

BREAKING THE TAX CHAIN: CHINA'S VALUE-ADDED TAX REFORM AND THE RISE OF CAPITAL DEEPENING

Yawen Xue¹, Zhaoyuan Chen^{1*}, Shujing Zhang¹, Fengjin Chen¹, Jiachang Liu¹

¹School of Public Finance and Taxation, Southwestern University of Finance and Economics, China;

Corresponding author: Zhaoyuan Chen
qqaa2024@126.com²

Abstract: Reducing cascading taxation is a global priority for improving tax efficiency and supporting sustainable growth. China's nationwide transition from business tax (BT) to value-added tax (VAT), initiated in 2012 and implemented gradually across sectors and regions, represents a landmark reform of its indirect tax system. This study examines the impact of the BT-to-VAT reform on firms' capital deepening using panel data on A-share listed companies from 2007 to 2021. Using a staggered difference-in-differences (DID) approach, we identify the causal effects of the reform on firms' investment behavior. The results show that the shift from BT to VAT significantly increases capital intensity, with stronger effects among state-owned enterprises, large firms, and highly competitive industries. Mechanism analysis indicates that the reform reduces effective tax burdens and strengthens incentives for fixed-asset investment, thereby promoting capital accumulation and long-term capital deepening.

Keywords: Business tax to value-added tax reform; Capital deepening; Tax burden

1. Introduction

Reducing cascading and duplicate taxation has emerged as a critical policy objective worldwide to enhance tax efficiency and promote sustainable economic growth (Hoseini & Briand, 2020; Khoja & Khan, 2020). In response, many countries have undertaken reforms to modernize their indirect tax systems by replacing turnover-based taxes with value-added taxes (VAT). For instance, Japan introduced a consumption-type VAT, known as the "consumption tax" in April 1989, replacing narrowly based commodity taxes. The Japanese VAT featured a simple structure with a uniform 3% tax rate and limited exemptions (Onji, 2009). Similarly, India implemented the Goods and Services Tax (GST) in 2017, marking the largest indirect tax reform in the country's history. GST is a destination-based, single tax system that consolidated multiple indirect taxes—including Central Excise, Service Tax, VAT, Entry Tax, and Octroi—into one unified framework (Asokan & Jayakodi, 2018). Such reforms are designed to minimize tax distortions along production chains, enhance tax neutrality, and thereby stimulate investment (Guo & Li, 2023; Hoseini & Briand, 2020).

Building on the global trend toward VAT-based tax reforms, China, as the world's largest developing country, has undertaken a significant tax restructuring known as the business tax to value-added tax (BT-to-VAT) reform. Historically, the coexistence of business tax (BT) and VAT created a structural inefficiency in China's indirect tax system (Wang, Singh-Ladhar, & Davey, 2019): BT was levied on the gross turnover of service industries, while VAT applied to value added in the industrial sector. For example, in the case of fixed asset investment, although VAT has already been paid when fixed assets are sold to BT taxpayers, these BT taxpayers still have to pay BT on the final goods or services produced using those fixed assets and other intermediate inputs, resulting in double taxation (Yu & Qi, 2022). As a result, many enterprises resorted to in-house provision of intermediate goods and services prior to the reform to avoid the burden of double taxation (Tang, Wang, & Shu, 2024). Following the reform, however, the extended deduction chain effectively mitigated duplicate taxation and reduced firms' tax burdens (Qi, Xiong, & Bilan, 2025; Tang et al., 2024).

The pilot VAT reform program was launched in Shanghai on January 1, 2012 (Administration, 2011), initially targeting the transportation sector and six modern service industries: Research and technical services, information technology services, cultural and creative services, logistics support services, tangible goods leasing services, and verification and consulting services (Yu & Qi, 2022). The reform was subsequently expanded both geographically and across industries, extending to eight additional provinces in mid-2012 and achieving nationwide rollout by 2013 (Yu & Qi, 2022). In later phases, further industries were incorporated into the VAT system, including railway transportation, postal services, telecommunications, construction, real estate, finance, and lifestyle services. This culminated in a comprehensive implementation of VAT across all sectors and regions previously subject to business tax by May 2016 (Yu & Qi, 2022). Table 1 provides a detailed overview of the VAT reform pilot program, including its timeline and the specific sectors involved.

Table 1: Timeline of VAT reform pilot implementation.

