Taxation and Supplier Networks: Evidence from India*

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Abstract

Do tax systems affect the efficiency of supplier networks in developing countries? This paper considers the implications of tax policy for supply chain efficiency using administrative tax data on the universe of firms paying taxes in West Bengal, India, between 2010 and 2015; this data includes information on nearly 5 million annual transactions between suppliers and buyers. We first document substantial market segmentation between firms paying Value-Added-Taxes (VAT) and non-VAT-paying firms, even after observable heterogeneity is controlled for. We then develop a theoretical framework to understand how firms' production, sourcing and tax status decisions interact and are affected by tax policy. The model predicts equilibrium (partial) market segmentation because of both supply-chain distortions (taxes affect how much firms trade with each other) and complementarities in tax status decisions. Finally we test the model's predictions using a 2013 reform which increases the VAT rate on some commodities. We find evidence of a causal impact of taxes on supplier networks: the tax rate increase reduces transactions between VAT- and non-VAT-paying firms and we see exits from the VAT of both firms directly affected by the reform and their clients, in line with predicted complementarities in tax status choices.

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1 Introduction

Do tax systems affect the efficiency of supply chains? Most tax systems allow economic agents to select into different tax status and potentially alter the incentives they have to exchange with each other. This is particularly true of the Value-Added-Tax (VAT), a form of taxation that has spread rapidly around the globe in the last four decades and is used today by over 140 countries (Bird and Gendron, 2007). VAT is levied on firms' sales minus their input purchases, but the latter are only tax deductible if purchased from VAT paying firms. In markets in which VAT-paying and non-VAT-paying firms co-exist, this creates incentives for VAT-paying firms to favour sourcing inputs from other VAT-paying firms. Under a VAT system, we expect taxes to distort firms' sourcing decisions, leading to a segmentation of the market by tax status (VAT- vs. non-VAT- paying firms) and potentially decreasing the overall efficiency of production networks.

In this paper we start by documenting to what extent inter-firm supplier networks are segmented by tax status in a large developing economy. We use administrative data containing the universe of firms' tax returns in West Bengal, India for the period 2010-2015. Two particularities of the context and the data enable us to characterize market segmentation. First, small firms in West Bengal can choose not to pay VAT but to opt instead for a turnover tax scheme under which they pay a linear tax on their sales. Firms that choose to do so (12% of the 180,000 tax-registered firms) are at a disadvantage in VAT supply chains: VAT-paying firms cannot deduct purchases from firms in the turnover scheme from their tax liability. Second, VAT-paying firms have to report annual transactions with other tax-registered firms to the tax authorities, so we have data on 4.8 million annual buyer-supplier pairs. This allows us to map supplier networks by matching sellers' and buyers' tax identifiers, and consider the extent to which VAT and non-VAT paying firms trade with each other. We find that VAT-paying firms are 30% more likely to trade with other VAT-paying firms than firms in the turnover scheme are. The correlation between firms' tax status and how much they buy from or sell to VAT-paying firms is robust to controlling for firms' location and product characteristics. This correlation also holds within firms: firms' tax status changes are highly correlated with changes in how much they trade with VAT-paying firms.

Having established the existence of partial market segmentation seemingly driven by firms' tax status choices we study the effect of the tax system on supplier networks from both a theoretical and empirical perspective. Our first contribution is a multi-stage supply-chain model in which firms make sourcing, production and tax status (whether or not to pay

VAT) decisions. This model is a bi-partite application of trade network models – and in particular Tintelnot et al. (2017) – and allows us to determine how the tax system affects the supply chain. Our key theoretical result is that a VAT system will yield partial market segmentation between VAT and non-VAT firms, 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 firm does. This mechanism implies some endogenous market segmentation by tax status, increasing in firms' elasticity of substitution in production, even in a world in which firms' tax status are exogenously given. Endogenising firms' tax status choices introduces a second mechanism, *complementarities in tax status decisions*, that leads to further segmentation: firms are more likely to choose to pay VAT the more VAT-paying suppliers and clients they have.

Our second contribution lies in estimating the causal effect of a change in taxes on supplier networks. To do so we consider a tax reform introduced in 2013-2014 which increased the VAT rate paid on some products but left other parameters of the tax system unchanged. Our model predicts that increases in the VAT will increase supply-chain distortions by decreasing transactions between VAT-paying and non-VAT-paying firms. It will also lead some firms to change tax status, either because of changes to their tax liabilities (direct effects) or because their trading partners change tax status (indirect effects through complementarities in tax status decisions). Comparing over time firms directly affected by the reform, firms whose trading partners were affected by the reform, and firms not affected directly or indirectly allows us to test these predictions using a difference-in-differences strategy. We find that the tax system does cause supply-chain distortions: the increase in VAT increases the share of VAT firms' sales that goes to VAT-paying clients. A 1 percentage-point increase in tax reduces the probability that VAT-paying firms sell to non-VAT-paying firms by roughly 1.3 %. Looking at the impact of the reform at the transaction level yields an estimate of the elasticity of substitution in production of around 1.2. We also find evidence of complementarities in tax status choice: firms whose tax liabilities increase because of the reform are more likely to exit the VAT scheme and enter the turnover scheme, and so are the suppliers of these firms, even when their tax liabilities are not directly affected by the reform.

To the best of our knowledge this paper is the first to consider the efficiency cost of taxation at the level of supply chains, and to present evidence regarding the causal effect of taxes on supplier networks.[1] Our results contribute to the literature on public finance that asks

[1] In an independently developed project Gerard et al. (2018) study a question similar to ours in the context

how the particular context of developing countries changes the equity-efficiency trade-offs associated with different taxes.[2] We show that the co-existence of VAT-paying and non-VAT paying firms (small firms in simplified tax schemes, but also firms in the informal sector), a pervasive feature of markets in developing economies, implies that the tax system distorts supply chains. Results also illustrate how the structure of supplier networks simultaneously affects the tax system through complementarities in tax status choice. This paper is more particularly related to the literature on the VAT which typically argues that the VAT's build-in incentive structure, by generating a third party reported paper trail on transactions between firms, makes it well-suited to the developing country context of low tax compliance – some evidence on the impact of the VAT's third party reporting features is found in Pomeranz (2015) and Naritomi (2016). Our paper suggests that this compliance advantage of the VAT must be weighted against the distortions it generates at the supply chain level. The idea that the VAT creates 'informality chains' – or links in tax status choices along the supply chain – was first formally introduced by de Paula and Scheinkman (2010). We develop this idea by incorporating tax decisions in a trade network model and provide causal evidence on the existence of such chains.[3]

Our results also contribute to the growing literature on firm supplier networks, reviewed in Bernard and Moxnes (2017), and in particular recent papers that leverage new datasets on domestic firm to firm transactions to characterize supplier networks and the propagation of shocks within these networks. Bernard et al. (2015) and Carvalho et al. (2016) use a survey of Japanese firms and study, respectively, the impact of new rail infrastructure and that of earthquakes on supplier networks; Atalay et al. (2011) characterize US production networks using US survey data and Tintelnot et al. (2017) use administrative VAT data for Belgium to characterize gains from trade. We contribute to this literature in three ways, using administrative data for a large developing economy. First we consider theoretically and empirically how a particular policy - the tax system - affects supplier networks. Second, we show how these networks themselves affect firms' decisions, by creating complementarities in tax choices. Third, our results provide some evidence regarding the nature of buyer-supplier relationships and hence the determination of links within supplier networks; specifically our estimates of the supply chain distortions created by taxes sug-

of the state of São Paulo, Brazil.

