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Sub-National VAT**

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THE REVENUE EFFICIENCY OF INDIA'S SUB-NATIONAL VAT

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1. INTRODUCTION

The rise of the value-added tax (VAT) has undoubtedly been one of the most significant tax developments since its inception in 1954 in France. The main reason for the popularity of the VAT is its efficiency over other types of indirect taxes. Not only does it eliminate production inefficiencies associated with the turnover tax, it also is generally thought to be superior to retail sales taxes as they are more vulnerable to evasion and avoidance and they may lack a “self-policing” aspect of administration. The self-policing of the VAT has a higher probability of exposing forged accounts and an informal economy than the retail sales tax (Bird 2005 and Agha et al 1996). Primarily for the same reason, a VAT is generally regarded as a more promising consumption tax for developing countries where the size of the informal sector is large. However, opponents of the VAT do not quite agree. Some studies argue that the opposite is true. For example, Emran and Stiglitz (2005) show that in the presence of a substantial ‘informal’ sector, the VAT that falls on the formal sector acts to deter the growth and development of the economy as a whole. Also, the retail sales tax may be cheaper to administer since there are fewer taxpayers and thus it is less complicated. Despite these contradictory views, the VAT has replaced some version of a retail sales tax regime in many developing countries and it continues to do so.

From the arguments advanced above, questions which naturally come to mind are: do countries with the VAT have a more efficient system than the ones without it? Has the VAT improved revenue mobilization in these countries? There is no simple way to answer these sorts of questions. The answers clearly depend on many factors including the federal structure of the country we are looking at, the type of VAT (national or sub-national, origin or destination based, income-type or consumption-type), the base of the VAT, threshold limit, and many other design

features. Additionally, no one type of a VAT is supreme to the other. Different VATs may be best for different nations at different points of time as Bird (2005) points out that ‘*no one size fits all*’. Therefore the questions raised above demand empirical investigation.

Nellor (1987) performed one of the earliest analyses of the impact of a VAT on revenue growth on a sample of 11 European countries and his results establish that the VAT improves revenue performance. Bogetic and Hassan (1993) examine the main determinants of VAT revenue using a cross country framework of 34 countries. Their main findings show that, other things being constant, the VAT generates higher revenue in countries with a single VAT rate than in countries with multiple VAT rates. Keen and Lockwood (2010) answer the same question using a panel of 143 countries over 26 years. They establish that in general the VAT has a significant but modest effect on the revenue performance. Martinez and Bird (2011) build on the empirical question of Keen and Lockwood (2010) using different econometric techniques and focusing more on the comparisons of the impact on developing versus developed countries. Their research shows that the positive effect of the VAT is significant only in the developing countries.

At the same time, other related studies provide evidence of poor revenue performance of a VAT in low-income countries¹. Bird and Gendron (2006) assert that the unsatisfactory performance of the VAT in developing countries is grounded in its inefficient administration and poor tax design. Tanzi (1992) points out the formidable challenges faced by developing countries in the establishment of efficient tax systems. These include large informal sector activities, a large share of agriculture in total output and employment, many small establishments, and limited capacity of the tax administration. Also, opponents of a VAT argue that a broken VAT chain gives rise to production inefficiencies and this could more than offset the benefits from the VAT leading to an overall reduction in the efficiency. All this cited research brings out one critical fact, that is, in reality, the presence of the VAT *may or may not* improve overall government revenue performance and efficiency.

Effective implementation of a sub-national VAT gets more challenging because of cross

¹ Baungsaard and Keen (2005) raise concerns of revenue gains from a VAT in low-income countries. Emran and Stiglitz (2005) show that the VAT reduces welfare in the developing countries.

border trade² and the non-uniformity of VAT rates across states or regions within a country³. All these facts make it imperative to empirically evaluate performances of the existing VAT reforms to better understand their accomplishments and to continually improve their designs. This paper explores the performance of a recently implemented consumption type, sub-national VAT in India. We believe it is a valuable contribution because performance of a sub-national, consumption type VAT is far from well-understood in low and middle-income countries.

The type of sub-national VAT which was put in place in India neither resembles the theoretically optimal form of a sub-national VAT suggested by McLure (2000)⁴ or Keen and Smith (1999)⁵ nor replicates a successful 'Dual-VAT' system thriving in Canada. The VAT in the states of India replaced an administratively complex and economically distortionary turnover type of sales tax. However, the homegrown design of a state level VAT casts concerns regarding its performance. As far as we know, no existing research work systematically examines the performance of the state level VATs introduced in India.

The purpose of this paper is to analyze changes in revenue efficiency of the tax system from substitution of a consumption type VAT for a turnover-type sales tax at the sub-national level in India. By *increase in revenue efficiency we mean an increase in the level of optimal revenue raised by a benevolent government*. We first build on the theoretical model developed by Keen and Lockwood (2010) by incorporating revenue dependent administrative and compliance costs of taxation in the model, to gauge the theoretical change in revenue efficiency from a tax innovation like a VAT. Our theoretical model also differentiates between long-run revenue dependent administrative costs and short-run exogenous administrative costs. We then proceed to empirically investigate a change in the revenue efficiency using data on all 29 states of India (including the national capital territory of Delhi) for 1990 to 2010. In the empirical analyses we

² The application of a VAT on the interstate trade is often pointed out as the most serious practical issue with the use of a sub-national VAT (Bird and Gendron (1998)). There is no general consensus on the best way to apply a destination-based VAT to the interstate trade. (McLure (2005) explains why a sales tax with a destination principle is more desirable). Bird (1993) points out other problems related to a sub-national VAT. These include coordination of federal and regional taxes, loss of macroeconomic control and high administrative and compliance costs.

³ The logical reasoning behind the existence of the non-uniform rates is to preserve the regional government's autonomy.

⁴ The sub-national VAT recommended by McLure (2000) is called Compensating VAT (CVAT). This VAT proposes a feasible solution for implementing a destination-based VAT on inter-state trade.

⁵ Keen and Smith (1999) propose a viable integrated VAT (VIVAT). This type of VAT implements differential tax rates on the interstate sales made to registered merchants and sales made to non-registered buyers (which implies final consumption).

use revenue per capita to measure the revenue efficiency.

The paper proceeds as follows. Section 2 broadly reviews the fiscal background of the states of India before the VAT in 1990s and briefly outlines the salient features of the existing state-level VAT. Section 3 explains the theoretical model, section 4 presents the results and section 5 concludes.

2. BACKGROUND

The states in India are classified as special and non-special category states by the Government of India (Saxena 1999). In 2001, 11 out of the 29 states were classified as the special category states (or less developed states), which share the common characteristics of poor infrastructure, hilly and difficult terrain, and large tribal populations⁶. They have limited revenue generating capacity of their own. According to the Gadgil formula which determines the allocation of central assistance for development to the states of India, special category states are given preference in terms of the development based financial assistance from the federal government over the non-special states.⁷

The second half of the 1990s is characterized by a period of fiscal crisis for all the states of India as they were grappling with serious erosion of state finances lead by unsustainable debt trends, low revenue collections, and a remarkable pressure on the availability of resources for the infrastructure and basic social services (World Bank, 2008). In the late 1990s, the state's own tax revenue (OTR) from direct and indirect sources remained between 6 to 7% of its Gross State Domestic Product (GSDP) for the non-special category states and between 2 to 3% for the special category states. While this OTR of the states was mostly decreasing between the years 1990 and 2000, states were consistently required to undertake increasing developmental responsibilities. Consequently, the states had to turn to an increased level of borrowing to meet their expenses. This led to an increase in their revenue deficits as an absolute figure and also as a proportion of the gross fiscal deficit.

⁶ Saxena (1999) and Das-Gupta (2011).

⁷ 30 percent of these funds to the states go to the special category states. In addition, 90 percent of the center's development plan assistance received by these states is in the form of grants and just 10 per cent is in the form of loans as opposed to 30 percent grant and 70 percent loan to the non-special category states.