Pilot regions	Pilot period	Pilot industries
Shanghai	2012-01-01	1+6 sectors
Beijing	2012-09-01	1+6 sectors
Jiangsu, Anhui	2012-10-01	1+6 sectors
Fujian, Guangdong	2012-11-01	1+6 sectors
Tianjin, Zhejiang, Hubei	2012-12-01	1+6 sectors
Nationwide	2013-08-01	1+6 sectors
Nationwide	2014-01-01	Railway transportation, Postal services
Nationwide	2014-06-01	Telecommunications
Nationwide	2016-05-01	Other industries previously subject to BT

Note: The "1+6 sectors" framework refers to the transportation sector along with six modern service sectors: research and technical services, information technology services, cultural and creative services, logistics support services, tangible goods leasing services, and verification and consulting services. Other industries that were previously subject to the business tax regime include the construction, real estate, financial, and lifestyle service sectors.

Since the BT-to-VAT reform substantially reduced cascading and duplicate taxation, its economic impact extends well beyond improvements in tax administration. One particularly important outcome is its potential impact on capital deepening. By allowing firms to deduct input taxes on capital goods, the VAT system reduces the effective cost of investment, thereby incentivizing greater accumulation of fixed assets. This process is especially relevant in sectors previously subject to business tax, where firms were unable to claim such deductions and thus faced a higher marginal tax burden on investment. This paper investigates whether and how the BT-to-VAT reform contributed to capital deepening at the firm level. We use empirical analysis leverages detailed panel data of A-share listed companies from 2007 to 2021 and employs a staggered difference-in-differences strategy, exploiting the temporal and sectoral variation in the reform's implementation. Our results show that the BT-to-VAT reform significantly increased capital intensity among treated firms. These effects are more pronounced among state-owned enterprises, large firms, and firms operating in highly competitive industries. Mechanism analysis indicates that the reform reduced firms' effective tax burdens and stimulated fixed asset investment, which collectively enhanced capital accumulation. These findings highlight the importance of reducing cascading taxation in shaping microeconomic behavior and align with global trends toward more efficient and neutral tax systems.

2. Literature overview

Our paper contributes to several strands of literature. First, it deepens our understanding of the relationship between taxation and capital. A substantial body of research has explored how taxes influence corporate capital decisions, including capital structure, capital investment (Hosono, Hotei, & Miyakawa, 2023; Jacob, Wentland, & Wentland, 2022), and the quality composition of capital (Goolsbee, 2004). Many of these studies exploit tax reforms or policy shocks as quasi-natural experiments to identify causal effects. For example, Givoly et al. (1992) investigate firms' leverage adjustments following the 1986 U.S. Tax Reform, while An (2012) studies how the integration of China's corporate income tax affected foreign-invested enterprises' capital structures. Our paper contributes to the literature by offering a causal interpretation of corporate capital deepening from the perspective of reducing cascading taxation—an angle that has been largely overlooked in prior empirical work.

Another growing body of literature has examined the economic impacts of China's VAT reform. Fan, Li, and Zhu (2019) provide a comprehensive analysis of tax burden indicators across macro, industry, and firm levels, finding an overall decline in tax burdens post-reform. Yu and Qi (2022) show that the reform significantly enhanced firm productivity, especially among private, large, and capital-intensive firms. Lan, Wang, and Cao (2020) and Qi et al. (2025) highlight the reform's role in boosting R&D investment and innovation by easing financial constraints and enabling greater tax shifting. Tang et al. (2024) find that VAT-related tax reductions curbed the financialization of real enterprises, while Xing, Bilicka, Hou, and Raei (2024) reveal positive spillovers to firm performance and supply chain dynamics by eliminating turnover tax distortions. Collectively, these studies illustrate the multifaceted effects of the VAT reform on firm behavior, yet the impact on corporate capital decisions remains underexplored. Our paper contributes to the literature by focusing specifically on firms' capital behavior in response to the VAT reform.

The remainder of this study is structured as follows. Section 3 describes the data, outlines the empirical strategy, and details the staggered difference-in-differences framework used for the reduced-form analysis. Section 4 presents the baseline regression results and discusses the main findings. Section 5 explores the underlying mechanisms and examines heterogeneity across firm ownership, size, and industry competition. Finally, Section 6 concludes the study and offers relevant policy implications.