[2]See e.g. Emran and Stiglitz (2005); Boadway and Sato (2009); Kleven and Waseem (2013); Best et al. (2015); Gerard and Gonzaga (2016); Bachas and Soto (2017); Cagé and Gadenne (2017); Carrillo et al. (2017).

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

gest firms have a low willingness to substitute across suppliers. This is consistent with a large literature on firms in developing countries that studies the role of market frictions in the formation of buyer-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)

Finally this paper contributes to the large literature explaining firm-level productivity differentials between rich and developing countries by misallocation across firms. In particular Banerjee and Duflo (2005) and Hsieh and Klenow (2009) discuss the role of, and provide evidence for, substantial misallocation of factors of production across firms in developing countries relative to rich countries. Both point to tax systems as potential drivers of this misallocation (see also Brandt et al., 2013; Khwaja and Mian, 2005). Our evidence on market segmentation indicates that another form of misallocation – of suppliers to their corporate clients – may contribute to lower productivity levels in developing countries; our results regarding the causal effect of tax changes suggest this misallocation is in part the result of policy.

The paper is organized as follows. Section 2 describes our context of study and data and provides descriptive evidence on market segmentation. Section 3 develops a two production stages model of firm sourcing and tax status decisions and derives predictions regarding the impact of an increase in the VAT rate. Section 4 presents our empirical strategy to estimate the causal impact of the tax system on supply chains using a reform, and section 5 discusses 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 and which accounts for 7% of the country's GDP. The main source of revenues at the state level is the value-added-tax (VAT); the main VAT rates in 2010-2011 were 4% (medium tax schedule) and 14% (high tax schedule), with some goods taxed at 0 or 1% (low tax schedule) - see the Appendix for a list of the goods included in each tax schedule. Firms' VAT liabilities are defined by their total sales minus VAT paid on their inputs. All firms with a turnover greater than 500,000 INR must register to pay taxes with the state tax authorities. Small firms, defined as firms with a turnover less than 5 million INR, can opt

not to pay VAT but instead pay taxes under the 'turnover scheme' and only pay a 0.025% tax on their total sales. Importantly for the purpose of this paper, firms in the VAT scheme cannot deduct taxes paid on their inputs purchased from firms in the turnover scheme from their tax liability.

In fiscal year 2013-2014 the two main VAT rates increased by one percentage point: from 4 to 5% for commodities in the low tax schedule and from 14 to 15% for commodities in the high tax schedule. This corresponds to a 25% increase in the tax rate for the low tax schedule and a 7% increase for the high tax schedule. There was no change in the types of commodities included in each schedule or in the tax rate paid by firms in the turnover scheme. We will return to this reform when estimating the causal effect of the VAT on firms' sourcing decisions and their supply chains.

2.2 Data and descriptive statistics

Firm-level data We use administrative data on firm-level tax returns and 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 180,000 firms paying taxes to the state over the period, whether in the VAT or the turnover scheme. Firms paying taxes under the VAT scheme (hereafter VAT firms) 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 turnover scheme (hereafter turnover firms) report their total sales and total input purchases, but the latter isn't used to compute their tax liabilities. The main variables we use from the tax returns are firms' gross total sales and the firm's tax status: whether it is paying taxes in the VAT or turnover scheme. We also use information on the total output taxes (taxes paid on sales prior to the deductions due to the input tax credit) paid by VAT firms to compute firms' effective VAT rate. In addition to the variables used to compute their tax liabilities firm must report the main three commodities they sell and how much they sell of each, we use information on the main commodity sold to allocate firms to one of 170 commodity categories and a (potential) VAT tax schedule. Registration information gives us firms' location at the postcode level and age. Restricting our sample to firms for which we have information on location and commodities sold our sample contains 806,932 observations at the firm-year level.

Data on supplier-buyer matches Firms in the VAT scheme must also report to the tax authorities all transactions with other registered firms of more than 50,000 INR annually, regardless of whether the trading partner is in the VAT or the turnover scheme, as well as the tax id of their trading partners. Compiling this information gives us a transaction dataset with 4.8 million annual buyer-supplier pairs. Firms in the turnover scheme do not report transactions to the tax authorities, so we do not observe trade between turnover firms. Merging this transaction data with the firm data allows us to compute for each firm the share of its sales that it sells to VAT clients and the share of its inputs that is buys from from VAT suppliers.

Descriptive statistics Table 1 presents the key characteristics of firms in our data in fiscal year 2010-2011. The first column includes all firms in the turnover scheme (13% of the sample), the second all firms in the VAT scheme but with a turnover under 5 million INR and therefore eligible to choose the turnover scheme (54%) and the last all remaining VAT firms (33%). We see that, whilst the data contains some very large firms, most have a turnover of less than 5 million. Less than one-third are in Kolkata, though this share increases amongst larger firms. The share of sales bought by VAT clients is very low (1%) for turnover firms, and much lower than that of VAT firms. The share of inputs coming from VAT suppliers is similarly lower for turnover firms than for VAT firms, and this even amongst firms of similar sizes. The difference between the share of VAT sales and the share of VAT inputs suggests that firms in the turnover scheme tend to be located downstream in supply chains, at least in supply chains that also include VAT firms. The last three lines of Table 1 show that the lower shares of VAT sales and inputs for turnover firms can be explained both by the fact that they are less likely to trade with VAT firms, and by the fact that they have less trading partners, conditional on having at least one, than VAT firms.

Table 1 provides evidence of partial market segmentation between VAT and turnover firms: VAT firms are more likely to sell to or buy from VAT firms than turnover firms. This could be due to different characteristics of VAT and turnover firms, unrelated to their tax status, that lead them not to trade with each other - different locations for example. Table 2 assesses whether this is the case by considering the correlation between a firm's own tax status and the share of its sales (inputs) that goes to (comes from) VAT firms on the sample of firms eligible to the turnover scheme. We find that part of the correlation with the share of VAT sales can be explained by VAT and turnover firms selling different goods (column 3) and being in different locations (column 4) but the correlation remains large

and statistically significant when controlling for these firm characteristics. The last column of the table shows that the correlation remains positive within-firms over time: the timing of changes in firms' tax status is correlated with changes in their shares of VAT sales and VAT inputs.

The types of commodities sold by firms in 2010-2011 are presented in Table 3. 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 turnover scheme (column 3) is highest for commodities typically sold to other firms (machines, metal product and mining) and lowest for good categories 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.

3 Model

We draw the structure of the model from Tintelnot et al. (2017). We extend it by introducing taxes and allowing firms to choose their tax status but simplify the network by making it bipartite: they are two layers of firm in the economy, upstream and downstream. Upstream firms sell to downstream firms and the final consumer, downstream firms buy from upstream firms and sell to the final consumer.

