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

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Abstract

India recently adopted a nationwide tax reform, the Goods and Services Tax (GST), enhancing third-party reporting and enforcement. This study examines how the GST affected business tax compliance. After the reform, firms reported higher revenues and costs, which can be attributed to increased efficiency and improved tax compliance. To isolate the impact of the GST on tax compliance, we focus on financial statement fraud. We find that while the GST likely reduced revenue underreporting, it 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 and use it to show 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

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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 (Pomeranz, 2015; Kleven et al., 2016; Slemrod and Velayudhan, 2022; Garbinti et al., 2023). 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—akin to a game of whack-a-mole. Specifically, if firms make offsetting adjustments by misreporting less verifiable items, improvements in the verification of final and intermediate goods 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.

We examine the extent to which this tax reform has enhanced tax compliance among businesses using a novel administrative dataset of corporate tax returns from the Ministry of Corporate Affairs (MCA), Government of India. This dataset includes comprehensive balance sheet and income statement information, crucial for analyzing financial statement fraud. Unlike publicly available datasets that primarily focus on manufacturing establishments, the MCA dataset covers both manufacturing and non-manufacturing firms, offering a broader view of corporate financial activities across sectors.

We find that a segment of enterprises adjusted to the tax reform by inflating their reported expenditures, thereby partially mitigating the tax compliance benefits associated with third-party reporting. Previous research has predominantly employed differences-in-differences (DD) methodologies to identify instances of overreported costs (Carrillo et al., 2017; Slemrod et al., 2017; Naritomi, 2019; Mascagni et al., 2021). Specifically, extant stud-

ies reveal that firms exhibit elevated declarations of both revenues and costs in response to an increase in third-party reporting. The observed correlated adjustments in revenue and costs, which leave the overall tax liability largely unperturbed, are construed as indicative of cost overreporting.[1] Nevertheless, the conventional DD approach encounters challenges in disentangling evasion responses from production responses when treated firms experience disparate growth trajectories compared to control firms. This challenge assumes heightened significance in the context of the Indian GST, where the tax reform not only influenced third-party reporting but also harmonized the indirect tax code, abolished border tariffs, and alleviated instances of double taxation—all factors likely to impact production.[2] A DD design that contrasts the responses of firms supplying GST-exempt goods with those subject to GST would be incapable of distinguishing between such production responses and cost overreporting.

To address this concern, our paper proposes an alternative method to detect cost overreporting which identifies evasion using variations in the composition of firms' verifiable and non-verifiable expenses around tax exemption thresholds.[3] 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. This integrated approach encourages businesses to maintain accurate records and comply with tax regulations to claim eligible credits. As a result, 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 social security

[1] 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.

[2] Indeed, there is some precedence for such production responses. In an earlier update of the commodity tax code, Indian states moved from a sales tax system to a VAT in a phased manner between 2003 and 2008. VAT adoption lowered the complexity of the tax system and reduced double taxation to some extent. Agrawal and Zimmermann (2022) show that these changes positively impacted production. The GST, which further simplified the tax code (by eliminating differences in the commodity tax regimes across states) and reduced tax cascading, could have led to similar effects.

[3] While the inspection of discontinuities in input factor shares has been previously used to detect evasion in other contexts (see, for instance, Chen et al. (2021) who use it to detect relabelling of firm expenses), it has not been applied to detect instances of cost overreporting.

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 their wage bills 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. Focusing on the (financial) years 2017 and 2018, 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 2018, 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 (The Economic Times, 2018). 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.

Our RD analysis relies on identifying discontinuities around tax exemption thresholds, making it suitable for examining the presence of cost overreporting rather than its overall magnitude. To gauge the level of cost overreporting, we structurally estimate a model using the MCA data. This approach is crucial because the extent of overreporting can only be ascertained by contrasting reported non-verifiable costs with actual non-verifiable costs. Actual non-verifiable costs, however, are unobservable by the econometrician. By utilizing the structural model, we can estimate the genuine level of non-verifiable costs, thereby unveiling the extent of cost overreporting.

Our structural model accounts for how firms' decisions to overreport their costs interact with their production decisions. More specifically, we calibrate the model to the observed firm size distribution in India and use it to demonstrate 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, reducing a firm's size also reduces its probability of being audited, allowing it to overreport its input costs to a larger extent, thus reducing its 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 $[0, T + \text{INR } 40 \text{ lakhs}]$ 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. Best et al. (2015) argue that in economies where firms engage in evasive practices through cost inflation, a substantial reduction in the tax gap can be achieved by reducing the tax deductibility of costs. This transition toward a turnover tax attenuates the marginal benefit of evasion without impacting its marginal cost, resulting in diminished evasion by firms. Their result, however, relies on the assumption that all firms face a positive probability of being audited. In the context of the Indian GST, firms above the tax exemption threshold, who remain under the scrutiny of the tax authorities, are exposed to the mechanism outlined in Best et al. (2015) and thereby evade less as the tax deductibility of costs is reduced. Conversely, entities below the exemption threshold, beyond the scope of audits, manifest a propensity for increased evasion as costs become less tax deductible. Our estimates indicate that a reduction in the tax deductibility of costs increases cost overreporting by firms below

the tax exemption threshold to a greater extent than the decrease above the threshold. This upswing in aggregate evasion implies that the tax gap does not fall to the same extent in our model as it would in the framework outlined in Best et al. (2015).

To summarize, 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 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). Although there exists some theoretical work on the importance of information and third-party reporting for effective taxation in developing countries (Kopczuk and Slemrod, 2006; Gordon and Li, 2009), empirical evidence in this domain, while rapidly growing, is nascent (Carrillo et al., 2017; Naritomi, 2019; Kumler et al., 2020; Bachas and Soto, 2021; Brockmeyer and Hernandez, 2022; Bellon et al., 2022; Almunia et al., 2023). 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.[4] 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. 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. In this vein, our paper is related to Bustos et al. (2022), who show that an increase in enforcement can lead to firms adapting to the new enforcement environment without necessarily raising tax revenue.

Our model of cost overreporting bears resemblance to the model outlined in Best et al.

[4]See, for instance, Pomeranz (2015) and Almunia and Lopez-Rodriguez (2018).

(2015), who examine the differential ease of evasion under profit versus turnover taxation. Nevertheless, Best et al. (2015) 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. Furthermore, the model presented in Best et al. (2015) lacks differentiation between verifiable and non-verifiable costs, as all costs in their framework are considered non-verifiable. In contrast, our model places particular importance on distinguishing between verifiable and non-verifiable costs, as this distinction is pivotal in gauging the extent of cost overreporting. Bachas and Soto (2021) use the framework of 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 likely decreased taxpayer manipulation of line items that became more transparent, such as revenues and the cost of intermediate goods, while increasing manipulation of other, less verifiable line items.

While several studies have documented instances of cost overreporting, they have not fully explored the specific channels through which firms engage in such practices. In this paper, we argue that firms in developing countries inflate informal labor costs as a means of overreporting expenses, thus contributing a new dimension to the understanding of tax compliance. In this context, our work is closely related to the broader literature on the causes and consequences of informality; see Ulyssea (2020) for an excellent survey. Our findings build on this literature by providing new insights into how informal labor is strategically used for tax evasion and its broader implications for policy design.

2 Institutional Background

2.1 Predominance of High Corporate Taxation

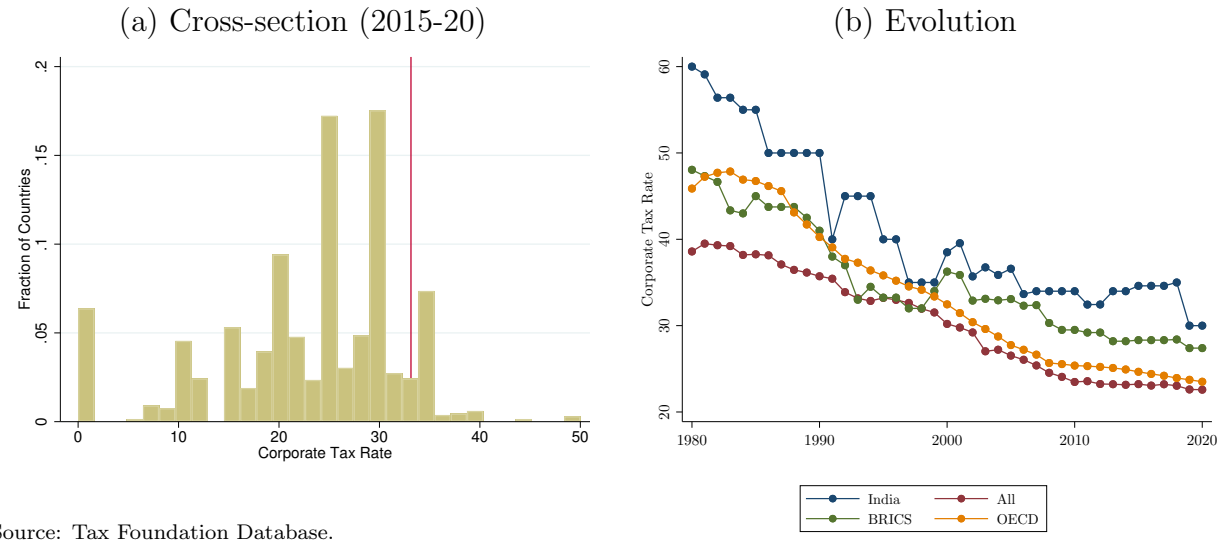
Prior to the corporate tax cut in September 2019, which is toward the end of our sample, the tax burden on Indian firms was substantial. Domestic companies with an annual turnover of up to INR 250 crores were taxed at a rate of 25 percent, while those above this threshold were taxed at 30 percent. Foreign 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 2015–2020. Each bar represents the fraction of countries with corporate tax rates falling within specified intervals. The average statutory corporate tax rate in India is highlighted in red and is situated in the right tail of the distribution, indicating that India's corporate tax rates are significantly higher than those of most other countries. 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 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.

2.2 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)). India is no exception. 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.

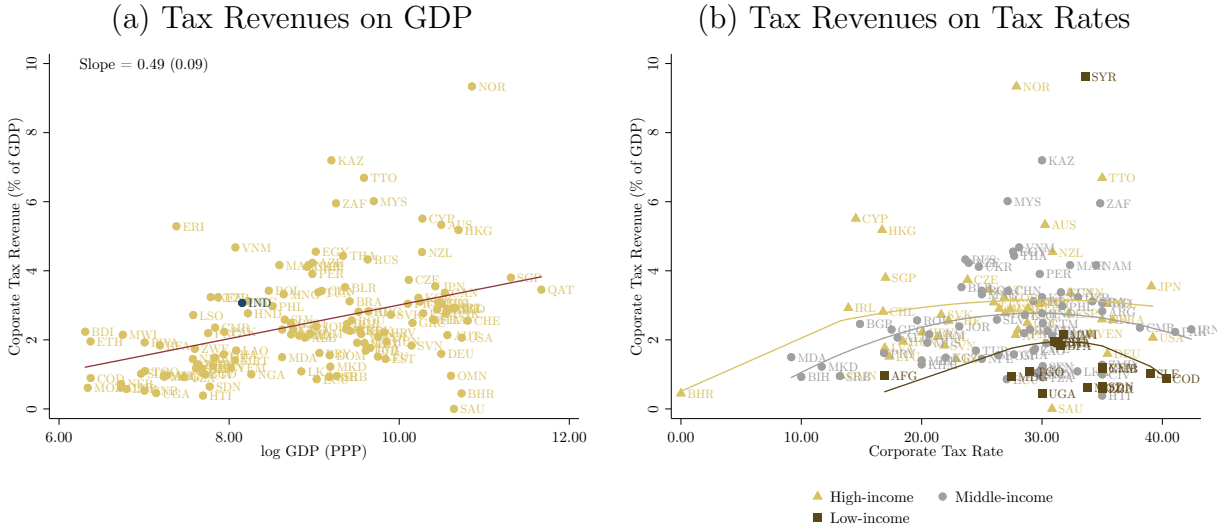
Even survey evidence suggests that financial statement fraud is pervasive in India, whereby a substantial amount of firms hide sales or inflate expenses, often via ghost employees and fictitious contracts. Deloitte India Fraud survey report tracks sentiments on the



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



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

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 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.

