THE REVENUE PRODUCTIVITY OF INDIA'S SUB-NATIONAL VAT

ABSTRACT

Skepticism exists regarding the revenue potential of a sub-national value added tax (VAT). India is one of only three countries to embrace a sub-national VAT and it did so between 2003 and 2008. We analyze the impact of this historic policy reform on revenue productivity and find that implementation of the tax yields a 13 percent increase in sales tax revenue for India's more developed states. This analysis is unique in providing empirical evidence of a revenue impact of a major tax policy reform for a subset of sub-national governments in a developing country.

I. INTRODUCTION AND BACKGROUND

The rise of the value added tax (VAT) is one of the most significant tax policy developments of the past century with more than 150 countries adopting the tax since the 1960s (James, 2015). Theoretically, the VAT is considered a strong revenue producer due to its broad base and "self-policing" invoice system that increases the chance to expose evasion in the informal economy (Bird, 2005 and Agha and Haughton, 1996). A broad base, consistency of tax rates, and embedded refund for taxes paid on inputs could increase economic efficiency as well as enhance revenue. The VAT is therefore generally regarded as a promising consumption tax for developing economies.

Between 2003 and 2008, India introduced a state-level VAT that replaced a complex system of sales taxes. States adopted the VAT at various times over the period which, provides us the opportunity to test the value of the VAT as a revenue producer at the sub-national level. In this paper, we add to a growing empirical literature that examines the performance of the VAT in developing countries by analyzing the revenue impact of India's tax policy reform.

There is a broad literature on the impact of VAT on revenue that focuses on central governments in developed economies. This literature suggests that the VAT improves revenue performance (Nellor, 1987, Bogetic and Hassan, 1993, and Lockwood, 2010). As the use of VAT in developing countries has expanded, empirical literature on the impact of VAT on revenue has increased and focused on the effect of the underlying infrastructure for VAT, namely tax policy, tax administration, and economic behavior. For example, Bird and Gendron (2006), provide evidence that inexperienced tax administration and poor tax design contribute to poor revenue performance of the VAT in developing economies. Country focused studies allow researchers to home in on specific attributes of the VAT, which affect revenue productivity. For Chile,

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Pomeranz (2015) finds that the structure and enforcement of the invoice-credit system supports revenue productivity, however Waseem (2020) finds that that system can break down at the final points of consumption in his analysis of Pakistan. And, while there have been innovations to mitigate the impact of weaknesses in VAT administration (Naritomi, 2019), they are few and far between.

This growing body of empirical literature in developing economies demonstrates that revenue productivity of a VAT can be compromised by inadequate administration, policy, and enforcement. However, as a counter to the revenue cost of inadequate administration, there is recent evidence that the structure of India's sub-national VAT may increase economic activity and potentially increase tax revenue due to a reduction in tax cascading and tax burden on capital in India (Aneja et al., 2021 and Agrawal and Zimmerman, 2019). Our paper complements and expands this recent literature on India's sub-national VAT by estimating the effect of the VAT on revenue productivity of sales taxes at the state level.[1] Our results show that the VAT implementation leads to a 12 percent increase in the revenue productivity of sales taxes for more developed states. In this paper, we measure revenue productivity as revenue per capita. While India's experience will not fully generalize to all less developed countries, this analysis provides a framework for analysis in similar countries and provides some clues regarding the impact of such a reform.

The paper proceeds as follows. Section II provides the institutional context for the VAT reform in India. Section III explains the conceptual model, Section IV presents the data, analysis and results and Section V concludes.

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[1] In this paper, "sales taxes" are the state sales tax (pre-reform) or the state VAT (post-reform).

II. INSTITUTIONAL CONTEXT

India is a complex democracy. For the period of our analysis, there were 29 states with state-governing power[2] and six union territories governed directly by the central government. The central government targeted the 29 states with training and financial support but did not provide the same support for the six union territories. We therefore excluded the union territories from the analysis. The Government of India further categorizes the 29 states based on the level of development into 11 "special" states with low levels of social and economic indicators, and 18 "non-special" states.[3] To compensate for their low level of economic activity, the 11 special states are afforded intergovernmental aid that is not available to the other 18 states. All 29 states have revenue raising authority and state own revenues account for slightly over one-third of state plus central government revenue (Rao, 2000).

The majority of state own tax revenue comes from indirect sources including a sales tax on commodities, which is referred to here as the "sales tax" and is the subject of the VAT reform; a sales tax surcharge; separate indirect and excise taxes on certain services such as electricity and entertainment; excise on alcohol and fuel; taxes on vehicles and passengers; and finally a tax on commodities involved in inter-state trade also known as the central sales tax, CST, even though it is a state tax.[4] The single most important own revenue source at the state level is the sales tax, and on average, it accounts for 62 percent of own indirect tax revenue and 55 percent of total own tax revenue annually over the period 2002-2010.

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[2] Including the national capital territory of Delhi.
[3] See Bhattacharjee (2014) for a detailed discussion of the classification mechanism.
[4] Other taxes like the property tax, entry tax and user charges on utilities are collected by some local governments, mainly large urban cities. Jharkhand is the only state government that collected an entry tax. In 2002, it collected a 4 and a 5 percent entry tax. These taxes bring meagre revenues as their scope is very limited (see Bernardi and Fraschini, 2005 and Rao, 2000).

