

Taxation and Supplier Networks: Evidence from India*

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Abstract

Do tax systems distort firm-to-firm trade? This paper considers the effect of tax policy on supplier networks in a large developing economy, the state of West Bengal in India. Using administrative panel data on firms including transaction data for 4.8 million supplier-client pairs, we first document substantial segmentation of supply chains between firms paying Value-Added Taxes (VAT) and non-VAT-paying firms. We then develop a model of firms' sourcing and tax decisions within supply chains to understand the mechanisms through which tax policy interacts with supply networks. The model predicts equilibrium (partial) segmentation because of both supply-chain distortions (taxes affect how much firms trade with each other) and strategic complementarities in firms' tax choices. Finally, we test the model's predictions using variations over time within-firm and within supplier-client pairs. We find that the tax system distorts firms' sourcing decisions, and suggestive evidence of strategic complementarities in firms' tax choices within supplier networks.

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1 Introduction

Intra-national trade costs are large in developing countries and gains from better integration of supply chains within these countries are potentially substantial (WTO, 2004). Whilst the existing literature on the topic has mostly focused on geography as a determinant of trade costs (see for example Atkin and Donaldson, 2015), tax policy can also play a role because most tax systems alter the incentives agents have to trade with each other. This is true in particular of the Value-Added Tax (VAT), one of the largest source of revenues in developing countries (Bird and Gendron, 2007; Gordon and Li, 2009), as only VAT-paying firms can deduct VAT paid on their purchases from their tax liabilities. The tax system thus potentially distorts firm-to-firm trade in markets where VAT and non-VAT-paying firms co-exist – a pervasive feature of developing countries – leading to segmentation of supplier networks by tax status.

This paper considers how the VAT affects firms’ sourcing decisions and in turn how firms’ supplier networks determine their tax decisions in the context of a large developing economy. We build a model of firms’ sourcing and tax decisions to understand the mechanisms through which tax policy interacts with supplier networks. We then test the predictions of our model using a rich panel dataset on firm-to-firm transactions for the state of West Bengal in India. We find both that the tax system distorts trade and that there are strategic complementarities in firms’ tax decisions within supplier networks.

Our first contribution is to document the segmentation of supplier networks between firms with different tax status (VAT-paying and non-VAT-paying firms) in our context. A key constraint faced by the literature on intra-national trade is that domestic trade flows are hard to characterize because firm-to-firm trade is rarely observed¹; similarly administrative tax data typically does not contain information on agents with different tax status. We overcome both these observational challenges by using administrative tax data on the universe of the 180,000 firms paying taxes in West Bengal for the period 2010-2016, and two particularities of our context. First, we observe both VAT-paying and non-VAT-paying firms because firms below a size threshold can opt for a non-VAT ‘simplified’ tax status, under which they pay a small tax on their sales but cannot deduct VAT paid on their purchases from their tax liabilities (14% of firms choose this simplified scheme, all others pay VAT). Second, we observe trade between 4.8 million annual client-supplier pairs, because VAT-

¹Exceptions include Atalay et al. (2011); Bernard et al. (2015); Carvalho et al. (2016); Tintelnot et al. (2018) who use firm-to-firm trade data for the US, Japan and Belgium. We discuss our contribution to this literature below.

paying firms report transactions with other tax-registered firms. This allows us to map supplier networks by matching clients' and suppliers' tax identifiers.²

We find that VAT-paying firms are substantially more likely than non-VAT-paying firms to trade with other VAT-paying firms. The correlation between firms' tax status and how much they buy from, or sell to, VAT-paying firms is large and robust to controlling for detailed location and industry characteristics and holds for firms of all sizes. VAT-paying firms on average sell 13% more to VAT clients, and buy 9% more from VAT suppliers, all else equal, than non-VAT-paying firms, in line with the idea that the VAT system leads to partial segmentation of supplier networks by tax status.

Our second contribution lies in a model that clarifies the mechanisms leading to the supply chain segmentation we observe. Our model is a bi-partite application of models of supplier networks (see for example [Tintelnot et al., 2018](#)), augmented to include a tax status choice decision – whether or not to pay VAT. Our set-up is one in which firms at two stages in supply chains simultaneously take tax and sourcing decisions under monopolistic competition. Our main result is that under a VAT system there is partial market segmentation by tax status in equilibrium, for two reasons. First, the VAT's incentive structure leads to *supply-chain distortions*: all else equal a VAT-paying firm buys a higher share of its inputs from VAT-paying suppliers than a non-VAT-paying one does. This mechanism implies that the VAT decreases trade between firms with different tax status, even in a world where firms' tax status are exogenously given. Endogenising firms' tax status choices introduces a second mechanism, *strategic complementarities in tax decisions*: firms are more likely to choose to pay VAT the more VAT-paying suppliers and clients they have.

Finally, our third contribution is to provide empirical evidence on the mechanisms defined in our model. We first estimate the causal effect of taxes on firm-to-firm trade (supply chain distortions) and then the causal effect of the tax decisions of a firm's trading partners on its own tax decisions (strategic complementarities). Our identification of supply chain distortions relies on using transaction level data and within supplier-client pairs variations in trade over time. We find that firms buy 14% more on average from VAT-paying suppliers when they themselves choose to pay VAT. Our estimates imply a trade elasticity between 4 and 7, in the range of estimates obtained in the international trade literature ([Caliendo and Parro, 2015](#); [Bartelme et al., 2018](#)).

To identify strategic complementarities in firms' tax status decision we use within-firm

²[Alfaro-Urea et al. \(2018\)](#) use similar administrative data on firm-to-firm transactions for Costa Rica to consider the effect of joining multinational supply chains on firm productivity.

changes over time in the share of sales (inputs) that firms can sell to VAT-paying clients (purchase from VAT-paying suppliers) that are due to the entry and exit of VAT-paying trading partners. We find evidence consistent with strategic complementarities in tax status choice: our estimates imply that forcing all of a firm's trading partners to pay the VAT would increase that firm's propensity to pay the VAT by 5-8 percentage points compared to a situation where none of the firm's trading partners pay VAT. These results are robust to controlling for location- and product- specific shocks that could explain both firm entry and changes in tax status choice, and to restricting the sample to firms that are small relative to the threshold above which they have to be in the VAT scheme. The magnitude of the effects imply that strategic complementarities explain a non-trivial share of the supply chain segmentation by tax status that we observe.

A large literature has considered how taxes (tariffs) affect international trade flows (see [Goldberg and Pavcnik, 2016](#), for a review), but to the best of our knowledge this paper is the first to consider the role played by the tax system in shaping intra-national firm-to-firm trade. Our results more generally contribute to the recent literature that considers the role of intra-national trade costs ([Agnosteva et al., 2014](#); [Atkin and Donaldson, 2015](#); [Cosar and Fajgelbaum, 2016](#); [Fajgelbaum and Redding, 2018](#)) by showing how the tax system affects these costs and distorts firm-to-firm trade. This paper also speaks to the large literature on firms in developing countries that studies the role of market frictions in the formation of client-supplier relationships, and finds that enforcement and information constraints loom large in this context ([McMillan and Woodruff, 1999](#); [Banerjee and Duflo, 2000](#); [Allen, 2014](#); [Macchiavello and Morjaria, 2015](#)). Unlike much of this literature, which studies relationships between multinational companies and their suppliers in developing countries, we focus on within-country trading relationships. We find that whilst frictions may also be substantial in our context they do not lead to a low willingness of firms to substitute across suppliers in response to changes in input costs.

This paper similarly contributes to the growing literature on supplier networks that leverages new datasets on firm-to-firm transactions to characterize the determinants of supplier networks and the propagation of shocks within these networks ([Atalay et al., 2011](#); [Bernard et al., 2015](#); [Acemoglu et al., 2016](#); [Carvalho et al., 2016](#); [Bernard and Moxnes, 2018](#); [Tintelnot et al., 2018](#); [di Giovanni et al., 2018](#)). Using data for India we contribute to this literature in two ways. First, we consider theoretically, and provide empirical evidence on, the role of the tax system in shaping supplier networks. Second, we show that firms' decisions are linked within these networks through strategic complementarities in tax choices. Our

results imply that shocks to the tax system will propagate through supplier networks: an enforcement policy that induces some firms to start paying VAT will have multiplier effects as others in these firms' supply chains will also start paying VAT.

Our results also contribute to the literature on public finance in developing countries that asks how the particular context of these countries changes tax policy trade-offs (Emran and Stiglitz, 2005; Boadway and Sato, 2009; Best et al., 2015; Bachas and Soto, 2017; Carrillo et al., 2017; Gerard and Gonzaga, 2017; Cage and Gadenne, 2018; Jensen, 2019): we focus on how the VAT affects supply chains when VAT-paying and non-VAT-paying firms co-exist within markets, a pervasive feature of the developing country context. The literature on the VAT typically argue this tax is well-suited to contexts in which compliance is low, because it generates a third-party reported trail on transactions between firms (Pomeranz, 2015; Naritomi, 2018). Our innovation is to show that this compliance advantage must be weighted against the efficiency cost created by our supply chain distortions mechanism, and provide empirical evidence regarding the magnitude of these tax-induced distortions.³

The idea of strategic complementarities in VAT tax choices was first introduced by De Paula and Scheinkman (2010); we build on their work by incorporating tax decisions in a supplier network model and providing causal evidence of the existence of these complementarities.⁴

Finally, this paper speaks to the large literature that considers misallocation of factors of production across firms in developing countries (see Hopenhayn, 2014, for a review). Banerjee and Duflo (2005) and Hsieh and Klenow (2009) provide evidence of substantial misallocation across firms in developing countries relative to rich countries (see also Brandt et al., 2013; Khwaja and Mian, 2005; Boehm and Oberfield, 2018). This literature often discusses government regulation as a likely cause of misallocation but this paper is the first to provide causal evidence on the role of taxes in distorting input markets, potentially leading to misallocation of inputs across firms. Our evidence on supply chain segmentation more generally suggests that misallocation within supply chains may contribute to lower productivity levels in developing countries; our results indicate that part of this misallocation may be due to tax policy.

The paper is organized as follows. Section 2 describes our context of study and data and provides descriptive evidence on segmentation of supplier networks. Section 3 develops a two production stages model of firm sourcing and tax status decisions. Section 4 discusses

³In an independently developed project Gerard et al. (2018) study a similar question in the context of the state of Sao Paulo, Brazil.

⁴Evidence of complementarities in tax choices is also found in Almunia et al. (2016) who show that higher input use increases the probability that firms choose to voluntarily register to the VAT in the UK.

the empirical strategy used to provide causal evidence on the model's mechanisms, and section 5 presents our results.

2 Context and data

2.1 Institutional background

Our context of study is West Bengal, a large state in the East of India with 90 million inhabitants which accounts for 7% of the country's GDP; our period of study is 2010-2016. The main source of revenues at the state level is the value-added-tax (VAT). All firms with a turnover of more than 500,000 INR (7,100 USD) are required to pay taxes to the state. Firms with a turnover of less than 5 million INR (70% of tax-registered firms) can opt to pay taxes under a 'simplified' tax scheme under which they only pay a 0.025% tax on their total sales. Importantly for the purpose of this paper, firms in the simplified scheme cannot deduct taxes paid on their inputs from their tax liabilities. All other firms must pay the VAT, and can deduct VAT paid on their inputs from their tax liabilities, but not taxes paid by their suppliers in the simplified tax scheme. Firms pay different VAT rates depending on the goods they sell: 75% of them sell goods belonging to the 'reduced' tax schedule and taxed at 4% , 21% sell goods in the 'main' tax schedule taxed at 12.5%, whilst the remainder of firms pay super-reduced rates of 0% or 1%. In fiscal year 2014 the VAT rates of the main and reduced schedules increased by 1 percentage point.

2.2 Data

2.2.1 Firm-level data

We use administrative data on firm-level tax returns and tax registration information from the Directorate for Commercial Taxes of the state of West Bengal, India, for the fiscal years 2010-2011 to 2015-2016. This dataset contains the annual tax returns of the nearly 180,000 firms paying taxes to the state over the period, whether in the VAT or the simplified scheme. Firms paying taxes under the VAT scheme report their total sales, total input purchases, and VAT paid on these inputs; the latter gives rise to an 'input tax credit' which is deducted from the total taxes due on sales. Firms paying taxes under the simplified scheme report their total sales and total input purchases. In addition to the variables used to compute their tax liabilities firm must report the main product they sell, we use this information

to allocate firms to one of 170 product categories and a VAT tax schedule. We obtain information on firms' location and age from the tax registration data. Our sample contains 818,865 observations at the firm-year level for 178,011 firms over 6 years .