The trend in the revenue deficit (RD, deficit on the current or revenue account as a percentage of GSDP) for the years 1991 to 2010 demonstrates that the severity of the state fiscal crisis was more intense in the non-special states (more developed states) as compared to the special category states. Due to fiscal pressures, state governments actively initiated various fiscal and institutional reforms in consultation with the federal government⁸. As a result of the improved economic growth in India from 2003-04 and the fiscal correction efforts initiated by the central and the state governments (World Bank 2008), the states achieved fiscal improvements starting from the early 2000s and the revenue deficit for the more developed states turned into surplus from 2006 to 2010.

Since 2000, the states initiated numerous fiscal reform measures to overcome the fiscal crisis. The implementation of the VAT was one of the most important tax reforms undertaken by the states on the revenue side in the second half of 2000s. The states realized that they needed an innovative and efficiency improving strategy to augment their revenue receipts.

Indirect taxes have always been more important than direct sources of taxes in developing countries at the sub-national level. India is no exception to this as demonstrated in Table 1. The first column of Table 1 reports the states' indirect tax revenue (ITR) from its own sources as a percentage of OTR. ITR measures revenue collected by the states from taxes on commodities and services. The ITR as a percentage of OTR is roughly constant at 87% for periods prior to the VAT implementation and it has gone up slightly from 2006 to 2010, after the majority of the states of India embraced the VAT. The second column of Table 1 emphasizes the importance of the sales tax component of ITR. It shows the average revenue for the states from the sales tax (and then after the substitution of the VAT for the sales tax, it shows the average revenue from the VAT) as a percentage of the state's ITR. This percentage has also gone up to 64.4% in the period after the VAT adoption.

At the state level, the existing sales tax component of the indirect tax system was replaced by the VAT between 2003 and 2008. Previous to VAT, the state governments used a turnover type sales tax on goods⁹. Since it was a turnover type tax, states ended up taxing input goods as well as final consumption. This double taxation created incentives for vertical integration of firms

⁸ Reserve Bank of India (RBI), State Finances (2002-03) and (2003-04).

⁹ The states can levy a sales tax only on commodities. States can tax certain services but separate indirect taxes are collected on them. The majority of services have always been taxed by the federal government.

in the production chain. In addition to this inefficient form of sales tax, most states used to levy an additional tax called surcharge tax on final consumption goods. Furthermore, there existed other inefficient forms of indirect taxes which were charged on the interstate sale of goods such as an entry tax¹⁰ and a central sales tax (CST)¹¹. Such a complex taxation system is expected to impose significant compliance, administrative and distortionary costs. To remove these inefficiencies, a VAT at the state level was proposed and instituted in all of the states by the end of 2008. The Government of India (GOI) expected the VAT to rationalize the overall tax burden, eliminate inefficiencies, decrease tax evasion and eventually lead to the state's tax revenue growth. VAT successfully replaced the turnover type sales tax of the states. The states also got rid of the additional surcharge taxes at the time of their transition to the VAT. However, some states held onto the entry taxes. Additionally, CST continued to exist with the adoption of VAT although its rate was decreased in 2006.

On 17 January 2005, a government committee released the White Paper on State Level Value Added Tax (White Paper) which revealed the salient features of the sub-national VAT. The White Paper mentions that the VAT is a state subject. It laid down the foundation of a common model and each state was expected to develop its own VAT legislation from that base. The states were able to choose certain features, for example the threshold limit and the specific list of the exempted goods. Three main rates were outlined by the central government: a 12.5% standard rate, a 4% reduced rate which is applicable to most of the items of basic necessities¹², and a third rate of 1% which is applicable on gold, silver and precious and semi-precious stones. All of the states uniformly adopted all the three VAT rates outlined by the central government at the time of their transition to the VAT. However, since 2010, some of the states, at their own discretion, increased the standard rate from 12.5% to 14% or 14.5% or 15% and some have increased the 4% rate on the basic necessities to 5%. These rates exist in addition to a specific category of exempted goods¹³.

¹⁰ Entry tax is a tax charged by the state governments of India on goods at the time of their entry into the state in the form of inter-state trade or country's imports.

¹¹ CST is charged by the exporting state on the inter-state sale of goods. It is distortionary as the tax on inputs in the form of CST is not refunded in the importing state even after the adoption of the state-level VAT.

¹² These include goods such as medicines, agricultural and industrial inputs, capital goods etc. This category includes 270 goods approximately on average.

¹³ The states have the discretion to decide which goods to exempt from VAT with some restrictions by the central government.

The state-level VAT allows input tax deductions on the basis of invoices with respect to the purchases made within the state for the purposes of both sales within the state and other states. In the case of capital goods, the input tax is deductible over a period of one year from the date of purchase. The state VAT does not allow input tax deductions on petroleum or natural gas as these are not treated as inputs by the state governments.

Haryana was the first state to introduce a VAT on its own initiative. According to the White Paper, all the other states agreed to embrace the VAT on April 1, 2005 but later seven states backed out. Six out of these seven states were ruled by the BJP political party (opposition party at the center). Five of these six states adopted the VAT in the following year. By 2008, all 29 states (including the national capital territory) had replaced their turnover type sales taxes on goods with the VAT. Figure 1 shows the adoption of the VAT by the states¹⁴ of India by year on a geographical map.

The next section develops a theoretical model to gauge a change in the optimal level of revenue from the change in the use of an indirect tax instrument from one type to another.

3. THEORETICAL FRAMEWORK

We start with the model of Keen and Lockwood (2010, p. 140) and consider an economy with a representative consumer with preferences $U(C, G)$ defined over private consumption C and public expenditure G . Utility (U) is strictly increasing in both of its arguments and is quasi-concave. Let C represent consumption of a normal good. Public expenditure is financed by a type of tax instrument (V) that generates revenue R . This tax instrument may be a distortionary tax. Given R represents the level of revenue from this type of tax, consumer's welfare is $U(Y-R, R)$ where Y is the consumer's pre-tax income. Note that the revenue level $R = G$ where G is the level of expenditure on the public good and $C = Y - R$. Consequently, in this model the government operates a balanced budget and we assume no presence of externalities. When government tax revenue is equal to government expenditure ($R = G$) then revenue collection efficiency is one hundred percent. This happens when the revenue collection costs incurred by the government are zero and there is no leakage in the form of tax evasion or tax avoidance or in the form of corruption.

¹⁴ In 2000 three new states were carved out from three existing ones. Chhattisgarh was formed out of Madhya Pradesh, Jharkhand from Bihar and Uttarakhand from Uttar Pradesh. This increased the total number of states in India from 26 to 29.

The basic model of Keen and Lockwood (2010) is modified in the next sections to include endogenous compliance and administrative costs associated with the process of taxation. These two types of costs imposed by taxation play a compelling role in determining the effectiveness of a tax policy and theoretical implications of the model become more realistic with incorporation of these two important forms of costs.

Y is a function of R and V . In our empirical case a change in the tax instrument, V , can be thought of as a tax innovation brought about by the replacement of a turnover type sales tax by the consumption-type VAT. In this model Y is assumed to be a function of R in order to make more explicit the loss coming from the excess burden of a tax. The excess burden is a pure distortionary cost¹⁵ which arises from the act of levying an indirect tax. We assume that the utility loss created from excess burden is a function of the level of tax revenue raised because the excess burden increases (non-linearly) with the increase in tax revenue (as *deadweight loss* $\approx \frac{1}{2} \times \text{tax rate} \times \Delta \text{quantity}$). The decrease in Y for a one unit increase in R is defined here as marginal deadweight loss (MDL). Since it is a loss, it is negative and denoted by $Y_R < 0$ (throughout this paper subscripts denote derivatives). Also, since MDL increases with the amount of tax revenue, we have, $Y_{RR} < 0$ ¹⁶. The excess burden is also a function of the type of the tax instrument used (V) since each tax has its own welfare costs. This explains the dependence of Y on V . If a change in the tax instrument (or tax innovation like adoption of a VAT in our empirical analyses) raises the revenue productivity of the tax system then MDL decreases and $Y_{RV} > 0$. A decrease in MDL will increase the consumer's gross income which could be used to consume more of the private good or the public good or both. This will increase the consumer's total utility.

