Tax systems and inter-firm trade:
Evidence from the VAT in Brazil [*]

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May 21, 2018

*****NOT** for circulation****
A set of slides with results follows attached

1   Extended Abstract

Incentives to trade among economic agents are often affected by the tax incentives that they face. On the one hand, because of production efficiency concerns, tax systems allow buyers to deduct some purchases from their tax liability. On the other hand, pervasive exemptions or special regimes imply that such deductions apply differentially depending on the identity of trade partners. For instance, a Child Care Tax Credit for the Personal Income Tax (PIT) creates incentives for families to hire formal childcare (producing a receipt) rather than an informal babysitter. If the family is below the PIT threshold, however, such incentive no longer exists as the PIT liability is zero, and an informal arrangement may become more likely.

Conceptually, this link between the tax system and transactions among economic agents matter in at least three important ways. First, it could generate production inefficiencies through mis-allocation: a taxpayer may not choose the cheapest or best supplier as its choice may be affected by the tax incentives it faces. Second, it could change tax revenue directly and along the supply chain: an exemption may reduce tax revenue from the exempt taxpayer directly, but also from its trade partners if the exemption causes the taxpayer to change trade partners. Third, taxpayers' behavior may be distorted to ensure eligibility to an exemption, and this distortion may spill over to their trade partners. For instance, if an exemption is size-based, disincentives to grow could be transmitted along the supply chain (De Paula & Scheinkman, 2010).

Although such combination of deductions and exemptions are common in modern tax systems, little is known about their effect on trade networks. The sparse evidence can be attributed to the difficulty of combining (i) the necessary policy variation to identify causal impacts and (ii) the necessary wealth of data

to measure those impacts. In this paper, we contribute to filling this gap by studying the causal effect of tax systems on firms' choice of trade partners. In particular, we exploit administrative data based on electronic invoices for business-to-business (B2B) transactions in São Paulo, Brazil, to study a Value Added Tax (VAT) system, where deductions and inter-firm trade are first-order features of the tax. VATs exist in more than 160 countries, including in many developing countries. 80% of countries in sub-Saharan Africa have adopted the VAT, and it is now responsible for typically raising around one-quarter of all tax revenue (Keen, 2007).

In the VAT, sellers receive tax credit from the VAT charged on their inputs against the VAT charged on their sales. On theoretical grounds, a VAT with a uniform rate and no exemptions is equivalent to a sales tax and is an efficient tax instrument. Unlike turnover or import taxes, there is no cascading or production distortion (Keen, 2007). Moreover, from a tax administration perspective, the VAT can be more effective than a retail sales tax due to its self-enforcing properties along the supply chain (Kopczuk & Slemrod 2006, Pomeranz 2015). These properties are arguably reasons why the VAT was widely adopted around the world.

It is rarely the case, however, that a VAT system features a uniform rate and no exemptions. In fact, many firms are often exempt from the VAT. We study one of the most common modes of exemptions across countries: revenue thresholds below which firms can choose not to be part of the VAT (Keen & Mintz, 2004). The presence of these VAT-exempt firms ("non-VAT" firms hereafter) can have important implications for the link between taxation and firms' networks. Typically, VAT-registered firms do not get tax credits from purchases outside the VAT system and non-VAT firms (which are sometimes subject to an alternative tax on their revenue) cannot take tax credits from purchases within the VAT system. As a result, VAT exemptions may create partial segmentation of trade between VAT-registered and non-VAT firms (De Paula & Scheinkman, 2010). This debate is particularly relevant for tax systems and informality in developing countries, where VAT thresholds tend to be high and a large number of informal firms that are *de facto* exempt from taxes could face similar production distortions as formal firms that are *de jure* exempt.

In this paper, we document a number of new empirical patterns on the relationship between the tax system and inter-firm trade using anonymized administrative data from the tax authority of the state of São Paulo.[1] The data include aggregated yearly flows between firms from electronic invoices. One of the key advantages of the Brazilian electronic invoice data over other newly available datasets on firm-to-firm transactions is that both VAT-registered and non-VAT firms must use electronic invoicing.[2] As a result, the data allow us to map the trade network of VAT-registered and non-VAT firms, including when firms switch tax regimes. We exploit these data using a rich set of research designs, including a reform that changed the location of the revenue-based VAT threshold within the period of analysis.

As a starting point, we show that some firms below the VAT threshold bunch at the threshold to *avoid* the mandatory VAT registration, while other firms *voluntarily* register. This pattern is in line with Liu *et al.* (2017) who study the VAT system in the UK. We use information from firms' characteristics and firms' network to show systematic patterns in the choice of voluntary registration. For instance, firms that voluntarily register have higher input shares from VAT-registered suppliers.

Next, we use variation from firms switching tax regime to show that there is a clear link between tax regimes and trade networks beyond a pure selection story (e.g., firms characteristics such as sector of activity

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[1]The VAT is subnational in Brazil; each of the 27 states administer the VAT within the state.

[2]Usually, such data is available through VAT declarations where firms itemize inputs and outputs (e.g., India and Uganda). Therefore, only transactions for which a VAT-registered firm is either a buyer or a supplier can be observed, and transactions between non-VAT firms are not covered by the data. In addition, because firms declare their inputs and outputs, the declaration of the same transaction is subject to mistakes and misreporting by the two parties. In the case of Brazil, the electronic invoicing covers all B2B transactions and each invoice has a unique key such that the same transaction cannot be reported differently by suppliers and buyers. The data thus mitigate both concerns of data censoring and misreporting.

that could determine both registration and trade networks). We implement an event study exploiting firms switching into the VAT and out of the VAT to show how the VAT intensity of their inputs changes. This research design exploits the panel feature of our data, which allows us to control for fixed characteristics of firms through fixed effects. Our main finding is that firms start trading relatively more with firms in their new tax regime as soon as they switch regime.

There are three candidate explanations for this result. First, there could be time-variant omitted variables unrelated to a firm's (potential) trade network driving both tax regime switches and changes in trade patterns. The most obvious concern is that firms that switch into (resp. out of) VAT are growing more (resp. less) in previous years than the average firm. Yet, we show that controlling for pre-trends in revenue and input does not affect our results. Although this does not remove all potential sources of omitted variable bias unrelated to a firm's (potential) trade network, it indicates that such a bias does not necessarily drive our results. In that case, there remains two explanations that imply causal links between tax regimes and (potential) trade networks. Firms may change tax regime because they experience or expect changes in the composition of their trade network. Firms may change the composition of their trade network because they change tax regime. These findings suggest a causal link between tax regime and firm networks, in any one of the two directions of causality.

To get at the causal effect from firms' tax regime to trade networks, we employ two research designs. First, we exploit a reform that increased the VAT threshold by 50% through a differences-in-differences strategy. Second, we study the impact of a supplier's change of tax regime on a firm's decision to purchase inputs from that supplier through an event analysis. For the second research design we restrict attention to firms that are a "small economy" to their supplier such that they do not influence the decision of their supplier to switch tax regimes. In both cases, we find evidence that the tax regimes of potential trade partners have a causal effect on their likelihood of trading and the volume of their trade.

Overall, our results are consistent with production distortions: we find (partial) segmentation in the network between VAT-registered and non-VAT firms, i.e., firms trade relatively more with firms in their own tax regime. The degree of segmentation, however, is mitigated by the fact that firms are heavily dependent on key suppliers. In fact, most firms trade across tax regimes, and most firms have a VAT-registered firm among their main trade partners (note: we are still deriving the quantitative implications of our findings). Moreover, these distortions should be weighted against other key motivations for exemptions such as compliance costs that could be quite large for small firms below the threshold.

This paper contributes to the literature by shedding new light on how tax systems interact with taxpayers sourcing decisions in the context of one of the main tax instruments in the world: the VAT. Although the literature has emphasized the potential relevance of such effects (Liu *et al.* 2017; Pomeranz 2015; De Paula & Scheinkman 2010), there is little empirical evidence of VAT chain effects using micro-data on firm trade flows.[3] The paper also contributes to a broader literature on misallocations (e.g., Hsieh & Klenow 2009), size-based regulation and taxation (e.g., Garicano *et al.* 2016, Monteiro & Assunção 2012, Boonzaaier *et al.* 2016, Best *et al.* 2015), and a growing literature documenting firm responses to VAT thresholds through avoidance (e.g., Onji 2009), evasion (e.g., Asatryan & Peichl 2016), and real desincentives to grow (e.g., Harju *et al.* 2015).

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[3]Concurrent to this paper, there is some work in progress using data from India (Gadenne *et al.* 2018, Rios & Setharam 2018).

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Tax systems and inter-firm trade: evidence from the VAT in Brazil

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Motivation

Tax systems and networks of economic activities

- Incentives to trade between economic agents are often affected by the tax incentives that they face
  - Modern tax systems often allow buyers to deduct purchases from sellers from their tax liability ("production efficiency")
  - But pervasive exemptions or special regimes → deductions often apply differentially depending on the identity of trade partners.

