

Origin Principle, Inter-regional Distribution of VAT, and Overcapacity in China

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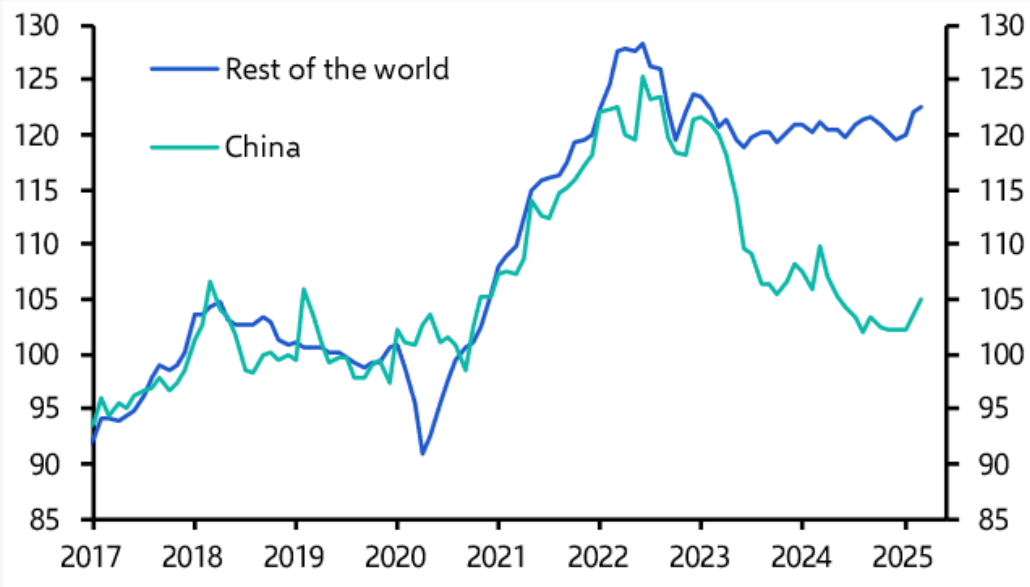
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Motivation

- China's manufacturing production capacity has undergone a transformation from shortage to surplus. At the same time, China's overcapacity has become a highly concerned issue that has been constantly troubling the economic policy departments.
- In recent years, deglobalization has led to a sharp contraction in global market demand, dealing a severe blow to China's foreign trade. As a result, domestic manufacturing overcapacity has become intertwined with international geopolitical and economic frictions.





Motivation

- As academia and policy sectors have gained deeper insights into the characteristics of China's economic operation model, it has become increasingly clear that the fiscal and taxation system constitutes a critical factor behind the formation and persistent resolution challenges of domestic manufacturing overcapacity.

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着力化解体制性产能过剩

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产能过剩不能完全归咎于市场
着力化解体制性产能过剩

改革财税体制，完善地方政府绩效考核体系。科学的财税体制是优化资源配置、促进社会公平、实现国家长治久安的制度保障。应进一步深化财税体制改革，合理分配中央和地方的税收收入，通过增加地方税种、税源以及完善财政转移支付制度，保证地方的财权和事权相匹配。同时，完善地方政府绩效考核体系，将公共服务水平、生态文明建设绩效等纳入考核指标体系，破除以地区生产总值论英雄的不合理做法。通过这些举措，降低地方政府的投资冲动，促使其提高经济决策科学化水平，遏制地区恶性竞争和重复建设。

处理好政府与市场的关系，深化垄断性行业改革。尊重市场经济规律，减少行政干预，加快推进垄断性行业改革，放开自然垄断行业竞争性业务，引入民营资本，从而既增加民营资本投资机会，又增加有效供给。对于产能已经过剩的领域，通过提高质量技术标准、环保标准等措施，倒逼过剩产能退出市场。政府应做好兜底工作，引导资金和下岗失业人员流向亟待发展的领域，促进资源优化配置。

国家税务总局
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用好政策性工具 助推供给侧结构性改革
——税务部门积极落实五大发展理念和“三去一降一补”五大任务

