# The Real Effects of China's Carbon Dioxide Emissions Trading Program

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# Research Background

- China's emissions trading system (ETS) is the world's largest by emissions volume coverage and was first established in an emerging economy.
  - National + 7 regional pilots
  - The national market is estimated to cover 5 billion $tCO_2e$ as of 2023
- China’s ETS applies a salient two-stage emissions intensity-based compliance allowance allocation scheme, different from the “cap-and-trade” scheme prevalent in the developed economies.

# Research Questions

- The real effects of China's emissions trading program on the compliance firms' capital investment, R&D, and employment decisions
- The implications for output, profit, productivity, and operating efficiency
- The interactions with state ownership, industry heterogeneity, and region disparity

# Institutional Backgrounds

- ETS over carbon taxation as the primary policy tool
  - Weak legal framework, region disparity, industrial heterogeneity, and continuously evolving climate policies (Duan and Zhou, 2017; Goulder et al., 2017; Karplus and Zhang, 2017)
  - Market-based carbon pricing and greater autonomy for firms in terms of determining how to achieve the emissions target
- The implementation has followed a learning-by-doing approach
  - 7 regional pilot programs (East: Beijing, Shanghai, Tianjin; South: Guangdong, Shenzhen; Central: Hubei; West: Chongqing) were established in 2013-2014
  - The national program was launched in 2021

# Institutional Backgrounds: Industry Coverage

- Regional pilots
  - Energy-intensive sectors: power, petrochemicals, chemical, iron and steel, nonferrous metals, construction materials, paper, and civil aviation
  - Reflecting regional characteristics, e.g., seaports and airports in Shanghai; hotels and hospitals in Beijing
- The national market
  - Long-term scope: the energy-intensive sectors, over 7000 entities, and 70% of China's carbon emissions
  - Current coverage: 2162 entities with annual emissions over 26,000 $tCO_2e$ in the power sector
  - The Ministry of Ecology and Environment (MEE) has required firms in the other 7 sectors with annual emissions exceeding 26,000 $tCO_2e$ to report carbon emissions in 2021

# Institutional Backgrounds: Emissions Quota

- Two-staged emissions allowance allocation scheme:
  - Firms receive a fraction (typically 60-70%) of the allowance benchmarked to historical emissions, following the "grandfather" rule
  - Firms obtain the rest of the allowance based on the actual production at the end of the compliance period
- Effectively intensity-based (carbon per unit output) allocation constitutes an output subsidy (Goulder and Morgenstern, 2018; Goulder et al. 2022).
- Policymakers have hinted that China will switch to the emissions-based allowance allocation scheme when the ETS becomes more mature.

# Institutional Backgrounds: Auction and Trading

- In the regional markets, nearly 95% of the emissions allowances are allocated for free, and 3% to 10% of the budgeted allowances are reserved for auction.
- Allowances are currently allocated for free in the national market. It has been announced that auctions will be introduced and gradually expanded, but there is no specific timeline.
- The average carbon price in the national ETS was about USD 10 per $tCO_2e$ in 2023.
  - Korea ETS (USD 8) and Tokyo C&T (USD 5)
  - European Union ETS (USD 90) and California C&T (USD 33)

# Institutional Backgrounds: MRV and Penalty

- Monitoring, reporting, and verifying (MRV) emissions have been a significant challenge (Zhang et al., 2019)
  - The MEE has been amending the MRV guidelines and technical specifications for the national ETS every year.
  - Provincial-level ecological and environmental authorities are responsible for the verification of the emissions reports.
- Penalties for violations have been increased but are still lenient.
  - Fines for failing to submit a report have increased from CNY 10,000-30,000 (USD 1,411-4,234) to CNY 50,000-200,000 (USD 7,058-28,232).
  - Fines for compliance failure have increased from CNY 20,000-30,000 (USD 2,822-4,234) to five to ten times the market value of the exceeded emissions.
- Borrowing from future compliance periods is permitted (in a flavor of carbon credit).

# Methodology

- The baseline DiD model:

$$Decision/Performance_{i,t} = \beta ETS_{i,t} + \gamma Controls_{i,t} + \epsilon_{i,t}$$

- Decisions: *capital expenditure, R&D, number of employee, wage*
- Performance: *revenue, EBITDA, TFP, revenue per capita, Tobin's Q, ROA*
- Control variables: size, age, leverage, cash, tangibility, growth, BM, stock returns, stock return volatility + the dependent variable lagged by one period + firm and year fixed effects
- The variables are CPI-adjusted

# Data

- Compliance entities include listed firms or their subsidiaries or holding companies. Manually matched the compliance entities to the listed firms.
  - Treated firms: the listed firms if themselves, or their subsidiaries or holding companies are covered by the ETS (regional or national) at time *t*
  - Control firms: listed firms not covered by the ETS at time *t*
- The final sample contains 28,797 firm-ETS-year observations from 3,796 individual firms in 2009-2021, among which 510 compliance firms provide 2,459 observations.