3. Research

3.1 Data

The firm-level data used in this study are obtained from the CSMAR (China Stock Market & Accounting Research) database (CSMAR, 2007-2021), which contains comprehensive financial and accounting information on Chinese listed companies. The sample covers the period from 2007 to 2021. To ensure data quality and consistency, several screening criteria are applied. First, B-share firms are excluded due to their distinct trading mechanisms and investor base. Second, only firms classified as normally listed are retained, excluding those marked as ST, *ST, or delisted. Third, firms are categorized into industries based on the 2012 CSRC (China Securities Regulatory Commission) industry classification guidelines to maintain consistency in industry assignment (CSRC, 2012). Companies classified under the "comprehensive" industry category are excluded to avoid ambiguity in industry identification. Since the industry classifications under the BT-to-VAT reform and the CSRC system do not perfectly align, the detailed industry matching process is as follows:

- (1) **Transportation industry sectors:** railway transportation (G53); road transportation (G54); water transportation (G55); air transportation (G56); pipeline transportation (G57); and loading, unloading, and freight forwarding services (G58).
 - (2) **Research and technical services:** research and experimental development (M73); professional and technical services (M74); and science and technology promotion and application services (M75).
 - (3) **Information technology services:** internet and related services (I64); software and information technology services (I65).
 - (4) **Cultural and creative services:** news and publishing (R85); broadcasting, television, film and audio-visual production (R86); cultural and artistic services (R87).
 - (5) **Logistics support services:** warehousing (G59).
 - (6) **Tangible goods leasing services:** leasing (L71).
 - (7) **Verification and consulting services:** professional, scientific and technical services (M74); business services (L72).
 - (8) **Railway transportation:** railway transport (G53).
 - (9) **Postal services:** postal services (G60).
 - (10) **Telecommunications services:** telecommunications services (I63).
 - (11) **Construction sectors:** housing construction (E47); civil engineering construction (E48); building installation (E49); building decoration and other construction activities (E50).
 - (12) **Real estate sectors:** real estate sectors (K70)
 - (13) **Financial sectors:** monetary financial services (J66); capital market services (J67); insurance industry (J68); other financial services (J69).
 - (14) **Lifestyle service sectors:** accommodation industry (H61); catering industry (H62); water conservancy management industry (N76); ecological protection and environmental management industry (N77); public facilities management industry (N78); residential services industry (O79); repair of motor vehicles, electronic products, and daily-use products (O80); other services industry (O81); sports industry (R88); entertainment industry (R89).
- Additionally, firms whose primary industry classification changed during the sample period are excluded to ensure the stability of industry-specific analyses. Ultimately, we obtained 25,299 observations for the regression analysis.

3.2 Estimation framework

To evaluate the causal effect of the VAT reform on capital deepening, we employ a staggered difference-in-differences framework, following the approach of Yu and Qi (2022). This approach enables us to compare the evolution of capital deepening between treated and control groups before and after the policy implementation, while accounting for the staggered timing of the reform across provinces and industries. To address potential biases arising from unobserved firm-specific heterogeneity and common time shocks, we incorporate firm-fixed effects and year-fixed effects into the model. The baseline specification is as follows:

$$CD_{it} = \alpha + \beta Policy_{pjt} + \gamma X_{it} + \mu_i + v_t + \varepsilon_{it} \quad (1)$$

where CD denotes the degree of capital deepening for firm i in year t , measured as the ratio of total assets to operating revenue. The key explanatory variable $Policy$ is a binary indicator that equals 1 if the VAT reform has been implemented in province p and industry j by year t , and 0 otherwise. Specifically, if the reform pilot was initiated in the first half of year t , the value is set to 1 in year t ; if it began in the second half of year t , the value is set to 1 starting from year $t+1$. In the robustness checks, we further test the sensitivity of results by uniformly assigning the policy treatment to either the implementation year or the following year.

The vector X includes a set of firm-level control variables that may affect capital deepening, including asset turnover ratio, fixed asset ratio, Tobin's Q , shareholding ratio of the largest

shareholder, earnings per share and debt per share. Firm fixed effects μ_i control for time-invariant heterogeneity across firms, while year fixed effects v_t absorb common temporal shocks.