时间：2016-07-25 来源：国家税务总局办公厅

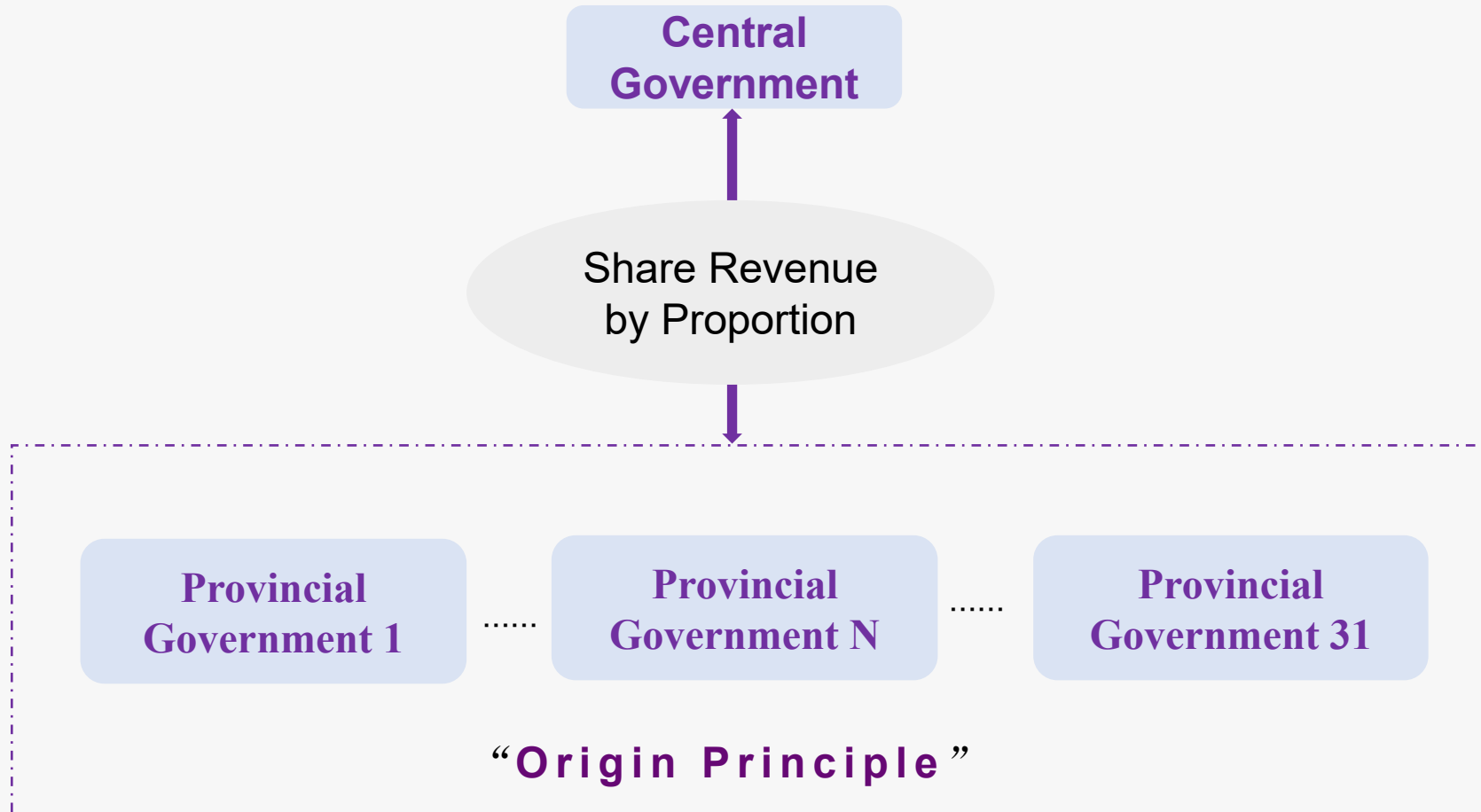
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推进供给侧结构性改革，去产能、去库存、去杠杆、降成本、补短板，是2016年我国经济工作的重点任务，也是引领我国经济发展新常态的重大创新和必然要求。税务部门深入学习贯彻十八届五中全会、中央经济工作会议决策部署，**找准税收推进供给侧结构性改革的切入点**，用好税收政策性工具，全力服务发展大局，当好供给侧结构性改革的“促进派”，最大程度释放改革红利。



Background

- China's current fiscal and taxation institutional framework was established by the tax-sharing reform of 1994.





Background

- **Origin Principle:** VAT revenue is distributed to the jurisdiction where value-added production activities occur.
- **Destination Principle:** VAT revenue is allocated to the region where final consumption of goods and services takes place.
- **VAT is highly susceptible to tax shifting** (Benedek et al., 2021), with end consumers bearing the majority of VAT liabilities across all production links.
- The distribution of VAT revenues under the origin principle creates a mismatch between the jurisdiction entitled to tax proceeds and the jurisdiction where the tax burden is ultimately borne.



