

The Short- and Medium-Run Effects of
Computerized VAT Invoices on Tax Revenues in
China
(Very Preliminary)

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Motivation

- ▶ All governments tax: central questions
 - ▶ Enforcement
 - ▶ Economic consequences
 - ▶ Short run vs Long Run
- ▶ Large body of evidence on short-run responses
- ▶ No direct evidence on longer-run elasticities, which can be very different from SR

This paper

- ▶ Examines the short and longer-run effects of increasing Value Added Tax (VAT) on Chinese Manufacturing Firms
- ▶ VAT is one of the most important sources of government income for developing countries
 - ▶ Largest source of Chinese state revenue, e.g. 47% in 2002
 - ▶ Theoretically self-enforcing
 - ▶ upstream firms incentivized to understate sales
 - ▶ downstream firms incentivized to overstate input costs
 - ▶ Government needs to link sales invoices along the production chain (and punish evasion)
 - ▶ The Chinese government computerized invoices in 2001/2002

Main Challenges

- ▶ Little is known about the details of the Chinese tax system
- ▶ Data limitation
- ▶ Casual identification

This paper

- ▶ Observe VAT paid from the Manufacturing Census, 1998-2007
- ▶ Interviews tax authorities and firm managers to understand the Chinese tax system
 - ▶ Rampant evasion prior to computerization
 - ▶ Manual audits focused on high-deductible sectors
- ▶ Exploit computerization to identify effect of increased enforcement
 - ▶ Compare outcomes before and after 2001, between sectors with high-deductible shares and sectors with low deductible shares.
 - ▶ Instrument for sector-specific deductible share in China with measures taken from U.S. data

Preview of Main Result

- ▶ Computerization increased VAT revenues
 - ▶ Short run gains are larger than longer-run gain
- ▶ Consistent with simple model where firms can adjust more in the LR than the SR
 - ▶ Verify additional empirical implications: computerization reduces increases TFP, reduces sales and inputs

Related Literatures

- ▶ Short vs. Long-run responses to taxes (see review by Saez et al., 2012)
 - ▶ Empirical evidence focus on short run
 - ▶ Has not examined VAT or China
- ▶ Third-party enforcement increases VAT (Naritomi, 2015; Pomeranz, 2015)
- ▶ State capacity and development (Besley and Persson, 2009, 2010)
 - ▶ Technology and governance (Duflo et al., 2012; Muralidharan et al., 2014)
- ▶ Chinese VAT – focused on exports (Chandra, 2013; Garred, 2016)
- ▶ Chinese firm productivity (e.g., Hsieh and Klenow, 2009; Hsieh and Song, 2015)

Roadmap

- ▶ Background
- ▶ Empirical strategy
- ▶ Data
- ▶ Result on VAT
- ▶ Interpretation – model, additional empirical results
- ▶ Conclusion

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VAT in China

- ▶ Started in

$$\text{VAT paid} = 0.17 * (\text{Sales} - \text{Deductible Inputs}) \quad (1)$$

- ▶ Full deductions: manufactured inputs, repair inputs, retail inputs, and wholesale inputs, which typically come with VAT special invoices.
- ▶ Partial deductions (10%): agricultural products.
- ▶ No deductions: labor costs, fixed asset purchases (until 2009), capital depreciation, abnormal losses, rent, fringe benefits, interests from bank loans, and overhead/operating expenses.

Enforcement

- ▶ Government issues official receipts for sales/purchases of VAT deductible inputs
- ▶ Before 2001, manually administered
 - ▶ Prone to errors and evasion
 - ▶ Costly for tax officials to manually link information from all of the invoices (China is very big)
 - ▶ Focused attention on **sectors with high shares of deductibles** (e.g., furniture)
- ▶ Computerized all invoices in 2001 – provides near perfect enforcement
 - ▶ Firms file monthly for deductions
 - ▶ Physically submit invoices and the IC card
 - ▶ Checked against national database
 - ▶ Refund when the data are verified

Caveats

- ▶ Export rebates and tariffs on imports (inputs) existed in China throughout the period
- ▶ Rebate and tariff amount changed over time
- ▶ WTO entry in 2001 may have caused systematic changes
 - ▶ Will control for sector-year rebates and tariffs.