# Key Findings

- Compliance firms significantly invested additionally in capital assets, more prominent for state-owned enterprises (SOEs).
- R&D is not significantly correlated with the ETS coverage after controlling the previous year's R&D.
- Compliance firms hired more workers, but there are no significant differences between the wages of compliance firms and non-compliance firms.
- The percentage of low-skilled workers is positively correlated with ETS coverage, while the percentage of high-skilled workers is negatively correlated, implying a workforce structure adjustment.

# Key Findings (continued)

- Production output (proxied by revenue) and profit (proxied by EBITDA) are not significantly correlated with the ETS coverage.
- Compliance firms exhibit higher profitability (ROA) but indifferent TFP, revenue per capita, and Tobin's Q.
- ETS coverage harms the SOEs' profitability.

# Key Findings (continued)

- Different sectors exhibit different patterns
  - Additional investment and hiring largely happened in the power and manufacturing sectors.
  - Firms in the transportation sector only trimmed R&D and wages.
  - Real estate firms boosted outputs and TFP.
- Different markets
  - Firms covered by the national market boosted investment and hiring.
  - Compliance firms in the regional markets reduced hiring and wages.
  - The compliance effects are strong in South China (Guangdong and Shenzhen), followed by East China (Beijing, Shanghai, and Tianjin), but weak in less developed Central and West China (Hubei and Chongqing).

# Interpretations

- China's ETS is in a premature and rapidly developing stage
  - Free allowance
  - Lenient intensity-based emissions allowance allocation scheme
  - Immature monitoring, reporting, and verifying framework
  - Light penalties
- The ETS has evoked firms' climate awareness and stimulated some real actions (Duan and Zhou, 2017).
- No shocks to output, profit, productivity, and efficiency
- State ownership tends to reinforce the ETS effects
- Heterogenous effects across sectors and regions

Table 4: Capital Investment and ETS

This table presents the regression results of capital investment on ETS. $logCAPX$ is the logarithm of the capital expenditure. See Table 2 for the definitions of the variables. Standard errors, reported in parentheses, are clustered at the firm level. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

| | $logCAPX_{i,t}$ | | | $logRDSpend_{i,t}$ | | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| $ETS_{i,t}$ | 0.177*** | 0.142*** | 0.088*** | 0.220*** | 0.174** | 0.082 |
| | (3.44) | (3.27) | (2.90) | (3.01) | (2.30) | (1.15) |
| $logASSETS_{i,t}$ | | 1.160*** | 0.713*** | | 0.667*** | 0.526*** |
| | | (34.82) | (26.27) | | (13.54) | (9.67) |
| $logAGE_{i,t}$ | | -0.900*** | -0.597*** | | -0.756** | -0.358 |
| | | (-4.89) | (-4.70) | | (-2.57) | (-1.23) |
| $LEVERAGE_{i,t}$ | | -0.418*** | -0.368*** | | -0.218** | -0.054 |
| | | (-3.83) | (-4.32) | | (-2.23) | (-0.51) |
| $ROA_{i,t}$ | | 0.851*** | 0.907*** | | -0.351*** | -0.354*** |
| | | (4.92) | (6.27) | | (-2.90) | (-3.00) |
| $CASH_{i,t}$ | | -0.445*** | -0.189** | | -0.170** | -0.089 |
| | | (-4.28) | (-2.23) | | (-2.04) | (-1.08) |
| $TANGIBILITY_{i,t}$ | | -0.036 | -0.940*** | | 0.176 | 0.242 |
| | | (-0.24) | (-8.10) | | (1.09) | (1.55) |
| $GROWTH_{i,t}$ | | 0.012 | 0.134*** | | 0.099*** | 0.163*** |
| | | (0.56) | (6.67) | | (4.65) | (6.71) |
| $SOE_{i,t}$ | | -0.109* | -0.059 | | -0.085* | -0.079* |
| | | (-1.68) | (-1.20) | | (-1.94) | (-1.87) |
| $BM_{i,t}$ | | -0.222*** | -0.167*** | | -0.152** | -0.182*** |
| | | (-4.42) | (-4.52) | | (-2.39) | (-3.25) |
| $RET_{i,t}$ | | -0.065*** | -0.023 | | -0.050*** | -0.028* |
| | | (-3.64) | (-1.40) | | (-3.00) | (-1.83) |
| $VOL_{i,t}$ | | 0.011 | 0.032 | | 0.080*** | 0.048* |
| | | (0.29) | (0.97) | | (2.77) | (1.71) |
| $logCAPX_{i,t-1}$ | | | 0.386*** | | | |
| | | | (38.63) | | | |
| $logRDSpend_{i,t-1}$ | | | | | | 0.252*** |
| | | | | | | (10.77) |
| Firm FE | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Year FE | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Observations | 28307 | 24623 | 24615 | 11400 | 10167 | 7674 |
| Adjusted $R^2$ | 0.746 | 0.809 | 0.839 | 0.928 | 0.937 | 0.959 |