To summarize, Y decreases at an increasing rate as R increases. Y is also a function of V because V determines the magnitude of Y_R for every level of R . In the empirical analyses, V will be a dummy variable and it will take a value of one in the presence of a VAT.

This economy's benevolent government chooses R to maximize the representative consumer's utility subject to the balanced budget constraint. As shown in Keen and Lockwood (2010) the optimization gives rise to a modified Samuelson condition:

¹⁵ This distortionary cost is separate from administrative costs incurred by the government in the process of levying a tax.

¹⁶ We do not consider the special case of lump sum taxes or head taxes.

$$\frac{U_G}{U_C} = 1 - Y_R = 1 - MDL \quad (1)$$

At this point, suppose that the absolute value of Y_R decreases (or MDL decreases) because of an exogenous change in V (or a tax innovation). As a result, the right hand side of equation (1) will become smaller as compared to the left hand side. In order to restore the equality in equation (1), the consumption of the public good will go up and this in turn will increase the expenditure G and R . This illustrates that the fall in efficiency cost or MDL due to a change in V increases the optimum level of tax revenue (R^*).

We further refine Keen and Lockwood (2010) by introducing compliance and administrative costs in the model as two different types of costs and as a function of R . The compliance costs are introduced at the consumer's end because consumers bear this cost and the administrative costs come into play through the government's budget constraint because the government directly incurs this cost. Ignoring these costs in the revenue efficiency model will underestimate the overall costs of taxation and reduces the ability to differentiate among types of taxes. Also the compliance and administrative costs can be thought of as substitutes of each other to an extent. An increase in one may reduce the other—or vice versa.

The compliance costs are expected to be a function of the type of tax, V , and the level of revenue, R . With compliance costs, the modified equation for private consumption changes from the simple version of $C = Y(R, V) - R$ to the following:

$$C = Y(R, V) - R - t(R, V; h) \quad (2)$$

Where,

t = compliance costs

h = hours spent in maintaining and filing of tax records

All other variables in equation (2) are defined as before.

Maximizing the objective function

$$\max_R \{U(Y(R, V) - R - t(R, V; h), R)\} \text{ s.t. } G = R \quad (3)$$

We come to a modified version of equation (1):

$$\frac{U_G}{U_C} = 1 + (t_R - Y_R) > 0 \quad (4)$$

Equation (4) is the modified form of equation (1). In this equation the marginal rate of substitution between the public and the private good is equal to unity plus the marginal compliance cost (MCC which is denoted by t_R) and MDL.

Define TMC (total marginal cost) as:

$$TMC = MCC + MDL$$

$$TMC = t_R - Y_R$$

$$TMC > 0 \text{ since } t_R > 0 \text{ and } Y_R < 0$$

Therefore, $1 + (t_R - Y_R) > 1$ and $(1 + TMC) > 1$ in Equation (4)

Equation (4) can be re-written as:

$$\frac{U_G}{U_C} = 1 + TMC \tag{5}$$

In equation (5), TMC will change with a change in V (tax instrument), which will change the optimal revenue level R^* . A change in TMC depends on the change in MCC and MDL. If t_R (MCC) increases or Y_R (MDL) increases or both increase then TMC will increase. If t_R (MCC) decreases or Y_R (MDL) decreases or both decrease then TMC will decrease.

A change in V leading to an increase in the overall marginal cost or TMC will decrease the optimal level of tax revenue R^* raised by the government. On the other hand, a decrease in TMC will increase the optimal revenue level of R^* . A benevolent government is able to increase the representative consumer's welfare by increasing the tax revenue if and only if the total taxation costs borne by the consumer fall at the margin. Therefore, an increase in the optimal level of R^* is indicative of the use of a more efficient tax system. We now move on to introduce administrative costs in this model.

Administrative costs are the costs incurred by the tax levying authority or the government in the process of establishing and operating a tax system. The basic model presented above assumes that $R = G$ or that there are no collection costs, which is unrealistic. As the administrative costs come into play $G < R$ because the amount the government is able to spend on the public good G is strictly less than the revenue collected¹⁷. Part of the collected revenue is lost in the form of the

¹⁷ We assume no government borrowing.

administrative costs. Real world examples of such costs include computerization and technological advancement of the tax administrative system, tax audits conducted by the government to reduce tax evasion, training of the government employees in new technology, reforming of the tax laws and the maintenance of taxpayer's records. Before we discuss endogenous administrative costs and their inclusion in the model, we model the impact of an exogenous form of administrative costs.

Case of exogenous (or temporary or short-run) administrative cost

$$A = a(V, D, T) \quad (6)$$

where,

A = administrative cost

D = regional or country's characteristics which includes institutions, corruption, level of education and existing revenue productivity

T = time and

Administrative cost A depends on V as a change in the tax instrument is expected to lead to a modification of the existing tax collection system or installation of a new system. With the use of a new tax instrument, this cost could increase or decrease. This models a temporary impact of a change in V on A. The idea is analogous to some type of a start-up cost or a onetime exogenous shock in the government's administrative costs associated with a change in the tax instrument. This cost component has a short-run impact. A is also expected to be a function of some regional characteristics D and the time T. For example, for a given region, its specific institutional characteristics or the existing education level may keep the administrative costs of the government lower in this region as compared to other regions or states, thereby making it cheaper to administer any tax instrument. In the analysis presented below we consider a case of positive exogenous shock. The magnitude of an increase in the onetime costs or a positive shock is determined by the regional characteristics outlined by D. Such administrative costs when greater than zero reduces the amount of the tax revenue collected and make lesser amount available to the government for financing of the public good. As a result, the new budget constraint is as follows:

$$G = R - a(V, D, T) \quad (7)$$

With A given by equation (6), the new objective function is:

$$\max_R \{ U(Y(R, V) - R - t(R, V; h), G) \} \text{ s.t. } G = R - A \quad (8)$$

Optimization yields:

$$\frac{U_G}{U_C} = 1 + TMC \quad (\text{same as equation 5})$$

Where, $TMC = t_R - Y_R$ and $TMC > 0$

A change in the optimal level of R from a change in V for the modified maximization problem in the equation (8) is not the same as for the maximization problem in equation (3). With the change of V, now two things are changing simultaneously for every given level of R, which are the absolute values of A and TMC (MDL and MCC). A increases with a change in V for a given region at a point of time. With an increase in A with a change in V, the government expenditure on the public good G will decrease for a given level of revenue R. This follows from equation (7). As public expenditure decreases, the consumer is now able to consume less quantity of the public good as compared to before for the same amount of the tax revenue R. This¹⁸ will decrease the consumer's total utility but increase the marginal utility i.e. U_G . If this economy was in equilibrium before the change in V then, after the change, A will rise and the left hand side of equation (5) will be greater than the right hand side. However, this is not a complete description of the changes occurring. With a change in V, the absolute value of TMC may also change. The net effect on the optimal level of revenue R^* due to a change in V is determined by the magnitude and direction of the simultaneous changes in A, Y_R , and t_R in TMC.

One possible scenario is that a change in V increases TMC and also A. The final change in the optimal R is then determined by the magnitude of the increase in the two losses. The possible scenarios are included in Appendix A. The analysis in the appendix shows that when both the endogenous and exogenous costs are rising simultaneously, then the net effect on R^* could be an increase or a decrease (depending on the magnitude of the increase in the two types of costs). So the actual result remains an empirical question.

Finally, we consider the case of endogenous administrative costs. As the size of the government expands, the costs of administering the government may increase in absolute and/or relative terms. Therefore, an increase in R may cause an increase in A. However these administrative costs could increase with R at a decreasing rate because of the economies of scale.

¹⁸ Note that we are doing a purely partial equilibrium analysis here. Better tax administration in period zero may lead to higher consumption in period one, but we are not modeling the dynamic time component.