Pre-reform, the sales tax was effectively a turnover tax, which taxed inputs and final consumption. State governments had the authority to set tax rates by product. The discretion resulted in wildly different rates by product and state; states could have 17 to 20 categories of commodities with rates ranging from 0.25 percent to 37 percent (see Table 1).[5] Exporting states also collected a four percent CST on the sale of domestic goods to other states. This additional tax added to the complexity of the indirect tax system and increased the pressure for tax reform.

The stagnation of revenue from the sales tax relative to GDP in the 1990s (Rao and Rao, 2006) was a major concern for policy makers. The central government, policy experts, and NIPFP (1994) highlighted an urgent need to reform the sales tax and recommended a move to a destination-based, consumption type value added tax at the state level to simplify the existing tax system and address revenue stagnation. In 1994, a Government of India study group was tasked with recommending measures that would reform the state-level tax system concerns regarding revenue generation and the complexity of tax policy (NIPFP, 1994). The 1994 report proposed a broad reform whereby the state sales tax and surcharge would be replaced with a VAT on commodities while retaining other indirect taxes and eliminating the CST.

In 1999, the Ministry of Finance established the Empowered Committee (EC) to engage states in cooperative planning to design the state-level VAT and structure its implementation. In October 2002, the Prime Minister announced April 1, 2003, as the date of implementation of the state VAT. Haryana was the only state to adopt in 2003. The general launch was subsequently pushed back to April 1, 2005 due to the need for training, development, and education about the new VAT.[6] While the structure of the VAT was generally known by October 2002, the structure

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[5] Agarwal and Zimmerman (2019) provide detailed accounting of the differences in sales tax rates.
[6] Details of the development and progress of the VAT are available in EC (2005), Sharma (2005), Sinha and Srivastava (2020), Shaikh (2010), and Bernardi and Fraschini (2005).

was finally published in the "White Paper on VAT" (EC, 2005). Under that structure, states were given the authority to choose the threshold limit for the VAT and the specific list of exempted goods. As part of the common design, all states imposed three rates: a 12.5 percent standard rate, a four percent reduced rate for basic necessities[7], and a one percent rate on gold, silver, precious and semi-precious stones. The state VAT allowed input tax deductions based on invoices for purchases made within the state and from other states. In the case of capital goods, the input tax could be deducted over a period of one year from the date of purchase. The VAT did not allow input tax deductions on petroleum or natural gas.

Despite these events and agreements, on April 1, 2005, only 18 states implemented the reform. Table 2 provides the actual implementation dates.[8] Three more states implemented the VAT later in 2005 and seven states implemented their VAT in subsequent years. The VAT rates were uniform until 2010 when some states, at their own discretion, increased the standard rate from 12.5 percent to 14.5 percent and some increased the four percent rate on basic necessities to five percent.

From a careful review of the institutional background that led to the development and implementation of the VAT, it appears that the variation in the timing of implementation across states was primarily steered by the external factor of politics. To support this contention, it is helpful to identify political alignments between the states and the central government. India has a multi-party system with multiple state regional parties and two main parties at the central level, the Indian National Congress (INC) and Bhartiya Janta Party (BJP). The smaller regional parties

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

[8] Based on our reading of the legislative process and the popular press over the period we analyze, legal adoption of the state VAT happened immediately before the actual implementation of the VAT and there was virtually no time between the two events. For this reason, adoption and implementation may be used interchangeably. In the text we use the word implementation to emphasize the actual occurrence of the VAT reform policy across the states on the dates specified in Table 2.

typically align with one of the national parties. The state VAT implementation was developed when the BJP was in power at the central level. However, the INC won the general national elections in 2004 and replaced the BJP at the center. Of the seven states that did not implement the VAT in 2005, five were governed by the administration of BJP (Chhattisgarh, Gujarat, Jharkhand, Madhya Pradesh, and Rajasthan), which is the primary opposition to INC. These five states were the only BJP states in 2005 and they delayed VAT implementation until 2006. News articles from the VAT reform period in *The Economic Times* (2005) and *The Hindu* (2005), and Sinha and Srivastava (2020), noted that the delayed implementation of the VAT was tied to these politics. To add to the supposition of politics playing a role in actual implementation date of the VAT, all the special states implemented the VAT policy reform in 2005. The special states receive additional grants and technical assistance with capital projects, procurement, etc. from the central government that is not provided to the non-special states. To remain in good standing with the central government, the special states were keen to follow the mutual agreement among the states to implement the VAT in 2005. The agreement was facilitated by the central government's EC.

Based on our reading of the press of the time, the design of the VAT did not appear to impact the timing of implementation among states. Furthermore, the central government put in place two specific policies to eliminate concerns that the state governments might have regarding the potential revenue loss from the VAT due to the elimination of the CST[9], and the loss of the tax revenue from removal of the cascading effect associated with the previous turnover type sales tax. The first of these two policies was a phase-out of the CST over a few years instead of

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[9] In the collaborative discussions within the EC, at first CST was proposed to be eliminated, but this never happened due to the central government's accommodations.

immediate elimination of the CST.[10] Second, the central government agreed to compensate the

states for their initial revenue losses in the first three years of the VAT implementation via a

grant (EC, 2005). Finally, the Government of India set up a technical expert committee to assist

states with the administrative transition to the VAT, which offered limited assistance in the form

of technical advice and guidance on administration and help with installation of IT equipment

(Sinha and Srivastava, 2020). State governments were given sufficient time to perform the

necessary administrative preparations such as computerization in the tax collections offices,

additional collections training, and organization of VAT workshops for taxpayers.