2.3 Implications of the GST on Tax Compliance

The GST, introduced in India in July 2017, marked a significant shift from the previous VAT regime. Under the GST, all state and federal taxes were consolidated into a single, simpler-to-navigate system. This section describes the implications of the GST on tax compliance. Appendix B provides a detailed background of the economic, fiscal, and administrative implications of the GST.

Firms whose aggregate turnover in a financial year exceeded INR 20 lakhs were liable to be registered under the GST Act.[5,6] 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.[7] Firms with annual revenues below INR 20 lakhs were

[5]With the introduction of state VAT Acts at the turn of the century, firms that were already registered under the existing state sales tax laws or the Central Sales Tax Act (1956) were grandfathered in and generally remained liable to pay sales tax or purchase tax, as applicable. Other firms became liable upon exceeding a turnover threshold within a specified period, typically not exceeding twelve months. While turnover threshold criteria varied among states, the maximum exemption threshold during the VAT era was INR 10 lakhs annually. Under the GST regime, this exemption threshold increased to INR 20 lakhs (Figure A.1). In special category states (i.e., Arunachal Pradesh, Assam, Himachal Pradesh, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim, Tripura, Uttarakhand, and Telangana), the registration threshold was kept at INR 10 lakhs.

[6]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.

[7]Firms with turnover below INR 1.5 crores could also opt for the composition scheme. Under this scheme,

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 VAT system operating in India before the introduction of GST was fragmented in terms of tax enforcement and compliance. Under the VAT regime, states in India had the autonomy to set their own thresholds for VAT registration. These thresholds varied significantly across states, unlike the uniform threshold under GST.[8] This variation meant that the enforcement notch was not uniform across the country under VAT. Moreover, the VAT system was more complex due to the presence of multiple indirect taxes, each with its own compliance requirements. In addition, the frequency of reporting and the nature of compliance mechanisms also varied by state and tax type under VAT. This system was generally less rigorous than the GST in terms of regular and detailed reporting requirements for all transactions.

The GST regime is bolstered by its reliance on a centralized digital platform, the GST Network (GSTN), which streamlines tax return filing and processing. This digitization has led to a paradigm shift in the audit process. Unlike the fragmented and often manual approaches under the VAT regime, GST leverages technology for efficient data collection, processing, and cross-verification of transactions. The capability to electronically match data from GSTR-1 forms (which provide details of the outward supplies of goods or services) and GSTR-2 forms (which provide details of the inward supplies of goods or services) enables tax authorities to accurately assess and audit tax liabilities and input tax credits. This systemic integration and data transparency are instrumental in identifying discrepancies and non-compliance. Moreover, the expansion of the tax base under GST also allows for more tax oversight. Unlike the VAT system, which was primarily focused on goods, GST encompasses both goods and services, broadening the spectrum of economic activities under scrutiny. This comprehensive coverage under GST facilitates a more extensive audit reach.

In the previous regime, not only did different states have the authority to set their own tax rates, but tax authorities had limited jurisdiction outside their respective states.[9] The tran-

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).

[8]Barring special category states, the exemption threshold for VAT typically ranged from INR 5 lakhs to INR 10 lakhs.

[9]The following example illustrates how such fragmentation can facilitate tax evasion. Consider a scenario wherein State A levied a lower tax rate on a specific category of goods compared to State B. A business engaged in the sale of these goods that operated in both State A and State B could strategically route its transactions to minimize tax liabilities. For sales transpiring in State A, where the tax rate was lower, the business might manipulate invoicing and documentation to project an augmented volume of transactions in

sition to a unified system has conferred broader jurisdiction upon tax authorities, facilitating the monitoring of transactions across state boundaries and fortifying regulatory compliance. Notably, the incorporation of e-way bills within the GST framework has introduced a pivotal dimension to the audit mechanism. In the previous VAT regime, documentation pertaining to the movement of goods was often a manual undertaking and exhibited substantial variations from one state to another. The GST system standardizes this process electronically across the entire country, aiding the real-time tracking of goods.

Another reason to expect better tax compliance in the GST era is the increased utilization of the ITC (Pomeranz, 2015). While the earlier system also had the concept of input tax credit, the GST expanded and streamlined this concept. More specifically, though the previous regime featured input credits for Central Value Added Taxes (CENVAT), there were delays in credits against the CENVAT, major sectors (such as agriculture, real estate construction, oil and gas production) were excluded from the CENVAT, and credit for the Central Sales Tax (CST) paid on inter-state purchases was not available (Keen, 2014). These idiosyncrasies disappeared with the introduction of the GST in 2017. Under GST, input tax credits are provided across the supply chain. This integrated approach encourages businesses to maintain accurate records and comply with tax regulations to claim eligible credits.

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. The randomization was conducted by the MCA prior to our access to the data. 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,

that jurisdiction. Conversely, for sales in State B with a higher tax rate, the business might deliberately underreport transactions. The absence of comprehensive visibility and coordination between tax authorities across states exacerbated the challenge of detecting such manipulative practices.

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). The ASI is a census of all manufacturing firms in the country with at least 100 employees. 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. Since the ASI data is at the plant level while the MCA data is at the firm level, these data cannot be matched one-to-one. Instead, we leverage the ASI data to calculate out-of-state procurement ratios within specific industries, and then examine variations in RD estimates across these industry-level indicators. Additionally, 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. Here we have deliberately narrowed our focus to a select subset of firms for which comprehensive tax records are available for each consecutive year spanning from 2015 through 2019. 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 increase in firm revenues and costs post the implementation of GST. Average firm revenues in our balanced panel increased from INR 69.98 crores to INR 89.47 crores, while average expenses increased from INR 67.45 crores to INR 85.63 crores. As an additional check, Figure A.2 shows that aggregate-level trends in revenues and expenses are similar in our MCA sample and the ASI dataset.

One plausible explanation for this simultaneous rise in revenues and costs post-GST implementation is the enhanced production efficiency resulting from the tax reform. As we discuss in Appendix B, the GST brought about a reduction in trade frictions across Indian states, increased the utilization of ITCs, and created a more uniform commodity tax regime. These alterations possess the potential to boost firm production. Given that a growing firm typically incurs growing costs, any increase in production due to the GST can reasonably justify both elevated revenues and costs. An alternative explanation is that the GST led to better income monitoring, which increased reported firm revenues without a substantial

Table 1: Summary Statistics for Balanced Panel

	Observations (1) Total	All (2) Mean (S.D.)	Pre-GST (3) Mean (S.E.)	Post-GST (4) Mean (S.E.)	Difference (4) - (3) Est. (S.E.)
P&L a/c variables					
Total revenue	51,519	77.78	69.98	89.47	19.49
		(391.67)	(1.98)	(3.13)	(3.70)
Total expenses	51,519	74.72	67.45	85.63	18.18
		(304.89)	(1.53)	(2.45)	(2.89)
Employee compensation	51,519	5.44	4.70	6.56	1.86
		(22.20)	(0.10)	(0.19)	(0.22)
Cost of materials	51,505	39.03	34.78	45.42	10.65
		(94.91)	(0.48)	(0.75)	(0.89)
Power and fuel costs	36,437	1.40	1.76	0.81	-0.96
		(62.74)	(0.53)	(0.02)	(0.53)
Finance cost	51,497	4.20	3.89	4.68	0.79
		(218.19)	(1.10)	(1.75)	(2.07)
Insurance expenses	36,437	0.03	0.03	0.03	≈ 0
		(0.19)	(< 0.01)	(< 0.01)	(< 0.01)
Auditing expenses	36,437	0.01	0.01	0.01	≈ 0
		(0.06)	(< 0.01)	(< 0.01)	(< 0.01)
Balance sheet variables					
Total assets	51,488	90.49	79.34	107.24	27.91
		(3541.56)	(16.69)	(29.94)	(34.28)
Borrowings	51,486	26.34	21.46	33.66	12.20
		(1715.32)	(6.86)	(15.86)	(17.28)
Equity	51,488	5.59	5.14	6.26	1.13
		(34.09)	(0.12)	(0.33)	(0.35)
Cash	51,488	3.38	3.28	3.52	0.24
		(42.67)	(0.30)	(0.15)	(0.33)

Notes: All variables are denominated in INR Crore. To create a balanced panel, we discard observations in 2020 and only include the set of firms for which we have tax returns for all years between 2015 and 2019. The pre- and post-GST periods correspond to the years 2015–2017 and 2018–2019, 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.

change in production. In order to reduce their corporate tax burden, firms reported higher costs, which were harder to monitor. In Section 4, we document evidence supporting the latter hypothesis.

4 Reduced-form Analysis

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.

4.1 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:

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

where i denotes a firm, t denotes the tax filing year, and $r_{i,t}$ denotes the revenue of firm i in period t.

Until March 2019, the GST exemption threshold for all businesses in India stood at INR 20 lakhs. Commencing from April 2019, there was a significant policy shift: the exemption threshold for firms engaged in the supply of goods was elevated to INR 40 lakhs, effectively doubling the previous limit. However, this adjustment was not mirrored for service providers, whose exemption threshold remained unchanged. This divergence in policy could have potentially incentivized service providers to misclassify their business category, falsely claiming to be engaged in the supply of goods to avail themselves of the elevated exemption threshold. Such a scenario poses a significant challenge for our empirical analysis as it could introduce inaccuracies in the data. To circumvent this issue and ensure a more controlled setting, our baseline analysis focuses on the years 2017 and 2018. The year 2017 is particularly significant as it represents the tax filing period immediately preceding the

implementation of GST. Similarly, the year 2018 is critical as it marks the tax filing year immediately following the GST implementation. By concentrating on these specific years, our analysis aims to provide a clearer picture of the economic landscape both before and after the implementation of GST, thus avoiding the confounding effects of the subsequent policy shift in exemption thresholds that began in April 2019.

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 and f is a continuous function. Our main outcome variable is the non-verifiable expense ratio. 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.[10]

4.2 Results

Table 2 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 column 1 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. We do not find any evidence of cost overreporting in the year preceding the implementation of GST, mitigating concerns of a placebo effect (column 2). Our baseline results are driven by firm responses in the year 2018, i.e., the tax filing year immediately following the implementation of GST (column 3).

[10] We also drop observations that feature non-verifiable expense ratios larger than one. Our main result is robust to winsorizing the outliers instead of discarding them.

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}.[11] Following Calonico et al. (2019), the covariates are introduced in a joint least-squares fit to minimize the underlying assumptions required for the covariate-adjusted RD estimator to remain consistent for the standard RD treatment effect. When we include covariates in the analysis, there are no significant changes in the estimated effects or increases in the standard errors, alleviating concerns of a misspecified functional form.

To visualize the RD design, in Figure A.3, 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. The figure confirms that the jump in the non-verifiable expense ratio at the cutoff is unusually large compared to the bumps in the ratio away from the cutoff. These results suggest that firms with revenues around the exemption threshold responded to the tax change by overreporting their non-verifiable costs.

Table 2: Exemption Threshold and Non-verifiable Expense Ratio

Sample period	2017–2018	Pre-GST	Post-GST
	(1)	(2)	(3)
Panel A: Excluding covariates			
RD estimate	-0.118**	-0.021	-0.144*
	(0.054)	(0.107)	(0.085)
	[804]	[451]	[353]
Panel B: Including covariates			
RD estimate	-0.092*	-0.019	-0.200***
	(0.053)	(0.097)	(0.074)
	[802]	[449]	[353]

Notes: To compute the RD estimates, we follow the method of Calonico et al. (2014). 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. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A.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 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

[11] Our measure of equity is current share capital and our measure for borrowing is total current long-term borrowings.

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.

It is worth noting that although firms with revenues below INR 20 lakhs are not obligated to register for GST, some may choose to do so voluntarily to claim ITCs.[12] Voluntary registration reduces the opacity of information about firms below the threshold, introducing a downward bias in our estimate. While this bias suggests that the extent of cost overreporting may be larger than the observed estimate if voluntary registration were not permitted, it does not preclude the identification of cost overreporting instances.