3.1 Set-up

3.1.1 Final consumer

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

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

where q_{iF} is the quantity of good i consumed by the final consumer. Maximising her utility we obtain a demand for good i:

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

where $P_F = \left(\sum_i \beta_i^\sigma p_{iF}^{1-\sigma}\right)^{\frac{1}{1-\sigma}}$ is the consumer price index and we have used $E = \sum_i q_{iF} p_{iF}$. The price elasticity of final demand for good i is simply given by $-\sigma$. Writing total demand in value $x_{iF} = p_{iF} q_{iF}$:

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

3.1.2 Downstream firms

Downstream firms, indexed by k, produce using labour and goods from upstream firms j and sell only to the final consumer. Their production function is:

$$q_{kF} = \phi_k \left(\sum_j \alpha_{jk} q_{jk}^{\frac{\rho-1}{\rho}} + \alpha_{\ell j} q_{\ell k}^{\frac{\rho-1}{\rho}}\right)^{\frac{\rho}{\rho-1}}$$

where q_{jk} are the inputs of good j purchased by firm k and ρ is the elasticity of substitution in production. Writing p_{jk} the price paid by k for good j, we can write demand for good j as

$$q_{jk} = \frac{q_{kF}}{\phi_k} \left(\frac{\alpha_{jk} P_k}{p_{jk}}\right)^\rho \tag{2}$$

and the cost function as

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

where P_k is an index of firm k's input prices. Total demand for good j in value – j's sales to k – can be written as $x_{jk} = p_{jk} q_{jk}$ is:

$$x_{jk} = \frac{q_k}{\phi_k} \left(\alpha_{jk} P_k\right)^\rho p_{jk}^{1-\rho}$$

The share of firm k's costs that it spends on good j is:

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

3.1.3 Upstream firms

Upstream firms, indexed by j, produce using only labour and sell to downstream firms k and final consumers. Their production function is

$$q_j = \phi_j \alpha_{\ell j}^{\frac{\rho}{\rho-1}} q_{\ell j}$$

Their cost function is

$$c_j = \frac{P_j}{\phi_j} \text{ with } P_j = \alpha_{\ell j}^{\frac{\rho}{1-\rho}} w$$

3.2 Prices and taxes

Our assumptions imply that firms sell to consumers at a constant markup $\mu = \frac{\sigma}{\sigma-1}$ and to other firms at constant markup $\nu = \frac{\rho}{\rho-1}$. We denote as v_i the tax status of firm i. If $v_i = 1$ firm i is in the VAT scheme, it pays a tax t_i on its sales and deducts the VAT paid on its input purchases from its tax liabilities. If $v_i = 0$ firm i is in the turnover scheme, it pays a tax τ on its sales. 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 can write the prices to final consumers and to intermediate firms as:

$$p_{iF} = \frac{P_i \mu}{\phi_i \gamma_{iF}}, \forall i = j, k \tag{3}$$

$$p_{jk} = \frac{P_j \nu}{\phi_j \gamma_{jk}} \tag{4}$$

with

$$P_k = w \left(\alpha_{\ell k}^{\rho} + \nu^{1-\rho} \sum_j (\alpha_{\ell j} \alpha_{jk})^{\rho} \phi_j^{\rho-1} \gamma_{jk}^{\rho-1} \right)^{\frac{1}{1-\rho}} \tag{5}$$

3.3 Tax status choice

In this section we assume that firms take other firms' tax status choice as given when choosing whether to be in the VAT or turnover scheme. The profits firms make from final sales are:

$$\pi_{iF} = (\mu - 1)\mu^{-\sigma} \left(\frac{\phi_i}{P_i} \right)^{\sigma-1} (\beta_i \gamma_{iF})^{\sigma} P_F^{\sigma-1} E$$

The profits (upstream) firms make from intermediate sales are:

$$\pi_{jI} = (\nu - 1)\nu^{-\rho}\mu^{-\sigma}P_F^{\sigma-1}E\left(\frac{\phi_j}{P_j}\right)^{\rho-1}\sum_k(\alpha_{jk}\gamma_{jk})^{\rho}(\beta_k\gamma_{kF})^{\sigma}\phi_k^{\sigma-1}P_k^{\rho-\sigma}$$

Downstream firms will attempt to maximise $\pi_k = \pi_{kF}$. A downstream firm k will choose the VAT scheme iff:

$$\frac{\alpha_{\ell j}^{\rho}\nu^{\rho-1} + \sum_j(\alpha_{\ell j}\alpha_{jk})^{\rho}\phi_j^{\rho-1}[v_j + (1-v_j)(1-\tau)^{\rho-1})]}{\alpha_{\ell j}^{\rho}\nu^{\rho-1} + \sum_j(\alpha_{\ell j}\alpha_{jk})^{\rho}\phi_j^{\rho-1}[v_j(1-t_j)^{\rho-1} + (1-v_j)(1-\tau)^{\rho-1})]} > \left(\frac{1-\tau}{1-t_k}\right)^{\mu(\rho-1)} \tag{6}$$

Using first-order approximations that are valid when tax rates are small compared to one, we find that a downstream firm k will choose to pay taxes under the VAT scheme when:

$$\sum_j v_j t_j \tilde{s}_{jk} > \mu(t_k - \tau)$$

where $\tilde{s}_{jk}$ denotes the share of k's costs to goes to input j when tax rates are close to zero, $\tilde{s}_{jk} = \alpha_{jk}^{\rho}\tilde{P}_k^{\rho-1}\tilde{p}_{jk}^{1-\rho}$, with $\tilde{p}_{jk} = \frac{\nu P_j}{\phi_j}$ and $\tilde{P}_k = \left(\sum_j \alpha_{jk}^{\rho}\tilde{p}_{jk}^{1-\rho} + \alpha_{lk}^{\rho}w^{1-\rho}\right)^{\frac{1}{1-\rho}}$. This expression indicates that k is more likely to choose the VAT scheme when a higher share of its inputs comes from VAT suppliers (high $\sum_j v_j\tilde{s}_{jk}$) and when the weighted average VAT rate paid by its suppliers is higher (high t_j), less likely when its own VAT rate is high and final consumers have low price elasticity (high μ): the latter is because the cost of being in the VAT scheme is lower demand by final consumers, this cost is higher when the mark-up on sales to final firms is higher.

For upstream firms, the total profits π_j is the sum $\pi_{jF} + \pi_{jI}$. Finding the tax status for j that maximises π_j is equivalent to finding the tax status that maximises:

$$\gamma_{jF}^{\sigma} + \sum_k b_{jk}\gamma_{jk}^{\rho}$$

with $b_{jk} = \frac{\nu-1}{\mu-1}\nu^{-\rho}\left(\frac{\phi_j}{P_j}\right)^{\rho-\sigma}\alpha_{jk}^{\rho}\beta_k^{\sigma}\gamma_{kF}^{\sigma}\phi_k^{\sigma-1}P_k^{\rho-\sigma}\beta_j^{-\sigma}$. The weights b_{jk} represent how important for firm j's profits firm k is, compared to the final consumer. If b_{jk} are high, firm j care more about its corporate buyers than about the final customer. b_{jk} is larger when α_{jk}, β_k, ϕ_k are large and when β_j is small.