The eventual implementation of a VAT with three consistent statutory rates of 12.5, four,

and one percent brought some uniformity to the commodity tax system post reform. Although

the states had some flexibility with their VATs such as the choice of a certain number of VAT

exempted goods, the degree of autonomy was relatively limited (Bagchi, 2005).

III. CONCEPTUAL FRAMEWORK

The VAT reform could affect sales tax revenue via changes in tax administration and the

tax base. First, the VAT may be more or less efficient to collect and may result in more or less

tax evasion. Under the pre-reform sales tax, the tax was imposed at each stage of production and

the tax could be passed forward to the next stage of production by increasing the price of the

good. At the end of the production chain, the taxes charged and paid at intermediate stages

resulted in higher final prices. This compounding phenomenon is referred to as tax cascading

(aka 'tax on a tax') and it incentivizes tax evasion and puts pressure on tax administration to

accurately determine and collect the tax at various stages. A weak or poorly sourced tax

administration cannot collect revenue effectively in such a system. The credit-invoice system of

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[10] The rate of CST was decreased at the time of the VAT reform, but it was never phased out. It was finally removed when the state-level general sales tax (GST) was introduced in 2017.

the VAT reform could reduce administrative burdens and improve collection efficiency and tax compliance. But, as noted earlier, there are important concerns regarding the capacity of tax administrations and the available infrastructure to effectively administer a VAT. Moreover, Emran and Stiglitz (2005) and Tanzi (1992), show that the large informal sector in developing countries can severely limit the performance of a VAT.

Second, a VAT may decrease the tax base by avoiding tax cascading or it may improve economic efficiency by avoiding tax cascading. By design, a VAT reduces the administrative burden of VAT paid in earlier stages of production through a system of credit for taxes paid at a previous stage and in this way does not stick to the price of the good. Therefore, the turnover tax could inflate the tax base and yield higher levels of revenue relative to the VAT. On the contrary, removal of the cascading could improve economic efficiency and expand economic activity, and the overall tax base.

Considering these and other complexities of India's VAT design, it is difficult to predict the impact of the reform on revenue, leading us to the following empirical analysis.

IV. DATA AND EMPIRICAL RESULTS

The main empirical question of interest is: did the implementation of a state VAT increase state revenue in India? We use data from 2002 to 2010 to investigate the impact of VAT implementation on revenue productivity. We focus on this period for two reasons. We start at 2002 due to evidence of parallel trends in the dependent variable between the treatment and control groups (described below) in the pre-treatment years. We stop at 2010 because it precedes the period when states started tinkering with the rates and bases of their new VAT. Because most states implemented the VAT in 2005, we follow most states for six years post-reform and analyze whether revenue productivity increases because of the reform. In this paper, revenue

productivity implies revenue performance, and we measure revenue productivity as tax revenue per capita.

Table 3 reports the descriptive statistics for all states, and separately for the special and the non-special states, which helps to demonstrate the overall levels of development and revenue capacity in India, and the notable differences between the special and the non-special states. For the entire sample, the average Gross State Domestic Product (GSDP) is Rs. 42,167 per capita.[11] The GSDP of special states (Rs. 37,154 per capita) is much lower than that of the non-special states (Rs. 45,231 per capita). Special states are much less populated than the non-special states as well (6.3 million versus 50.83 million). Given this, it is perhaps not surprising that the urbanization rates are much lower in special states (19 percent) than in non-special states (31 percent). In terms of the industry presence, the average size of the mining sector (which is commonly thought of as a broad development indicator) as a percent of GSDP is smaller in the special states (1.9 percent) in comparison to the non-special states (2.7 percent).[12] The overall per capita sales tax revenue is Rs. 1,378 over the period 2002-2010. The per capita sales tax revenue is much higher for the non-special states (Rs. 1,743 versus Rs. 757) indicating an availability of a larger tax base in this group of states. This is also true for indirect taxes per capita (that includes the state's tax revenue from all indirect tax sources including the sales tax, CST, and state excise)[13], which are Rs. 2,780 and 1,321 per capita for non-special and special states respectively.

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[11] The conversation rate for Indian rupees (abbreviated as Rs.) is 0.013 dollars per rupee; Rs. 42,167 is approximately $534.

[12] We employed t test on the equality of means for these variables across the two groups of states. These tests show that their means are statistically significantly different.

[13] For a complete list of tax types that are including in the indirect taxes see Table 2A in the online Appendix.

We observe that the size of the unregistered manufacturing sector is larger in the non-special states which could be indicative of overall larger economic activity in the non-special states. The central government channels additional grants to the special states, which receives average non-plan grants of Rs. 2,989 per capita as opposed to the Rs. 207 per capita for the non-special states.

For our empirical analysis, we employ a difference in differences (DID) design. The regression framework of a typical DID design is often expanded to a generalized setting with multiple groups and multiple time periods using a two-way fixed effects (TWFE) parameterization.[14] Recently, an extensive literature applies the TWFE specification in cases of a staggered adoption of policies (see Autor, 2003, Stevenson and Wolfers, 2006, Athey and Imbens, 2022, Shumberger, Singla and Spreen, 2020, and Goodman-Bacon, 2021).[15] In our case, the implementation of the VAT was staggered over time by state, which makes the TWFE specification appealing for our estimation of the impact of VAT implementation on state revenues.