Considering that the policy shock occurs at the provincial level, we cluster standard errors at the province level to account for potential correlations of the error terms among firms within the same province. This clustering strategy helps capture unobserved province-level shocks or spillover effects that might affect all firms within a region. Clustering at the provincial level is generally considered more conservative than clustering at the firm level, as the number of clusters is relatively smaller, which tends to produce larger standard errors and more cautious hypothesis testing. To ensure the robustness of our results, we also cluster standard errors at the firm level and obtain qualitatively similar estimates.

An essential prerequisite for the validity of the staggered difference-in-differences design is the parallel trends assumption, which requires that the treated and control groups exhibit similar trends in the outcome variable prior to the policy intervention. Given that the BT-to-VAT reform was implemented at different years across pilot industries and provinces, it is inappropriate to use a single time dummy as the cutoff point for all observations. Instead, we construct a series of event-time dummies that capture the relative time distance to the policy implementation for each treated unit. To formally test the parallel trends assumption, we estimate the following event-study specification:

$$CD_{it} = \alpha + \sum_{k \neq -1} \beta_k D_{pjt}^k + \gamma X_{it} + \mu_i + v_t + \varepsilon_{it} \quad (2)$$

where D denotes a dummy variable that equals 1 if firm i , located in province p and operating in industry j , is k years away from the VAT reform implementation in year t , and 0 otherwise. The event time $k=-1$ (i.e., the year immediately before the implementation) is omitted and serves as the reference period. The coefficients β reflect the dynamic treatment effects k years before and after the policy shock, allowing for a test of the parallel trends assumption and an exploration of policy lag effects. All other variables are defined as in Equation (1).

We present the definitions of the variables used in the regressions, along with their descriptive statistics, in Table 2. The key dependent variable of interest is capital intensity (CD), measured as the ratio of total assets to operating revenue. The main control variables include fixed asset ratio (Far), Tobin's Q (Tq), shareholding ratio of the largest shareholder (Srl), earnings per share (Eps) and debt per share (Dps).

Table 2: List of variables and descriptive statistics

Variabl es	Description	N	Mean	St.dev.	Max	Min
<i>CD</i>	Capital deepening	25299	3.29	32.56	5069.13	0.11
<i>Far</i>	Fixed asset ratio	25299	0.22	0.16	0.95	0.00
<i>Tq</i>	Tobin's Q	25299	2.08	2.06	126.95	0.64
<i>Srl</i>	Shareholding ratio of the largest shareholder	25299	34.88	15.11	89.99	2.79
<i>Eps</i>	Earnings Per Share	25299	0.52	1.05	41.76	-16.46
<i>Dps</i>	Debt per share	25299	13.43	619.79	71719.0	0.02

0

4. Results

4.1 Baseline estimate

Table 3 presents the estimated effects of the BT-to-VAT reform on firms' capital deepening. Columns (1) and (3) report results without control variables, while Columns (2) and (4)

include a set of firm-level controls as described in Table 2. Standard errors are clustered at the firm level in Columns (1) and (2), and at the province level in Columns (3) and (4). In all four columns, the coefficient on the reform indicator is positive and statistically significant at the 1% level. Specifically, the coefficient is 1.609 in Column (1) and increases slightly to 1.643 in Column (2) with controls, both clustered at the firm level. When clustering at the province level, the coefficient is similar, showing robust and highly significant estimates across specifications. These results indicate that the BT-to-VAT reform has effectively promoted capital deepening in firms, suggesting that the tax policy change encourages firms to increase their capital intensity relative to operating revenue.

Table 3. Baseline regression results on the impact of BT-to-VAT reform on capital deepening.

Variables	(1) CD	(2) CD	(3) CD	(4) CD
<i>Policy</i>	1.609*** (0.34)	1.643*** (0.34)	1.609*** (0.34)	1.643*** (0.33)
<i>Far</i>		-7.690* (4.25)		-7.690* (4.42)
<i>Tq</i>		-0.121 (0.09)		-0.121 (0.10)
<i>Srl</i>		-0.013 (0.01)		-0.013* (0.01)
<i>Eps</i>		-0.277* (0.15)		-0.277* (0.16)
<i>Dps</i>		0.001 (0.00)		0.001 (0.00)
<i>Clustered standard errors</i>	Firm	Firm	Province	Province
<i>Firm FEs</i>	Yes	Yes	Yes	Yes
<i>Year Fes</i>	Yes	Yes	Yes	Yes
<i>Observations</i>	25299	25299	25299	25299
<i>R²</i>	0.515	0.515	0.515	0.515

Note: *, ** and *** denote 0.1, 0.05 and 0.01 significance levels, respectively. Standard errors in parenthesis.