Table 5: Employment and ETS

This table presents the regression results of employment on the ETS. $logEMP$ is the logarithm of the number of employees. See Table 2 for the definitions of the explanatory variables. Standard errors, reported in parentheses, are clustered at the firm level. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

| | $logEMP_{i,t}$ | | | $logWAGES_{i,t}$ | | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| $ETS_{i,t}$ | 0.061* | 0.056** | 0.025** | 0.012 | 0.008 | 0.012 |
| | (1.79) | (2.10) | (1.98) | (0.37) | (0.38) | (1.34) |
| $logASSETS_{i,t}$ | | 0.652*** | 0.274*** | | 0.730*** | 0.268*** |
| | | (33.20) | (21.14) | | (42.24) | (21.82) |
| $logAGE_{i,t}$ | | 0.136 | -0.043 | | 0.265*** | -0.060* |
| | | (1.12) | (-0.86) | | (2.85) | (-1.72) |
| $LEVERAGE_{i,t}$ | | 0.066 | -0.004 | | 0.022 | -0.036 |
| | | (1.07) | (-0.12) | | (0.42) | (-1.50) |
| $ROA_{i,t}$ | | 0.108 | 0.096* | | 0.183** | 0.102** |
| | | (1.23) | (1.81) | | (2.37) | (2.39) |
| $CASH_{i,t}$ | | -0.167*** | -0.033 | | -0.243*** | -0.023 |
| | | (-3.18) | (-1.21) | | (-5.51) | (-1.15) |
| $TANGIBILITY_{i,t}$ | | 0.634*** | 0.213*** | | 0.530*** | 0.152*** |
| | | (7.81) | (5.18) | | (7.97) | (4.74) |
| $GROWTH_{i,t}$ | | 0.017 | 0.184*** | | -0.025*** | 0.230*** |
| | | (1.58) | (18.53) | | (-2.99) | (25.17) |
| $SOE_{i,t}$ | | 0.059* | 0.023 | | 0.080*** | 0.034*** |
| | | (1.73) | (1.36) | | (3.14) | (2.69) |
| $BM_{i,t}$ | | -0.115*** | -0.033** | | -0.205*** | -0.073*** |
| | | (-3.99) | (-2.48) | | (-8.17) | (-6.74) |
| $RET_{i,t}$ | | -0.023*** | 0.001 | | -0.069*** | -0.032*** |
| | | (-2.84) | (0.25) | | (-10.34) | (-7.00) |
| $VOL_{i,t}$ | | -0.005 | -0.003 | | 0.028** | 0.006 |
| | | (-0.31) | (-0.26) | | (2.07) | (0.65) |
| $logEMP_{i,t-1}$ | | | 0.650*** | | | |
| | | | (54.27) | | | |
| $logWAGES_{i,t-1}$ | | | | | | 0.711*** |
| | | | | | | (66.71) |
| Firm FE | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Year FE | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Observations | 28320 | 24634 | 24626 | 28318 | 24632 | 24629 |
| Adjusted $R^2$ | 0.899 | 0.937 | 0.969 | 0.917 | 0.961 | 0.984 |

Table 7: OUTPUT and ETS

This table presents the regression results of OUTPUT on the ETS. *logOUTPUT* is the logarithm of the number of employees. See Table 2 for the definitions of the explanatory variables. Standard errors, reported in parentheses, are clustered at the firm level. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