- Example: Child Care Tax Credit for the Personal Income Tax (PIT)
  - If positive tax liability ⇒ incentive to hire a formal babysitter (producing a receipt) rather than an informal babysitter
  - If income below the PIT threshold, no such incentive

Motivation
Tax systems and networks of economic activities

- Link tax systems (deductions + exemptions) ⇔ trade network matters because:
  - ▶ Potential "production inefficiency" (mis-allocation): choose suppliers because of tax status, so don't source from cheapest/best supplier
  - ▶ Change tax revenue directly *and* along the supply chain
  - ▶ Possible spillover effect of tax status along trade network
    - ★ Matters because if, e.g, exemptions are size based → disincentives to grow can be transmitted along the supply chain

- So causality can go both ways
  - ▶ Choice of tax status based on trade network
  - ▶ Choice of trade network based on tax status/system

- In general, relatively little evidence in the literature on the interaction between tax systems and trade networks

Motivation
Value Added Tax (VAT)

- This paper: study this link in the VAT system
  - over 160 countries have adopted the VAT (Benzarti et al, 2017)
- Inter-firm trade key to VAT: sellers are liable for VAT on their sales and receive credit (deduction) for VAT charged on their inputs
- VAT has desirable properties when there is a uniform VAT rate and all firms are formal and subject to the VAT
  1. Unlike turnover tax, no cascading or production distortion (Keen, 2016)
  2. Unlike import tax, no production distortion (Keen, 2016)
  3. Compared to retail sales tax, built-in compliance along the supply chain
     (Kopczuk and Slemrod, 2006; Keen and Lockwood, 2010; Pomeranz, 2015)

Motivation
Value Added Tax (VAT)

However, in practice, many firms often exempt from VAT

1. Informality: firms exempt *de facto*

2. Exemption thresholds (e.g. revenue threshold): firms exempt *de jure*

$\Rightarrow$ VAT exemptions may create partial segmentation of trade between VAT firms and VAT-exempt firms (de Paula and Scheinkman, 2010)

Motivation
Intuition for de Paula and Scheinkman, 2010

- Two stages (homogeneous good): Upstream and Downstream
- Firms can be either VAT (tax τ_V) or Non-VAT (if small enough)

	VAT	**Non-VAT**
Upstream	Sell good at p_V	Sell good at p_N
Downstream	Sell good at p_{DV} Cost(VAT input): p_V Cost(Non-VAT input): p_N	Sell good at p_{DN} Cost(VAT input): $(1 + \tau_V) \cdot p_V$ Cost(Non-VAT input): p_N

Motivation
Intuition for de Paula and Scheinkman, 2010

- Two stages (homogeneous good): Upstream and Downstream
- Firms can be either VAT (tax τ_V) or Non-VAT (if small enough)

	VAT	**VAT-exempt**
Upstream	Sell good at p_V	Sell good at p_N
Downstream	Sell good at p_{DV} Cost(VAT input): p_V Cost(Non-VAT input): p_N	Sell good at p_{DN} Cost(VAT input): $(1 + \tau_V) \cdot p_V$ Cost(Non-VAT input): p_N

- Equilibrium conditions for coexistence of VAT and Non-VAT firms
  - Downstream: $(1 + \tau_V) \cdot p_{DV} = p_{DN}$
  - Upstream: $(1 + \tau_V) \cdot p_V \geq p_N \geq p_V$
  - $\Rightarrow$ Segmentation of trade between VAT and Non-VAT firms
  - $\Rightarrow$ Production inefficiency and subsidize inefficient/small firms

Overview of the project

- In practice, there are many reasons why two firms may trade (e.g. specific inputs), which will limit the actual degree of segmentation
- But there may still be partial segmentation induced by the tax system

- **This project**: Provide empirical evidence of how a VAT system with exemptions affect inter-firm trade
- Use variation from VAT registration threshold in Brazil: study how firms' tax regimes affect their trade networks
- Use administrative data on inter-firm trade in São Paulo
  - Observe flows between firms for VAT firms and "de-jure" exempt firms
  - Unique data: includes all B2B formal transactions irrespective of tax regime

Literature

- Size-based regulation and taxation (e.g., Garicano et al., 2013; Monteiro and Assunção, 2012; Boonzaaier et al., 2016; Best et al., 2015)

- Evidence on firm responses to VAT Thresholds
  - Avoidance (e.g., Onji, 2009)
  - Evasion (e.g., Asatryan et al, 2016)
  - Real desincentives to grow (e.g., Harju et al., 2016)

- Still little empirical evidence on VAT chain effects (e.g. Liu et al., 2017; Pomeranz, 2016; de Paula and Scheinkman, 2010)
  - Work in progress concurrently to our project: Gadenne, Rachelot and Nandi (2018); and Rios and Setharam (2018)

- Propagation of shocks in firms' networks (e.g., Carvalho et al, 2016)

- Little evidence on link between tax systems and inter-firm trade

Outline

1. Institutional Background & Data
2. Stylized facts and cross-sectional analysis
3. Evidence of causal link between tax regime and inter-firm trade
4. Next steps

Outline

1. **Institutional Background & Data**
2. Stylized facts and cross-sectional analysis
3. Evidence of causal link between tax regime and inter-firm trade
4. Next steps

Institutional Background
VAT in Sao Paulo (SP), Brazil

- In Brazil, VAT at the state level ("ICMS"; 87% of tax revenue in SP)
  - Tax base includes goods and some services
  - Sales generate tax debit and purchases generate tax credit
  - Most common rate: 18%; exports exempt; imports taxed
  - Monthly filing and remittance

- States legislate over specific exemptions and are responsible for enforcement and administration

- As it is common in many countries: firms below a turnover threshold are eligible to be taxed on turnover instead of value-added

- In Brazil, revenue-based VAT threshold set at the federal level

Institutional Background

- Until 2012 (after 2012): R\$ 2.4m (R\$ 3.6m; R\$2$\simeq$US\$1 in 2012)
  - Revenue includes total from all establishments within a firm
  - Turnover tax replaces VAT + federal and municipal taxes (e.g. CIT): SIMPLES
  - Average tax rate $\simeq$4%
  - A few exceptions: firms with foreign owners/capital never eligible

- In January of every calendar year, firms below threshold can choose to register for turnover tax regime ("non-VAT" firms) or for VAT
  - Overall tax and administrative burden typically lower
  - But some eligible firms may prefer to join VAT system

- VAT firms that purchase goods from non-VAT firms: can claim tax credit for $1/3$ of the turnover tax ($\simeq$1.34%) $\Rightarrow$ for the same after tax price, it is much better to buy from a VAT firm (claim $\simeq$18%)

Source of trade data
Electronic invoicing across firms

- Electronic invoicing in Brazil
  - Ambitious nation-wide project to digitize invoices and tax returns
  - Electronic receipts (NF-e): mandatory for B2B transactions since 2011
  - Overall project still in progress (e.g. pre-population of tax returns)

- We use data from the largest Brazilian state, São Paulo (SP)
  - 34% of Brazilian GDP; population 42 million; large informal sector

- Advantages of the data in general
  - Include trade between all formal firms, VAT and VAT-exempt firms
  - Irrespective of mode of payment or value
  - Limited room for errors (no manual reporting) or unilateral misreporting

- Limitations of the data in general
  - Don't include trade with informal firms and compliance incentives may affect the information recorded in the receipts by formal firms
  - Some information not yet harmonized (e.g., product codes, units)

Actual data for this project

This research project uses **anonymized** datasets from the Department of Finance of Sao Paulo (SEFAZ/SP). This work does not necessarily represent the views of SEFAZ/SP.

- Construct trade data based on aggregate yearly trade flows between pairs of (anonymized) establishments (2011-2016)
  - ▶ Firms that could be identified despite anonymization are aggregated

- Detailed trade data for wholesalers (85,371 *origin sample*)
  - ▶ Yearly trade flows for all trade pairs involving a wholesale establishment and other establishments belonging to the same firm
  - ▶ 15,061,773 input pairs-year and 82,609,580 output pairs-year

- Aggregate trade data by tax regime of trading partner for supplier and clients of "origin" establishments ($>$1,100,000 firms)
  - ▶ Total of input transactions by year and tax regime of supplier

- Registry data for these firms (*full sample*; 2008-2016)
  - ▶ Year of registration, tax regime and total revenue in each year
  - ▶ Anonymized 5-digit sector $+$ dummy for manuf., retail, wholesale

Illustration of our data

Simples
VAT
Not known
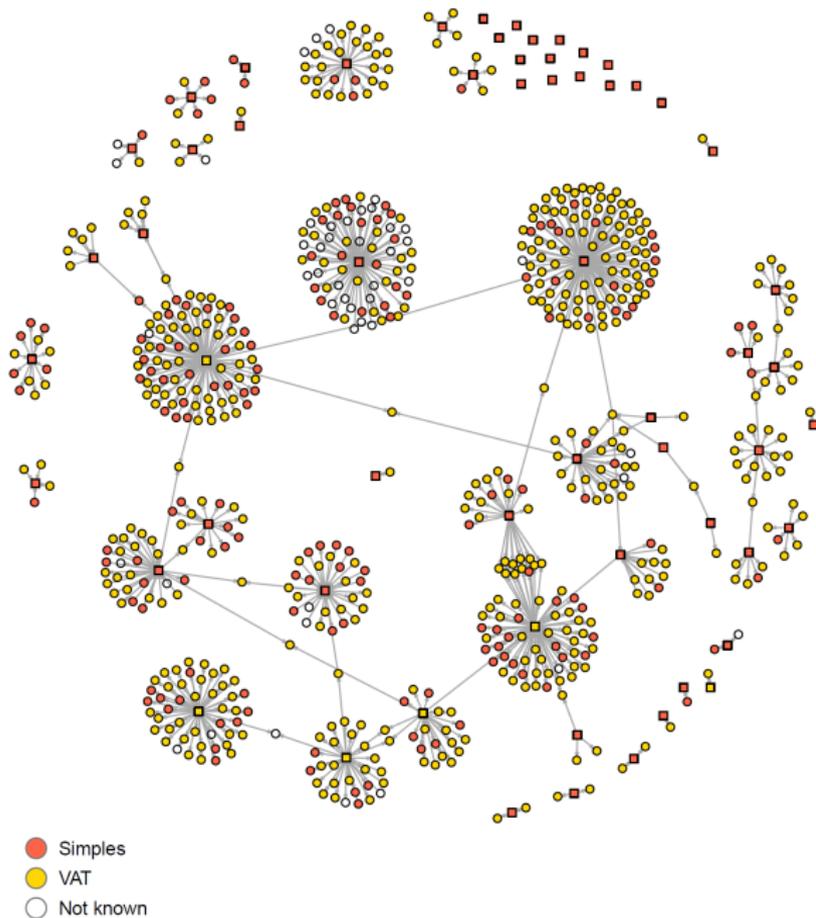
Firm size distribution

- Given firm size distribution and exemption thresholds, most firms (origin sample: $> 80\%$; full sample $> 90\%$) can choose tax regime

