Impact of Third-party Reporting on Corporate Tax Evasion: Evidence from Indian Tax Records*

Sumit Agarwal† Shashwat Alok‡ Shiv Dixit§ Tejaswi Velayudhan¶

September 14, 2023

Abstract

India recently adopted a nationwide tax reform, the Goods and Services Tax (GST), that enhanced third-party reporting and enforcement. This study examines how the GST affected business tax compliance. Firms reported higher revenues and costs in response to the tax change, which can be attributed to both increased efficiency and greater tax compliance. We focus on financial statement fraud to tease out the effect of the regime change on tax compliance. The GST reduced revenue underreporting but increased evasion through overreporting of non-verifiable costs. We present a novel approach to detect cost overreporting that exploits variations in firms' non-verifiable input cost shares around tax exemption thresholds. We find that informal labor-intensive enterprises overreported wage bills after the regime shift, partially offsetting the tax compliance advantages of third-party reporting. We develop a structural model consistent with these empirical patterns and use it to study several ways of increasing tax revenues.

Keywords: Corporate tax evasion, third-party information, cost overreporting

JEL: D22, H25, H26

*We thank Alan Auerbach, Pierre Bachas, Jim Poterba, Krishnamurthy Subramanian as well as seminar and conference participants at the American Economic Association Annual Meetings, Ashoka, Asian and European Meetings of the Econometric Society, and the Indian Statistical Institute for their valuable comments. Shubham Roy provided excellent research assistance. We are grateful to the Ministry of Finance, Government of India, for sharing administrative data.

†National University of Singapore; ushakri@yahoo.com

‡Indian School of Business; shashwat_alok@isb.edu

§Indian School of Business; shiv_dixit@isb.edu

¶UC Irvine; tvelayud@uci.edu

1 Introduction

In many developing nations, limited tax capacity is a major challenge. In turn, limited tax capacity hinders the provision of public goods and the nation's long-term development (Besley et al., 2013). A growing body of research highlights the importance of tax structures that encourage information sharing directly with federal authorities or indirectly via third parties in preventing tax evasion. Such structures can increase tax revenues by increasing the transparency of economic transactions and decreasing income underreporting. However, plugging a specific hole in the tax revenue bucket may result in the creation of another. Specifically, if firms make offsetting adjustments by misreporting less verifiable items, improvements in the verification of final and intermediate products may not increase tax collections. This paper investigates the presence of such evasion shifting in the context of corporate taxation in India.

India's corporate tax rates are among the highest in the world. Given the large tax burden, the return on tax evasion is high (Gutmann, 1977; Clotfelter, 1983). Further, historically, tax norms varied considerably across Indian states, making tax enforcement difficult. It is, therefore, not surprising that financial statement fraud has been a concern in India, where many enterprises conceal sales or inflate expenses.

In July 2017, India replaced its fragmented indirect tax structure with a single indirect tax that applied across the country–the Goods and Services Tax (GST). A key objective of the regime change was to address low tax compliance levels using third-party reporting and invoice matching (GST Council, 2023). A centralized electronic filing system was established, allowing the various state and federal tax authorities to share information, including the consolidated financial statements of companies registered in the country. Using a novel administrative dataset of corporate tax returns of Indian firms, we study the extent to which this tax reform has been successful in enhancing tax compliance by businesses.

This paper proceeds in three steps. First, we employ a difference-in-differences (DD) design to determine the impact of the GST on firm revenues and expenses. The regime change had a statistically significant and positive impact on firm revenues and costs. However, these results do not shed light on the underlying mechanism; they can potentially be explained by increased production efficiency as a result of the reduction in border tariffs and the harmonization of the commodity tax code or by greater tax compliance as a result of increased enforcement under the new regime. To pin down the impact of the GST on tax compliance, we examine two types of financial statement fraud: underreporting of revenues and overreporting of expenses.

Next, using techniques from the bunching literature, we demonstrate that revenue underreporting decreased in the GST era. We follow Saez (2010), Chetty et al. (2011), and Kleven and Waseem (2013) to determine the magnitude of revenue underreporting at indirect tax exemption thresholds. We find that the extent of bunching in the distribution of firm revenues around tax exemption thresholds reduced significantly after the regime change.[1] Moreover, we find that the extent of bunching in the GST era is highly correlated with the return to evasion, i.e., the tax rate.

Finally, we propose a new method to detect cost overreporting and argue that this margin of evasion increased after the implementation of GST for a subset of firms. To identify financial statement fraud, the existing literature has primarily focused on the input-output share (Johnson et al., 1997). This approach assumes a stable relationship between some physical input and output. Deviations from the fixed input-output ratio are then interpreted as income underreporting. However, firms can evade taxes by overreporting deductible expenses as well. Carrillo et al. (2017) find that third-party reporting in Ecuador increased revenue reporting while also increasing reported costs leaving the tax burden of the firm unchanged, presumably, because sales are easier to monitor than costs.[2] In such a scenario, inferences based on the deviations of the input-output ratio may be incorrect.

However, detecting cost overreporting is challenging. Tax reform could increase production efficiency resulting in greater production and, consequently, an increase in the cost of production. To overcome this challenge, we propose a novel technique to detect cost overreporting which identifies tax evasion using variations in the composition of firms' verifiable and non-verifiable expenses. Our identification strategy leverages two institutional details. First, under GST, firms with revenues greater than INR 20 lakhs are required to file a form every month detailing all outward supplies made, input tax credit claimed, tax liability ascertained, and taxes paid. Firms with revenues below INR 20 lakhs were exempted from such monthly filings. Thus, the operations of firms below the exemption threshold are more opaque to the tax administrators. Second, under the new tax regime, taxpayer reports were verified against third-party information using invoice matching. Moreover, the previous indirect tax regime did not permit input tax credit (ITC) claims for several taxes, such as the Central Sales Tax, the Entry Tax, and the Luxury Tax. But under GST, there is no restriction on claiming ITCs. Thus, monitoring external costs (such as the cost of intermediate goods) became more effective than monitoring internal costs (such as wages). In India, about two-thirds of wage employees are daily wage contract workers who do not receive

[1] It is worth noting that while the bunching of firms below tax exemption thresholds is indicative of revenue manipulation, it does not necessarily imply that firms misreported their sales. Another possible reason for such sorting is that some firms deliberately reduce the scale of their operations to avoid scrutiny from the tax authorities.

[2] Slemrod et al. (2017) find a similar result for sole proprietorships in the U.S. Another related paper is Handley and Moore (2017), who show that reported (deductible) transport costs vary positively with tariff rates, which they attribute to misreporting.

social security benefits (ILO, 2018a). The wages of these workers lack a verifiable paper trail making it difficult for tax authorities to detect irregularities. In contrast, intermediate inputs are easier to verify using invoice matching. Thus, we reason that GST nudged firms to overreport non-verifiable expenses in order to reduce their tax burden.

We present a simple model to illustrate the mechanism. We consider a setting in which productivity shocks are the only source of variation between firms. Holding everything else constant, the cost shares of different inputs in the production process should be independent of revenues and identical for similar firms. However, the non-verifiability of some firm expenses engenders incentives for firms to inflate such costs to reduce their tax burden, particularly if they lie below the tax exemption revenue thresholds. This introduces a negative discontinuity in the ratio of non-verifiable expenses to total expenses at the enforcement notches. We employ a sharp regression discontinuity (RD) design to test this hypothesis. In our baseline sample, which focuses on the period 2017-18, we detect a negative jump in the non-verifiable expense ratio at the tax exemption threshold. Specifically, the ratio of non-verifiable expenses to total expenses is approximately 12 percent higher for firms just below the exemption threshold relative to those above. Our RD estimates are most pronounced in FY2018, i.e., which is the first fiscal year following the implementation of GST. Importantly, we do not find any evidence of cost overreporting before the implementation of GST ruling out any placebo effects.

To provide further credence to our proposed mechanism, we exploit variation in the visibility of intermediate inputs relative to labor inputs. State governments issued waybills for cross-border shipments under the value-added tax (VAT) system before GST. Border checks were common because the VAT was origin-based, and rates varied by state. The GST, in contrast, is a destination-based tax on final consumption, and the tax rates are uniform across the country. Thus, waybills were no longer needed to calculate the tax liability. After the July 2017 GST rollout, states eliminated border checkpoints. State governments still intended to track commodities entering and leaving their borders to prevent tax evasion. However, disruptions in the rollout of the new system, which began in June 2018, caused a blackout period of about a year where cross-border transactions were relatively less visible than before. Thus, the increase in the visibility of intermediate goods due to the regime shift was temporarily higher for firms that procured a smaller portion of their intermediate inputs from out-of-state, which increased their incentives to overreport their labor costs to lower their tax bill. RD estimates support this thesis. Specifically, firms with below-average out-of-state input procurement have a sharp discontinuity in the ratio of labor costs to total expenses at the exemption threshold. Firms with above-average out-of-state input procurement do not show such a tendency.

Since our reduced-form analysis relies on discontinuities around tax exemption thresholds, it is suitable to examine the existence of cost overreporting but not the overall magnitude. To estimate the level of cost overreporting, we structurally estimate a model that is consistent with results from reduced-form estimators. Notably, our model accounts for endogenous responses in costs and revenues. We find that firms scale back on production when tax enforcement is imperfect relative to the case in which the authorities can perfectly observe firms' revenues and costs. Intuitively, decreasing the size of a firm reduces its probability of being audited. This allows firms to overreport their input costs to a larger extent, which reduces their tax liability. As a result, firms bunch below tax exemption thresholds in the model, as in the data. By endogenously accounting for such sorting of firms, our structural estimation approach allows us to relax a key assumption in our RD analysis (i.e., the density of firm revenues is continuous at the thresholds). We also confirm that the shape of the non-verifiable expense ratio around tax exemption thresholds in the data broadly aligns with our model's predictions. Our results suggest that firms around the tax exemption threshold (i.e., those with revenues in the range $[0, T + \text{INR 40 lakhs}]$ where T is the tax exemption threshold) overreported their costs by 9.2 percent.

Lastly, we use the estimated model to study how the authorities can best increase tax revenues. A notable counterfactual experiment that we run is reducing the tax deductibility of costs, which may seem like a natural solution to the problem of cost overreporting. Our baseline model features a pure profit tax, similar to that implemented in India. Best et al. (2015) argue that reducing the tax deductibility of costs can lower evasion as it reduces the marginal benefit of evasion without affecting its marginal cost. We show that the presence of an enforcement notch can overturn this result. While firms above the tax exemption threshold are exposed to the mechanism outlined in Best et al. (2015) and thereby evade less, firms below the exemption threshold that face a lower probability of being audited evade more. We show that reducing the tax deductibility of costs increases cost overreporting by firms below the tax exemption threshold by more than the decrease above the threshold. Hence, reducing the tax deductibility of costs achieves the opposite of its intended effect.[3]

Summarizing, our identification strategy relies on detecting discontinuities in the behavior of firms around tax exemption thresholds. These firms are relatively small by construction. Nonetheless, one can infer the impact of the GST on large firms using the underlying characteristics of evading firms. Service providers primarily drive our baseline RD results. These

[3]We present these results with a noteworthy caveat. In the extreme case of a pure turnover tax, firms below the tax exemption threshold have no incentive to overreport their costs. Nevertheless, Diamond and Mirrlees (1971) show that a turnover tax is inefficient. Thus, in principle, a turnover tax could be welfare-enhancing if the shadow price of public funds is large relative to the efficiency cost associated with adopting a turnover tax.

firms tend to be labor-intensive with a substantial wage bill. In contrast, we do not find any evidence of cost overreporting for non-service providers or for capital-intensive firms. Since large firms tend to be capital intensive, our results imply that the regime change is unlikely to have increased financial statement fraud in such firms. Thus, overall, our results suggest that the net impact of GST on tax compliance is likely to be positive, barring a set of relatively small labor-intensive firms that responded by overreporting their costs.

Our paper contributes to the literature that examines the effect of third-party reporting on tax compliance. Much of the previous work has focused on how third-party information is essential for tax collection in developed countries (Kleven et al., 2016). The literature that studies the importance of information and third-party reporting for effective taxation in developing countries is primarily theoretical (Kopczuk and Slemrod, 2006; Gordon and Li, 2009), and empirical evidence in this domain is thin. Due to cross-country differences in enforcement and informational constraints, the impact of third-party reporting on compliance in developing economies could be substantially different from that in the developed world. There is strong evidence that third-party information increases the reporting of firm revenues considerably in developed countries (see, for instance, Pomeranz (2015) and Almunia and Lopez-Rodriguez (2018)). The reduction in revenue underreporting may be more pronounced in emerging economies as they tend to have a larger pool of self-employed workers and informal firms. Better detection may stimulate the entry of these agents into the formal sector and thereby raise tax revenues. Indeed, we find that Indian firms increased reported revenues considerably with the advent of third-party verification in the GST era. On the other hand, the effectiveness of third-party reporting in developing economies may be limited as firms may respond by making offsetting adjustments. Specifically, in response to increased detection of sales, firms may inflate costs that are harder to verify using third-party reports. Carrillo et al. (2017) provide suggestive evidence along these lines using data from Ecuador. Our study complements Carrillo et al. (2017) by providing direct causal evidence that firms reduce their tax burden by overreporting non-verifiable expenses in response to third-party verification under GST. This study is the first to provide such evidence.

To examine the differential ease of evasion under profit versus turnover taxation, Best et al. (2015) also present a model in which firms can overreport costs. Nevertheless, they admit that cost evasion is not crucial for their empirical or conceptual results. Their bunching estimates identify approximately the aggregate evasion reduction when switching from profit to turnover taxation, i.e., their estimation procedure cannot separate cost from output evasion. Bachas and Soto (2021) rely on a framework similar to Best et al. (2015) to compute the elasticity of taxable corporate profit with respect to the tax rate using Costa Rican data. While their reduced-form approach only provides a lower bound to cost elasticity, they structurally decompose the observed reduction in profits into a decrease in reported revenue and an increase in reported cost. Their approach recovers the extent of cost overreporting around notches in taxable income, but not around enforcement notches. Our approach, in contrast, speaks to how cost overreporting responds to enforcement intensity.

Our paper also contributes to the literature that examines the effect of changes in information reporting requirements on taxpayer behavior. Garbinti et al. (2023) study a reform of the French wealth tax that allowed some taxpayers to file a simplified return reporting only total gross and net taxable wealth, with no breakdown by components. The wealth growth rate of treated taxpayers fell after the reform, likely due to increased evasion. While the French wealth tax reform reduced information reporting requirements, the Indian GST increased them by requiring businesses to report detailed information on their sales and purchases. Consistent with the existing literature, we find that the increase in reporting requirements after the implementation of GST decreased taxpayer manipulation of line items that became more transparent, such as revenues and the cost of intermediate goods. In addition, our study is the first to show that the increase in reporting requirements of some line items increases taxpayer manipulation of other line items that are relatively less verifiable.

2 Institutional Background

2.1 Recent Developments in the Indirect Tax Regime

The GST is an indirect tax levied at each step in the production process and refunded to all parties in the production chain barring the final consumer. Before the implementation of GST, India had a fragmented VAT system.

There are substantial differences in tax administration in the pre- and post-GST era. In the previous system, companies were paying taxes at different production stages and were also being taxed separately by various government authorities. This often led to double taxation, i.e., goods were being taxed at the factory gate and the retail store. This led to cascading effects as sales taxes were levied on the gross value without any input credits. This was partially addressed in the previous regime via input credits for Central Value Added Taxes (CENVAT). The state VATs, however, were separate from the CENVAT, and these taxes were not allowed to be credited against each other. This issue was aggravated by the fact that some states levied draconian entry taxes that restricted the free movement of goods around the country.