As in the case of compliance costs, we are not making any assumptions about the functional form of A. The only assumption we make here is that the administrative costs are revenue dependent in the long run and are directly proportional to R i.e. the first derivative of A w.r.t R is positive. The modified equation of A is shown below:

$$A = a(V, D, t, R) \quad (9)$$

A_R is defined as the marginal administrative cost (MAC) associated with a change in R. Following presents, the consumer maximization problem with A as a function of R.

$$\max_R \{U(Y(R, V) - R - t(R, V; h), G)\} \quad \text{s.t. } G = R - A$$

Once again maximizing and solving first order conditions leads us to the following result:

$$U_G/U_C = (1 + MCC - MDL)/(1 - MAC) > 0, \quad \text{where } MDL < 0 \quad (10)$$

Equation (10) presents the modified optimization rule when both the compliance and the administrative costs of taxation are present and are endogenous. The optimal level of revenue R^* should satisfy this equation in order to maximize the representative consumer's utility. A comparison of the modified Samuelson rule derived here which is given by equation (10) with the one derived by Keen and Lockwood (2010) given by equation (1), shows that equation (10) has an additional term in the numerator (MCC) and an additional term in the denominator (MAC). The result in equation (10) shows that at the margin, we need to account for all the types of taxation costs in order to gauge the net impact of a change in the tax instrument used by the government on the optimal level of revenue R^* .

Since, $TMC = MCC + MDL$ and $TMC > 0$ as $t_R > 0$ and $Y_R < 0$

We can rewrite equation (10) as the following:

$$U_G/U_C = (1 + TMC)/(1 - MAC) \quad (11)$$

The impact of a change in V on the optimal level of tax revenue R using equation (11) depends on the relative levels and changes of TMC and MAC. As shown in Appendix A, as V changes, the optimal R can increase or decrease. More precisely, if all the types of taxation costs

considered here are endogenous and are changing simultaneously then a net increase / decrease in them at the margin will be followed a net increase/decrease in R^* respectively. The empirical results of this paper primarily focus on testing this hypothesis.

To sum up, the impact of a change in V on the optimal revenue R^* can be summarized by two important points. First, exogenous and endogenous administrative costs have a differential impact on R^* . In the presence of an exogenous increase (which identifies a short-run increase) in the government's administrative costs, the net change in R^* is not straightforward. For example, R^* may increase even when the exogenous administrative costs and other endogenous costs are rising simultaneously. On the contrary, when all the three types of taxation costs considered here are endogenous in the model, things are simpler. Equation (11) is valid when this is the case and it shows that as long as the net endogenous costs of taxation are falling at the margin, it will always be welfare improving to increase the consumption of the public good which implies that R^* will increase. Hence it is important to distinguish between exogenous and endogenous tax administration costs.

Second, it is important to consider the change in direction and the magnitude of all the costs incurred from taxation when analyzing the impact of a change in the type of the tax instrument used by the government and there is more than one type of taxation cost. A final change in the optimal level of R^* will be determined by the net change in all the types of taxation costs¹⁹.

4. DATA AND THE EMPIRICAL RESULTS

The main empirical question of interest is the following: has the tax innovation in the form of the replacement of the turnover sales tax by the VAT improved the revenue efficiency at the state level in India? According to the theoretical model explained above, the impact of the transition to the VAT is ambiguous in the short-run when the administrative costs are more likely to be independent of the level of revenue. Recall from the model that a change of an indirect tax instrument used by the government is likely to cause a one-time positive exogenous shock in the government's administrative costs. This positive shock in the costs is independent of the revenue and in its presence the impact of the VAT on the optimal level of revenue R^* is ambiguous. In this

¹⁹ This model does not incorporate two other important forms of taxation costs which are costs of tax evasion and tax avoidance.

case, in order to pin down the exact change in R^* , complete knowledge of the direction and the magnitude of the changes in all the costs is required. But, fortunately this exogenous shock is temporary and over a longer period of time the administrative costs tend to be revenue-varying. When this is the case, the optimal revenue R^* will increase if and only if there is a net decrease in the deadweight loss (or distortionary costs), compliance costs, and administrative costs at the margin.

The empirical analyses presented in this paper uses data for 1990 to 2010 to explore the impact of the adoption of the state level VAT on revenue efficiency. Twenty-two out of 29 states had adopted the VAT by year 2005, and 5 more states put it into place in the following year. Therefore, for these 27 states we are able to capture the impact of the VAT on the revenue efficiency over a 4 to 5-year period. Considering a 4 to 5-year period to be a reasonably long period of time, by the end of our period, all the costs of taxation are expected to be endogenous. Therefore, from the model, we infer that if we observe an increase in the optimal level of revenue R^* in our empirical results, this increase is a result of a net decrease in the marginal costs of taxation and vice versa. If the VAT led tax reform is found to reduce taxation costs, then this efficiency gain will show up as an increase in R^* and we will be able to conclude that the VAT reform in India has proved to be efficiency improving at the state level.

We use the states' tax revenue per capita to measure R^* (revenue efficiency). Two different measures of tax revenue are used; one is the states' own revenue from all sources of indirect taxes (ITR) and the other is the state's own revenue from the sales tax component only. The ITR measure can be thought of as a broader measure of revenue efficiency which includes the sales tax component (which was replaced by VAT), surcharge tax which was separately collected by the states on top of its sales tax (before the adoption of VAT), and other forms of indirect taxes.

The sales tax is levied by the state governments on goods and it is the main form of indirect tax for the states as it brings in 28% of the state's total tax revenue. States essentially replaced this sales tax component with VAT. Keen and Lockwood (2010) point to the fact that the performance of the VAT needs to be evaluated not only by itself but also with respect to the total revenue collected from all the types of indirect taxes. This argument makes it useful to capture the change in revenue efficiency of both of the revenue measures explained above.

Union territories of India are excluded from the analyses because they do not have autonomous state governments except for Puducherry. Union territories together represent only

about 7% of India's population. All of the data used in the empirical analyses is obtained from Reserve Bank of India (RBI) publications, Ministry of Statistics and Programme Implementation (MOSPI), National Sample Survey Office (NSSO) at MOSPI, Ministry of Labour and Employment, Labour Bureau, Government of India and Indiastat. Details on the state level VAT are obtained from the website of Empowered Committee of State Finance Ministers.

Summary statistics of the covariates are presented separately in Table 2 for the 11 special category states and the 18 non-special category states. The special category of states is characterized by lower average GSDP per capita (GSDP pc), a higher percentage share of agricultural in GSDP, and lower urbanization, all reflective of a lower level of development. In addition to the agricultural sector, the unregistered manufacturing sector is difficult to tax and it hides within the shadow economy. The size of this unregistered manufacturing sector in India is non-trivial and therefore it is used as one of the explanatory variables in our analyses.

The central government's grants to all the states increased temporarily for 3 to 4 years during the time period when the states were transitioning to the VAT. The state governments were mainly concerned about the initial revenue loss from the transition to the VAT and the central government agreed to compensate them for any such losses up to a certain percentage through temporary grants. To account for this special form of assistance to the states from the center on the state's revenue effort, we use the non-plan grants from the center as one of the covariates in the analyses. The average value of such grants made to the special states was higher than the grants made to the other 18 states as evident from Table 2.

Annual total interest payments include interest on loans, internal debt and market loans and is used as a proxy for the fiscal crisis among the states in the second half of the 1990s. NEC (North Eastern Council) grants are a special form of grant prominently given by the federal government for development purposes to 8 north eastern states. All of these states fall into the "special states" category and the additional central government revenue may affect their revenue collection. All other covariates reported in Table 2 are popularly used by the previous tax effort literature to explain revenue productivity. For example, the level of urbanization is shown to have a positive and significant effect on the revenue performance in the previous literature. The mining sector is usually dominated by a few large sized firms and hence it could generate large tax surpluses for the government. Therefore, we include the share of the mining sector as an explanatory variable.