2.2.2 Data on supplier-client pairs

Firms in the VAT scheme are required to report to the tax authorities all transactions with other registered firms of more than 50,000 INR (710 USD) annually, regardless of whether the trading partner is in the VAT or the simplified scheme. They report the annual transaction amount as well as the tax ID of the client or supplier involved in the transaction in the 'Annexure B' part of their tax returns, which has been made available to us. Firms in the simplified scheme do not report transactions to the tax authorities, so we do not observe trade between firms in the simplified scheme. Transactions between VAT-paying firms must be reported by both parties in the transaction. These two parties have no incentive to collude (a transaction increases the tax liability of the supplier, but decreases the tax liability of the client) and tax authorities systematically cross-check amounts reported by the two parties involved. Transactions between VAT-paying firms and non-VAT-paying firms in the simplified scheme however are only reported by VAT-paying firms so cannot be cross-checked against third-party information. VAT-paying firms have an incentive to report purchases from non-VAT-paying suppliers truthfully: these do not affect their tax liabilities, but all types of mis-reporting lead to fines if detected through a tax audit regardless of their impact on tax liabilities. Firms can similarly expect to be penalized if they mis-report sales to non-VAT-paying clients, but these sales increase their tax liabilities. If firms only pay taxes on the sales that the tax authorities have third-party reported information on, under-reporting of sales to clients in the simplified scheme is a potential concern.

Several pieces of evidence suggest that in practice under-reporting by VAT firms of sales to non-VAT firms is unlikely to be a major concern. First, we find that firms are not less likely to report sales to non-VAT clients than purchases from non-VAT suppliers, despite the fact that only sales can potentially increase their tax liabilities.⁵ On the contrary, we see a lot more transactions from VAT suppliers to non-VAT clients than from non-VAT suppliers to VAT clients, as we detail in Table 1 below. Second, we decompose firms' sales into 'third-party-reported sales' (sales to VAT clients) and 'voluntarily reported sales' (all remaining

⁵We find that 6% of VAT firms report at least one non-VAT client, less than 1% report a non-VAT supplier.

sales). Declaring sales to clients in the simplified scheme only increases firms' tax liabilities if these sales are larger than the 'voluntarily reported sales' firms report. We find that firms report total sales that are much larger than their third-party-reported sales: third-party reported sales represent only 30% of total sales on average (see Appendix Table B.1). Reporting non-VAT clients truthfully will thus not increase the liabilities of the average firm. Third, we find that the share of third-party reported sales is not positively correlated with the share of sales to clients in the simplified scheme, contrary to what we would see if only firms with a large 'voluntarily reported sales' share were willing to truthfully report sales to these clients. Appendix Figure B.1 plots the share of sales to clients in the simplified scheme as a function of the share of sales that are third-party reported. We find that the relationship is increasing except for firms with very high third-party reported shares. These firms however also report less sales to small VAT-paying clients: these are firms which only sell to large firms, which by definition all pay VAT.

Overall our data contains information for 4.8 million annual supplier-client pairs. Combining this transaction data with the firm data allows us to observe, for each firm in each year, its VAT-paying clients and suppliers and how much it sells to/buys from each of its VAT-paying trading partners.

2.3 Descriptive statistics

Table 1 presents the key characteristics of firms in our data. The first column includes all firms in the simplified scheme, the second column all firms in the VAT scheme but with a turnover under 5 million INR (therefore eligible to choose the simplified scheme) and the last all remaining VAT firms. Less than one-third are in the capital region Kolkata, though this share increases amongst larger firms. Appendix Figure B.3 plots the location of the firms in our data on a map and shows there are firms paying taxes in all regions in the state. Looking at firm size (turnover) we see that most firms (70%) have a turnover of less than 5 million and are therefore eligible to choose between the VAT and simplified schemes. Among those the vast majority (80%) choose to pay taxes under the VAT scheme. The detailed distribution of firm size by tax status, presented in Appendix Figure B.2, however shows a substantial amount of bunching below the 5 million threshold for firms in the simplified scheme, suggesting some firms have a high preference for this scheme that leads them to produce less (or report less sales) to avoid paying VAT.

Firms in the simplified scheme sell a much smaller share of their sales to VAT-paying

clients (1%) compared to similar-sized firms in the VAT scheme (28%). The share of inputs purchased from VAT-paying suppliers is similarly lower for these firms than for VAT-paying firms. The last four lines of Table 1 indicate that the low trade volumes between firms in the simplified and the VAT scheme, can be explained both by the fact that firms in the simplified scheme are less likely to trade with VAT-paying firms, and that even when they do they have less VAT-paying clients and suppliers. Figure 1 plots trade with VAT-paying firms as a function of firm size separately for firms in different tax schemes. We see that VAT-paying firms trade more with other VAT-paying firms than firms in the simplified scheme at all points of the size distribution.

Table 1 and Figure 1 provide evidence of partial segmentation of supply chains by tax status: VAT-paying firms are more likely to sell to, or buy from, VAT-paying firms than firms in the simplified scheme. This could be due to different characteristics of VAT- and non-VAT-paying firms, unrelated to their tax status, that lead them not to choose not to trade with each other. Table 2 assesses whether this is the case by considering the correlations between a firm's own tax status and the share of its sales (inputs) that is sold to (purchased from) VAT firms, controlling for firm characteristics that affect their position in supply chains: the products they sell and their location. We restrict the sample to firms which are eligible to choose their tax status; to allow for the possibility that firms could choose to produce more than 5 million whilst in the VAT scheme and bunch at the 5 million threshold whilst in the simplified scheme we consider all firms with a turnover of less than 7 million INR. We find that up to 40% of the correlation between tax status and trade with VAT clients can be explained by firms in different tax schemes selling different products (column 2) and/or being in different locations (columns 3 and 4), though the correlation between tax status and trade with VAT suppliers is unaffected by controls. The correlations remains large and statistically significant when controlling for all firm characteristics.

The types of products sold by firms in 2010-2011 are presented in Appendix Table B.2. Over one-fourth of tax-registered firms in West Bengal sell machines or construction materials, other commonly sold categories are electronic and electronic goods, food, chemical products, textiles and metal products. The share of VAT firms among firms eligible to choose the simplified scheme is highest for products most often used as intermediate inputs (machines, metal product and mining) and lowest for products more commonly sold to households (household goods, textiles and food). This is in line with the idea that firms selling to non-VAT clients are less likely to choose to be in the VAT scheme. Finally, Appendix Figure B.3 plots the location of firms by tax scheme on a map. We see that our data

contains firms in all parts of West Bengal, and that there are firms in both schemes in all parts of the state.

3 Model

We model an economy in which two different types of firms, upstream and downstream, take sourcing and tax decisions to maximize their profits. Upstream firms produce using only labor and sell to downstream firms and final consumers, whilst downstream firms produce using inputs purchased from upstream firms and sell only to final consumers. Compared to recent trade network models (see for example [Tintelnot et al., 2018](#)) we simplify the network by imposing a bipartite structure, introduce a tax system and endogenize firms' tax decisions.

3.1 Preferences and demand

The final consumer F is endowed with income E and has CES preferences over goods i :

$$U = \left(\sum_i (\beta_i q_{iF})^{\frac{\sigma-1}{\sigma}} \right)^{\frac{\sigma}{\sigma-1}}. \quad (1)$$

where q_{iF} is the quantity of good i consumed by the final consumer. Writing p_{iF} the consumer price of good i , utility maximization yields the following demand for good i :

$$q_{iF} = \left(\frac{\beta_i}{p_{iF}} \right)^\sigma P_F^{\sigma-1} E \quad (2)$$

where $P_F = \left(\sum_i \beta_i^\sigma p_{iF}^{1-\sigma} \right)^{\frac{1}{1-\sigma}}$ is the consumer price index. We assume that final goods are substitutes and therefore the (absolute value of the) elasticity of demand σ is greater than 1.

3.2 Production and market structure

Downstream firms produce goods k using a CES input bundle of goods j with elasticity of substitution $\rho > 1$. The production function of the firm producing good k , which we call

firm k , is:

$$q_k = \phi_k \left(\sum_j \alpha_{jk} q_{jk}^{\frac{\rho-1}{\rho}} \right)^{\frac{\rho}{\rho-1}} \quad (3)$$

where q_{jk} are the quantities of good j purchased by firm k . Writing p_{jk} the price paid by k for good j , we can write demand of firm k for good j as:

$$q_{jk} = \frac{q_{kF}}{\phi_k} \left(\frac{\alpha_{jk} P_k}{p_{jk}} \right)^{\rho} \quad (4)$$

and firm k 's cost function as:

$$c_k = \frac{P_k}{\phi_k} \text{ with } P_k = \left(\sum_j \alpha_{jk}^{\rho} p_{jk}^{1-\rho} \right)^{\frac{1}{1-\rho}} \quad (5)$$

where P_k is firm k 's input price index.

Upstream firms produce goods j using only labour and sell to downstream firms k and final consumers. The production function of firm j is:

$$q_j = \phi_j \alpha_{\ell j} q_{\ell j} \quad (6)$$

Its cost function is $c_j = \frac{P_j}{\phi_j}$ with $P_j = \alpha_{\ell j} w$.

Finally, we assume the market structure is monopolistic competition so that firms sell to consumers at a mark-up $\mu = \frac{\sigma}{\sigma-1}$ and to other firms at a mark-up $\nu = \frac{\rho}{\rho-1}$.

3.3 Taxes and tax status choice

Downstream and upstream firms choose whether to pay taxes under the VAT scheme or under the simplified tax scheme. Under the VAT scheme firm i pays a tax t_i on its sales and deducts the VAT paid on its input purchases from its tax liabilities. Under the simplified scheme it pays a tax τ on its total sales and is constrained to sell less than a fixed amount \bar{x} . We write v_i the tax status of firm i , $v_i = 1$ if i chooses the VAT firm, zero otherwise. Defining the tax wedges $\gamma_{iF} = 1 - \tau - v_i(t_i - \tau)$ and $\gamma_{jk} = (1 - \tau - v_j(t_j - \tau) + v_j v_k t_j)$ we write the prices to final consumers and to intermediate firms as a function of the tax system

and exogenous parameters:

$$p_{iF} = \frac{P_i \mu}{\phi_i \gamma_{iF}}, \forall i = j, k \quad (7)$$

$$p_{jk} = \frac{P_j v}{\phi_j \gamma_{jk}} \quad (8)$$

Firm i 's profits when its sales are unconstrained can now be written as:

$$\Pi_i(v_i) = q_{iF}(\gamma_{iF} p_{iF} - c_i) + \sum_k q_{ik}(\gamma_{ik} p_{ik} - c_i), \forall i = j, k \quad (9)$$

We assume that firms choose the tax status v_i that maximizes their profit Π_i taking all other firms' tax status as given. Some firms choose the VAT scheme regardless of their size, governed by ϕ_i , other firms choose the simplified scheme for small values of ϕ_i , the VAT scheme for large values of ϕ_i and choose to sell exactly \bar{x} and remain in the simplified scheme for intermediate values of ϕ_i . See the Appendix for a detailed characterization of firms' tax status choice.

Finally, we define the first-best supplier network as a function of the trade that would occur in the absence of taxes. Formally we characterize this first-best network by defining \tilde{s}_{jk} the share of firm k 's purchases bought from upstream firm j in the absence of taxes. The terms \tilde{s}_{ji} are a function of firms' technology parameters α and mark-ups and can be written as:

$$\tilde{s}_{ji} = \alpha_{ji}^\rho \left(\frac{\tilde{P}_i \phi_j}{\alpha_{lj} w v} \right)^{\rho-1} = s_{ji} \frac{\sum_l \tilde{s}_{li} \gamma_{li}^{\rho-1}}{\gamma_{ji}^{\rho-1}} \quad (10)$$

where \tilde{P}_i is firm i 's input price index in the first-best world.⁶ In what follows we also use $\tilde{\lambda}_{jk}$, the share of j 's sales purchased by k in the first best world.

3.4 Equilibrium

Market clearing implies that $q_k = q_{kF}, \forall k$ and $\sum_k q_{jk} = q_j, \forall j$. An equilibrium is characterized by the tax status of all firms, $\{v_i\}$, which in turn determines prices and production through equations (7), (8), (4) and (2).

Our first proposition considers the impact of a change in a firm's tax status on its trade with other firms, keeping the tax status of all other firms' constant. We focus on the type

⁶Formally $\tilde{P}_i = \left(\sum_j \alpha_{jk}^\rho \left(\frac{\alpha_{lj} w}{\phi_j} \right)^{1-\rho} \right)^{\frac{1}{1-\rho}}$.

of tax status change and trade we are more likely to observe in the data: the impact of a change in a downstream firm k 's tax status on its trade with upstream firms j in the VAT scheme. The share of k 's purchases from j in k 's total input costs is:

$$s_{jk} = \alpha_{jk}^\rho \left(\frac{P_k}{p_{jk}} \right)^{\rho-1} \quad (11)$$

Setting $v_j = 1$ and taking the derivative of s_{jk} with respect to k 's tax status choice we obtain the following proposition.