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Second Stage: Differences-in-Differences

- ▶ More affected vs. less affected sectors, before and after 2001
- ▶ Baseline:

$$y_{ist} = \gamma_0 + \sum_{t=1999}^{2007} \beta_t t_t * \widetilde{VAT}_s + \tau_t + \phi_i + \varepsilon_{st}. \quad (2)$$

- ▶ ϕ_i firm fixed effects, τ_t year fixed effects. SE clustered at the sector level.

Instrumental Variables

- ▶ To avoid endogeneity, we use pre-computerization data to calculate the sector-VAT share

$$\widetilde{VAT}_s = \left(\frac{\widetilde{Sales - Inputs}_s}{Sales_s} \right) .17. \quad (3)$$

- ▶ But pre-computerization VAT Share captures true VAT share and evasion.
 - ▶ Problem if tax officials use better/different dataset (can't verify).
 - ▶ Instrument with U.S. data (2007 U.S. Input-Output Accounts Data from the Bureau of Economic Analysis)
 - ▶ 9 interaction instruments for 9 endogenous interaction variables in the baseline
 - ▶ First stage F-stat around 10.
 - ▶ Instrument mainly deals with measurement error
 - ▶ Later: Robustness controls for omitted variables

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Data

- ▶ *Annual Survey of Industrial Production*, 1998-2007
- ▶ All manufacturing firms with revenues of 5+ mil RMB
- ▶ Cutoff is not applied systematically. We impose a strict cutoff to be consistent.
- ▶ Key variables: VAT, assets, employment, inventory, liability and sales.

Enforcement pre 2001

Dependent Variable: # of Tax Officials		
	(1) Officials	(2) Ln Officials
VAT Share	-159,543*** (39,824)	-46.44*** (5.835)
<i>Normalized Coef.</i>	-0.162	-0.556
Ruggedness	2,314 (1,684)	0.151 (0.110)
<i>Normalized Coef.</i>	0.125	0.0965
Size of Province (Square km)	0.000685 (0.00231)	2.20e-07 (2.15e-07)
<i>Normalized Coef.</i>	0.0189	0.0717
# Firms	2.146*** (0.272)	0.000125*** (1.85e-05)
<i>Normalized Coef.</i>	0.644	0.442
Observations	91	91
R-squared	0.404	0.502

Notes: This sample comprises of a panel of provinces during 1999-2001. All regressions control for year fixed effects. The observations are at the province-year level. Robust standard errors are presented in the parentheses. *** p<0.01, ** p<0.05, * p<0.1. Data are reported by the *Tax Yearbook of China*.

Means

Variable	Full Sample		
	Obs (1)	Mean (2)	Std. Dev (3)
VAT (1000s RMB)	236487	4644	8241
Sales (1000s RMB)	236487	96858	165826
Asset (1000s RMB)	236487	69358	552556
Employment (workers)	236487	442	563
Inventory (1000s RMB)	236487	25333	142651
TFPR	199410	0.11	0.46

Notes: A unit of observation is a firm in a given year. The sample comprises a balanced panel of firms, 1998-2007.

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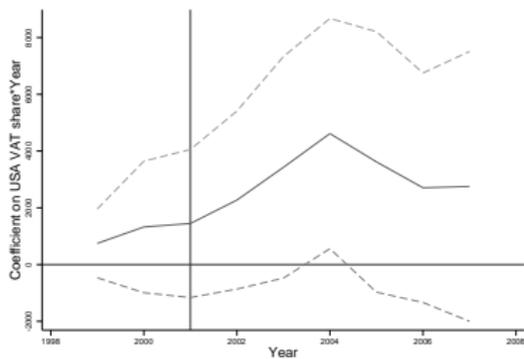
Data

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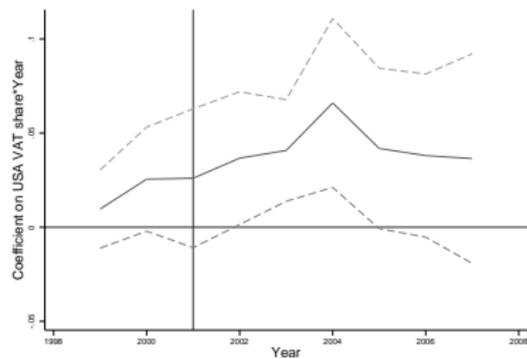
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VAT Payment