4.2 Event study

We further investigate the dynamic effects of the VAT reform on capital deepening by estimating an event study specification, with results presented in Figure 1. The analysis includes a balanced event window from five years before to five years after the policy implementation. The year immediately preceding the reform ($k=-1$) is omitted and serves as the reference period, denoted by the vertical dashed line in the figure.

The estimated coefficients for the pre-reform periods are statistically insignificant and relatively small in magnitude, supporting the parallel trends assumption and suggesting no systematic differences in capital deepening trajectories between the treatment and control groups prior to the policy shock. Following the implementation of the VAT reform, we observe a pronounced and statistically significant increase in capital deepening, particularly during the first three years after the policy takes effect. This suggests that the reform played a meaningful role in enhancing capital intensity at the firm level over time.

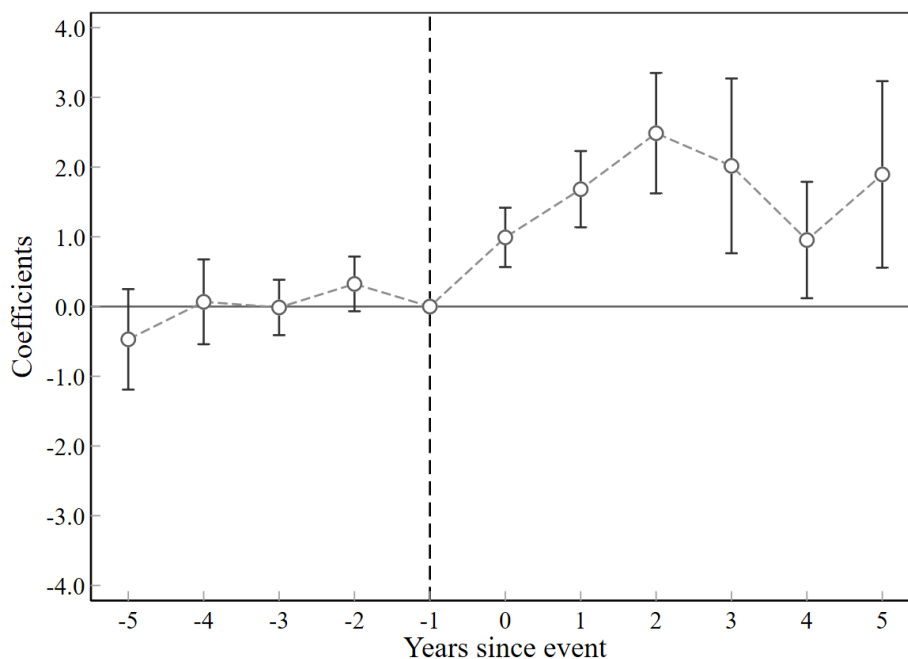


Figure 1. Event study of the BT-to-VAT reform on capital deepening

4.3 Addressing selection bias: PSM-DID

Although the DID approach effectively isolates the average treatment effect of the pilot reform, the transformation from BT to VAT does not constitute a strictly exogenous natural experiment. As a result, the empirical analysis may still suffer from selection bias in the observational data, potentially undermining the internal validity of the estimated treatment effects. To mitigate this concern, we incorporate a propensity score matching difference-in-differences (PSM-DID) framework, which selects a more comparable control group for the treated firms based on observable pre-treatment characteristics, thereby improving the balance between groups and enhancing the credibility of causal inference.

We employ a period-by-period matching approach, wherein firms are matched annually based on their propensity scores. After matching within each year, the matched samples are vertically merged across all years to construct a balanced panel dataset suitable for subsequent regression analysis. Specifically, the propensity scores are estimated using a logistic regression model, and matching is performed with the nearest two neighbors, applying a caliper of 0.05 to ensure that matched firms have sufficiently close propensity scores. The common support condition is imposed to guarantee adequate overlap between treated and control groups. The propensity score model includes key firm-level covariates such as fixed asset ratio, Tobin's Q, shareholding ratio of the largest shareholder, earnings per share, and debt per share. This approach allows for controlling observable confounding factors year by year and producing a reliable panel for difference-in-differences estimation.