| | $logOUTPUT_{i,t}$ | | | $logEBITDA_{i,t}$ | | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| $ETS_{i,t}$ | 0.051 | 0.018 | 0.002 | 0.130*** | 0.038* | 0.010 |
| | (1.49) | (0.88) | (0.41) | (3.03) | (1.82) | (0.69) |
| $logASSETS_{i,t}$ | | 0.807*** | 0.082*** | | 0.983*** | 0.660*** |
| | | (52.01) | (7.18) | | (67.55) | (42.46) |
| $logAGE_{i,t}$ | | 0.346*** | 0.007 | | 0.146 | 0.243*** |
| | | (3.97) | (0.36) | | (1.60) | (3.76) |
| $LEVERAGE_{i,t}$ | | 0.344*** | 0.055*** | | -0.098* | 0.046 |
| | | (6.55) | (3.55) | | (-1.83) | (1.15) |
| $ROA_{i,t}$ | | 1.709*** | 0.299*** | | 8.286*** | 6.846*** |
| | | (20.94) | (9.38) | | (42.77) | (36.10) |
| $CASH_{i,t}$ | | -0.203*** | 0.002 | | -0.076 | -0.086** |
| | | (-4.51) | (0.21) | | (-1.63) | (-2.41) |
| $TANGIBILITY_{i,t}$ | | 0.321*** | 0.067*** | | 0.803*** | 0.622*** |
| | | (4.79) | (3.57) | | (12.57) | (13.15) |
| $GROWTH_{i,t}$ | | 0.202*** | 0.781*** | | 0.132*** | 0.363*** |
| | | (23.86) | (99.29) | | (11.45) | (24.41) |
| $SOE_{i,t}$ | | 0.058* | 0.011 | | 0.006 | 0.041 |
| | | (1.91) | (1.34) | | (0.17) | (1.50) |
| $BM_{i,t}$ | | -0.173*** | 0.004 | | -0.239*** | -0.111*** |
| | | (-6.89) | (0.55) | | (-8.37) | (-4.90) |
| $RET_{i,t}$ | | -0.058*** | 0.004 | | -0.012 | 0.054*** |
| | | (-8.66) | (1.50) | | (-1.27) | (6.26) |
| $VOL_{i,t}$ | | 0.026** | -0.005 | | -0.023 | -0.067*** |
| | | (1.97) | (-0.88) | | (-1.23) | (-3.93) |
| $logOUTPUT_{i,t-1}$ | | | 0.921*** | | | |
| | | | (88.91) | | | |
| $logEBITDA_{i,t-1}$ | | | | | | 0.315*** |
| | | | | | | (26.89) |
| Firm FE | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Year FE | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Observations | 28319 | 24633 | 24632 | 26903 | 23367 | 22700 |
| Adjusted $R^2$ | 0.912 | 0.966 | 0.995 | 0.828 | 0.931 | 0.946 |

Table 8: Productivity, Efficiency, and Firm Value

This table presents the regression results of productivity, efficiency, and firm value on ETS. *logOUTPUT* is the logarithm of the amount of revenue. $TFP$ is the total factor productivity computed following Levinsohn and Petrin (2003). $REVperCapita$ is the ratio of revenue to the number of employees. $TobinQ$ is the ratio of market equity and total liabilities to total assets. See Table 2 for the definitions of the variables. Standard errors, reported in parentheses, are clustered at the firm level. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

| | $TFP_{i,t}$ | $logREVperCapita_{i,t}$ | $TobinQ_{i,t}$ | $ROA_{i,t}$ |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| $ETS_{i,t}$ | 0.015 | -0.021 | -0.018 | 0.004*** |
| | (0.85) | (-0.76) | (-0.39) | (2.62) |
| $logASSETS_{i,t}$ | 0.585*** | 0.139*** | -0.557*** | 0.008*** |
| | (41.39) | (7.03) | (-15.29) | (6.18) |
| $logAGE_{i,t}$ | 0.265*** | 0.206* | -0.543*** | 0.009 |
| | (3.41) | (1.75) | (-2.75) | (1.16) |
| $LEVERAGE_{i,t}$ | 0.338*** | 0.306*** | -0.374*** | -0.112*** |
| | (7.23) | (4.96) | (-3.36) | (-21.49) |
| $ROA_{i,t}$ | 1.654*** | 1.644*** | 3.858*** | |
| | (22.75) | (16.46) | (15.83) | |
| $CASH_{i,t}$ | -0.129*** | -0.020 | 0.188 | 0.005 |
| | (-3.25) | (-0.38) | (1.49) | (1.06) |
| $TANGIBILITY_{i,t}$ | 0.160** | -0.298*** | -0.186 | -0.019*** |
| | (2.56) | (-3.26) | (-1.41) | (-3.33) |
| $GROWTH_{i,t}$ | 0.210*** | 0.185*** | -0.061*** | 0.037*** |
| | (25.51) | (15.63) | (-2.79) | (28.68) |
| $SOE_{i,t}$ | 0.033 | -0.001 | -0.060 | -0.003 |
| | (1.20) | (-0.04) | (-0.91) | (-1.14) |
| $BM_{i,t}$ | -0.110*** | -0.050 | | -0.023*** |
| | (-4.91) | (-1.64) | | (-12.21) |
| $RET_{i,t}$ | -0.037*** | -0.034*** | 1.083*** | 0.025*** |
| | (-6.13) | (-3.83) | (43.69) | (22.42) |
| $VOL_{i,t}$ | 0.018 | 0.027 | 0.365*** | -0.023*** |
| | (1.47) | (1.52) | (6.57) | (-11.44) |
| $ROA_{i,t-1}$ | | | | 0.216*** |
| | | | | (18.18) |
| Firm FE | ✓ | ✓ | ✓ | ✓ |
| Year FE | ✓ | ✓ | ✓ | ✓ |
| Observations | 24631 | 24633 | 24634 | 23188 |
| Adjusted $R^2$ | 0.954 | 0.844 | 0.753 | 0.555 |