4.3 Validity of the RD Design

4.3.1 Placebo Tests

We perform additional placebo tests to further strengthen the causal interpretation of our findings regarding cost overreporting. Specifically, in Table 3, 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 3: 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 follow the method of Calonico et al. (2014). 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 4, 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

[12] Upon the implementation of GST, all registrations under the VAT Act were automatically canceled. Businesses were required to complete a formal verification process to migrate to GST, which involved submitting additional documents and confirming details on the GST portal to obtain a permanent GST registration.

(columns 1–5 of Table 4). 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 (see Figure A.4 for the corresponding figure).

Table 4: Placebo Tests: Share of Verifiable Expenses

	Cost of Materials	Power and Fuel Costs	Finance Cost	Insurance Expenses	Auditing Expenses
	(1)	(2)	(3)	(4)	(5)
RD estimate	0.028	0.072	-0.039	0.002	0.003
	(0.117)	(0.055)	(0.039)	(0.003)	(0.004)
	[786]	[754]	[800]	[754]	[754]

Notes: To compute the RD estimates, we follow the method of Calonico et al. (2014). We use a linear estimator with a triangular kernel and MSE-optimal bandwidth. We discard ratios that are larger than one or less than zero. Standard errors are clustered at the firm level. Observations are reported in square brackets.* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

4.3.2 Covariate Balance

In Table 5, 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 0.161 to 0.504. 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 (see Figure A.5 for the corresponding figure).

4.3.3 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 (Lee and Lemieux, 2010).

We follow Cattaneo et al. (2017) to test that the density of the running variable is continuous at the cutoff. Panel (a) of Figure A.6 provides a graphical representation of the

Table 5: Testing Balance of Covariates around Tax Exemption Thresholds

Variable	Optimal Bandwidth	RD Estimator	p-value	Confidence Interval
Panel A: MSE-optimal bandwidth				
Total assets	7.66	290.92	0.161	[-140.35, 845.73]
Borrowings	6.56	215.95	0.169	[-100.12, 570.66]
Equity	5.16	54.01	0.504	[-77.64, 157.86]
Cash	5.02	-4.48	0.390	[-16.26, 6.35]
Panel B: CER-optimal bandwidth				
Total assets	5.44	280.22	0.217	[-182.88, 805.01]
Borrowings	9.55	203.67	0.227	[-133.91, 564.04]
Equity	3.68	21.26	0.816	[-101.15, 128.49]
Cash	3.57	-5.47	0.340	[-17.10, 5.90]

Notes: All variables are denominated in INR lakhs. To compute the RD estimates, we follow the method of Calonico et al. (2014). We use a linear estimator with a triangular kernel. Standard errors are reported in parenthesis and are clustered at the firm level.

continuity in density test approach, exhibiting both a histogram of the data and the actual density estimate with shaded 95% confidence intervals. We do not find any statistically significant evidence of revenue bunching around the tax exemption threshold in 2018 (i.e., the tax filing year immediately following GST implementation), which also happens to be the year in which we detect the presence of cost overreporting.[13] Nevertheless, to further alleviate the concern that revenue bunching can bias our estimates of cost overreporting, we explicitly account for such responses in our structural model (Section 5.2).

4.3.4 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 6, 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.

[13]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.

Table 6: 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 follow the method of Calonico et al. (2014). 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. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

4.3.5 Firm Composition

An additional factor contributing to potential discontinuities in input factor shares at tax exemption thresholds is the heterogeneity in firms' production technologies. Disparities in the composition of firms across these thresholds could result in variations in non-verifiable expense ratios due to the divergent production technologies employed by firms on either side of the threshold. For instance, if the proportion of service providers is greater just below the thresholds compared to above them, this could lead to a negative discontinuity in the ratio of wages to total expenses, given that service providers typically exhibit higher labor intensity than manufacturers.

This issue may be particularly relevant in our context, as service providers tend to be less likely to voluntarily register for GST. This is because service providers are heavily reliant on labor, which is exempt from GST. In industries where production relies relatively less on GST-able inputs, non-registration is less costly in terms of the loss of input tax credits, making firms below the exemption threshold less likely to voluntarily register. These firms may thus be disproportionately represented just below the exemption threshold, as they avoid registration, unlike manufacturers who are more likely to voluntarily register and are therefore unaffected by the threshold. The higher composition of service providers below the threshold may then result in a higher average labor cost ratio among firms in that region.

To investigate this possibility, we construct an indicator variable to determine whether a firm is a manufacturer or a service provider. No significant discontinuity is observed in this indicator at exemption thresholds (p-value = 0.4). Another way to relax the assumption of continuous firm composition at the thresholds is to directly test for discontinuities in non-verifiable expense ratios using only within-sector variations, which we explore in Section 4.5.1. While our RD estimates are more pronounced in the subsample of service providers, we do not detect any evidence of revenue bunching at exemption thresholds when focusing on these firms, as shown in panel (b) of Figure A.6.

4.4 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 goods, 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. Thus, the net increase in the visibility of intermediate goods due to GST was 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 in order to reduce their tax liability. On the other hand, businesses with a higher ratio of out-of-state input procurement could overstate the cost of their intermediate goods to a larger extent rather than overreport labor costs.[14]

Table 7 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.

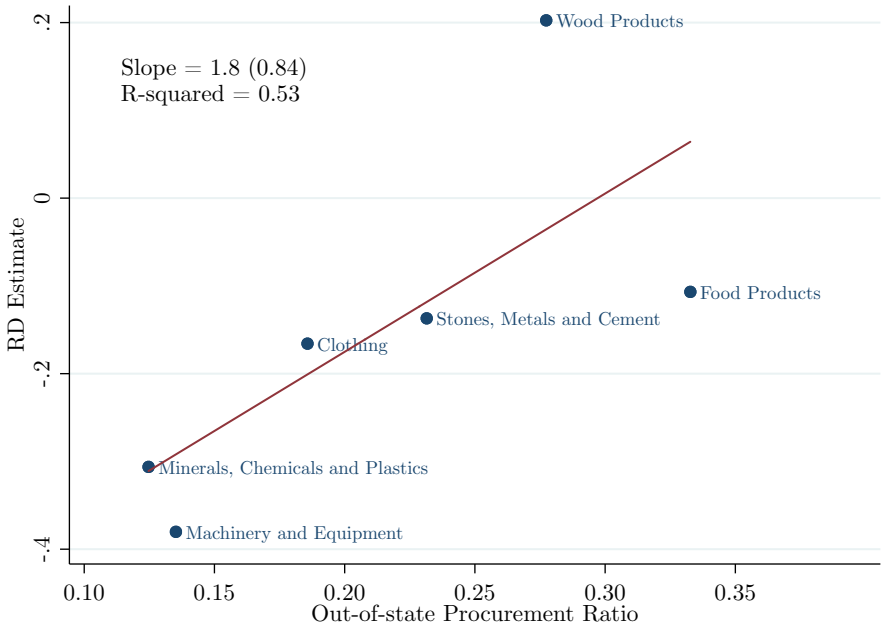
Table 7: Variation in RD Estimates (by Out-of-state Input Procurement)

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 follow the method of Calonico et al. (2014). 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. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

[14] The details of the method used to calculate out-of-state input procurement ratios are outlined in Appendix C.

These findings are echoed in Figure 3, 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 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 $\geq$ 2500 and $<$ 4100; "Wood Products" includes firms with ITC-HS codes $\geq$ 4400 and $<$ 5000; "Clothing" includes with ITC-HS codes $\geq$ 5000 and $<$ 6800; "Stones, Metals and Cement" includes firms with ITC-HS codes $\geq$ 6800 and $<$ 8400; "Machinery and Equipment" includes firms with ITC-HS codes $\geq$ 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 $\geq$ 9900). We also exclude firms classified as supplying hides & skins (i.e., those with ITC-HS codes $\geq$ 4100 and $<$ 4400), miscellaneous products (i.e., those with ITC-HS codes $\geq$ 9400 and $<$ 9700), works of art (i.e., those with ITC-HS codes $\geq$ 9700 and $<$ 9900) as we do not have enough observations to perform bandwidth calculations for our RD estimates.

Figure 3: Variation in RD estimates and Out-of-state Input Procurement Ratio (by Product Classifications)

4.5 Heterogeneity

4.5.1 Industry and Factor Intensity

In Table 8, 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. Moreover, we find no statistically significant evidence of a discontinuity in the non-verifiable expense ratio of service providers when focusing on the pre-GST period (see Table A.2). 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.

Table 8: 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 follow the method of Calonico et al. (2014). 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. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

4.5.2 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.[15] We collapse the informality index, which is measured at a 5-digit National Industrial Classification (NIC) level, to a 4-digit measure using arithmetic

[15]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.

averages. Using the 4-digit NIC measure, we match the informality index of each industry to all firms belonging to that industry in the MCA dataset. 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. When we focus on firms in industries with below-average informality, the RD estimate is statistically indistinguishable from zero (columns 1–2 of Table 9).[16]

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 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.[17] 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. In contrast, when we restrict attention to industries with above-average exposure to NREGA, the RD estimate is not statistically significantly different from zero (columns 3–4 of Table 9).

5 Structural Analysis

In this section, we structurally estimate a model of cost overreporting. Our structural analysis has at least three main advantages over our RD analysis. First, while our RD analysis can detect the presence of cost overreporting, a reduced-form approach is not informative about the underlying *level* of cost overreporting. This is because estimating the level of cost overreporting requires information on not only firms' reported non-verifiable costs (which are observable) but also their actual non-verifiable costs (which are unobservable). Through the structural model, we can gauge the actual level of non-verifiable costs, thereby

[16] 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).

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

Table 9: 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 follow the method of Calonico et al. (2014). 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. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

uncovering the extent of cost overreporting. Second, a limitation of the RD analysis is that it only estimates local average treatment effects (LATE) close to tax exemption thresholds. However, the structural model can be used to estimate treatment effects away from tax exemption thresholds. Third, the RD analysis may incorrectly find a treatment effect if the true relationship between the outcome and the score is non-linear; our structural analysis is not plagued by this issue.

In our structural model, firms decide the amount of 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.[18] 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 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.

5.1 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

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

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 in the model 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.[19] 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 (reported) 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 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, if T is large enough and $c_v > 0$, then

$$\lim_{r \to T} \frac{\hat{c}_n}{\hat{c}_n + c_v} \mid_{r<T} > \lim_{r \to T} \frac{\hat{c}_n}{\hat{c}_n + c_v} \mid_{r \geq T}.$$

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

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

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

where $\bar{r}$ denotes the upper bound of the revenue domain.[20] To see this, consider panel (a) of Figure 4, 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. In other words, to calculate the level of cost overreporting, the difference between reported and actual non-verifiable costs for each firm is computed and then summed across all firms in the revenue domain.

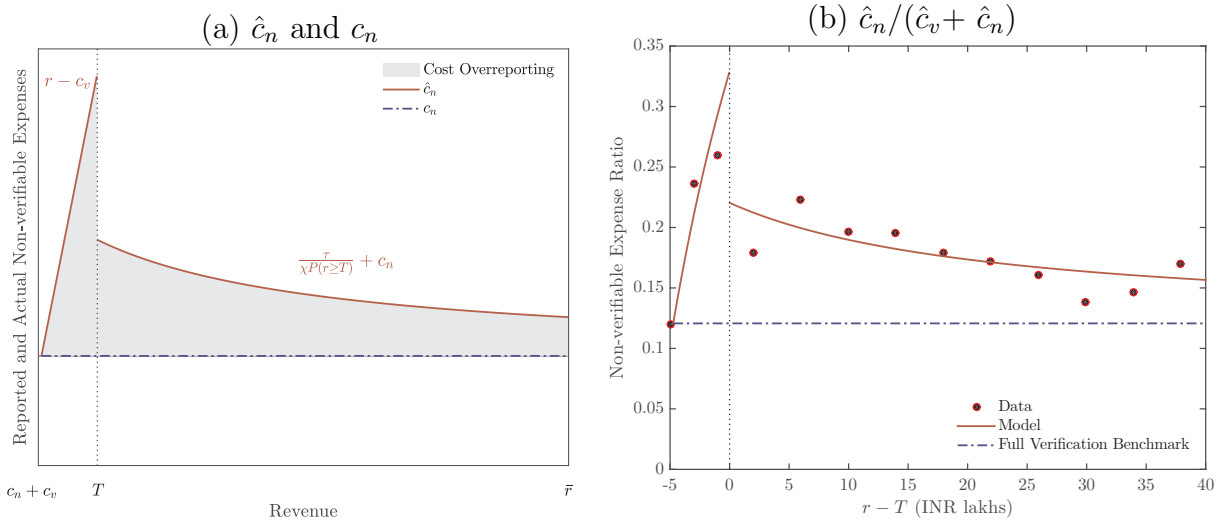


Figure 4: Estimating the Level of Cost Overreporting

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 corresponding 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

[20] 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 5.2.