A. Main Empirical Results

We estimate the impact of VAT implementation on revenue productivity of states' own revenue from the sales tax per capita. "Sales tax" is in per capita terms and is state sales tax revenue (pre-reform) and state VAT revenue (post-reform) divided by population.[16] We analyze

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[14] The implementation of the TWFE specification is explained in detail in Pischke (2005), Wing, Simon, and Bello-Gomez (2018) and Angrist and Pischke (2008).

[15] Athey and Imbens (2022) refer to this specific application as a staggered adoption design (SAD).

[16] We also estimate the effect of the VAT reform on overall indirect tax revenues per capita. Table 2A provides details on the composition of the indirect taxes. There are potential spillover effects of the VAT that may affect other indirect taxes. For example, losing or diminishing the cascading effects of the pre-reform sales tax could reduce the tax base for the other indirect taxes such as the surcharge and central state tax (CST) and reduce these components of indirect tax revenues. Conversely, the new VAT could be a generous revenue producer that might simply reduce the state administrations' incentive to collect other indirect taxes. The results of the indirect tax analysis do not change our main conclusions and are contained in an online appendix.

the impact of the VAT implementation on the sales tax revenue for all states and then separately

for the non-special to capture any heterogeneous impact of the treatment on them. We implement

a generalized DID design, as explained above, using a TWFE parameterization. In this case, the

treatment (VAT implementation) timing varies from 2003 to 2008. Specifically, we estimate the

following specification for the years 2002 to 2010:

$$\ln(Sales\ tax)_{it} = \gamma + \alpha v_{it} + \beta' X_{it} + a_i + b_t + \varepsilon_{it} \tag{1}$$

In Equation (1), the dependent variable is the natural log of sales tax for state i in time t.

a_i and b_t are the state and the year fixed effects, and ε_{it} is the unobserved error term. We cluster

the standard errors ε_{it} at the state level to account for serial correlation within states. v_{it} is a

binary dummy variable (0/1) that takes a value of zero for state i in year t before implementation

of the VAT (pre-reform years) and a value of one in the year of VAT implementation and the

years thereafter (post- reform starting with the year of implementation).

Our definition of v_{it} is consistent with the definition of a binary dummy variable used in

the previous staggered adoption design DID literature.[17] The coefficient of v_{it}, α, is the estimate

of the average treatment effect in the treated states in the years after the adoption of the

treatment. In this design, the estimation of the single DID coefficient α in Equation (1) uses both

the within state variation across time periods (before and after the treatment) and across state

variation (treated and untreated states) in a given time period, making this a difference-in-

differences estimate.

We employ several time-varying covariates in our empirical model to control for

observed factors that may affect the tax revenue per capita and their summary statistics are

reported in Table 3. Our selected covariates represent the common set of explanatory variables

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[17] For example, see Author (2003), Stevenson and Wolfers (2006), and Athey and Imbens (2022).

that are used in the VAT revenue literature (for example, see Keen and Lockwood, 2010, and Martinez and Bird, 2011). All of the covariates discussed below are either in percentage or in per capita terms.

India has a long tradition of providing grants to state governments and in the VAT transition they added a temporary grant to total non-plan grants to mitigate concerns over revenue loss.[18] Grants from the central government to the states could impact own revenue collection. The literature on the impact of grants on own revenue collection is inconclusive since grants may substitute for tax collection, which would reduce tax effort, or they may be used to simply increase expenditures (see Bahl, Sethi and Wallace, 2009 for an analysis in India). The expected sign on the non-plan grants is therefore ambiguous. North Eastern Council (NEC) grants are a special form of grant provided specifically to the eight northeastern states for development purposes.[19] Like the non-plan grants, NEC grants has an ambiguous impact on revenue productivity.

Annual interest payments include interest on loans, internal debt, and market loans. We include this covariate as a proxy for the fiscal crisis that the states were grappling with in the late 1990s and early 2000s. We expect higher interest payments will be associated with higher revenue productivity if states feel a responsibility toward interest repayment.

Emran and Stiglitz (2005) and Tanzi (1992) conclude that the size of the informal sector could negatively impact the revenue productivity of the VAT due to breaks in the VAT chain at the advanced stages of production. Larger informal sectors, therefore, could reduce sales taxes, all else equal. We control for the size of the informal sector by including the unregistered

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[18] Non-plan grants are grants provided to the states. In publicly available data, the VAT-related temporary grants are included in total non-plan grants; we are not able to separately identify the temporary grants.
[19] These eight states are also listed as special states.

manufacturing sector as a share of state's GDP as a proxy. The percent of urban population may increase the effectiveness of revenue collection through economies of scale and is expected to have a positive and significant effect in our analysis. The mining sector plays a significant role in tax revenue due to the focus of tax administration on foreign mining companies and we expect that states with large mining sectors will have a larger tax base. Moreover, the percent share of mining in the state's GDP is expected to be positively correlated with revenue productivity as this sector is usually dominated by a few large firms, which could increase the efficiency of tax collection and reduce evasion. The percent share of agriculture in GDP is hypothesized to negatively affect revenue productivity due to the difficulty of taxing this sector legally and in practice. As a measure of general economic activity, gross state domestic product (GSDP) should be positively related to revenue productivity as it represents an increase in the tax base.

Table 4 reports the generalized DID results for sales tax for all states and separately for the non-special states.[20] We are unable to estimate Equation (1) separately for special states since all the special states adopted the VAT in 2005 leaving no state in the control group. Furthermore, we assume that the non-special states are in a better position to derive benefits from the VAT due to a higher level of administrative capacity, taxpayer education, and a larger tax base associated with their higher level of economic activity, better infrastructure, larger population, and higher level of economic development and urbanization.