Proposition 1. Supply chain distortions. *The tax system causes supply chain distortions: downstream firms will, all else equal, buy more from upstream firms in the VAT scheme when they themselves are in the VAT scheme. To see this consider the impact of a change in downstream firm k 's tax status on the share of its purchases bought from an upstream firm j in the VAT scheme:⁷*

$$\frac{\partial \log(s_{jk})}{\partial v_k} = (\rho - 1) \frac{t_j}{1 - t_j} (1 - s_{V_k}) \quad (12)$$

where s_{V_k} is the share of firm k 's purchases bought from VAT suppliers when not in the VAT scheme. Proof: see Appendix.⁸

This proposition states that there will be partial market segmentation between VAT and non-VAT firms even in a world in which firms' tax status are exogenous, because of supply chain distortions. Intuitively this is because firms pay a tax on their purchases from VAT suppliers only if they themselves are not in the VAT scheme; the after-tax input cost of inputs purchased from VAT suppliers is thus lower for firms in the VAT scheme than for firms in the simplified scheme. The effect of downstream firm k 's tax status on its purchases from a VAT supplier j is moreover decreasing in s_{V_k} , the share of its total purchases bought from VAT suppliers when in the simplified scheme. This effect goes through firm k 's input price index P_k : the more k buys from VAT suppliers the more P_k decreases when it becomes VAT. At the limit when k buys all its purchases from VAT suppliers ($s_{V_k} = 1$) the relative price of its inputs is unaffected by k 's tax status choice so a change in its tax status does not affect its input mix.

⁷We assume here for simplicity that all of k 's VAT suppliers pay the same tax rate t_j , see the appendix for a proof of this proposition that relaxes this assumption.

⁸We present the case of a downstream firm changing tax status because this is the prediction we can test empirically as we observe many downstream firms changing tax status. There are few cases of upstream firms choosing to be in the turnover scheme in our data but the mirror result holds for a change in the tax status of an upstream firm: an upstream firm going from the turnover to the VAT scheme will sell more (less) to clients in the VAT (turnover) scheme.

Endogenizing firms' tax status choice yields predictions regarding the impact of a firm's trading partners' tax status on the firm's tax status choice, summarized in the following proposition.

Proposition 2. Strategic complementarities in firms' tax status choice. *We can write firm i 's propensity to be in the VAT scheme v_i as:*

$$v_i = f\left(t_i, t_i \sum_k v_k \tilde{\lambda}_{ik}, \sum_j t_j v_j \tilde{s}_{ji}\right) \quad (13)$$

where v_i is decreasing in the firm's own VAT rate t_i , an increasing function of the firm's VAT rate multiplied by its first-best share of sales to VAT-paying clients (second term), and of its first-best share of inputs purchased from VAT-paying suppliers, weighted by each supplier's VAT rate (third term). Moreover, firms' propensity to 'bunch' - remain in the simplified tax scheme by constraining their sales to be exactly \bar{x} - is decreasing in both $t_i \sum_k v_k \tilde{\lambda}_{ik}$ and $\sum_j t_j v_j \tilde{s}_{ji}$. Proof: see Appendix.

This proposition states that there are strategic complementarities in firms' tax decisions within supply chains. To see this note that the second and third terms of expression (13) will increase with the (weighted) number of the firms' potential suppliers and clients that are in the VAT scheme: the more a firm buys from, and sells to, VAT-paying firms, the more likely it is to itself choose to pay VAT. Intuitively, firms with many potential VAT-paying suppliers will face a lower input price index if they choose to be in the VAT scheme rather than in the simplified scheme. Similarly firms with many potential VAT-paying clients will face more demand for their products if they choose to be in the VAT scheme.

Overall the model predicts that there will be partial segmentation of supply chains between VAT- and non-VAT- paying firms in equilibrium, because of two mechanisms. The first, detailed in proposition 1, holds even when firms' tax status are exogenous: because VAT inputs are cheaper for VAT-paying clients than for non-VAT-paying clients the tax system distorts firms' choice of input mix and leads to more transactions, all else equal, between firms with the same tax status than between firms with different tax status. The second, detailed in proposition 2, states that a firm's tax status decision is a function of those of its potential trading partners: firms with many potential VAT trading partners are more likely to choose to be VAT, re-enforcing market segmentation. The following sections provide evidence regarding both mechanisms.

4 Empirical strategy

4.1 Graphical evidence

Our model predicts that VAT-paying firms trade more with other VAT-paying firms than firms in the simplified scheme, and this regardless of whether these firms' tax status choice is constrained by the rule stating that firms whose turnover exceeds 5 million INR must pay the VAT. Among firms whose tax status choice is constrained by this rule the model predicts those with more VAT-paying trading partners will be less likely to bunch, ie constrain their sales to be exactly at the 5 million threshold in order to qualify for the simplified tax scheme. Figure 2 shows this is indeed the case. We plot the distribution of firms by size (turnover) around the threshold separately for firms with below and above median shares of sales sold to VAT-paying clients and shares of inputs purchased from VAT-paying suppliers. We see clear evidence of bunching below the threshold, but mostly among firms with low sales to, and purchases from, VAT-paying firms. The model also predicts that firms facing a higher VAT rate will be more likely to bunch when their share of sales to VAT-paying clients decreases compared with firms facing a low VAT rate. Figure 3 tests this prediction by plotting density distributions for firms with high and low shares of sales to VAT clients separately for firms in the low and medium tax schedules and firms in the high tax schedule. We see substantially more bunching among firms with a low share of VAT sales in the group facing a high VAT rate than in the group facing a low VAT rate.

This graphical evidence is in line with the model's predictions, but unobserved firm characteristics may be driving part of the cross-sectional correlation between tax status choice and trade with VAT-paying firms observed in these Figures and Table 2. In what follows we use within-firm and within-trading relationships changes over time to estimate both the causal effect of the tax system on firms' sourcing decisions and strategic complementarities in firms' tax choices. Figure 4 presents graphical evidence regarding the within-firm correlation over time between tax status and trade. It plots the average share of inputs purchased from VAT firms before and after firms change tax status (blue line for firms switching from the simplified to the VAT scheme, red line for firms switching from the VAT to the simplified scheme) as well as the average in each year for firms that never change tax status. We see a clear positive correlation between a firm's decision to switch to a new tax status and its sourcing decisions, with firms buying 12 percentage points more of their inputs from VAT firms when they enter the VAT scheme (8 percentage points less of their inputs when they leave the VAT scheme). This correlation suggests at least one of the mechanisms

outlined by our model is at play: firms may be entering the VAT scheme because their suppliers enter the VAT scheme (strategic complementarities) and/or buying more from VAT suppliers because they've chosen to enter the VAT scheme (supply chain distortions). This section presents the empirical strategy that enables us to separately estimate the magnitude of each mechanism.

4.2 Supply chain distortions

We first test proposition 1 by considering the causal effect of a change in firms' tax status on their sourcing decisions. Specifically we estimate the impact of a change in client k 's tax status on its purchases from VAT firm j in the following way:

$$\log(s_{jkt}) = \beta_1 v_{kt} + \beta_2 v_{kt}(1 - s_{V_k}) + \gamma_t + \gamma_{jk} + \gamma_{jt} + \epsilon_{jkt} \quad (14)$$

where s_{jkt} is the share of the transaction between client k and supplier j in k 's total input purchases in year t , s_{V_k} is the average share of k 's inputs purchased from VAT suppliers when k is in the simplified scheme, γ_{jk} is a pair jk fixed effect and γ_{jt} different year fixed effects for each supplier.⁹ We allow for potential changes in input mix as firms grow, potentially correlated with the firms' tax status, by controlling for the client firm k 's turnover. Standard errors are clustered at the level of the product sold by firm k .

Comparing specification (14) with expression (12) in the model above we see that, under identifying assumptions described below, the estimate of β_1 will be equal to $(\rho - 1) \frac{t_j}{1-t_j}$, enabling us to estimate the elasticity of substitution in production ρ . We can further test our model's predictions that a change in tax status will have no impact on trade if the client purchases all its inputs from VAT suppliers by testing that $\beta_2 + \beta_1 = 0$.

Several identification challenges must be addressed for specification (14) to identify the causal effect of within firm changes in tax status over time on their trade with VAT firms. First, strategic complementarities (or correlated shocks within potential supply chains) and the fact that we do not observe trade between firms in the simplified tax scheme may lead to reverse causality: if two firms j and k trade whilst in the simplified scheme, and firm j enters the VAT scheme in the same year t as firm k (either because of complementarities or a shock that affects both firms at the same time) we will observe no trade between j and k before t and positive trade after t , even if the real trade between both firms does not

⁹For firms that are never observed in the simplified scheme we use the average share of inputs from VAT suppliers over the period. Note that these firms are not used to identify β_2 .

change in year t . To circumvent this issue we restrict our sample to pairs (j, k) in which the firm j is always much bigger than the eligibility cut-off size.¹⁰ This ensures that the (potential) supplier is in the VAT scheme throughout the period so that we always observe trade between j and k .

Second, some pairs may be more likely to trade for reasons we do not model but are correlated with their tax status. Firms whose owners belong to the same community for example may be more likely to both trade with each other and share information on the tax system. We allow for such pair-specific effects by including pair (j, k) fixed effects in all specifications. Third, reverse causality may be a cause for concern even when we restrict the sample to pairs in which the potential suppliers is always in the VAT scheme. Shocks to VAT firms' productivity may make them more attractive to all potential clients and induce some non-VAT firms to buy from them, strategic complementarities suggest some of these firms will choose to enter the VAT scheme because they have acquired a new VAT supplier. We include supplier \times year fixed effects γ_{jt} to allow for such unobserved changes in suppliers' productivity over time. Our preferred specification thus identifies the causal effect of interest by comparing the relative changes over time in trade between a large VAT supplier and its clients that change tax status and those that do not. Our identifying assumption is that there are no unobserved pair-specific productivity shocks that vary over time and lead only some clients to start trading with large VAT suppliers.

Finally, we restrict our attention to pairs (j, k) that trade at least once over the period in years during which both firms k and j file tax returns. We impute a value equal to the minimum reporting threshold of 50,000 INR to transactions between firms that do not trade in a given year. Our sample consists of 7.5 million observations and 1.4 million pairs, in 37,570 of these pairs the client changes tax status at some point.

Table 3 presents descriptive statistics on the sample used to estimate (14), separately for transactions on which the medium VAT rate is paid and those on which the high VAT rate is paid. We see that the firms are observed trading 40-45% of the time only, so there is substantial variation on the extensive margin of trade. The average transaction represents a very small share of suppliers' sales (less than 1%) but a non trivial share of client's inputs, as expected given the exclusion of transactions with small suppliers from the sample. Our identification strategy relies on comparing clients of the same supplier over time, it is therefore reassuring to see that the average supplier has 83 clients in the medium tax group

¹⁰Our baseline specification considers a sample of pairs in which the client has a turnover of more than 7 million, we consider alternative samples as a robustness.

and 127 clients in the high tax group (median number of clients are respectively 43 and 44).

4.3 Strategic complementarities in tax choices

We test proposition 2 in our model by estimating the causal effect on firms' tax status decisions of changes in the share of their sales they sell to VAT-paying clients and the share of their inputs they buy from VAT-paying suppliers. Following our expression (13) for firms' tax status choice we estimate the following equation:

$$v_{it} = \delta_1 t_i \sum_k \tilde{\lambda}_{ik} e_{kt} v_{kt} + \delta_2 \sum_j t_j \tilde{s}_{ji} e_{jt} v_{jt} + \gamma_i + \gamma_t + \epsilon_{it} \quad (15)$$

where v_{it} is equal to 1 if firm i is in the VAT scheme in year t , e_{it} is an indicator equal to 1 if firm i is in the data in year i , $\tilde{\lambda}_{ik}$ is a proxy for the share of i 's sales sold to firm k in the first best, \tilde{s}_{ji} is a proxy for the share of i 's inputs purchased from firm j in the first best, and γ_i and γ_t are respectively firm and year fixed effects. We allow for correlation in error terms both within postcode and within types of goods sold by firm i .

We estimate specification (15) on the sample of firms which can choose between the simplified and the VAT scheme. We observe some bunching of firms just below the 5 million INR threshold above which firms can no longer opt for the simplified scheme. All the extra mass just below the threshold is composed of firms in the simplified scheme, which would produce more than 5 million had they chose the VAT scheme. We therefore also include firms 'just above' the threshold in our sample, as these firms could make themselves eligible to the simplified scheme by reducing their production. Our baseline specifications include all firms with a turnover of less then 7 million INR, we present results using alternative thresholds as a robustness check.