Figure 2 illustrates the standardized mean differences of the matching covariates before and after propensity score matching, providing a visual summary of covariate imbalance through a dot chart. In the figure, solid black dots represent the standardized bias prior to matching, while "x" markers denote the bias after matching. It is evident that the standardized mean differences for all covariates are substantially reduced after matching. Specifically, with the exception of the fixed asset ratio, all covariates exhibit standardized biases below the commonly accepted threshold of 10% post-matching. These results indicate that the matching procedure significantly improves covariate balance between the treatment and control groups, thereby enhancing the reliability of the subsequent PSM-DID estimation.

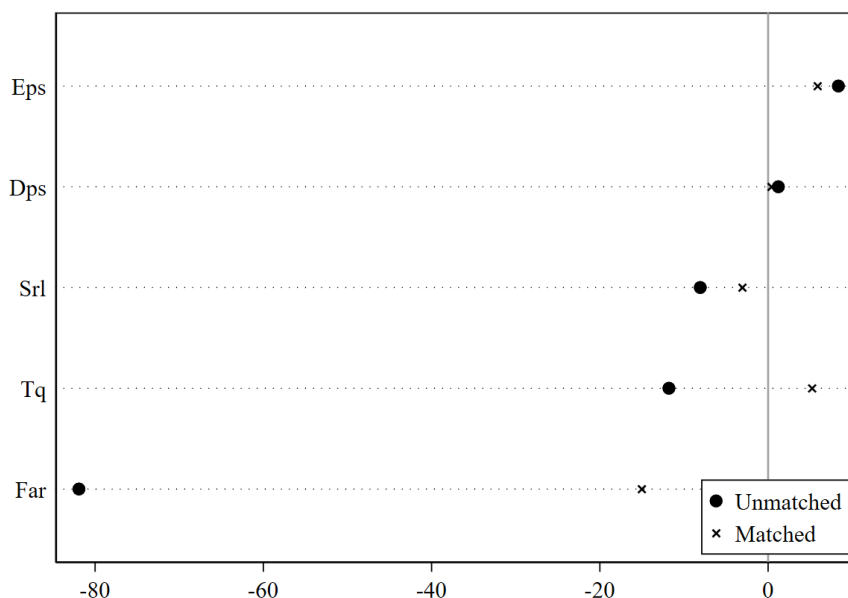


Figure 2. Standardized bias of covariates before and after matching

Column (1) of Table 4 reports the regression results based on the PSM-DID approach. The coefficient on the policy variable (Policy) remains significantly positive, consistent with the baseline estimation results. This suggests that the positive effect of the BT-to-VAT reform on capital deepening is robust to concerns about sample selection bias.

Table 4. Addressing selection bias and robustness checks.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	PSM-DID	Current-Year Policy	Next-Year Policy	Excluding Crisis Period	Province-by-Year FE	Capital-Labor Ratio	Dropping Post-2007 Entrants
<i>Policy</i>	1.223** * (0.38)	1.767** * (0.35)	1.596** * (0.30)	1.628** * (0.32)	1.756** * (0.36)	0.057** (0.02)	0.778** (0.33)
<i>Far</i>	-7.786* (4.46)	-7.706* (4.42)	-7.692* (4.42)	-8.080* (4.69)	-7.859* (4.53)	-0.009 (0.01)	-6.411 (4.60)
<i>Tq</i>	-0.122 (0.10)	-0.120 (0.10)	-0.122 (0.10)	-0.119 (0.10)	-0.117 (0.10)	-0.000 (0.00)	- 0.035** (0.01)
<i>Srl</i>	-0.013* (0.01)	-0.013* (0.01)	-0.012* (0.01)	-0.013* (0.01)	-0.013* (0.01)	0.000 (0.00)	-0.016* (0.01)
<i>Eps</i>	-0.302* (0.17)	-0.279* (0.16)	-0.277 (0.16)	-0.286 (0.17)	-0.249 (0.17)	0.004** * (0.00)	- 0.214** (0.09)
<i>Dps</i>	0.000* (0.00)	0.001 (0.00)	0.001 (0.00)	0.001 (0.00)	0.001 (0.00)	0.000 (0.00)	0.032** (0.01)
<i>Firm FEs</i>	Yes	Yes	Yes	Yes	Yes	Yes	Yes
<i>Year Fes</i>	Yes	Yes	Yes	Yes	Yes	Yes	Yes
<i>Observations</i>	24858	25299	25299	24543	25299	25299	9286
<i>R²</i>	0.509	0.515	0.515	0.515	0.517	0.957	0.641

Note: *, ** and *** denote 0.1, 0.05 and 0.01 significance levels, respectively. Standard errors in parenthesis.