N: 42613; 2002-07 joint p-value: .019

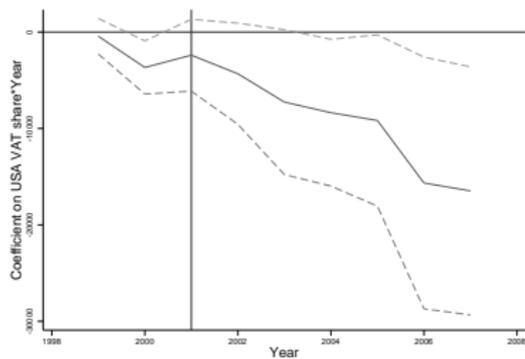
(a) VAT



N: 42613; 2002-07 joint p-value: 0

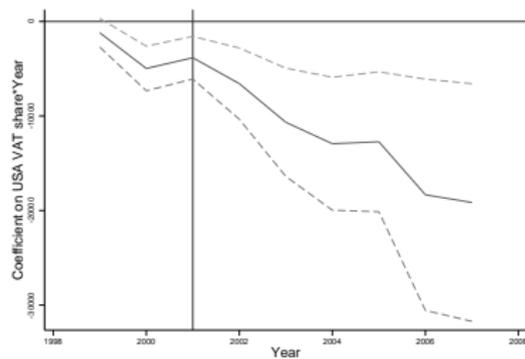
(b) VAT/Sales

VAT Gross and Deductibles



N: 42613; 2002-07 joint p-value: .247

(c) Gross VAT



N: 42613; 2002-07 joint p-value: .012

(d) VAT Deductibles

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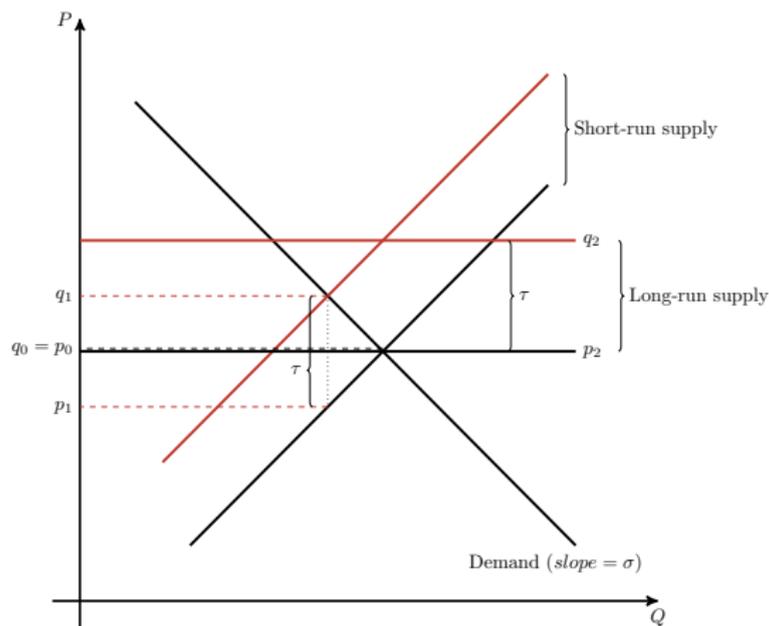
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Simple Model

- ▶ Cobb-Douglas technology $k^\alpha l^{1-\alpha}$
- ▶ Perfect Competition
- ▶ Three periods
 - ▶ $t = 0$: $\tau_0 = 0$
 - ▶ $t = 1$: $\tau_1 > 0$, firms can only adjust l
 - ▶ $t = 2$: $\tau_2 = \tau_1 > 0$, firms can adjust l, k
- ▶ Here, k reflects intermediate inputs