Our estimates of interest – δ_1 and δ_2 – are supplier network effects similar to the social effects estimated in the social networks literature (see for example [Giorgi et al., 2010](#)). Several challenges arise when attempting to identify such network effects. First, the existence of a link between two agents (in our case a supplier-buyer relationship) is often endogenous to these agents' decisions of interest. Our model makes clear that in our case the structure of the network is endogenous to firms' tax status decision (see proposition 1), and that using the observed network would lead to upward bias in our estimates. It also offers a solution to this challenge: the relevant network in the specification for firms' tax status choice is not the realized network but the first best network characterized by the $\tilde{\lambda}$ and \tilde{s} . We use the

pair-level average shares over time to proxy for the first best network. The observed shares between two firms in the VAT scheme are approximately equal to the first best shares, as transactions between VAT-paying firms are not distorted by the tax system¹¹, but using this proxy introduces measurement error for other pairs. However this method, combined with firm fixed effects, ensure that our network measure is time-invariant and therefore that changes in the network, or different firm positions within the network, cannot be driving our estimates.

Second, network effects naturally give rise to a reflection problem, compounded by the possibility of unobserved correlated effects across firms driving tax choices (Manski, 1993). In practice however only a small share of the within-firm variation in both the weighted share of VAT sales $t_i \sum_k \tilde{\lambda}_{ik} e_{kt} v_{kt}$ and the weighted share of VAT inputs $\sum_j t_j \tilde{s}_{ji} e_{jt} v_{jt}$ comes from changes in firms' trading partners tax status (less than 5%). This is because firms that change tax status over time are by definition small, and represent only a small fraction of their trading partners' sales and input purchases. The remaining variation comes from entry and exit of trading partners (variables e_{kt} and e_{jt}). We observe on average 9% of firms entering the data, and 8% exiting the data in each year.¹² Our baseline results are thus obtained using only this source of variation for identification (keeping the tax status of firms' trading partners v_{kt} and v_{jt} constant in the right-hand-side variables in (15)). This identifies our estimates of interest under the assumption that entry and exit of firms' VAT trading partners only affect their tax status decision through their propensity to sell to (buy from) VAT firms. Because entry and exit of trading partners likely affect firms' size (total sales) this identification assumption is potentially violated for firms close to the 5 million INR threshold for which size is an important determinant of tax status choice. We therefore present results obtained on a sample of firms whose turnover is less than 4 million INR, controlling for firms' size, to check that the effects of entry and exit on firm size are not driving our results.

¹¹Observed shares are exactly equal to first best shares for transactions between VAT-paying firms if $\tau = 0$. In practice τ is very low (0.25%) so this approximation is reasonable.

¹²Entry and exit rates are lower for firms with a turnover of more than 7 million (5% entry rate, 4% exit rate), but comparable across tax scheme among firms with a turnover of less than 7 million: entry (exit) rates are 8% (8%) for firms in the simplified tax scheme, 11% (10%) for firms in the VAT scheme.

5 Results

5.1 Supply chain distortions

Table 4 presents results obtained by running specification (14), where the outcome variable is an indicator equal to 1 when the pair trades, zero otherwise. In the first three columns the sample consists of all pairs in which the supplier is in the medium tax schedule, so that the tax paid on the transaction if the client is in the VAT scheme is 4-5%, and in the last three columns the supplier is in the high tax schedule so the potential tax paid is two to three times higher, at 12.5-13.5%. Columns 2 and 3, and 5 and 6, present results obtained using our preferred specification with $\text{supplier} \times \text{year}$ fixed effects to allow for shocks to suppliers' productivity.

Results indicate that the average firm trades more with VAT suppliers when it enters the VAT scheme: 13% more when the supplier is in the medium tax scheme (column 2), 20% more when it is in the high tax scheme (column 5). Columns 3 and 6 show that effects vary with how much the firm trades with VAT suppliers when in the simplified scheme: the effect of joining the VAT scheme is smaller the higher the client's share of inputs purchased from VAT suppliers. The estimates imply no effect of joining the VAT scheme on trade with VAT firms for a firm that only buys its inputs from VAT suppliers regardless of its tax status (VAT input share equal to 1), in line with the model's predictions. The relative magnitude over the two samples of the effect for a firm with no VAT suppliers is also in line with the model's predictions, which state that this effect increases with the tax rate paid on the transaction. The effect is twice as large among pairs for which the high VAT rate is (potentially) paid than for pairs for which the medium VAT rate applies.

The sign and magnitude of the effects are robust to considering alternative sub-samples of potential pairs (see Appendix Table B.3). Results are extremely similar when we exclude pairs in which clients are not eligible to enter the turnover scheme because of their size (reducing the sample size by half) and when we restrict the sample to pairs in which the supplier is very far from the eligibility threshold (turnover greater than 10 million INR). Overall, firms trade 11-13% more with VAT suppliers in the medium tax scheme and 18-21% more with those in the high tax scheme. We find similar effects when considering an indicator equal to 1 if the pair trades in a given year as an alternative outcome variable.

The value of the elasticity of substitution in production ρ that these results imply is therefore relatively stable across samples, in the 6-7 range for firms trading with suppliers in the

medium tax scheme and in the 4-5 range for firms trading with suppliers in the high tax scheme. This range is in line with values typically found in the literature (see for example Broda et al., 2017) .

5.2 Strategic complementarities in tax choices

Table 5 presents results obtained by running specification (15) which models a firm's choice of whether to be in the VAT scheme as a function of the share of its inputs purchased from VAT-paying suppliers (where each supplier is weighted by its VAT rate) and the share of its sales sold to VAT-paying clients (multiplied by the firm's own VAT rate). All columns include firm and year fixed effects. The first column presents results obtained when we consider the observed VAT shares of sales and inputs, which vary within firms over time because of i) changes in trade between firms (network changes) ii) changes in the tax status of the firms' clients and suppliers iii) entry and exit of clients and suppliers. The second column presents results obtained when holding the network constant over time using our proxy for the 'first-best' network. The third and fourth column present results obtained when holding both the network and clients' and suppliers' tax status constant – our preferred specification. Finally in the fourth column we exclude from the sample firms for which firms' size is a determinant of their tax status choice by restricting the sample to firms with a turnover of less than 4 million INR.

We find that estimates are slightly higher in the first column, as expected given the predicted effect of a firms' change in VAT change on its trade with VAT partners (supply chain distortions), a source of upward bias. Results are similar however when considering both variations coming from changes in partners' tax status and from entry and exit of partners (column 2) and considering only variations coming from entry and exit, in line with the fact that most of the variation in the variables comes from entry and exit of VAT-paying trading partners over time. Estimates are very similar when we restrict the sample to firms far away from the threshold above which they have to be in the VAT scheme and control for firm size (column 4), suggesting the effect isn't driven by firms changing both size and tax status when they acquire or loose a trading partner. Appendix Table 5 shows that the magnitudes of the effects are also similar when we change the thresholds used to define our sample or include year times location fixed effect to allow for local shocks which could potentially affect both firm's entry dynamics and tax status choice.

Overall we find that a 10 percentage point increase in the share of firms' inputs purchased

from VAT-paying suppliers leads to an increase in the probability they choose to themselves pay VAT of 0.03-0.04 percentage points, and a 10 percentage point increase in the share of their sales sold to VAT-paying clients increases this probability by roughly half that amount. These estimates imply that a firm facing a VAT rate of 13.5% and whose suppliers also pay that rate will increase its propensity to pay the VAT by 5 to 8 percentage points if all its trading partners start paying VAT.

5.3 How much of the observed segmentation can we explain?

This sub-section investigates how much of the observed segmentation of supply chains along firms' tax status choice observed in Table 2 can be explained by our two mechanisms. To do this we sequentially remove the effect of supply chain distortions, then that of strategic complementarities in tax choices, and compute counterfactual correlations between firms' decision to pay taxes under the VAT scheme and how much they buy from, or sell to, firms paying taxes under the VAT scheme. Results are presented in Table 6 in which the first column replicates the observed correlation (conditional on firms' products and locations) between the share of firms' sales sold to VAT-paying clients, the share of firms' inputs purchased from VAT-paying suppliers, and firms' own decision to pay VAT.

We start by considering what happens if firms' sourcing decisions are no longer distorted by the tax system. Formally, we construct counterfactual firm-to-firm trade in the absence of supply chain distortions by increasing the trade between clients in the simplified tax scheme and suppliers in the VAT scheme by a factor $(1 + \beta_1)$ where β_1 is a function of the VAT rate paid by the supplier as estimated in Table 4: 0.126 when the supplier is in the medium tax schedule, 0.205 when the supplier is in the high tax schedule.¹³ We assume firms' total inputs purchased and total sales are unaffected, so removing supply chain distortions only leads to a re-allocation of trade: in our counterfactual supplier network VAT-paying suppliers sell more to their clients in the simplified scheme, and less to their clients in the VAT scheme. Firms' tax status is unaffected by removing distortions to trade due to the tax system. We then simulate firms' tax status choice in a world in which there are no strategic complementarities in firms' tax choices. To do so, we compute the firm level propensity to pay VAT because of trade with VAT firms using our estimates of strategic complementarities presented in Table 5 and obtain for each firm the probability

¹³We set $\beta = 0$ as predicted by our model for the few pairs involving a supplier in the low tax schedule.

that it pays VAT in a counterfactual world without these complementarities.¹⁴ We then compute for each firm how much it sells to, and buys from, VAT-paying partners in this counterfactual world, using partners’ predicted probability of being in the VAT scheme.

The second column of Table 6 presents the correlation between a firm’s propensity to trade with VAT-paying partners and its own decision of whether to pay VAT in a counterfactual world with no supply chain distortions. We see that the correlation between a firm’s tax status choice and the share of its sales sold to VAT-paying clients is hardly affected, but the correlation with the share of inputs purchased from VAT-paying suppliers decreases by roughly 50%. This difference is explained by the fact that the increase in trade between suppliers in the VAT scheme and clients in the simplified scheme represents a non-trivial share of the clients’ inputs, but a much smaller share of the suppliers’ sales. In column 3 we consider what happens when we predict firms’ probability of being in the VAT scheme in the absence of complementarities. Again we find that removing complementarities hardly affects the correlation between how much firms sell to VAT clients and firms’ propensity to pay VAT, but it decreases the correlation with the share of inputs purchased from VAT firms by 23%. Overall the two mechanisms in our model can explain a large share of the observed segmentation by tax status in upstream markets, in which only firms participate, but cannot explain the level of segmentation in downstream markets. This can potentially be explained by the fact that we do not observe the behavior of households (and firms in the informal sector) who – according to our model – buy more from non-VAT-paying firms, and who may represent the bulk of the sales of these firms.

6 Conclusion

In this paper we have set out to understand how tax policy affects firm-to-firm trade and how firms’ positions in supply chains affect their tax decision, focusing on the role of VAT in a large developing economy. We use novel panel data from the state of West Bengal in India in which we observe both VAT- and non-VAT- paying firms and firm-to-firm transactions. This enables us to first document the segmentation of supplier networks between firms with different tax status (VAT-paying and non-VAT-paying). We find evidence that VAT-paying firms both sell more to, and buy more from, other VAT-paying firms, all else equal, than other non-VAT-paying firms, in line with the idea that the tax system leads to partial

¹⁴Formally for each firm we compute $\delta_1 \lambda_{ik} e_{kt} v_{kt} + \delta_2 \sum_j t_j s_{ji} e_{jt} v_{jt}$ using our estimates of δ_1 and δ_2 : $\delta_1 = 0.155$ and $\delta_2 = 0.346$.

segmentation of supply chains.

To help us understand the mechanisms leading to market segmentation we then build a model of firms' sourcing and tax decisions within supply chains. Our key prediction is that under a VAT system there is partial market segmentation by tax status in equilibrium for two reasons. First, the VAT's incentive structure leads to supply-chain distortions: all else equal a VAT-paying firm buys a higher share of its inputs from VAT-paying suppliers than a non-VAT-paying one does. Second, there are strategic complementarities in firms' tax decisions: firms are more likely to choose to pay VAT the more VAT-paying suppliers and clients they have.

We finally provide empirical evidence on the mechanisms defined by our model using within-firm and within supplier-client pairs variations over time. We find that firms buy 14% more from VAT-paying suppliers when they themselves choose to pay VAT. Our estimates imply a trade elasticity and an elasticity of substitution in production in the range of estimates obtained in the international trade literature. Using changes in how much firms can trade with VAT trading partners generated by the entry and exit of firms we also find evidence suggestive of strategic complementarities in firms' tax choices. Our estimates imply that forcing all of a firm's trading partners to pay the VAT would increase that firm's propensity to pay the VAT by 5-8 percentage points compared to a situation where none of the firm's trading partners pay VAT.

