The Dynamic Effects of Computerized VAT Invoices on Chinese Manufacturing Firms, 1998-2007 (Incomplete)

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Motivation

- All governments tax: central questions
  - Enforcement
  - Economic consequences
    - Short run vs Long Run – can be different
- Large body of evidence on short-run responses
- No direct evidence on longer-run elasticities.

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

- Relatively little is known about the details of the Chinese tax system
- Data limitations
- Casual identification

This paper

- Observe VAT paid from the Manufacturing Census, 1998-2007
- Understand the Chinese tax system
  - Detailed reading of government white papers and interview tax authorities and firm managers
  - 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.

Preview of Main Results

1. Computerization significantly increased VAT
2. Short-run effects differ from long-run effects.
   - Short-run (3-5 years) VAT gains are larger than longer-run (6-7 years) gain
   - In the long-run, firms contract (sales, inputs, deductible inputs decline) and TFPR increases

Related Literatures

- Short vs. Long-run responses to taxes (see review by Saez et al., 2012)
  - Existing 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 (Barnwal, 2017; Duflo et al., 2012; Muralidharan et al., 2014; Sukhtankar, 2014)
- Chinese VAT – focused on exports (Chandra, 2013; Garred, 2016)
- Chinese firm productivity (e.g., Hsieh and Klenow, 2009; Hsieh and and Song, 2015)

Roadmap

- Background
- Empirical strategy
- Data
- Results
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VAT in China

- Started in 1994

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

- 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.

Pre-2001 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
  - Low enforcement everywhere
  - Focused limited attention on **sectors with high shares of deductibles** (e.g., furniture)
- Audit targeting
  - Official instructions focused on firms with **VAT/Sales ("VAT Share")** too high or too low relative to the region-sector mean
  - Region definition vague "above prefecture"
  - In practice, officials used rule-of-thumb short cut and focused on firms in sectors with **high VAT share.**
  - No audit data. Will substantiate indirectly in two ways.

Post-2001 Enforcement

- 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
- Evasion is still possible, just a lot harder
- No other changes in rules or target auditing during 2001-2007 (major revamping began in 2009)

Tax Personnel Across Provinces

	Dependent Variable: Ln # of Tax Officials	
	1998-2000	2001-2007
	(1)	(2)
Avg. Chinese VAT Share	-13.79***	-12.80***
	(1.706)	(1.178)
Beta Coef.	*-0.241*	*-0.270*
Ruggedness	-0.0559	-0.0596*
	(0.0471)	(0.0342)
Beta Coef.	*-0.0488*	*-0.0548*
Ln Area (Square km)	0.129***	0.152***
	(0.0285)	(0.0253)
Beta Coef.	*0.184*	*0.228*
Ln Population (10,000 people)	0.597***	0.535***
	(0.0622)	(0.0381)
Beta Coef.	*0.627*	*0.573*
Ln # Firms	0.137**	0.121***
	(0.0523)	(0.0260)
Beta Coef.	*0.224*	*0.220*
Observations	91	216
R-squared	0.947	0.899

Notes: This sample is comprised of a panel of provinces. 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

Caveats

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

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Differences-in-Differences

- Before vs. after 2001
- More affected vs Less affected sectors
  - Sectors w/ high VAT share (i.e., low deductible share) sectors experience larger increase in enforcement

Treatment Intensity Measure

- Intensity measure = $\widetilde{VAT}_s$

$$\widetilde{VAT}_s = \left(\frac{Sales - \widetilde{Inputs}_s}{Sales_s} \right) .17. \tag{2}$$

- Reform intensity increases with $\widetilde{VAT}_s$

Baseline Equation

- Baseline:

$$y_{ist} = \alpha + \sum_{\tau=2}^{4} \beta_\tau Period_\tau * \widetilde{VAT}_s + \Gamma X_{ist} + \delta_t + \gamma_i + \varepsilon_{ist}. \quad (3)$$

- γ_i firm fixed effects (balanced panel of firms), δ_t year fixed effects. $Period_\tau = 1, 2, 3, 4$ for $t = 1998 - 2000, 2001/2, 2003/5, 2006/7$.
- Baseline controls: year FE $\times$1998 sector characteristics
  - HHI
  - sales
  - exporting share
- SE clustered at the sector level (425 sectors).

Measurement error in $\widetilde{VAT}_s$

- Using average VAT share 1998-2007 is potentially endogenous
- Solution 1: use 1997 Chinese Input-Output tables
  - Reflect true VAT share *and* evasion.
  - Problem if ranks in VAT share across sector not positively corr with tax officials' data.
- Solution 2: Proxy with U.S. data (main results)
  - Assume that rank in VAT share across sectors similar between the U.S. and China
- Results are similar with the two ways of measuring VAT obligations (in paper)
- Also similar with U.S. measures as instruments for Chinese measures (in paper)

Omitted Variables

- Did something else happen in 2001 to increase taxes from high VAT share sectors?
  - Not that we know of....
- Pre-trend analysis
- Placebo exercises: exporters, corporate tax.
- Additional controls: sector-specific trade tariffs, firm size x year FE, export x year FE, etc.