Table 6: Different Types of Employees

This table presents the results of regressing different types of employees on ETS. $RDPerson_pct$ is the percentage of R&D staff to total employees. $LOWSKILL_pct$ is the percentage of low-skilled workers to total employees. $HIGHSKILL_pct$ is the percentage of high-skilled workers to total employees. $SALEMAN_pct$ is the percentage of salespeople to total employees. $ADM_pct$ is the percentage of the number of administrative staff to total employees. See Table 2 for the definitions of the explanatory variables. Standard errors, reported in parentheses, are clustered at the firm level. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

| | $LOWSKILL_pct_{i,t}$ | $HIGHSKILL_pct_{i,t}$ | $RDPerson_pct_{i,t}$ | $ADM_pct_{i,t}$ | $SALEMAN_pct_{i,t}$ |
|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) |
| $ETS_{i,t}$ | 0.018*** | -0.017*** | 0.002 | -0.002 | -0.000 |
| | (2.82) | (-3.36) | (0.58) | (-0.49) | (-0.09) |
| $logASSETS_{i,t}$ | 0.001 | 0.005 | 0.001 | -0.005** | -0.007** |
| | (0.25) | (1.51) | (0.40) | (-2.17) | (-1.96) |
| $logAGE_{i,t}$ | 0.001 | -0.033 | -0.021 | 0.018 | 0.004 |
| | (0.03) | (-1.35) | (-0.91) | (1.03) | (0.18) |
| $LEVERAGE_{i,t}$ | 0.036** | -0.022* | -0.025*** | -0.015** | -0.012 |
| | (2.56) | (-1.96) | (-2.80) | (-2.20) | (-0.98) |
| $ROA_{i,t}$ | 0.075*** | -0.019 | -0.022* | -0.017 | -0.023 |
| | (3.40) | (-1.11) | (-1.67) | (-1.51) | (-1.25) |
| $CASH_{i,t}$ | 0.000 | -0.004 | -0.002 | -0.007 | 0.009 |
| | (0.00) | (-0.42) | (-0.26) | (-1.10) | (0.99) |
| $TANGIBILITY_{i,t}$ | 0.142*** | -0.049*** | -0.022** | -0.015* | -0.080*** |
| | (7.20) | (-2.90) | (-2.12) | (-1.69) | (-5.26) |
| $GROWTH_{i,t}$ | -0.002 | 0.002 | -0.001 | 0.000 | 0.004** |
| | (-0.80) | (0.83) | (-0.46) | (0.07) | (2.09) |
| $SOE_{i,t}$ | 0.002 | -0.008 | -0.006 | 0.007 | 0.001 |
| | (0.18) | (-1.19) | (-1.36) | (1.64) | (0.17) |
| $BM_{i,t}$ | 0.001 | -0.013** | -0.004 | 0.001 | 0.004 |
| | (0.12) | (-2.43) | (-0.93) | (0.22) | (0.80) |
| $RET_{i,t}$ | 0.005* | -0.005** | -0.003** | -0.000 | 0.000 |
| | (1.87) | (-2.48) | (-2.26) | (-0.01) | (0.31) |
| $VOL_{i,t}$ | -0.007 | 0.001 | -0.001 | 0.000 | 0.000 |
| | (-1.53) | (0.28) | (-0.56) | (0.18) | (0.13) |
| Firm FE | ✓ | ✓ | ✓ | ✓ | ✓ |
| Year FE | ✓ | ✓ | ✓ | ✓ | ✓ |
| Observations | 20022 | 22227 | 15038 | 19908 | 21554 |
| Adjusted $R^2$ | 0.877 | 0.868 | 0.908 | 0.669 | 0.876 |

Table 9: SOE

This table reports the regression results of Political Influence on ETS. $logWAGES$ is the logarithm of total wage received by all employees, including executives and directors. $logAWAGES$ is the logarithm of average wage received by all employees. See Table 2 for the definitions of the explanatory variables. Standard errors, reported in parentheses, are clustered at the firm level. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