Our findings have wide-ranging implications for tax policy in developing countries, most of which use VAT. A key characteristic of these countries is that tax-paying firms co-exist in markets, and potentially trade with, a large number of non-tax paying firms in the informal sector. Our results regarding how the tax system affects trade between VAT and non-VAT-paying firms (here, firms paying taxes under a simplified tax scheme) naturally extend to trade between VAT-paying firms and informal firms. Informal firms, like the firms in the simplified tax scheme we consider, pay taxes on purchases from VAT suppliers and are therefore less likely to source inputs from them than from other informal firms. The magnitude of the effects we estimate suggest these distortions in input mix could be substantial. This effect of taxes on supply chains increase the efficiency cost of levying a VAT: they imply that an increase in the VAT rate will decrease firm-to-firm trade and increase distortions in non-VAT firms input mix. We similarly expect strategic complementarities in firms' decisions of whether to enter the formal sector under a VAT system. Our results imply that a compliance shock causing some firms to start paying VAT will have multiplier compliance effects on these firms' supply chains: trading partners of these firms paying

taxes under the simplified scheme or in the informal sector will have stronger incentives to themselves start paying VAT.

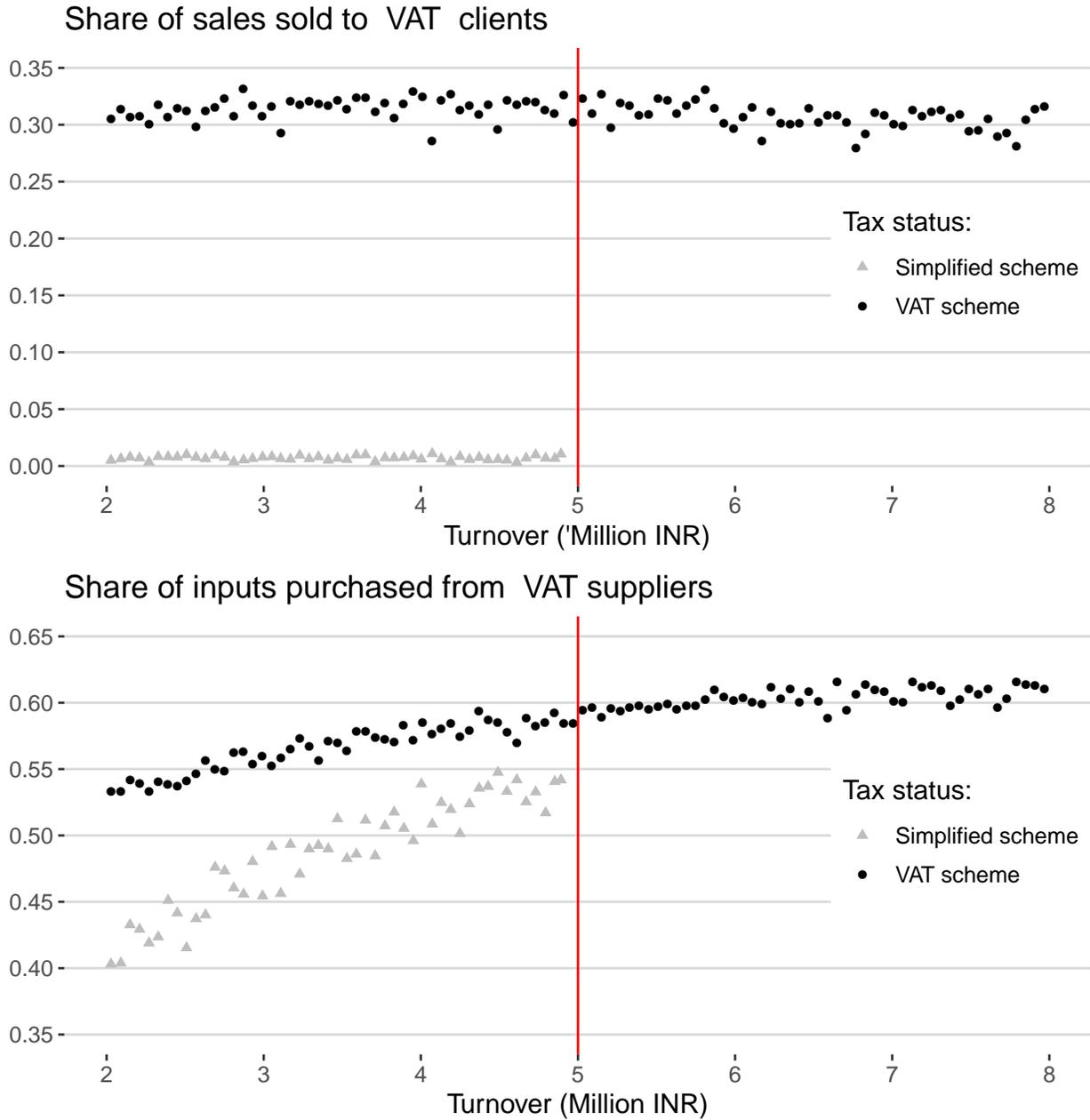
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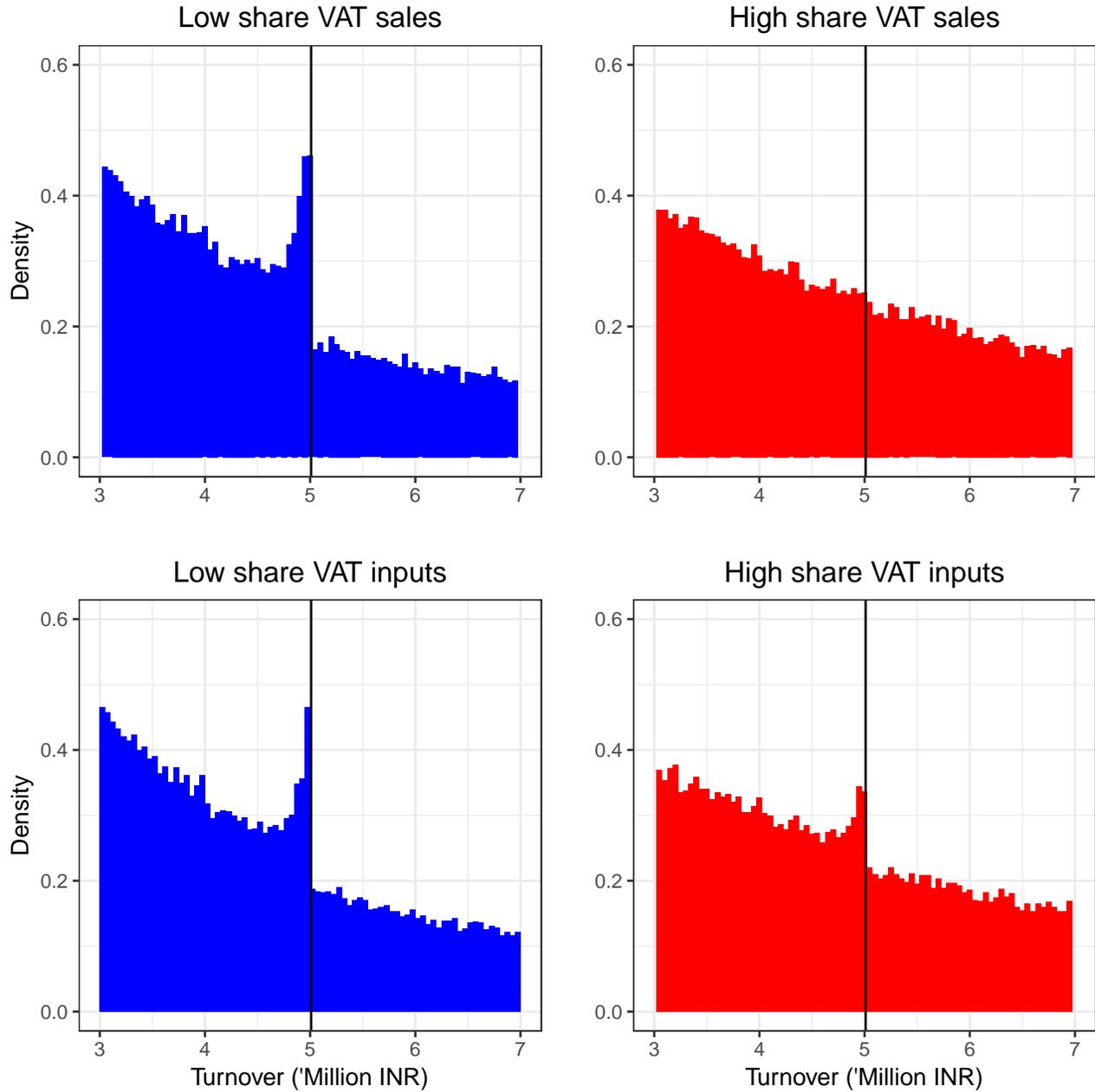
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Figure 1: Trade with VAT-paying firms and tax status choice



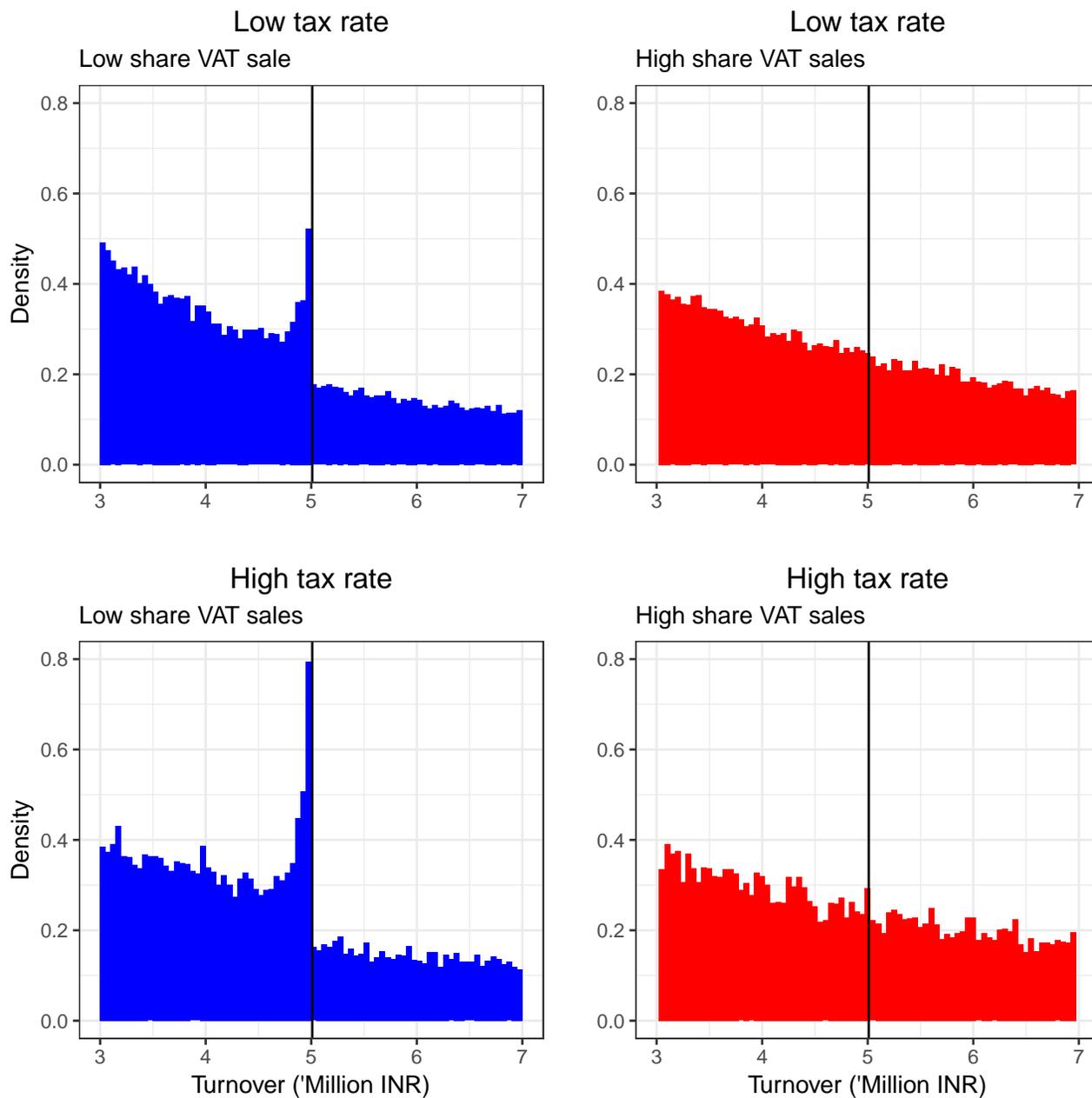
These graph plot the firm-level share of sales that are sold to VAT-paying clients (top graph) or the share of inputs purchased from VAT-paying suppliers (bottom graph) as a function of firm size. The black dots indicate VAT-paying firms, the grey triangles firms paying taxes under the simplified scheme. The red line indicates the size threshold above which firms have to pay VAT. We restrict the sample to firms with a turnover between 2 and 8 million INR, which represent 30% of the total sample.