(Origin sample, 2012-2016)
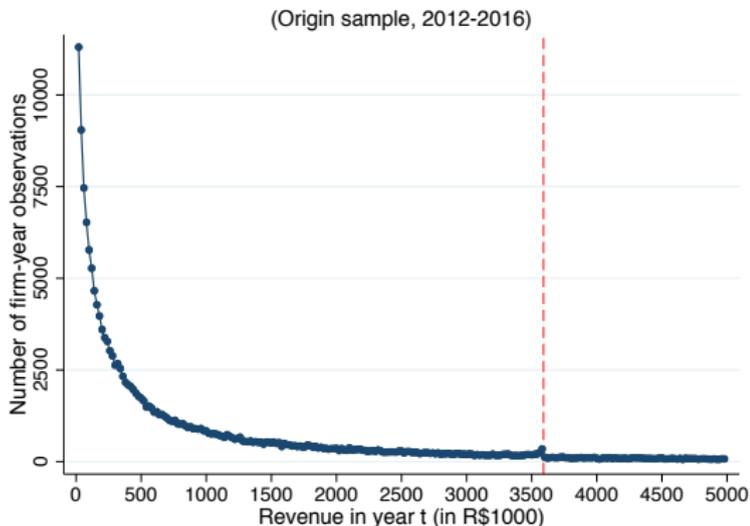
- Non-VAT firms much more numerous than non-VAT firms, but VAT firms are much more important for all firms' networks
- Firms above the threshold account for only 16.4% of the sample but 91.2% of the total revenue

Outline

Descriptive Statistics

Table 1: Descriptive statistics for the origin sample (2012-2016)

| | All firms | Above VAT threshold | Below VAT threshold | |
| | | | VAT-registered | Non-VAT |
	(1)	(2)	(3)	(4)
Share VAT registered	0.404	0.981	1	0
Share of the sample	1	0.164	0.242	0.593
Mean age of the firm	10.012	14.353	10.434	8.636
Mean number of establishments	1.507	3.054	1.395	1.124
Mean log(revenue)	13.031	16.501	12.750	12.184
Share of total revenue	1	0.912	0.036	0.052
Share with any input transaction	0.961	0.999	0.976	0.944
Mean log(input) if input>0	12.529	15.934	12.565	11.515
Share of total input transactions	1	0.861	0.075	0.065
Mean log(revenue/input)	0.614	0.568	0.250	0.781
Number of suppliers: p10-p50-p90	2 - 15 - 87	15 - 70 - 245	2 - 13 - 58	2 - 11 - 51
Mean VAT input share (share of input subject to VAT)	0.817	0.953	0.884	0.750
Number of firm-year observations	229771	37774	55673	136324
Number of firms	66422	11316	21930	42620

Tax systems and inter-firm trade
Main stylized facts

1. Firms bunch to avoid VAT registration, and firms voluntarily register in the VAT
2. Trade is highly concentrated: few top suppliers account for most of a firm's input
3. Partial segmentation in supply chains between VAT-registered and non-VAT registered

1. **Firms bunch to avoid VAT registration, and firms voluntarily register in the VAT**
   - In line with UK evidence in Liu et al (2017)
2. Trade is highly concentrated: few top suppliers account for most of a firm's input
3. Partial segmentation in supply chains between VAT-registered and non-VAT registered

Bunching at VAT threshold

(Origin sample, 2012-2016)
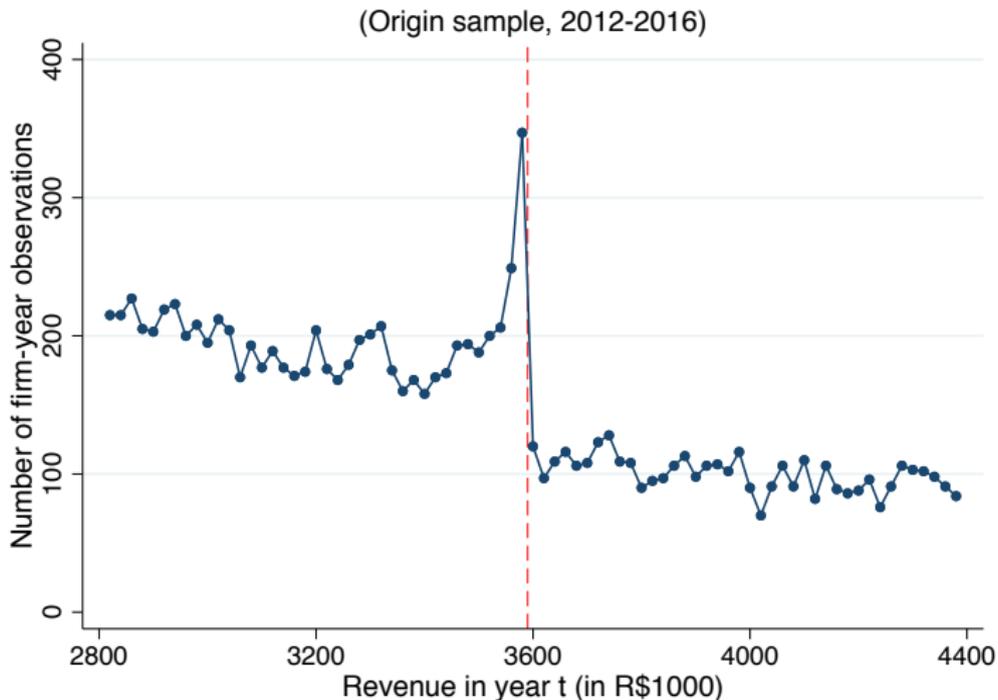
- Some firms avoid crossing the threshold

Bunching at VAT threshold

(Origin sample, 2012-2016)
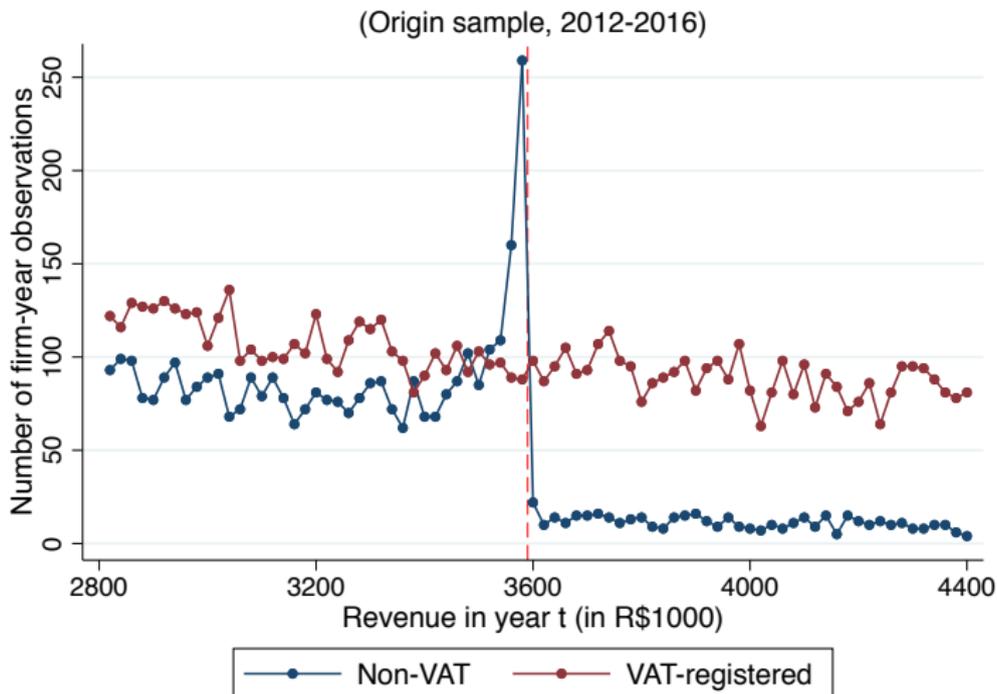
- Bunching is driven by non-VAT firms

Voluntary VAT registration

(Origin sample, 2012-2016)
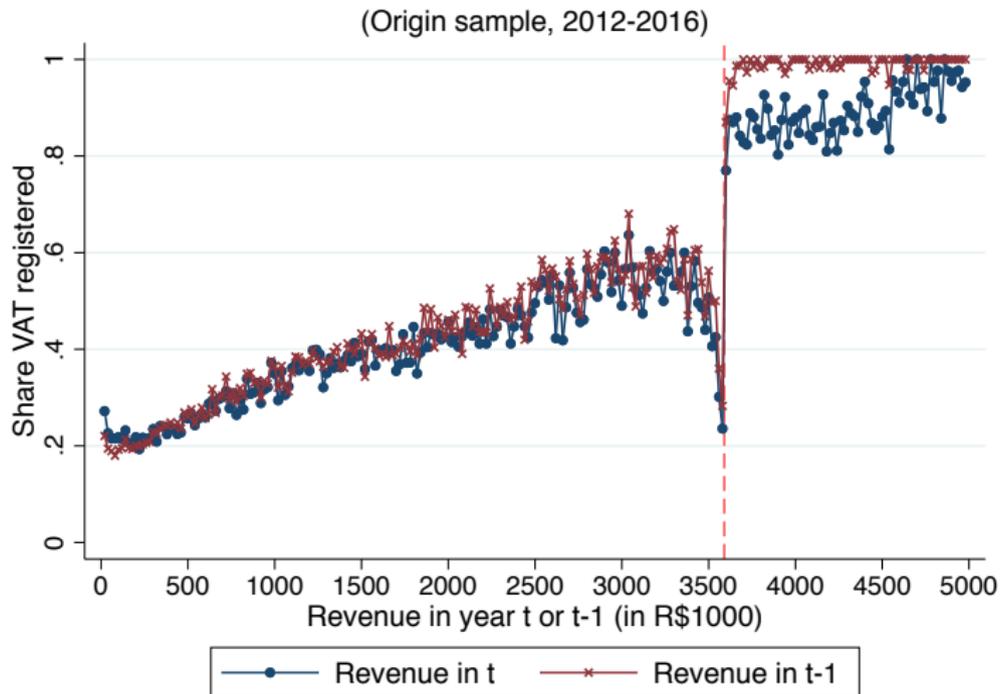
- The VAT threshold is binding
- Some firms voluntarily join the VAT