Research Question

- **Limitations of Existing Literature:**
 - Most research links fiscal decentralization to overcapacity but neglects interregional VAT distribution principle.
 - Few studies emphasize the tight linkage between local fiscal revenue and local productive tax bases, which is the key production-biased feature of China's VAT system.
- **Research Question:**
 - Does origin-based interregional VAT revenue misalignment trigger manufacturing overcapacity?



Variable: Capacity utilization rate

We construct the model based on the Cobb-Douglas production function:: $Y_{it} = f(K_{it}, L_{it}) = A_i K_{it}^{\alpha} L_{it}^{\beta} e^{-\mu}$ (1)

Logarithmic transformation yields: $\ln Y_{it} = \alpha \ln K_{it} + \beta \ln L_{it} + \ln A - \mu$ (2)

Extrapolate the production function to the frontier, where Y_{it}^* denotes the theoretical maximum output level:

$$\ln Y_{it}^* = \alpha \ln K_{it} + \beta \ln L_{it} + \ln A \quad (3)$$

Let $\ln A = \alpha$, $E(\mu) = \varepsilon$:

$$\ln Y_{it} = \alpha \ln K_{it} + \beta \ln L_{it} + (\alpha - \varepsilon) - (\mu - \varepsilon) \quad (4)$$

Given $E(\mu - \varepsilon) = 0$, we estimate Equation (4) via OLS and obtain:

$$\ln \widehat{Y}_{it} = \hat{\alpha} \ln K_{it} + \hat{\beta} \ln L_{it} + (\alpha - \hat{\varepsilon}) \quad (5)$$

Equation (5) is the average production function, and further manipulation gives:

$$\text{Max}(\ln Y_{it} - \ln \widehat{Y}_{it}) = \text{Max}\{\ln Y_{it} - [\hat{\alpha} \ln K_{it} + \hat{\beta} \ln L_{it} + (\alpha - \hat{\varepsilon})]\} \quad (6)$$

Substitute the maximum value derived from Equation (6), and we can derive the frontier production function:

The capacity utilization rate is defined as: $\widehat{Y}_{it} = e^{\hat{\alpha}} K_{it}^{\hat{\alpha}} L_{it}^{\hat{\beta}}$ (7)

$$CU = \frac{Y_{it}}{\widehat{Y}_{it}} \quad (8)$$



Variable: VAT distribution distortion

- Adopt multi-regional input-output tables to calculate VAT allocation under the origin principle and destination principle respectively

➤ VAT Allocation under the Origin Principle

$$VAT_{ijt}^{producer} = \frac{VA_{ijt}}{VA_{jt}} \times VAT_{jt}^{producer}$$

➤ VAT Allocation under the Destination Principle:

- Calculate provincial industrial consumption volume:

$$Consumption_{ijt} = Y_{ijt} - intermediate_{ijt} - (EX_{ijt} - IM_{ijt}) - (outflow_{ijt} - inflow_{ijt})$$

- Eliminate cross-industry tax rate disparities:

$$Consumption_{ijt}^N = \frac{1}{1+tax_{jt}} \times consumption_{ijt}$$

- Derive regional industrial VAT revenue under the destination principle

$$VAT_{ijt}^{consumer} = \frac{demand_{ijt}^N}{demand_{jt}^N} \times VAT_{jt}^{producer}$$

- Construct the VAT distribution distortion index between the origin principle and destination principle

- $$VAT_twist_{ijt} = (VAT_{ijt}^{producer} - VAT_{ijt}^{consumer}) / VAT_{ijt}^{producer}$$



Empirical analysis

Identification Strategy	$CU_{ijkt} = \alpha + \beta_1 VAT_twist_{ijt} + X_{ijt} + \gamma_i + \delta_j + \eta_t + \varepsilon_{ijt}$
Dependent Variable	Firm-level capacity utilization rate CU_{ijkt} , constructed via production function approach
Core Independent Variable	VAT distribution distortion VAT_twist_{ijt}
Control Variables	• Firm age: Current year minus the firm's founding year plus one • Ownership: Set to 1 for state-owned enterprises, 0 for non-state-owned enterprises • Labor size: Logarithm of total firm employees • Net profit margin: After-tax corporate profit divided by net assets • Firm size: Logarithm of fixed capital stock • Leverage ratio: Ratio of total liabilities to total capital • Capital intensity: Logarithm of the ratio of fixed capital stock to employee count • Urban economic & social development: Log of per capita GDP, secondary industry output share
Fixed Effects & Standard Error Adjustment	• Year, province, and industry fixed effects • Standard errors clustered at province-industry level