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 4 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.

In the above structural analysis, we relied on two assumptions. Firstly, we employed a quadratic cost function to model the penalty associated with misreporting costs. To address concerns regarding the restrictiveness of this assumption, we also explored a model in which the penalty for misreporting costs was not limited to a quadratic form, but rather was permitted to take on a broader range of convex functions of the form $\chi(\hat{c}_n - c_n)^\rho/\rho$, where $\rho > 1$. In this more general framework, the estimate for ρ obtained using the GMM strategy employed in our baseline analysis was approximately equal to 2, validating our initial assumption of quadratic misreporting costs.

Secondly, we assumed homogeneity in production technologies among firms situated around tax exemption thresholds, with differences primarily arising from productivity disparities. However, such an assumption overlooks the inherent disparities in production technologies between service providers and manufacturers, with the former typically exhibiting higher labor intensity. To address this limitation, we reestimated our model by focusing solely on service providers within our dataset. In this constrained framework, our estimate for cost overreporting increases to 9 percent.

5.2 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 $\{x_v, x_n\}$:

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

where

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

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

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

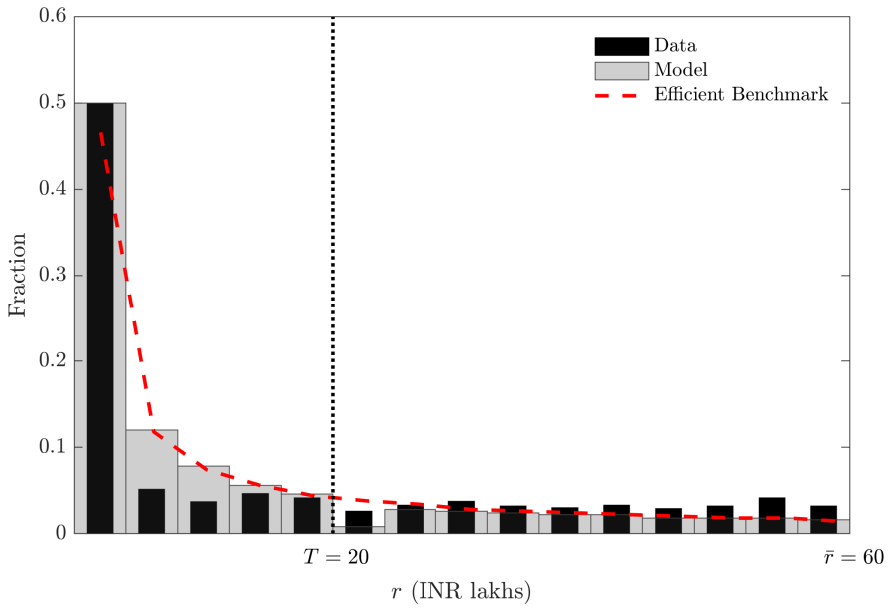
Reported and actual non-verifiable expenses are then given by:

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

We use the following approach to estimate the level of cost overreporting. We compute optimal allocations under the parameters estimated in Appendix D, barring input prices, which we set to unity. To close the model, we also require distributional assumptions on z. Our assumption posits z to follow a uniform distribution over a domain, which we discipline using empirical moments. More specifically, we assume $z \sim U(a,b)$ where a is calibrated such that the simulated fraction of firms generating revenues below INR 4 lakhs coincides with its corresponding moment in the data (0.5, 2018 estimate) and b is calibrated such that the upper bound of the simulated distribution of firm revenues equals $\bar{r}$ (INR 60 lakhs). This strategy yields $a=0.82$ and $b=2.08$. We then 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. Figure 5 shows that the model generates more small firms than large ones, as in the data. Moreover, the

model can account for the slight bunching observed in the distribution of firm revenues at the tax exemption threshold even after the GST was implemented. This can be clearly seen by comparing the distribution of firm revenues in our model in which tax enforcement is imperfect to that in a scenario in which firms' revenues and costs are perfectly observable by the tax authorities. Bunching around the exemption threshold occurs endogenously in our model because firms reduce the size of their operations to avoid audits, allowing them to overreport their costs to a larger extent.[21] This insight connects to a strand of corporate finance literature that examines the impact of tax policy on firm performance. Desai et al. (2007), for example, argue that institutional reforms in Russia that curtailed a form of revenue evasion—managerial diversion—led to improved firm performance. Mironov (2013) provides similar evidence. In contrast, our findings offer a caveat to this positive association between revenue evasion-reducing policies and firm performance. Our model suggests that while the institutional changes accompanying GST enhanced revenue transparency and curtailed evasion along this dimension, they may have also incentivized some firms to remain small to continue evading corporate taxes by inflating costs. As discussed in Section 4.3.3, the observed amount of revenue bunching post-GST implementation is very small, and our model slightly overpredicts this phenomenon.



Notes: The empirical distribution corresponds to the distribution of firm revenues in 2018 when the tax exemption threshold (T) was INR 20 lakhs. In the efficient benchmark, we assume $z \sim U(0.82, 2.08)$ and firms with productivity z solve the standard profit maximization problem: $\max_{x_v, x_n}(1-\tau)[z x_v^{\alpha_v} x_n^{\alpha_n} - w_v x_v - w_n x_n]$.

Figure 5: Distribution of Firm Revenues

[21] It is worth emphasizing that we do not explicitly target this moment when we calibrate the firm productivity distribution.

Panel (a) of Figure 6 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. As illustrated in the figure, this difference in our estimates is primarily driven by differences in firms' real responses below the exemption threshold across the two settings. To see this, it is helpful to contrast optimal allocations here to those in the model outlined in Appendix D 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 implies that the demand for non-verifiable inputs is lower when production decisions are endogenous relative to the case in which revenues are exogenously given. As reported non-verifiable expenses are the same across the two settings, but actual non-verifiable expenses are larger in the model in which revenues are exogenous, cost overreporting (i.e., the difference between reported and actual non-verifiable expenses) is larger in the model in which production decisions are endogenous.

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 6 verifies that our model does a good job in matching reported non-verifiable expense ratios in the data.

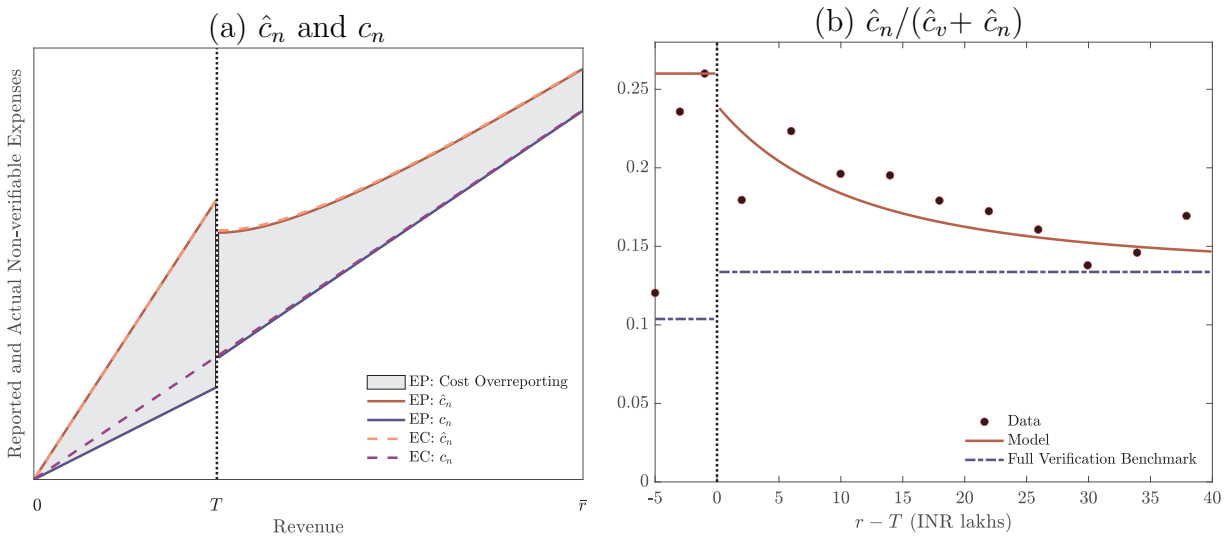
5.3 Counterfactual Experiment 1: Partial Tax Deductibility of Costs

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 costs 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 objective function of firms is given by

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

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, given policies $\{\tau, \mu, T, \chi\}$ and



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 D for details on the EC model.

Figure 6: Estimating the Level of Cost Overreporting under Endogenous Production

production decisions $\{c_v, c_n, r\}$, it is optimal for firms to 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 (reported) non-verifiable expense ratio as

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

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

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

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 7, 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. More specifically, the rise in cost overreporting by firms below the exemption threshold outweighs the reduction in cost overreporting by firms above the threshold (see panel (a) of Figure 8).[22]

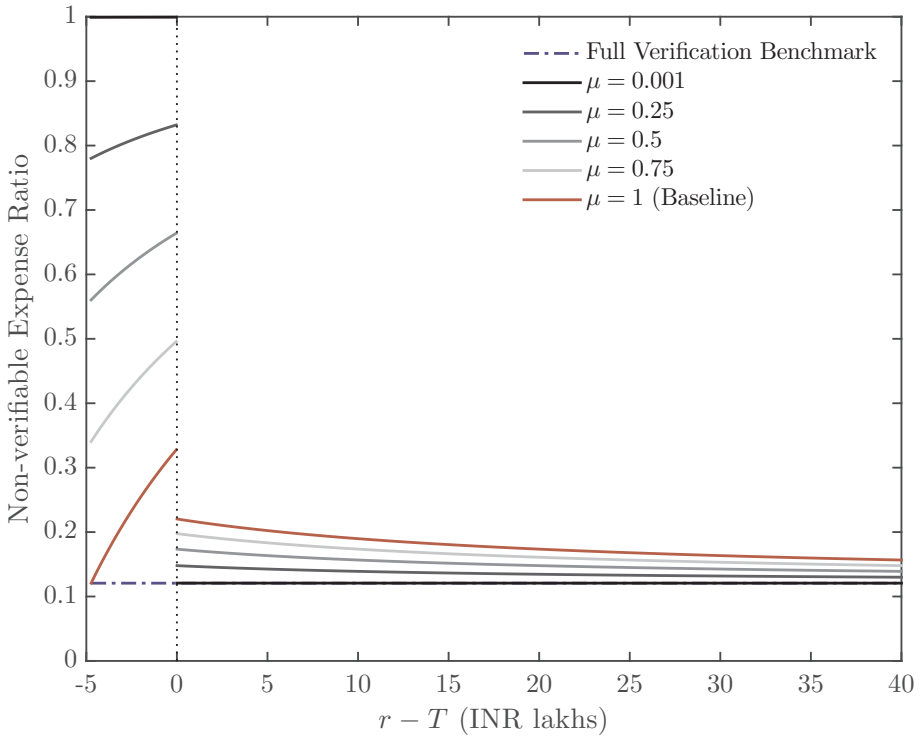


Figure 7: Effect of the Tax Deductibility of Costs on the Non-verifiable Expense Ratio

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. More specifically, Best et al. (2015) argue that in developing economies with large informal sectors, moving toward a turnover tax (by reducing the tax deductibility of costs) attenuates the marginal benefit of evasion without impacting its marginal cost, reducing cost overreporting and the tax gap. 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 exemption threshold. This upswing in aggregate evasion implies that tax revenues do not

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

rise to the same extent in our model as they would in the framework outlined in Best et al. (2015), who assume universal firm audits in their analysis.