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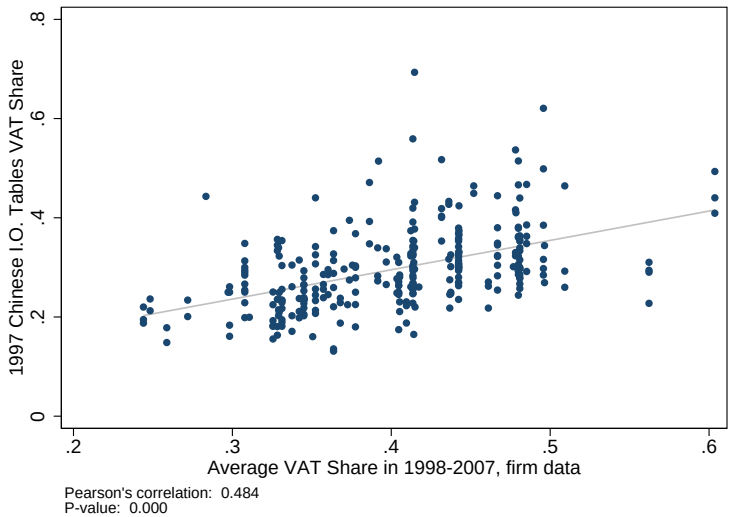
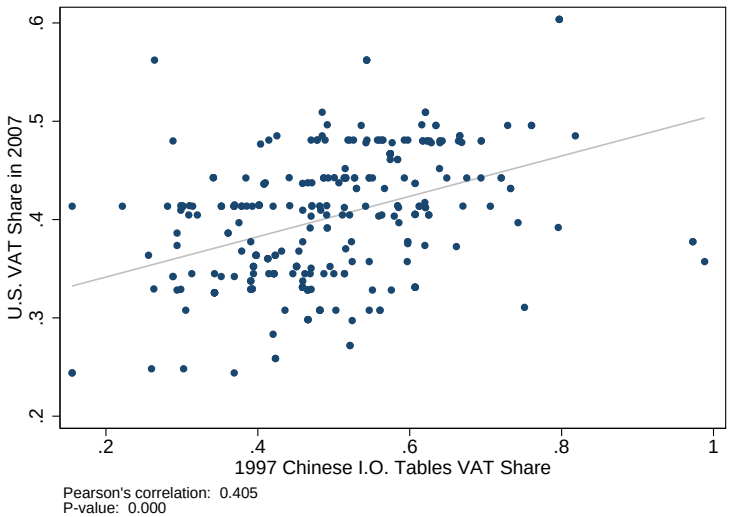
- *Annual Survey of Industrial Production* ("Manufacturing Census"), 1998-2007
- All manufacturing firms with revenues of 5+ mil RMB
- Cutoff is not applied systematically. We impose a strict cutoff to be consistent.
- Balanced panel (no entry or exit)
- Winsorize 1% to avoid outlier (doesn't matter that much)
- Key variables: VAT, assets, employment, inventory, liability and sales.
- RHS VAT Share: 2007 U.S. Input-Output Accounts Data from the Bureau of Economic Analysis
- 1997 Chinese Input-Output Tables