Construction of Continuous-year Multi-regional Input-Output Tables

Benchmark IO Table	Number of Sectors	Number of Regions	Covered Years
2002 Inter-provincial Multi-regional Input-Output Table	28	31	2000、 2001、 2002、 2003、 2004
2007 Inter-provincial Multi-regional Input-Output Table	28	31	2005、 2006、 2007、 2008、 2009
2012 Inter-provincial Multi-regional Input-Output Table	58	31	2010、 2011、 2012、 2013、 2014、 2015
2017 Inter-provincial Multi-regional Input-Output Table	42	31	2016、 2017

- Multi-regional input-output tables covering 30 Chinese regions and 28 sectors from 2000 to 2017
- Official multi-regional input-output tables released by National Bureau of Statistics of China (1992, 2002, 2007, 2012, 2017)
- Listed firm database, 2000–2017
- China Tax Yearbooks, 2000–2017
- Detailed government subsidy data for listed companies, 2003–2017
- China Industrial Statistical Yearbooks (2000–2017)



Results

- VAT distribution distortion stemming from the origin principle significantly reduces firms' capacity utilization rate.
- This conclusion remains robust after sequentially controlling for firm characteristics and the economic & social development level of host cities.

	(1)	(2)	(3)
	CU	CU	CU
VAT_twist	-0.604** (0.267)	-0.703** (0.275)	-0.582* (0.330)
firmage		-0.0696 (0.0461)	-0.0763 (0.0470)
SOE		1.472*** (0.388)	1.614*** (0.395)
lnlabor		-1.023 (1.432)	-0.772 (1.496)
roa		45.62*** (3.933)	45.39*** (4.042)
size		0.282 (1.482)	0.134 (1.513)
debratio		6.940*** (1.462)	6.573*** (1.507)
CI		-0.998 (1.479)	-0.746 (1.520)
lrjgdp			0.836** (0.407)
ind_structure			6.032** (2.912)
Year fixed	Yes	Yes	Yes
Province fixed	Yes	Yes	Yes
Industry fixed	Yes	Yes	Yes
_cons	65.70*** (0.00456)	76.82*** (6.659)	62.75*** (8.527)
N	31900	31900	29026
R ²	0.218	0.278	0.280



Robustness checks

- **Alternative Dependent Variables:**

- ✓ Recalculate capacity utilization rate via Stochastic Frontier Analysis (SFA)

$$CU_{SFA} = \frac{E[f(x_{it}, \beta) \exp(v_{it} - u_{it})]}{E[f(x_{it}, \beta) \exp(v_{it} - u_{it}) | u_{it} = 0]}$$

- ✓ Corporate financial indicators: Total asset turnover ratio, fixed asset turnover ratio

- **Alternative Independent Variable:**

- ✓ VAT distribution distortion adjusted for intermediate inputs

$$Consumption_{ijt} = Y_{ijt} - (EX_{ijt} - IM_{ijt}) - (outflow_{ijt} - inflow_{ijt})$$

- **Alternative Sample Restrictions:**

- ✓ Drop firm samples from municipalities directly under central government
- ✓ Exclude observations from the 2008–2009 global financial crisis



Robustness checks

	(1)	(2)	(3)	(4)	(11)	(12)
	CU_SFA	Total asset turnover ratio	fixed asset turnover ratio	VAT distribution distortion adjusted for intermediate inputs	Drop municipalities	Drop 2008&2009
VAT_twist	-0.646** (0.278)	-0.0346*** (0.0110)	-0.0704** (0.0295)	-0.620* (0.349)	-0.749*** (0.246)	-0.737*** (0.260)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed	Yes	Yes	Yes	Yes	Yes	Yes
Province fixed	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed	Yes	Yes	Yes	Yes	Yes	Yes
_cons	85.96*** (6.055)	1.747*** (0.230)	2.435*** (0.614)	76.88*** (6.646)	73.84*** (6.084)	77.49*** (6.686)
N	31900	31900	31893	31900	25338	28883
R ²	0.252	0.351	0.329	0.277	0.300	0.282