In addition, the disparity between state tax policies created a complex tax system. Under the GST, all state and federal taxes were consolidated into a single, simpler-to-navigate system. Moreover, the exemption threshold for VAT under the previous regime ranged from INR 5 to 10 lakhs, dependent on the state, and was INR 10 lakhs under The Finance Act

(1994).[4] When the GST was rolled out, the threshold limit for registration had been kept at INR 20 lakhs for both goods and services.[5] Importantly, all registered firms were required to routinely self-declare details of all outward supplies made, input tax credit claimed, tax liability ascertained, and taxes paid.[6] Firms with annual revenues below INR 20 lakhs were exempt from filing these forms. The probability of detecting tax evasion likely increased due to the increased frequency of the exchange of detailed financial information above the threshold. Consequently, the tax exemption threshold introduced an enforcement notch with a discontinuous jump in the likelihood of enforcement above the threshold.

The new system also aims to improve tax compliance using invoice matching. Both the federal and state GST administrations have auditing authority. To facilitate enforcement, a common nationwide IT backbone–the GST Network (GSTN)–has been established through which all transactions must be reported. In most countries, enforcement is achieved using operational audits. In contrast, compliance with the Indian GST is achieved by matching invoices. Another reason to expect better tax compliance in the GST era is the increased utilization of the ITC (Pomeranz, 2015).

2.2 Predominance of High Corporate Taxation

Prior to the corporate tax cut in September 2019, which is toward the end of our sample, the tax burden on Indian firms was substantial. Domestic companies with an annual turnover of up to INR 250 crores were taxed at a rate of 25 percent, while those above this threshold were taxed at 30 percent. Foreign companies were taxed at a higher rate of 40 percent. Companies with a turnover of more than a crore faced graduated surcharges, while those below were exempt.

Corporate tax rates in India are among the highest in the world. This can be seen clearly in Panel (a) of Figure 1, which depicts the distribution of statutory corporate tax rates over the sample period that we study, i.e., 2015-2020. This is not a recent phenomenon. Panel (b) of Figure 1 compares the evolution of statutory corporate tax rates in India with the rest of the world. In 1980, corporate tax rates around the world averaged 40.1 percent, while in India, they were 60 percent. Despite the secular downward trend in corporate tax rates over the past four decades, corporate taxes in India have consistently been larger than in

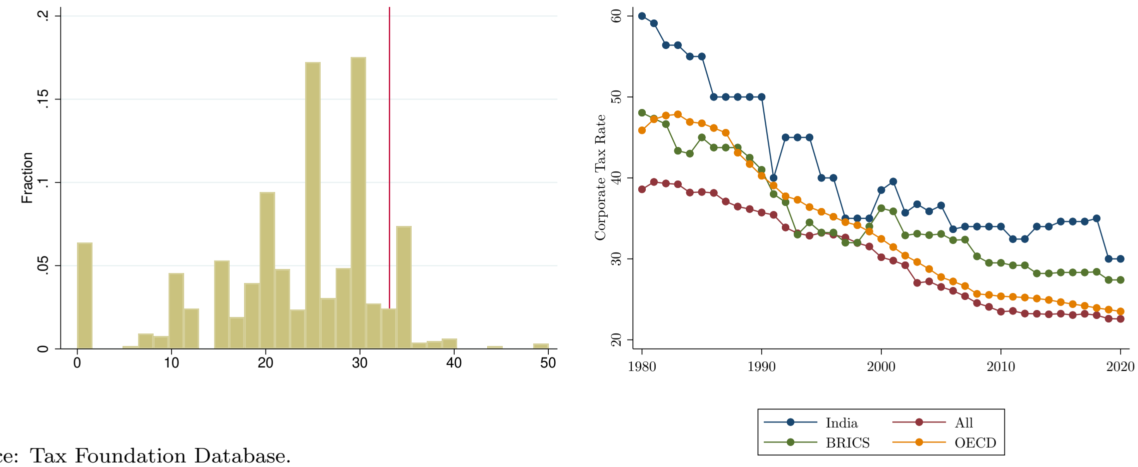
[4] However, companies producing a set of listed products were earlier exempt from paying central excise duties under the small-scale industry exemption which let off firms with revenue of up to INR 1.5 crores.

[5] Until March 2019, the GST exemption threshold for all businesses was INR 20 lakhs. With effect from April 2019, the exemption threshold for firms supplying goods was doubled to INR 40 lakhs, while the exemption threshold for service providers remained the same.

[6] Firms with turnover below INR 1.5 crores could also opt for the composition scheme. Under this scheme, firms are required to file quarterly returns instead of monthly returns and do not need to provide information on their purchases. However, a majority of firms eligible for the scheme opt out as they would have to forgo ITCs (GST Council, 2018).

the developed and developing world. In 2020, the OECD and BRICS had average statutory rates of 23.5 and 27.4 percent, considerably lower than that in India.

(a) Cross-section (2015-20)　　　　(b) Evolution



Source: Tax Foundation Database.

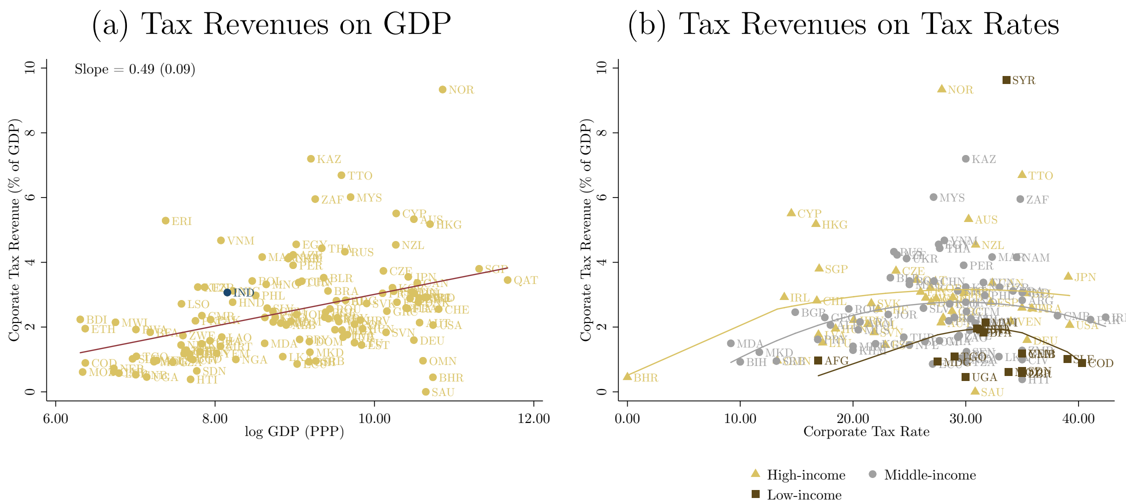
Notes: The data capture top statutory corporate income tax rates levied on domestic businesses. In particular, the data does not capture (i) special tax regimes (including but not limited to patent boxes, offshore regimes, or special rates for specific industries); (ii) lower rates for businesses below a certain revenue threshold; (iii) countries that levy gross revenue taxes instead of corporate income taxes; and (iv) nonresident tax rates that differ from the general corporate rate. In panel (a), we only include observations in the period 2015-2020. The red line marks the average corporate tax rate in India over this period.

Figure 1: Statutory Corporate Tax Rates

2.3 Prevalence of Financial Statement Fraud

Developing countries collect substantially less corporate tax revenue as a share of their gross domestic product than developed countries (Figure 2(a)). While it is plausible that lower corporate tax revenues in India stem from the fact that statutory rates are relatively high in the country, it could also be due to tax evasion (Gordon and Li, 2009; Bachas and Soto, 2021). Figure 2(b) shows that differences in tax rates cannot entirely explain the cross-country distribution of corporate tax revenues. While the existence of a Laffer curve for corporate taxes is prevalent within each income group, conditional on corporate tax rates, high-income countries tend to raise about twice as much corporate tax revenue as a share of the gross domestic product than low-income countries. This pattern suggests that tax evasion may be of first-order importance in explaining variations in corporate tax revenues across countries.

Even survey evidence suggests that financial statement fraud is pervasive in India, whereby a substantial amount of firms hide sales or inflate expenses, often via ghost employees and fictitious contracts. Deloitte India Fraud survey report tracks sentiments on the topic of corporate fraud in India. In 2016, three surveys–which focused on large (domestic and multinational) companies, small and medium enterprises, and working professionals–were conducted. In their large companies survey, 10 percent of the respondents experienced



Source: Tax Foundation Database, UNU-WIDER Government Revenue Dataset, World Bank World Development Indicators Database.

Notes: Observations reflect averages over the period 2000-2015. Countries with less than one million in population are excluded. In panel (b), we estimate Laffer curves (across income groups according to the World Bank classification) by fitting a fractional polynomial of degree two.

Figure 2: Corporate Tax Revenues

financial misreporting over the last two years. In the small and medium companies survey, 21 percent of survey respondents experienced financial misreporting over the previous two years. In their working professionals survey, 40 percent of the respondents suspected their organization had experienced financial statement fraud. A majority of the respondents also felt that corporate tax fraud is likely to rise in the coming years (Deloitte, 2016).

There are at least two reasons for the prevalence of financial statement fraud in India. First, the country's high level of direct and indirect tax rates imply a high return to evasion. Second, tax exemption thresholds prompt businesses to underreport their revenues. Like in most countries around the world that use VATs, there is a minimum registration threshold based on annual turnover below which companies in India do not need to register for VAT. As VAT rates are often quite high, this incentivizes firms to underreport their reported turnover to avoid registering for the VAT. This allows firms to avoid bearing the compliance cost associated with registration and enables them to fly under the tax authorities' radar by withholding detailed information regarding their inputs. Since tax authorities cannot construct a comprehensive picture of firms' costs through third-party information, avoiding VAT registration permits firms to continue to reduce their tax liability by overreporting costs.

3 Data and Descriptive Statistics

Our primary data source is administrative tax records from the Ministry of Corporate Affairs (MCA), Government of India. As emphasized by Card et al. (2010), administrative data have far fewer problems with attrition, non-response, and measurement error than traditional survey data sources. We rely on a random sample of all registered companies in India. Our sample ranges from 2015 to 2020 and covers 21,538 firms.

We match stock and flow data from firm balance sheets and profit & loss accounts. We rely on tax filings under three umbrellas: AOC-4, IND-AS, and XBRL. Form AOC-4 is used to file the financial statements for each financial year with the Registrar of Companies (ROC). Non-bank financial corporations (NBFCs) are required to comply with Indian Accounting Standards (IND-AS). Barring a few exceptions, the following set of companies report their financials in the XBRL form: (i) companies listed with any Stock Exchange(s) in India and their Indian subsidiaries; (ii) companies having paid-up capital of INR 5 crores or above; (iii) companies having turnover of INR 100 crores or above; (iv) companies required to prepare their financial statements as per Companies Rules (2015). Companies in banking, insurance, the power sector, NBFCs, and housing finance companies are exempted from XBRL filing.

We combine the administrative data with two surveys conducted by the National Statistical Office, Ministry of Statistics & Programme Implementation, Government of India: the Annual Survey of Industries (ASI) and the National Sample Survey Office (NSSO). ASI data has detailed information regarding input costs allowing us to assess firms' dependence on inputs with varying visibility to tax authorities. In particular, we proxy the relative change in the visibility of intermediate goods after the implementation of GST using the percentage of inputs sourced from out-of-state. After the implementation of GST, intermediate goods were not scrutinized at state borders, and thus the net effect on the visibility of these goods due to the regime change was subdued for those firms that sourced more inputs from out-of-state. Importantly, ASI allows us to assess the dependence of firms on intermediate inputs with varying visibility relative to labor inputs. Labor costs are less visible to tax authorities, particularly for firms relying on informal workers. NSSO data allows us to assess the dependence of firms on informal labor supply, providing an additional margin to test our thesis.

Table 1 reports summary statistics for the firms used in the analysis. The last column of the table tests for differences in group means of firms in the pre- and post-GST period. We see a marked decline in firm revenues and costs post the implementation of GST. Average firm revenues reduced from INR 261.0 crores to INR 95.3 crores, while average expenses reduced from INR 246.7 crores to INR 91.9 crores. As we argue below, these differences do not capture the causal impact of the GST.

Table 1: Summary Statistics

	Observations	All	Pre-GST	Post-GST	Difference
	(1)	(2)	(3)	(4)	(4) - (3)
	Total	Mean	Mean	Mean	Est.
		(S.D.)	(S.E.)	(S.E.)	(S.E.)
P&L a/c variables					
Total revenue	87,309	206.81	261.00	95.27	-166.73
		(3079.63)	(15.53)	(2.38)	(15.71)
Total expenses	87,309	196.10	247.65	91.94	-155.71
		(2897.06)	(14.62)	(1.93)	(14.75)
Employee compensation	87,302	14.45	18.14	6.99	-11.14
		(239.82)	(1.21)	(0.17)	(1.22)
Cost of materials	87,302	96.84	120.23	49.60	-70.63
		(1523.63)	(7.70)	(0.71)	(7.73)
Power and fuel costs	54,142	4.22	5.94	0.76	-5.19
		(354.28)	(2.28)	(0.02)	(2.28)
Finance cost	87,302	7.45	8.99	4.34	-4.64
		(179.79)	(0.67)	(1.25)	(1.42)
Insurance expenses	54,142	0.06	0.07	0.03	-0.04
		(1.40)	(0.01)	(< 0.01)	(0.01)
Auditing expenses	54,142	0.01	0.01	0.01	≈ 0
		(0.08)	(< 0.01)	(< 0.01)	(< 0.01)
Balance sheet variables					
Total assets	93,325	446.25	387.52	549.15	161.64
		(6577.09)	(22.40)	(44.39)	(49.72)
Borrowings	93,320	81.26	76.51	89.59	13.08
		(1743.96)	(5.70)	(12.12)	(13.40)
Equity	93,320	146.16	25.74	357.15	331.42
		(22295.51)	(1.42)	(200.84)	(200.85)
Cash	93,320	15.73	16.39	14.59	-1.80
		(205.09)	(0.90)	(0.96)	(1.32)

Notes: All variables are denominated in INR Crore. The pre- and post-GST periods correspond to the years 2015-2017 and 2018-2020 respectively. Columns 2–4 report means and standard deviations in parentheses. Column 5 reports differences of group means between columns 3 and 4 with standard errors in parentheses.

4 Impact of the GST on Reported Revenues and Costs

Table 1 shows that both revenues and costs decreased after the implementation of GST in our sample of firms. However, one cannot attribute these changes to the GST since it coincided with a period of relatively anemic growth that could be due to other policies (such as Demonetization) and negative shocks from home and abroad. Moreover, our sample is unbalanced due to firm entry and exit, which may lead to selection bias when testing for differences in group means of firms in the pre- and post-GST period. Indeed, we find the opposite when we control for these confounding conditions using a difference-in-differences (DD) strategy. Despite the decreasing trend in mean revenues and costs, we find that the GST positively impacted both variables.

Our DD results are consistent with two hypotheses. The first hypothesis is that the GST led to firm growth in the sample of impacted firms; this increase in production justifies both higher revenues and costs. An alternative explanation is that the GST led to better income monitoring, which increased reported firm revenues without a substantial change in production. In order to reduce their corporate tax burden, firms reported higher costs, which were harder to monitor. In Section 6, we document evidence supporting the latter hypothesis.