Column 1 of Table 4 shows that the VAT's implementation has a positive impact of a 10.60 percent on sales tax for all states, but this treatment coefficient is not precisely estimated.[21]

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[20] Table 3A provides the results of the same analysis for the indirect taxes and we conclude that the VAT implementation did not significantly affect revenue collection of overall indirect taxes.

[21] The percent changes were calculated from the regression coefficients using the standard transformation (exp(coefficient)-1)*100 in a log linear model.

Column 2 in Table 4 demonstrates that the implementation of the VAT leads to an approximately 13.2 percent increase in the sales tax in the non-special states.

Few of the covariates demonstrate an economically or statistically significant effect on states' sales tax revenue. Across all states, as expected, GSDP has a positive and statistically significant effect on revenue per capita. As per the regression coefficient reported in Column 2 of Table 4, a one percent increase in the GSDP per capita leads to a 0.65 percent increase in the sales tax revenue per capita. Population also has a positive effect on the tax revenue, and it is significant for the non-special states. In general, the other covariates are not significant, which is not surprising given the relatively small changes in these variables over the time frame included in the estimation.

B. Event Study Analysis

The integrity of our DID design assumes that the treatment timing is exogenous with respect to revenue. It also assumes the existence of parallel trends, implying that the time trend of the outcome in the treated and the control groups should differ by fixed amounts every period in the absence of treatment. In other words, the relevant unobserved attributes are either group varying but time-invariant or time-varying but group invariant. This is the parallel trends assumption (PTA). The institutional and political factors presented in Section II suggest that the implementation decision was exogenous to revenue and was a function of politics regarding alignment with the ruling party of the central government in 2005. We use an events study to evaluate the existence of parallel trends. An event study model is an augmented specification of a DID design since it breaks down the single estimated DID coefficient (the average treatment effect) of Equation (1) into year-by-year treatment effects over the time panel.

We follow the standard specification of an event study model from the previous literature as used in the staggered treatment adoption literature and estimate the following:

$$\ln(\text{Sales tax})_{it} = \gamma + \sum_{j=-m}^{-2} \delta_j VAT_{it}^j + \sigma VAT_{it}^0 + \sum_{k=1}^{q} \rho_k VAT_{it}^k + \beta' X_{it} + a_i + b_t + \varepsilon_{it} \quad (2)$$

$\ln(Sales\ tax)_{it}, a_i, b_t\ and\ \varepsilon_{it}$ are as defined in Equation (1) where the dependent variable is the natural log of sales tax for state i in time t. We again cluster the standard errors at the state level to account for serial correlation within states. VAT_{it}^j, VAT_{it}^0 and VAT_{it}^k are binary 0/1 variables (event time dummies) indicating that a given state i is certain periods away from the treatment in the respective time period t. The first summation term on the righthand side allows for yearly lead (or anticipatory) effects of the treatment, indexed by j. Thus, δ_j is the lead coefficient in the jth year prior to the occurrence of the treatment. The second summation term outlines the yearly lag (or post-implementation) effects of the treatment, and are tracked by the time index k. Thus, ρ_k is the lag coefficient of the treatment in the kth year post-treatment. Finally, the coefficient σ captures the immediate treatment effect. Following the previous literature, we omit the first lead coefficient (δ_{-1}) of the treatment in the above estimation as it serves as the reference period. Finally, X_{it} are the same time-varying controls used in the estimation of Equation (1).

Given the implementation timeline in our panel data (Table 2), a fully saturated event study model would include a total of six lead ($\delta_{-2}, \delta_{-3}, ... \delta_{-6}$) and seven lag coefficients ($\rho_1, \rho_2, ... \rho_7$) in addition to the immediate treatment effect σ. This fully saturated event study model is under-identified in our sample because of the absence of a never treated unit. To

address this problem, we restrict the leads and lags to three and accumulate all leads and lags beyond three at three, following Schmidheiny and Siegloch (2019).[22]

Figure 1 presents the event study plots from the estimation of Equation (2) for all states and separately for the non-special states. The table of event study results is included in the online appendix (see Table 1A). The independent lead coefficients and the F-test of joint significance of the lead terms (reported in Table 1A) are not statistically significant[23], which implies that the parallel trends assumption holds. Moreover, it is reassuring that the lead coefficients are close to zero in their size. For all states, the coefficients of lead two (δ_{-2}) and three (δ_{-3}) of the VAT reform on sales tax are 0.91 and 0.34 percent respectively. For the non-special states, these lead coefficients are negative and statistically insignificant with values of -2.83 and -5.24 percent respectively. Therefore, our event study results support the absences of pre-treatment trends in the years leading up to the treatment. The single DID coefficient (the average treatment effect) reported in Table 4 for all and the non-special states is consistent with the magnitudes and the statistical significance of the immediate treatment effect and the yearly lag effects graphed in Figure 1 (and reported in Table 1A in the online appendix). For all states, the immediate treatment and the annual lag effects of the treatment range from 9.97 to 12.98 percent. Among these estimates only the coefficient of lag one (ρ_1) is significant at 12.98 percent.