Tax systems and inter-firm trade

Main stylized facts

1. Firms bunch to avoid VAT registration, and firms voluntarily register in the VAT
2. **Trade is highly concentrated: few top suppliers account for most of a firm's input**
   - The VAT input share is high for firms in both tax regimes
   - The median firm has 15 suppliers; The mean of top 1 is $> 30\%$; the top 3 add up to $> 50\%$
3. Partial segmentation in supply chains between VAT-registered and non-VAT registered

Tax systems and inter-firm trade
Stylized facts

1. Firms bunch to avoid VAT registration, and firms voluntarily register in the VAT
2. Trade is highly concentrated: few top suppliers account for most of a firm's input
3. **Partial segmentation in supply chains between VAT-registered and non-VAT registered**

Partial segmentation

Mean VAT input share by revenue level

(Origin sample, 2012-2016)
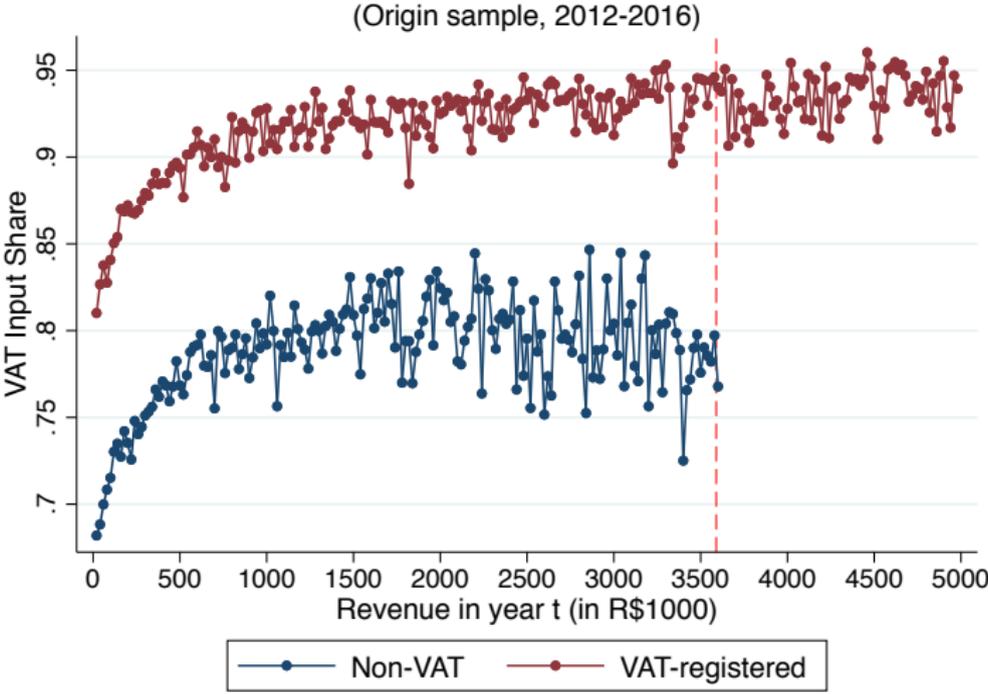
Partial segmentation

Importance and VAT registration status of top 10 suppliers – VAT-registered firms below the VAT threshold

(Origin sample, VAT-registered firms below VAT threshold, 2012-2016)
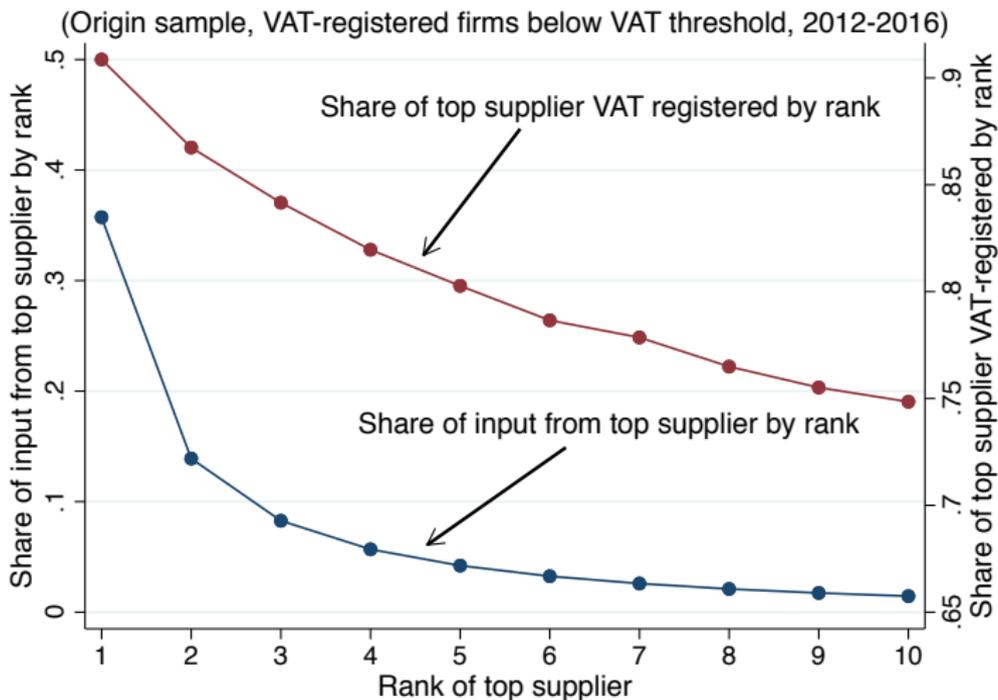
Partial segmentation

Importance and VAT registration status of top 10 suppliers – Non-VAT firms below the VAT threshold

(Origin sample, Non-VAT firms below VAT threshold, 2012-2016)

Share of top supplier VAT registered by rank

Share of input from top supplier by rank
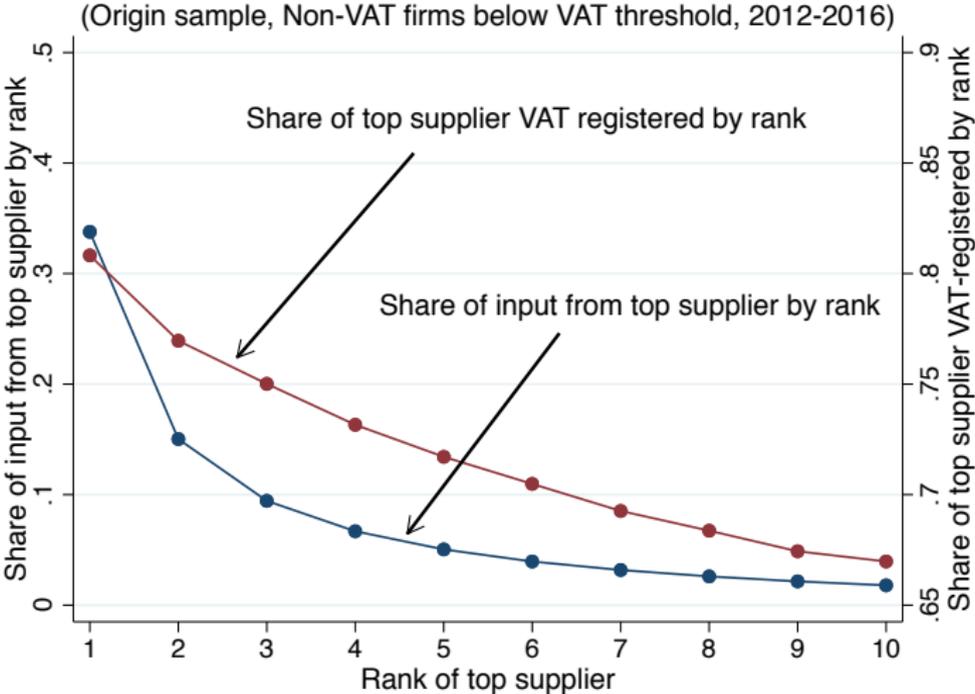
VAT registration and firm characteristics

- the share of VAT input is also correlated with VAT registration

(Origin sample, firms below VAT threshold, 2012-2016)

Without controls: b=.38 (.006).
With controls (log revenue, year and sector FE): b=.332 (.006).
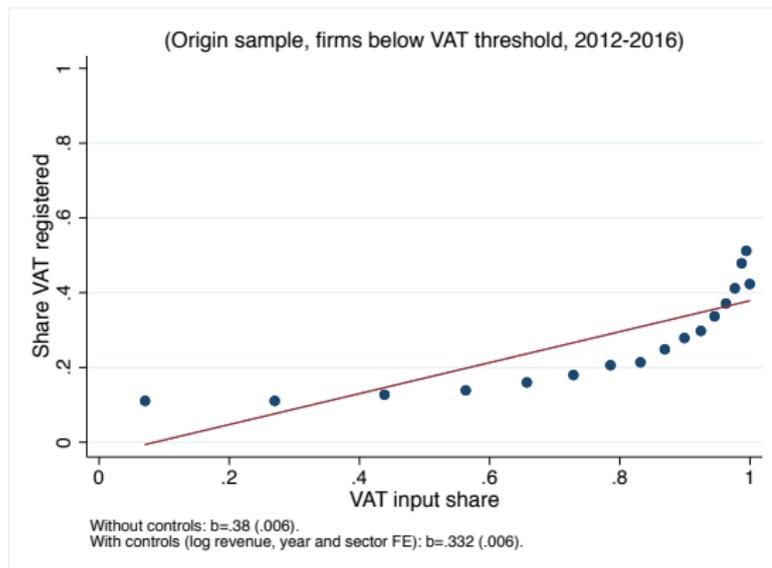
- Network $\rightarrow$ tax regime: Input composition matters for the VAT liability
- Tax regime $\rightarrow$ Network: Firms in the VAT system may have an incentive to trade with other VAT-registered firms (segmentation).