To see this more clearly, it is helpful to define the corporate income tax gap as $\frac{\text{CTL}-\text{CTR}}{\text{CTL}}$, where $\text{CTL} = \int \tau(r - \mu(c_n + c_v))dr$ denotes the corporate tax liability, and $\text{CTR} = \int \tau(r - \mu(\hat{c}_n + c_v))dr$ denotes corporate tax revenues. Note that the tax gap is monotonically increasing in the tax deductibility of costs (μ) under universal audits.[23] In contrast, when audits are partial, as is the case in India, then the tax gap can be non-monotone in μ. This is because when μ is low enough, a marginal reduction in μ may leave cost overreporting above the tax exemption threshold virtually unchanged, while significantly increasing the level of cost overreporting below the threshold (see Figure 7). As a result, the tax gap, which depends on the aggregate level of cost overreporting, may rise as the tax deductibility of costs is reduced. This is summarized in panel (b) of Figure 8, which depicts the impact of variations in μ on the tax gap under the two auditing regimes. The figure also illustrates how the impact of μ on the tax gap depends on the shape of the revenue distribution. Note that decreasing μ amplifies cost overreporting among firms below the exemption threshold, and such firms constitute a larger proportion of the total when the revenue distribution follows a Pareto rather than a uniform distribution. Consequently, the tax gap escalates more rapidly when μ is reduced in the former case.

5.4 Counterfactual Experiment 2: 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 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.

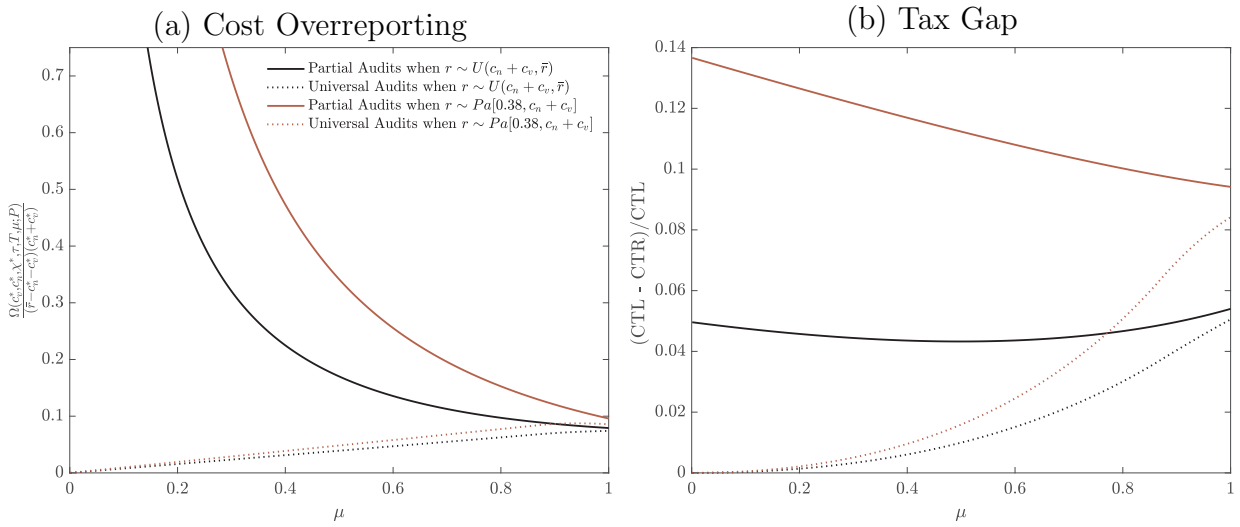
In our baseline model, corporate tax revenue (CTR) raised from firms generating revenue below $\bar{r}$ is given by $\int_0^{\bar{r}} \tau(r - \hat{c}_n - c_v)dr$. In Appendix E, we show that the elasticity of CTR with respect to enforcement intensity ($\mathcal{E}_{\text{CTR},\chi}$) can be larger or smaller than the elasticity of CTR with respect to the tax rate ($\mathcal{E}_{\text{CTR},\tau}$) depending on the value of χ and τ.[24] Specifically,

[23] As τ is non-zero, we can express the tax gap as $\frac{\int \mu(\hat{c}_n - c_n)dr}{\int (r - \mu(c_n + c_v))dr}$. Partially differentiating this expression with respect to μ:

$$\frac{\partial \text{Tax Gap}}{\partial \mu} = \frac{\int (\hat{c}_n - c_n + \mu \frac{\partial \hat{c}_n}{\partial \mu})dr}{\int (r - \mu(c_n + c_v))dr} + \frac{\int \mu(\hat{c}_n - c_n)(c_n + c_v)dr}{[\int (r - \mu(c_n + c_v))dr]^2} > 0,$$

where the last inequality holds because $\frac{\partial \hat{c}_n}{\partial \mu} > 0 \ \forall r > 0$ when audits are universal (i.e., when $T = 0$).

[24] Note that, in our model, χ parametrizes not only the penalty for evasion but also enforcement intensity.



Notes: This figure juxtaposes the impact of variations in the tax deductibility of costs (μ) on the levels of cost overreporting and the tax gap under two distinct auditing regimes: universal and partial. Under the universal audit scenario, $T = 0$. In the partial audit scenario, assumptions align with baseline conditions concerning tax exemption thresholds. These scenarios are analyzed for settings where the distribution of firm revenues is assumed to be (i) Uniform and (ii) Pareto. The Pareto distribution, characterized by a shape parameter of 0.38, is estimated using empirical data, exhibiting consistency across tax filing years pre- and post-GST implementation. The scale parameter of the Pareto distribution is determined as the minimum revenue threshold necessary for a firm to achieve non-negative profits.

Figure 8: Effect of the Tax Deductibility of Costs on the Tax Gap

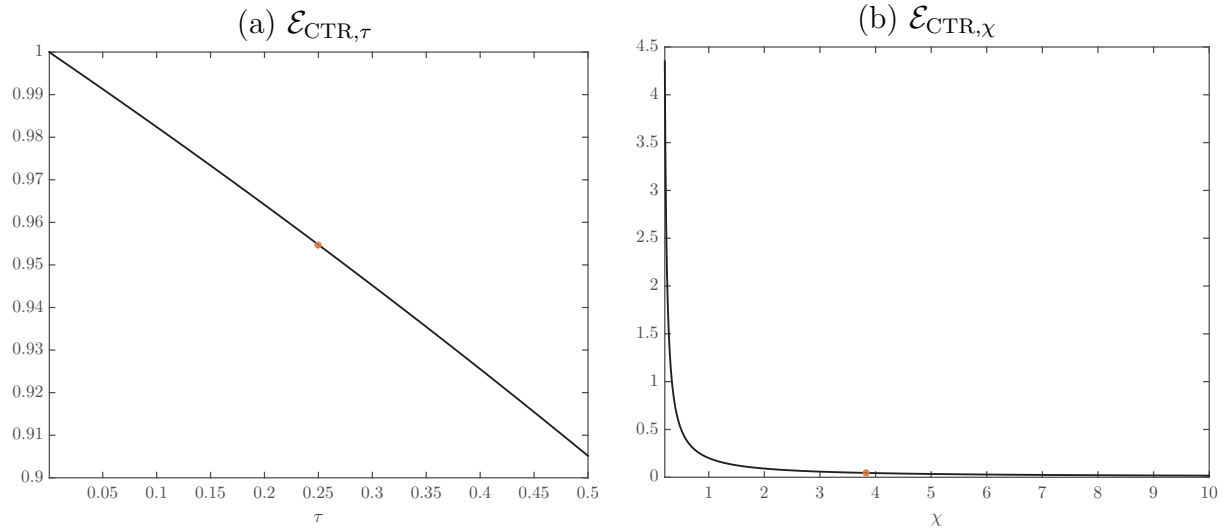
the elasticity of CTR with respect to the tax rate is given by

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

and the elasticity of CTR with respect to enforcement intensity 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 $\chi \in \left\{\frac{\tau}{\mathbb{P}(r \geq T)[(\bar{r}+T)/2 - c_n - c_v]}, \frac{2\tau}{\mathbb{P}(r \geq T)[(\bar{r}+T)/2 - c_n - c_v]}\right\}$, then $\mathcal{E}_{\text{CTR},\chi} > 1 > \mathcal{E}_{\text{CTR},\tau} > 0$. On the other hand, if χ is large enough, then $\mathcal{E}_{\text{CTR},\chi} < \mathcal{E}_{\text{CTR},\tau}$. 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 9). 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 9: Elasticities of Corporate Tax Revenue

6 Conclusion

In many developing nations, where evasion and informality limit tax capacity, low corporate tax revenues pose a significant challenge. Examining a recent change in the indirect tax regime in India—the switch from a decentralized VAT to a unified GST—this paper contributes to the literature that highlights the limitations of third-party verification in preventing corporate tax evasion in the developing world.

The GST resulted in an increase in third-party reporting by allowing businesses to claim credit for the tax paid on all inputs, 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. Leveraging these institutional changes and an administrative dataset of corporate tax returns from Indian enterprises, we show that the tax reform 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 re-

porting. 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.

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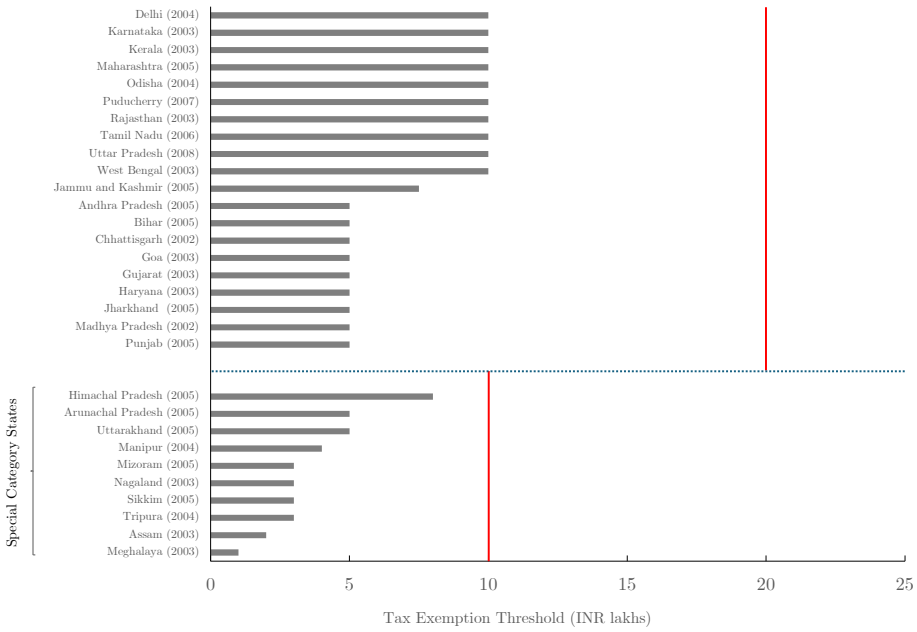
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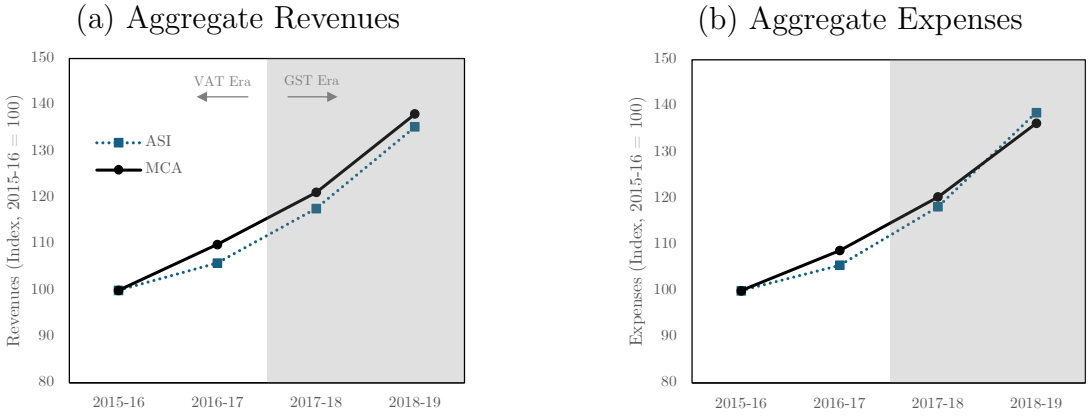
Appendix