Table 2 also reports four different measures of tax revenue per capita (pc). The broadest measure among them is the states' total tax revenue (TTR). It includes the states' own revenue from direct and indirect taxes and also the states' revenue shares of the direct and the indirect central taxes. The second measure is the states' own tax revenue (OTR) which includes both indirect and direct tax sources. The third measure is the states' own indirect tax revenue (ITR) which is a subset of the above two measures and the last and narrowest measure is the state's revenue from the sales tax / VAT which is a subset of the ITR measure. The states' revenue from the sales tax came from the turnover type sales tax before the transition to the VAT and from the VAT after the adoption of the state VAT. All the four revenue measures are consistently lower in value for the special states as compared to the non-special states.

Figure 2 shows the average trend in OTR, ITR and the sales tax/VAT revenue measure as a percentage of TTR for all the states. The dotted vertical lines mark the years when one or more states adopted the VAT. The ratios OTR /TTR and ITR /TTR follow very similar trends over time. These two ratios reach their respective peaks in year 2002 and begin to decrease in 2003. They begin trending up after 2007. For the majority of the VAT adoption period from 2005 to 2007, these ratios are falling. A slightly different trend is followed by the sales tax /VAT revenue measure. This ratio falls from 2000 to 2002 but then stabilizes at 30% of TTR through 2007 at which time it trends upward. The consistent drops in all the three revenue ratios after the year 2003 are perhaps reflecting the sharp deterioration in the states' fiscal conditions in the year 2003-04. Figures 3 and 4 demonstrate the growth patterns in ITR and the sales tax/ VAT revenue as a percent of TTR for the special and the non-special states. We observe that the two growth rates have been marginally trending downwards for the non-special states in 2002 and then starts to increase post 2007 although this increase is not sustained in the later years. On the other hand, the special states experienced dramatic fluctuations in the growth rates over the entire time period and no systematic trend emerges. It is hard to tell from these graphs if the VAT implementation changed revenue productivity in either category of states.

We estimate equation (12) using fixed effects (FE) methodology:²⁰

$$r_{it} = \alpha v_{it} + \beta' X_{it} + \mu_i \varepsilon_{it} \quad (12)$$

²⁰ We also estimated this equation using pooled OLS coefficient and found similar results.

Where,

- $i =$ index which represents state ($i = 1, \dots, 29$)
- $t =$ index which represents time ($t = 1990, \dots, 2010$)
- $r_{it} =$ log ITR per capita or log sales tax/VAT revenue per capita of a state i at a time t . It is a $(NT \times 1)$ vector of N states and T years.
- $v_{it} =$ takes a value 1 if a state i has a VAT in a year t , and takes a value zero otherwise (referred as D_{VAT} in the empirical results presented below)
- $X_{it} =$ denotes a column vector of other observable time varying covariates
- $\mu_i =$ state specific error
- $\varepsilon_{it} =$ denotes an idiosyncratic error

Tables 3 and 4 provide estimates of the above parameters using a FE model. The only difference between the results in Tables 3 and 4 is that in Table 3 the dependent variable is the log of states' own ITR per capita and in Table 4 the dependent variable is the log of sales tax/VAT revenue per capita.

The estimates are shown for all states and then separately for the special and the non-special states. We control for time trend in all the specifications and cluster the standard errors over the states. This produces robust standard error estimates that allow heteroskedasticity within the states. We suspect heteroskedasticity because the error ε_{it} is expected to be correlated over time for a given state²¹. We started by estimating the FE model without inclusion of the lagged term of the dependent variable but we detected the presence of serial correlation in these regressions using Wooldridge (2002). As a result, we report the FE model results in Tables 3 and 4 with the inclusion of the first order of the lagged dependent variable as one of the regressors.

We are primarily interested in the behavior of α which is the coefficient of D_{VAT} in equation (12). D_{VAT} in all the tables is the dummy variable indicating the presence of the VAT in a state in a given year. The estimate of α in Table 3 shows that the presence of VAT increases state's ITR pc significantly by 3.4% in the non-special states. The time trend is significant in all columns of Table 3 but it is insignificant in Table 4. Table 4 shows that the presence of the VAT has a bigger and a significant effect on the revenue efficiency of the sales tax component. Specifically, we observe that with the use of a consumption type VAT by the state governments instead of the

²¹ Note that the specification does not allow for the correlation of errors across the states.

turnover type sales tax, the sales tax/VAT revenue per capita increases by 8.5% in the non-special states.

The Wooldridge (2002) test of serial correlation in Tables 3 and 4 still shows a significant presence of serial correlation. The inclusion of the lagged term of the dependent variable in the specification perhaps does not completely solve the underlying problem. It is commonly the case that the errors are serially correlated when the dynamic model is misspecified.

If the correlation in errors follows AR (1) ($u_{it} = \rho u_{i,t-1} + \varepsilon_{it}$), we can obtain more efficient estimates in its presence by using the FE estimator which explicitly allows AR(1) errors. The results of this model are shown in Table 5 for all the states and the non-special states²². Columns (1) and (2) of Table 5 present results using ITR pc as the dependent variable and columns (3) and (4) use the sales tax/ VAT revenue pc as the dependent variable. The significant effect of the VAT on ITR pc of the non-special states vanishes with the use of the FE model with AR (1) errors. However, the impact of the VAT is still significant and positive on the sales tax / VAT revenue pc for the non- special states. The size of this effect is 6.67% which is close to the value obtained from the FE results reported in Table 4.

Cameron and Trivedi (2009) note that the FE estimator is inconsistent once lagged regressors are introduced because the first lagged term of the dependent variable for a given state i can be shown to be correlated with the error terms of this state i . Nonetheless, consistent parameter estimates can be obtained from the IV estimators of first-difference (FD) model by instrumenting the first lagged term of the dependent variable with its own lagged term of the higher order. Anderson and Hsiao (1981) estimator uses this model. Table 6 presents the results using this estimator. The VAT's presence is found to be significantly positive on the sales tax / VAT revenue pc for the non-special states and the size of this effect is 6.65% in Table 6. This size of the VAT coefficient for the non-special states is once again consistent with its values obtained from the FE model with AR(1) errors. For all the specifications presented in Tables 3 to 6, we identify a consistent positive and significant impact of VAT on the sales tax/VAT revenue pc for the 18 non-special states (developed states). Overall, the empirical results show that even though the VAT does not seem to improve efficiency of the aggregate indirect tax system of all the states, it does

²² Results for special category states are not presented in the table because coefficient of VAT dummy variable is insignificant.

seem to improve efficiency of the sales tax component of the indirect tax system (which it had essentially replaced) in the non-special states.

We identify a consistent increase in the long-run revenue efficiency of the sales tax instrument used by the state governments in the non-special states from the substitution of a consumption type VAT for a turnover type sales tax. Our theoretical model implies that the observed increase in the revenue efficiency of the sales tax component is a result of a net decrease in the marginal costs of taxation associated with the sales tax instrument. Similarly a “no change” in the revenue efficiency of the aggregate indirect tax system can be inferred to be a result of no net change in the marginal distortionary, compliance and administrative costs. Note that here we are talking about a net change in *all the costs of taxation*. So when the net change in the total marginal costs is zero, it could mean that some costs increased and other costs decreased in such a way that the net effect is zero. The most consistent other co-variables are GSDP, which is positively correlated with revenue efficiency (as anticipated) and grants per capita.

As explained above, our findings provide some evidence of a net decrease in the marginal taxation costs from the use of a VAT as an indirect tax instrument at the state-level. However we are not able to pin-point which type of taxation costs fall more/less than the others. We believe this is a question which can be addressed by future research work. It will be worthwhile to identify which taxation costs changed the most (and in which direction) among the compliance, distortionary and the administrative costs.