4.1 Empirical Strategy

A DD estimation strategy follows naturally from the GST policy variation. While GST subsumes most indirect taxes from the previous VAT regime, certain levies have been kept out of its purview.[7] We construct the treatment variable as follows:

$$\text{GST}_{i,t} = \mathbb{1}_{p_i \in \text{Non-exempted goods}} \times \mathbb{1}_{r_{i,t} > \text{ INR 20 lakhs}} \times \mathbb{1}_{t>2017},$$

where i denotes a firm, t denotes the tax filing year, p_i denotes the HSN code of the product supplied by firm i, and $r_{i,t}$ denotes the revenue of firm i in period t. The DD strategy is implemented using the regression framework:

$$y_{i,t} = \beta \text{GST}_{i,t} + \phi_i + \psi_t + \epsilon_{i,t},$$

where $y_{i,t}$ denotes outcome variables for firm i in period t, ϕ_i denotes firm fixed effects, and ψ_t denotes year fixed effects. Our primary parameter of interest is β, which captures the average treatment effect (ATE).

Our treatment group comprises of firms supplying goods that were not exempt from GST and had a turnover above INR 20 lakhs as these firms were required to bear the compliance cost associated with filing GST returns. Our control group comprises of firms supplying goods exempt from GST or had a turnover below INR 20 lakhs or both. Note that the control group in our baseline empirical strategy includes two sets of firms that were partially treated. The first set of firms supply products exempt from GST but have revenues above

[7] See Notification No. 2/2017-Central Tax (Rate) issued by the Ministry of Finance of the Government of India on June 28, 2017.

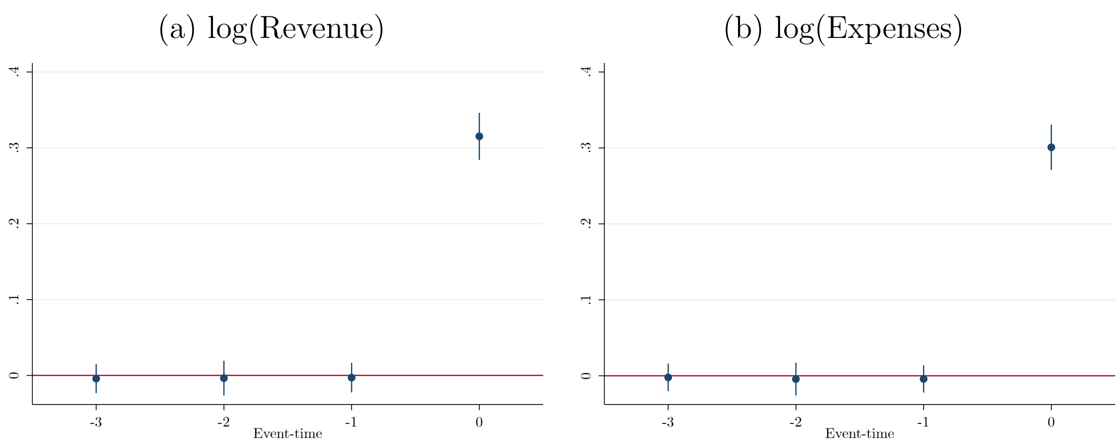
INR 20 lakhs, due to which these firms still have to bear GST compliance costs. The second set of firms have revenues lower than INR 20 lakhs but supply products that are not exempt from GST; changes in the tax structure itself may have induced a behavioral response in such firms. More specifically, even though firms with revenues lower than INR 20 lakhs are not liable to pay GST, some may voluntarily register for the GST to claim ITCs. If these firms produce products that were taxed differently after the GST was introduced, then the GST may have affected their production decisions. Thus, including these two sets of firms in our analysis can potentially bias the treatment effects. For robustness, we also repeat our tests with a control group of firms that are both GST-exempt and have revenues less than INR 20 lakhs.

4.2 Validity of the DD Design

The identifying assumption for the consistency of β requires the presence of parallel trends in outcomes across the treatment and control groups. To test this assumption, we follow Autor (2003) and estimate:

$$y_{i,t} = \sum_{l=-3}^{0} \beta_l \text{GST}_{i,t}(t = 2018 + l) + \phi_i + \psi_t + \epsilon_{i,t}.$$

A test of the parallel trends assumption is $\beta_l = 0\ \forall l < 0$, i.e., the coefficients on all leads of the treatment should be zero. Figure 5 reports the results, which verify the DD assumption.



Notes: We use the truncated sample that excludes (i) firms that have revenues lower than INR 20 lakhs and supply products that are not exempt from GST, and (ii) firms that have revenues above INR 20 lakhs and supply products exempt from GST.

Figure 3: Parallel Trends

4.3 Results

Focusing on Table 2, columns 1–2, we find that the implementation of GST led to an increase in both reported revenues and costs. In columns 3–4, for robustness, we repeat the analysis after excluding partially treated firms from our control group, i.e., we exclude observations corresponding to firms that have revenues above the tax exemption threshold and supply tax-exempted products and observations corresponding to firms that have revenues below the tax exemption threshold and supply non-tax-exempted products. Applying our empirical strategy to this truncated sample allows us to contrast the experiences of fully treated firms with fully untreated ones. Using our truncated sample, we find that the GST increased reported revenues by 245.1 percent and reported expenses by 194.4 percent.[8] As discussed in Section 4, these results could be driven by increased production or changes in tax evasion incentives. In the subsequent sections, we attempt to pin down the impact of GST on tax evasion.

Table 2: Effect of Treatment on Firm Revenues and Costs

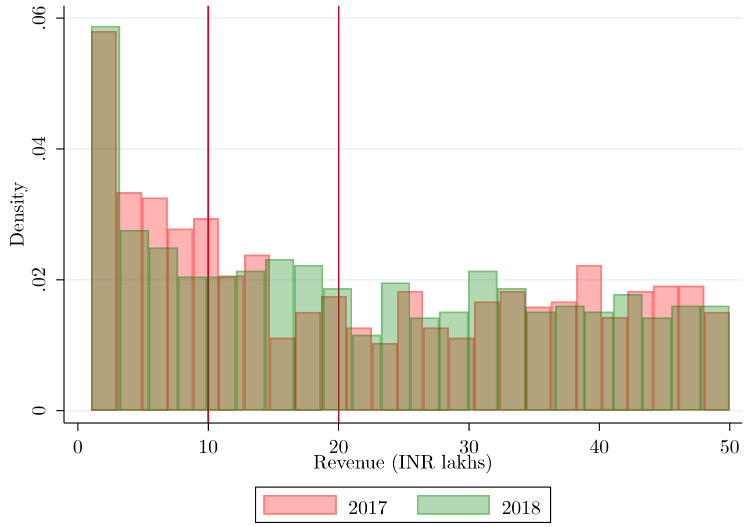
Sample of firms	Full sample		Truncated sample	
Outcome variable	log(Revenue)	log(Expenses)	log(Revenue)	log(Expenses)
	(1)	(2)	(3)	(4)
GST	1.403***	0.986***	2.451***	1.944***
	(0.0701)	(0.0525)	(0.411)	(0.352)
Firm FE	Y	Y	Y	Y
Year FE	Y	Y	Y	Y
Observations	85842	86866	81799	81793

Notes: In the truncated sample, we exclude observations satisfying $r_{i,t}$ < INR 20 lakhs and $p_i \in$ Non-exempted goods and observations satisfying $r_{i,t} \geq$ INR 20 lakhs and $p_i \in$ Exempted goods. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Robust standard errors in parentheses.

5 Revenue Underreporting

A firm with relatively modest input costs may find it desirable to restrict the scale of its operations or misreport sales. In this case, bunching occurs, where a firm keeps its reported taxable turnover just below the registration threshold. Figure 4 plots the histogram of firm revenues in the tax filing year prior to and post the implementation of GST. In the old tax regime, firms with a turnover of below INR 10 lakhs were exempt from registration. In the new regime, this exemption threshold was increased to INR 20 lakhs. In response, we see that the excess mass of firms below the INR 10 lakhs threshold moves closer to the new threshold of INR 20 lakhs.

[8] Carrillo et al. (2017) find that in Ecuador, third-party reporting increased reported revenues by 93 cents per dollar of notified discrepancy and increased reported costs by 96 cents for every dollar of revenue adjustment.



Notes: We restrict attention to firms with revenues above INR 1 lakhs and below INR 50 lakhs. The tax exemption threshold was changed from INR 10 lakhs to INR 20 lakhs under the new tax regime.

Figure 4: Distribution of Firm Revenues

5.1 Empirical Strategy

We follow Saez (2010), Chetty et al. (2011), and Kleven and Waseem (2013) to quantify the extent of bunching at indirect tax exemption thresholds. In particular, we denote the number of firms in a discrete revenue bin j by c_j, and the midpoint of revenue in the respective bin as r_j. The bin size is set to INR 25000 to ensure that there is at least one observation in each bin. We estimate the counterfactual density by fitting a p degree polynomial to these counts, excluding observations in a range $[r_L, r_U]$ around the exemption threshold T:

$$c_j = \sum_{i=0}^{p} \beta_i (r_j)^i + \sum_{i=r_L}^{r_U} \gamma_i \mathbb{1}[r_j = i] + \epsilon_j.$$

The excess number of firms who locate near the kink relative to the counterfactual density is given by $B = \sum_{j=r_L}^{r_U} (c_j - \hat{c}_j)$, where $\hat{c}_j = \sum_{i=0}^{p} \hat{\beta}_i (r_j)^i$ denotes the estimated counterfactual density. We define the excess mass around the bunch point relative to the average density of the counterfactual revenue distribution between r_L and r_U:

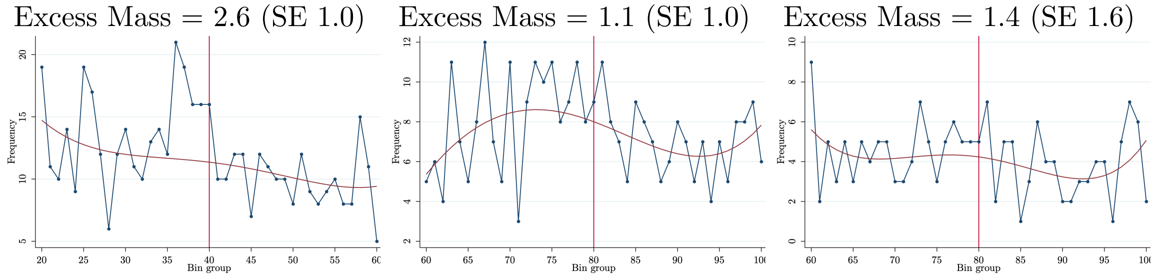
$$b = \frac{B}{\sum_{j=r_L}^{r_U} \hat{c}_j / (r_U - r_L)}.$$

The bunching window is determined by visual inspection of the excess mass in the pre-GST period. In particular, the leftmost (rightmost) bin in the bunching window is set to 5 (1) bins below (above) the bunch point.

5.2 Results

Figure 5 reports the results. There is substantial excess mass around the INR 10 lakhs threshold in the pre-GST regime. This is consistent with existing theoretical and empirical evidence on bunching below VAT exemption thresholds (Keen and Mintz, 2004; Liu et al., 2019). Moreover, the excess mass around INR 20 lakhs in the pre-GST period is statistically indistinguishable from zero. After the policy change, we find a marginal increase in the excess mass around the INR 20 lakhs threshold. However, the excess mass around the new threshold remains statistically insignificant and is considerably lower than that around the old threshold, which suggests that third-party reporting under the GST reduced revenue underreporting. Given our empirical setup, we can only comment on the changes in revenue underrporting around the exemption thresholds. In Appendix A, we show that revenue underreporting is also positively associated with the return to evasion. Specifically, we find that the excess mass around tax exemption thresholds is larger in the subsample of firms facing higher than average GST rates.

(a) $t \leq 2017$, $\bar{r}$ = INR 10L Excess Mass = 2.6 (SE 1.0) (b) $t \leq 2017$, $\bar{r}$ = INR 20L Excess Mass = 1.1 (SE 1.0) (c) $t > 2017$, $\bar{r}$ = INR 20L Excess Mass = 1.4 (SE 1.6)



Notes: These figures show the revenue distribution around the GST exemption thresholds (demarcated by the vertical red lines) for firms between 2015-2019. The series shown in dots is a histogram of revenues. Each point shows the number of observations in an INR 25,000 bin. The solid line beneath the empirical distribution is a four-degree polynomial fitted to the empirical distribution excluding 20 bins above and below the cutoff. The leftmost (rightmost) bin in the bunching window is 5 (1) bins below (above) the bunch point. Firms with revenues below INR 1 lakh and above INR 50 lakhs are discarded. In panel (a), we consider observations on or before 2017 around the threshold of INR 10 lakhs. In panel (b), we consider observations on or before 2017 around the threshold of INR 20 lakhs. In panel (c), we consider observations after 2017 around the threshold of INR 20 lakhs.

Figure 5: Revenue Bunching at GST Exemption Thresholds

6 Cost Overreporting

In this section, we propose a novel approach to detect cost overreporting and find that this margin of evasion increased after the implementation of GST. In contrast to prior literature that focuses on aggregate reported costs, we examine the impact of GST on the share of non-verifiable expenses. The underlying idea is that, given third-party reporting, firms in the post-GST era would find it difficult to evade taxes by inflating verifiable expenses. Consequently, tax-evading firms would inflate non-verifiable expenses to reduce their corporate tax bill.

Assuming that the production technologies of firms are similar around tax exemption thresholds, we should not observe any discontinuity in expense ratios around these thresholds. However, if firms are inflating non-verifiable expenses, they are likely to do so by more below tax exemption thresholds that allow them to fly under the authorities' radar, introducing a negative discontinuous jump in the ratio of non-verifiable expenses to total expenses at these thresholds.

6.1 Empirical Strategy

To detect such jumps, we use a sharp RD design. The RD design (Hahn et al., 2001, Imbens and Lemieux, 2008) exploits a discontinuity in the treatment assignment to identify a causal effect. It can be used when treatment assignment is determined on the basis of a cutoff score, s, on an observed forcing variable. The forcing variable in this design is excess revenue relative to the time-specific tax exemption thresholds. We construct a score for the treatment as follows:

$$s_{i,t} \equiv \begin{cases} r_{i,t} - \text{INR 10 lakhs} & t \leq 2017 \\ r_{i,t} - \text{INR 20 lakhs} & t > 2017 \end{cases}.$$

We consider the following specification for estimating the RD treatment effect:

$$y_{i,t} = \alpha + \beta \mathbb{1}(s_{i,t} \geq 0) + f(r_{i,t}) + \epsilon_{i,t} \quad \forall r_{i,t} \in (0, \text{INR 50 lakhs}),$$

where $y_{i,t}$ is the outcome variable (i.e., non-verifiable expense ratio) and f is a continuous function.

We proxy non-verifiable costs using employee benefits expenses, which include all forms of compensation given by an enterprise in exchange for service rendered by employees. Wage employment is composed of salaried and casual wage employment. The tax authorities can track the wages of salaried workers by matching contributions to the Employees' Provident Fund Scheme, which is obligatory for all firms with at least 20 employees. However, about 62 percent of wage employees are casual workers–consisting mainly of people from poorer households engaged in irregular work–compensated on a daily basis (ILO, 2018a). Casual wages lie outside the purview of tax authorities in contrast to expenditures on intermediate goods (which can be tracked by invoice matching) and salaried wages (which can be tracked using compulsory pension payments). We focus on firm-year observations with revenues less than INR 50 lakhs and discard outliers that are respectively below and above the 5th and 95th percentile of observations of non-verifiable expenses and total expenses.[9]

[9] We also drop observations that feature non-verifiable expense ratios larger than one. Our baseline analysis is focused on the years 2017 and 2018. Our main result is robust to winsorizing the outliers instead of discarding them.

