Supplemental Appendix to

"Taxation and Supplier Networks: Evidence from India"

Lucie Gadenne, Tushar Nandi, Roland Rathelot

A Theory Appendix

A.1 Proof of Proposition 1

Step 1: Getting an expression of s_{jk} as a function of the no-tax-world $\tilde{s}_{jk}$
We start by: $p_{jk}q_{jk} = \alpha_{jk}^{\rho} p_{jk}^{1-\rho} P_k^{\rho} q_{kF} \phi_k^{-1}$ and by:

$$s_{jk} = \frac{p_{jk}q_{jk}}{\sum_j p_{jk}q_{jk}}$$

Note that all the terms in k that do not depend on j are going to be eliminated in the ratio. Opening up P_j and eliminating the terms that do not depend on j, we get an expression of s_{jk} that depends only on structural parameters and tax rates/statuses:

$$s_{jk} = \frac{\gamma_{jk}^{\rho-1} \phi_j^{\rho-1} \alpha_{jk}^{\rho} \alpha_{lj}^{1-\rho}}{\sum_j \gamma_{jk}^{\rho-1} \phi_j^{\rho-1} \alpha_{jk}^{\rho} \alpha_{lj}^{1-\rho}}$$

We introduce the input share $\tilde{s}_{jk}$ that prevails in the absence of taxes:

$$\tilde{s}_{jk} = \frac{\phi_j^{\rho-1} \alpha_{jk}^{\rho} \alpha_{lj}^{1-\rho}}{\sum_j \phi_j^{\rho-1} \alpha_{jk}^{\rho} \alpha_{lj}^{1-\rho}}$$

and note that:

$$s_{jk} = \frac{\gamma_{jk}^{\rho-1} \tilde{s}_{jk}}{\sum_j \gamma_{jk}^{\rho-1} \tilde{s}_{jk}}$$

Step 2: Taking the differences between $v_k = 1$ and $v_k = 0$
Under the assumption that the tax rate on simplified firms is negligible, we have $s_{jk}(1) = s_{jk}(v_k = 1) = \tilde{s}_{jk}$. The input share of a simplified client is:

$$s_{jk}(0) = \frac{\tilde{s}_{jk}(v_j(1-t_j)^{\rho-1} + (1-v_j))}{\sum_j \tilde{s}_{jk}(v_j(1-t_j)^{\rho-1} + (1-v_j))}$$

Define the share of VAT suppliers in the no-tax world when k is in the VAT regime as $s_{Vk}(1) = \sum_j \tilde{s}_{jk} v_j$. When k is in the simplified regime, this is:

$$\begin{aligned} s_{Vk}(0) &= \frac{\sum_j \tilde{s}_{jk} v_j (1-t_j)^{\rho-1}}{\sum_j \tilde{s}_{jk}(v_j(1-t_j)^{\rho-1} + (1-v_j))} \\ &= \frac{(1-\bar{t}_k)^{\rho-1} s_{Vk}(1)}{(1-\bar{t}_k)^{\rho-1} s_{Vk}(1) + 1 - s_{Vk}(1)} \end{aligned}$$

Inverting this relationship, we can get an expression of $s_{Vk}(1)$ as a function of $s_{Vk}(0)$. Then, we get:

$$\frac{s_{Vk}(0)}{s_{Vk}(1)} = (1-\bar{t}_k)^{\rho-1} + s_{Vk}(0)[1 - (1-\bar{t}_k)^{\rho-1}]$$

Now, going back to the expression of $s_{jk}(0)$, and dividing it by $s_{jk}(1) = \tilde{s}_{jk}$:

$$\frac{s_{jk}(0)}{s_{jk}(1)} = \frac{v_j(1-t_j)^{\rho-1} + (1-v_j)}{\sum_j \tilde{s}_{jk}(v_j(1-t_j)^{\rho-1} + (1-v_j))} \tag{18}$$

From the expression of $s_{Vk}(0)$ above, the denominator of this expression is equal to $\frac{(1-\bar{t}_k)^{\rho-1} s_{Vk}(1)}{s_{Vk}(0)}$, which can be replaced using the expression of the ratio above:

$$\frac{s_{jk}(0)}{s_{jk}(1)} = \left(v_j(1-t_j)^{\rho-1} + (1-v_j)\right)\left(1 + s_{Vk}(0)\left[\frac{1}{(1-\bar{t}_k)^{\rho-1}} - 1\right]\right)$$

Using a linear approximation valid for $t_j \ll 1$, we have:

$$\frac{s_{jk}(0)}{s_{jk}(1)} = \left(1 - (\rho-1)t_j v_j\right)\left(1 + s_{Vk}(0)(\rho-1)\bar{t}_k\right)$$

Developing, subtracting 1, eliminating the second-order term, and taking the opposite:

$$\log(s_{jk}(1)) - \log(s_{jk}(0)) = (\rho-1)(t_j v_j - \bar{t}_k s_{Vk}(0)).$$

A.2 Proof of Proposition 2 – tax scheme choice with no size restriction

Start by assuming that firms can choose to pay taxes under the simplified scheme regardless of their total sales. The profits of upstream firm j and downstream firm k are given by:

$$\Pi_j = \kappa_{jF}\gamma_{jF}^{\sigma} + \sum_k \kappa_{jk} r_k^{\rho-\sigma}\gamma_{jk}^{\rho}\gamma_{kF}^{\sigma}$$
$$\Pi_k = \kappa_k \frac{\gamma_{kF}^{\sigma}}{r_k^{\sigma-1}}$$

with:

$$\kappa_{jF} = E\beta_j^{\sigma}\left(\frac{P_F}{\alpha_{\ell j} w\mu}\right)^{\sigma-1}\sigma^{-1}\phi_j^{\sigma-1}$$
$$\kappa_{jk} = P_F^{\sigma-1}E\left(\frac{\beta_k}{\mu}\right)^{\sigma}\alpha_{jk}^{\rho}(\nu P_j)^{1-\rho}\tilde{P}_k^{\rho-\sigma}\rho^{-1}\phi_j^{\rho-1}$$
$$\kappa_k = \sigma^{-1}P_F^{\sigma-1}E\beta_k^{\sigma}\mu^{1-\sigma}\tilde{P}_k^{1-\sigma}\phi^{\sigma-1}$$
$$r_k = \frac{P_k}{\tilde{P}_k} \approx 1 + s_{Vk}\bar{t}_k.$$

For downstream firms, we have:

$$\frac{\Pi_k^V}{\Pi_k^S} = \frac{(1-t_k)^{\sigma}}{(1-s_{Vk}\bar{t}_k)^{\sigma-1}}$$

For upstream firms, we define $\kappa_{jS} = \sum_k \kappa_{jk}(1-v_k)$, and $\kappa_{jV} = \sum_k \kappa_{jk}v_k$.

$$\Pi_j^V = \kappa_{jF}(1-t_j)^{\sigma} + \kappa_{jV}(1-\bar{t}_j)^{\sigma-1} + \kappa_{jS}\bar{r}_j^{\rho-\sigma}(1-t_j)^{\rho}$$
$$\Pi_j^S = \kappa_{jF} + \kappa_{jV}(1-\bar{t}_j)^{\sigma-1} + \kappa_{jS}\bar{r}_j^{\rho-\sigma}$$

Therefore:

$$\Pi_j^V - \Pi_j^S = -\kappa_{jF}[1-(1-t_j)^{\sigma}] - \kappa_{jS}\bar{r}_j^{\rho-\sigma}[1-(1-t_j)^{\rho}]$$

The first two results of the Proposition come directly out of these expressions. For the third one, we need to link the expression for the upstream firms with the share of VAT clients in

the no-tax world. We have $x_{jk} = \kappa_{jk}\rho r_k^{\rho-\sigma}\gamma_{jk}^{\rho-1}\gamma_{kF}^{\sigma}$, so that the share of VAT clients is:

$$\lambda_{jV} = \frac{\sum_k x_{jk}v_k}{x_{jF} + \sum_k x_{jk}} = \frac{\kappa_{jV}(1-\bar{t}_j)^{\sigma}}{\frac{\sigma}{\rho}\kappa_{jF}(1-t_j)^{\sigma-1}\kappa_{jV}(1-\bar{t}_j)^{\sigma} + \kappa_{jS}\bar{r}_j^{\rho-\sigma}(1-v_jt_j)^{\rho-1}}$$