Figure 2: Distribution of firm size and trade with VAT-paying firms



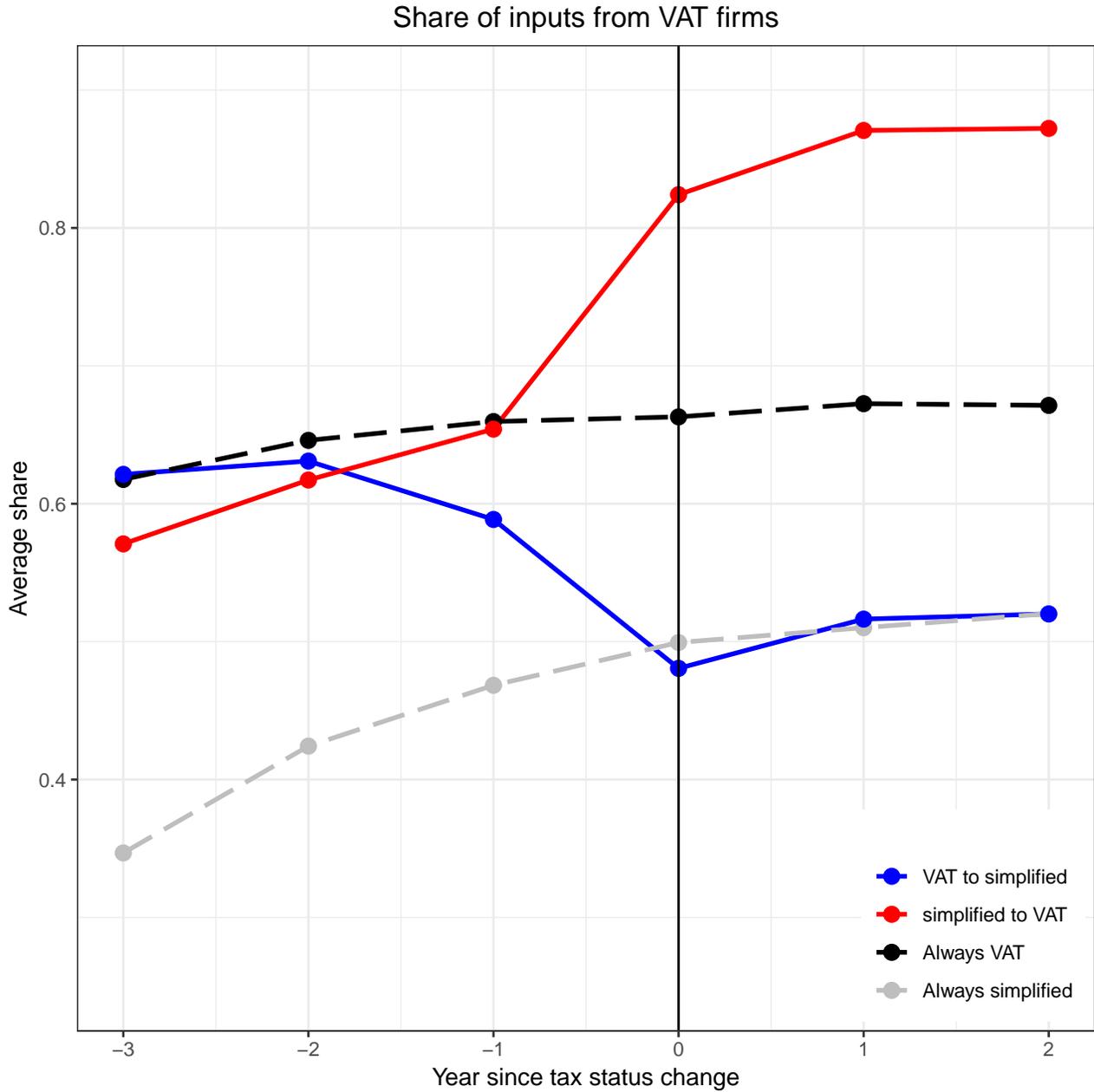
These graph plot the density distribution of firms by firm size for different sub-samples of firms with a turnover between 3 and 7 million INR. The top left (right) graph considers firms whose share of sales sold to VAT-paying clients is below (above) the sample median; the bottom left (right) graph considers firms whose share of inputs purchased from VAT-paying suppliers is below (above) the sample median. Bin sizes are 50,000 INR in all graphs.

Figure 3: Distribution of firm size and tax rate



These graph plot the density distribution of firms by firm size for different sub-samples of firms with a turnover between 3 and 7 million INR. The top two graphs considers firms which produce goods in the low and medium tax schedule, the bottom two firms which produce goods in the high tax schedule. Graphs on the left (right) include firms whose share of sales sold to VAT-paying clients is below (above) the sample median. Bin sizes are 50,000 INR in all graphs.

Figure 4: Share of inputs purchased from VAT suppliers and tax status choice



This graph plots the average share of inputs purchased from VAT suppliers over time for four groups of firms with a turnover of less than 7 million: firms that switch from the simplified to the VAT scheme (3,861 firms), firms that switch from the VAT to the simplified scheme (2,490 firms), firms that remain in the VAT scheme throughout the period (82,635 firms) and firms that remain in the simplified scheme throughout the period (10,810 firms). Each point represents an annual average, where year 0 is the year of the tax status change for firms that change tax status, and 2014 for those that do not.

Table 1: Firm-level descriptive statistics

	Simplified scheme	VAT scheme (small)	VAT scheme (large)
Turnover	1843 (1393)	1591 (1367)	117,133 (1,321,115)
In Kolkata	0.18	0.27	0.38
Share VAT sales	0.01 (0.07)	0.28 (0.38)	0.33 (0.36)
Share VAT inputs	0.48 (0.42)	0.59 (0.44)	0.81 (0.33)
Has a VAT client	0.03	0.45	0.76
Has a VAT supplier	0.65	0.69	0.92
Number VAT clients	1.20 (0.72)	3.07 (3.17)	17.31 (36.30)
Number VAT suppliers	2.73 (2.26)	3.63 (3.61)	12.56 (19.89)
Number of firms	18,176	106,447	53,388
Observations	86,708	417,660	314,497

Mean (standard deviation). Column 1 includes all firms in the simplified tax scheme, column 2 all firms in the VAT scheme with a turnover under 5 million INR, column 3 all firms in the VAT scheme with a turnover over 5 million INR. The last two rows (number of VAT trading partners) are conditional on the firm having at least one VAT client or supplier. The variable "share VAT sales" is the ratio of total sales to VAT firms reported in the transaction data to total sales reported by the firm in the firm data, the variable "share VAT inputs" is the ration of total purchases from VAT firms in the transaction data to total purchases reported by the firm in the firm data. Period: fiscal year 2010-2011. Turnover is in 1000 INR.

Table 2: Correlation between a firm's tax status and its use of VAT trading partners

	Outcome: In VAT scheme			
	(1)	(2)	(3)	(4)
Share VAT sales	0.229*** (0.026)	0.200*** (0.027)	0.168*** (0.021)	0.133*** (0.019)
Share VAT inputs	0.078*** (0.017)	0.089*** (0.014)	0.084*** (0.014)	0.088*** (0.014)
Product FE		x	x	
Location FE			x	
Product \times Location FE				x
Observations	640,634	640,634	640,634	640,634

Standard errors in parentheses are clustered at the level of the good sold by the firm and the location of the firm. The dependent variable is an indicator equal to 1 if firm i is in the VAT scheme in year t , 0 if it is in the turnover scheme. Each column presents estimates from a regression of this indicator variable on the share of firm i 's sales that are sold to VAT clients and the share of firm i 's inputs purchased from VAT suppliers in year t , as well as product fixed effects (columns 2 and 3), location fixed effects (column 3) and/or product \times location fixed effects (column 4). The sample includes all firms with a turnover of less than 7 million INR over the fiscal years 2010-2011 to 2015-2016, all specifications include year fixed effects. Significance levels: * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

Table 3: Transaction sample: descriptive statistics

VAT rate on transaction:	Medium tax rate	High tax rate
<i>Pair characteristics</i>		
Positive trade	0.405	0.446
Share of trade in client's inputs	0.061 (0.150)	0.100 (0.212)
Share of trade in supplier's sales	0.009 (0.040)	0.007 (0.031)
<i>Client characteristics</i>		
Number of suppliers	22.13 (37.55)	17.01 (35.38)
Turnover	570,933 (4,049,742)	435,289 (3,526,486)
Eligible to VAT scheme	0.422	0.524
Of which, in VAT scheme	0.934	0.833
Number of firms	120,065	66,128
<i>Supplier characteristics</i>		
Number of clients	83.26 (111.02)	126.57 (215.47)
Turnover	843,060 (5,098,105)	1,010,746 (2,835,937)
Number of firms	24,144	7,416
Number of pairs	1,195,476	222,524
Number of observations	6,347,650	1,220,529

Mean (standard deviation). This table presents descriptive statistics on the sample of annual transactions used to estimate supply chain distortions following specification (14). There is one observation per pair*year as long as both firms in the pair exist during this year, with 6.3 million pairs over the period 2010-2016. Turnover is in 1000 INR, the variable 'Positive trade' is an indicator for the transaction being positive, the variable 'Eligible to VAT scheme' indicates whether the firm's turnover is below 7000 INR and the variable 'Of which, in VAT scheme' is defined for firms that are eligible to the VAT scheme only and equal to one if the firm has chosen the VAT scheme.

Table 4: Results on supply chain distortions

	(1)	(2)	(3)	(4)	(5)	(6)
Supplier tax rate t_j :	Medium tax			High tax		
<i>Outcome variable: Log input share s_{jkt}</i>						
VAT client	0.163*** (0.014)	0.126*** (0.013)	0.308*** (0.030)	0.232*** (0.029)	0.205*** (0.028)	0.599*** (0.065)
VAT client * VAT input share			-0.304*** (0.061)			-0.624*** (0.087)
p. value of $\beta_1 + \beta_2 = 0$			0.867			0.264
$\rho \approx 1 + \beta(1 - t_j)/t_j$			6.9			4.7
Supplier*Year FE		x	x		x	x
Observations	6,347,650	6,347,650	6,347,650	1,220,529	1,220,529	1,220,529

Standard errors in parentheses are two-way clustered at the level of the product sold by the client and the location of the client. The sample includes all pairs that trade at least once during the period in which the supplier is never eligible to the turnover scheme (minimum turnover greater than 7 million), in columns 1 to 3 we consider pairs in which the supplier pays the medium VAT rate, in columns 4 to 6 pairs in which the supplier pays the high VAT rate. All specifications include pair fixed effects, in columns 1 and 4 we include year fixed effects and in columns 2,3, 5 and 6 year \times supplier fixed effects. Significance levels: * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

Table 5: Results on strategic complementarities in tax choices

Sample : $y_i <$	Outcome: In VAT Scheme			
	(1) 7 million	(2) 7 million	(3) 7 million	(4) 4 million
Share VAT inputs (weighted)	0.616*** (0.078)	0.385*** (0.114)	0.361*** (0.113)	0.346*** (0.113)
Share VAT sales (weighted)	0.207*** (0.027)	0.167*** (0.049)	0.119*** (0.045)	0.155*** (0.050)
Fixed network		x	x	x
Fixed tax status of partners			x	x
Observations	640,634	640,634	640,634	571,498

Standard errors in parentheses are two-way clustered at the product and location level. The sample includes all firms with a minimum turnover over the period of less than 7 million INR in columns 1 to 3, and all firms with a minimum turnover of less than 4 million INR in column 4. The right-hand side variables in column 1 are the observed share of inputs (sales) purchased from (sold to) VAT-paying firms, in columns 2 to 4 these input and sales shares are calculated holding trade (normalized by total input costs or total sales) constant, in columns 3 and 4 we also hold the tax status of the firms trading partners constant. All specifications include firm and year fixed effects. Significance levels: * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

Table 6: Supply chain segmentation under counterfactual scenarios

	Outcome: Probability in VAT scheme		
	Observed (1)	No trade distortions (2)	No complementarities (3)
Share VAT sales	0.133*** (0.021)	0.139*** (0.025)	0.126*** (0.021)
Share VAT inputs	0.088*** (0.014)	0.043*** (0.010)	0.069*** (0.014)
Observations	640,634	640,634	640,634

Standard errors in parentheses are two-way clustered at the product and location level. The sample includes all firms with a minimum turnover over the period of less than 7 million INR. The right-hand side variables are the share of inputs (sales) purchased from (sold to) VAT-paying firms. In column (1) we use the observed shares, in column (2) the shares are obtained using predicted trade in a world with no supply chain distortions and firms' observed tax status and in column (3) the share are obtained using the predicted probability that firms are in the VAT scheme in a world with no strategic complementarities. All specifications include location \times product and year fixed effects. Significance levels: * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

A Theory Appendix

A.1 Proof of proposition 1

In this section we relax the assumption made in expression (11) that all firm k 's VAT suppliers pay the same VAT rate t_j . Relaxing this assumption, expression (11) can now be written as:

$$\frac{\partial \log(s_{jk})}{\partial v_k} = (\rho - 1) \left(\frac{t_j}{1 - t_j} - s_{V_k} \frac{\hat{t}_k}{1 - \hat{t}_k} \right) \quad (16)$$

To obtain this expression replace for p_{jk} and P_k in expression (11) using (8) and (5), then take the derivative of s_{jk} with respect to v_k when $v_j = 1$. We obtain:

$$\frac{\partial \log(s_{jk})}{\partial v_k} = (\rho - 1) \left(\frac{t_j}{1 - t_j} - \sum_l v_l s_{lk} \frac{t_l}{1 - t_l} \right) \quad (17)$$

Taking linear approximations around $t_l = t_j$ yields expression (16).