Comparison of: Chinese IO VAT Share, Chinese Firm VAT Share, and U.S. VAT Share

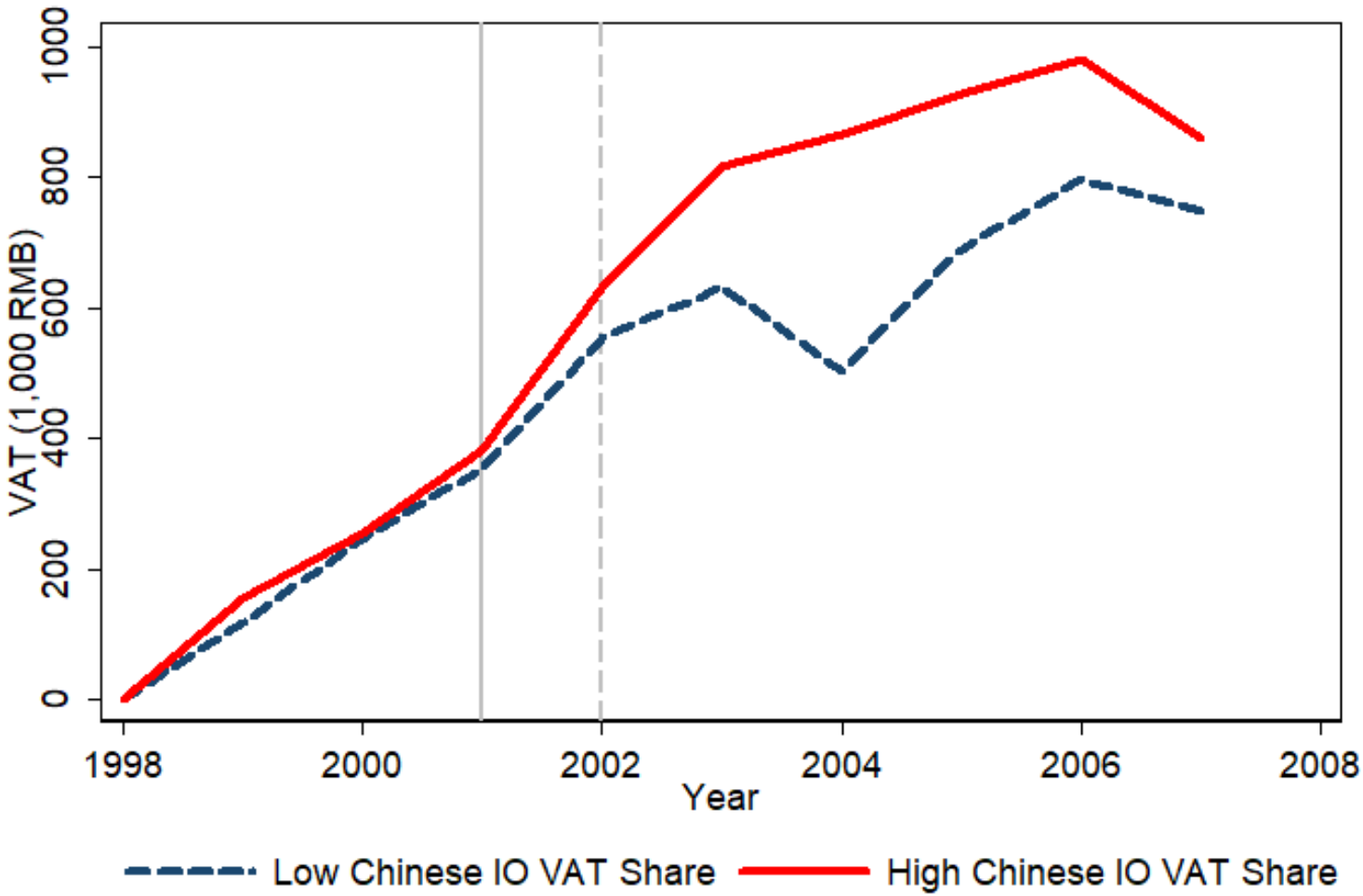


(a) 1997 Chinese IO VAT Share vs. 1998-2007 Chinese Firm VAT Share



(b) 1997 Chinese IO VAT Share vs. U.S. IO VAT Share

VAT Over Time



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Effect on VAT

	Dependent Variables	
	(1) VAT (000s RMB)	(2) VAT/Sales
Dep Var Mean	**2066**	**0.0495**
U.S. VAT share x 2001-2002	204.5	0.00387
	(237.6)	(0.00265)
Beta Coef.	*0.0153*	*0.0269*
U.S. VAT share x 2003-2005	839.0**	0.0126***
	(393.0)	(0.00346)
Beta Coef.	*0.0701*	*0.0978*
U.S. VAT share x 2006-2007	319.2	0.00960**
	(443.1)	(0.00442)
Beta Coef.	*0.0232*	*0.0646*
Observations	60,900	60,900
R-squared	0.782	0.657
H0: $\beta 1 = \beta 2$ (p-value)	0.00500	0.0100
H0: $\beta 2 = \beta 3$ (p-value)	0.114	0.404