And the share of potential VAT clients is:

$$\tilde{\lambda}_{jV} = \frac{\kappa_{jV}}{\frac{\sigma}{\rho}\kappa_{jF} + \kappa_{jV} + \kappa_{jS}}$$

From there:

$$\Pi_j^V - \Pi_j^S = (\tilde{x}_{jF} + \sum_k \tilde{x}_{jk}) \left[-\tilde{\lambda}_{jF}\sigma^{-1}[1-(1-t_j)^{\sigma}] - \tilde{\lambda}_{jS}\rho^{-1}\bar{r}_j^{\rho-\sigma}[1-(1-t_j)^{\rho}]\right]$$

Take the first approximation of $1-(1-t_j)^{\rho}$ and $1-(1-t_j)^{\sigma}$:

$$\Pi_j^V - \Pi_j^S = (\tilde{x}_{jF} + \sum_k \tilde{x}_{jk}) \left[-\tilde{\lambda}_{jF}t_j - \tilde{\lambda}_{jS}t_j\bar{r}_j^{\rho-\sigma}\right]$$

Consider an increase in $\tilde{\lambda}_{jV}$ that reduces either $\tilde{\lambda}_{jS}$, $\tilde{\lambda}_{jF}$, or both. For instance, consider $\frac{\partial\lambda_{jS}}{\partial\lambda_{jV}} = -\theta$ and $\frac{\partial\lambda_{jF}}{\partial\lambda_{jV}} = \theta - 1$, where $\theta \in (0,1)$. Then:

$$\frac{\partial(\Pi_j^V - \Pi_j^S)}{\partial\lambda_{jV}} = (\tilde{x}_{jF} + \sum_k \tilde{x}_{jk}) \left[(1-\theta)t_j + \theta t_j\bar{r}_j^{\rho-\sigma}\right]$$

A.3 Proof of Proposition 2 – tax scheme choice with a size restriction

We now introduce a constraint on firms paying taxes in the simplified scheme: these firms total sales must be lower than a threshold $\bar{x}$. Bunching occurs when the firm chooses to keep its total sales constant at $\bar{x}$ while its productivity increases, to remain in the simplified regime. We write ϕ_j^b the lowest productivity level at which firm j can obtain a level of sales $\bar{x}$. We write Π_j^b the profit of a bunching upstream firm j:

$$\Pi_j^b = \bar{x}_{jF}(1 - \frac{P_j}{\phi_j p_{jF}}) + \sum_k \bar{x}_{jk}(1 - \frac{P_j}{\phi_j p_{jk}})$$

From the expressions (6) and (7), taken for the case where j is in the simplified regime, we have $p_{jk} = p_{jF}\mu\nu^{-1}$ and:

$$\Pi_j^b = \bar{x}_{jF}(1 - \frac{P_j}{\phi_j p_{jF}}) + \sum_k \bar{x}_{jk}(1 - \frac{P_j \mu}{\phi_j p_{jF} \nu})$$

Where the $\tilde{}$ terms indicate values in the no-tax world. Defining $\tilde{\lambda}_{jV}, \tilde{\lambda}_{jS}, \tilde{\lambda}_{jF}$ the share of sales that firm j makes to VAT, simplified, and final clients in the no-tax world and $\tilde{x}_j(\phi_j)$ the total sales of firm j with productivity ϕ_j in a no-tax world, we can write:

$$\begin{aligned}
\sum_k \bar{x}_{jk} 1\{v_k = 1\} &= \tilde{\lambda}_{jV}(1 - \bar{t}_j)^\sigma \tilde{x}_j(\phi_j^b) \\
\sum_k \bar{x}_{jk} 1\{v_k = 0\} &= \tilde{\lambda}_{jS} \bar{r}_j^{\rho-\sigma} \tilde{x}_j(\phi_j^b) \\
\bar{x}_{jF} &= \tilde{\lambda}_{jF} \tilde{x}_j(\phi_j^b)
\end{aligned}$$

So that:

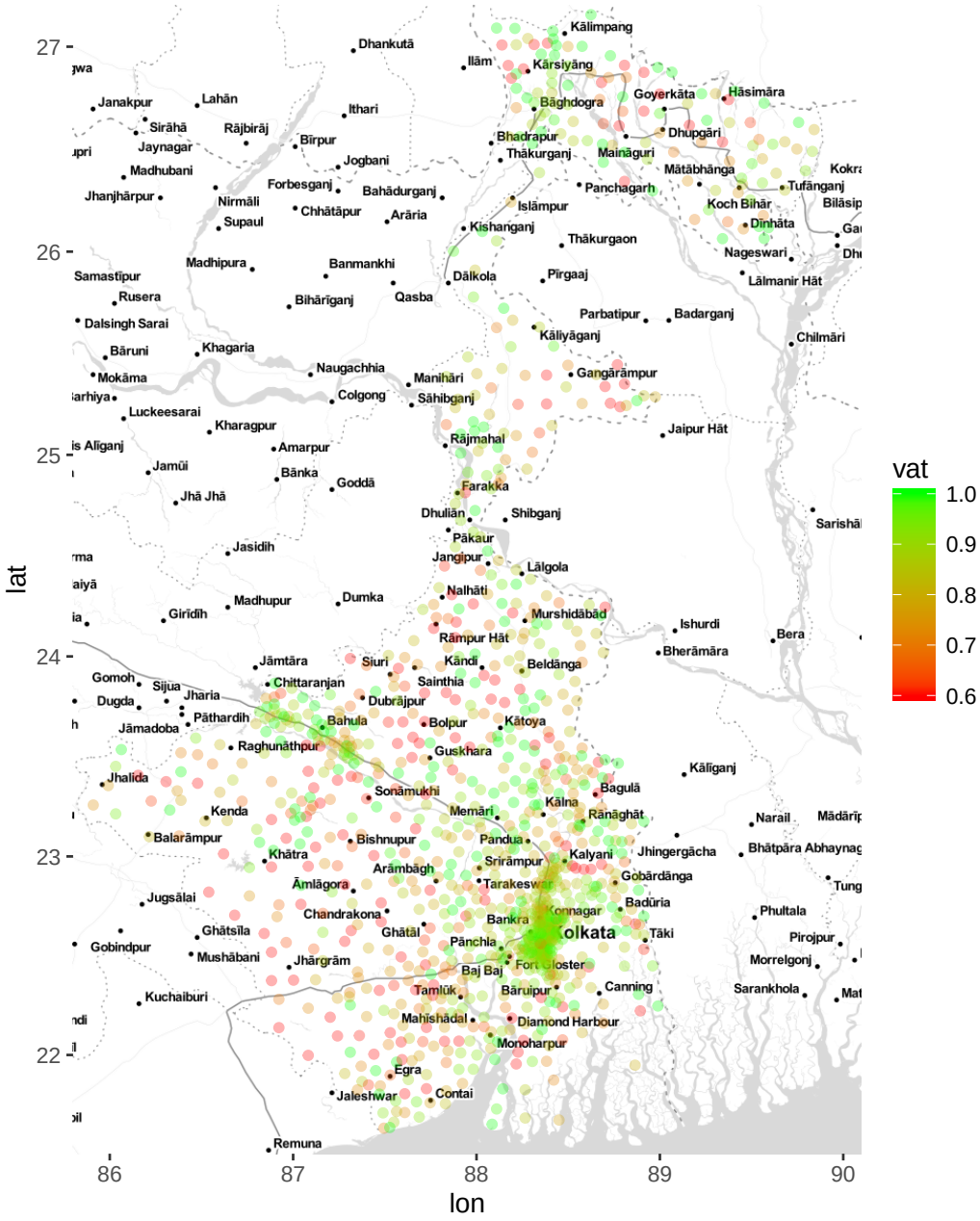
$$\Pi_j^b = \tilde{x}_j(\phi_j^b)[\tilde{\lambda}_F(1 - \frac{P_j}{\phi_j p_{jF}}) + \tilde{\lambda}_V(1 - \frac{P_j}{\phi_j p_{jF}}\frac{\mu}{\nu})(1 - \bar{t}_j)^\sigma + \tilde{\lambda}_S(1 - \frac{P_j}{\phi_j p_{jF}}\frac{\mu}{\nu})\bar{r}_j^{\rho-\sigma}]$$

Note that: $\bar{x}_{jF} = \tilde{\lambda}_{jF}\tilde{x}_j(\phi_j^b)$, and $p_{jF} = P_F E^{\mu-1}\beta_j^\mu x_{jF}^{1-\mu}$, so that $p_{jF} = P_F E^{\mu-1}\beta_j^\mu(\tilde{\lambda}_{jF}\tilde{x}_j(\phi_j^b))^{1-\mu}$. This expression does not depend on ϕ_j or any parameter of the tax system, from there it is easy to show that p_{jF} will decrease when $\tilde{\lambda}_{jF}$ increases.