5. CONCLUSION

The theoretical model in this paper establishes that, in the long-run, when all the costs of taxation are endogenous, then a net fall in these costs at the margin, makes it efficient for the government to increase the optimal revenue, R^* . This increase in the level of revenue therefore reflects an efficiency gain. In our empirical analyses we identify such an efficiency gain in the sales tax component in the developed states of India, over a 4 to 5 year time period, from the use of a consumption type VAT. This makes intuitive sense as a consumption type VAT replaced an administratively complex, non-uniform and a distortionary sales tax. However, this efficiency gain is not robust enough and it does not lead to the efficiency improvement of the aggregate indirect tax system. We observe an insignificant effect of the VAT on the revenue efficiency of the entire

indirect tax system. Nonetheless, the estimation results presented in this paper provide evidence of efficiency improvement of the sales tax component in a less developed economy from the use of a VAT at the sub-national level. This is an important finding which shows that a sub-national VAT can prove to be an effective tax instrument in the low and middle income countries also.

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Figure 2: Trend in state's revenue ratios (in percent)

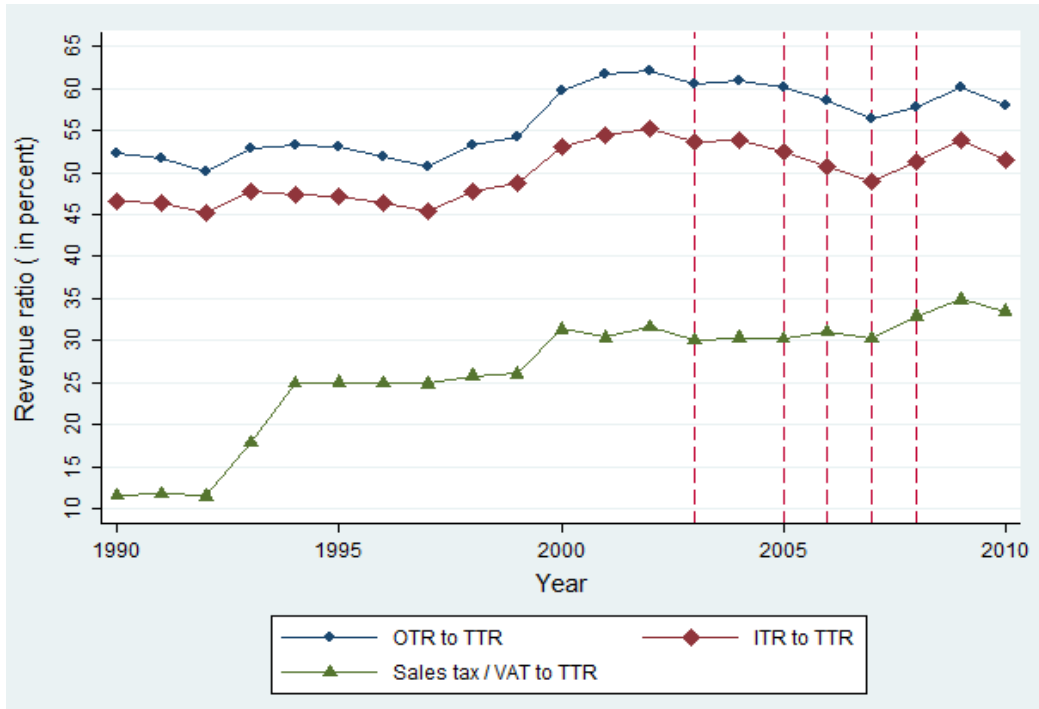


Figure 3: Growth rate in ITR as a percentage of TTR for special and non-special category of states

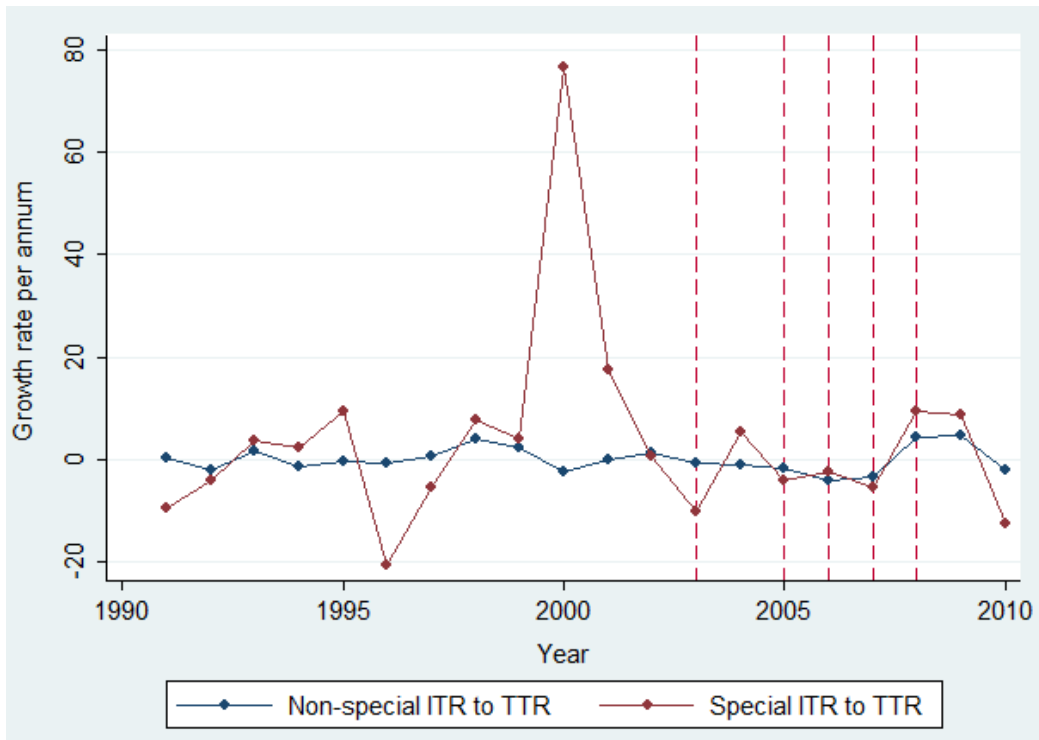
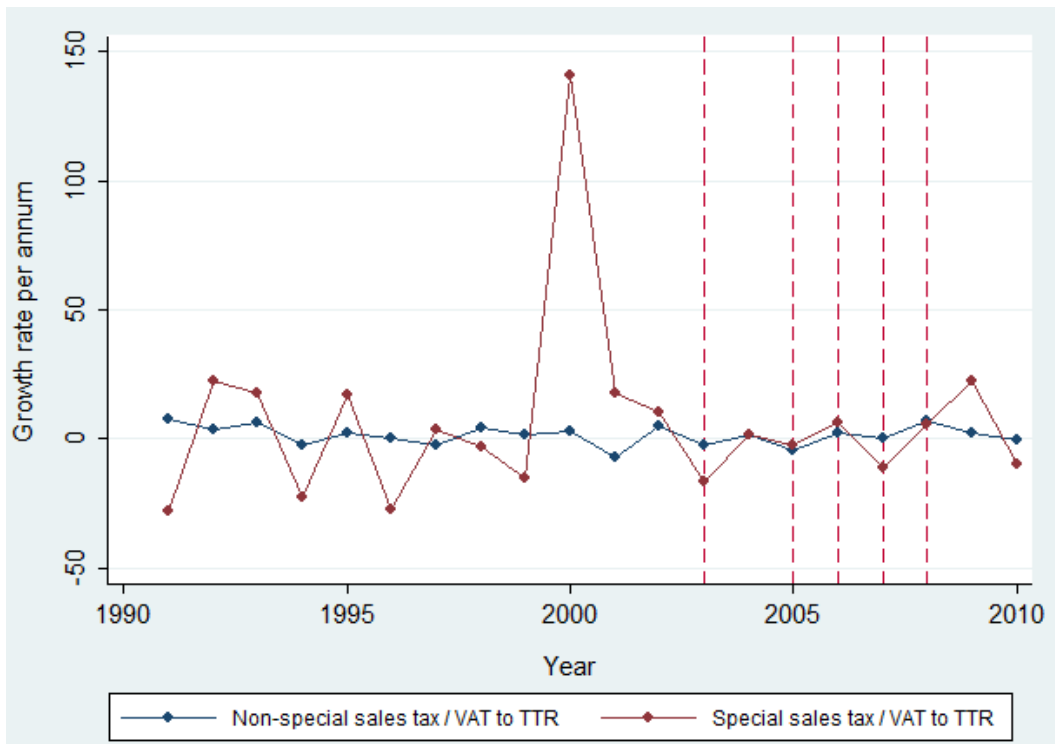


Figure 4: Growth rate in sales tax / VAT revenue as a percentage of TTR for special and non-special category of states



TABLES

Table 1: Percentage share of ITR to OTR and Sales tax / VAT revenue to ITR

All-India average	ITR to OTR (in percent)	Sales tax / VAT revenue to ITR (in percent)
1990 to 1995	87.85%	50.96%
1996 to 2000	87.6%	52.98%
2001 to 2005*	87.8%	58.42%
2006 to 2010	88.5%	64.38%

Notes:

*2005 is a significant year as 21 out of 29 states adopted the VAT in this year. Haryana was the first state to adopt a VAT in the year 2003.