Timing of the Effect

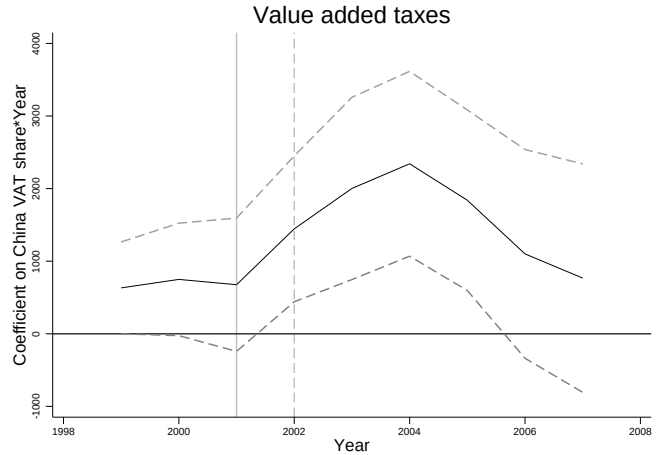

Figure: Chinese VAT Share Data

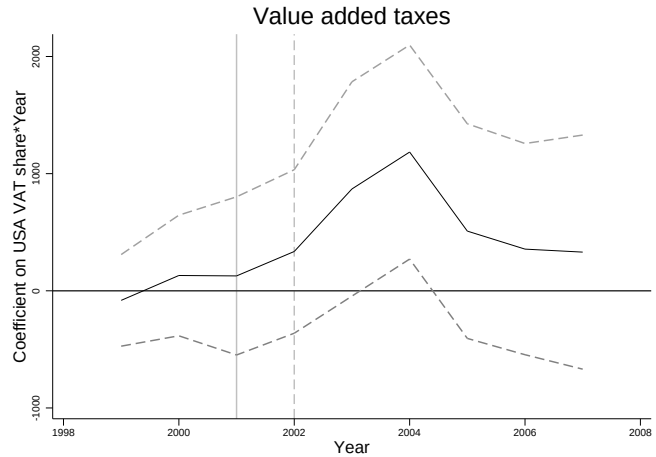

Figure: U.S. VAT Share Data

TFPR, Sales

	Dependent Variables		
	(1) TFPR (HK)	(2) TFPR (DLW)	(3) Sales (000s RMB)
Dep Var Mean	**1.100**	**0.379**	**46238**
U.S. VAT share x 2001-2002	0.00880**	-0.0400	-5,794*
	(0.00385)	(0.107)	(3,468)
Beta Coef.	*0.0228*	*-0.00554*	*-0.0210*
U.S. VAT share x 2003-2005	0.0123**	0.123	-14,808**
	(0.00600)	(0.167)	(6,769)
Beta Coef.	*0.0354*	*0.0191*	*-0.0599*
U.S. VAT share x 2006-2007	0.0150*	0.640***	-30,660**
	(0.00804)	(0.240)	(14,328)
Beta Coef.	*0.0377*	*0.0857*	*-0.108*
Observations	60,900	60,900	60,900
R-squared	0.941	0.963	0.772
H0: $\beta 1=\beta 2$ (p-value)	0.218	0.0430	0.0490
H0: $\beta 2=\beta 3$ (p-value)	0.308	0.000	0.126

Inputs

	Dependent Variables				
	Employees (#)	Wage Bill (000s RMB)	Intermediate Inputs (000s RMB)	Intermediate Inputs as a Share of Total Input	
				All	Deductible
	(1)	(2)	(3)	(4)	(5)
Dep Var Mean	**290.7**	**3018**	**32110**	**0.838**	**0.785**
U.S. VAT share x 2001-2002	12.48	320.7	-5,113*	0.00250	0.00238
	(23.40)	(259.3)	(2,648)	(0.00939)	(0.0382)
Beta Coef.	*0.00713*	*0.0164*	*-0.0270*	*0.00524*	*0.00104*
U.S. VAT share x 2003-2005	-17.35	517.2	-11,177**	-0.0220	-0.158***
	(42.76)	(478.8)	(4,762)	(0.0197)	(0.0473)
Beta Coef.	*-0.0111*	*0.0295*	*-0.0660*	*-0.0514*	*-0.0771*
U.S. VAT share x 2006-2007	-34.82	279.8	-15,034*	-0.0534*	-0.268***
	(68.05)	(739.4)	(8,543)	(0.0311)	(0.0811)
Beta Coef.	*-0.0193*	*0.0139*	*-0.0770*	*-0.108*	*-0.114*
Observations	60,900	60,900	60,900	60,900	60,900
R-squared	0.820	0.811	0.789	0.686	0.408
H0: $\beta 1=\beta 2$ (p-value)	0.300	0.540	0.0530	0.0600	0.00100
H0: $\beta 2=\beta 3$ (p-value)	0.559	0.527	0.504	0.0290	0.0450

Robustness

- Additional controls
  - Sector specific import/export duties and levels
  - Pre-reform export growth
  - Pre-reform sales and sales growth
  - Pre-reform HHI
- "Placebos"
  - No effect on big exporters or importters

Additional Results

- No effect on corporate income tax
- Currently investigating entry and exit with firm registry data (all registered firms in the economy)
- Larger effects for sector with more inputs, and sectors closest to final consumers
- Results similar for state-owned and privately owned firms

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- Computerization strengthened state capacity and increased tax revenues
- Short- and long-run effects differ
  - Long-run gains are likely to be smaller than short-run gains
  - Firms contract over time

$\Rightarrow$ Tradeoff for policy makers

The End

Thank you!

Comments and suggests are very welcome!