A Omitted Figures and Tables



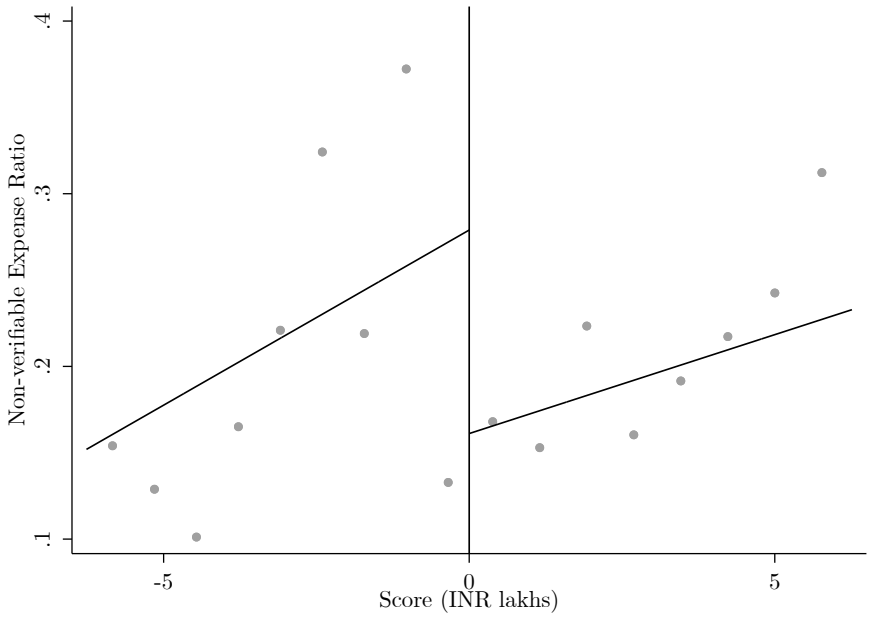
Notes: The grey bars (red lines) depict tax exemption thresholds in the VAT (GST) era. On the y-axis, we report the state and the year in which the VAT Act was passed in the respective state. In some states, amendments were passed to increase the exemption threshold after VATs had been enacted. In such cases, we report the updated exemption threshold. These states are Jammu and Kashmir (Amd. 2006), Tamil Nadu (Amd. 2007), Himachal Pradesh (Amd. 2015), Karnataka (Amd. 2015), Odisha (Amd. 2015), and West Bengal (Amd. 2015). In certain cases, exemption thresholds vary by the activity of the dealer; we report the maximum threshold across activities in such cases. These data were retrieved manually by going through the VAT acts and corresponding notifications on the state-specific Commercial Tax Department websites.

Figure A.1: Tax Exemption Thresholds: VAT vs. GST



Notes: This figure depicts the evolution of indices of the cross-sectional sum of firm revenues and expenses in the ASI and MCA datasets. The indices corresponding to the MCA dataset were created using a balanced panel of firms.

Figure A.2: Aggregate Trends in Corporate Revenues and Expenses: ASI vs. MCA



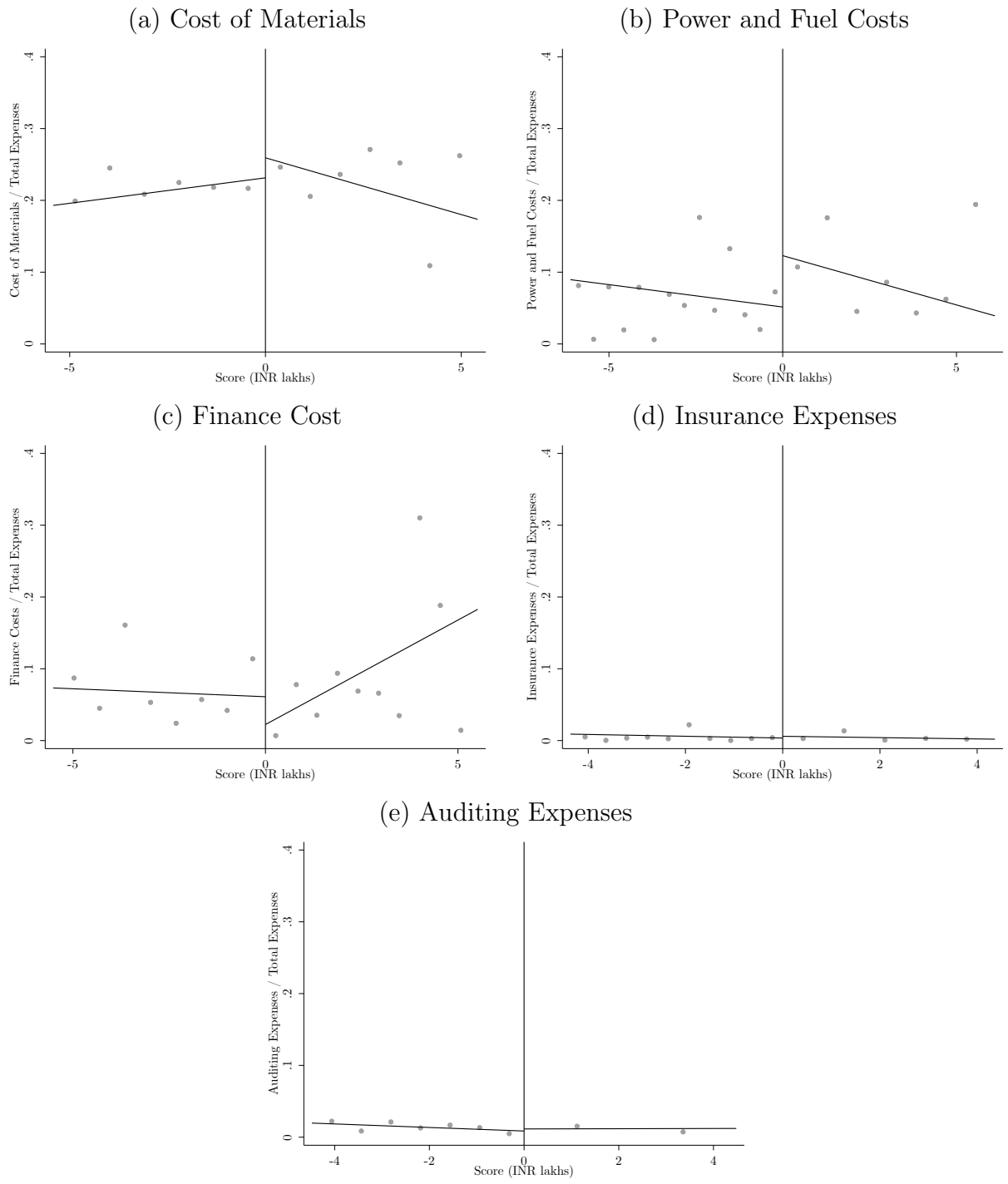
Notes: This figure depicts the negative discontinuity in the non-verifiable expense ratio at the tax exemption thresholds. We apply a triangular weighting kernel in distance from the threshold and a linear polynomial estimated on either side of the cutoff over MSE-optimal bandwidths as per the procedure outlined in Calonico et al. (2014). Outliers above (below) the 95th (5th) percentile of the numerator (i.e., wages) and the denominator (i.e., total expenses) are discarded. Expense ratios above (below) 1 (0) are discarded. See Table 2 for the corresponding statistical tests.

Figure A.3: Effect of Tax Exemption Thresholds on Non-verifiable Expense Ratio

Table A.1: Alternative RD Specifications

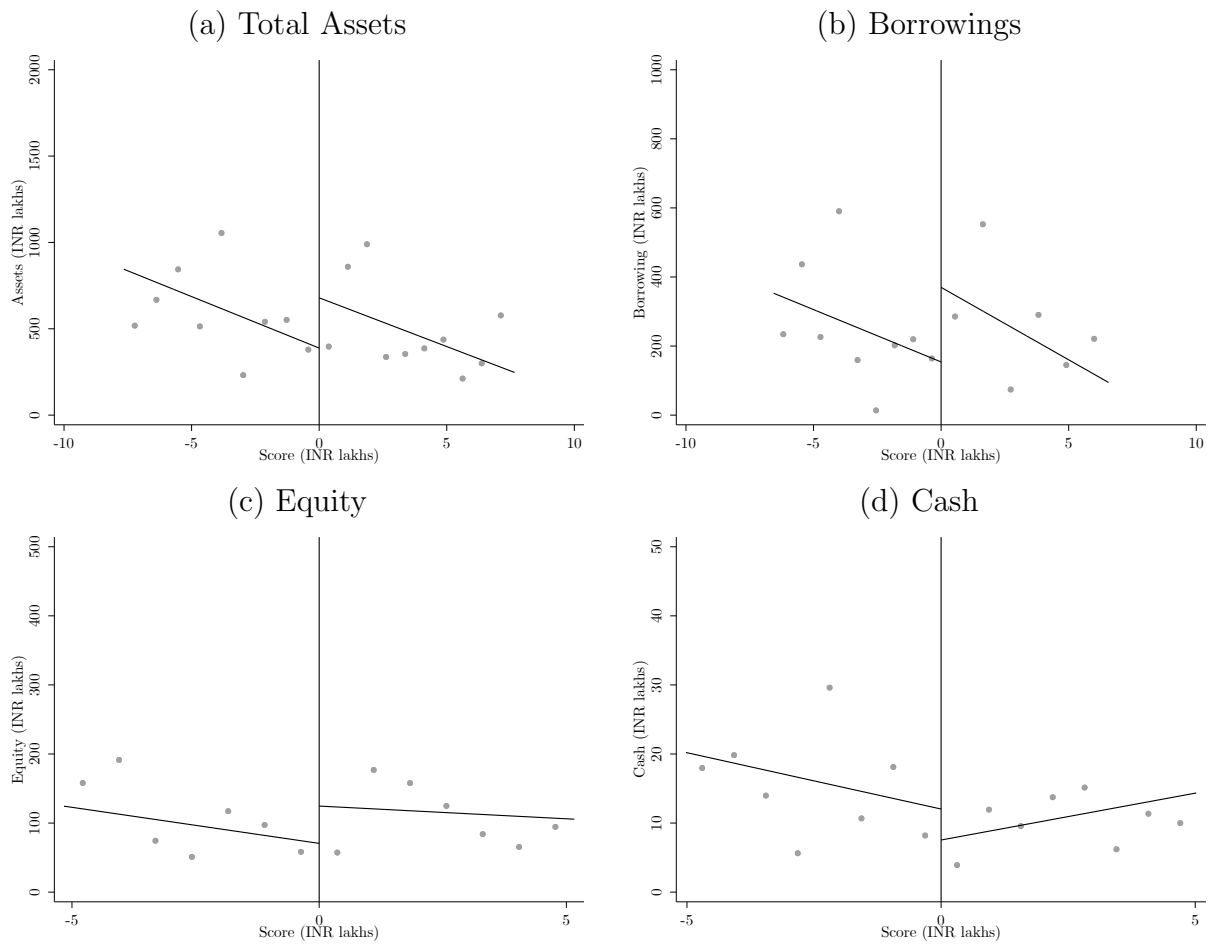
Kernel function	Triangular	Epanechnikov	Uniform
h_{MSE}	-0.118**	-0.116*	-0.109*
	(0.054)	(0.057)	(0.060)
$h_{MSE} \times 1.5$	-0.097**	-0.092**	-0.048***
	(0.044)	(0.043)	(0.041)