However, for the non-special states the yearly post-implementation coefficients are all statistically significant and the size of the yearly treatment effect post its implementation (captured through lag effects) grows progressively. We see a noticeable positive shock in the

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[22] When we accumulate (or restrict) the last estimated lag term at three, it means that the treatment effect is assumed to stay constant beyond this endpoint. The same is true for the endpoint restriction of the lead terms at three.
[23] The F-tests are reported in the table of event study results (Table 1A) in the online appendix.

trajectory of the treatment effect coefficients starting at time zero (the year of implementation) and this impact continues post-reform. The estimated size of the immediate treatment effect is 13.31 percent and the lag coefficients for years one, two, and three in the non-special states are 16.77, 20.92 and 24.23 percent respectively. Consequently, in the non-special states, the positive effect of the VAT policy on the state sales tax revenue appears to not only stick and stay approximately stable in the years following the treatment, but we also observe a growth in the yearly treatment effect with the passage of time after the reform implementation. These estimates support the presence of an increasing treatment effect over time.

Overall, our event study results render some confidence to our identification and the parallel trends in the outcomes in the pre-treatment years.

V. CONCLUSION

The presence of a sub-national VAT is rare and there are few empirical studies of its impact on revenue. The implementation of the sub-national VAT in India provides an opportunity to evaluate the performance of a "not theoretically perfect" but "workable" VAT in a large developing economy. As a federal country, it is critical for state and local governments in India to improve their revenue productivity and explore instruments that are feasible and effective.

Our empirical findings show that the VAT reform increased revenue productivity of sales tax (VAT post-reform) by 13 percent in the more developed states. We cautiously conclude that the VAT reform positively affected states' fiscal position in India specifically in the more developed states of India. If we assume that the more developed states have more capable tax administrations, this result is consistent with literature demonstrating the importance of capacity in tax administration (Bird and Gendron, 2006 and Best et al., 2015). Moreover, we observe a growth in the size of the yearly treatment effect in the event study results. This offers some

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additional good news for the policymakers on the strength of the VAT reform with the passage

of time. India's experience and the empirical evidence provided here may prove useful to other

countries looking to increase revenue autonomy of their sub-national governments.

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DISCLOSURES

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Table 1: Consumption taxes pre-VAT: total number, range of rates, and average rate (2001)

STATE NAME	PRE-VAT RATES (2001)		
	TOTAL NUMBER OF TAX RATES	RANGE OF TAX RATES (%)	TAX RATE ON LIQUOR (%, IF REPORTED)
Andhra Pradesh	10	1-20	70
Assam*	6	1-20	
Bihar	19	1-25	
Chhattisgarh	8	1-20	
Delhi (NCT)	7	1-20	
Goa	19	0.5-24	
Gujarat	12	1-22	54
Haryana	9	1-20	
Himachal Pradesh*	11	1-15	30
Jammu and Kashmir*	6	1-30	
Jharkhand	19	1-16	
Karnataka	11	0.25-20	60
Kerala	13	1-37	55 to 85
Madhya Pradesh	8	1-20	
Maharashtra	14	0.5-20	
Manipur*	8	3-15	30
Meghalaya*	7	1-25	
Mizoram*	Greater than 2	2 and 5	
Nagaland*	6	1-20	
Orissa	11	1-20	
Punjab	11	1-20	
Rajasthan	12	2-20	43
Sikkim*	7	1-20	
Tamil Nadu	15	1-30	50 to70
Tripura*	13	2-20	
Uttar Pradesh	15	1-32.5	32.5
Uttarakhand*	15	1-32.5	32.5
West Bengal	15	1-20	

Notes: States noted with an "*" are special states. Arunachal Pradesh (special state) is not reported due to unavailability of data. These reported figures do not include tax on fuel. State tax rates on fuel were in the range of 20 to 25 percent. These figures also omit the zero-rate used by the states. Delhi is the National Capital Territory (NCT). The highest tax rate slab of 25 percent in Meghalaya is for lime. The highest tax rate of 25 percent in Bihar and 30 percent in Tamil Nadu is for molasses. The highest tax rate of 32.5 percent in Uttar Pradesh and Uttarakhand is for opium and lottery tickets.

Sources: Purohit (2001) and India, *All India Sales Tax Tariff* (2002).

Table 2: VAT implementation timeline by state and status

SPECIAL STATES	DATE OF IMPLEMENTATION	TOTAL COUNT	NON-SPECIAL STATES	DATE OF IMPLEMENTATION	TOTAL COUNT
			Haryana	April 1, 2003	1
Arunachal Pradesh, Himachal Pradesh, Jammu and Kashmir, Manipur, Mizoram, Nagaland, Sikkim, Tripura	April 1, 2005	8	Bihar, NCT Delhi, Goa, Karnataka, Kerala, Maharashtra, Orissa, Punjab, West Bengal	April 1, 2005	10
Assam, Meghalaya	May 1, 2005	2			
Uttarakhand	October 1, 2005	1			
			Chhattisgarh, Gujarat, Jharkhand, Madhya Pradesh, Rajasthan	April 1, 2006	5
			Tamil Nadu	January 1, 2007	1
			Uttar Pradesh	January 1, 2008	1

Source: Das-Gupta (2012) and Reserve Bank of India *State Finances: Study of Budgets 2005-2006.*