The trade-off for upstream firms is that being VAT increases the output price they charge

to the final customers and turnover firms but reduces the price they charge to VAT clients. They will choose VAT status iff:

$$(1-t_j)^{\sigma} + \sum_k b_{jk}(v_k + (1-v_k)(1-t_j)^{\rho}) > (1-\tau)^{\sigma} + (1-\tau)^{\rho} \sum_k b_{jk} \tag{7}$$

Assuming tax rates are small compared to one, we can take a first-order approximation of this expression. A condition for a firm to choose the VAT status is then:

$$\rho\tau \sum_k b_{jk} > \sigma(t_j - \tau) + \rho(t_j \sum_k b_{jk}(1-v_k))$$

The left-hand side represents what firm j wins when switching to the VAT status: its corporate buyers will not pay the turnover tax anymore. The right-hand side represents what it loses: the final customer will pay the VAT rather than the turnover tax and the corporate buyers that are taxed at the turnover scheme will pay the VAT. From this expression it is clear that: (i) a higher σ, which increases the sensitivity of firm j to the final consumer makes it less likely to adopt the VAT scheme, (ii) a higher ρ, which increases the sensitivity of firm j to its corporate consumers makes it more likely to adopt the VAT scheme, (iii) having more important corporate customers that are VAT, makes it more likely to adopt the VAT scheme.

Overall the model predicts complementarities in tax status choice: firms are more likely to choose to be in the VAT scheme if they have more VAT suppliers and/or more VAT clients.

3.4 Equilibrium

An equilibrium is characterised by the tax status of both upstream and downstream firms $\{v_j, v_k\}$ and the price faced by downstream firms P_k, as a function of policy parameters τ, $\{t_g\}$, the technological parameters $\boldsymbol{\alpha}$, $\boldsymbol{\beta}$, $\boldsymbol{\phi}$, σ, ρ, the endowment E and the wage w.

Inequation (6) defines each downstream firm's tax status v_k, given the vector of tax status of upstream firms $\{v_j\}$ and the parameters. Inequation (7) defines each upstream firm's tax status v_j, given the vector of tax status of downstream firms $\{v_j\}$, the parameters and P_k. Equation (5) defines P_k as a function of firms' tax status $\{v_j, v_k\}$ and parameters.

Once the firms' tax status $\{v_j, v_k\}$ and downstream firms' P_k are known, we can recover all prices using equations (3) and (4), quantities sol d to the final consumer using (1) and then quantities exchanged by firms using (2).

The system formed by (5), (7) and (6) is likely to lead to multiple equilibria. The part formed by the inequations (7) and (6) can be framed as a static discrete game between firms.

3.5 Theoretical predictions

3.5.1 Impact of a VAT rate change, keeping tax status constant

Consider a reform that increases the tax rate on some good g, and define g_i a dummy equal to one if i sales the 'treated good' g. We start by characterizing the effect of this reform on firms' total sales and how much they sell to VAT firms.
The reform will have the following effect on the price of intermediate goods:

$$\frac{\partial p_{jk}}{\partial t_g}\frac{1-t_g}{p_{jk}} = v_j(1-v_k)g_j$$

We can then derive the effect on all prices:

$$\begin{aligned}
\frac{\partial P_k}{\partial t_g}\frac{1-t_g}{P_k} &= (1-v_k)s_{vgk} \\
\frac{\partial p_{jF}}{\partial t_g}\frac{1-t_g}{p_{jF}} &= v_j g_j \\
\frac{\partial p_{kF}}{\partial t_g}\frac{1-t_g}{p_{kF}} &= v_k g_k + (1-v_k)s_{vgk}
\end{aligned}$$

where $s_{vgk} = P_k^{-\frac{1}{1-\rho}} \sum_{j\in g} \alpha_{jk}^{\rho} p_{jk}^{1-\rho} v_j$ is the share of k's costs that are spent on VAT suppliers selling good g.
For final sales we obtain:

$$\begin{aligned}
\frac{\partial x_{jF}}{\partial t_g}\frac{1-t_g}{x_{jF}} &= (\sigma-1)(\epsilon_P - v_j g_j) \\
\frac{\partial x_{kF}}{\partial t_g}\frac{1-t_g}{x_{kF}} &= (\sigma-1)(\epsilon_P - v_k g_k - (1-v_k)s_{vgk})
\end{aligned}$$

where ϵ_P is the change in the final consumer price P_f induced by the reform. This implies that downstream firms' sales can decrease for two reasons: if they sell the treated good and are VAT and if they buy the treated good from VAT firms (term s_{vgk}) but are not themselves

VAT. For intermediate sales we have:

$$\frac{\partial x_{jk}}{\partial t}\frac{1-t}{x_{jk}} = (\sigma-1)\epsilon_P - \sigma v_k g_k - (\sigma-\rho)(1-v_k)s_{vgk} - (\rho-1)v_j g_j(1-v_k)$$

Upstream VAT firms will sell less to turnover clients if they sell the treated good, upstream turnover firms will be negatively affected to the extent that they sell to VAT clients selling the treated good.

Overall, ignoring the negative effect coming through the change in the final consumer price which affects all firms equally ($(\sigma-1)\epsilon_P$) the model predicts that the reform will affect VAT and turnover firms in different ways. The increase in the VAT rate will lower VAT firms' sales if they sell the treated good or sell to VAT clients selling the treated good, but won't affect VAT firms if they only buy the treated good from VAT firms, as VAT isn't paid on transactions between two VAT firms. Turnover firms on the other hand won't be affected by the reform if they sell the treated good themselves, but will negatively affected if they trade with VAT firms selling it: if they buy the treated good from VAT firms their input costs will increase, if they sell to VAT firms selling the treated good their clients will demand less from them.

Writing λ_{jgV} the share of j's total sales that go to VAT clients selling good g we can write:

$$\frac{\partial \lambda_{jV}}{\partial t}\frac{1-t}{\lambda_{jV}} = -\sigma\frac{\lambda_{jgV}}{\lambda_{jV}}(1-\lambda_{jV}) + (\sigma-\rho)\sum_k (1-v_k)s_{vgk}\frac{x_{jk}}{x_j} + \lambda_{jF}v_j g_j(\sigma-1) + \lambda_{jT}(\rho-1)v_j g_j$$

This share will increase for VAT firms selling the treated good: an increase in the VAT rate will decrease turnover firms' willingness to purchase their inputs from VAT suppliers.

3.5.2 Impact of a VAT rate change on tax status choice

Let's define $V_k = \sum_j v_j t_j \tilde{s}_{jk} - \mu(t_k - \tau)$ a variable that reflects a downstream firm's propensity to choose the VAT scheme. As detailed above, if $V_k > 0$, firm k will choose to pay VAT. Fixing the tax status of other firms, how does V_k varies with an increase in VAT? Keeping the notation as in the previous section, we find:

$$\frac{\partial V_k}{\partial t} = \sum_j v_j \tilde{s}_{jk} g_j - \mu g_k$$

The increase in the VAT rate will:

- reduce the probability that firm k chooses the VAT status if k sells the treated good.
- increase the probability that firm k chooses the VAT status if k buys the treated good from VAT suppliers.

Both of these effects are *direct effects*, ie driven by changes in firms' VAT tax liabilities when the VAT rate increases. The second effect shows how an increase in VAT re-enforces the complementarities in tax status choice.

