise is close to zero. As for Bihar, over the decade the share of excise had nearly doubled from 3.3 per cent in 2001-02 to 7.4 per cent in 2013-14. Though such improvement is observed for Bihar in recent times, with the prohibition taking effect in 2016, this source of revenue will no longer be available. Thus various policy measures can impact these revenues. For example, ban on sale of liquor or setting up of beverage corporations, used by states for administering different measures such as improving the efficacy in revenue collection or to regulate consumption.

In the following sections the efficiency in state excise collection is estimated for Bihar, Rajasthan and Tamil Nadu[8] using stochastic frontier approach. While estimating the efficiency some of the policy measures are taken into account. Based on the estimated efficiency, revenues are projected for the years 2016-17 to 2022-23.

[8] note Gujarat has been dropped from the analysis since sale of alcohol is prohibited and the share in excise is only 0.2 per cent.

2. Efficiency in collection of state excise

2.1 Methodology

States are often constrained by fiscal rules thereby limiting their capacity to spend. Thus to be able to provide more goods and services they would have to collect higher revenues. In this context it is important for the states to evaluate if the states collect the taxes equivalent of their potential.Tax potential is defined as the tax ratio that would result if an economy uses all its resources and ability to collect all obtainable tax revenues from given bundles of determinant characteristics (Alfirman, 2003). In the literature, several methods are employed to measure the distance from the potential. The more traditional approach was based on a linear regression, where the tax potential was estimated using an OLS model (Lotz and Mors, 1967; Leuthold, 1991; Tanzi, 1992; Stotsky and WoldeMariam, 1997; Ghura, 1998; Piancastelli, 2001; Eltony, 2002; and Gupta, 2007). Though the approach is simple its main limitation is that the error or the measure of inefficiency may contain random component (Rao, 1993). Subsequently, studies used the Stochastic Frontier Approach (SFA). This method was proposed by Aigner, Lovell and Schmidt (1977) and Meeusen and van den Broeck (1977) to estimate firm production and technical efficiency. Later it was adapted to measure efficiency in tax. Although analogous to a production function, there are two differences between a production frontier and a tax frontier. First, output by a firm is produced using specific inputs whereas the inputs for tax revenue are less definite or clear. Second, there is difference in interpretation of results. While in the case of the production frontier the difference between the *actual* and the *potential* is inefficiency that for tax capacity includes existence of technical inefficiencies as well as policy issues such as difference in the level of tax rates (Pessino and Fenochietto, 2010). The SFA modifies the regression approach by putting a bound on the dependant variable and estimates using the maximum likelihood method to panel data (Brun and Diakite, 2016). Further, the error in the SFA is divided into two or more parts.

The first set of models used by Pitt and Lee (1981), Schmidt and Sickles (1984) and Battese and Coelli (1988) were time invariant. That is, in these models the country could not improve its tax performance over time. These were of the form-

$$logY_{it} = \alpha + f\,(logX_{it};\, \beta) + s_{it} \qquad (1)$$

$$s_{it} = v_{it} - u_i \qquad (2)$$

In the above equation log X_{it} represents the vector of structural factors that determine the country's or state's capacity to tax. β is the associated vector of parameters, $v_i t$ is two-sided random statistical noise and $u_i \geq 0$ is one-sided efficiency term. The error term, as was mentioned earlier was time invariant, an assumption that may not be credible. Battese and Coelli (1992) improved upon this by allowing the inefficiency component to change over time exponentially.

$$logY_i t = f\,(logX_i t;\, \beta) exp(v_{it} - u_{it}) \qquad (3)$$

$$u_i t = \eta_{it} u_i = exp[-\eta(t - T\,)]u_i \qquad (4)$$

For countries that improve their tax performance $\eta \geq 0$ and for those where it worsens $\eta \leq 0$. Note that the efficiency term can be half-normal distributed, truncated normal distributed or exponential. The half normal distribution assumes that the mode in the distribution is zero (Pascoe et al., 2003). "The assumption underlying is that the proportion of tax administrations achieving their potential is the greatest. However, the truncated distribution which is more general, assumes that this proportion can vary. Here the mode in the distribution is positive" (Brun and Diakite, 2016). Battese and Coelli further modified the model in 1995[9]. By replacing u_{it} linear function of explanatory variables reflecting producer-specific characteristics.