ITR = State's own indirect tax revenue

OTR = State's own tax revenue

Sales tax/ VAT revenue = Revenue collected by states by charging indirect taxes on goods.

Table 2: Summary statistics

Variable		Obs	Mean	Std. Dev.	Min	Max
GSDPpc	All states	609	25547.13	24065.72	2582.67	197423.50
	Special	231	22398.96	17912.22	3818.52	123533.30
	Non- special	378	27471.01	26990.76	2582.67	197423.50
Agri. GSDP share (in %)	All states	606	44.61	172.77	0.71	1804.05
	Special	228	77.29	278.64	7.96	1804.05
	Non- special	378	24.89	10.82	0.71	48.93
Unreg. Manuf. GSDP share (in %)	All states	592	5.15	25.52	0.63	622.96
	Special	223	2.60	1.42	0.63	7.20
	Non- special	369	6.69	32.22	1.23	622.96
Mining scetor GSDP share (in %)	All states	587	2.46	3.48	0.00	19.41
	Special	215	1.85	2.76	0.00	10.94
	Non- special	372	2.82	3.80	0.00	19.41
Urban Pop (in %)	All states	602	29.05	16.61	7.00	95.00
	Special	224	22.13	10.94	8.00	52.00
	Non- special	374	33.15	18.00	7.00	95.00
Non plan grants from Centre per capita	All states	595	716.90	1380.98	0.00	9305.10
	Special	228	1677.92	1857.49	0.00	9305.10
	Non- special	367	119.87	149.86	0.00	1408.87
NEC grants per capita	All states	604	37.54	115.59	0.00	1006.55
	Special	230	98.02	171.00	0.00	1006.55
	Non- special	374	0.35	2.70	0.00	38.05
Interest payments per capita	All states	603	728.96	612.12	40.84	3825.88
	Special	231	889.59	673.64	40.84	3113.33
	Non- special	372	629.21	548.29	51.34	3825.88
TTR pc	All states	605	2440.62	2075.30	285.36	16022.24
	Special	231	2269.26	1797.99	311.81	13408.67
	Non- special	374	2546.47	2225.15	285.36	16022.24
OTR pc	All states	605	1492.83	1697.65	29.44	12585.59

	Special	231	814.62	928.00	29.44	5356.44
	Non- special	374	1911.72	1917.04	95.52	12585.59
ITR pc	All states	605	1328.42	1526.90	25.67	11643.76
	Special	231	729.13	846.77	25.67	5154.28
	Non- special	374	1698.58	1724.33	81.17	11643.76
Sales tax / VAT revenue pc	All states	521	875.11	1062.83	2.80	7504.24
	Special	214	402.61	484.39	2.80	2643.10
	Non- special	307	1204.49	1221.18	63.66	7504.24

Notes:

GSDP = Gross state domestic product of state; TTR = State's total tax revenue; OTR = State's own tax revenue; ITR = State's own indirect tax revenue

Table 3: Results using the dynamic FE estimator with ITR per capita as the dependent variable

VARIABLES	(1)	(2)	(3)
	All states	Non-special states	Special states
ln (ITR per capita lag)	0.58561*** (0.128)	0.59152*** (0.036)	0.46150** (0.195)
D_{VAT}	0.00496 (0.015)	0.03405** (0.013)	-0.01967 (0.040)
Time trend	0.03695** (0.014)	0.03681*** (0.009)	0.09916** (0.034)
ln(GSDP_{pc})	0.12473 (0.078)	0.15895*** (0.045)	-0.15080 (0.160)
ln(Pop)	-0.15597 (0.180)	-0.23261 (0.214)	-0.57095 (0.324)
Np_grants_pc	0.00004** (0.000)	-0.00004 (0.000)	0.00001 (0.000)
Nec_pc	0.00023* (0.000)	-0.00093* (0.000)	0.00023 (0.000)
Interest_pc	0.00004 (0.000)	-0.00006* (0.000)	0.00013 (0.000)
Agriculture	0.00012** (0.000)	0.00025 (0.003)	0.00015* (0.000)
Unreg Manufacturing	0.00330 (0.008)	-0.00056 (0.004)	-0.01600 (0.019)
Mining	0.00088 (0.006)	-0.00185 (0.005)	0.00442 (0.012)

Urbanization	0.00192 (0.003)	0.00293 (0.002)	0.00642 (0.009)
Constant	1.10515* (0.618)	1.21565** (0.450)	2.69698* (1.440)
Observations	535	337	198
R-squared	0.971	0.983	0.965
Number of states	29	18	11
Serial correlation test	F(1,28) = 10.191 (0.0035)	F(1,17) = 36.159 (0.0000)	F(1,10) = 5.799 (0.0368)

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 4: Results using the dynamic FE estimator with sales tax/ VAT revenue per capita as the dependent variable

VARIABLES	(1) All states	(2) Non-special states	(3) Special states
ln (sales tax/ VAT pc lag)	0.45996*** (0.159)	0.60711*** (0.086)	0.37000* (0.180)
D_{VAT}	0.00353 (0.046)	0.08456** (0.031)	-0.12056 (0.128)
Time trend	0.01035 (0.029)	0.01536 (0.016)	0.09152 (0.086)
ln(GSDP_{pc})	0.41028 (0.271)	0.26883** (0.115)	-0.13286 (0.714)
ln(Pop)	0.20594 (0.475)	0.27536 (0.465)	-1.16388 (1.054)
Np_grants_pc	0.00009 (0.000)	-0.00001 (0.000)	0.00007 (0.000)
NEC_pc	0.00011 (0.000)	0.00166* (0.001)	0.00008 (0.000)
Interest_pc	0.00010 (0.000)	-0.00002 (0.000)	0.00027 (0.000)
Agriculture	0.00053** (0.000)	0.00097 (0.003)	0.00066** (0.000)
Unreg Manufacturing	-0.00582 (0.017)	0.00776 (0.009)	-0.10057* (0.052)

Mining	0.00554 (0.015)	0.00960 (0.008)	-0.03805 (0.035)
Urbanization	-0.01718* (0.009)	-0.00159 (0.006)	-0.04050** (0.017)
Constant	-0.63643 (2.322)	-0.64541 (1.190)	3.01584 (4.940)
Observations	454	276	178
R-squared	0.887	0.965	0.866
Number of states	29	18	11
Serial correlation test	F(1,28) = 7.609 (0.0101)	F(1,17) = 35.459 (0.0000)	F(1,10) = 6.498 (0.0289)

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 5: Results using the dynamic FE estimator with AR (1) errors