VAT registration and firm characteristics

- Caution: could be due to *selection* unrelated to trade network in our setting
- For instance, for a given revenue level, negative correlation between VAT registration and Value Added

(Origin sample, firms below VAT threshold, 2012-2016)

Without controls: b=-.046 (.002).
With controls (log revenue, year and sector FE): b=-.038 (.002).
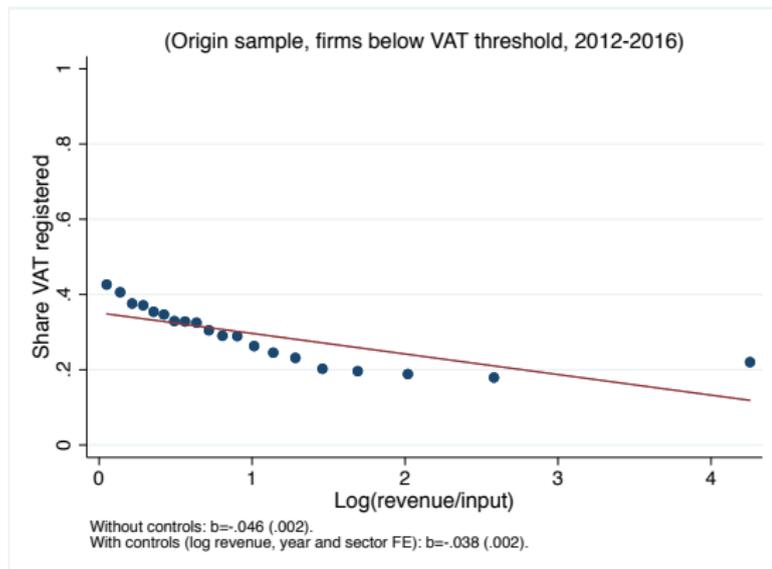
- Another potential explanation: causal effect of tax regime on reporting incentives

Reporting effects and causal links

- Tax evasion could be driving some of these facts
  - ▶ e.g., bunching could be a real response (Harju et al, 2015), but sharp bunching is likely a reporting effect; negative correlation between value added and VAT registration could also be driven by reporting incentives changes
  - ▶ The overall large share of VAT inputs could also be partially driven by under-reporting of trades with non-VAT firms

- The segmentation, however, is likely real
  - ▶ The degree of segmentation could actually be an underestimate: if there is more underreporting among non-VAT firms and we do not observe trades with informal firms
  - ▶ we can observe transitions in and out of the VAT to document patterns that are not easily explained by reporting effects only

- First step for isolating causal links: event analysis around tax regime switches (removing selection based on fixed characteristics)

Outline

Outline

- Event study: exploit timing of tax regime switches to study changes in inter-firm trade patterns before and after the switches
    1. Changes in trade patterns could be caused by VAT registration/exemption
    2. VAT registration/exemption could be caused by changes in trade network (actual or potential)
- Variation within firm over time: changes in trade patterns or VAT registration cannot be due to fixed firm characteristics
- Could still have time-variant omitted variables
    - E.g. when a firm grows, it becomes more likely to register and to trade with larger firms, which are more likely to be VAT firms
    - Firms that switch into (resp. out of) VAT are growing more (resp. less) than the average firm (in terms of revenue and input)
    - But we can control for pre-trends in revenue and input

▸ raw data

Change in tax regime and trade patterns

Event study: in practice

- 4-year balanced panel of firms between 2011-2016 to observe each firm for two years before and after a tax regime switch
- Origin sample: restricted to firms with positive input and output in all years (comparable results for full sample)
- **Treatment**: switched tax regime in 2013, 2014, or 2015 and always in same tax regime before and after the switch
- **Control**: placebo event year in 2013, 2014, or 2015 conditional on observed for 4-year window in the same tax regime

Change in tax regime and trade patterns

Event study: in practice

- Four groups: Always in VAT (14,132), Never in VAT (15,063), Switch out of VAT (986), Switch into VAT (769)
- Compare treatment to control from previous tax regime in two separate DD:
  - ▶ Switch out of VAT vs. Always in VAT
  - ▶ Switch into VAT vs. Never in VAT

$$y_{i,k,t} = \alpha_i + \beta_k + \gamma_t + \delta_k \cdot Treat_i + \psi_k \cdot \Delta^{pre} Revenue_i + \phi_k \cdot \Delta^{pre} Input_i + \varepsilon_{i,k,t}$$

- where α_i, β_k, and γ_t are fixed effects for each firm i, each event year k, and each calendar year t .
- event years are normalized such that $k = 0$ as the year of the tax regime switch
- Figures: plot $\widehat{\delta_k}$

Event study of own tax regime switching

VAT input share

(Origin sample, balanced panel)

VAT Input Share

Year relative to switch

- Switchers into VAT vs Non-VAT stayers
- Switchers out of VAT vs VAT stayers
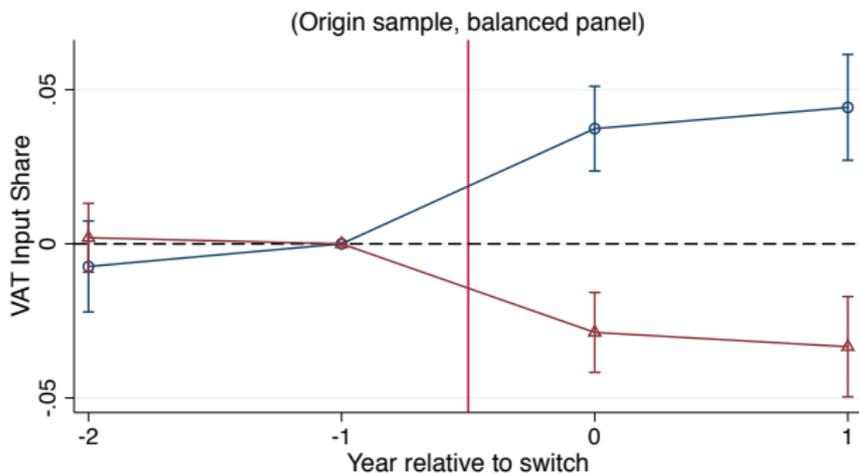
Baseline (into VAT): .84; Baseline (out of VAT): .87
DD estimate (into VAT): .044 (.007); DD estimate (out of VAT): -.032 (.006)

It increases by 4.4pp for switchers into VAT and decreases by 3.2pp for switchers out of VAT

Event study of own tax regime switching

Likelihood that Top 1 supplier is VAT registered

(Origin sample, balanced panel)

Baseline (into VAT): .85; Baseline (out of VAT): .87
DD estimate (into VAT): .049 (.014); DD estimate (out of VAT): -.026 (.012)
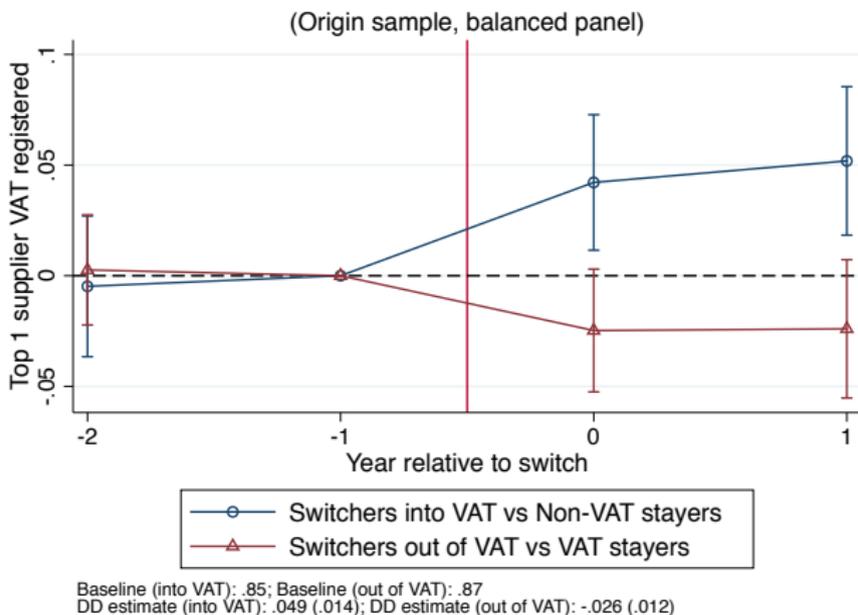
It increases by 4.9pp for switchers into VAT and decreases by 2.6pp for switchers out of VAT

Event study of own tax regime switching
VAT and non-VAT Inputs
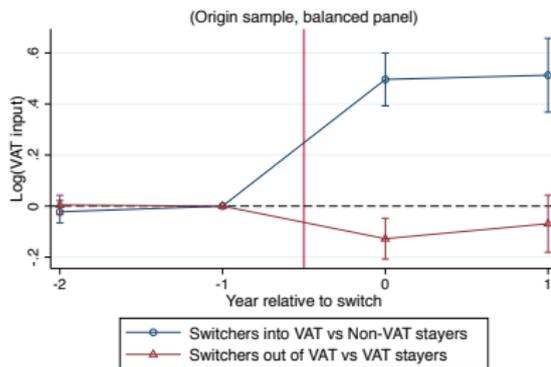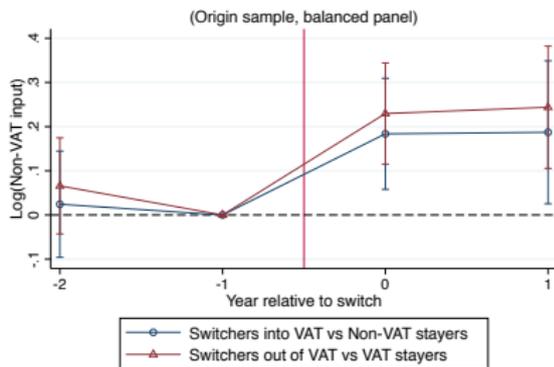
(a) Total VAT Input

(b) Total Non-VAT Input

Change in VAT input share: unlikely due to pure reporting effect because
Non-VAT Input increases for firms that become VAT-exempt

Event study of own tax regime switching

- Firms start trading relatively more with firms in their new tax regime as soon as they switch regime
  - ▶ not driven by fixed characteristics of firms; not driven by pre-trends in revenue and input
- Two explanations: causal links between tax regimes and (potential) trade networks.
  1. Firms may change the composition of their trade network because they change tax regime
  2. Firms may change tax regime because they experience or expect changes in the composition of their trade network
- In order to isolate the effect of [1]:
  - ▶ VAT threshold reform: look at how changes in tax regime affect firms' choices of trade partners
  - ▶ Event study from suppliers' changes in tax regime: look at likelihood that firms still trade with these suppliers (in cases where firms are relatively "small" for these suppliers at baseline)