| | $logCAPX_{i,t}$ | $logRDSpend_{i,t}$ | $logEMP_{i,t}$ | $logWAGES_{i,t}$ | $logOUTPUT_{i,t}$ | $logEBITDA_{i,t}$ | $TFP_{i,t}$ | $ROA_{i,t}$ |
|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| $ETS_{i,t}$ | 0.074*** | 0.074 | 0.008 | 0.221*** | -0.001 | 0.037*** | 0.041 | 0.002 |
| | (3.42) | (1.15) | (0.88) | (4.97) | (-0.26) | (3.09) | (1.53) | (1.14) |
| $ETS_{i,t} \times SOE_{i,t}$ | 0.056* | 0.160 | 0.004 | -0.060 | 0.009* | -0.009 | 0.025 | -0.004** |
| | (1.83) | (1.47) | (0.38) | (-1.04) | (1.71) | (-0.50) | (0.63) | (-1.99) |
| $SOE_{i,t}$ | -0.122*** | -0.172*** | -0.015*** | 0.178*** | 0.005** | -0.016** | 0.035 | 0.002*** |
| | (-7.91) | (-3.53) | (-3.32) | (6.61) | (2.45) | (-1.97) | (1.63) | (2.94) |
| $logASSETS_{i,t}$ | 0.362*** | 0.893*** | 0.071*** | 0.858*** | 0.018*** | 0.479*** | 0.669*** | 0.008*** |
| | (30.45) | (44.93) | (17.04) | (72.79) | (5.33) | (37.20) | (78.48) | (20.10) |
| $logAGE_{i,t}$ | -0.157*** | -0.002 | -0.030*** | 0.101*** | -0.003 | -0.018* | 0.040 | 0.005*** |
| | (-7.73) | (-0.04) | (-4.99) | (2.79) | (-0.97) | (-1.79) | (1.55) | (4.98) |
| $LEVERAGE_{i,t}$ | -0.073 | -0.295** | 0.023* | 0.346*** | 0.037*** | 0.165*** | 0.918*** | -0.060*** |
| | (-1.63) | (-2.56) | (1.72) | (4.78) | (4.84) | (6.23) | (16.15) | (-22.63) |
| $ROA_{i,t}$ | 1.433*** | 0.011 | 0.297*** | 1.325*** | 0.268*** | 5.944*** | 2.380*** | |
| | (13.01) | (0.05) | (7.50) | (9.58) | (11.37) | (37.38) | (21.80) | |
| $CASH_{i,t}$ | 0.149*** | 0.328** | 0.063*** | 0.516*** | 0.018** | -0.031 | 0.071 | 0.009*** |
| | (2.60) | (2.47) | (3.89) | (6.75) | (2.29) | (-1.09) | (1.24) | (2.86) |
| $TANGIBILITY_{i,t}$ | 0.329*** | -0.702*** | 0.067*** | 0.795*** | 0.015** | 0.664*** | -0.143** | 0.006*** |
| | (5.66) | (-4.36) | (4.55) | (8.91) | (2.42) | (23.09) | (-2.08) | (2.60) |
| $GROWTH_{i,t}$ | 0.275*** | 0.095*** | 0.266*** | -0.132*** | 0.810*** | 0.493*** | 0.164*** | 0.038*** |
| | (12.99) | (2.61) | (24.68) | (-8.99) | (110.58) | (32.42) | (12.87) | (28.74) |
| $BM_{i,t}$ | -0.160*** | -0.633*** | -0.041*** | -0.336*** | 0.015*** | -0.015 | 0.006 | -0.020*** |
| | (-6.05) | (-8.38) | (-5.29) | (-8.30) | (3.57) | (-1.00) | (0.18) | (-15.06) |
| $RET_{i,t}$ | -0.042** | 0.038 | -0.006 | -0.078*** | 0.006* | 0.106*** | -0.025*** | 0.032*** |
| | (-2.55) | (1.25) | (-1.04) | (-6.47) | (1.93) | (12.69) | (-2.61) | (29.45) |
| $VOL_{i,t}$ | 0.168*** | -0.129** | 0.012 | -0.064** | -0.009* | -0.117*** | -0.021 | -0.036*** |
| | (5.36) | (-2.02) | (1.21) | (-2.16) | (-1.67) | (-7.40) | (-0.95) | (-19.20) |
| $logCAPX_{i,t-1}$ | 0.665*** | | | | | | | |
| | (75.34) | | | | | | | |
| $logEMPLOYEE_{i,t-1}$ | | | 0.922*** | | | | | |
| | | | (213.67) | | | | | |
| $logOUTPUT_{i,t-1}$ | | | | | 0.983*** | | | |
| | | | | | (303.37) | | | |
| $logEBITDA_{i,t-1}$ | | | | | | 0.506*** | | |
| | | | | | | (42.29) | | |
| $ROA_{i,t-1}$ | | | | | | | | 0.489*** |
| | | | | | | | | (51.41) |
| Industry FE | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Year FE | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Observations | 25177 | 10766 | 25188 | 25194 | 25195 | 23277 | 25193 | 23667 |
| Adjusted $R^2$ | 0.807 | 0.602 | 0.963 | 0.781 | 0.868 | 0.940 | 0.834 | 0.489 |