Within the time variant models there is no specific model with an absolute advantage over others (Karagiannis and Tzouvelekas, 2009). Further, there is no statistical criteria to discriminate among them since the models are not nested[10] . Thus the selection of model depends on the "objectives of each empirical application or with data availability as well as the underlying hypotheses" (Karagiannis and Tzouvelekas, 2009). BC (95) allows for time variance of efficiency as well as firm specific effects. The improvements introduced through the true random effects and true fixed effects are able to measure transient component of inefficiency. Time variant models perform better, however there have been improvements over the years and the choice of models available

[9] from hereon referred to as BC95

[10] Maximum likelihood models are not in general nested to each other. Battese and Coelli's (1992) model specification is nested to that of Cuesta (2000) but not to that of Huang and Liu (1994) or to that of Battese and Coelli (1995). On the other hand, while random and fixed effects models can be statistically discriminated by means of LaGrange multiplier (LM) test, the same is not feasible for the various specifications of time-varying technical efficiency. Lee and Schmidt (1993) model specification nests that of Kumbhakar (1990) but not that of Cornwell et al., (1990).

for estimating efficiency are true random effects, true fixed effects and BC (95). Given that TFE and TRE models are ideally good and suitable for long panels (Belotti (2013), the BD (95) model is selected.

2.2 Estimates

As discussed in section 1, state excise duty is levied on alcohol. Therefore, the base for this tax is the alcohol consumption. There are various indicators of increase in consumption of alcohol that can be taken. Firstly, households alcohol consumption per month is captured by the NSS' household consumption survey. Further, the expenditure by type of alcohol is also reported. It is expected that states where households report higher monthly consumption of alcohol the revenues collected from excise will be higher. Thus monthly per capita consumption of alcohol are introduced in the estimated equations[11].

The consumption of alcohol in a state may not be solely that of locals, it is expected that states that attract higher tourists will also witness higher sale of alcohol. Thus contributing to excise revenues. Therefore number of domestic and foreign tourists visiting each state in a year, reported in India Tourism Statistics, is used for estimating the equation.

Further, the structural characteristics of the state, i.e. if it is service or agriculture dependent economy can have an impact on the pattern of consumption, that includes alcohol. For example, if a large fraction of the incomes earned in the state are from the service sector, then one may infer higher disposable incomes in the state that in turn may lead to relatively high value of consumption of alcohol. That is, the consumption value could be higher owing to higher incomes or higher value liquor being consumed. On the other hand, in states where agriculture or mining contribute a large share, the alcohol consumption may be relatively low. Therefore shares of mining, manufacturing and services are introduced to the equation.

Further, states with higher inequality may have lower consumption of alcohol. That is, with a large fraction of population that have low levels of income may result in lower levels of overall per capita consumption, that would include spending on alcohol. Thus

[11] This is reported by type i.e. foreign liquor, beer and country liquor and separately for rural and urban. All of these were used.

urban gini is introduced to the model[12]. Lastly, GSDP represents the income in a state. The consumption will depend on incomes therefore the GSDP provides a proxy for the tax base. Thus GSDP has been used across specifications[13]. The estimated equations are summarised as follows-

$$logexcise_{state,t} = \alpha + logttSDP_{state,t} + \beta_1 logtouriste_{state,t} + \beta_2 shareof\ manuacturinginttSDP_{state,t} + \upsilon_{state,t} - u_{state,t} \quad (5)$$

$$logexcise_{state,t} = \alpha + logttSDP_{state,t} + \beta_1 logtouriste_{state,t} + beta_2 shareof\ servicesinttSDP_{state,t} + \upsilon_{state,t} - u_{state,t} \quad (6)$$

$$logexcise_state,\ t = \alpha + \beta_1 logttSDP_{state,t} + \beta_2 logtourist_{state,t} + \beta_3 shareof\ servicesinttSDP_{state,t} + \beta_4 urbangini_{state,t} + \upsilon_{state,t} - u_{state,t} \quad (7)$$

The Table 2 presents the results for the estimated coefficients and Table 3 presents the numbers for the estimated inefficiency.