Outline

1. Institutional Background & Data
2. Stylized facts and cross-sectional analysis
3. **Evidence of causal link between tax regime and inter-firm trade**
   1. Event analysis - own regime switching
   2. **Difference in Differences - VAT threshold reform**
   3. Event analysis - trade partners switching regimes
4. Next steps

Difference in Differences - VAT threshold reform

- Reform increased the VAT threshold from R$2.4 million to R$3.6 million in 2012
- VAT-registered firms with revenue levels between these two thresholds prior to the reform: newly eligible for voluntary registration
- We use the full sample and focus on firms that were attached to the VAT system (VAT-registered for two years pre-reform)
- **Treatment**: firms that were VAT-registered for the two years prior to the reform and that already had a revenue level above the pre-reform threshold in 2010 (*in the reform region*)
- **Control**: firms with revenue levels in 2010 between R$3.6 million and R$4.8 million (*above the reform region*)

Difference in Differences - VAT threshold reform

$$y_{i,t} = \alpha_i + \gamma_t + \delta_t \cdot Treat_i + \varepsilon_{i,t}$$

- where α_i and γ_t are fixed effects for each firm i and each calendar year t
- Figures: plot $\widehat{\delta_t}$

- **Common trends assumption**:
  - ▶ No trade data before 2011
  - ▶ However, we do have revenue data since 2008
- **First stage**:
  - ▶ This assignment is fuzzy: revenue levels fluctuate from year to year, and we define treatment pre-reform
  - ▶ Test: firms in our treatment group were more likely to switch out of VAT

Difference in Differences - VAT threshold reform
Common trends assumption

(Origin sample, balanced panel)

(Full sample, balanced panel)

DD (pre vs. 2011): -.001 (.01) DD (post vs. 2011): -.02 (.011)

Legend:
- VAT-registered firms in reform region in 2010
- VAT-registered firms above reform region in 2010
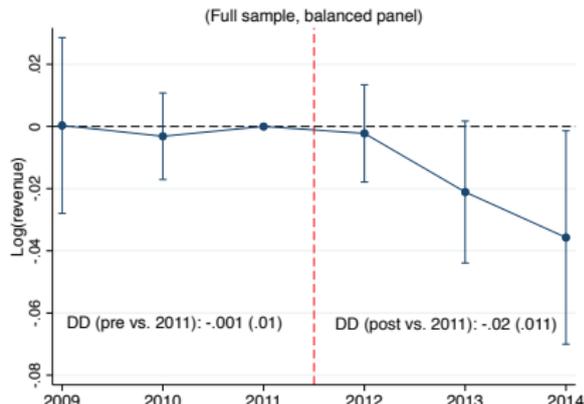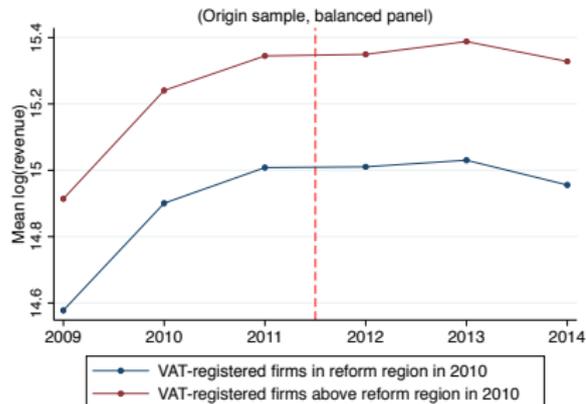
- No pre-trends in revenue before the reform → support for our identification assumption (we cannot test for common trends in other variables)

Difference in Differences - VAT threshold reform
First stage

(Origin sample, balanced panel)

DD (post vs. 2011): -.035 (.003)

Legend:
- VAT-registered firms in reform region in 2010
- VAT-registered firms above reform region in 2010

Y-axis: Share VAT registered
X-axis: 2009, 2010, 2011, 2012, 2013, 2014
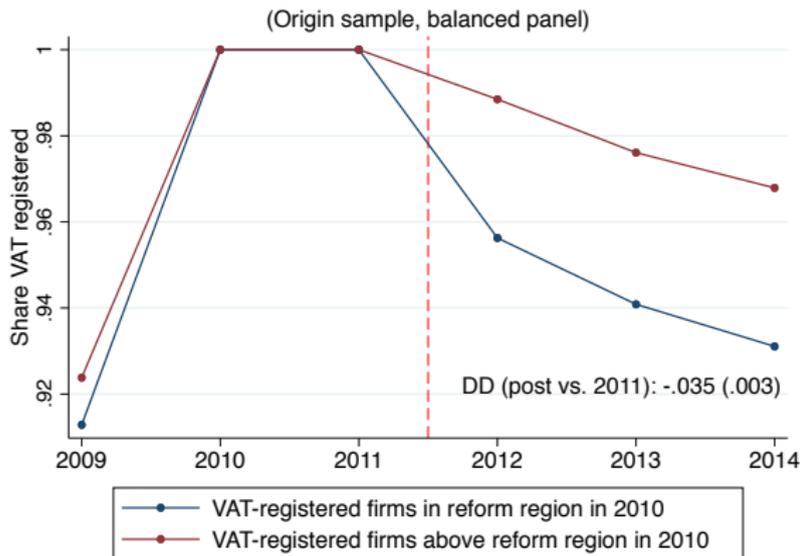
- The first stage starting in 2012 persists until 2014
- Relatively small: 3.5pp $\rightarrow$ most firms newly eligible for the simplified regime voluntarily choose to remain VAT-registered.

Difference in Differences - VAT threshold reform

VAT input share (DD estimates)

(Full sample, balanced panel)

DD (post vs. 2011): -.0041 (.0014)
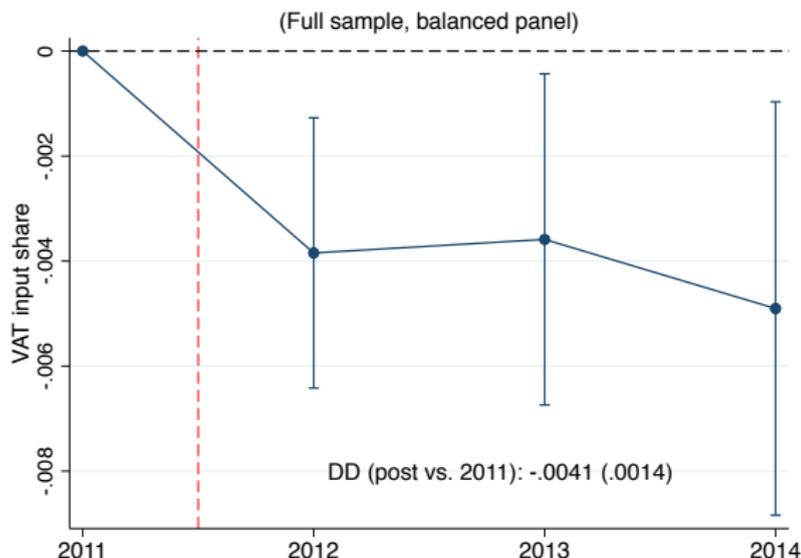
- The size of the reduced form is significant but small
- Scaling by the first stage, we obtain a LATE coefficient of 11.7pp.

Outline

1. Institutional Background & Data
2. Stylized facts and cross-sectional analysis
3. **Evidence of causal link between tax regime and inter-firm trade**

   1. Event analysis - own regime switching
   2. Difference in Differences - VAT threshold reform
   3. **Event analysis - trade partners switching regimes**
4. Next steps

Event study: top suppliers switching tax regime
(preliminary)

- **Event**: a firm ranked among top 10 suppliers at time $t-1$ that was also among the top 10 suppliers in $t-2$ (persistent trade partner) switches in or out of the VAT in $t=2013$, 2014 or 2015

- Analysis sample: origin sample firms that are a "small economy" for that supplier $\rightarrow$ not responsible for over 5% of the total sales of the supplier

- Four year window for the analysis and restrict attention to firms with positive input for 2 years before and after the event

- **Sets of treatments**:
  - firms for which a top supplier switched at time t to a **different tax regime than their own** in $t-1$ (i.e., away from firms' tax regime)
  - firms for which a top supplier switched at time t to the **same tax regime as their own** in $t-1$ (i.e., towards firms' tax regime)

Event study: top suppliers switching tax regime

$$y_{i,k,t} = \alpha_i + \beta_k + \gamma_t + \delta \cdot SupplierSwitchOut_i \cdot After_k + \psi_k \cdot \Delta^{pre} X_i + \varepsilon_{i,k,t}$$

- where α_i, β_k, and γ_t are again fixed effects for each firm i, each event year k, and each calendar year t
- $\Delta^{pre} X_i$ are pre-trends (from $k = -2$ to $k = -1$) in the firm's total input, total revenue, and total input from that supplier (logs)
- Figures: plot raw data and report $\widehat{\delta}$
  - (still working on a control group)

- Compare trade outcomes for pairs in which
  - client was Non-VAT and supplier switched to VAT (T1; away from client's tax regime) vs. out of VAT (T2; towards client's tax regime)
  - client was VAT-registered and supplier switched out of VAT (T3; away from client's tax regime) vs. to VAT (T4; towards client's tax regime)