Table 10: Industry

This table presents the regression results about the Political Influence using SOE as proxies for political influence. SOE equals one if the firm is a state-owned enterprise and 0 otherwise. See Table 2 for the definitions of the explanatory variables. Standard errors, reported in parentheses, are clustered at the firm level. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

| Panel A: Power | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | $logCAPX_{i,t}$ | $logRDSpend_{i,t}$ | $logEMP_{i,t}$ | $logWAGES_{i,t}$ | $logOUTPUT_{i,t}$ | $logEBITDA_{i,t}$ | $TFP_{i,t}$ | $ROA_{i,t}$ |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| $ETS_{i,t}$ | 0.288*** | 0.860* | 0.119* | 0.056 | -0.005 | -0.028 | -0.022 | -0.004 |
| | (3.42) | (1.68) | (1.79) | (1.04) | (-0.08) | (-0.60) | (-0.40) | (-0.72) |
| Controls | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Firm FE | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Year FE | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Observations | 794 | 224 | 794 | 794 | 794 | 783 | 794 | 767 |
| Adjusted $R^2$ | 0.894 | 0.837 | 0.940 | 0.970 | 0.976 | 0.950 | 0.965 | 0.526 |
| Panel B: Manufacturing | | | | | | | | |
| | $logCAPX_{i,t}$ | $logRDSpend_{i,t}$ | $logEMP_{i,t}$ | $logWAGES_{i,t}$ | $logOUTPUT_{i,t}$ | $logEBITDA_{i,t}$ | $TFP_{i,t}$ | $ROA_{i,t}$ |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| $ETS_{i,t}$ | 0.028 | 0.091* | 0.006 | 0.013 | 0.036 | 0.024 | 0.033* | 0.004** |
| | (0.84) | (1.75) | (0.44) | (0.62) | (1.62) | (1.50) | (1.65) | (2.12) |
| Controls | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Firm FE | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Year FE | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Observations | 16315 | 7336 | 16319 | 16322 | 16323 | 15129 | 16322 | 15361 |
| Adjusted $R^2$ | 0.820 | 0.950 | 0.971 | 0.966 | 0.972 | 0.945 | 0.962 | 0.587 |
| Panel C: Transportation | | | | | | | | |
| | $logCAPX_{i,t}$ | $logRDSpend_{i,t}$ | $logEMP_{i,t}$ | $logWAGES_{i,t}$ | $logOUTPUT_{i,t}$ | $logEBITDA_{i,t}$ | $TFP_{i,t}$ | $ROA_{i,t}$ |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| $ETS_{i,t}$ | 0.112 | -1.690** | 0.117 | -0.222** | -0.187 | -0.004 | -0.119 | 0.009 |
| | (0.81) | (-2.15) | (1.40) | (-2.42) | (-1.34) | (-0.06) | (-0.98) | (0.78) |
| Controls | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Firm FE | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Year FE | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Observations | 840 | 204 | 844 | 845 | 845 | 821 | 845 | 812 |
| Adjusted $R^2$ | 0.868 | 0.831 | 0.974 | 0.981 | 0.964 | 0.980 | 0.944 | 0.627 |
| Panel D: Real Estate | | | | | | | | |
| | $logCAPX_{i,t}$ | $logRDSpend_{i,t}$ | $logEMP_{i,t}$ | $logWAGES_{i,t}$ | $logOUTPUT_{i,t}$ | $logEBITDA_{i,t}$ | $TFP_{i,t}$ | $ROA_{i,t}$ |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| $ETS_{i,t}$ | -0.004 | 0.752 | 0.055 | 0.100 | 0.183** | -0.015 | 0.152*** | 0.002 |
| | (-0.02) | (1.45) | (0.90) | (1.02) | (2.61) | (-0.16) | (2.70) | (0.44) |
| Controls | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Firm FE | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Year FE | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Observations | 802 | 86 | 804 | 804 | 804 | 728 | 804 | 760 |
| Adjusted $R^2$ | 0.826 | 0.804 | 0.963 | 0.963 | 0.949 | 0.906 | 0.923 | 0.528 |
| Panel E: Others | | | | | | | | |
| | $logCAPX_{i,t}$ | $logRDSpend_{i,t}$ | $logEMP_{i,t}$ | $logWAGES_{i,t}$ | $logOUTPUT_{i,t}$ | $logEBITDA_{i,t}$ | $TFP_{i,t}$ | $ROA_{i,t}$ |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| $ETS_{i,t}$ | 0.179** | 0.257 | 0.053 | -0.042 | -0.091** | -0.011 | -0.078* | 0.005 |
| | (2.00) | (1.51) | (1.26) | (-0.65) | (-2.02) | (-0.25) | (-1.68) | (1.25) |
| Controls | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Firm FE | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Year FE | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Observations | 5808 | 2263 | 5809 | 5811 | 5811 | 5178 | 5810 | 5424 |
| Adjusted $R^2$ | 0.841 | 0.934 | 0.970 | 0.960 | 0.965 | 0.945 | 0.954 | 0.499 |