We can also define $V_j = \rho(\tau \sum_k b_{jk} - t_j \sum_k b_{jk}(1 - v_k)) - \sigma(t_j - \tau)$ a variable that reflects an upstream firm's propensity to choose the VAT scheme. As detailed above, if $V_j > 0$, firm j will choose to pay VAT. Fixing the tax status of other firms, how does V_j varies with an increase in VAT?

$$\frac{\partial V_j}{\partial t} = -g_j \left(\sigma + \sum_k (1 - v_k) b_{jk} \right) - \tau\rho\sigma \sum_k \frac{v_k b_{jk} g_k}{\gamma_{kF}}$$
$$+ (\sigma - \rho)\nu^{1-\rho}\rho(t_j - \tau) \sum_k (1 - v_k) b_{jk} \left(\frac{P_k}{w} \right)^{\rho-1} \sum_{j'} (\alpha_{\ell j'} \alpha_{j'k})^\rho \phi_{j'}^{\rho-1} \gamma_{j'k}^{\rho-1} v_{j'} g_{j'}$$

The first effect kicks in if firm j sells the treated good. In this case, the higher the share of its sales sold to non-VAT clients (turnover firms and consumers) the more likely firm j will be to adopt the turnover scheme. The second effect is a function of how much j's VAT clients sell the treated good. If many of them do they will reduce their production and hence their input demand, this will in turn reduce the incentive for firm j to be VAT. The third effect is a function of how much j's turnover clients purchase inputs from VAT suppliers selling the treated good – how much the reform increases their cost – and its sign is a function of $\rho - \sigma$. On the one hand this increase in costs lowers the demand these turnover clients face from final consumers, and hence how much inputs they demand from j; this means j receives less demand from turnover clients and is therefore more likely to choose the VAT scheme. This effect is a function of σ which drives the size of final consumers' response. On the other hand turnover clients will substitute away from suppliers whose price has increased and towards firm j; this positive effect is a function of ρ an decreases the probability that j chooses to be VAT.

Overall the model predicts that the probability that both firms selling the treated good and firms buying the treated good from VAT firms choose to be in the VAT scheme changes because of the reform because the change in tax will directly affect their tax liability. Firms selling to VAT clients selling the treated good will also be affected despite the reform having

no direct effect on their tax liability; this is because the share of their sales going to VAT clients decreases, lowering the gains from being in the VAT scheme.

4 Empirical strategy

This section tests the model's predictions regarding the impact of an increase in the VAT rate. We use variation in VAT rates created by the 2013-2014 reform to identify the causal impact of taxes on outcomes. Figure 1 plots the median effective VAT rate paid on sales (the ratio of VAT paid on sales to total sales) for firms in the three different tax schedules. We see that the VAT rate was unchanged throughout the period for firms in the low tax schedule (4% of firms) but increased in 2014 for firms in the high tax schedule (21% of firms) and firms in the medium tax schedule (74% of firms).[4] The increase was much higher for firms in the medium tax schedule than for firms in the high tax schedule (a 25% vs 5-8% increase). In what follows we use the higher increase in the VAT rate paid by firms in the medium tax schedule relative to other firms to identify causal effects of interest.

We define three potentially overlapping groups of firms whose incentives are affected by the reform.

- The first group – the 'treated good' group – consists of all firms whose main commodity sold is in the medium tax schedule.
- The second group – 'treated inputs' group – comprises firms that in 2013 purchase a higher share of their inputs from VAT firms in the medium tax schedule than the median firm.[5]
- The third group – 'treated demand' group – consists of firms that in 2013 sell a higher share of their total sales to VAT firms in the medium tax schedule than the median firm.

Our control group consists of firms that do not sell a commodity in the medium tax schedule, do not buy (or buy little) from VAT firms selling commodities in the medium tax schedule and do not sell (or sell little) to VAT firms selling these commodities.

Table 4 presents the distribution of these treatments across large commodity types and tax schemes – note that the same firm can belong to all three treatment groups at the same

[4] We categorize goods taxed at 0% and goods taxed at 1% as being in the low tax schedule.
[5] We consider the median values within tax scheme to define the groups.

time, indeed 23% of the firms do. Overall three quarters of the firms sell a commodity whose VAT rate has increased, nearly half are categorised as having treated inputs, over a third as having treated demand and 16% are in the control group. Panel A shows that there is variation in treatment status within tax scheme, with one caveat: as seen above firms in the turnover scheme are unlikely to sell to firms in the VAT firms, so few of them (less than 3%) are categorised as having treated demand. The decomposition by type of main commodity sold in Panel B shows that there is variation in treatment type among all large good categories. Firms selling commodities more likely to be sold to final consumers (food, household goods) are over-represented in the control group, as expected, whilst firms selling goods more likely to be intermediate inputs (machines & equipment, metal products, wood & paper) are under-represented.

Our reduced form specification takes the form:

$$Y_{itgk} = \pi_1 TG_i * P_t + \pi_2 TI_i * P_t + \pi_3 TD_i * P_t + \delta X_{itgk} + \gamma_t + \gamma_g + \gamma_k + \epsilon_{itgk} \tag{8}$$

where t indexes years, g commodities sold and k locations and we define $P_t = 1$ in the years following the reform, $TG_i = 1$ if firm i sells a good whose VAT rate increases, $TI_i = 1$ if it belongs to the treated inputs group, $TD_i = 1$ if it belongs to the treated demand group, and we control for the firms' size (total sales) in 2013.

The reform allows us to identify the causal impact of the increase in VAT on outcomes under the assumption that the (conditional) evolution of outcomes would have been the same among firms not affected by the increase in taxes and firms that experienced a change to the tax rate they pay on their sales, the tax rate paid on their inputs, or the tax rate paid by their clients. To assess the plausibility of this assumption Figure 2 plots the evolution of key outcomes of interest over time separately among firms in the control group and firms in the different treated groups. We see no evidence of clearly different pre-treatment trends amongst any of the treatment groups.

5 Results

5.1 Firm-level evidence of the impact of the tax reform

Table 5 presents results obtained when running (8) using log total sales as outcome variable, separately for firms that were in the VAT scheme in 2013 (first three columns) and firms

that were in the turnover scheme in 2013 (last three colums). In line with the model's predictions both VAT and turnover firms grow less after the reform when their clients pay a higher VAT rate ('treated demand' effect) but only turnover firms are negatively affected when the VAT rate on their inputs increase because no extra VAT is paid on VAT-VAT transactions after the reform ('treated inputs' effect). VAT firms selling commodities in the medium tax schedule grow less after the reform, as expected, but turnover firms grow more. This last result cannot be explained by our model – it predicts no change in sales among turnover firms selling these commodities – and suggests that our assumption of constant elasticity of substitution across goods is too strong. Turnover firms in the 'treated good' category likely sell goods that are closer substitutes to those sold by VAT firms in the same category than turnover firms in the control group; if so the higher production costs of these VAT firms has a positive effect on the turnover firms' sales.