6.2 Results

Table 3 reports the RD estimates using the bias-corrected estimator proposed by Calonico et al. (2014). Specifically, we use a linear estimator with a triangular kernel and MSE-optimal bandwidth. In panel A of the table, we present RD estimates without accounting for covariates. The results in columns 1–2 indicate that within the bandwidth, the ratio of non-verifiable expenses to total expenses is 11.8 percent higher for firms just below the tax exemption threshold. The estimated effect of the treatment is not only large but also statistically significant at conventional levels. The estimated change in the non-verifiable expense ratio remains negative but becomes imprecise when we consider the full sample period. In columns 3–4, we restrict attention to the sample of firms that supply products that are not exempt from GST. Our results remain robust. In panel B, we find that the point estimates are also robust to controlling for the following set of covariates: {total assets, borrowings, equity, cash}. To visualize the RD design, in Figure 6, we plot the binned means of the non-verifiable expense ratio against the score, adding a first-order global polynomial fit estimated separately for treated and control observations, adjusted for covariates. In Appendix B, we show that this result is robust to alternative choices of bandwidths and kernel functions. More importantly, in Appendix C, we show that our baseline results are driven by firm responses after the GST was implemented. We do not find any evidence of cost overreporting in the year preceding the implementation of GST mitigating concerns of a placebo effect. These results suggest that firms with revenues around the exemption threshold responded to the tax change by overreporting their non-verifiable costs.

Table 3: Exemption Threshold and Non-verifiable Expense Ratio

Sample of firms	Full sample		Non-exempted firms	
Sample period	2017-18	2015-20	2017-18	2015-20
	(1)	(2)	(3)	(4)
Panel A: Excluding covariates				
RD estimate	-0.118**	-0.046	-0.119**	-0.049
	(0.054)	(0.031)	(0.054)	(0.031)
	[804]	[2094]	[790]	[2043]
Panel B: Including covariates				
RD estimate	-0.112**	-0.030	-0.114**	-0.036
	(0.052)	(0.034)	(0.053)	(0.033)
	[717]	[1855]	[703]	[1807]

Notes: To compute the RD estimates, we use a linear estimator with a triangular kernel and MSE-optimal bandwidth. Standard errors are reported in parenthesis and are clustered at the firm level. Observations are reported in square brackets. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

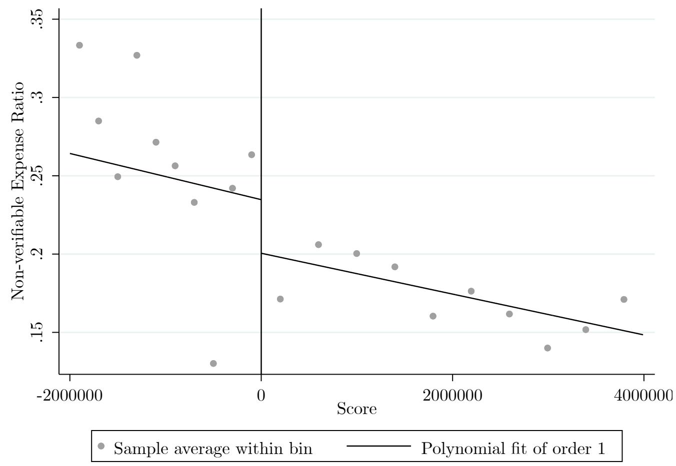


Figure 6: Effect of Exemption Threshold on Non-verifiable Expense Ratio

6.3 Validity of the RD Design

6.3.1 Placebo Tests

We perform additional placebo tests to further strengthen the causal interpretation of our findings regarding cost overreporting. Specifically, in Table 4, we examine discontinuity in the non-verifiable expense ratio at the INR 20 lakhs cutoff for the pre-GST period and at the INR 10 lakhs cutoff for the post-GST period. Since the tax exemption thresholds were revised from INR 10 lakhs to INR 20 lakhs under the GST, we should not see any discontinuous pattern at the respective cutoffs for these placebo outcomes. The point estimates for both placebo outcomes are statistically indistinguishable from zero.

Table 4: Placebo Tests: Alternative Exemption Thresholds

Sample period	Pre-GST	Post-GST
Running variable	$r_{i,t}$ − INR 20 lakhs	$r_{i,t}$ − INR 10 lakhs
	(1)	(2)
RD estimate	-0.042	0.119
	(0.065)	(0.177)
	[1451]	[643]

Notes: To compute the RD estimates, we use a linear estimator with a triangular kernel and MSE-optimal bandwidth. Standard errors are clustered at the firm level. Observations are reported in square brackets. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

In Table 5, we examine discontinuity in the share of verifiable expenses at the tax exemption thresholds. Specifically, we restrict attention to only verifiable expenses in these tests and examine if there are discontinuities in various verifiable input costs as a fraction of total verifiable expenses. We consider several types of verifiable expenses: cost of materials; power and fuel costs; finance costs for debt servicing; insurance expenses; and payments to auditors (columns 1–5 of Table 5). The greater visibility of these expenses stems from the fact that they are due to a third party, and thus evasion on these margins would be more costly as it would require firms to collude. We do not detect any discontinuities for these placebo variables, further supporting our findings.

Table 5: Placebo Tests: Share of Verifiable Expenses

	Cost of Materials (1)	Power and Fuel Costs (2)	Finance Cost (3)	Insurance Expenses (4)	Auditing Expenses (5)
RD estimate	0.027	0.064	-0.030	0.002	0.003
	(0.120)	(0.054)	(0.037)	(0.004)	(0.004)
	[787]	[755]	[802]	[755]	[755]

Notes: To compute the RD estimates, we use a linear estimator with a triangular kernel and MSE-optimal bandwidth. Standard errors are clustered at the firm level. Observations are reported in square brackets.* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

6.3.2 Covariate Balance

In Table 6, we inspect the control variables at the discontinuity. Each row presents RD estimates at the exemption threshold using a linear estimator with a triangular kernel. Our first set of results, reported in panel A of the table, employ MSE-optimal bandwidths. We do not observe any discontinuous jump in the covariates at the exemption threshold, with p-values ranging from 0.354 to 0.846. For falsification purposes, it may be more appropriate to use CER-optimal bandwidths as we are mostly interested in inference and not the point estimates. CER-optimal bandwidths leads to lower size distortions than tests implemented using the MSE-optimal bandwidths. In panel B of the table, we show that using CER-optimal bandwidths does not alter our conclusions.

Table 6: Testing Balance of Covariates around GST Exemption Thresholds

Variable	Optimal Bandwidth	RD Estimator	p-value	Confidence Interval
Panel A: MSE-optimal bandwidth				
Total assets	7.91×10^5	67.82	0.354	[-92.98, 259.90]
Borrowings	3.88×10^5	-111.72	0.846	[-1110.22,1354.81]
Equity	6.52×10^5	-51.89	0.561	[-213.03, 115.52]
Cash	3.73×10^5	404.79	0.346	[-2405.13, 6857.65]
Panel B: CER-optimal bandwidth				
Total assets	2.71×10^5	181.28	0.438	[-1761.30, 4068.60]
Borrowings	2.81×10^5	-460.03	0.424	[–1162.55, 489.21]
Equity	4.73×10^5	-60.41	0.569	[-260.92,143.54]
Cash	5.74×10^5	93.41	0.348	[-110.63, 314.20]

Notes: All variables are denominated in INR Crore. To compute the RD estimates, we use a linear estimator with a triangular kernel. Standard errors are reported in parenthesis and are clustered at the firm level.

6.3.3 Continuity of the Score Density

Sorting or bunching of firms along the threshold can bias the RD results. An underlying assumption in the RD design is that firms cannot *precisely* manipulate the running variable. So, we should observe approximately a similar number of firms on either side of the exemption threshold. Even if firms actively attempt to affect their score by underreporting revenues, in the absence of precise manipulation, random change can place roughly the same amount of firms on either side of the cutoff, leading to a continuous probability density function when the score is continuously distributed.

(a) FY2017-FY2018 (b) FY2018

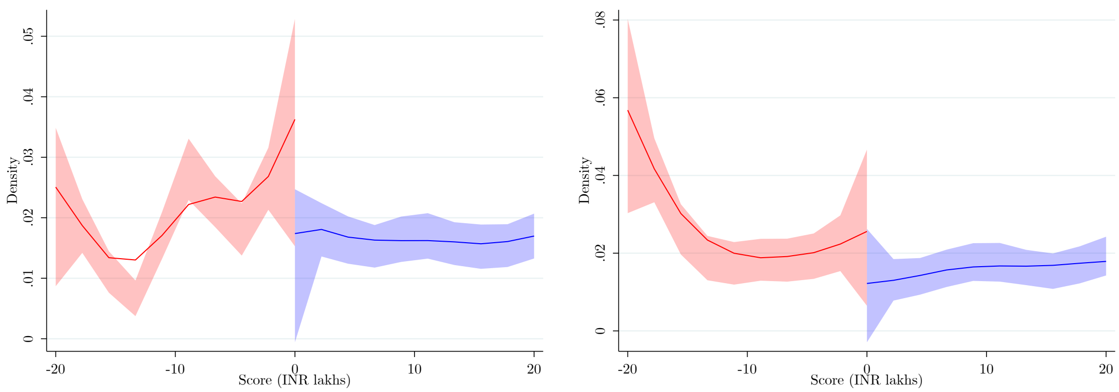


Figure 7: Estimated Density of Running Variable

We follow Cattaneo et al. (2017) to test that the density of the running variable is continuous at the cutoff. We do not find statistically significant evidence of manipulation at the cutoff, which supports the validity of the RD design. Panel (a) of Figure 7 provides a graphical representation of the continuity in density test approach, exhibiting both a histogram of the data and the actual density estimate with shaded 95% confidence intervals.[10]

As discussed in Section 5, we find statistically significant evidence of bunching around tax exemption thresholds only during the pre-GST period. We argued that the greater visibility of firm revenues after GST likely reduced the incidence of firms underreporting their sales. However, firms may still have an incentive to scale down their operations to avoid audits, allowing them to overreport their costs while flying under the authorities' radar. This can also lead to the bunching of firms below tax exemption thresholds, which can bias our RD results. While we explicitly account for such responses in our structural model (Section 6.6.2), we find that in the data, this type of bunching is not large enough to generate a

[10]The test proposed from Cattaneo et al. (2017) descends from McCrary (2008), but requires fewer choices of tuning parameters and takes fuller advantage of local polynomial regression. For robustness, we also check for discontinuities using McCrary's version of the test (McCrary, 2008). Again, we do not observe any discontinuity at the 5% significance level.

statistically significant discontinuity in the distribution of firm revenues at the threshold in the post-GST period (see panel (b) of Figure 7). In Appendix C, we show that our RD estimates remain negative and statistically significant even when we restrict attention to tax returns for FY2018, where bunching is less of a concern.

6.3.4 Sensitivity to Observations near the Exemption Threshold

In this section, we further investigate the possibility of firms manipulating their revenues, which determines the score in our RD design. If systematic manipulation of score values has occurred, it is natural to assume that the units closest to the cutoff are those most likely to have engaged in manipulation. To test if this is the case, we use a donut-hole approach and investigate the sensitivity of our RD estimates to the response of firms with revenues close to the GST exemption threshold. In Table 7, we exclude observations with $\mid s_{i,t} \mid < \Lambda$ and recompute MSE-optimal bandwidths for $\Lambda \in \{5000, 10000, 15000\}$. Our estimates remain robust.

Table 7: RD Estimation for the Donut-Hole Approach

Donut Hole Radius (in INR)	0	5000	10000	15000
	(1)	(2)	(3)	(4)
RD estimate	-0.118**	-0.118**	-0.123*	-0.130*
	(0.054)	(0.059)	(0.067)	(0.069)
	[804]	[803]	[800]	[799]

Notes: To compute the RD estimates, we use a linear estimator with a triangular kernel and MSE-optimal bandwidth. Standard errors are reported in parenthesis and are clustered at the firm level. Observations are reported in square brackets. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

6.4 Evidence on the Mechanism

Our mechanism for tax evasion relies on the differential visibility of intermediate goods and labor inputs. We test our proposed mechanism in this section by exploiting variation in the visibility of intermediate goods brought about by the implementation of GST.

Pre-GST, intermediate goods were inspected at state borders, making it more difficult for businesses to conceal these costs. To facilitate the movement of products, border tax checkpoints were eliminated after the introduction of the GST. This decreased the visibility of intermediate goods sourced from states other than the firm's home state, despite the fact that the net effect of the GST on the visibility of these goods may have been positive due to the advent of invoice matching. In order to reduce their tax liability, businesses with a higher ratio of out-of-state input procurement can overstate the cost of their intermediate products rather than overreport labor costs.[11]

[11]We make the following set of assumptions to calculate out-of-state input procurement ratios. First,

Table 8 provides evidence in support of our proposed mechanism. Post-GST, firms with higher than average out-of-state input procurement ratios did not shift to overreporting labor costs relative to other costs. However, we detect a discontinuity in the ratio of labor costs to total expenses for firms with below-average out-of-state input procurement ratios. Moreover, we do not find any evidence of discontinuities in the non-verifiable expense ratio for either set of firms before the GST was implemented. Consistent with our thesis, these results suggest that our empirical results are driven by variations in the extent of visibility of certain inputs relative to others.