A.2 Proof of proposition 2

This section proves proposition 2, using the approximations $\tau \approx 0$ $t_i = t, \forall i$. This simplifies expression without removing key insights.

We write firm i 's tax status choice decision as a function of its propensity to be in the vat θ_i :

$$\theta_i = \Pi_i(v_i = 1) - \Pi_i(v_i = 0) + \epsilon_i \quad (18)$$

where ϵ_i captures firm i 's idiosyncratic preference for being in the VAT scheme.

We show below that some types of firms will be such that $\theta_i > 0$, these firms will choose the VAT scheme regardless of their size. All other firms will choose the simplified scheme as long as they sell less than \bar{x} , where \bar{x} is the level of sales above which firms can no longer opt for the simplified scheme. When they reach a size for which the optimal level of sales $x_i(v_i = 0)$ is greater than \bar{x} they receive a profit $\Pi_i^B(v_i = 0)$ if they remain in the simplified scheme and 'bunch' by selling exactly \bar{x} , and $\Pi_i(v_i = 1)$ if they choose the VAT scheme. These firms will choose the simplified scheme and sell $x_i(v_i = 0)$ for $\phi < \phi_{1i}$, will choose the simplified scheme and bunch, selling \bar{x} for $\phi_{1i} \leq \phi \leq \phi_{2i}$, and will choose the VAT scheme and sell $x_i(v_i = 1)$ for $\phi > \phi_{2i}$. We prove this and characterize ϕ_{1i} and ϕ_{2i} below.

Downstream firms Starting with downstream firms, note that we can write their input price index in the absence of taxes, \tilde{P}_i , defined above, as:

$$\tilde{P}_i = \frac{P_i}{r_i} \quad (19)$$

where $r_i = \left(\sum_j \tilde{s}_{ji} \gamma_{ji}^{\rho-1} \right)^{\frac{1}{1-\rho}}$ is the increase in i 's input costs due to taxes. We have $r_i = 1$ if the firm chooses the VAT scheme and $r_i \approx 1 + \sum_j \tilde{s}_{ji} t_j v_j$ if the firm chooses the simplified scheme.

Firm i 's profits when in both tax schemes can be written as a function of its profit in the absence of taxes $\tilde{\Pi}_i$ so we have the following expression for θ_i

$$\theta_i = \tilde{\Pi}_i [(1 - t_i)^\sigma - r_i^{1-\sigma}] + \epsilon_i \quad (20)$$

Firms with $\theta_i > 0$ will choose the VAT scheme regardless of their size. Firms with $\theta_i < 0$ will choose the simplified scheme regardless of their size when $\phi_i < \phi_{1i}$ where ϕ_{1i} is defined by $x_i(v_i = 0, \phi_{1i}) = \bar{x}$. Firms with $\phi > \phi_{2i}$ will choose the VAT scheme, where ϕ_{2i} is defined by $\delta(\phi_{2i}) = \Pi_i(v_i = 1, \phi_{2i}) - \Pi_i^B(\phi_{2i}) = 0$.

To characterize ϕ_{2i} we need to define $\Pi_i^B(v_i = 0)$ the profits firms in the simplified tax scheme earn when their sales are constrained at \bar{x} . To do this note that firms profits can be written, using cost-minimization, as:

$$P_i = q_{iF} (\gamma_{iF} p_{iF} - P_i \phi_i^{-1}) \quad (21)$$

Utility maximization of the final consumer defines the final price as a function of constrained sales \bar{x} $p_{iF} = \left(\frac{E}{\bar{x}} \right)^{\frac{1}{\sigma-1}} \beta_i^{\frac{\sigma}{\sigma-1}} P_F$. Writing $q_{iF} = \frac{\bar{x}}{p_{iF}}$ and replacing in (21) we obtain:

$$\Pi_i^b = \bar{x} - \frac{P_i}{\phi_i} \bar{x}^\mu P_F^{-1} E^{-\frac{1}{\sigma-1}} \beta_i^{-\mu} \quad (22)$$

We can write

$$\delta(\phi_i) = a_i \phi_i^{\sigma-1} + b_i \phi_i^{-1} - \bar{x}.$$

We know that $\delta(\phi_{1i}) < 0$ (because $\theta_i(\phi_{1i}) < 0$) and that $\delta(\phi_i)$ tends to infinity when ϕ becomes large (because $\sigma > 1$ and $a_i > 1$). Therefore $\delta(\phi_i)$ admits at least one root over $[\phi_{1i}, \infty]$. Finally, we have:

$$\delta'(\phi_i) = \phi_i^{-2} [a_i(\sigma - 1)\phi_i^\sigma - b_i].$$

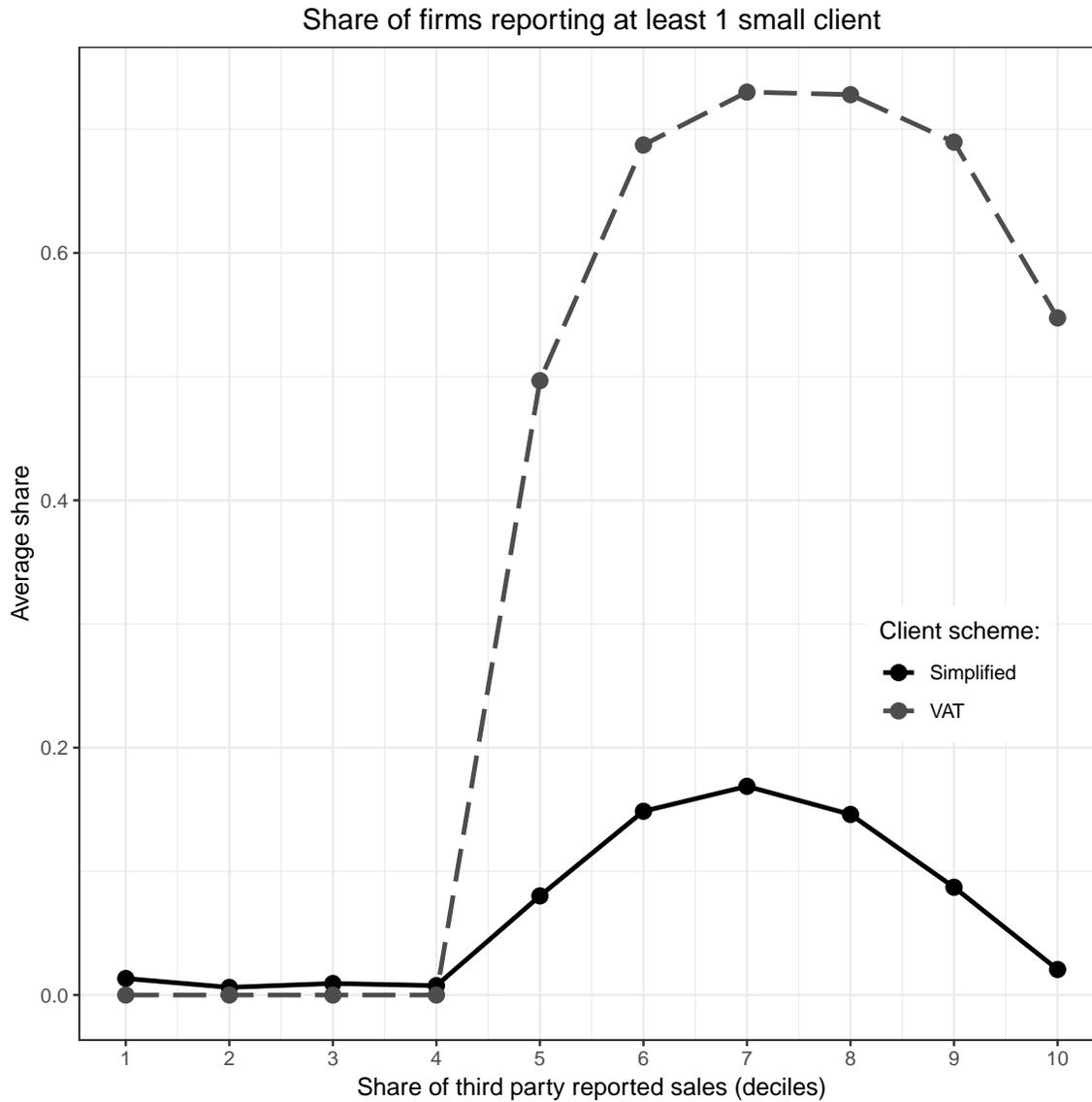
so $\delta'(\phi_i)$ is negative for small values of ϕ_i and positive for larger values. This implies that

$\delta(\phi)$ admits only one root, ϕ_{2i} with $\phi_{2i} > \phi_{1i}$.

Strategic complementarities First note that firms are more likely to choose the VAT scheme when they buy more from potential suppliers in the VAT scheme, regardless of their size. This is because θ_i is increasing in r_i , itself increasing in $\sum_j \tilde{s}_{ji} t_j v_j$. Firms for which $\theta_i < 0$ are also less likely to bunch, and more likely to pay VAT for smaller values of ϕ , when they have more VAT-paying suppliers. To see this note that ϕ_{1i} is increasing in r_i , because it is defined by $x_i(\phi_{1i}, v_i = 0) = \bar{x}$ and $\frac{\partial x_i(v_i=0)}{\partial r_i} < 0$, $\frac{\partial x_i(v_i=0)}{\partial \phi_i} > 0$. We can similarly show that ϕ_{2i} is decreasing in r_i by noting that $\Pi_i^B(v_i = 0)$ is decreasing in r_i for all levels of ϕ_i and $\Pi_i(v_i = 1)$ is unaffected by r_i . Overall, firms with more potential VAT-paying suppliers i) are more likely to have $\theta_i > 0$ and therefore choose to pay VAT regardless of their size and ii) when $\theta_i < 0$, will choose the VAT scheme for a wider range of size parameters ϕ_i , and will be less likely to bunch by selling exactly \bar{x} .