Table 6 presents results on the effect of the change in VAT rates on supply chains. The first three columns consider the impact on the share of VAT firms' sales that go to other VAT firms. We see that, in line with the model's predictions, firms selling the treated good sell relatively more to VAT firms after the reform. This indicates that an increase in the VAT increases market segmentation between turnover and VAT firms. Firms selling to VAT firms selling the treated good on the contrary sell relatively less to VAT clients after the reform, in line with evidence that these clients grow less because of the reform. The middle three columns show that this supply chain effect is not entirely due to substitution between firm and household clients: we see that firms selling the treated good are less likely to have a turnover client after the reform. Finally the last three columns consider the impact of the reform on firms' tax status choice. The first two lines present the direct effects of the reform. Firms selling goods on which the VAT rate increases are less likely to choose to be VAT after the reform; this is because the reform increases their VAT tax liabilities but not their turnover tax liabilities. Similarly firms buying from VAT firms inputs on which the VAT rate has increased experience a relative decrease in their VAT tax liabilities because of the reform and are consequently found to be more likely to be VAT (second line). Evidence of complementarities in tax status choice can be found in the last line of Table 6: we see that firms selling to VAT firms whose tax rate has increased are also less likely to be in the VAT scheme after the reform, and this despite the fact that their tax liabilities are not directly affected by the reform. This is in line with the social effect component of tax status choice predicted by the model: these firms are changing tax status because their clients are changing tax status.

5.2 Transaction-level evidence of supply-chain distortion effects

This section estimates the impact of the tax system on supply chains at the transaction level within firms.

$$s_{jk} = \frac{(\alpha_{\ell j}\alpha_{jk})^{\rho}\phi_j^{\rho-1}\gamma_{jk}^{\rho-1}}{\alpha_{\ell k}^{\rho}\nu^{\rho-1} + \sum_{j'}(\alpha_{\ell j'}\alpha_{j'k})^{\rho}\phi_{j'}^{\rho-1}\gamma_{j'k}^{\rho-1}}$$

We are interested in the effect of the VAT increase on the share of firm k's inputs it purchases from firm j, parameter s_{jk} in the model above.

We assume that supplier j represents a low share of k's costs: $s_{jk} \ll 1$. Focusing on the pairs such that $v_k = 0$ and $v_j = 1$, a change in VAT rates pushes γ_{jk} from $1 - t_j^{pre}$ to $1 - t_j^{post}$. The corresponding change in the input share of j is:

$$\frac{\Delta s_{jk}}{s_{jk}} = [(1 - t_j^{post})^{\rho-1} - (1 - t_j^{pre})^{\rho-1}] \simeq -(\rho - 1)\frac{\Delta t_j}{t_j}$$

To estimate this expression empirically we focus on supplier-buyer pairs in 2013 such that the buyer is in the turnover scheme and the supplier is in the VAT scheme. Let us denote $\Delta \log s_{jk}$ the difference between 2013 and 2014 of the log share of inputs that firm k buy from firm j. $\Delta \log t_j$ is the difference between 2013 and 2014 of the log VAT rate charged by firm j. The above expression shows that an increase in the VAT rate on a particular supplier will lead a downstream firm to reduce the share of inputs to this supplier by a factor $\rho - 1$ (in elasticity). Table 7 presents the results of the regression of $\Delta \log s_{jk}$ on $\Delta \log \tau_j$. In column (1), there is no control in the regression, the coefficient can be interpreted as the raw elasticity. In column (2), we add fixed effects for the goods and pincodes of the downstream firms. In column (3), we add fixed effects for the downstream firm. The elasticity is identified as the variation in the evolution of VAT rates across suppliers. The point estimate is very similar across specifications, but we lack statistical power in columns (2) and (3).

Our model predicts that the relationship between $\frac{\Delta t_j}{t_j}$ and $\frac{\Delta s_{jk}}{s_{jk}}$ is maximal when the share s_{jk} is very small. When the share becomes substantial, we can show that the elasticity goes to zero. In column (4), we restrict the sample of transactions to those accounting for less than 40% of the total purchases of the downstream firm (which is the case for 80% of transactions), keeping goods and pincodes fixed effects. The point estimate is indeed slightly higher, and the coefficient becomes significant at 10%.

Finally, some buyers could decide to change tax status and adopt the VAT regime in 2014.

Our model predicts that the share of inputs of these switching downstream firms should not react to the variation in VAT rates; this likely biases downwards our elasticity estimates obtained on the full sample. Restricting the sample to the downstream firms that remain in the turnover status in 2014 in column (5), we indeed obtain a slightly higher elasticity estimate, and the coefficient becomes significant at 10%.

Overall, the estimated elasticity, always between .1 and .2, suggests a value of ρ around 1.1 or 1.2. This value is low compared to those found by Broda et al. (2017) for India (around 3.7) and indicates that, at least in the short run, firms could be very constrained on their choices of inputs.

6 Conclusion

This paper considers how tax systems affect the efficiency of supply chains using administrative tax data on the universe of firms paying taxes in West Bengal, India for the period 2010-2015; we observe both firms paying Valued-Added-Taxes and firms paying taxes under a simpler turnover tax scheme. Data on the 4.8 million annual transactions between tax-registered firms allows us to map supplier networks and consider the extent to which VAT- and non-VAT-paying firms trade with each other. We first document substantial market segmentation between these two types of firms, the correlation between firms' tax status (VAT or non-VAT) and how much they trade with other VAT-paying firms is robust to controlling for firm observable characteristics and also holds within firms. We then develop a theoretical framework to understand how firms' production, sourcing and tax status decision interact and are affected by tax policy. We include in the model the key characteristic of VAT systems: firms cannot deduct from their VAT liability their input purchases from non-VAT-paying firms. The model predicts equilibrium partial market segmentation because of both supply-chain distortions (taxes affect how much firms trade with each other) and complementarities in tax status decisions (firms are more likely to choose to pay VAT if their trading partners do). Finally, we test the model's predictions using a 2013 reform which increases the VAT rate on some commodities but leaves other aspects of the tax system unchanged. We find that the tax system does cause supply-chain distortions: the increase in the tax increases the share of VAT firms sales that goes to VAT-paying clients. A 10 percentage-point increase in tax reduces the probability that VAT-paying firms sell to non-VAT-paying firms by roughly 13 %. We also find evidence of complementarities in tax status choice: firms whose tax liabilities increase because of the reform are more likely to

exit the VAT scheme and enter the turnover scheme, but so are the suppliers of these firms, even when their tax liabilities are not directly affected by the reform.

These findings have potential wide-ranging implications for the efficiency cost of the tax system when VAT and non VAT firms coexist and potentially trade with each other. Our data only enables us to measure market segmentation between VAT and non-VAT tax registered firms but our results likely extend to segmentation between VAT and informal firms whose role in the supply chain is similar to that of the non-VAT registered firms we observe. In future work we will study what our results imply for the optimal form of firm taxation in contexts characterized by a large number of non-VAT paying firms, such as those of developing countries.