Instrument Variable

- Adopt prefecture-level city terrain slope data
- IV 1**: Interaction term of city slope $\times$ one-period lagged VAT distribution distortion

$$VAT_twist_{ijt} = \alpha + \gamma Slope_c \times VAT_twist_{ijt-1} + X_{ijt} + \gamma_i + \delta_j + \eta_t + \varepsilon_{ijt}$$

$$CU_{ijkt} = \alpha + \delta VAT_twist_{ijt} + X_{ijt} + \gamma_i + \delta_j + \eta_t + \varepsilon_{ijt}$$

- IV 2**: Triple interaction term of city slope $\times$ 1992 VAT distribution distortion $\times$ time dummy variable

$$VAT_twist_{ijt} = \alpha + \gamma Slope_c \times VAT_twist_{ij}^{1992} \times year + X_{ijt} + \gamma_i + \delta_j + \eta_t + \varepsilon_{ijt}$$

$$CU_{ijkt} = \alpha + \delta VAT_twist_{ijt} + X_{ijt} + \gamma_i + \delta_j + \eta_t + \varepsilon_{ijt}$$

工具变量回归结果

	(1)	(2)
	IV 1	IV 2
VAT_twist	-1.943** (0.900)	-1.565* (0.840)
Controls	Yes	Yes
Year fixed	Yes	Yes
Province fixed	Yes	Yes
Industry fixed	Yes	Yes
N	28443	31735
R ²	0.068	0.115
First stage IV	0.766*** (0.0455)	0.0643*** (0.000992)
Cragg-Donald Wald F statistics	283.329	68.80



Mechanisms

◆ Factor Allocation Mechanism

- **Index Construction:** We measure factor misallocation using the relative distortion degree of capital and labor inputs

Assume the production function takes the following form:

$$Y_{iat} = AK_{iat}^{\beta_{Kia}} L_{iat}^{1-\beta_{Kia}}$$

Logarithmic transformation yields:

$$\ln\left(\frac{Y_{iat}}{L_{iat}}\right) = \ln A + \beta_{Kia} \ln\left(\frac{K_{iat}}{L_{iat}}\right) + \varepsilon_{iat}$$

Where,

$$K_{iat} = \frac{I_{iat}}{P_{iat}} + (1 - \delta)K_{iat-1}$$

Estimate the capital output elasticity and labor output elasticity at the province-industry level

$$\widehat{\gamma_{Kia}} = \left(\frac{K_{ia}}{K}\right) / (s_{ia}\beta_{Kia}/\beta_K)$$

$$\widehat{\gamma_{Lia}} = \left(\frac{L_{ia}}{L}\right) / (s_{ia}\beta_{Lia}/\beta_L)$$

We further derive the relative distortion degree of capital and labor:

$$Abstauk_{ia} = \left| \frac{1}{\widehat{\gamma_{Kia}}} - 1 \right|$$

$$Abstaul_{ia} = \left| \frac{1}{\widehat{\gamma_{Lia}}} - 1 \right|$$



Mechanisms

◆ Market Segmentation Mechanism

➤ Index Construction

- Supply side: Measured by the degree of domestic value chain participation
- Demand side: Measured by inter-provincial trade friction coefficient

Calculation of Domestic Value Chain Participation

$$Nup_{iaj} = \frac{\text{Intermediate goods inflow to other domestic provinces}}{\text{total outflows of province} - \text{industry}}$$

$$= ((v_i l_{ii})^T \# (a_{ij} b_{jj} y_{jj}) + (v_i l_{ii})^T \# (a_{ij} \sum_{k \neq i, j}^M b_{jk} y_{kk}) + (v_i l_{ii})^T \# (a_{ij} b_{jj} \sum_{k \neq i, j}^M y_{jk}) + (v_i l_{ii})^T \# (a_{ij} \sum_{k \neq i, j}^M b_{jk} \sum_{u \neq i, k}^M y_{ku})) / z_{i*}^a$$

$$Ndown_{iaj} = \frac{\text{Intermediate inputs from other domestic provinces}}{\text{total outflows of province} - \text{industry}}$$

$$= ((v_j b_{ji})^T \# y_{ij} + (\sum_{k \neq i, j}^M v_k b_{ki})^T \# y_{ij} + (v_j b_{ji})^T \# (a_{ij} l_{jj} y_{jj}) + (\sum_{k \neq i, j}^M v_k b_{ki})^T \# (a_{ij} l_{jj} y_{jj}) + (\sum_{j \neq i}^M v_j b_{ji})^T \# e_i) / z_{i*}^a$$

$$NVC_{iaj} = Nup_{iaj} + Ndown_{iaj}$$

Calculation of Inter-provincial Trade Friction Coefficient

Drawing on the trade gravity model: $trade_{iaj} = \frac{y_{ia} d_{ja}}{y_a} friction_{iaj}$