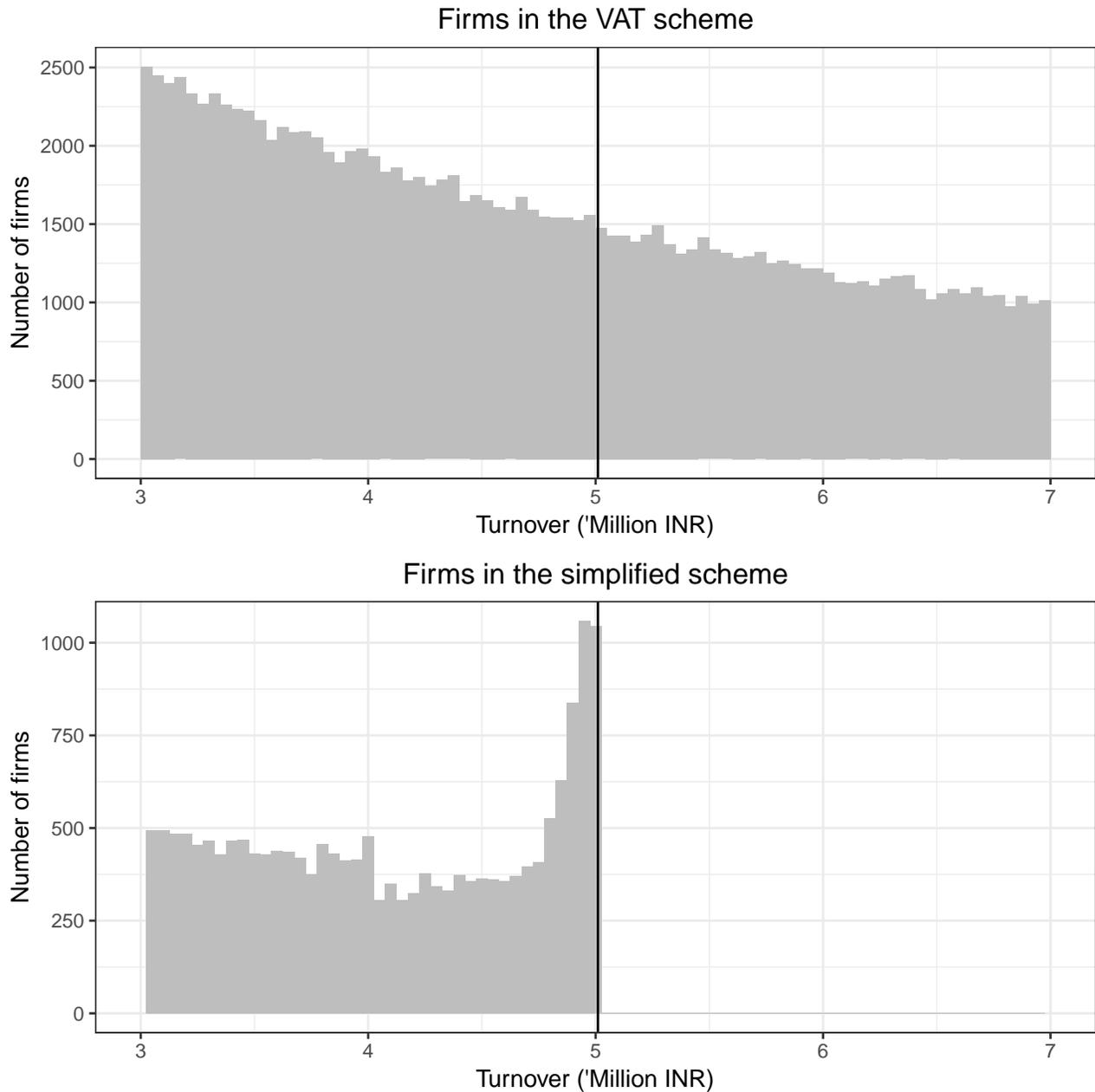
B Additional Tables and Figures

Figure B.1: Sales to simplified scheme clients as a function of third party reported sales



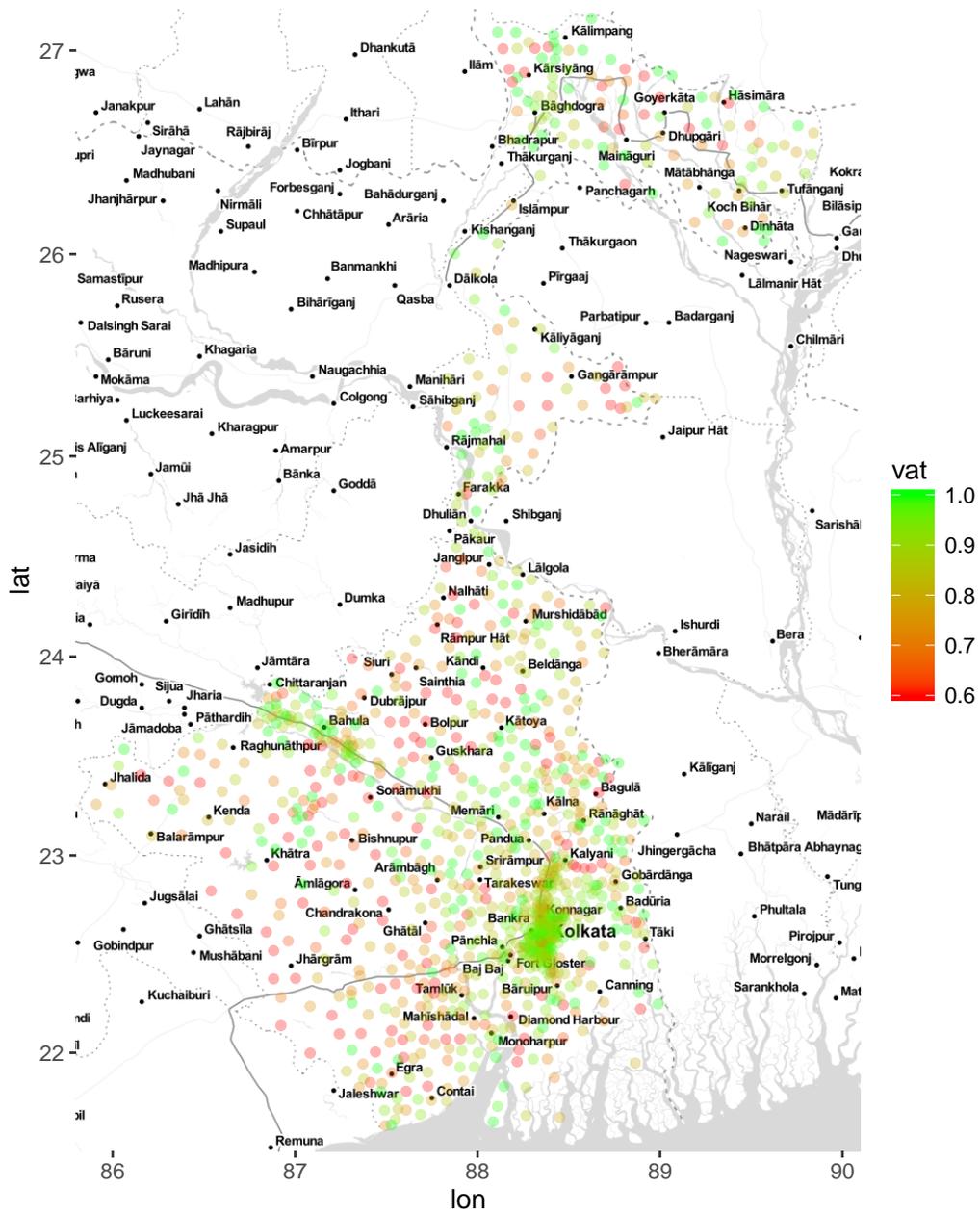
This graph plots the share of firms trading with at least one client with a turnover of less than 5 million INR for each decile of the distribution of the share of firms' sales that are third party reported. The dashed line plots the share of firms trading with at least one client in the VAT scheme, the unbroken line the share of firms trading with at least one client in the simplified scheme. 40% of firms have no third-party reported sales so the share of firms with a VAT client is zero by definition for the first four deciles.

Figure B.2: Distribution of firms around the simplified tax threshold



This graph plots the density distribution of firms by turnover size around the 5 million INR threshold above which firms can no longer opt to be in the simplified tax scheme. This threshold is indicated by the black vertical lines. The top graph plots the distribution for firms paying taxes under the VAT scheme, the bottom graph the distribution for firms paying taxes under the simplified scheme.

Figure B.3: Share of firms in the VAT scheme by location



Each dot represents a postcode in which firms in our data are located.

Table B.1: Share of third-party-reported sales and sales to simplified scheme clients

	Share of third-party-reported sales	Observations
All firms	0.30 (0.38)	732,114
<i>Of which</i>		
Positive sales to simplified scheme clients	0.38 (0.30)	50,358
No sales to simplified scheme clients	0.29 (0.28)	681,756

The sample includes all firms in the VAT scheme in the first line, only VAT firms with positive sales to clients in the simplified scheme in the second line, and all remaining VAT firms in the last line. We define 'third-party-reported sales' as sales to clients in the VAT scheme, and report the share of these sales in the total sales of the firm.

Table B.2: Products sold and firm tax status in 2010-2011

Commodity type	Turnover	% Large firms	Amongst small, % VAT	Nb firms
Machines & equipment	28,285 (422,356)	32.05	91.32	19510
Construction materials	12,137 (153,641)	24.69	79.19	16911
Electrical & electronic goods	33,474 (833,588)	33.62	81.21	15560
Food, drink & tobacco	40,277 (531,480)	40.82	73.61	14828
Chemical products	41,336 (977,889)	37.05	76.09	11107
Textiles	24,235 (170,384)	31.61	72.03	10969
Metal products	109,361 (781,319)	54.46	94.07	10739
Wood & paper	20,826 (140,983)	29.00	90.6	9417
Other commodities	60,963 (1,097,142)	27.57	88.78	8479
Rubber & plastic	44,919 (1,095,713)	34.48	87.42	4672
Household goods	9,656 (90,727)	17.86	77.06	3444
Mining & energy	72,134 (1,042,568)	52.29	89.95	2689
All	38,376 (657,094)	34.17	82.72	128325

This table presents descriptive statistics by type of main product sold by firms, where we have classified over 170 different product types into 13 large product categories. The first column presents the share of firms with a turnover of over 5 million INR, the second column the share of VAT firms amongst firms with a turnover of less than 5 million INR and the third column the total number of firms in that category in 2010-2011. Categories are ranked from the one with the largest number of firms (Machines & equipment) to the one with the lowest number of firms (Mining & energy) in 2010-2011.

Table B.3: Additional results on supply chain distortions

	(1)	(2)	(3)	(4)	(5)	(6)
Supplier tax rate t_j :	Medium tax			High tax		
<i>Panel A. Excluding clients that are not eligible to the VAT scheme</i>						
VAT client	0.154*** (0.014)	0.118*** (0.013)	0.301*** (0.029)	0.220*** (0.029)	0.188*** (0.028)	0.577*** (0.066)
VAT client * VAT input share			-0.304*** (0.062)			-0.612*** (0.088)
Id sup*Year FE		x	x		x	x
Observations	2,680,746	2,680,746	2,680,746	639,931	639,931	639,931
$\rho \approx 1 + \beta(1 - t_j)/t_j$		6.7		4.5		
<i>Panel B. Restricting to very large suppliers</i>						
VAT client	0.164*** (0.015)	0.129*** (0.014)	0.318*** (0.033)	0.237*** (0.029)	0.211*** (0.028)	0.627*** (0.067)
VAT client * VAT input share			-0.312*** (0.049)			-0.655*** (0.067)
Supplier*Year FE		x	x		x	x
Observations	5,807,785	5,807,785	5,807,785	1,137,714	1,137,714	1,137,714
$\rho \approx 1 + \beta(1 - t_j)/t_j$		7		4.9		
<i>Panel C. Outcome variable: Trade > 0</i>						
VAT client	0.145*** (0.007)	0.121*** (0.006)	0.275*** (0.010)	0.152*** (0.010)	0.140*** (0.008)	0.347*** (0.017)
VAT client * VAT input share			-0.256*** (0.017)			-0.327*** (0.027)
Supplier*Year FE		x	x		x	x
Observations	6,347,650	6,347,650	6,347,650	1,220,529	1,220,529	1,220,529

The dependent variable is the log input share s_{jkt} in Panels A and B, an indicator equal to 1 if the two firms trade in panel C. The sample in panel A includes all pairs in which the supplier is never eligible to the turnover scheme and the client is always eligible, in panel B the sample includes all pairs in which the supplier has a turnover larger than 10 million INR. The sample in panel C is the sample used in our baseline specification in Table 4. All specifications include pair fixed effects and control for the log turnover of the client firm k , in columns 1 and 3 we include year fixed effects and in columns 2 and 4 year \times supplier fixed effects. Standard errors are clustered at the level of the product sold by the client. Significance levels: * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

Table B.4: Additional results on complementarities

	Outcome: In VAT Scheme			
	(1)	(2)	(3)	(4)
<i>A. Lowering sample thresholds</i>				
Sample : $y_i <$	6 million	6 million	6 million	3.5 million
Share VAT inputs	0.622*** (0.078)	0.394*** (0.117)	0.361*** (0.116)	0.344*** (0.112)
Share VAT sales	0.209*** (0.028)	0.171*** (0.050)	0.121*** (0.046)	0.173*** (0.051)
Fixed network		x	x	x
Fixed tax status of partners			x	x
Observations	623,990	623,990	623,990	551,738
<i>B. Increasing sample thresholds</i>				
Sample : $y_i <$	8 million	8 million	8 million	4.5 million
Share VAT inputs	0.611*** (0.077)	0.384*** (0.114)	0.360*** (0.114)	0.367*** (0.119)
Share VAT sales	0.204*** (0.027)	0.162*** (0.048)	0.115*** (0.044)	0.147*** (0.049)
Fixed network		x	x	x
Fixed tax status of partners			x	x
Observations	654,851	654,851	654,851	587,610
<i>C. Adding year \times location fixed effects</i>				
Sample : $y_i <$	7 million	7 million	7 million	4 million
Share VAT inputs	0.598*** (0.075)	0.343*** (0.102)	0.324*** (0.103)	0.319*** (0.104)
Share VAT sales	0.209*** (0.028)	0.187*** (0.061)	0.142** (0.058)	0.167*** (0.061)
Fixed network		x	x	x
Fixed tax status of partners			x	x
Observations	640,634	640,634	640,634	571,498

Standard errors two-way clustered at the product and location level in parentheses. All specifications include year and firm fixed effects, in column (4) we also control for the firm's turnover. Significance levels: * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.