Table 3: Descriptive Statistics for Key Variables (2002-2010)

| VARIABLES USED IN ESTIMATION	DATA SOURCE	GROUP OF STATES	OBS	MEAN	STD. DEV.	MIN	MAX
*Gross state domestic product (**GSDP**)*	MOSPI, Govt of India (GOI)						
		All states	261	42,167	27,947	7,589	197,423
		Special	99	37,154	18,314	14,608	123,533
		Non- special	162	45,231	32,128	7,589	197,423
Population (in 10 million)	Central Statistical Office (CSO)						
		All states	261	3.86	4.18	0.06	19.93
		Special	99	0.63	0.79	0.06	3.04
		Non-special	162	5.83	4.19	0.14	19.93
Percent of agriculture in GSDP	MOSPI, GOI						
		All states	261	21.03	7.35	0.71	36.05
		Special	99	23.11	5.05	7.96	34.75
		Non- special	162	19.85	8.16	0.71	36.05
Percent of unregistered manufacturing in GSDP	MOSPI, GOI						
		All states	261	3.45	1.74	0.63	8.13
		Special	99	2.10	1.16	0.63	6.30
		Non- special	162	4.28	1.51	1.43	8.13
Percent of mining in GSDP	MOSPI, GOI						
		All states	248	2.39	3.08	0.00	14.23
		Special	92	1.91	2.81	0.00	10.87
		Non- special	156	2.68	3.20	0.00	14.23
Percent urban population	RBI, Central Statistical Office (CSO) and Indiastat						
		All states	261	26.15	16.91	7	93
		Special	99	18.89	9.81	8	49
		Non- special	162	30.59	18.73	7	93
Non-plan grants	State finances, RBI						
		All states	256	1,282	1,863	10.57	9,305
		Special	99	2,989	2,044	51.29	9,305
		Non- special	157	207	183	10.57	1,409
NEC grants	State finances, RBI						
		All states	261	66	151	0	950
		Special	99	173	204	0	950
		Non- special	162	0.1	0.3	0	1.9
Annual interest payments	State finances, RBI						
		All states	261	1,159	643	178	3,825
		Special	99	1,415	647	456	3,113
		Non- special	162	1,003	590	178	3,825
Indirect tax	State finances, RBI						
		All states	261	2,226	1,864	212	11,643
		Special	99	1,321	992	212	5,154
		Non- special	162	2,780	2,048	270	11,643
Sales tax	State finances, RBI						
		All states	254	1,378	1,266	145	7,504
		Special	94	757	545	145	2,643
		Non- special	160	1,743	1,419	184	7,504

Notes: MOSPI is the Ministry of Statistics and Programme Implementation, RBI is the Reserve Bank of India, and Indiastat is a private online data publishing company and maintains state-level data on various social and economic factors. Non-percentages are in Indian currency (Rupee). The variables GSDP, non-plan grants, NEC grants, annual interest payments, indirect tax and sales tax revenues are all measured in per capita terms.

Table 4: Effect of VAT Implementation on Sales Tax Revenue per capita for all States and Non-special States: Generalized Difference-in-Difference Results

VARIABLES	ALL STATES LN (SALES TAX)	NON-SPECIAL STATES LN (SALES TAX)
VAT implementation (v)	**0.101**	**0.124****
	(0.060)	**(0.050)**
NEC grants	-0.001	0.061***
	(0.000)	(0.017)
ln (non-plan grants)	0.001	-0.027
	(0.044)	(0.028)
ln (annual interest payments)	0.069	0.053
	(0.048)	(0.049)
ln (GSDP)	0.781*	0.656**
	(0.412)	(0.261)
ln (Population)	0.234	2.423**
	(0.989)	(0.841)
Percent mining in GSDP	-0.005	-0.010
	(0.030)	(0.027)
Percent urban population	-0.020	-0.000
	(0.016)	(0.012)
Percent of unregistered manufacturing in GSDP	0.050	-0.0002
	(0.044)	(0.032)
Percent of agriculture in GSDP	0.0003***	0.0004
	(0.000)	(0.009)
Constant	-1.730	-3.788
	(4.466)	(3.396)
Observations	238	151
R-squared	0.872	0.946
Number of states	29	18

Notes: Effects are estimated using the years 2002 to 2010 for Equation (1). The standard errors are clustered at the state-level and reported in the parentheses. Year dummy coefficients are suppressed. The independent variables GSDP, non-plan grants, NEC grants, annual interest payments, and the dependent variable sales tax revenue are all measured in per capita terms. The dependent variable is transformed to a natural log value, and the coefficients of the independent variables that are transformed to natural log are elasticity measures. There are some missing observations for non-plan grants, percent mining in GSDP, and sales tax for the states of Goa (2007-2010), Uttar Pradesh (2003), Uttarakhand (2002-2006), Manipur (2004-2010) and Delhi (2005-2010). *** denotes the effect is statistically significant at the 1% level, ** denotes significance at the 5% level and * denotes significance at the 10% level.