B Context and data

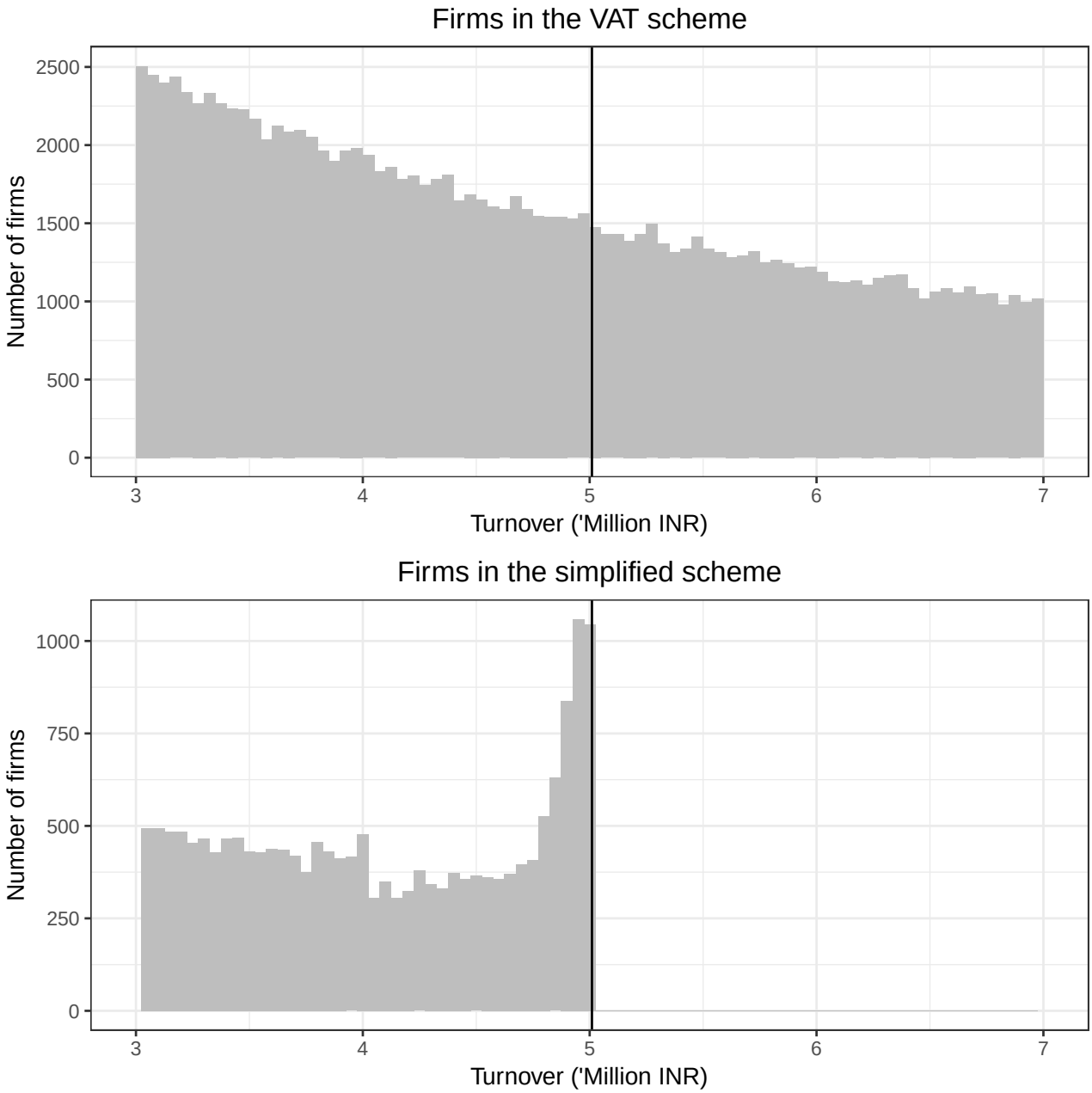
Figure B.2 plots the distribution of firms around the 5 million INR sales threshold above which firms have to pay taxes under the VAT scheme. Figure B.1 plots the location of firms in our data on a map of West Bengal. Each dot represents a postcode, the color of the dot indicates the share of firms in that postcode that are in the VAT scheme. State frontiers are indicated by the grey dotted lines. Table B.1 presents the types of products sold by firms as well as the average size and the share of VAT-paying firms among firms selling each product.

Figure B.1: Share of firms in the VAT scheme by location



Each dot represents a postcode in which firms in our data are located, the color of the dot represents the share of firms in the postcode that pay taxes under the VAT scheme. The dotted lines are state borders.

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.

Table B.1: Products sold and firm tax scheme in 2010-2011

Commodity type	Turnover	% Large firms	Amongst small, % VAT	Nb firms
Machines & equipment	29,944 (453,046)	31.94	91.36	19,848
Construction materials	14,934 (337,623)	24.60	79.10	17,170
Electrical & electronic goods	33,271 (827,021)	33.45	81.17	15,811
Food, drink & tobacco	40,405 (528,532)	40.73	73.57	15,064
Chemical products	41,193 (971,028)	36.86	76.09	11,269
Textiles	24,371 (170,209)	31.53	72.16	11,084
Metal products	110,203 (780,702)	54.39	94.16	10,957
Wood & paper	20,736 (140,134)	28.80	90.71	9,567
Other commodities	60,891 (1,092,316)	27.41	88.86	8,567
Rubber & plastic	44,409 (1,087,263)	34.46	87.56	4,745
Household goods	9,574 (90,148)	17.80	77.16	3,489
Mining & energy	77,557 (1,051,281)	51.95	90.06	2,743
All	39,168 (666,196)	34.06	82.76	130,314

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 second column presents the share of firms with a turnover of over 5 million INR, the third column the share of VAT firms amongst firms with a turnover of less than 5 million INR and the fourth 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.2: Correlation between a firm's tax scheme and its use of VAT trading partners - flexible firm size controls

	Dependent variable: In VAT scheme		
	(1)	(2)	(3)
Share VAT sales	0.138***	0.148***	0.133***
	(0.020)	(0.020)	(0.022)
Share VAT inputs	0.082***	0.105***	0.091***
	(0.013)	(0.016)	(0.016)
Product × Location FE	x	x	
Firm size	x	x	
Product × Location FE × Firm size-decile			x
Observations	571,513	571,513	571,513

The sample includes all firms with a minimum turnover of less than 4 million INR over the fiscal years 2010-2011 to 2015-2016. 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 simplified tax 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 intermediate inputs purchased from VAT suppliers in year t, year fixed effects, as well as product × location fixed effects and firm size. The first column of this table replicates the fifth one of Table 2 in the paper. In column (2), we add deciles of turnover to the specification. In column (3), we also introduce good × pincode × turnover-decile fixed effects instead of good × pincode fixed effects. Standard errors in parentheses are clustered at the level of the product sold by the firm and the location of the firm. Significance levels: *p<0.1; **p<0.05; ***p<0.01.

B.1 Additional information on the transaction data

Data construction Transaction amounts are recorded by both firms involved in the transaction in 79 % of the cases. The pattern of no-reporting does not suggest firms strategically choose not to report transactions to lower their tax liabilities. Strategic no-reporting would lead to sellers not reporting transactions yet we see that half of the no-reporting is due to purchasers not reporting transactions.

When both firms report positive amounts, the reported amounts differ by less than 10% in 83% of cases. Here again, the evidence does not suggest strategic under-reporting. When the two firms report different amounts, potential attempts at under-reporting (ie, cases where the seller reports less than the purchaser) are less likely than potential attempts at over-reporting (44% vs 56%). This suggests differences in reported amounts are mistakes and not strategic, so we use the information reported by sellers and purchasers in the following way. When only one of the two firms reports, we keep the reported amount as the transaction amount (regardless of the tax scheme of these firms, this also ensures consistency across tax schemes). When both firms report, we take the average of the two reported amounts.