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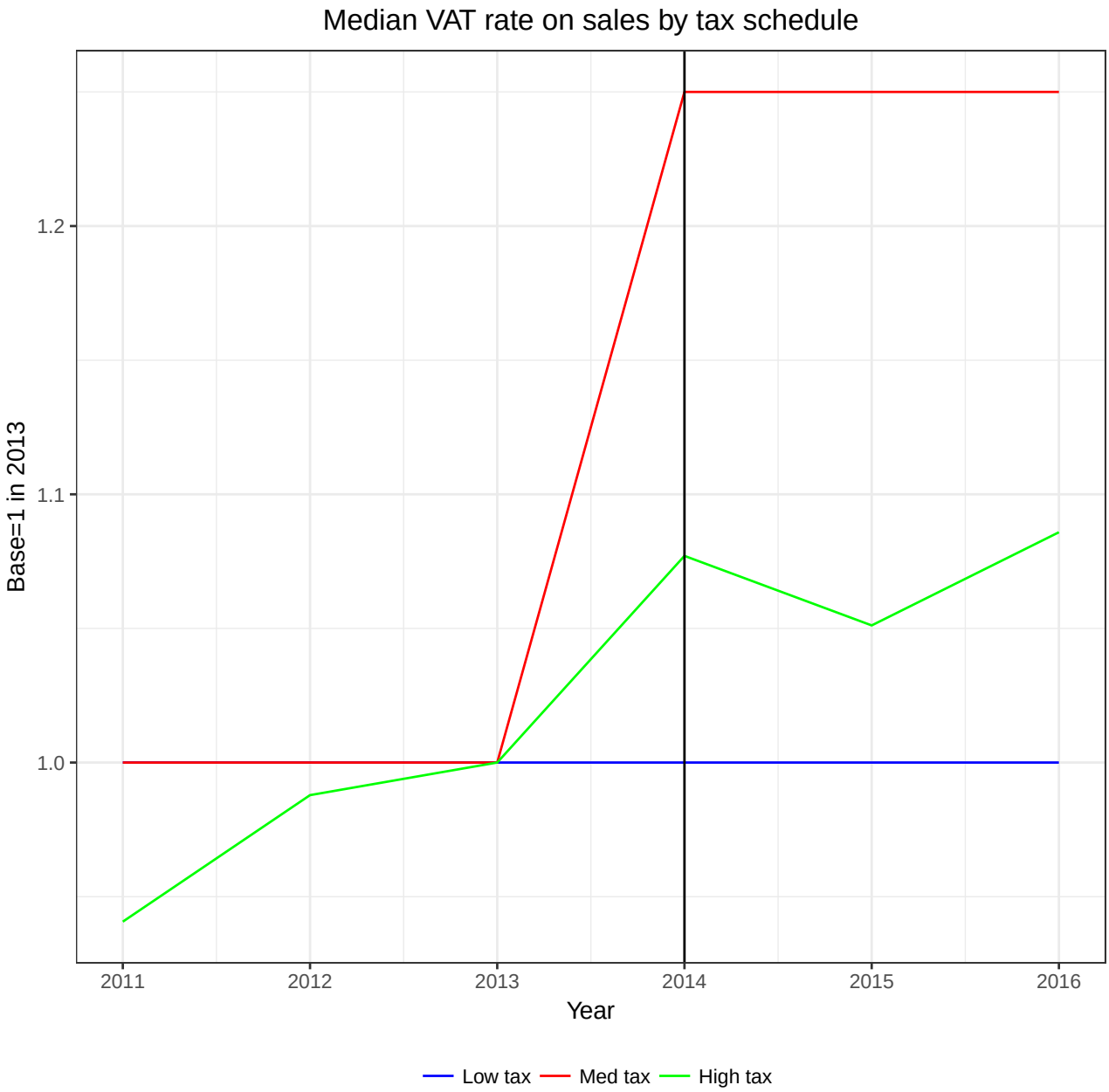
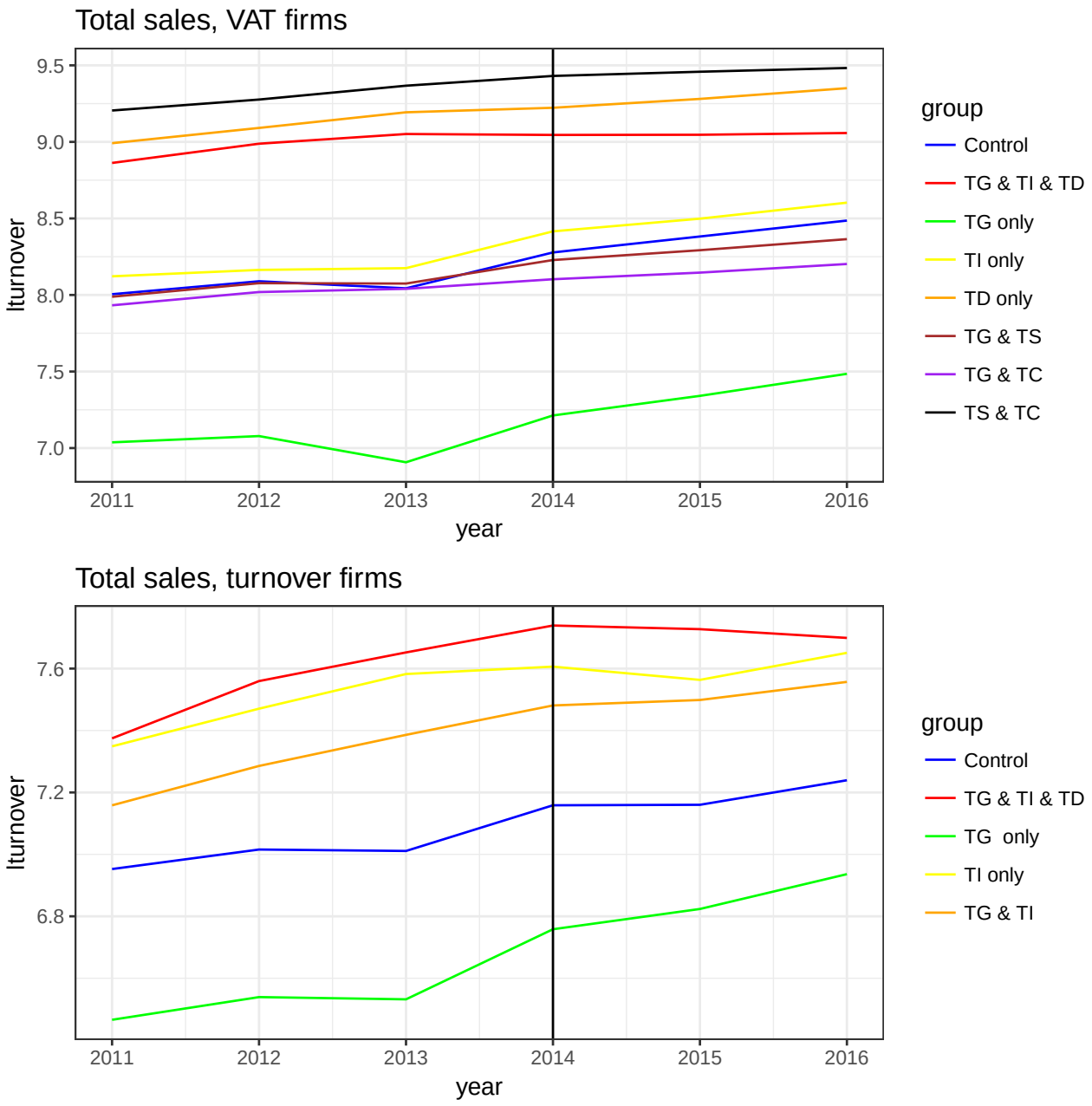
Figure 1: Effective VAT rate paid on sales over time by tax schedule



This graph plots for each year the median effective VAT rate paid on sales for VAT firms in the three tax schedules. The effective VAT rate on sales is obtained for each firm by dividing the VAT it paid on its sales by its total sales.