Figure 1. Event Study results with three leads, immediate and three lags effects for the sales tax. (a) All states. (b) Non-special states.
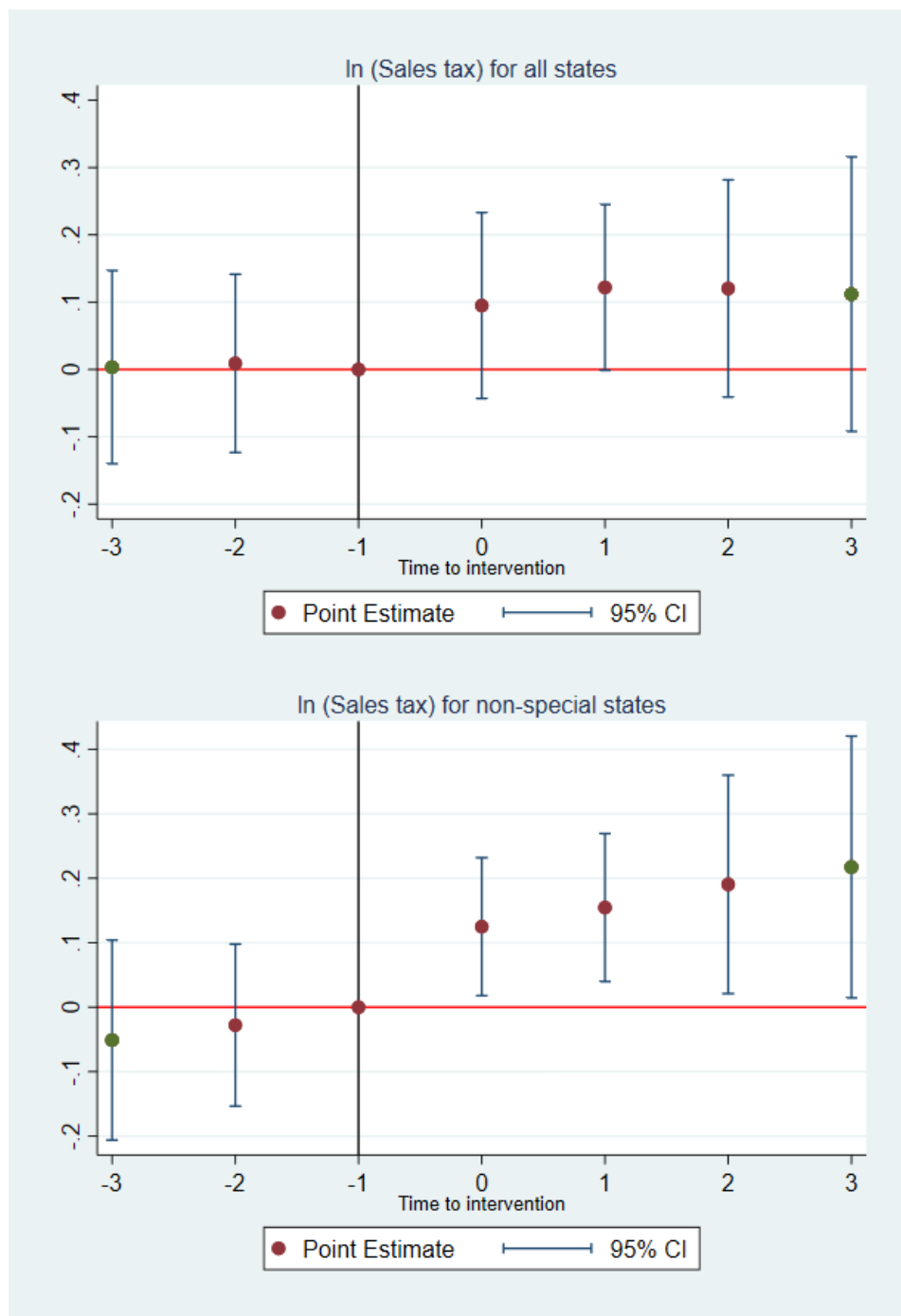
Notes: Each point in the graphs above corresponds to the coefficient estimates obtained from the event study regressions from the estimation of Equation (2). Estimation of Equation (2) uses the years of 2002 to 2010. The graphs plot the coefficients of the second and third lead effects, the immediate treatment effect in the year of the implementation of the VAT, and the treatment effect in each of the three years of post-VAT implementation. The blue lines accompanying the coefficient points are 95 percent confidence intervals using the standard errors clustered at the state-level. Time = 0 corresponds to the immediate treatment year when the treatment of the VAT policy reform is implemented. The estimation uses the one year prior to the implementation of the VAT as the base year, and this is depicted by the black vertical line at Time = -1.

NONTECHNICAL SUMMARY

Over the last sixty-plus years, a national Value Added Tax (VAT) has been embraced as an economically efficient revenue source that has the potential to raise substantial levels of revenue. Most of the VAT adoptions have been at the central level of government. At the sub-national level, the VAT is uncommon, and its impacts are not well-known. A sub-national VAT has been implemented in just three countries--Canada, Brazil, and India. Canada has one of the most credible tax administrations in the world, so the performance of its sub-national VAT is unlikely to generalize developing and less developed countries, which are often hampered by weak tax administrations and low levels of revenue.   Identification of robust sources of revenue is important for sub-national governments to provide public goods and services that fall under their jurisdiction. India's sub-national VAT reform in the mid-2000s provides an opportunity to evaluate the revenue productivity of an important policy reform.

India's sub-national VAT reform aimed to simplify a complex sales tax system and increase states' revenue and it was implemented over the period of 2003-2008. We use the staggered implementation of this important reform to gain insights into the revenue performance of a sub-national VAT in India. An understanding of the impact of India's VAT reform could be useful to other developing countries grappling with limited tax base and instruments. Using state level data for 29 states, we empirically estimate the impact of the implementation of the state sales tax revenue, controlling for other factors that could affect revenue productivity. We observe that the VAT, on average, increases the state government's sales tax revenue by 12.4 percent in the more developed (non-special) states of India. Moreover, our empirical evidence shows that the impact of the VAT reform grows overtime in the more developed states of India, implying a stronger impact of the tax policy reform in the long-run.