

The Value-Added Tax Reform Puzzle

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- Policy makers in many countries use tax incentives to promote firm investment and shift the composition of investment
 - Rebates for R and D
 - Rebates for investment in clean energy
- Identifying causal effects of tax reform on firm behavior is challenging:
 - Such reforms are not usually implemented in a piece-meal way
 - Endogenous selection problem
- This paper:
 - Evaluates the impact of VAT reform in China on firms' investment, employment, productivity, etc.
 - Identifies the causal effect by using propensity score matching combined with difference-in-difference estimation

Previous Work in This Area

- Nie, Fang, and Li (2010)
 - They test short-run effects of the VAT reform (1 year post-reform)
 - They find significant and positive effects on fixed investment using DID approach
 - They find negative effects on employment
 - Did not solve the endogenous selection issue
- Chen, He, and Zhang (2011)
 - Extend Nie et al (2010) over longer time horizon
 - Use DDD approach but did not solve the endogenous selection issue
 - They find significant and positive effects on fixed investment

- Explores the impact of the VAT reform using Matching combined with DID methods
- Unlike previous work, finds no significant impact of VAT reform on fixed investment
- Find negative effects on new product introduction
- Significant negative impact on employment
- We call this a "puzzle" because the policy has been extended from a few provinces and sectors to all of China

- I. Background
- II. Data and summary statistics
- III. Identification strategy
- IV. Estimation results
- V. Conclusion

I. Background: VAT in China I

- Value-added tax:
 - A tax on the difference between total sales and purchases of inputs
 - The most common type: "consumption-based" VAT
 - An example: assume VAT rate is 10%
 - A purchases capital inputs (100 RMB), and sells output (400 RMB)
 - A's VAT equals $(400 - 100) * 10\% = 30\text{RMB}$
- China's VAT:
 - Introduced in 1994: standard rate equals 17%
 - An important source of tax revenue: 36% on average (2001-2008)
 - "Production-based":
 - Purchases of fixed investment cannot be deducted from sales
 - Consequence: Double taxation on equipment purchase

I. Background: VAT in China II

- Transformation of the VAT to a "Consumption-type"
- Main objective:
 - To promote an equitable market environment
 - To stimulate investment
- Progress:
 - July 2004: three northeastern provinces, six industries (agricultural product processing, equipment manufacturing, petrochemical, metallurgy, ship building and automobile manufacturing)
 - May 2007: expanded to 26 industrial cities in six central provinces and eight selected industries (mining and electricity sectors were added)
 - Jan 2009: expanded to all industries and provinces

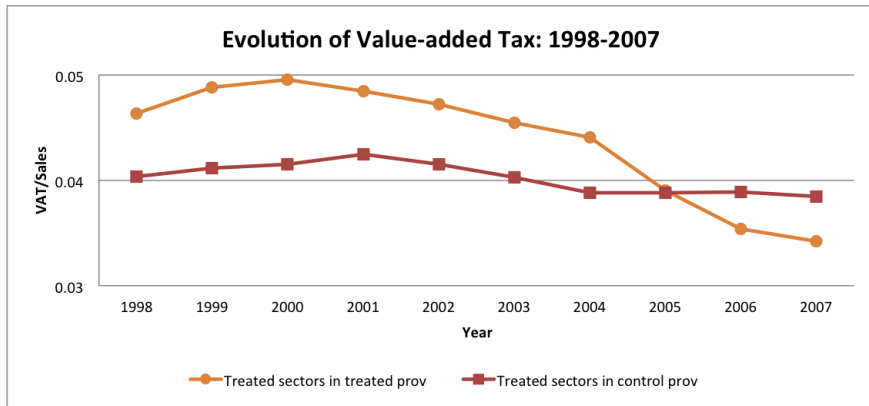
II. Data and Summary Statistics: Overview

- Chinese industrial firms data from NBS:
Annual survey of all enterprises with more than 5 million RMB sales
- Annual data from 1998 through 2007, unbalanced panel
 - Firm characteristics: ownership, employment, output, fixed assets, etc.
 - Financial information: sales, profit, tax, cash flow, etc.