Table 11: Region

This table presents the regression results about the Political Influence using SOE as proxies for political influence. SOE equals one if the firm is a state-owned enterprise and 0 otherwise. See Table 2 for the definitions of the explanatory variables. Standard errors, reported in parentheses, are clustered at the firm level. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

| Panel A: Nation | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | $logCAPX_{i,t}$ | $logRDSpend_{i,t}$ | $logEMP_{i,t}$ | $logWAGES_{i,t}$ | $logOUTPUT_{i,t}$ | $logEBITDA_{i,t}$ | $TFP_{i,t}$ | $ROA_{i,t}$ |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| $ETS_{i,t}$ | -0.042 | 0.219** | -0.035** | -0.054* | 0.024 | -0.030 | 0.040 | 0.020*** |
| | (-0.70) | (2.52) | (-2.29) | (-1.68) | (0.81) | (-1.01) | (1.49) | (3.68) |
| Controls | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Firm FE | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Year FE | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Observations | 20969 | 8919 | 20981 | 20986 | 20987 | 19261 | 20985 | 19691 |
| Adjusted $R^2$ | 0.807 | 0.932 | 0.964 | 0.953 | 0.959 | 0.934 | 0.947 | 0.552 |
| Panel B: Local | | | | | | | | |
| | $logCAPX_{i,t}$ | $logRDSpend_{i,t}$ | $logEMP_{i,t}$ | $logWAGES_{i,t}$ | $logOUTPUT_{i,t}$ | $logEBITDA_{i,t}$ | $TFP_{i,t}$ | $ROA_{i,t}$ |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| $ETS_{i,t}$ | 0.123*** | 0.279 | 0.040*** | 0.019 | 0.024 | 0.022 | 0.018 | 0.003* |
| | (3.54) | (0.90) | (2.72) | (0.84) | (1.07) | (1.33) | (0.90) | (1.75) |
| Controls | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Firm FE | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Year FE | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Observations | 23111 | 9453 | 23122 | 23128 | 23129 | 21256 | 23127 | 21745 |
| Adjusted $R^2$ | 0.831 | 0.942 | 0.967 | 0.960 | 0.966 | 0.945 | 0.954 | 0.552 |
| Panel C: East | | | | | | | | |
| | $logCAPX_{i,t}$ | $logRDSpend_{i,t}$ | $logEMP_{i,t}$ | $logWAGES_{i,t}$ | $logOUTPUT_{i,t}$ | $logEBITDA_{i,t}$ | $TFP_{i,t}$ | $ROA_{i,t}$ |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| $ETS_{i,t}$ | 0.180*** | 0.386 | 0.045** | -0.021 | -0.016 | 0.001 | -0.009 | 0.001 |
| | (3.62) | (0.95) | (1.99) | (-0.60) | (-0.49) | (0.03) | (-0.32) | (0.21) |
| Controls | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Firm FE | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Year FE | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Observations | 21420 | 8966 | 21431 | 21437 | 21438 | 19665 | 21436 | 20123 |
| Adjusted $R^2$ | 0.818 | 0.939 | 0.965 | 0.957 | 0.963 | 0.940 | 0.951 | 0.551 |
| Panel D: South | | | | | | | | |
| | $logCAPX_{i,t}$ | $logRDSpend_{i,t}$ | $logEMP_{i,t}$ | $logWAGES_{i,t}$ | $logOUTPUT_{i,t}$ | $logEBITDA_{i,t}$ | $TFP_{i,t}$ | $ROA_{i,t}$ |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| $ETS_{i,t}$ | 0.075 | 0.090*** | 0.054* | 0.074* | 0.097** | 0.054** | 0.075** | 0.005 |
| | (1.15) | (2.60) | (1.78) | (1.69) | (2.30) | (2.36) | (1.96) | (1.60) |
| Controls | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Firm FE | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Year FE | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Observations | 20656 | 8800 | 20668 | 20673 | 20674 | 18917 | 20672 | 19396 |
| Adjusted $R^2$ | 0.800 | 0.939 | 0.963 | 0.953 | 0.959 | 0.932 | 0.946 | 0.546 |
| Panel E: Midwest | | | | | | | | |
| | $logCAPX_{i,t}$ | $logRDSpend_{i,t}$ | $logEMP_{i,t}$ | $logWAGES_{i,t}$ | $logOUTPUT_{i,t}$ | $logEBITDA_{i,t}$ | $TFP_{i,t}$ | $ROA_{i,t}$ |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| $ETS_{i,t}$ | 0.081 | -0.219 | -0.008 | 0.026 | 0.014 | -0.003 | 0.006 | 0.009** |
| | (0.85) | (-1.37) | (-0.37) | (0.55) | (0.27) | (-0.08) | (0.14) | (2.15) |
| Controls | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Firm FE | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Year FE | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Observations | 20304 | 8678 | 20316 | 20321 | 20322 | 18598 | 20320 | 19048 |
| Adjusted $R^2$ | 0.800 | 0.939 | 0.964 | 0.953 | 0.959 | 0.932 | 0.947 | 0.548 |

Thanks!