Event study: top suppliers switching tax regime

Extensive margin (share of pairs still trading) for Non-VAT clients
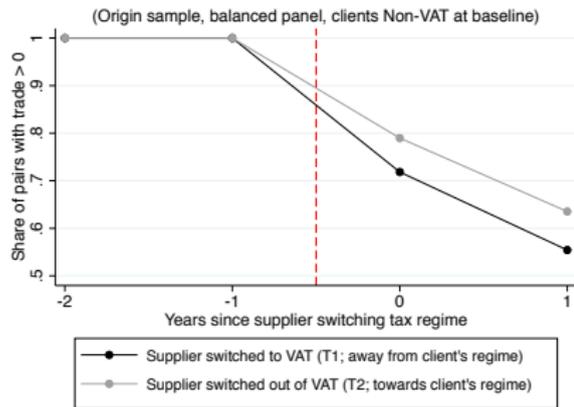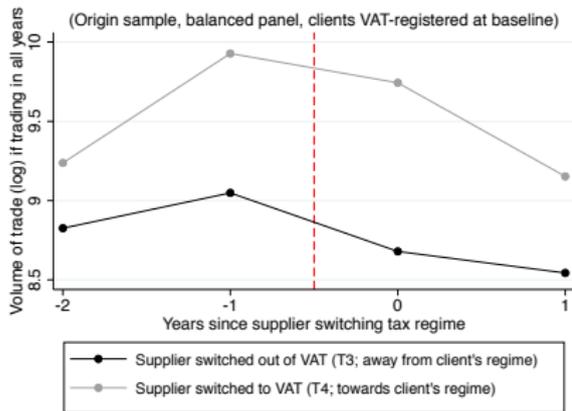

(a) Raw patterns for T1 and T2
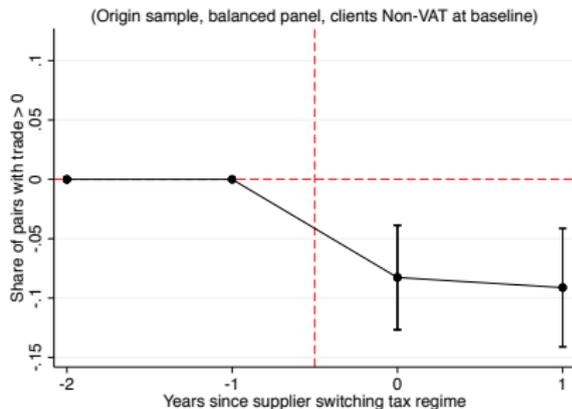
(b) Diff-in-diff estimates (T1 vs. T2)

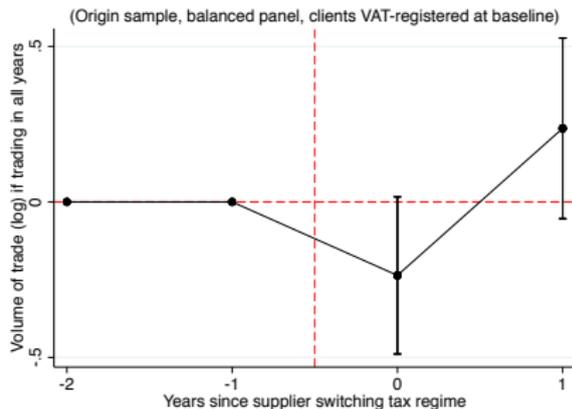- Extensive margin response for Non-VAT firms when supplier switches tax regime

Event study: top suppliers switching tax regime

Extensive margin (share of pairs still trading) for VAT-registered clients
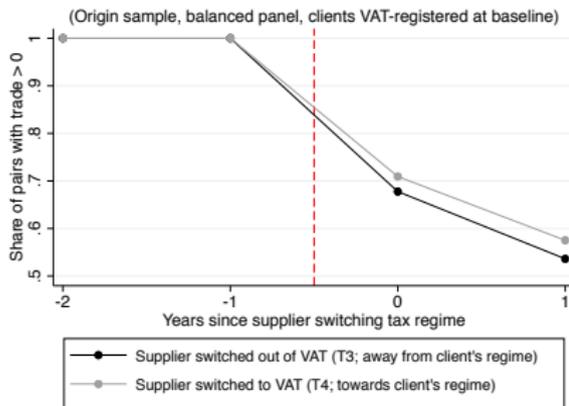
(a) Raw patterns for T3 and T4
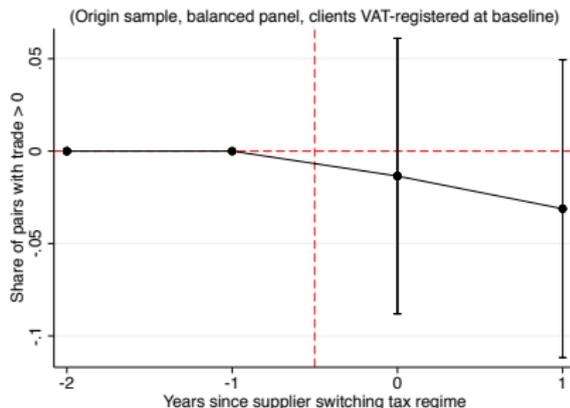
(b) Diff-in-diff estimates (T3 vs. T4)

- No clear extensive margin response for VAT-registered firms when supplier switches tax regime
- Asymmetry between Non-VAT and VAT-registered firms consistent with credit system of VAT

Event study: top suppliers switching tax regime

Intensive margin (trade volume conditional on trading) for Non-VAT clients
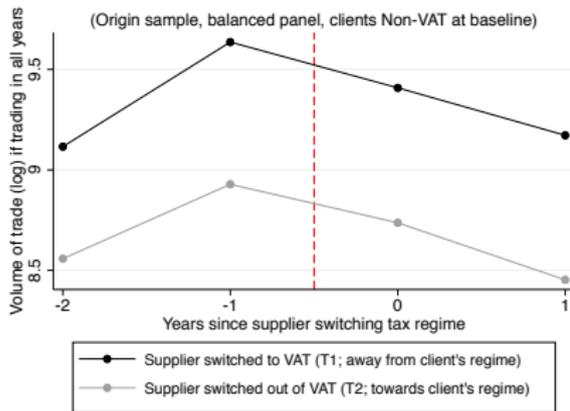
(a) Raw patterns for T1 and T2
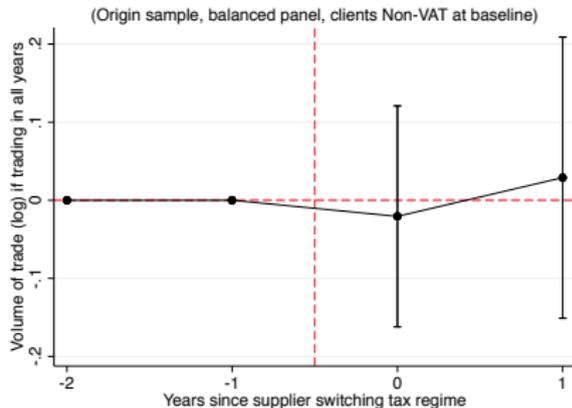
(b) Diff-in-diff estimates (T1 vs. T2)

- No clear intensive margin response for Non-VAT firms when supplier switches tax regime

Event study: top suppliers switching tax regime

Intensive margin (trade volume conditional on trading) for VAT-registered clients

(a) Raw patterns for T3 and T4

(b) Diff-in-diff estimates (T3 vs. T4)

- No clear intensive margin response for VAT-registered firms when supplier switches tax regime

Event study: top suppliers switching tax regime

VAT input share for Non-VAT clients
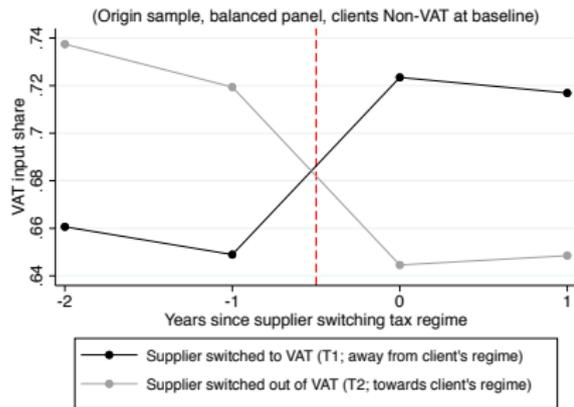
(a) Raw patterns for T1 and T2
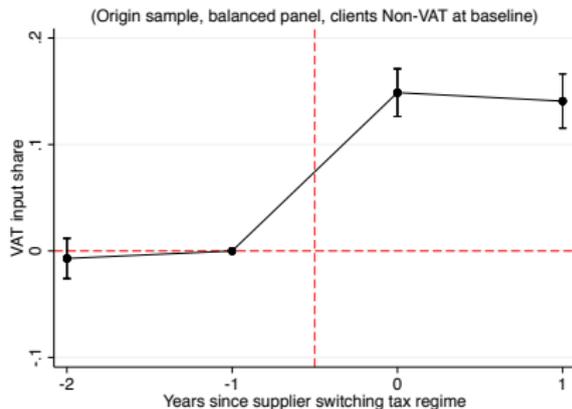
(b) Diff-in-diff estimates (T1 vs. T2)

- Despite extensive margin, overall response limited so clients source more input from the new tax regime of the supplier in both cases

Event study: top suppliers switching tax regime

VAT input share for VAT-registered clients
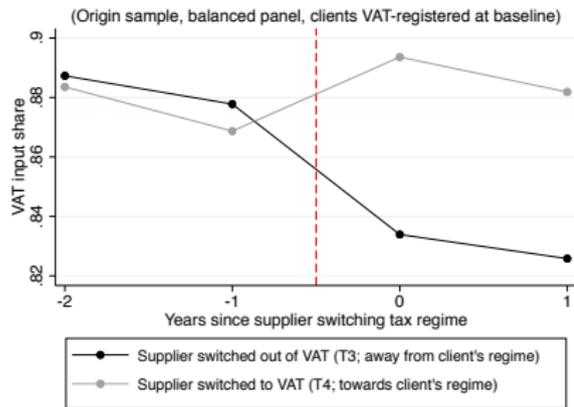
(a) Raw patterns for T3 and T4
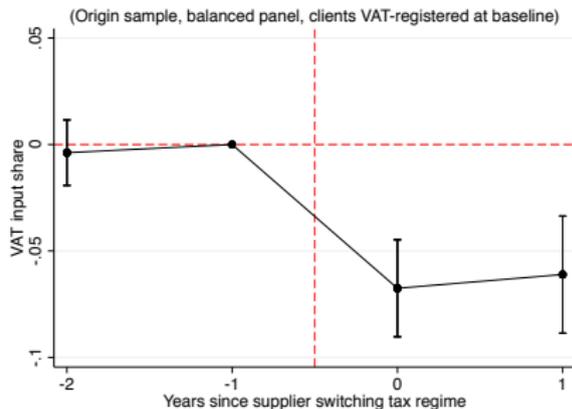
(b) Diff-in-diff estimates (T3 vs. T4)