Reporting threshold Firms have to report all transactions with tax-registered partners when transactions exceed 50,000 INR. Transactions below 50,000 represent 0.05 % of the sample of transactions and are excluded from our analysis (including them makes no difference to our results). Figure B.3 shows the distribution of transactions below 1 million INR.

B.2 Additional evidence on asymmetric under-reporting

This sub-section presents several pieces of evidence that suggest that under-reporting by VAT-paying firms of sales to firms in the simplified scheme is unlikely to be a major concern. First, we find no evidence that firms are 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. On the contrary, firms are a lot more likely to report a client in the simplified scheme than to report a supplier in the simplified scheme: we find that 6% of VAT firms report at least one non-VAT client, less than 1% report a non-VAT supplier. See also Table 1 in the paper. We hypothesize that this is because firms in the simplified scheme are often located downstream in supply chains and therefore substantially more likely to buy from other firms than to sell to other firms – see Table B.1.

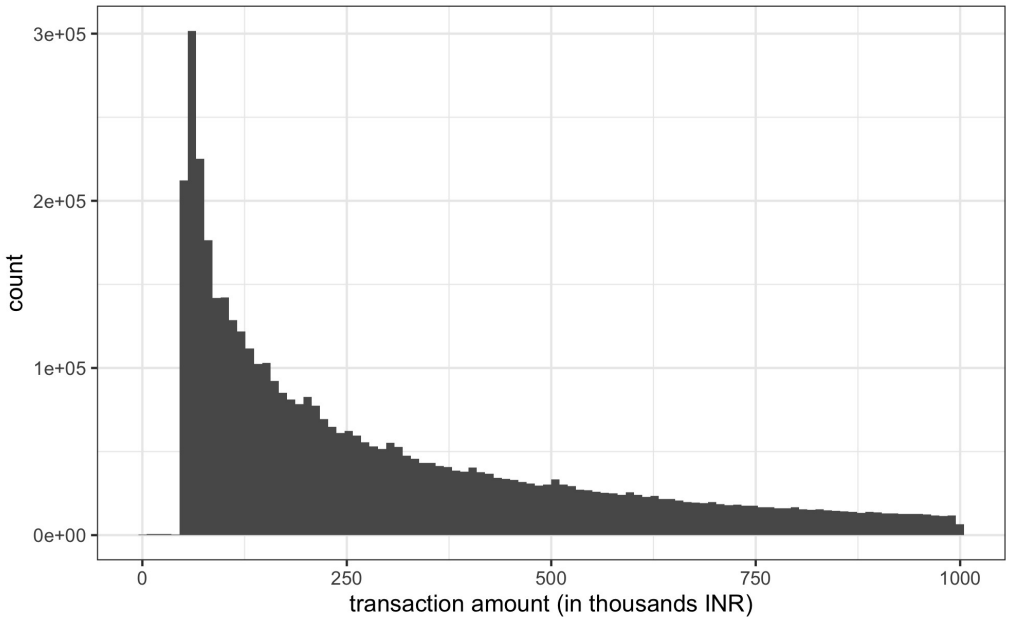
Second, we decompose firms' sales into 'third-party-reported sales' and 'voluntarily reported sales'. We define a sale as 'third-party-reported' if both the seller and the buyer involved in the transaction report the sale, i.e., both pay VAT. Declaring sales to clients in the simplified scheme only increases firms' tax liabilities if these sales are larger than the 'voluntarily reported sales' that firms report regardless. Table B.3 shows that firms report total sales that are on average three times larger than their total third-party-reported sales. This is true both for the entire sample of firms in the VAT scheme (panel A) and when we restrict the sample to firms with a turnover of less than 7 million (panel B), the sample of firms we focus on in the paper. Reporting non-VAT clients truthfully will therefore not increase the liabilities of the average firm.

Third, we find that the share of third-party reported sales is not negatively correlated with the share of sales to clients in the simplified scheme. If firms with a smaller 'voluntarily reported sales' share were less willing to truthfully report sales to these clients because it will increase their tax liabilities, we would see such a negative correlation. In Table B.3 we see that, on the contrary, the share of third-party-reported sales among total sales is slightly larger for firms that report at least one transaction with a client in the simplified scheme than for those that do not. Again, this is also true when we focus on firms with a turnover of less than 7 million.

To investigate this further, we plot the average share of firms reporting at least one client with a turnover of less than 7 million INR for each decile of the share of third-party-reported sales. Figure B.4 plots this for all firms in the VAT scheme, and Figure B.5 for firms in the VAT scheme with a turnover of less than 7 million. The black full line plots the share of firms reporting at least one client in the simplified scheme, the grey dashed line plots the share of firms reporting at least one small client in the VAT scheme.

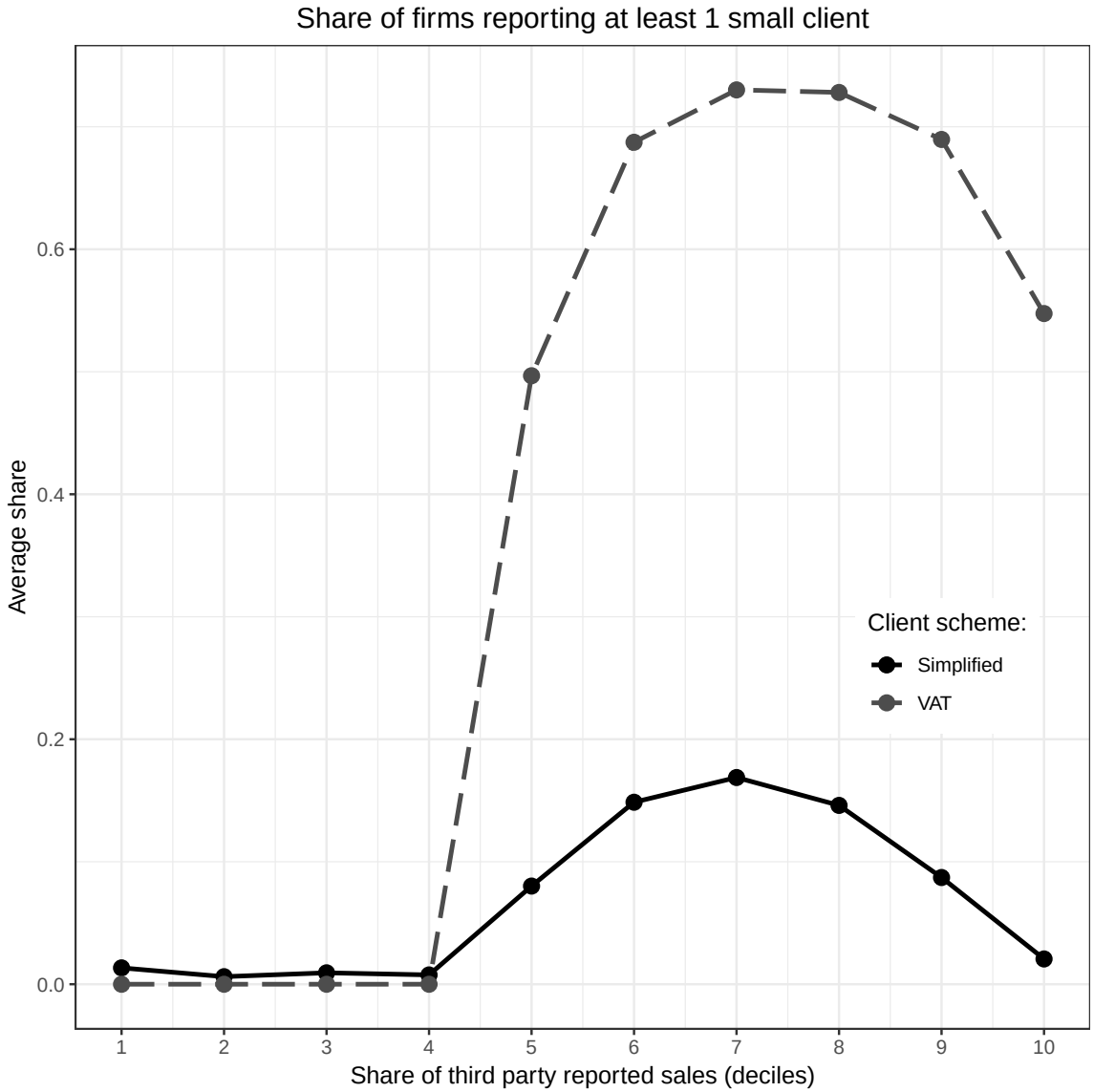
If firms were only willing to report sales to clients in the simplified scheme when reporting this transaction has no impact on their total sales, we would see a steep decline in the share of firms reporting clients in the simplified scheme as the share of third-party-reported sales increases. We would not however expect to see such a decline in the share of firms reporting a small VAT-paying client, as transactions with small VAT-paying clients are third-party reported. We see that this is not the case: firms with high shares of third-party-reported sales are less likely to report trading with small clients, regardless of the tax status of the client.