Table 2: Estimated equations

Variable	1	2	3
log tourist	0.07***	0.067***	**0.084*** **
log GSDP	0.98***	0.9***	**0.89*** **
share of services in GSDP		0.007***	**0.06*** **
share of manufacturing in GSDP	0.01***		
Urban Gini			**-4.58*** **
Constant	-5.18***	-3.79***	**-2.33*** **
lamda	**4.94**	**6.15**	**8.76**

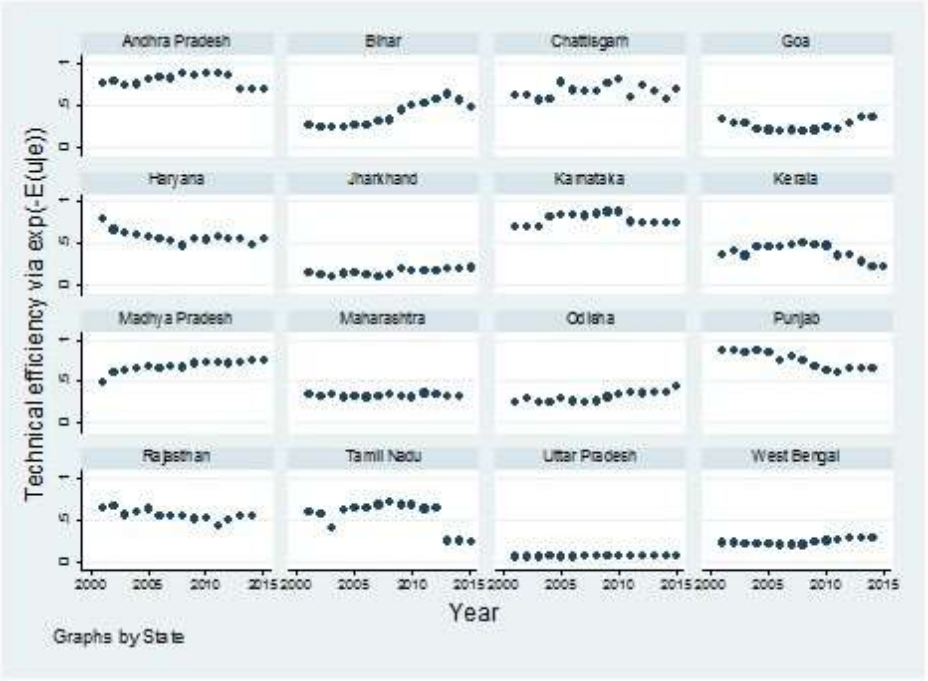
From the estimated equations it is observed that the number of tourists visiting a state, the GSDP, share of service and share of manufacturing have a positive impact on excise collections. Whereas, greater inequality tend to lower revenue collected from excise.

[12] both urban and rural gini were used, but the former turned up significant

[13] note that other variables such as share of urban population and share of tribal population were introduced to states however these do not turn up as significant and hence are not reported

All the models perform well in terms of predicting efficiency. However, one of these will have to be selected for the purpose of projecting future revenue streams. From the above models, the first specification is selected based on the LR test[14]. The efficiency estimates from model 1 are reported in Figure 2.