Table 8: Variation in RD Estimates (by Out-of-state Input Procurement)

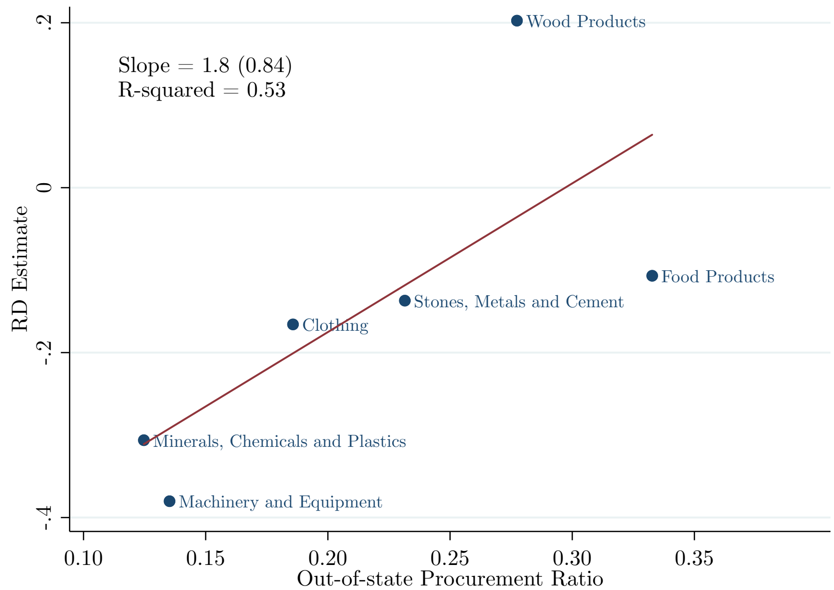
Sample period	Post-GST		Pre-GST	
Sample of firms	High OPR	Low OPR	High OPR	Low OPR
	(1)	(2)	(3)	(4)
RD estimate	0.108	-0.281**	-0.003	0.850
	(0.147)	(0.142)	(0.059)	(0.581)
	[122]	[153]	[126]	[186]

Notes: High (low) out-of-state input procurement ratio (OPR) refers to the subsample of firms with OPR greater than or equal to (less than) mean values. To compute the RD estimates, we use a linear estimator with a triangular kernel and MSE-optimal bandwidth. Standard errors are clustered at the firm level. Observations are reported in square brackets. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

These findings are echoed in Figure 8, which shows the relationship between our RD estimates and out-of-state procurement ratios for firms across different standardized (output) product classifications. The figure shows that firms that supply products whose inputs were primarily sourced from the state where the products were manufactured were more disposed to overreport their labor costs relative to other expenses after the GST was implemented. Firms that fall into this category are those supplying machinery, equipment, minerals, chemicals, and plastics. This is not surprising given the fact that these firms belong to heavy industries, and thus a key factor determining the location of their plants is the distance from their primary input source. In contrast, firms supplying food products, which procure a substantial share of their inputs from out-of-state, exhibit a smaller negative jump in their reported wage bills relative to other costs. We caution that these estimates should

we exclude fuel inputs from the calculation because they do not come under the purview of GST. Second, we exclude items classified as "others" in the ASI as they cannot be mapped to standardized product classifications. Third, ASI provides data on inputs at the manufacturing unit level and not the product level. Thus, we do not know the mix of inputs used to generate each output for firms supplying multiple products. For these firms, we assume that all recorded inputs are used to generate a specific product in proportion to the respective product's share of total output. Lastly, we assume that a manufacturer will only look to procure a good from outside the state in which it is located if the in-state production of that good fails to meet the in-state demand.

be interpreted as providing only suggestive evidence as they lack precision at this level of disaggregation.



Notes: We restrict attention to the post-GST period when computing the RD estimates. We define product classifications as follows: "Food and Animal Products" includes firms with codes for Indian Trade Clarification based on Harmonized System (ITC-HS) below 2500; "Mineral, Chemicals and Plastics" includes firms with ITC-HS codes ≥ 2500 and < 4100; "Wood Products" includes firms with ITC-HS codes ≥ 4400 and < 5000; "Clothing" includes with ITC-HS codes ≥ 5000 and < 6800; "Stones, Metals and Cement" includes firms with ITC-HS codes ≥ 6800 and < 8400; "Machinery and Equipment" includes firms with ITC-HS codes ≥ 8400 and < 9400. Since the ASI records data on only manufacturing firms, we discard service sector firms from our analysis (i.e., those with ITC-HS codes ≥ 9900). We also exclude firms classified as supplying hides & skins (i.e., those with ITC-HS codes ≥ 4100 and < 4400), miscellaneous products (i.e., those with ITC-HS codes ≥ 9400 and < 9700), works of art (i.e., those with ITC-HS codes ≥ 9700 and < 9900) as we do not have enough observations to perform bandwidth calculations for our RD estimates.

Figure 8: Variation in RD estimates and Out-of-state Input Procurement Ratio (by Product Classifications)

6.5 *Heterogeneity*

6.5.1 *Industry and Factor Intensity*

In Table 9, we show that our baseline results are primarily driven by labor-intensive firms in the service sector. For service providers, the share of non-verifiable expenses jumps down by 12.8 percent at the tax exemption thresholds. For non-service providers, which includes manufacturing firms, we do not observe a similar jump. Similarly, we find no evidence of cost overreporting for capital-intensive firms (i.e., those with a higher than average material cost to total expense ratio). Instead, our baseline results are driven by labor-intensive firms, which seems natural since wages comprise a substantial share of such firms' expenses, so there is more room to evade.[12]

[12] In Appendix D, we extrapolate these results to derive implications for large firms. We argue that since labor-intensive firms drive our baseline results, the GST is unlikely to have adversely impacted compliance among large firms that tend to be capital intensive.

Table 9: Heterogeneity in RD Estimates (by Sector and Factor Intensity)

		by sector		by factor intensity	
Sample of firms	All	Service providers	Non-service providers	Labor-int. firms	Capital-int. firms
	(1)	(2)	(3)	(4)	(5)
RD estimate	-0.118**	-0.128**	0.179	-0.145*	-0.020
	(0.054)	(0.060)	(0.292)	(0.078)	(0.054)
	[804]	[672]	[132]	[514]	[290]

Notes: Service providers are classified under heading numbers above 9900 as per the NPCS. Capital-intensive firms are firms that have a ratio of the cost of materials to total expenses above average; labor-intensive firms are the residual. To compute the RD estimates, we use a linear estimator with a triangular kernel and MSE-optimal bandwidth. Standard errors are reported in parenthesis and are clustered at the firm level. Observations are reported in square brackets. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

6.5.2 Informality

We reason that the lack of transparency regarding the wages of informal workers allows firms to overreport such costs. As an additional test of our theory, we now investigate how our RD estimates vary across industry-level indicators of informality. Using data from the NSSO, we first construct an index of informality at the industry level by taking the ratio of gross value added (GVA) by informal (unregistered) firms in each industry to the total GVA by all firms in that industry.[13,14] We then split our sample based on the informality index and run our estimation procedure over the subsamples. In line with our hypothesis, we detect a large and statistically significant negative discontinuity in the non-verifiable expense ratio at tax exemption thresholds when restricting attention to firms with above-average informality indices (Table 10). When we focus on firms in industries with below-average informality, the RD estimate is statistically indistinguishable from zero.[15]

A publically funded workfare program in India, the National Rural Employment Guarantee Act (NREGA), also provides an opportunity to investigate the dependence of cost overreporting on informal worker supply. NREGA is typically utilized by rural households that are not enrolled in social security programs. Imbert and Papp (2015) and Agarwal et al. (2021) show that public-sector hiring due to NREGA crowds out private-sector work. All

[13]The NSSO mainly contains data on informal manufacturing firms. Informal firms engaged in manufacturing are classified as belonging to either: (i) own-account manufacturing enterprises (OAME) if they operate without any hired worker employed on a fairly regular basis; (ii) non-directory manufacturing establishments (NDME) if they employ less than six workers (household and hired workers taken together); and (iii) directory manufacturing establishment (DME) if they employ household members and hired workers of a total of six or more.

[14]We collapse the informality index, which is measured at a 5-digit National Industrial Classification (NIC) level, to a 4-digit measure using arithmetic averages. Using the 4-digit NIC measure, we then match the informality index of each industry to all firms belonging to that industry in the MCA dataset.

[15]As cost overreporting weakens the government's ability to generate fiscal revenues, our evidence aligns with existing work that shows government revenues (as a share of GDP) in developing economies with above-median informality are lower than those with below-median informality (Ohnsorge and Yu, 2022).

other things equal, informal worker supply to the private sector should therefore be lower in states with higher NREGA beneficiaries, and we should observe less cost overreporting by firms in these states.[16] To test this hypothesis, we construct a variable that measures how exposed an industry is to NREGA. Specifically, we compute industry i's exposure to NREGA using a weighted sum of NREGA beneficiaries in state j where the weights equal the ratio of total output by industry i in state j to total output by industry i in all states. Consistent with our hypothesis, when we restrict attention to industries with below-average exposure to NREGA, we detect a statistically significant negative discontinuous jump in the non-verifiable expense ratio at tax exemption thresholds (Table 10). In contrast, when we restrict attention to industries with above-average exposure to NREGA, the RD estimate is not statistically significantly different from zero.

Table 10: Heterogeneity in RD Estimates (by measures of Informality)

	by index of informality		by NREGA exposure	
Sample of firms	Above-average	Below-average	Above-average	Below-average
	(1)	(2)	(3)	(4)
RD estimate	-0.552***	0.040	-0.056	-0.163***
	(0.135)	(0.096)	(0.139)	(0.075)
	[185]	[265]	[175]	[384]

Notes: To compute the RD estimates, we use a linear estimator with a triangular kernel and MSE-optimal bandwidth. Standard errors are clustered at the firm level. Observations are reported in square brackets. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

6.6 Estimating the Level of Cost Overreporting

Marginal changes in cost overreporting at exemption thresholds can be directly obtained from our RD analysis. However, a reduced-form approach is not informative about the underlying *level* of cost overreporting. To compute this, we structurally estimate a model that is consistent with results from reduced-form estimators. In our model, firms decide the amount of (non-verifiable) expenses to declare for tax purposes. Our model incorporates the notion that firms have the incentive to inflate non-verifiable expenses in order to reduce their corporate income tax burden. When tax enforcement is perfect, expense ratios are independent of firm revenues.[17] When tax enforcement is imperfect, the ratio of reported non-verifiable expenses to total expenses varies with revenues. Specifically, the non-verifiable expense ratio is (locally) increasing in revenues below the tax exemption threshold, exhibits a negative jump at the threshold, and is decreasing in revenues above the threshold–all of which are consistent with the patterns in the data.

[16]Admittedly, this logic rests on the rather strong assumption that the supply of NREGA programs is uncorrelated with the supply of informal workers.

[17]This assertion assumes that productivity shocks are the only source of variation across firms.

6.6.1 Baseline Model

It is useful to first analyze the cost reporting decision separately from production decisions as it allows us to obtain an explicit formula for the level of cost overreporting. The optimal cost reporting decision of a firm can be derived as the solution to the following problem:

$$\min_{\hat{c}_n} \mathbb{1}(r \geq c_v + \hat{c}_n)\tau(r - c_v - \hat{c}_n) + \chi\mathbb{P}(r \geq T)(\hat{c}_n - c_n)^2/2,$$

where r denotes the revenue of the firm, c_v denotes verifiable input costs, c_n denotes non-verifiable input costs, $\hat{c}_n$ denotes reported non-verifiable costs, τ denotes the corporate tax rate, and T denotes the GST exemption threshold. The indicator $\mathbb{1}(r \geq c_v + \hat{c}_n)$ rules out subsidies for reported losses.

All firms with reported revenues above the tax exemption threshold are required to file every month a form detailing all outward supplies made, input tax credit claimed, tax liability ascertained, and taxes paid. This provides tax authorities with rich information regarding firm revenues and expenses, increasing the probability of detecting financial statement fraud. We capture this by assuming that the audit probability, $\mathbb{P}(r \geq T)$, is positive when $r \geq T$ and zero otherwise. Moreover, the authorities may choose to allocate more audit officers to investigate the operations of firms that appear to be larger based on tax filings. We capture such size-dependent enforcement by allowing the audit probability to be conditional on reported revenues.[18] We model the penalty for cost misreporting using a quadratic cost function. In particular, we assume that the fine for misreporting costs is given by $\chi(\hat{c}_n - c_n)^2/2$, where $\chi > 0$.

Given (r, c_v), the optimal report of non-verifiable costs when revenues are below the exemption threshold is

$$\hat{c}_n \mid_{r<T} = r - c_v.$$

When revenues are above the exemption threshold, in contrast, the optimal reporting choice of the firm is

$$\hat{c}_n \mid_{r\geq T} = \frac{\tau}{\chi\mathbb{P}(r \geq T)} + c_n.$$

Using the Envelope Theorem, we can express the non-verifiable expense ratio as

$$\frac{\hat{c}_n}{\hat{c}_n + c_v} = \begin{cases} 1 - \frac{c_v}{r} & \text{if } r < T \\ \frac{\tau + \chi\mathbb{P}(r\geq T)c_n}{\tau + \chi\mathbb{P}(r\geq T)(c_n + c_v)} & \text{if } r \geq T \end{cases}.$$

The above expression has three key implications. First, the reported expenditure share of

[18] To save notation, we suppress this dependence in the exposition.

non-verifiable inputs is increasing in r when $r < T$. Second, if $\mathbb{P}(r \geq T)$ is increasing in r, then the reported expenditure share of non-verifiable inputs is decreasing in r when $r \geq T$. Third, $\lim_{r \to T} \frac{\hat{c}_n}{\hat{c}_n + c_v} \mid_{r<T} > \frac{\hat{c}_n}{\hat{c}_n + c_v} \mid_{r \geq T}$ if T is large enough and $c_v > 0$. That is, the reported expenditure share of non-verifiable inputs exhibits a negative discontinuity at the tax exemption threshold when the threshold is high enough.

We compute the level of cost overreporting by

$$\Omega(c_v, c_n, \chi, \tau, T; P) \equiv \int_{c_n + c_v}^{T} (r - c_v) dr + \int_{T}^{\bar{r}} \left\{ \frac{\tau}{\chi \mathbb{P}(r \geq T)} + c_n \right\} dr - (\bar{r} - c_n - c_v) c_n,$$

where $\bar{r}$ denotes the upper bound of the revenue domain.[19] To see this, consider panel (a) of Figure 9, which compares reported and actual non-verifiable expenses over the revenue domain $[c_n + c_v, \bar{r}]$. Note that the first two terms of the above expression capture the area under non-verifiable expenses under hidden information, while the last term captures the area under non-verifiable expenses under complete information.

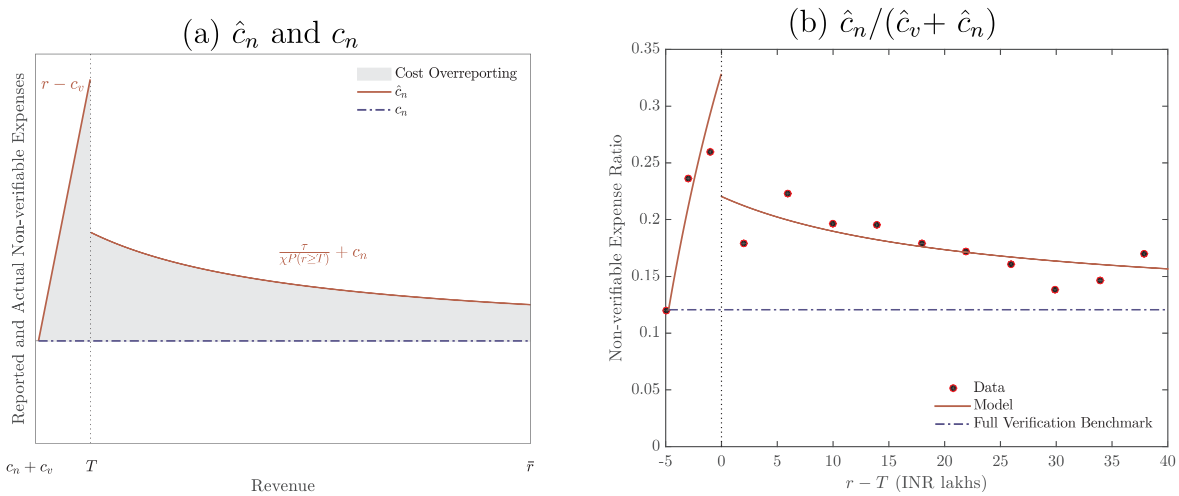


Figure 9: Estimating the Level of Cost Overreporting

To estimate Ω, we use Generalized Method of Moments (GMM). Specifically, we first estimate firm expenses, $\{c_n, c_v\}$, and the penalty parameter, χ, using

$$(c_n^*, c_v^*, \chi^*) \in \text{argmin}_{(c_n, c_v, \chi) \in \mathbb{R}_+^3} \mathcal{D}(c_n, c_v, \chi \mid \tau, T)' W \mathcal{D}(c_n, c_v, \chi \mid \tau, T),$$

where W is a weighting matrix. Here $\mathcal{D}$ is a vector that collects distances between binned means of non-verifiable expense ratios that we obtain from our RD analysis and the corre-

[19] Here we implicitly assume that the distribution of firm revenues is uniform over $[c_n + c_v, \bar{r}]$. We relax this assumption in Section 6.6.2.

sponding model moments. Specifically, the i^{th} entry of $\mathcal{D}$ is given by

$$\mathcal{D}_i(c_n, c_v, \chi \mid \tau, T) \equiv \begin{cases} 1 - \frac{c_v}{\hat{r}_i} - \frac{\hat{c}_{ni}}{\hat{c}_{ni}+\hat{c}_{vi}} & \text{if } \hat{r}_i < T \\ \frac{\tau+\chi\mathbb{P}(\hat{r}_i \geq T)c_n}{\tau+\chi\mathbb{P}(\hat{r}_i \geq T)(c_n+c_v)} - \frac{\hat{c}_{ni}}{\hat{c}_{ni}+\hat{c}_{vi}} & \text{if } \hat{r}_i \geq T \end{cases},$$

where a hat over a variable denotes reported values. We map the running variable back to revenue bins by adjusting them upwards by INR 20 lakhs, and normalize the revenue bins by dividing by INR 10 lakhs. In the model, we assume that the audit probability is linear in revenue, i.e., $\mathbb{P}(r_i > T) = r_i/\bar{r}$. We set the upper bound of the revenue domain in the model, $\bar{r}$, to match the corresponding upper bound in the running variable in our RD analysis. We set the corporate tax rate and the GST exemption threshold to those observed in reality. Using this estimation procedure under the identity weighting matrix, we obtain $(c_n^*, c_v^*, \chi^*) = (0.18, 1.34, 3.84)$. Panel (b) of Figure 9 shows that our model does a good job in matching the data. We then use these results to estimate the underlying level of cost overreporting. Note that actual costs around the exemption threshold are given by $(\bar{r} - c_n^* - c_v^*)(c_n^* + c_v^*)$. Hence, costs were overreported by $\frac{\Omega(c_v^*, c_n^*, \chi^*, \tau, T; P)}{(\bar{r}-c_n^*-c_v^*)(c_n^*+c_v^*)} = 7.9$ percent by firms around the exemption threshold.