Take logarithms and control bilateral province fixed effects to obtain

$$lntrade_{iajt} = \beta_0 + \beta_1 \ln \frac{y_{iat} d_{jat}}{y_{at}} + \theta_{ij} + \varepsilon_{iajt}$$

The residual obtained from regression is defined as the trade friction coefficient of product flows



Mechanisms

机制分析结果

	(1)	(2)	(3)	(4)	(5)	(6)
	Factor Allocation		Market Segmentation			
	abstauk	abstaul	Nup	Ndown	NVC	friction
VAT_twist	0.584*** (0.192)	-0.00626 (0.0133)	-0.445 (0.383)	-0.271*** (0.0851)	-0.266*** (0.0843)	0.115*** (0.0190)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed	Yes	Yes	Yes	Yes	Yes	Yes
Province fixed	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed	Yes	Yes	Yes	Yes	Yes	Yes
_cons	4.728*** (0.739)	1.298*** (0.00261)	0.997*** (0.0311)	0.238*** (0.0167)	0.248*** (0.0165)	-0.121*** (0.00352)
N	13286	14230	426900	426900	426900	409475
R ²	0.217	0.496	0.350	0.295	0.290	0.560



Heterogeneity

- Ownership: The negative impact of VAT distribution distortion on capacity utilization is significantly stronger for state-owned enterprises.
- Firm Size: Larger firms suffer a more pronounced negative effect on capacity utilization from VAT distortion.
- Industry: High-tech sectors and traditional overcapacity industries experience stronger adverse impacts of VAT misalignment.
- Region: Firms in eastern regions and areas hit by negative export shocks face more severe capacity utilization declines driven by VAT distortion.

	(1)	(2)	(3)	(4)
	CU			
	High-tech	Non-hightech	overcapacity	Non-overcapacity
VAT_twist	-1.469** (0.728)	-0.489 (0.401)	-1.836* (0.742)	-0.251 (0.316)
Controls	Yes	Yes	Yes	Yes
Year fixed	Yes	Yes	Yes	Yes
Province fixed	Yes	Yes	Yes	Yes
Industry fixed	Yes	Yes	Yes	Yes
_cons	70.27*** (7.166)	80.03*** (3.460)	62.32*** (2.711)	80.83*** (7.183)
N	6854	25044	8111	23788
R ²	0.238	0.309	0.294	0.287

	(1)	(2)	(3)	(4)
	CU			
	SOE	Non-SOE	Big firms	Small firms
VAT_twist	-1.027** (0.447)	-0.0781 (0.479)	-0.865*** (0.290)	-0.490 (0.442)
Controls	Yes	Yes	Yes	Yes
Year fixed	Yes	Yes	Yes	Yes
Province fixed	Yes	Yes	Yes	Yes
Industry fixed	Yes	Yes	Yes	Yes
_cons	71.74*** (7.952)	87.30*** (6.178)	129.8*** (10.03)	122.3*** (8.065)
N	17615	14285	13819	18081
R ²	0.312	0.273	0.435	0.257

	(1)	(2)	(3)	(4)
	CU			
	East	Middle & west	Negative export shocks	Others
VAT_twist	-0.582** (0.231)	-0.310 (0.304)	-0.669*** (0.237)	-0.517 (0.580)
Controls	Yes	Yes	Yes	Yes
Year fixed	Yes	Yes	Yes	Yes
Province fixed	Yes	Yes	Yes	Yes
Industry fixed	Yes	Yes	Yes	Yes
_cons	92.03*** (1.334)	79.94*** (2.039)	72.90*** (6.809)	91.42*** (8.155)
N	20897	11003	24332	7568
R ²	0.244	0.274	0.276	0.262



Conclusion

- The origin principle links VAT revenue to local productive tax bases, and the resulting VAT distribution distortion significantly reduces the capacity utilization rate of firms in local industries.
- The VAT distribution distortion induced by the origin principle depresses firms' capacity utilization mainly through two channels: impaired factor allocation efficiency and aggravated market segmentation.
- Policy Implications: Reform the fiscal revenue-sharing rules among governments by shifting the VAT allocation benchmark from the origin principle to the destination principle.
- Contributions: construct a theoretical framework illustrating how the VAT allocation regime shapes local government incentives and further affects firms' capacity decisions, enriching literature on tax revenue distribution and local government behavior.

T h a n k s !