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



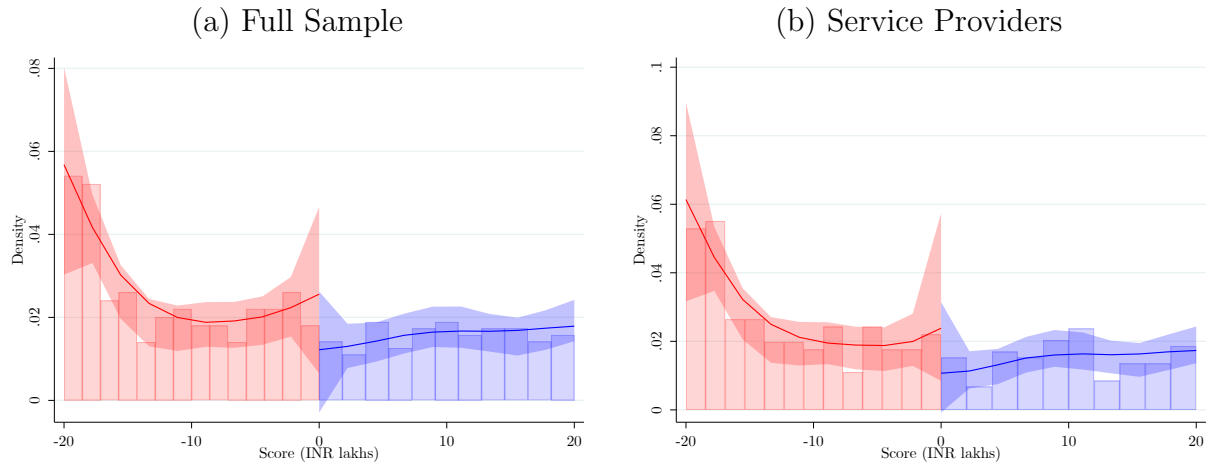
Notes: These figures depict that there is no statistically significant discontinuity in the ratio of specific verifiable expenses to total (verifiable) expenses. We apply a triangular weighting kernel in distance from the threshold and a linear polynomial estimated on either side of the cutoff over MSE-optimal bandwidths as per the procedure outlined in Calonico et al. (2014). The data is segmented into 10 bins on either side of the cutoff. 95 percent confidence intervals (for each bin) are shaded. Expense ratios above (below) 1 (0) are discarded. See Table 4 for the corresponding statistical tests.

Figure A.4: Placebo Tests: Effect of Exemption Thresholds on Verifiable Expense Ratios



Notes: These figures inspect control variables at the discontinuity. We apply a triangular weighting kernel in distance from the threshold and a linear polynomial estimated on either side of the cutoff over MSE-optimal bandwidths as per the procedure outlined in Calonico et al. (2014). The data is segmented into 10 bins on either side of the cutoff. 95 percent confidence intervals (for each bin) are shaded. In each panel, outliers above (below) the 95th (5th) percentile of the relevant outcome variable are discarded. See Table 5 for the corresponding statistical tests.

Figure A.5: Balance on Covariates



Notes: These figures depict the density of the running variable in our RD analysis for the year following GST implementation (i.e., 2018). In panel (a), we use the full sample, while in panel (b), we focus on the subsample of service providers. For manipulation testing, we employ a local polynomial density estimate (solid blue and red lines) and robust bias-corrected confidence intervals (shaded blue and red areas), following the procedure described in Cattaneo et al. (2020).

Figure A.6: Estimated Density of Running Variable

Table A.2: Time Pattern of RD Estimates conditional on Factor Intensity

Sample period	Post-GST		Pre-GST	
Sample of firms	Service providers	Non-service providers	Service providers	Non-service providers
	(1)	(2)	(3)	(4)
RD estimate	-0.198**	0.498	-0.047	-0.088
	(0.087)	(0.551)	(0.104)	(0.234)
	[295]	[58]	[377]	[74]

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 follow the method of Calonico et al. (2014). 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. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

B Additional Institutional Details on the GST

Before GST, the indirect tax structure in India was balkanized, with a plethora of state and central taxes that created a complex and often inefficient system. The VAT was a significant part of this structure, levied at the state level and playing a crucial role in the revenue generation of states.[25] However, VAT had its limitations, including a narrow tax base, cascading taxes, and substantial administrative burdens. The GST was introduced to address these limitations and create a unified market across the nation. The rationale behind GST was multifaceted. Primarily, it was intended to create a single national market, which would reduce the cost of goods and services and spur economic growth. Secondly, by subsuming various indirect taxes into one, GST sought to simplify the tax administration and increase compliance.

B.1 Integration of Indirect Taxation

The theoretical foundations of VAT and GST are rooted in the principles of efficient tax collection and minimal market distortion. VAT, a type of indirect tax, was designed to be levied at each stage of the production and distribution process. It was based on the principle of taxing the value added at each stage, allowing for input tax credits, which reduces the cascading effect of taxes. However, VAT in India was applied inconsistently across states, leading to disparities and complexities in the tax regime.

The most significant shift in GST, compared to VAT, is its uniform application across all Indian states and territories. This uniformity is aimed at creating a seamless national market, reducing tax-induced market distortions, and enhancing competition. Under VAT, each state in India could levy tax at varying rates. GST, in contrast, introduced a uniform tax rate across the country with five primary slabs: 0%, 5%, 12%, 18%, and 28%.[26,27] This unification of tax rates under GST simplifies the tax regime, making it easier for businesses to comply and for the government to administer.

[25] Before the VAT, the sales tax levied on manufacturing and agricultural goods was the primary source of tax revenue for the Indian state governments. However, the sales tax in India was subject to multipoint levies, creating sizeable distortions in the economy. In the early 2000s, the central government provided detailed guidelines for states to harmonize their tax schedules and to implement a VAT. The VAT was implemented in a staggered fashion across Indian states between 2003 and 2008.

[26] There is a special rate of 0.25% on rough precious and semi-precious stones and 3% on gold. In addition, a cess of 15% or other rates on top of 28% GST applies on few items like aerated drinks, luxury cars, and tobacco products.

[27] The GST's tiered rate structure was aimed at minimizing inflationary pressures while ensuring revenue neutrality. The multiplicity of rates under GST serves the purpose of taxing goods and services based on their essentiality. Essential goods are taxed at lower rates or exempted to protect the lower-income segments from price hikes. This progressive approach was somewhat reflected in the previous commodity tax regimes as well where goods considered to be necessities were mostly exempt from sales tax or subject to lower tax rates than other products and luxuries (Purohit, 2001).

Table B.1: Central and State Taxes Subsumed by GST

CENTRAL TAXES	Rate
1. Central Value Added Tax (CENVAT) or Central Excise duty Tax levied on the production of manufacturing goods.	12.36%
2. Service Tax Tax levied on provided services.	15%
3. Central Sales Tax (CST) Tax on cross-state trade.	2%
4. Countervailing Duties (CVD) Additional import duty on imported goods produced in India to 'level the playing field' between domestic and foreign producers. Additional CVDs might be applied to offset the effect of concessions and subsidies granted by an exporting country to its exporters.	12.36%
5. Special Additional Duty of Customs (SAD) Additional import duty to counterbalance the sales or value added tax payable by local manufacturers.	4%
STATE TAXES	**Rate Range**
1. Value Added Tax (VAT) Tax levied on the production of manufacturing goods.	10%-14.5%
2. Sales Tax Additional tax levied on the production of manufacturing goods. It was replaced in most states by VAT, but not all.	0%-15%
3. Entry Tax Tax on the entry of goods for consumption, use or sale in that state.	0%-12.5%
4. Luxury Tax Tax on luxury goods and services that include hotels, resorts, and congregational halls used for weddings, conferences, etc.	3%-20%
5. Entertainment Tax Tax on feature films, major commercial shows and private festivals.	15%-50%

Source: Van Leemput and Wiencek (2017)

In addition to state-specific VATs, there were various taxes being levied by central and state governments in the previous commodity tax regime. Taxes imposed by the central government included a central excise duty/CENVAT on the manufacture of goods, a service tax on the provision of services, customs duties on imports of goods, a CST on the sale of goods, as well as other surcharges and cesses (such as Swachh Bharat Cess and Krishi Kalyan Cess). State governments imposed not only VATs but also an Entry Tax/Octroi on goods entering from outside municipal limits as well as other taxes and duties (such as the Luxury Tax and Entertainment Tax). The GST subsumed all these taxes, simplifying the tax structure significantly (see Table B.1).[28]

[28]Taxes that have not been subsumed under GST include the Basic Customs Duty (BCD), cess on the import of goods into India, and Stamp Duty on registration of immovable property and legal instruments. Further, GST has not yet replaced existing taxes on electricity, petroleum products, and alcoholic liquor for human consumption.

B.2 Broadening the Tax Base

By including both goods and services under its purview, GST expands the tax base significantly compared to the VAT regime, which predominantly focused on goods. Atkinson and Stiglitz (1976), Laroque (2005), and Kaplow (2006) show that, under weak separability of utility between labor and all consumption goods, differential commodity taxation is a suboptimal way of raising revenue in the presence of direct tax instruments. GST brought several goods under the tax regime that were previously exempt or taxed at lower rates under the Value Added Tax (VAT) system, leading to a more equitable and efficient taxation landscape. Although certain petroleum products like petrol and diesel are still not under the ambit of GST, the inclusion of other petroleum products like kerosene, naphtha, and liquefied petroleum gas (LPG) under GST has helped in creating a more unified commodity tax regime.

The GST may have also induced businesses that previously operated in the informal sector to transition into the formal sector. This shift is primarily motivated by the need to comply with the new tax system to take advantage of the additional ITCs offered under GST. ITCs incentivize businesses to purchase inputs from formal suppliers in order to refund the taxes paid on inputs. This, in turn, creates an incentive for the suppliers to register for GST in order to retain their formal customers. In this manner, a significant portion of economic activity that was previously untaxed or under-taxed can be brought into the formal tax net, thus expanding the tax base.

B.3 Cascading Effect of Taxes

One of the most significant advantages of GST over VAT is its ability to reduce the cascading effect of taxes. Diamond and Mirrlees (1971) argue that production efficiency requires that producers should all face the same relative input prices before and after taxes. However, taxes were being levied on several intermediate goods without any input credits in the previous indirect tax regimes, lowering efficiency (Chelliah and Committee, 1992; Hoseini and Briand, 2020; Agrawal and Zimmermann, 2022). Not only were companies paying taxes at different production stages, but they were also being taxed separately by various government authorities, which often led to double taxation (Bagchi et al., 1994).

The introduction of CENVAT did remove the cascading burden of taxes to some extent by providing a mechanism of set-offs for tax paid on inputs and services up to the stage of production, improving upon the pre-CENVAT central excise duty. However, the CENVAT did not extend input credits to the chain of value additions in the distributive trade below the stage of production. Further, it did not include several central taxes (such as additional excise duties, additional customs duties, and surcharges) in its overall framework. GST,

with its comprehensive input tax credit system, addresses these issues effectively. It allows businesses to claim credit for the tax paid on all inputs, thereby reducing the cascading effect of taxes.

B.4 Interstate Trade and Financial Flows

The GST regime has significantly altered the landscape of interstate trade in India. Under the VAT system, the CST was levied on goods sold from one state to another, which did not allow for input tax credit. With the introduction of GST, this barrier was removed. The Integrated GST (IGST) model under GST ensures that tax is collected by the central government but shared with the state where the goods or services are consumed.[29] The IGST mechanism under GST enables full credit for the taxes paid across states. This is expected to foster a more competitive market, increase economies of scale, and enhance the overall efficiency of the Indian economy.

Additionally, the concept of destination-based taxation under GST ensures that the tax revenue accrues to the location where the goods or services are consumed, rather than where they are produced. This is a pivotal change from the VAT system, which was origin-based. This shift has profound implications for states that are primarily consumers rather than producers, potentially altering the dynamics of inter-state financial flows.

B.5 Fiscal Federalism and Revenue Sharing

Previously, under the VAT regime, states had significant autonomy in setting tax rates, exemptions, and thresholds on intra-state sales. This allowed each state space to tailor its commodity tax policies to local economic conditions and priorities. The central government, on the other hand, managed its own set of taxes on inter-state sales of goods, contributing to a segmented tax system. GST amalgamated various central and state levies into a single tax, bringing about a dual system where both the central and state governments have the authority to tax a common base. This unification of indirect taxes across the nation significantly changed the revenue collection and management process. It implied a dilution in the fiscal autonomy of individual states, as they no longer held the power to independently alter tax rates or introduce new state-specific taxes.[30]

[29]The power to levy GST is derived from Article 246A of the Constitution which confers concurrent powers to both Parliament and State Legislatures to make laws with respect to GST. However, clause 2 of Article 246A read with Article 269A provides exclusive power to the Parliament to legislate with respect to inter-state trade or commerce.