Figure B.3: Histogram of transactions below 1 million INR



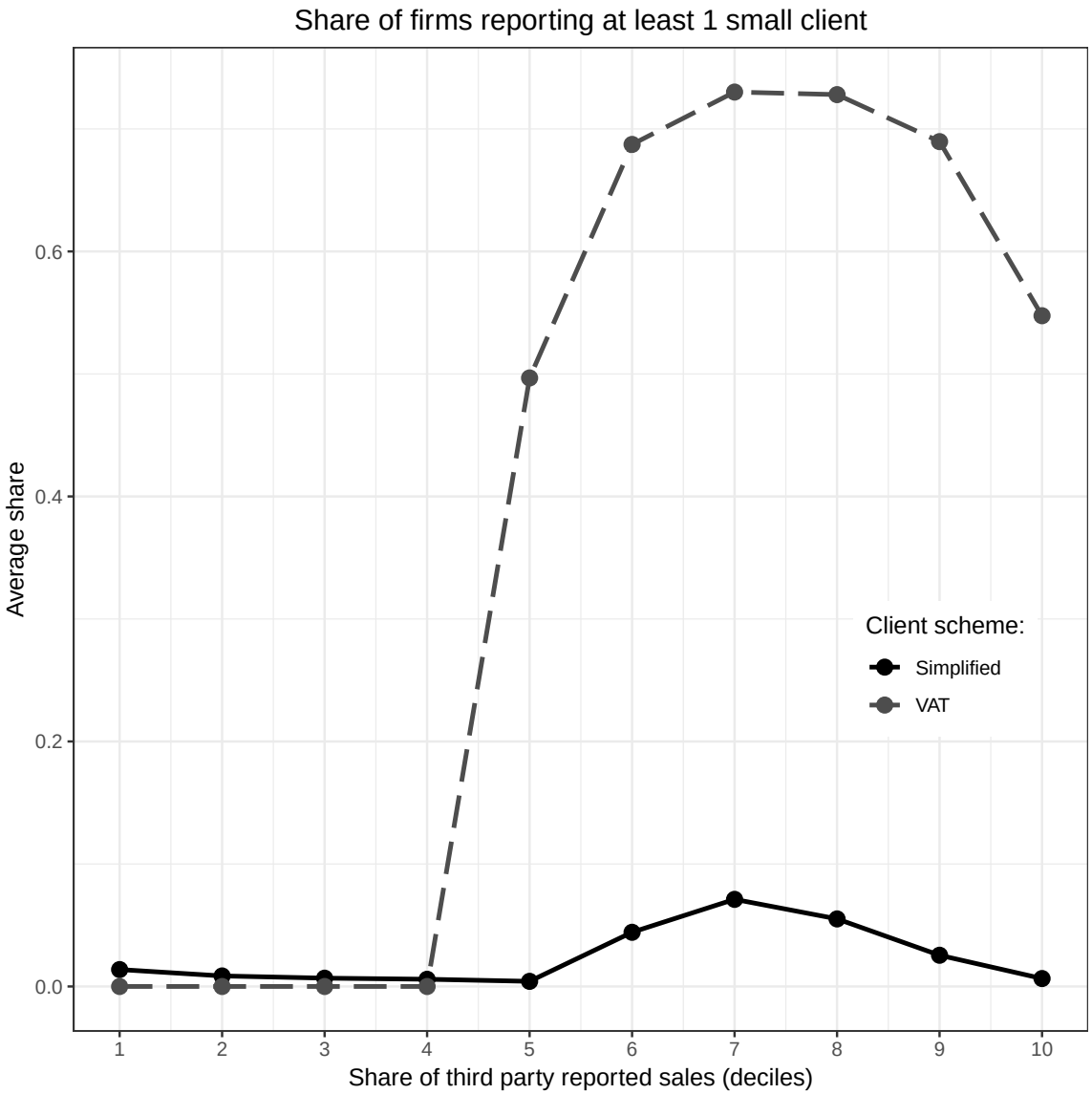
This graph plots the histogram of transactions (pair of firms per year), on the subsample below 1 million INR.

Figure B.4: Sales to simplified scheme clients and third party reported sales: all firms



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 sample of firms considered contains only firms in the VAT scheme. 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.5: Sales to simplified scheme clients and third party reported sales: small firms only



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 sample of firms considered contains only firms in the VAT scheme with a turnover of less than 7 million INR. 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. 50% 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.

Table B.3: Share of third-party-reported sales and sales to simplified scheme clients

	Share of third-party-reported sales	Observations
A. Entire sample		
All firms	0.28 (0.36)	732,114
Firms with > 0 sales to simplified scheme clients	0.36 (0.29)	50,358
Firms with no sales to simplified scheme clients	0.27 (0.36)	681,756
B. Firms with a turnover of less than 7 million INR		
All firms	0.25 (0.36)	466,177
Firms with > 0 sales to simplified scheme clients	0.29 (0.27)	11,275
Firms with no sales to simplified scheme clients	0.25 (0.36)	454,902

Mean values, standard errors in parentheses. Panel A includes all firms in the VAT scheme, panel B all firms in the VAT scheme with a turnover of less than 7 million. In both panels the second line restricts the sample to firms with positive sales to clients in the simplified scheme in the second line and the third line to firms with no sales to clients in the simplified scheme. 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.

C Empirical strategy

C.1 Bunching evidence

Figure C.6 plots the distribution of firms by turnover size 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. Table C.4 presents descriptive statistics on the variables and the sample used to estimate strategic complementarities, see the main body of the paper for a discussion.

C.2 Proxying potential input and sales shares

We do not observe $\tilde{s}_{Vk}$, the share of input firm k buys from suppliers in the VAT regime in the no-tax counterfactual and $\tilde{\lambda}_{jV}$, the share of sales firm j sells to clients in the VAT regime in the no-tax counterfactual.

As showed in the Proof of Proposition 1, the share of input k buys from supplier j is equal to $\tilde{s}_{jk}$ with k in the VAT regime, and the the share of input firm k buys from suppliers in the VAT regime when k is in the VAT regime $s_{Vk}(1)$ is equal to $\tilde{s}_{Vk}$.

We don't have such equality for sales shares. From the proof of Proposition 2, the share of VAT clients is:

$$\lambda_{jV} = \frac{\kappa_{jV}(1-\bar{t}_j)^{\sigma}}{\frac{\sigma}{\rho}\kappa_{jF}(1-t_j)^{\sigma-1}\kappa_{jV}(1-\bar{t}_j)^{\sigma} + \kappa_{jS}\bar{r}_j^{\rho-\sigma}(1-v_j t_j)^{\rho-1}}$$

And the share of potential VAT clients is:

$$\tilde{\lambda}_{jV} = \frac{\kappa_{jV}}{\frac{\sigma}{\rho}\kappa_{jF} + \kappa_{jV} + \kappa_{jS}}$$

To simplify the rest of the reasoning, assume that there is only one VAT rate $t_j = t, \forall j$. We have:

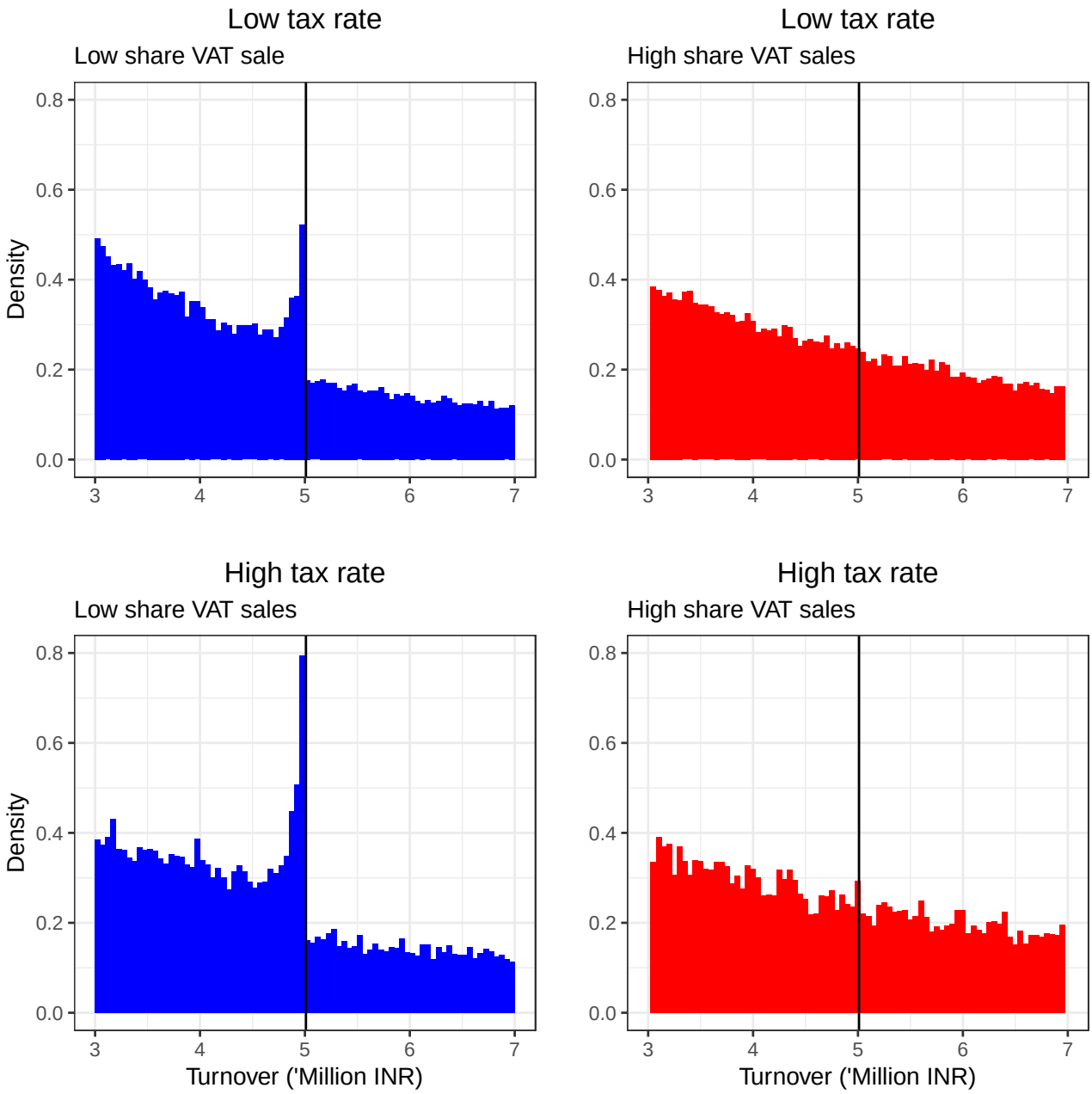
$$\lambda_{jV}(0) = \frac{\kappa_{jV}}{\frac{\sigma}{\rho}\kappa_{jF}(1+t)^{\sigma} + \kappa_{jV} + \kappa_{jS}(1+s_V t)^{\rho-\sigma}(1+t)^{\sigma}}$$
$$\lambda_{jV}(1) = \frac{\kappa_{jV}}{\frac{\sigma}{\rho}\kappa_{jF} + \kappa_{jV} + \kappa_{jS}(1+s_V t)^{\rho-\sigma}}$$

where $\lambda_{jV}(0)$ ($\lambda_{jV}(1)$) is the VAT sale share of firm j when $v_j = 0$ ($v_j = 1$). Assuming that $t << 1$, the first-order approximation of the previous expressions are:

$$\lambda_{jV}(0) \approx \tilde{\lambda}_{jV}\left(1 - t\frac{\frac{\sigma^2}{\rho}\kappa_{jF} + \sigma\kappa_{jS} + (\rho-\sigma)\kappa_{jS}s_V}{\frac{\sigma}{\rho}\kappa_{jF} + \kappa_{jV} + \kappa_{jS}}\right)$$
$$\lambda_{jV}(1) \approx \tilde{\lambda}_{jV}\left(1 - t\frac{(\rho-\sigma)\kappa_{jS}s_V}{\frac{\sigma}{\rho}\kappa_{jF} + \kappa_{jV} + \kappa_{jS}}\right)$$

From these expressions, we see that both $\lambda_{jV}(0)$ and $\lambda_{jV}(1)$ are below $\tilde{\lambda}_{jV}$ and that $\lambda_{jV}(1)$ is a better proxy for $\tilde{\lambda}_{jV}$.

Figure C.6: 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 that sell products in the low and medium tax schedule, the bottom two firms that sell products 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.

Table C.4: Descriptive statistics, strategic complementarities sample

	Always simpl. scheme	Always VAT scheme	Switchers
Turnover	1,697	4,160	3,310
	(1,277)	(39,253)	(8,675)
Wtd share VAT inputs	0.033	0.033	0.050
	(0.040)	(0.034)	(0.045)
Wtd share VAT sales	0.000	0.013	0.002
	(0.005)	(0.021)	(0.010)
Wtd share VAT inputs (entry/exit IV)	0.029	0.033	0.043
	(0.032)	(0.028)	(0.036)
Wtd share VAT sales (entry/exit IV)	0.001	0.015	0.003
	(0.005)	(0.020)	(0.010)
Wtd share VAT inputs (tax rate IV)	0.030	0.031	0.046
	(0.038)	(0.033)	(0.043)
Wtd share VAT sales (tax rate IV)	0.000	0.013	0.002
	(0.005)	(0.020)	(0.009)
Has a trading partner	0.65	0.81	0.79
Nb trading partners	2.7	5.8	3.8
	(2.2)	(7.5)	(3.9)
Has an enter./exiting partner	0.15	0.37	0.25
Nb enter./exiting partners	1.2	2.0	1.6
	(0.6)	(2.1)	(1.1)
Trading partner's turnover	518,984	383,153	610,101
	(705,128)	(591,112)	(703,626)
Enter./exiting partner's turnover	197,307	138,020	221,899
	(455,126)	(325,834)	(497,978)
Number of firms	13,345	108,554	7,098
Observations	65,690	470,225	35,598

Mean (standard deviation). This table presents descriptive statistics on the sample of firms used to estimate strategic complementarities in (12). Turnover is in thousand INR, the variables 'weighted share VAT inputs', 'weighted share VAT sales' are defined in the text. The entry/exit instruments are z^{λ}_{it} and z^{s}_{it} which use only variation coming from a firm's trading partner entry and exit over time. These instruments are defined in equation (13). The tax rate instruments are w^{λ}_{it} and w^{s}_{it} which use only variation coming from changes in tax rates over time. These instruments are defined in equation (14). The last two lines present the average turnover of the firm's trading partners. The sample in the first column includes all firms that are always in the VAT scheme, in the second column all firms always in the simplified scheme, and in the third column all firms that change tax scheme over the period.