Figure 2: Evolution of outcomes over time by treatment group



Both graphs plot average log total sales by group in each year. The top graph considers the sample of small VAT firms, the bottom graph the sample of small turnover firms. 'TG only' stands for the group of firms in the treated good group, but not in the treated inputs or treated demand groups, 'TG and TD only' stands for the group of firms in the treated good and treated demand groups, but not in the treated inputs group, etc.

Table 1: Descriptive statistics on firms in 2010-2011

	Turnover scheme	VAT scheme (small)	VAT scheme (large)
Turnover	1656	1525	109,361
	(1346)	(1348)	(1,120,874)
In Kolkata	0.18	0.29	0.41
Share VAT sales	0.01	0.25	0.34
	(0.09)	(0.38)	(0.38)
Share VAT inputs	0.36	0.52	0.81
	(0.46)	(0.47)	(0.38)
Has a VAT trading partners	0.59	0.75	0.97
Nb VAT clients (> 0)	1.20	2.77	15.65
	(0.75)	(2.47)	(31.50)
Nb VAT suppliers (> 0)	2.33	3.27	12.12
	(1.83)	(3.14)	(18.79)
Observations	14,601	69,889	43,835

Column 1 includes all firms in the turnover 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 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)	(5)
Share VAT sales	0.255***	0.256***	0.209***	0.174***	0.007***
	(0.027)	(0.027)	(0.026)	(0.020)	(0.002)
Share VAT inputs	0.046***	0.046***	0.059***	0.055***	0.035***
	(0.016)	(0.016)	(0.009)	(0.010)	(0.005)
Year FE	No	Yes	Yes	Yes	Yes
Good FE	No	No	Yes	Yes	No
Location FE	No	No	No	Yes	No
Firm FE	No	No	No	No	Yes
Observations	495,385	495,385	495,385	495,385	495,385

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 year fixed effects (columns 2 to 5), commodity fixed effects (columns 3 and 4), location fixed effects (column 4) and/or firm fixed effects (column 5). The sample includes all firms with a turnover of less than 7 million INR over the fiscal years 2010-2011 to 2015-2016.

Table 3: Commodities 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

ADD. mention fact that we've aggregated over 170 different commodity categories here.

Table 4: Post reform treatment by type of commodity sold and tax scheme

	% Treated good	% Treated inputs	%Treated demand	%Control
All firms	75.6	48.6	36.5	16.1
A. By 2013 tax status				
VAT scheme	76.5	48.8	48.5	15.6
Turnover scheme	67.1	48.1	2.5	21.6
B. By type of commodity sold				
Machines & equipment	94.1	63.5	58	3
Construction materials	73.6	35.3	26.7	17.5
Electrical & electronic goods	70.9	52.8	33.4	17.1
Food, drink & tobacco	54	34.3	12.1	34.3
Chemical products	50.7	39.1	29.2	31.5
Textiles	94.9	40	32.5	2.8
Metal products	97	77.8	66.9	1.1
Wood & paper	98.5	40	32.5	2.8
Other commodities	56.7	31.8	22.8	37.4
Rubber & plastic	78.6	59	50	10.5
Household goods	32.5	47	20.6	36.3
Mining & energy	88.4	54.5	48	5.5

Each cell represents a the share (in %) of a row that belongs to a column group. Treatments are defined in the last fiscal year prior to the reform (2012-2013). In Panel B large commodity types are ranked in descending order of the number of firms in each category.

Table 5: Impact of the reform on sales

Outcome: Log-turnover						
Sample:	*VAT firms*			*Turnover firms*		
Treated good x Post	-0.073^{***}	-0.072^{***}	-0.068^{***}	0.108^{***}	0.106^{***}	0.106^{***}
	(0.024)	(0.024)	(0.025)	(0.027)	(0.026)	(0.026)
Treated inputs x Post	-0.007	-0.007	-0.012	-0.073^{***}	-0.067^{***}	-0.049^{***}
	(0.014)	(0.014)	(0.015)	(0.011)	(0.012)	(0.013)
Treated demand x Post	-0.130^{***}	-0.128^{***}	-0.109^{***}	-0.112^{***}	-0.108^{***}	-0.113^{***}
	(0.021)	(0.020)	(0.022)	(0.033)	(0.033)	(0.038)
Pincode+Good FE	No	Yes	No	No	Yes	No
Firm FE	No	No	Yes	No	No	Yes
Observations	631,272	631,272	631,272	61,363	61,363	61,363

All columns include year fixed effects and controls for firm size in 2013, standard errors are clustered at the commodity level. See the text for a description of the variables used.

Table 6: Impact of the reform on supply chains

Outcome:	Log share VAT sales			Has a turnover client			Is in VAT scheme		
Sample:	*VAT firms*			*VAT firms*			*All small firms*		
Treated good x Post	0.007^{**}	0.007^{***}	0.007^{**}	-0.011^{***}	-0.012^{***}	-0.010^{***}	-0.023^{***}	-0.018^{***}	-0.015^{***}
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.004)	(0.004)	(0.004)
Treated inputs x Post	-0.001	-0.001	-0.002	0.003^{*}	0.003^{*}	0.002	0.022^{***}	0.021^{***}	0.020^{***}
	(0.002)	(0.002)	(0.002)	(0.001)	(0.001)	(0.002)	(0.003)	(0.003)	(0.003)
Treated demand x Post	-0.015^{***}	-0.016^{***}	-0.013^{***}	0.004^{**}	0.004^{**}	-0.0001	-0.006^{**}	-0.008^{***}	-0.008^{***}
	(0.003)	(0.003)	(0.003)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Pincode+Good FE	No	Yes	No	No	Yes	No	No	Yes	No
Firm FE	No	No	Yes	No	No	Yes	No	No	Yes
Observations	631,272	631,272	631,272	631,272	631,272	631,272	479,529	479,529	479,529

The sample is the first 6 columns includes all firms that are in the VAT scheme in 2013 and remain in that scheme afterwards. The sample in the last three columns includes all firms with a turnover below 7 million INR. All columns include year fixed effects and controls for firm size in 2013, standard errors are clustered at the commodity level. See the text for a description of the variables used.

Table 7: Transaction level evidence on supply chain distortions

	Outcome: Dlog share input				
	(1)	(2)	(3)	(4)	(5)
Dlog VAT rate	-0.125^{**}	-0.106	-0.116	-0.159^{*}	-0.131^{*}
	(0.060)	(0.071)	(0.119)	(0.083)	(0.077)
Firm FE	No	No	Yes	No	No
Goods+Location FE	No	Yes	No	Yes	Yes
Sample	All	All	All	Share $< 40\%$	Stayers
Observations	26,012	26,012	26,012	21,133	22,338

The data is at the buyer-seller pair level. The sample includes all pairs present in 2013 such that the buyer is in the turnover scheme and the supplier is in the VAT scheme. Columns 1-2 present the result on the full sample. Column 3 restricts the sample to transactions representing less than 40% of total inputs. Columns 4 restricts the sample to transactions such that the downstream firm is still turnover in 2014. In columns 2-4, we introduce fixed effects for downstream firms. In all columns, standard errors are clustered at the level of downstream company.