Key Intuition: $q_0 < q_1 < q_2$



- ▶ q is pre-tax (consumers pay) price, p is post-tax (producer's get) price

Tax Revenues

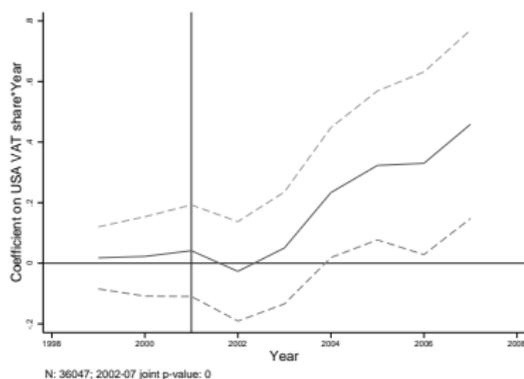
- ▶ tax revenues depend on tax rate and sales, $\frac{\tau_t}{1+\tau_t} \times q_t y_t$
- ▶ $0 = \tau_0 < \tau_1 = \tau_2$
- ▶ $qy_0 > qy_1 > qy_2$
 - ▶ $q_0 < q_1 < q_2$, but $y_0 > y_1 > y_2$.
 - ▶ If $\sigma > 1$, $y \downarrow$ faster than $q \uparrow \Rightarrow qy_0 > qy_1 > qy_2$.
- ▶ $t = 1$: increase in tax rate offset fall in sales.
- ▶ $t = 2$: sales keep falling, but tax rate is constant
→ $\text{taxes}_0 < \text{taxes}_2 < \text{taxes}_1$

Empirical Implications

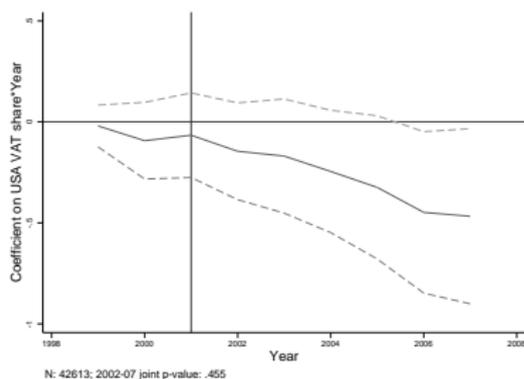
- ▶ $\text{taxes}_0 < \text{taxes}_2 < \text{taxes}_1$
- ▶ $q_0 < q_1 < q_2$ ($q = \frac{qy}{k^\alpha l^{1-\alpha}} = TFPR$)
- ▶ $qy_0 > qy_1 > qy_2$
- ▶ $l_0 > l_1 > l_2, k_0 > k_1 > k_2$

TFPR and Sales

- ▶ Follow De Loecker et al. (2012) to estimate TFPR

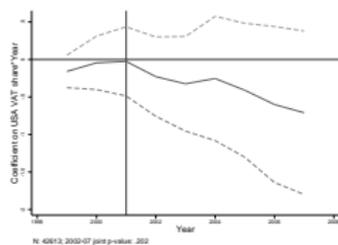


(e) TFPR

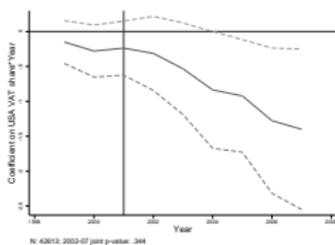


(f) Ln Sales

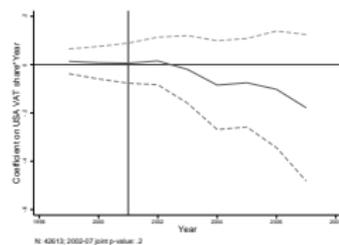
Inputs



(g) Ln Employment



(h) Ln Intermediate
Inputs



(i) Intermediate Input
Share

Alternative Explanation – Firms Learn to Evade

- ▶ Consistent with decline in sales
- ▶ Inconsistent with decline in deductible VAT inputs, intermediate inputs, and intermediate input share
- ▶ Hard to reconcile with increase in TFPR
- ▶ Look at firms at the top and bottom of the chain
 - ▶ always relatively easier to evade
 - ▶ no differential effect

Other Results

- ▶ Robust to sector-year specific export/import tariffs (WTO)
- ▶ No effect on ln exports, export share, ln assets
- ▶ All firms (allow entry and exit) results similar to balanced panel
 - ▶ No effect on # firms per sector (i.e., net entry/exit)
- ▶ By ownership
 - ▶ No effect on foreign firms
 - ▶ Effect on domestic state-owned and privately owned firms are similar

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Preliminary Conclusion

- ▶ Computerization increased VAT revenues
 - ▶ Technology can improve state capacity, even absent third-party info
- ▶ Long-run gains are smaller than short-run gains
 - ▶ Evidence consistent with real effects – LR elasticities are larger, firms can adjust production downward
- ▶ Work-in-progress:
 - ▶ Extend data to 2013 (some data quality and sampling issues)
 - ▶ Extend model: GE, three factors, one factor is deductible

The End

Thank you!

Comments and suggests are very welcome!