6.6.2 Endogenous Production Responses

In our baseline model of cost overreporting, firms' production decisions are divorced from their evasion decisions. In this section, we estimate the level of cost overreporting while taking into account endogenous production responses.

The problem of a firm with productivity $z \in \mathcal{Z}$ is to choose verifiable and non-verifiable inputs, $\{x_v, x_n\}$, and report non-verifiable costs, $\{\hat{c}_n\}$, to maximize:

$$\underbrace{z x_v^{\alpha_v} x_n^{\alpha_n} - w_v x_v - w_n x_n}_{\text{Profits}} - \underbrace{\tau[z x_v^{\alpha_v} x_n^{\alpha_n} - w_v x_v - \hat{c}_n]}_{\text{Tax Liability}} - \underbrace{\mathbb{1}(r \geq T)\chi z x_v^{\alpha_v} x_n^{\alpha_n} (\hat{c}^n - w_n x_n)^2/(2\bar{r})}_{\text{Evasion Costs}},$$

where α_i denotes the output elasticity of input i and w_i denotes the cost of utilizing one unit of input i.

Optimal allocations can be characterized by the following 2x2 system in $\{x_v, x_n\}$:

$$\begin{aligned} z x_v^{\alpha_v}\{\alpha_n x_n^{\alpha_n - 1}[1 - \tau - \frac{\tilde{\chi}}{2}(\hat{c}_n - w_n x_n)^2] + \tilde{\chi} w_n x_n^{\alpha_n}(\hat{c}_n - w_n x_n)\} &= w_n, \\ z\alpha_v x_v^{\alpha_v - 1} x_n^{\alpha_n}[1 - \tau - \frac{\tilde{\chi}}{2}(\hat{c}_n - w_n x_n)^2] &= (1-\tau) w_v, \end{aligned}$$

where

$$\hat{c}_n = \begin{cases} z x_v^{\alpha_v} x_n^{\alpha_n}(1-\alpha_v) & \text{if } \tilde{\chi} = 0 \\ \frac{\tau}{z x_v^{\alpha_v} x_n^{\alpha_n} \tilde{\chi}} + w_n x_n & \text{if } \tilde{\chi} > 0 \end{cases},$$

and $\tilde{\chi} \equiv \mathbb{1}(r \geq T)\frac{\chi}{\bar{r}}$. Let the solution to this problem under the assumptions $\tilde{\chi} = 0$ and $\tilde{\chi} > 0$ be denoted by $\{x_v^*(z) \mid_{\tilde{\chi}=0}, x_n^*(z) \mid_{\tilde{\chi}=0}\}$ and $\{x_v^*(z) \mid_{\tilde{\chi}>0}, x_n^*(z) \mid_{\tilde{\chi}>0}\}$, respectively. Define $\forall z \in \mathcal{Z}$:

$$r^*(z) \equiv \begin{cases} r(z) \mid_{\tilde{\chi}=0} & \text{if } r(z) \mid_{\tilde{\chi}=0} < T \\ r(z) \mid_{\tilde{\chi}>0} & \text{if } r(z) \mid_{\tilde{\chi}>0} \geq T \end{cases},$$

where

$$\begin{aligned} r(z) \mid_{\tilde{\chi}=0} &\equiv z(x_v^*(z) \mid_{\tilde{\chi}=0})^{\alpha_v}(x_n^*(z) \mid_{\tilde{\chi}=0})^{\alpha_n}, \\ r(z) \mid_{\tilde{\chi}>0} &\equiv z(x_v^*(z) \mid_{\tilde{\chi}>0})^{\alpha_v}(x_n^*(z) \mid_{\tilde{\chi}>0})^{\alpha_n}. \end{aligned}$$

Reported and actual non-verifiable expenses are then given by:

$$\hat{c}_n^*(z) = \begin{cases} r^*(z)(1-\alpha_v) & \text{if } r^*(z) < T \\ \frac{\tau}{r^*(z)\tilde{\chi}} + w_n x_n^*(z) \mid_{\tilde{\chi}>0} & \text{if } r^*(z) \geq T \end{cases}, \text{ and } c_n^*(z) = \begin{cases} w_n x_n^*(z) \mid_{\tilde{\chi}=0} & \text{if } r^*(z) < T \\ w_n x_n^*(z) \mid_{\tilde{\chi}>0} & \text{if } r^*(z) \geq T \end{cases}.$$

We use the following approach to estimate the level of cost overreporting. We compute optimal allocations under the parameters estimated in Appendix E, barring input prices, which we set to unity. We assume that z is uniformly distributed over a grid and compute $\{r^*(z), \hat{c}_n^*(z), c_n^*(z)\}$ $\forall z$. Notably, this procedure endogenously generates a revenue distribution, which relaxes the uniformity assumption we made in our baseline model of cost overreporting. Panel (a) of Figure 10 shows that the model generates more small firms than large ones, as in the data. Moreover, we find that when expenses cannot be perfectly verified, firms bunch below the tax exemption threshold. This can be clearly seen by comparing the distribution of firm revenues in our model in which tax enforcement is imperfect (panel (a) of Figure 10) to that in a scenario in which firms' revenues and costs are perfectly observable by the tax authorities (panel (b) of Figure 10). Bunching around the exemption threshold occurs in our model because firms reduce the size of their operations to avoid audits, allowing them to overreport their costs.

Panel (a) of Figure 11 plots simulated non-verifiable expenses and depicts the implied level of cost overreporting. Our estimate for the level of cost overreporting here is 9.2 percent, which is larger than the corresponding estimate in our baseline model. This difference is driven by real responses below the exemption threshold across the two settings. To see this,

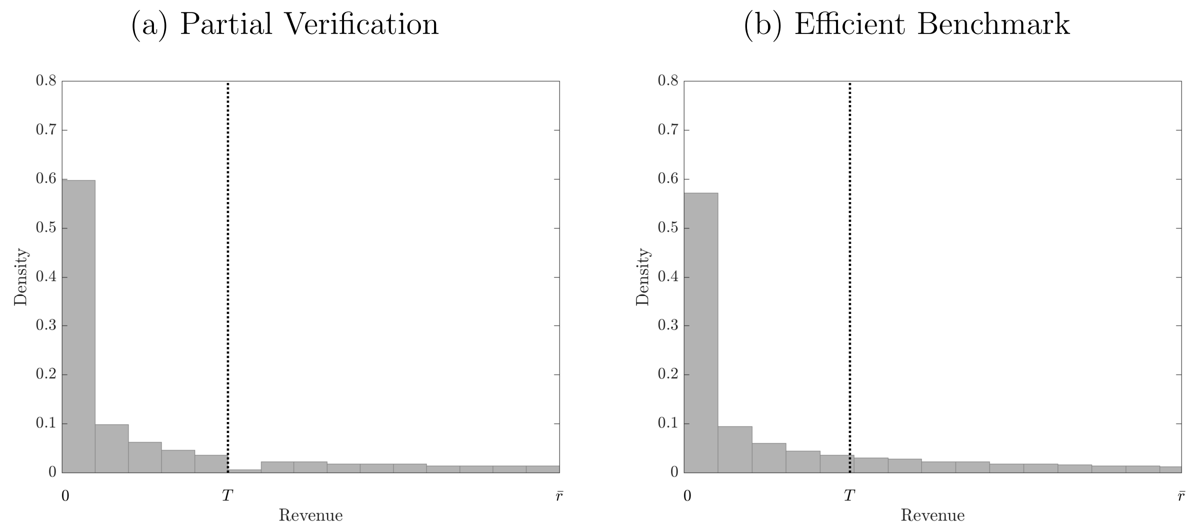


Figure 10: Simulated Distribution of Revenues

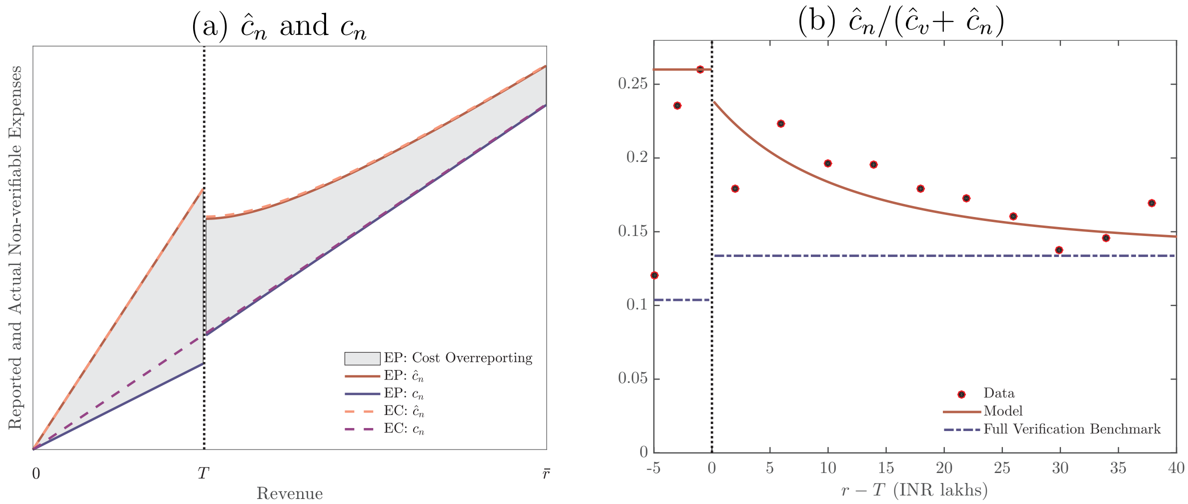
it is helpful to contrast optimal allocations here to those in the model outlined in Appendix E where the link between production and evasion decisions is severed. Note that reported non-verifiable costs below the exemption threshold are a constant fraction $(1 - \alpha_v)$ of revenues in both settings. However, when production decisions are endogenous, firms internalize that below the exemption threshold, the marginal benefit of hiring non-verifiable inputs (in terms of increased production) is taxed, unlike its marginal cost. This dichotomy reduces the demand for non-verifiable inputs and increases cost overreporting relative to the case in which revenues are exogenous. Another reason why our estimate for cost overreporting is larger in the model featuring endogenous production responses relates to the shape of the simulated distribution of firm revenues. Since cost overreporting by firms above the exemption threshold is similar across the two settings, the difference between the aggregate levels of cost overreporting would be smaller if the distribution of firm revenues was uniformly distributed instead of being positively skewed. Panel (b) of Figure 11 verifies that our model does a good job in matching reported non-verifiable expense ratios in the data.

6.6.3 Counterfactual Experiment: Partial Tax Deductibility of Costs

Note that firms are incentivized to overreport their costs precisely because they are tax deductible. It may then seem natural to lower the tax deductibility of expenses to stem evasion. This section argues that such a policy change may achieve the opposite of its intended effect.

Following Best et al. (2015), we assume that proportion μ of costs are deductible from taxes. In particular, the firms' objective is given by

$$\mathbb{1}(r \geq c_v + \hat{c}_n)\tau(r - \mu[c_v + \hat{c}_n]) + \chi\mathbb{P}(r \geq T)(\hat{c}_n - c_n)^2/2.$$



Notes: Panel (a) contrasts non-verifiable costs in the model featuring endogenous production responses (EP) with those in the model where only the cost structure is endogenous (EC). See Appendix E for details on the EC model.