- No clear response so clients source more input from the new tax regime of the supplier in both cases

Summary

- We use detailed invoicing data to study the link between tax regime and inter-firm trade in a real-world VAT system with exemption
  - ▶ We document a number of descriptive facts about the VAT, exemptions and inter-firm trade
  - ▶ Key fact: (partial) segmentation between VAT and non-VAT firms

- Main result: causal effect of tax regime on trade network
1. Using variation from own regime switching: firms start trading relatively more with firms in their new tax regime as soon as they switch regime
2. Using variation from the reform: drop in VAT input share when firms become eligible to switch out of VAT
3. Using variation from suppliers switching regimes:
   - ▶ Non-VAT firms (but not VAT-registered firms) more likely to trade with supplier when it switches into vs. out of their own tax regime
   - ▶ Asymmetry consistent with credit system of VAT
   - ▶ Overall response limited so clients source more input from new tax regime of supplier in all cases

# Next steps
Still work-in-progress

- Implications for economic efficiency:
    - Formal and informal supply chains
        - Likely large when many firms exempt (e.g. informality)
        - Effects likely constrained by nature of exemption that we study (small firms)
    - Repressed growth for non-VAT firms

- Next steps:
    - Explore variation from tax withholding rules
    - Exploit other source of variation from 2012 reform: notches within the turnover tax schedule
    - Conceptual framework to help guide and quantify the results

Thank you!

Event study: Inputs
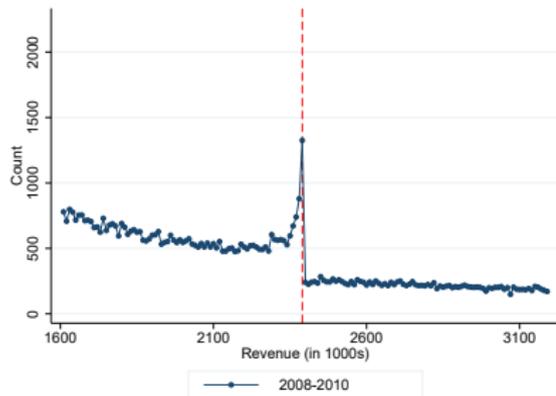
(a) Before 2012
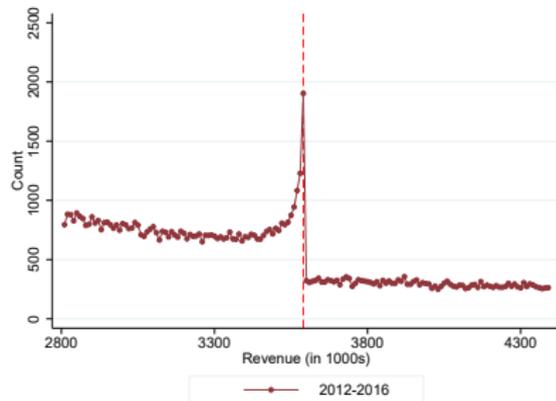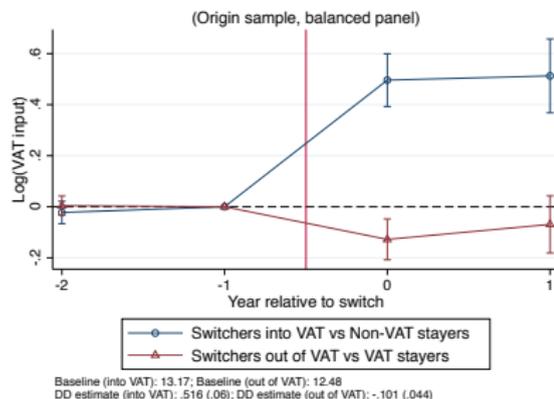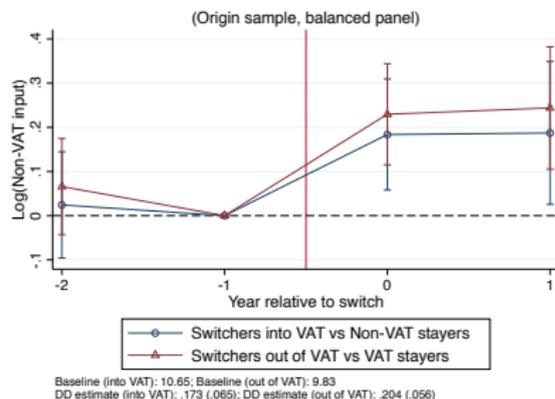
(b) After 2012

Event study: Inputs
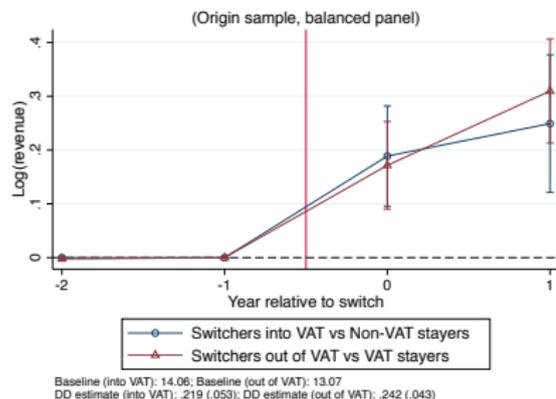
(a) Revenue
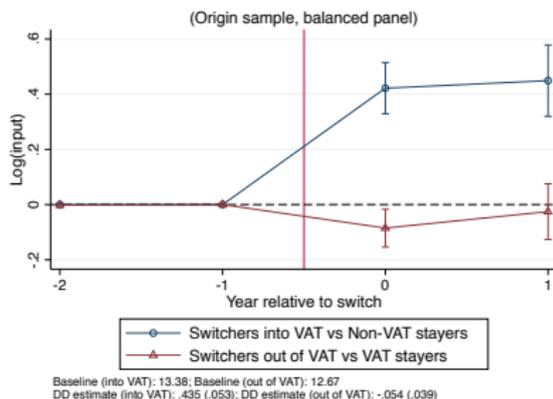
(b) Input

Change in VAT input share: unlikely due to pure reporting effect because Non-VAT Input increases for firms that become VAT-exempt ▸ back

Event study: Inputs
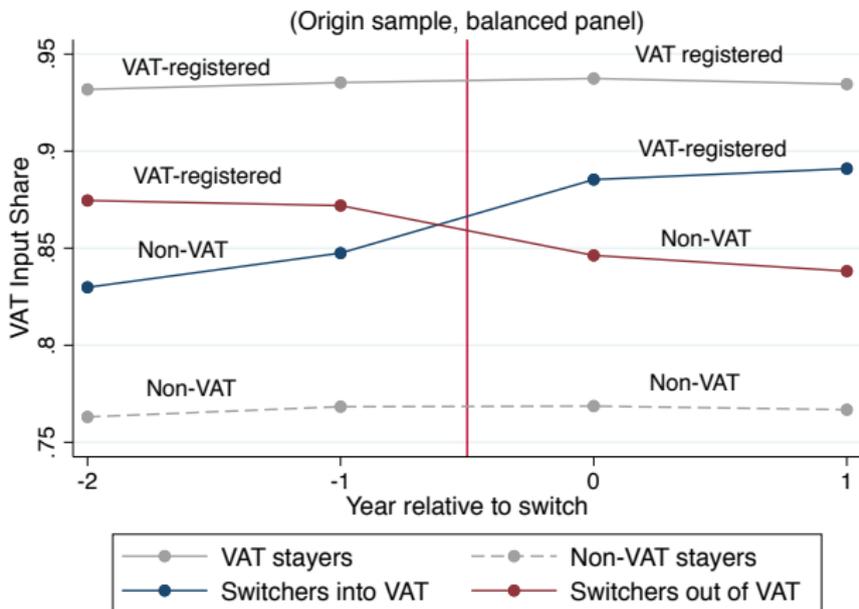

(a) Total VAT Input

(b) Total Non-VAT Input

Change in VAT input share: unlikely due to pure reporting effect because Non-VAT Input increases for firms that become VAT-exempt
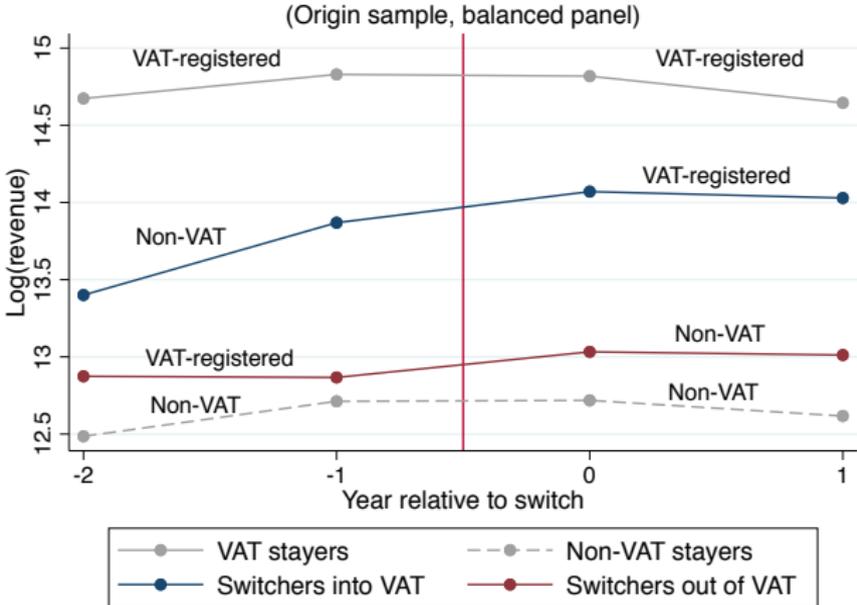
Raw data

VAT input share

(Origin sample, balanced panel)

Note: no controls. ▸ back

Raw data

Total revenue

Note: no controls. ▸ back