II. Data and Summary Statistics: Variables

- Investment ratio: $(K_t - K_{t-1})/K_t$
- Capital intensity: K/L
- RD Intensity: share of new product output in total output
- TFP: estimated using Olley and Pakes (1996)

II. Data and Summary Statistics: VAT Evolution I



II. Data and Summary Statistics: VAT Evolution II

- Significant decrease of VAT in domestic treated firms
- No decrease of VAT in control firms

	All Sample		Domestic Firms		Foreign Firms	
	Treatment	Control	Treatment	Control	Treatment	Control
1998	0.089	0.092	0.092	0.095	0.073	0.078
1999	0.089	0.098	0.091	0.102	0.077	0.08
2000	0.093	0.129	0.096	0.103	0.078	0.087
2001	0.092	0.099	0.094	0.101	0.083	0.09
2002	0.089	0.097	0.091	0.099	0.08	0.092
2003	0.092	0.101	0.095	0.104	0.079	0.09
2004	0.103	0.112	0.107	0.115	0.09	0.1
2005	0.095	0.103	0.095	0.106	0.096	0.093
2006	0.087	0.108	0.087	0.112	0.088	0.095
2007	0.085	0.104	0.085	0.105	0.085	0.098
All	0.091	0.105	0.092	0.105	0.085	0.102

II. Data and Summary Statistics: By treatment

- Treated firms are larger and more capital intensive
- Firms become smaller over time
- Treated firms experience a faster growth in capital intensity
- Productivity is similar between treated and control groups

	Employment		Fixed asset for production		Capital intensity		lnTFP	
	Treatment	Control	Treatment	Control	Treatment	Control	Treatment	Control
1998	568	333	44012	24516	53	53	1.71	1.76
1999	535	331	53530	28393	63	56	1.74	1.77
2000	498	313	51118	29348	69	62	1.80	1.83
2001	454	293	57652	29147	71	62	1.84	1.85
2002	403	281	57339	29673	76	63	1.87	1.89
2003	364	271	62216	28954	82	64	1.94	1.95
2004	259	225	42147	23796	80	63	2.00	2.02
2005	252	239	47119	26569	85	66	2.06	2.09
2006	219	230	41164	27540	82	71	2.14	2.15
2007	204	221	38242	28956	91	76	2.20	2.20
Total	325	261	47193	27574	79	66	2.00	2.00

III. Identification Strategy I

- Propensity score matching combined with DD
 - 1st step: propensity score matching based on observable characteristics
 - 2nd step: difference-in-difference estimation

III. Identification Strategy II

- Identify a list of key determinants of policy assignment:

$$\begin{aligned} \text{Treatment}_{ij} = & \omega_0 + \omega_1 \text{ForeignShare}_{ij} + \omega_2 \text{StateShare}_{ij} \\ & + \omega_3 \log \text{Output}_{ij} + \omega_4 \text{OutputGrowth}_{ij} \\ & + \omega_5 \text{Age}_{ij} + \omega_6 \log \text{TFP}_{ij} + \omega_7 \text{sector}_{ij} + \epsilon_{ij} \end{aligned} \quad (1)$$

- Probability of receiving treatment:

$$P_{it} = E(D_{it} = 1 | X_{it} - 1) \quad (2)$$

III. Identification Strategy III

- The difference-in-difference measure:

$$\hat{\beta}_{DDM} = \frac{1}{n_1} \sum_{i \in I_1 \cap S_P} \left[(Y_{it} - Y_{it-1}) - \sum_{j \in I_0 \cap S_P} W(P_{it}, P_{jt}) (Y_{jt} - Y_{jt-1}) \right]$$

where $W(\cdot)$ is a Gaussian kernel weighting function of the distance between treated and control firms:

$$W(P_{it}, P_{jt}) = \frac{G\left(\frac{P_{jt} - P_{it}}{a_n}\right)}{\sum_{k \in I_0 \cap S_P} G\left(\frac{P_{kt} - P_{it}}{a_n}\right)}$$

- Define the first difference:
 - $Y_{2007} - Y_{2003}$
 - $Y_{post} - Y_{pre}$

IV. Estimation Results: Matching I

- Variables used for matching affect policy treatment significantly:

Variables	Policy treatment		
	All sample	Domestic	Foreign
	(1)	(2)	(3)
Foreign Share	-0.166*** (0.027)	-1.32 (1.091)	-0.402 (0.055)
State Share	0.216*** (0.036)	0.156*** (0.042)	0.571*** (0.116)
log(Output)	-0.194*** (0.014)	-0.218*** (0.018)	-0.207*** (0.027)
Output growth	0.00003 (0.0006)	-0.001 (0.002)	0.0003 (0.0006)
log(Fixedasset)	0.149*** (0.009)	0.152*** (0.011)	0.137*** (0.017)
Age	-0.0046*** (0.001)	-0.004*** (0.001)	-0.013*** (0.003)
log(TFP)	0.216*** (0.047)	0.24*** (0.059)	0.282*** (0.084)
Observations	74174	48284	25890
R-squared	0.0663	0.0623	0.0803