VARIABLES	All states	Non-special states	All states	Non-special states
	Ln (ITR pc)	Ln (ITR pc)	Ln (Sales tax pc)	Ln (Sales tax pc)
D_{VAT}	-0.00337 (0.027)	0.02046 (0.021)	0.01160 (0.068)	0.06662** (0.032)
Time trend	0.04184*** (0.008)	0.03445*** (0.010)	0.03510* (0.019)	0.03522** (0.014)
ln(GSDP_{pc})	0.35865*** (0.046)	0.23627*** (0.063)	0.39117*** (0.098)	0.24999*** (0.091)
ln(Pop)	-0.03340 (0.155)	-0.16182 (0.243)	0.29518 (0.341)	-0.15762 (0.385)
Np_grants_pc	0.00005*** (0.000)	-0.00004 (0.000)	0.00011*** (0.000)	-0.00001 (0.000)
Nec_pc	0.00020** (0.000)	-0.00085 (0.002)	0.00005 (0.000)	0.00252 (0.003)
Interest_pc	0.00006* (0.000)	-0.00007** (0.000)	0.00014 (0.000)	-0.00003 (0.000)
Agriculture	0.00020*** (0.000)	0.00061 (0.002)	0.00075*** (0.000)	0.00195 (0.004)
Unreg Manufacturing	0.01218 (0.009)	0.00277 (0.006)	-0.00826 (0.024)	0.01008 (0.010)
Mining	0.00731 (0.008)	0.00087 (0.006)	-0.00699 (0.020)	0.00045 (0.009)
Urbanization	0.00174	0.00266	-0.01513	-0.00287

	(0.004)	(0.002)	(0.010)	(0.005)
ln (ITR pc lag)	0.32504*** (0.043)	0.55394*** (0.050)		
ln (Sales tax/ VAT pc lag)			0.26384*** (0.047)	0.54768*** (0.051)
Constant	0.18058 (0.258)	0.57794 (0.636)	0.20357 (0.603)	0.30881 (0.822)
Observations	506	319	425	258
Number of states	29	18	29	18

Standard errors in parentheses
 *** p<0.01, ** p<0.05, * p<0.1

Table 6: Results using the IV estimator of the First-difference model

VARIABLES	All states	Non-special states	All states	Non-special states
	Ln (ITR pc)	Ln (ITR pc)	Ln (Sales tax/ VAT pc)	Ln (Sales tax/ VAT pc)
LD.ln (ITR pc)	-0.07919 (0.126)	0.42892 (0.340)		
D_{VAT}	0.01514 (0.029)	-0.03777 (0.033)	0.00045 (0.076)	0.06648* (0.035)
ln(GSDP_{pc})	0.18698* (0.099)	0.13618 (0.116)	0.23652 (0.299)	0.36860** (0.154)
ln(Pop)	-0.85316*** (0.302)	-1.14584* (0.683)	-1.83007** (0.862)	-0.26955 (0.808)
Np_grants_pc	0.00002* (0.000)	0.00005 (0.000)	0.00012*** (0.000)	0.00000 (0.000)
Nec_pc	-0.00005 (0.000)	-0.00362 (0.002)	-0.00011 (0.000)	-0.00143 (0.003)
Interest_pc	0.00011** (0.000)	0.00002 (0.000)	0.00004 (0.000)	0.00003 (0.000)

Agriculture	0.00003 (0.000)	0.00637* (0.003)	0.00010 (0.000)	0.00171 (0.004)
Unreg Manufacturing	0.00634 (0.010)	0.00663 (0.009)	-0.00849 (0.029)	0.01416 (0.014)
Mining	-0.00969 (0.011)	-0.02798** (0.012)	-0.03252 (0.032)	-0.01017 (0.016)
Urbanization	0.02163** (0.009)	0.01598 (0.010)	-0.02056 (0.026)	0.01241 (0.013)
LD.ln (Sales tax/ VAT pc)			-0.03057 (0.124)	0.08316 (0.358)
Constant	0.13250*** (0.023)	0.08413** (0.035)	0.13460** (0.054)	0.08483 (0.052)
Observations	480	302	388	235
Number of stateid	29	18	29	18

Standard errors in parentheses
 *** p<0.01, ** p<0.05, * p<0.1

Appendix A: Scenarios describing theoretical change in R when compliance and administrative costs are included

Case A: Case of exogenous (or temporary or short-run) administrative cost

Below we consider all the possible scenarios associated with a change in V leading to an increase in A and their net effect on the optimal level of R*

Scenario A1: With a change in V, both TMC and A increase. The net effect is discussed below:

- (i) If $TMC \uparrow > U_G \uparrow$ then in equation (5) $U_G/U_C < 1 + TMC$ and R* will decrease with a change in V
- (ii) If $TMC \uparrow < U_G \uparrow$ then in equation (5) $U_G/U_C > 1 + TMC$ and R* will increase with a change in V.
- (iii) If $TMC \uparrow = U_G \uparrow$ then in equation (5) $U_G/U_C = 1 + TMC$ and R* will not change with a change in V.

Intuition: At the margin, if the increase in revenue-varying taxation costs are greater than the loss in the total utility from lower expenditure on the public good due to an increase in the administrative costs, the consumer would want to consume lesser of the public good and so the optimal revenue R* will decrease. On the other hand, if the increase in revenue-varying taxation costs are smaller than the loss in the total utility from a lower level of G, then the consumer would desire more of the public good which will lead to an increase in R*.

Scenario A2: With a change in V, the absolute value of Y_R decreases and A increases

- (i) If $TMC \downarrow$ and $U_G \uparrow$ then in equation (5) $U_G/U_C > 1 + TMC$ and R* will increase with a change in V.

Intuition: At the margin, if the revenue-varying costs decrease and the total utility also decreases from lower expenditure on the public good due to an increase in the administrative costs, the consumer would want to consume more of the public good and so the optimal revenue R^* will increase.

The above explanations show that the net impact of the change in costs on R^ is not straightforward. When both the endogenous and exogenous costs are rising simultaneously, then the net effect on R^* could be an increase or a decrease (depending on the magnitude of the costs).*

Case B: Case of endogenous administrative costs

Below we consider all possible scenarios associated with a change in V and the net effect on the optimal level of R^*

Scenario B1: With a change in V , TMC decreases and MAC does not change. Note that TMC could decrease because of a decrease in MCC or MDL or both of its components. This is because $TMC = MCC + MDL$.

If $TMC \downarrow$ and $\Delta MAC = 0$, then $\frac{U_G}{U_C} > 1 + \frac{TMC}{1 - MAC}$ and the optimal R^* will increase with a change in V .

Scenario B2: With a change in V , TMC decreases and MAC also decreases.

If $TMC \downarrow$ and $MAC \downarrow$, then $\frac{U_G}{U_C} > 1 + \frac{TMC}{1 - MAC}$ and the optimal R^* will increase with a change in V .

Intuition: At the margin, when some or all the endogenous costs are decreasing then higher consumption of the public good will increase the consumer's total utility which will increase R^* .

Scenario B3: With a change in V , TMC increases and MAC does not change. Again, note that TMC could increase because of the increase in MCC or MDL or both of its components.

If $TMC \uparrow$ and $\Delta MAC = 0$, then $U_G/U_C < 1 + TMC/1 - MAC$ and optimal R^* will decrease with a change in V .

Scenario B4: With a change in V , TMC increases and MAC also increases.

If $TMC \uparrow$ and $MAC \uparrow$, then $U_G/U_C < 1 + TMC/1 - MAC$ and the optimal R^* will decrease with a change in V .

Intuition: At the margin, when some or all the endogenous costs are increasing then lower consumption of the public good will increase the consumer's total utility which will decrease R^* .

Scenario B5: With a change in V , TMC increases and MAC decreases.

(i) If $TMC \uparrow > MAC \downarrow$, then $U_G/U_C < 1 + TMC/1 - MAC$ and the optimal R^* will decrease with a change in V .

(ii) If $TMC \uparrow < MAC \downarrow$, then $U_G/U_C > 1 + TMC/1 - MAC$ and the optimal R^* will increase with a change in V .

Scenario B6: With a change in V , TMC decreases and MAC increases.

(i) If $TMC \downarrow > MAC \uparrow$, then $U_G/U_C > 1 + TMC/1 - MAC$ and the optimal R^* will increase with a change in V .

(ii) If $TMC \downarrow < MAC \uparrow$, then $U_G/U_C < 1 + TMC/1 - MAC$ and the optimal R^* will decrease with a change in V .

Intuition: At the margin, if all the endogenous costs are changing simultaneously then a net decrease / increase in the marginal costs will lead to an unambiguous increase/decrease in R^* respectively.