Figure 11: Estimating the Level of Cost Overreporting under Endogenous Production

Our benchmark estimation assumes $\mu = 1$, which captures a pure, nondistortionary profit tax akin to that implemented in India. A pure output tax can be captured by $\mu = 0$. When $0 < \mu < 1$, costs are only partially tax deductible. In this case, the firm will report the following non-verifiable expenses

$$\hat{c}_n = \begin{cases} \frac{r}{\mu} - c_v & \text{if } r < T \\ \frac{\tau\mu}{\chi\mathbb{P}(r\geq T)} + c_n & \text{if } r \geq T \end{cases}.$$

Using the Envelope Theorem, we can express the non-verifiable expense ratio as

$$\frac{\hat{c}_n}{\hat{c}_n + c_v} = \begin{cases} 1 - \frac{\mu c_v}{r} & \text{if } r < T \\ \frac{\mu\tau + \chi\mathbb{P}(r\geq T)c_v}{\mu\tau + \chi\mathbb{P}(r\geq T)(c_n+c_v)} & \text{if } r \geq T \end{cases}.$$

Note that the inclusion of partial tax deductibility of costs has important implications for the level of cost overreporting and its detection. To see this, observe that

$$\frac{\partial\{\frac{\hat{c}_n}{\hat{c}_n+c_v}\;|_{r<T}\}}{\partial\mu} < 0 \text{ and } \frac{\partial\{\frac{\hat{c}_n}{\hat{c}_n+c_v}\;|_{r\geq T}\}}{\partial\mu} > 0.$$

That is, relative to a nondistortionary profit tax, partial tax deductibility of costs exerts a force that induces firms to inflate their non-verifiable expenses by more (less) below (above) the tax exemption threshold. Thus, making costs less tax-deductible increases the jump in the non-verifiable expense ratio at the tax exemption threshold, which makes cost overreporting easier to detect. This can be seen clearly in Figure 12, which depicts a series of counterfactuals where we progressively reduce the tax deductibility of costs, μ, keeping fixed the parameters estimated using our baseline model. Also note that, in general, reducing the tax deductibility of costs has an ambiguous effect on the level of cost overreporting. Nonetheless, our quantitative simulations suggest that its net impact on the level of cost overreporting is negative. That is, the rise in cost overreporting by firms below the exemption threshold outweighs the reduction in cost overreporting by firms above the threshold; see Table 11.[20]

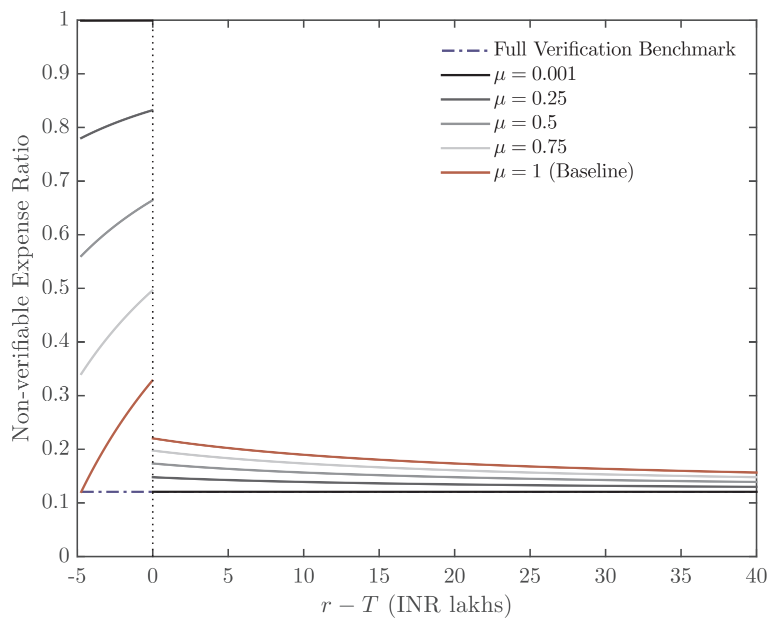


Figure 12: Effect of the Tax Deductibility of Costs on the Non-verifiable Expense Ratio

These results have important policy implications. Diamond and Mirrlees (1971) show that when tax enforcement is perfect, production efficiency can be achieved while taxing profits but not turnover. Best et al. (2015) argue that Diamond and Mirrlees' prescription is ill-suited to settings with limited tax capacity. They show that in developing economies with large informal sectors, moving toward a turnover tax (by reducing the tax deductibility of costs) may be desirable because it lowers evasion. This would also be true in our model if all firms faced a positive probability of being audited, an implicit assumption in Best et al. (2015). However, firms below the tax exemption threshold are never audited in our setting. We show that reducing the tax deductibility of costs increases evasion in this set of firms, which outweighs the reduction in evasion by firms above the tax threshold. Hence, in the presence of an enforcement notch, moving toward a turnover tax can increase aggregate evasion.[21]

[20] In the augmented version of the model that features partial tax deductibility of costs, cost overreporting is computed using $\Omega(c_v, c_n, \chi, \tau, T, \mu; P) \equiv \int_{c_n+c_v}^{T} (\frac{r}{\mu} - c_v)dr + \int_{T}^{\bar{r}} \left\{\frac{\tau\mu}{\chi\mathbb{P}(r\geq T)} + c_n\right\}dr - (\bar{r} - c_n - c_v)c_n$.

[21] In Appendix F, we use our framework to assess two additional approaches for increasing tax revenues: tax rates and enforcement intensity.

Table 11: Effect of the Tax Deductibility of Costs on the Level of Cost Overreporting

μ	0.001	0.25	0.5	0.75	1
$\frac{\Omega(c_v^*,c_n^*,\chi^*,\tau,T,\mu;P)}{(\bar{r}-c_n^*-c_v^*)(c_n^*+c_v^*)}$	122.222	0.399	0.170	0.104	0.079

7 Conclusion

In many developing nations, where evasion and informality limit tax capacity, low corporate tax revenues pose a significant challenge. Examining a recent regime change in India–the switch from a decentralized VAT to a unified GST–this paper emphasizes the benefits and limitations of indirect tax administration in preventing corporate tax evasion. The governance change resulted in an increase in third-party reporting, making the cost of materials more visible to the authorities than other firm expenses. It also established a turnover threshold above which businesses were required by law to periodically share financial data with tax administrators.

We document three key findings using an administrative dataset of corporate tax returns from Indian enterprises for the period 2015-2020. First, firms reported higher revenues and costs after the implementation of GST. Second, much of the increase in reported revenue was due to a decrease in revenue underreporting. Third, the regime change prompted labor-intensive businesses to overstate their wage expenses, which were relatively difficult to verify. Our methodological innovation is to detect the presence of cost overreporting by utilizing variation in the relative visibility of specific inputs along with discontinuous jumps in enforcement intensity at tax exemption thresholds.

This paper's findings have implications for policymakers in emerging economies worldwide. Over 61 percent of the world's employed population is informal, and the majority of these workers reside in developing nations (ILO, 2018b). Less developed economies also tend to be more labor-intensive (Kaldor, 1957). Our findings imply that the presence of informal labor-intensive firms may partially offset the tax compliance advantages of third-party reporting. Having a large informal workforce allows firms to inflate labor costs, which reduces the increase in corporate taxable income caused by the increased monitoring of final and intermediate goods.

References

Agarwal, S., S. Alok, Y. Chopra, and P. Tantri (2021): "Government employment guarantee, labor supply, and firms' reaction: Evidence from the largest public workfare program in the world," *Journal of Financial and Quantitative Analysis*, 56, 409–442.

Almunia, M. and D. Lopez-Rodriguez (2018): "Under the radar: The effects of monitoring firms on tax compliance," *American Economic Journal: Economic Policy*, 10, 1–38.

Autor, D. H. (2003): "Outsourcing at will: The contribution of unjust dismissal doctrine to the growth of employment outsourcing," *Journal of labor economics*, 21, 1–42.

Bachas, P. and M. Soto (2021): "Corporate Taxation under Weak Enforcement," *American Economic Journal: Economic Policy*, 13, 36–71.

Basri, M. C., M. Felix, R. Hanna, B. A. Olken, et al. (2021): "Tax Administration versus Tax Rates: Evidence from Corporate Taxation in Indonesia," *American Economic Review*, 111, 3827–3871.

Besley, T., E. Ilzetzki, and T. Persson (2013): "Weak states and steady states: The dynamics of fiscal capacity," *American Economic Journal: Macroeconomics*, 5, 205–235.

Best, M. C., A. Brockmeyer, H. J. Kleven, J. Spinnewijn, and M. Waseem (2015): "Production versus revenue efficiency with limited tax capacity: theory and evidence from Pakistan," *Journal of political Economy*, 123, 1311–1355.

Calonico, S., M. D. Cattaneo, and R. Titiunik (2014): "Robust nonparametric confidence intervals for regression-discontinuity designs," *Econometrica*, 82, 2295–2326.

Card, D., R. Chetty, M. S. Feldstein, and E. Saez (2010): "Expanding access to administrative data for research in the United States," *American Economic Association, Ten Years and Beyond: Economists Answer NSF's Call for Long-Term Research Agendas*.

Carrillo, P., D. Pomeranz, and M. Singhal (2017): "Dodging the taxman: Firm misreporting and limits to tax enforcement," *American Economic Journal: Applied Economics*, 9, 144–64.

Cattaneo, M. D., N. Idrobo, and R. Titiunik (2017): "A practical introduction to regression discontinuity designs," *Cambridge Elements: Quantitative and Computational Methods for Social Science-Cambridge University Press I*.

Chetty, R., J. N. Friedman, T. Olsen, and L. Pistaferri (2011): "Adjustment costs, firm responses, and micro vs. macro labor supply elasticities: Evidence from Danish tax records," *The quarterly journal of economics*, 126, 749–804.

Clotfelter, C. T. (1983): "Tax evasion and tax rates: An analysis of individual returns," *The review of economics and statistics*, 363–373.

Deloitte (2016): "India Fraud Survey: Edition II," https://www2.deloitte.com/in/en/pages/finance/articles/india-fraud-survey-edition-ii.html.

Diamond, P. A. and J. A. Mirrlees (1971): "Optimal taxation and public production I: Production efficiency," *The American economic review*, 61, 8–27.

Fisman, R. and S.-J. Wei (2004): "Tax rates and tax evasion: evidence from "missing imports" in China," *Journal of political Economy*, 112, 471–496.

Garbinti, B., J. Goupille-Lebret, M. Muñoz, S. Stantcheva, and G. Zucman (2023): "Tax Design, Information, and Elasticities: Evidence From the French Wealth Tax," Tech. rep., National Bureau of Economic Research.

Gordon, R. and W. Li (2009): "Tax structures in developing countries: Many puzzles and a possible explanation," *Journal of public Economics*, 93, 855–866.

GST Council (2018): "Minutes of 25th GST Council Meeting held on 18 January 2018," https://gstcouncil.gov.in/sites/default/files/Minutes/Signed%20Minutes%20-%2025th%20GST%20Council%20Meeting.pdf.

——— (2023): "Goods and Services Tax Council: About Us," https://gstcouncil.gov.in/about-us.

Gutmann, P. M. (1977): "The subterranean economy," *Financial Analysts Journal*, 33, 26–27.

Hahn, J., P. Todd, and W. Van der Klaauw (2001): "Identification and estimation of treatment effects with a regression-discontinuity design," *Econometrica*, 69, 201–209.

Handley, K. and T. J. Moore (2017): "Tariffs, Transport Costs, and Tax Evasion," *Working Paper*.

ILO (2018a): "India wage report: Wage policies for decent work and inclusive growth," *India: International Labor Organization*.

——— (2018b): "Women and men in the informal economy: A statistical picture. Third edition," https://www.ilo.org/global/publications/books/WCMS_626831/lang--en/index.htm.

Imbens, G. W. and T. Lemieux (2008): "Regression discontinuity designs: A guide to practice," *Journal of econometrics*, 142, 615–635.

Imbert, C. and J. Papp (2015): "Labor market effects of social programs: Evidence from india's employment guarantee," *American Economic Journal: Applied Economics*, 7, 233–263.

Johnson, S., D. Kaufmann, A. Shleifer, M. I. Goldman, and M. L. Weitzman (1997): "The unofficial economy in transition," *Brookings papers on economic activity*, 1997, 159–239.

Kaldor, N. (1957): "A model of economic growth," *The economic journal*, 67, 591–624.

Keen, M. and J. Mintz (2004): "The optimal threshold for a value-added tax," *Journal of Public Economics*, 88, 559–576.

Kleven, H. J., C. T. Kreiner, and E. Saez (2016): "Why can modern governments tax so much? An agency model of firms as fiscal intermediaries," *Economica*, 83, 219–246.

Kleven, H. J. and M. Waseem (2013): "Using notches to uncover optimization frictions and structural elasticities: Theory and evidence from Pakistan," *The Quarterly Journal of Economics*, 128, 669–723.

Kopczuk, W. and J. Slemrod (2006): "Putting firms into optimal tax theory," *American Economic Review*, 96, 130–134.

Liu, L., B. Lockwood, M. Almunia, and E. H. Tam (2019): "VAT notches, voluntary registration, and bunching: Theory and UK evidence," *Review of Economics and Statistics*, 1–45.

McCrary, J. (2008): "Manipulation of the running variable in the regression discontinuity design: A density test," *Journal of econometrics*, 142, 698–714.

Ohnsorge, F. and S. Yu (2022): *The long shadow of informality: Challenges and policies*, World Bank Publications.

Pomeranz, D. (2015): "No taxation without information: Deterrence and self-enforcement in the value added tax," *American Economic Review*, 105, 2539–2569.

Saez, E. (2010): "Do taxpayers bunch at kink points?" *American economic Journal: economic policy*, 2, 180–212.

Slemrod, J., B. Collins, J. L. Hoopes, D. Reck, and M. Sebastiani (2017): "Does credit-card information reporting improve small-business tax compliance?" *Journal of Public Economics*, 149, 1–19.

Appendix

Impact of the GST on Corporate Tax Evasion: Evidence from Indian Tax Records

Sumit Agarwal, Shashwat Alok, Shiv Dixit, and Tejaswi Velayudhan

A Revenue Underreporting and the Return to Evasion

In this section, we examine if the extent of bunching in firm revenues around tax exemption thresholds is dependent on the level of GST rates. Note that the return to evasion is not only a function of direct tax rates but also indirect tax rates. In the context of indirect taxes, tax rates are dependent on product type, while the exemption threshold is dependent on firm revenues. We exploit this variation in indirect tax rates around the exemption threshold to estimate the effect of tax rates on bunching. In particular, we investigate if the excess mass in the revenue distribution around the GST exemption threshold is higher for firms selling products that are subject to higher than average GST rates. Table A.1 reports the results, which suggest that there is more revenue underreporting in the subsample of firms facing higher than average GST rates. This finding is robust to alternative measures of the counterfactual density. These results complement the analysis of Fisman and Wei (2004), which identifies the response of evasion to product-specific import tariffs and value-added tax in China.[22]

Table A.1: Bunching at Exemption Thresholds and GST Rate

	Degree 4	Degree 5	Degree 6
Full Sample	2.031	2.026	1.696
Below average GST	0.718	0.718	0.855
Above average GST	3.002	3.002	2.234

Notes: This table reports the excess mass of the revenue distribution at the bunch point INR 20 lakhs relative to the counterfactual density using polynomials of degrees four, five, and six. The sample is restricted to observations after 2017 in which revenues are larger than INR 1 lakh and less than INR 50 lakhs. The bin-width is set to INR 1.5 lakhs. The bunching window spans one bin to the left and right of the bunch point. When fitting the polynomial, we consider four bins to the left and to the right of the bunch point.

B Alternative RD Specifications

Table B.1 reports additional RD estimates for different bandwidths and kernel functions. Variation in kernels is ordered by column and bandwidths by row. Our baseline results are derived using the MSE-optimal bandwidth. It is well known that as the bandwidth increases, the bias of the local estimator increases, and its variance decreases. In the second row of the

[22] Fisman and Wei (2004) use a different approach but obtain similar conclusions. They measure evasion using discrepancies in export and import data, and find that the extent of underreporting is highly correlated with the tax rate.

table, we increase the bandwidth by 50% of the MSE-optimal bandwidth and find a similar estimate with smaller standard errors. We also investigate the sensitivity of our estimates to the choice of kernel functions. In addition to the triangular kernel, we use Epanechnikov and uniform kernels to construct the estimators. The estimates are broadly consistent with our baseline empirical findings in that they are negative and statistically significant.

Table B.1: Alternative RD Specifications

Kernel function	Triangular	Epanechnikov	Uniform
h_{MSE}	-0.118**	-0.116*	-0.109*
	(0.054)	(0.057)	(0.060)
$h_{MSE} \times 1.5$	-0.097**	-0.092**	-0.048***
	(0.044)	(0.043)	(0.041)

Notes: Standard errors are clustered at the firm level. h_{MSE} denotes the MSE-optimal bandwidth. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

C Heterogeneity in RD Estimates by Year

In Table C.1, we present RD estimates corresponding to subsamples in which we restrict attention to observations in the year before and after GST's implementation. We detect a statistically significant negative jump in the non-verifiable expense ratio in the immediate year following the implementation of GST. In contrast, we do not find any evidence of cost overreporting by firms before the implementation of GST.