IV. Estimation Results: Matching II

- No significant difference between treated and matched sample:

	Mean		P-Value
	Treated	Matched	
Foreign Share	0.125	0.125	0.893
State Share	0.114	0.112	0.78
Export Share	0.165	0.162	0.642
log(output)	10.018	10.016	0.94
log(fixedasset)	8.707	8.692	0.673
Age	15.199	15.251	0.835
log(TFP)	1.935	1.929	0.278

IV. Estimation Results: Investment Ratio

- Negative but insignificant effect on investment
- Results are robust to different specifications:
OLS, DID, DID with matching, DDD

	All Firms	Domestic Firms			Foreign Firms
		All	SOE	Non-SOE	
PSM & DD	-0.0122	-0.0188	-0.0176	-0.0172	-0.0014
<i>2007-2003</i>	(0.0285)	(0.034)	(0.095)	(0.0366)	(0.0521)
PSM & DD	-0.0101	-0.0161	-0.0117	-0.026	0.0007
<i>Post-mean - Pre-mean</i>	(0.0166)	(0.0199)	(0.0527)	(0.0218)	(0.03)

IV. Estimation Results: RD Intensity

Although no effect on improving investment, did firms switch investment to new technology?

- Barely significantly negative effect on RD intensity of domestic non-SOEs

	All Firms	Domestic Firms			Foreign Firms
		All	SOE	Non-SOE	
PSM & DD	-0.0063**	-0.0079***	-0.0124	-0.007*	-0.0011
<i>2007-2003</i>	(0.003)	(0.0037)	(0.0133)	(0.0038)	(0.0063)
PSM & DD	-0.0065***	-0.009***	-0.0132	-0.0079***	0.0003
<i>Post-mean - Pre-mean</i>	(0.0024)	(0.0027)	(0.008)	(0.0028)	(0.005)

IV. Estimation Results: TFP

- Barely significantly negative effect on TFP of domestic non-SOEs

	All Firms	Domestic Firms			Foreign Firms
		All	SOE	Non-SOE	
PSM & DD	0.0102	0.0082	-0.0073	0.0094	0.0142
<i>2007-2003</i>	(0.0074)	(0.009)	(0.034)	(0.0089)	(0.014)
PSM & DD	-0.0077	-0.0145***	-0.0255	-0.0115*	0.0131
<i>Post-mean - Pre-mean</i>	(0.0052)	(0.006)	(0.0223)	(0.006)	(0.01)

IV. Estimation Results: Labor

- Large and negative effect on employment of all types of firms

	All Firms	Domestic Firms		
		All	SOE	Non-SOE
PSM & DD	-0.072***	-0.0754***	-0.029	-0.088***
<i>2007-2003</i>	(0.012)	(0.014)	(0.0561)	(0.0146)
PSM & DD	-0.1049***	-0.1161***	-0.097***	-0.12***
<i>Post-mean - Pre-mean</i>	(0.01)	(0.0116)	(0.037)	(0.012)

IV. Estimation Results: Capital-Labor Ratio

- Positive effect on capital intensity of all types of firms

	All Firms	Domestic Firms		
		All	SOE	Non-SOE
PSM & DD	-2.349	0.859	1.606	0.3551
<i>2007-2003</i>	(1.83)	(2.039)	(6.83)	(2.146)
PSM & DD	4.557***	7.292***	8.243***	6.8189***
<i>Post-mean - Pre-mean</i>	(1.2938)	(1.362)	(3.853)	(1.4633)

IV. Estimation Results: Summary

- Firms became more capital intensive after the VAT reform
- However, this was done through reducing labor without changing investment
- There's no evidence of change in investment compositions or productivity

V. Conclusion

- This paper tests for both intended and unintended consequences of a VAT reform introduced in China in 2004
- The reform only covered some regions and sectors, allowing us to create a control and treatment group
- We use matching estimation to address endogenous selection problem
- Results suggest no significant impact on firm investment, but negative effects on new product introduction and employment

V. Final Take-aways

- Why did China extend the VAT reform to the rest of China, when results suggest negative effects on employment and insignificant effects on investment?
- We call this the VAT reform "puzzle"
- Anecdotal evidence suggests that the reform was extended as part of the 2008-2009 stimulus