D First stages and robustness checks

Table D.5: Strategic complementarities: first stage results

Outcome variable:	Weighted share VAT inputs		Weighted share VAT sales	
	(1)	(2)	(3)	(4)
A. Entry & exit instruments:				
Weighted share VAT inputs	0.493***	0.006		
	(0.017)	(0.006)		
Weighted share VAT sales	0.024	0.690***		
	(0.021)	(0.023)		
B. Tax rate instruments:				
Weighted share VAT inputs			0.833***	-0.007***
			(0.006)	(0.001)
Weighted share VAT sales			0.006**	0.854***
			(0.002)	(0.009)
Observations	571,498	571,498	571,498	571,498

Standard errors in parentheses are two-way clustered at the product and location level. This table presents the first stage results corresponding to the second stage in Table 4, columns 2 and 3. The sample includes all firms with a minimum turnover over the period of less than 4 million INR. The outcome variables 'share VAT inputs' and 'share VAT sales' are the variables $t_{it} \sum_k \lambda_{ikt} v_{kt}$ and $\sum_j t_{tj} s_{jit} v_{jt}$: the share of the firm's intermediate inputs purchased from VAT-paying suppliers, weighted by each supplier's VAT rate, and the share of the firm's sales sold to VAT-paying clients multiplied by the firms' own VAT rates. Panel A presents first stage results with instruments z_{it}^{λ} and z_{it}^{s} which use only variation coming from a firm's trading partner entry and exit over time. These instruments are defined in equation (13). Panel B presents first stages results with instruments w_{it}^{λ} and w_{it}^{s} which use only variation coming from changes in tax rates over time. These instruments are defined in equation (14). All specifications control for firm size and include firm and year fixed effects.

Table D.6: Additional results on strategic complementarities

	Outcome: In VAT Scheme					
	(1)	(2)	(3)	(4)	(5)	(6)
Weighted share VAT inputs	0.720***	0.694***	0.714***	0.692***	0.790***	0.726***
	(0.203)	(0.079)	(0.203)	(0.079)	(0.207)	(0.084)
Weighted share VAT sales	0.217***	0.158***	0.210***	0.154***	0.188***	0.139***
	(0.076)	(0.024)	(0.075)	(0.024)	(0.070)	(0.023)
Instrument	Entry& exit	Tax rates	Entry& exit	Tax rates	Entry& exit	Tax rates
Sample	Baseline	Baseline	Baseline	Baseline	<7 million	<7 million
Turnover control	Linear	Linear	Quadratic	Quadratic	None	None
Observations	571,498	571,498	571,498	571,498	640,634	640,634

The sample includes all firms with a minimum turnover of less than 4 million INR over the fiscal years 2010-2011 to 2015-2016, except for columns 5 and 6 where sample includes all firms with a minimum turnover of less than 7 million INR. The dependent variable is an indicator equal to 1 if the firm is in the VAT scheme, 0 otherwise. The right-hand side variables 'Weighted share VAT inputs' and 'Weighted share VAT sales' are the variables $t_{it}\sum_k \lambda_{ikt} v_{kt}$ and $\sum_j t_{tj} s_{jit} v_{jt}$: the share of the firm's intermediate inputs purchased from VAT-paying suppliers, weighted by each supplier's VAT rate, and the share of the firm's sales sold to VAT-paying clients multiplied by the firms' own VAT rates. In columns 1, 3, and 5, these variables are instrumented for using the instruments z_{it}^{λ} and z_{it}^{s} which use only variation coming from a firm's trading partner entry and exit over time. These instruments are defined in equation (13). In columns 2 ,4 and 6 these variables are instrumented for using the instruments w_{it}^{λ} and w_{it}^{s} which use only variation coming from changes in tax rates over time. These instruments are defined in equation (14). All specifications year and firm fixed effects. Columns 1, 2, 5, and 6 control for firm size (turnover) linearly. Columns 3 and 4 control for a quadratic form of firm size. Sanderson and Windmeijer (2016) conditional F stats are 850.0 and 251.8 in column 3 and 930.5 and 247.7 in column 6. See the text for a description of these variables. Standard errors in parentheses are two-way clustered at the product and location level. Significance levels: *p<0.1; **p<0.05; ***p<0.01.

Table D.7: Strategic complementarities using entry and exit as instruments: controlling for size and number of potential trading partners

	Outcome: In VAT Scheme		
	(1)	(2)	(3)
Weighted share VAT inputs	0.720***	0.968***	0.774***
	(0.203)	(0.164)	(0.179)
Weighted share VAT sales	0.217***	0.149**	0.442**
	(0.076)	(0.072)	(0.197)
Average size of potential supplier		0.248	0.120
		(0.528)	(0.536)
Average size of potential client		-1.05*	-1.01*
		(0.564)	(0.556)
Number of potential suppliers			0.005
			(0.004)
Number of potential clients			-0.009*
			(0.005)
Instrument		Entry& exit	
Time fixed effects		Year	
Observations	571,498	287,604	287,604

The sample includes all firms with a minimum turnover of less than 4 million INR over the fiscal years 2010-2011 to 2015-2016. The dependent variable is an indicator equal to 1 if the firm is in the VAT scheme, 0 otherwise. The right-hand side variables 'Weighted share VAT inputs' and 'Weighted share VAT sales' are the variables $\sum_j t_{tj} s_{jit} v_{jt}$ and $t_{it} \sum_k \lambda_{ikt} v_{kt}$: the share of the firm's intermediate inputs purchased from VAT-paying suppliers, weighted by each supplier's VAT rate, and the share of the firm's sales sold to VAT-paying clients multiplied by the firms' own VAT rates. In all columns, these variables are instrumented for using the instruments z_{it}^{λ} and z_{it}^{s} which use only variation coming from a firm's trading partner entry and exit over time. 'Number of potential suppliers' and 'Number of potential clients' are the number of potential suppliers/clients in the firms' trade network, as defined by eq (13). 'Average size of potential supplier' and 'Average size of potential client' are the average sales of the potential suppliers/clients of the firm (in billion INR). All specifications include firm size (turnover), year fixed effects, and firm fixed effects. Standard errors in parentheses are two-way clustered at the product and location level. Significance levels: *p<0.1; **p<0.05; ***p<0.01.

Table D.8: Additional results on supply chain distortions

	(1)	(2)	(3)	(4)	(5)	(6)
Client in VAT	0.152***	0.153***	0.157***	0.156***	0.172***	0.238***
	(0.031)	(0.031)	(0.030)	(0.033)	(0.032)	(0.009)
Client in VAT * VAT input share	-0.209***	-0.197***	-0.216***	-0.202***	-0.185***	-0.259***
	(0.051)	(0.050)	(0.048)	(0.052)	(0.050)	(0.013)
Client in VAT * High tax supplier	0.196***	0.157***	0.196***	0.225***	0.224***	0.060***
	(0.058)	(0.052)	(0.056)	(0.060)	(0.059)	(0.017)
Client in VAT * VAT input share * High tax supplier	-0.200**	-0.186**	-0.206***	-0.233***	-0.228***	-0.056**
	(0.077)	(0.072)	(0.074)	(0.075)	(0.074)	(0.023)
Outcome variable	Baseline	Baseline	Baseline	Baseline	Baseline	Trade >0
Sample	Baseline	B2B sales share<0.9	Baseline	All eligible clients	Baseline	Baseline
Turnover control	Linear	Linear	Linear	None	Polynomial	Linear
Location $*$Year FE	No	No	Yes	No	No	No
Supplier $*$Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	2,553,100	2,095,169	2,553,100	3,301,435	3,301,435	2,553,100
Number of pairs	508,062	467,171	508,062	648,677	648,677	508,062

Standard errors in parentheses are two-way clustered at the level of the product sold by the client and the location of the client. All columns include supplier$\times$year fixed effects. Column 1 replicates the baseline specification in column 3, Table 5. In column 2 the sample excludes pairs in which the supplier sells more than 90% of its sales to VAT-registered clients, in column 3 we add client location$\times$ year fixed effects, in column 4 the sample includes all pairs in which the client is eligible at least once to the simplified tax scheme, in column 5 we control for a polynomial in firm size and in column 6 the dependent variable is an indicator equal to 1 if the pair trades, 0 otherwise. Significance levels: *p$<$0.1; **p$<$0.05; ***p$<$0.01.