Table C.1: Heterogeneity in RD Estimates (by Year)

Sample of firms	Full sample		Non-exempted firms	
Sample period	2017	2018	2017	2018
RD estimate	-0.021	-0.144*	-0.017	-0.145*
	(0.107)	(0.085)	(0.107)	(0.085)
	[451]	[353]	[441]	[349]

Notes: To compute the RD estimates, we use a linear estimator with a triangular kernel and MSE-optimal bandwidth. Standard errors are reported in parenthesis and are clustered at the firm level. Observations are reported in square brackets. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

D Implications for Large Firms

Our identification strategy relies on the discontinuities in the behavior of firms around tax exemption thresholds; these firms are relatively small in size. However, one can extrapolate the impact of the GST on the compliance of large firms by examining the characteristics of small firms that overreport costs. In particular, we showed that our RD estimates for cost overreporting are driven by service providers that are typically labor intensive. In contrast, larger firms tend to be capital intensive. This can be seen clearly in Figure D.1, which plots the binned means of wage bills and the cost of materials (as a share of total expenses) across revenue deciles. Moreover, we do not detect any fraud in reports concerning the cost of materials; see placebo test in the first column of Table 5. Thus, our results suggest that the regime change did not have an adverse impact on compliance among large firms.

(a) Labor Intensity (b) Capital Intensity

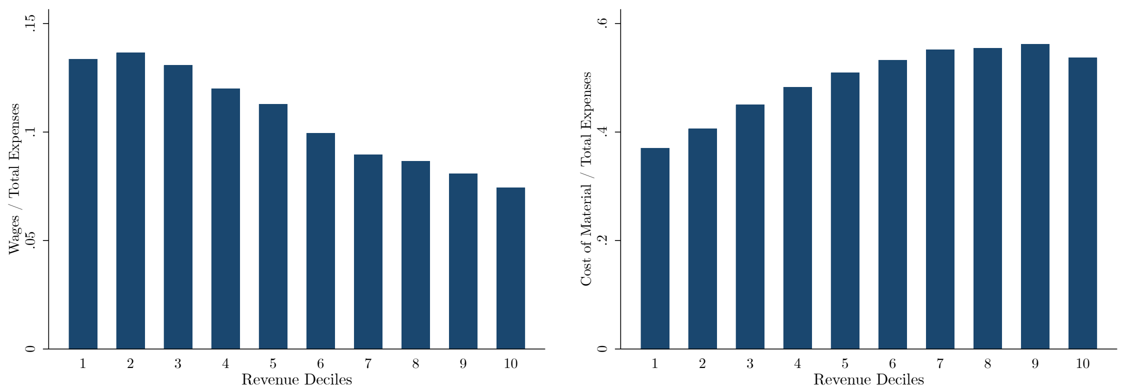
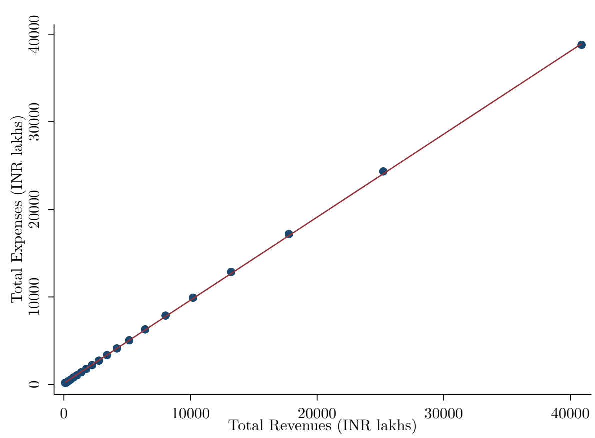


Figure D.1: Factor Intensity by Firm Size

E Endogenous Cost Structure

In the data, expenses are highly correlated with revenues; see Figure E.1. In our baseline model of cost overreporting, however, we treat actual costs as fixed around the exemption threshold. Though our RD analysis does not rely on this assumption, it has important implications for the underlying level of cost overreporting. We relax this assumption in this section by allowing costs to endogenously vary with revenues.



Notes: We discard observations with negative revenues, as well as outliers that are respectively below and above the 5th and 95th percentile of observations of expenses.

Figure E.1: Expenses and Revenues

We consider a setting in which production decisions are made before evasion decisions. In the production stage, profit maximization implies that input costs are a constant fraction of revenues:

$$c_j = r\alpha_j \ \forall j \in \{n, v\}.$$

This implies that reported non-verifiable expenses are given by

$$\hat{c}_n = \begin{cases} r(1-\alpha_v) & \text{if } r < T \\ \frac{\tau}{\chi \mathbb{P}(r \geq T)} + r\alpha_n & \text{if } r \geq T \end{cases}.$$

Hence, the level of cost overreporting around the tax exemption threshold in this setting is given by

$$\int_0^T r(1-\alpha_v)dr + \int_T^{\bar{r}} \left\{ \frac{\tau}{\chi \mathbb{P}(r \geq T)} + r\alpha_n \right\} dr - \frac{\bar{r}^2 \alpha_n}{2}.$$

This is depicted in panel (a) of Figure E.2.

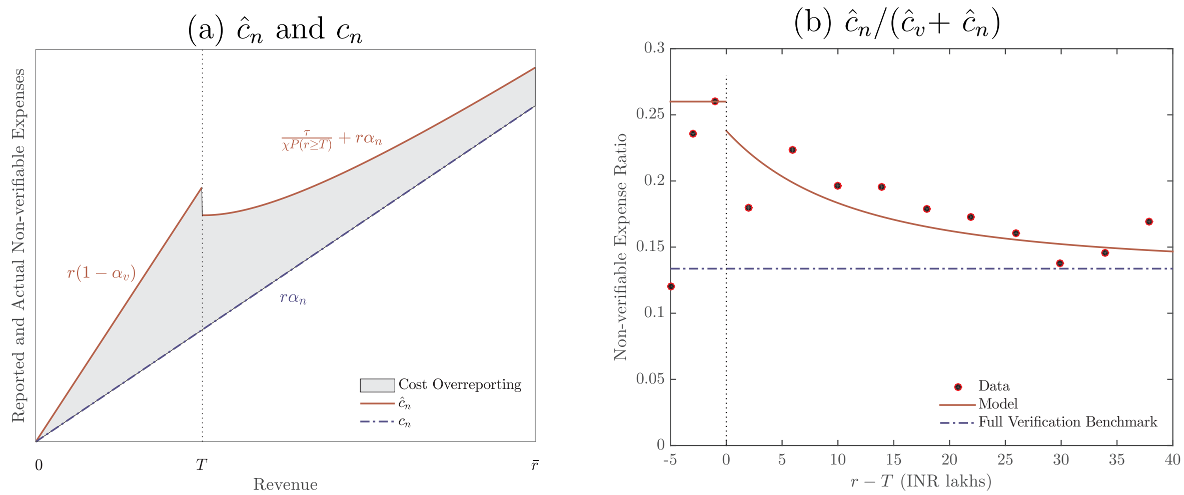


Figure E.2: Estimating the Level of Cost Overreporting under Endogenous Cost Structure

We use a two-step estimation procedure to estimate the level of cost overreporting in this setting. First, note that when costs are treated as endogenous, then the reported non-verifiable expense ratio before the exemption threshold is equal to $(1-\alpha_v)$. We set $\alpha_v = 0.74$ to match the observation that the average reported non-verifiable expense ratio conditional on revenues being less than the exemption threshold is 0.26. We then estimate (α_n, χ) using a GMM estimation procedure analogous to our baseline approach that minimizes distances between binned means of the non-verifiable expense ratio around the exemption threshold in the data and the corresponding moments in the model; see panel (b) of Figure E.2. This procedure yields $\alpha_n^* = 0.11$ and $\chi^* = 3.21$, which we use to estimate the underlying level of cost overreporting. Using this alternative method, we find that firms around the exemption threshold overreported costs by 5.2 percent. To see why this estimate is lower than our baseline estimate, note that here the marginal increase in the level of cost overreporting in response to a unit increase in revenue below the exemption threshold is $1 - \alpha_v - \alpha_n$, which is strictly lower than that in our baseline model. This is because verifiable costs rise with revenues when the former is endogenous, which reduces profits and thus the incentive to inflate non-verifiable costs.

F Elasticity of Corporate Tax Revenue: Tax Rates vs. Enforcement Intensity

In this section, we revisit Basri et al. (2021), which compares two natural approaches for increasing tax revenues: tax rates and enforcement intensity. On the one hand, if the elasticity of reported revenues and costs with respect to the tax rate is low, then simply increasing tax rates may be an effective way of increasing tax revenues. On the other hand, if the elasticity of the tax base with respect to the staff-to-taxpayer ratio is high, increasing enforcement intensity may be a more cost-effective approach.

In our model, corporate tax revenue (CTR) raised from firms generating revenue below $\bar{r}$ is given by

$$\text{CTR} = \int_0^{\bar{r}} \tau(r - \hat{c}_n - c_v)dr.$$

Since firms earning negative profits exit the market, we can decompose the above expression into

$$\text{CTR} = \int_{c_n+c_v}^{T} \tau(r - \hat{c}_n \mid_{r<T} - c_v)dr + \int_T^{\bar{r}} \tau(r - \hat{c}_n \mid_{r\geq T} - c_v)dr.$$

Using the Envelope Theorem, we can express tax revenues as

$$\text{CTR} = \tau(\bar{r} - T)\left[\frac{\bar{r}+T}{2} - \left(\frac{\tau}{\mathbb{P}(r \geq T)\chi} + c_n + c_v\right)\right].$$

The elasticity of CTR with respect to τ is given by

$$\mathcal{E}_{\text{CTR},\tau} = \frac{\partial \text{CTR}}{\partial \tau} \times \frac{\tau}{\text{CTR}} = \frac{\tau[(\bar{r}+T)/2 - 2\tau/(\mathbb{P}(r \geq T)\chi) - c_n - c_v]}{(\bar{r}+T)/2 - \tau/(\mathbb{P}(r \geq T)\chi) - c_n - c_v}.$$

Note that since $\tau \in [0,1]$, $\frac{(\bar{r}+T)/2 - 2\tau/(\mathbb{P}(r\geq T)\chi) - c_n - c_v}{(\bar{r}+T)/2 - \tau/(\mathbb{P}(r\geq T)\chi) - c_n - c_v} \leq 1$ and thus $\mathcal{E}_{\text{CTR},\tau} \leq 1$. Intuitively, the elasticity of CTR with respect to the tax rate is less than one because the tax base endogenously falls as the tax rate increases. It is worth noting that this behavioral response is purely due to evasion. In our calculations, we are implicitly assuming that the revenue distribution is uniform and inelastic to the tax rate, so in effect, we are switching off endogenous production responses. Thus, what we compute here serves as an upper bound for the elasticity of CTR with respect to the tax rate.

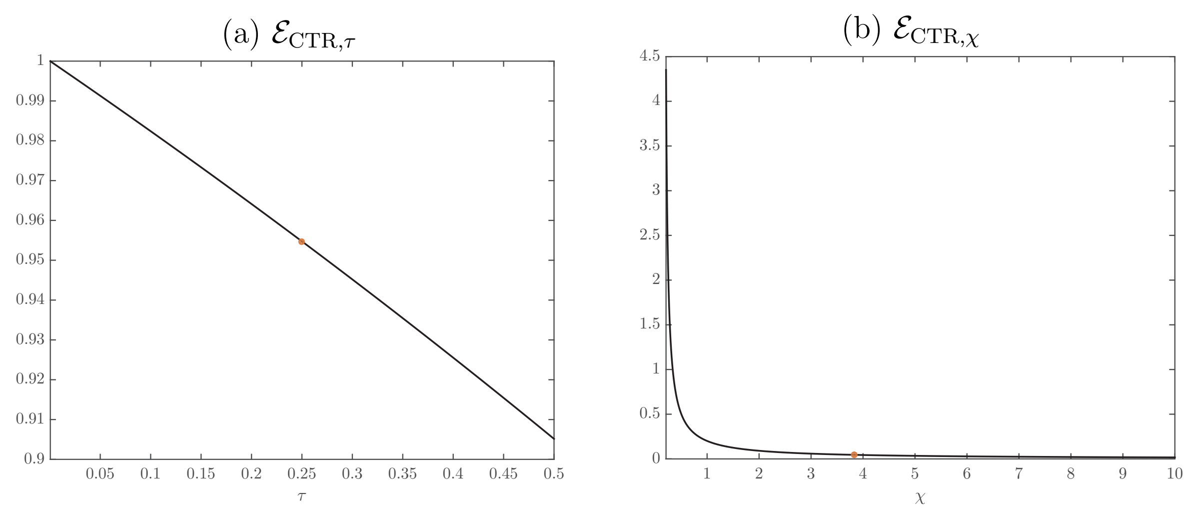
In our model, χ parametrizes not only the penalty for evasion but also enforcement intensity. The elasticity of CTR with respect to χ is given by

$$\mathcal{E}_{\text{CTR},\chi} = \frac{\partial \text{CTR}}{\partial \chi} \times \frac{\chi}{\text{CTR}} = \frac{\tau}{[(\bar{r}+T)/2 - c_n - c_v]\chi\mathbb{P}(r \geq T) - \tau}.$$

Note that if $[(\bar{r}+T)/2 - c_n - c_v]\chi\mathbb{P}(r \geq T) > \tau$, then $\mathcal{E}_{\text{CTR},\chi} > 0$. Also note that $\mathcal{E}_{\text{CTR},\chi} > 1$ if $\chi < \frac{2\tau}{\mathbb{P}(r\geq T)[(\bar{r}+T)/2 - c_n - c_v]}$. Hence, if $\chi \in \left\{\frac{\tau}{\mathbb{P}(r\geq T)[(\bar{r}+T)/2-c_n-c_v]}, \frac{2\tau}{\mathbb{P}(r\geq T)[(\bar{r}+T)/2-c_n-c_v]}\right\}$, then

$$\mathcal{E}_{\text{CTR},\chi} > 1 > \mathcal{E}_{\text{CTR},\tau} > 0.$$

On the other hand, if χ is large enough, then $\mathcal{E}_{\text{CTR},\chi} < \mathcal{E}_{\text{CTR},\tau}$. To see this, note that $\mathcal{E}_{\text{CTR},\chi}$ and $\mathcal{E}_{\text{CTR},\tau}$ are continuous in χ, $\lim_{\chi\to\infty} \mathcal{E}_{\text{CTR},\chi} = 0$ and $\lim_{\chi\to\infty} \mathcal{E}_{\text{CTR},\tau} = \tau$. This also turns out to be the case in our quantitative analysis where we find that increasing the corporate tax rate by one percent has a larger impact on CTR than increasing the enforcement intensity by one percent (Figure F.1). This is primarily because the prevailing level of enforcement intensity is estimated to be quite large to begin with, and thus marginal increases do not have a substantial impact on tax evasion. On the other hand, while an increase in the tax rate increases cost overreporting, the reduction in the tax base due to an increase in such evasion is not large enough to completely erode the increase in CTR stemming from an increase in the tax rate itself.



Notes: In panel (a), the red dot depicts the elasticity of CTR with respect to tax rates evaluated at 25 percent (i.e., the corporate tax rate in India levied on domestic firms with annual turnover upto INR 250 crore during our sample period). In panel (b), the red dot depicts the elasticity of CTR with respect to enforcement intensity evaluated at the enforcement intensity estimated using GMM to match non-verifiable expense ratios in Indian data around the GST exemption threshold.

Figure F.1: Elasticities of Corporate Tax Revenue