Figure 2: Efficiency estimated as a percentage of potential



3. Projection for states

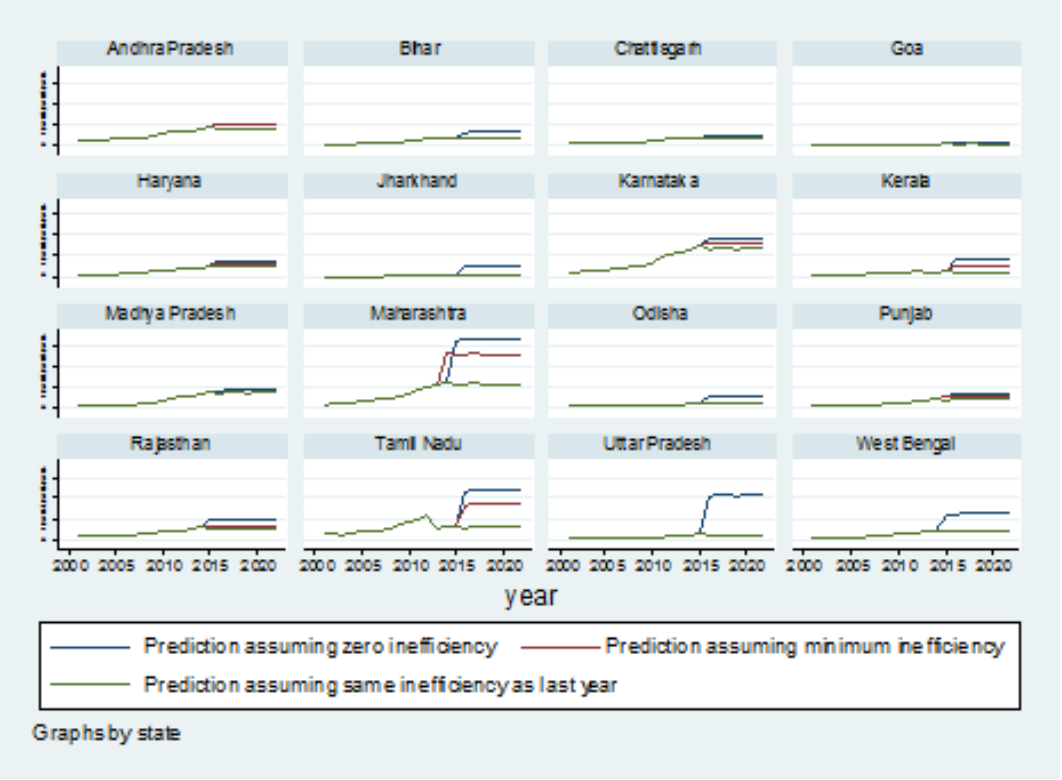
Although these estimates are not usually used to forecast. Using the estimated inefficiency the growth in revenue can be predicted. As was shown in the previous section the inefficiency is time varying and varies across states. Using the estimates from stochastic frontier model, the state excise revenues are projected for forward for years 2017 to 2023 for three scenarios. In order to do so, the number for GSDP, tourists and share of manufacturing used. One, inefficiency is constant, Two, inefficiency declines to the period minimum and Three when inefficiency declines to zero. For predicting we take the moving average for tourists and share of manufacturing[15]. Whereas the GSDP

[14] check appendix tables A.1-3

[15] the moving average takes care of volatility in the numbers.

numbers are projected forward by comparing the national average nominal growth rate with the state average and then applying that ratio to IMF projections for GDP growth in the years 2017 to 2023.

Figure 3 Share of Excise in GSDP projected based on efficiency estimates



As can be seen from Figure 3, there are states where significant revenue gains can be achieved through a decline in inefficiency. These include states such as Maharashtra, Tamil Nadu, Uttar Pradesh and West Bengal. Whereas most other states are operating close to full efficiency. With the prohibition in effect in Bihar, the above projections can be interpreted as the revenues that the State could have earned.

Appendix

Table A.1: LR test for model 1 and 2

Specification	AIC	BIC
2	500.9	525.12
1	506.8	531

Note: degrees of freedom 3

Table A.2: LR test for model 1 and 3

Specification	AIC	BIC
1	506.8	531
3	489.4	517.1

Note: degrees of freedom 3

Table A.3: LR test for model 2 and 3

Specification	AIC	BIC
2	500.9	525.12
3	489.4	517.1

Note: degrees of freedom 3

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