Table D.9: Supply chain distortions: adding client × year fixed effects

	Outcome variable: Log input share s_{jkt}			
	(1)	(2)	(3)	(4)
Client in VAT	0.269***	0.174***	0.152***	
	(0.038)	(0.034)	(0.031)	
Client in VAT * VAT input share	-0.307***	-0.215***	-0.209***	
	(0.049)	(0.054)	(0.051)	
Client in VAT * High tax supplier		0.228***	0.196***	0.160***
		(0.057)	(0.058)	(0.060)
Client in VAT * VAT input share * High tax supplier		-0.231***	-0.200**	-0.190**
		(0.075)	(0.077)	(0.081)
p. value of $\beta_1 + \beta_2 = 0$		0.14	0.04	
p. value of $\beta_3 + \beta_4 = 0$		0.93	0.93	0.51
ρ (medium tax)		4.87 (0.74)	4.38 (0.68)	
ρ (high tax)		3.67 (0.67)	3.31 (0.68)	2.88 (0.71)
Supplier $*$Year FE	No	No	Yes	Yes
Client $*$ Year FE	No	No	No	Yes
Observations	2,553,100	2,553,100	2,553,100	2,553,100
Number of pairs	508,062	508,062	508,062	508,062

Standard errors in parentheses are two-way clustered at the level of the product sold by the client and the location of the client, standard errors for ρ are obtained using the Delta method.The sample includes all pairs that trade at least once during the period in which the supplier is never eligible to the simplified scheme (minimum turnover greater than 7 million), and the client is always eligible to the scheme (minimum turnover lower than 4 million). The variable 'Client in VAT' is equal to 1 if the client is in the VAT scheme, 0 otherwise. The variable 'VAT input share' is equal to the share of the client's intermediate inputs purchased from VAT suppliers when the client is in the simplified scheme. The variable 'High tax supplier' is equal to 1 is the supplier faces the high VAT rate. All specifications include pair fixed effects and control for the size of the client, as well as year fixed effects (columns 1 and 2), supplier×year fixed effects (columns 3 and 4) and client × year fixed effects (column 4). Significance levels: *p<0.1; **p<0.05; ***p<0.01.

Table D.10: Supply chain distortions: dynamic effects

	Outcome: Log input share s_{jkt}	
	(1)	(2)
Client in VAT	0.152***	0.192***
	(0.031)	(0.036)
Client in VAT * VAT input share	-0.209***	-0.249***
	(0.051)	(0.063)
Client in VAT * High tax supplier	0.196***	0.129**
	(0.058)	(0.056)
Client in VAT * VAT input share * High tax supplier	-0.200**	-0.108
	(0.077)	(0.085)
Lag client in VAT		-0.046**
		(0.020)
Lag client in VAT * VAT input share		0.082**
		(0.036)
Lag Client in VAT * High tax supplier		0.033
		(0.031)
Lag Client in VAT * VAT input share * High tax supplier		-0.070
		(0.061)
Supplier $*$Year FE	Yes	Yes
Observations	2,553,100	2,045,038
Number of pairs	508,062	506,068

Standard errors in parentheses are two-way clustered at the level of the product sold by the client and the location of the client, standard errors for ρ are obtained using the Delta method.The sample includes all pairs that trade at least once during the period in which the supplier is never eligible to the simplified scheme (minimum turnover greater than 7 million), and the client is always eligible to the scheme (minimum turnover lower than 4 million). The variable 'Client in VAT' is equal to 1 if the client is in the VAT scheme, 0 otherwise. The variable 'VAT input share' is equal to the share of the client's intermediate inputs purchased from VAT suppliers when the client is in the simplified scheme. The variable 'High tax supplier' is equal to 1 is the supplier faces the high VAT rate. All specifications include pair fixed effects and control for the size of the client, as well as year fixed effects (columns 1 and 2), supplier$\times$year fixed effects (columns 3 and 4) and client $\times$ year fixed effects (column 4). Significance levels: *p$<$0.1; **p$<$0.05; ***p$<$0.01.

E Counterfactual analysis

In this section we explain how we obtain estimates of the effect of the reform outlined in section 6 in the paper. This reform forces all firms in the simplified scheme to adopt the VAT scheme. We use the indicator v_i below to refer to firm i's choice of tax scheme prior to this reform.

E.1 Theoretical expressions

Input prices

The input costs of VAT-paying firms remain unchanged, as no taxes are paid on their inputs before and after the reform (we maintain the assumption that the simplified tax rate τ is approximatively zero). The input costs of firms that switch from the simplified to the VAT scheme decrease, as they no longer pay VAT on their inputs from VAT-paying suppliers. The total effect on the input cost P_i of a firm i that goes from the simplified to the VAT scheme and buys from suppliers j is:

$$\frac{\partial P_i}{P_i} = -\sum_j v_j \frac{t_j}{1-t_j} s_{ji} < 0 \tag{19}$$

where v_j is equal to one if j is a VAT firm prior to the reform, t_j is the VAT rate on goods sold by firm j, and s_{ji} is the share of inputs sold by j among those bought by i.

Prices to final consumers

The reform does not affect the price to final consumer p_{iF} for VAT-paying firms. For firms that switch from the simplified to the VAT scheme, the price to final consumers is affected in two ways. First, lower input costs P_i push final consumer prices p_{iF} down. Second, final consumers now have to pay VAT (with rate t_i) on their purchases from these firms, pushing prices up. These two counteracting effects appear in the following expression.

$$\frac{\partial p_{iF}}{p_{iF}} = \left(-\sum_j v_j \frac{t_j}{1-t_j} s_{ji} \right) + t_i \tag{20}$$

The final consumer price index will also change:

$$\frac{\partial P_F}{P_F} = -\sum_i (1-v_i) s_{iF} \frac{\partial p_{iF}}{p_{iF}} \tag{21}$$

where s_{iF} is the share of firm i among all purchases made by final consumers.

Sales to final consumers

The change in sales to final consumers is given by the sum of the change in the final consumer price index given in equation (21), for all firms, and the change in each firm's own final price given by equation (20), only for firms previously in the simplified scheme:

$$\frac{\partial q_{iF}}{q_{iF}} = -\sigma(1 - v_i)\frac{\partial p_{iF}}{p_{iF}} + (\sigma - 1)\frac{\partial P_F}{P_F} \tag{22}$$

Firm-to-firm transactions

Firm-to-firm transactions are affected through two channels. First, a scale effect: as the demand q_i for goods sold by firm i changes, so will its demand for inputs. This occurs for all firms. Second, a reallocation effect: as the relative prices of inputs change, firms will buy more from relatively cheaper suppliers. This is the case for firms in the simplified scheme with VAT-paying suppliers.

$$\frac{\partial q_{ji}}{q_{ji}} = \frac{\partial q_i}{q_i} + \rho\left(\frac{\partial P_i}{P_i} - \frac{\partial p_{ji}}{p_{ji}}\right) \tag{23}$$

Total sales

For downstream firms, $\frac{\partial q_i}{q_i}$ is simply equal to $\frac{\partial q_{iF}}{q_{iF}}$. For firms selling both to other firms and final consumers:

$$\frac{\partial q_i}{q_i} = \frac{q_{iF}}{q_i}\frac{\partial q_{iF}}{q_{iF}} + \sum_{k \in K_i} \frac{q_{ik}}{q_i}\frac{\partial q_{ik}}{q_{ik}} \tag{24}$$

where K_i is the set of firm i's clients.

E.2 Calibration and implementation

Calibrating the above expressions gives us the direct effect of the reform on prices, output and trade. We calibrate the elasticity of substitution in production ρ using our estimates ($\rho \approx 5$) and use the average value of σ, the price elasticity of demand of final consumers in DellaVigna and Gentzkow (2019), 2.5.

Changes in the output of firms then lead to indirect effects on these firms' suppliers as the amount they buy from them changes, which then leads to changes in trade further up the supply chain. Effects spread upwards throughout the supply chain: when a client k's

output changes by $\frac{\partial q_k}{q_k}$ its supplier j's output changes by $\frac{q_{jk}}{q_j}\frac{\partial q_k}{q_k}$, and this supplier's supplier l's output changes by $\frac{q_{lj}}{q_l}\frac{q_{kj}}{q_j}\frac{\partial q_k}{q_k}$, and so on. As we move up the supply chain these effects become smaller, we stop considering additional supply chain effects when the median change between two rounds is lower than 0.01% of the value of the previous round.

Collected VAT revenues

The change in VAT revenues is the sum of:

- A loss coming from the fact that transactions between firms in the VAT scheme and formerly-simplified newly-VAT firms are no longer taxed.
- A gain coming from the fact that the sales to final consumers made by formerly-simplified newly-VAT firms are now taxed.

The net effect is positive but very small, because the bulk of VAT revenues is collected from large firms, which are hardly affected by the reform. Compared to the initial amount of VAT collected, we find that the reform would induce a net increase of .01%. To close the model, we could imagine to redistribute the newly collected tax revenues to final consumer. We do not do it because the amount is negligible.