[30]The GST Council emerged as the cornerstone of this new fiscal framework. Comprising representatives from the central government and all state governments, the Council is tasked with making critical decisions regarding GST. This includes determining: (a) taxes, surcharges, and cess; (b) goods and services to be exempted from GST; (c) IGST distribution between state and central governments; (d) registration thresholds; (e) floor rates; (f) calamities special rates; (g) provision with regard to special category rates. The consensus-

Another key aspect of this transition is the revenue sharing and compensation mechanism under GST. A formula for revenue sharing between the central and state governments was established to ensure a fair distribution of tax revenues. Moreover, to address concerns about potential revenue losses for states due to the shift to GST, a compensation mechanism was introduced. This mechanism, funded through a cess on specific luxury and demerit goods, is intended to offset revenue shortfalls for states during the initial years of GST implementation.

C Computing Out-of-state Input Procurement Ratios

We make the following set of assumptions to calculate out-of-state input procurement ratios:

1. We exclude fuel inputs from the calculation because they do not come under the purview of GST.

2. We exclude items classified as "others" in the ASI as they cannot be mapped to standardized product classifications.

3. For firms supplying multiple products, we assume that all recorded inputs are used to generate a specific product in proportion to the respective product's share of total output.

   For example, the following are the outputs created by a manufacturing unit (code 100110):

HS Section (Output)	Value of Output (INR Mn)	Share of Value (%)
7	9.6	21%
11	19.8	43%
15	1.5	3%
20	15.5	33%
Total	46.4	100%

   In addition, the following are the inputs consumed by the same manufacturing unit:

HS Section (Input)	Value of Input (INR Mn)	Share of Value (%)
7	5.4	14%
9	5.2	14%
11	20.5	53%
15	7.5	20%
Total	38.7	100%

based decision-making process within the GST Council is designed to strike a balance between maintaining a uniform tax policy across the nation and respecting the fiscal needs and autonomy of individual states.

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. So, for these firms, our assumption is that all inputs are used to generate a given output. Moreover, we assume that the value of inputs consumed to create an output is divided in proportion to the respective product's share of the firm's total output. In our example:

HS Section (Output)	Value of Output	Share of Output (%)	HS Section (Inputs)	Total Value of Inputs Consumed	Input Required to Create Output
7	9.6	21%	7	5.4	1.1
7	9.6	21%	9	5.2	1.1
7	9.6	21%	11	20.5	4.2
7	9.6	21%	15	7.5	1.6
11	19.8	43%	7	5.4	2.3
11	19.8	43%	9	5.2	2.2
11	19.8	43%	11	20.5	8.7
11	19.8	43%	15	7.5	3.2
15	1.5	3%	7	5.4	0.2
15	1.5	3%	9	5.2	0.2
15	1.5	3%	11	20.5	0.7
15	1.5	3%	15	7.5	0.2
20	15.5	33%	7	5.4	1.8
20	15.5	33%	9	5.2	1.8
20	15.5	33%	11	20.5	6.8
20	15.5	33%	15	7.5	2.5

4. 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. More specifically,

$$\text{In-state Procurement in Industry } i = \min\left(\frac{\text{State Output in Industry } i}{\text{Input Consumption in Industry } i}, 1\right).$$

The following table illustrates this for a specific state in our example:

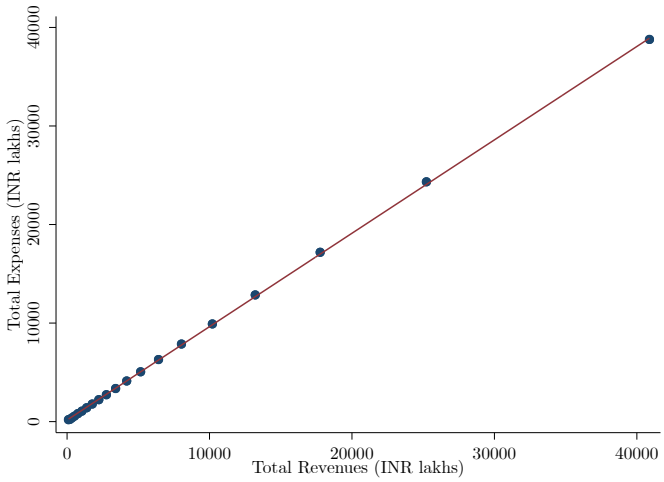
State Code	HS Section	State Output (INR Bn)	Input Consumption (INR Bn)	In-State Procurement (%)
1	1	1.8	1.8	99%
1	2	12.3	14.5	85%
1	3	3.8	1.8	100%
1	4	14.2	3.9	100%
1	5	15.5	11.9	100%
1	6	84.3	39.7	100%
1	7	10.2	11.2	91%
1	8	0.2	0.2	100%
1	9	0.2	0.7	30%
1	10	11.1	2	100%

We then compute out-of-state procurement ratios across industries (as per HS section classification). Specfically, $\forall i \in$ HS Sections:

$$\text{Out-of-state Procurement in Industry } i = 1 - \text{In-state Procurement in Industry } i.$$

D Endogenous Cost Structure

In the data, expenses are highly correlated with revenues; see Figure D.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 D.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 D.2.

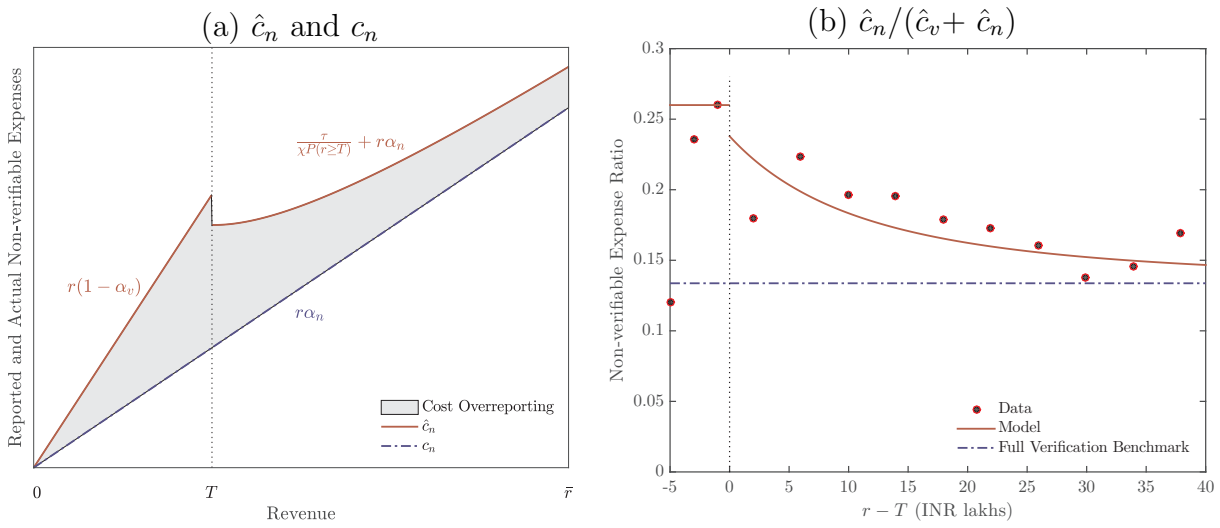


Figure D.2: Estimating the Level of Cost Overreporting under Endogenous Cost Structure

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 D.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.

E Elasticities of CTR with respect to τ and χ

Since firms earning negative profits exit the market, we can decompose CTR 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 CTR as

$$\begin{aligned}
\text{CTR} &= \int_{T}^{\bar{r}} \tau(r - \tau/(\mathbb{P}(r \geq T)\chi) - c^n - c^v)dr \\
&= \tau(\bar{r}^2/2 - \bar{r}(\tau/(\mathbb{P}(r \geq T)\chi) + c^n + c^v) - \{T^2/2 - T(\tau/(\mathbb{P}(r \geq T)\chi) + c^n + c^v)\}) \\
&= \tau((\bar{r}^2 - T^2)/2 - (\bar{r} - T)(\tau/(\mathbb{P}(r \geq T)\chi) + c^n + c^v)) \\
&= \tau((\bar{r} - T)(\bar{r} + T)/2 - (\bar{r} - T)(\tau/(\mathbb{P}(r \geq T)\chi) + c^n + c^v)) \\
&= \tau(\bar{r} - T)[(\bar{r} + T)/2 - (\tau/(\mathbb{P}(r \geq T)\chi) + c^n + c^v)] \\
&= \tau(\bar{r} - T)\left[\frac{\bar{r} + T}{2} - \left(\frac{\tau}{\mathbb{P}(r \geq T)\chi} + c_n + c_v\right)\right].
\end{aligned}$$

Thus, the elasticity of CTR with respect to τ is given by

$$\mathcal{E}_{\text{CTR},\tau} = \frac{\partial \text{CTR}}{\partial \tau} \times \frac{\tau}{\text{CTR}}.$$

Note that

$$\frac{\partial \text{CTR}}{\partial \tau} = (\bar{r} - T)[(\bar{r} + T)/2 - (\tau/(\mathbb{P}(r \geq T)\chi) + c^n + c^v)] - \tau(\bar{r} - T)/(\mathbb{P}(r \geq T)\chi)$$

or

$$\frac{\partial \text{CTR}}{\partial \tau} = \tau(\bar{r} - T)[(\bar{r} + T)/2 - 2\tau/(\mathbb{P}(r \geq T)\chi) - c^n - c^v].$$

Thus

$$\begin{aligned}
\mathcal{E}_{\text{CTR},\tau} = \tau(\bar{r} - T)[(\bar{r} + T)/2 - 2\tau/(\mathbb{P}(r \geq T)\chi) - c^n - c^v] \\
\times \frac{\tau}{\tau(\bar{r} - T)[(\bar{r} + T)/2 - (\tau/(\mathbb{P}(r \geq T)\chi) + c^n + c^v)]}.
\end{aligned}$$

Canceling τ and $(\bar{r} - T)$ from the numerator and denominator:

$$\mathcal{E}_{\text{CTR},\tau} = \frac{\tau[(\bar{r} + T)/2 - 2\tau/(\mathbb{P}(r \geq T)\chi) - c^n - c^v]}{(\bar{r} + T)/2 - \tau/(\mathbb{P}(r \geq T)\chi) - c^n - c^v}.$$

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.

Moreover, 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

$$\mathcal{E}_{\mathrm{CTR},\chi} = \frac{\partial \mathrm{CTR}}{\partial \chi} \times \frac{\chi}{\mathrm{CTR}}.$$

Note that

$$\frac{\partial \mathrm{CTR}}{\partial \chi} = \tau^2(\bar{r} - T)/(\chi^2 \mathbb{P}(r \geq T)).$$

Thus

$$\mathcal{E}_{\mathrm{CTR},\chi} = \frac{\tau^2(\bar{r} - T)}{\chi^2 P} \times \frac{\chi}{\tau(\bar{r} - T)[(\bar{r} + T)/2 - (\tau/(\mathbb{P}(r \geq T)\chi) + c^n + c^v)]}.$$

Cancelling χ, τ and $(\bar{r} - T)$ from the numerator and the denominator:

$$\mathcal{E}_{\mathrm{CTR},\chi} = \frac{\tau}{[(\bar{r} + T)/2 - c^n - c^v]\chi \mathbb{P}(r \geq T) - \tau}.$$

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

Thus, 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

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

On the other hand, if χ is large enough, then $\mathcal{E}_{\mathrm{CTR},\chi} < \mathcal{E}_{\mathrm{CTR},\tau}$. To see this, note that $\mathcal{E}_{\mathrm{CTR},\chi}$ and $\mathcal{E}_{\mathrm{CTR},\tau}$ are continuous in χ, $\lim_{\chi \to \infty} \mathcal{E}_{\mathrm{CTR},\chi} = 0$ and $\lim_{\chi \to \infty} \mathcal{E}_{\mathrm{CTR},\tau} = \tau$.