4.4 Robustness check

To verify the robustness of our baseline results, we conduct several robustness checks presented in Table 4. The findings remain consistent across all specifications. Considering that the BT-to-VAT pilot reform was implemented mid-year, our baseline approach codes firms affected in the first half of the year as treated within the current year, while firms affected in the second half are coded as treated starting from the following year. To further examine the robustness of this coding scheme, Column (2) re-estimates the model by assigning all treated firms as beginning treatment in the current year, whereas Column (3) assumes treatment begins in the following year for all firms. Since the treatment exposure in Column (3) is effectively shorter than in Column (2), the estimated coefficient in Column (3) (1.596) is correspondingly smaller than that in Column (2) (1.767).

Additionally, Column (4) excludes observations from 2008 to mitigate potential distortions caused by the global financial crisis. The 2008 financial crisis was an exogenous shock that significantly disrupted economic activities and firm behaviors (Bernanke, 2018), potentially confounding the estimated effects of the VAT reform on capital deepening. By removing data from this period, we aim to isolate the policy's impact from these extraordinary macroeconomic fluctuations, ensuring that our results are not driven by external economic turbulence but rather reflect the true effect of the tax reform.

Column (5) introduces province-by-year fixed effects to further control for time-varying regional factors that may simultaneously influence both the implementation of the VAT and firms' capital deepening behavior. Including these fixed effects helps account for unobserved heterogeneity across provinces and years, such as regional economic policies or shocks, thereby enhancing the credibility of the estimated policy effects. In Column (6), we replace the dependent variable with the capital-labor ratio (measured as total assets per employee) to verify the robustness of our results using an alternative measure of capital intensity. This substitution tests whether the estimated effect of the VAT reform on capital deepening holds consistently across different operationalizations of the outcome variable. Column (7) excludes firms listed after 2007 to address concerns that newly listed companies may exhibit different investment behaviors or respond differently to tax policy changes compared to more established firms. By limiting the sample to firms with longer listing histories, we reduce potential bias from heterogeneous treatment effects associated with firm age or entry timing, thereby providing a more stable estimate of the reform's impact.

5 Mechanism test and heterogeneity analysis

To further investigate the underlying channels through which the VAT reform fosters capital deepening, we conduct a mechanism analysis along two dimensions: capital investment and tax burden. We first examine whether the reform incentivizes firms to increase capital investment. Specifically, we employ two proxy variables to capture capital investment intensity: the natural logarithm of cash paid for the acquisition and construction of fixed assets and other long-term assets (Capcash), and the natural logarithm of capital expenditures (Capex). As shown in Columns (1) and (2) of Table 5, the estimated coefficients are significantly positive across both specifications. These results suggest that the reform effectively promotes capital investment, which in turn supports capital deepening within firms. Second, we test whether the VAT reform reduces firms' tax burdens, thereby facilitating capital accumulation. We measure tax burden using two indicators: the indirect tax rate (Indtax) and the effective total tax rate (Efftax). Columns (3) and (4) of Table 5 show that both variables yield significantly negative coefficients on the Policy term. These findings

indicate that the reform leads to a meaningful reduction in tax burdens, which could relax firms' financial constraints and enhance their capacity for capital investment.

Table 5. Mechanism test.

Variables	Capital Investment Mechanism		Tax Burden Mechanism	
	(1) Capcash	(2) Capex	(3) Indtax	(4) Efftax
<i>Policy</i>	0.293*** (0.09)	0.293*** (0.09)	-0.026*** (0.00)	-0.037*** (0.00)
<i>Far</i>	-0.601** (0.25)	-0.601** (0.25)	-0.003 (0.01)	-0.024*** (0.01)
<i>Tq</i>	-0.024 (0.02)	-0.024 (0.02)	-0.000 (0.00)	-0.000* (0.00)
<i>Srl</i>	0.000 (0.00)	0.000 (0.00)	-0.000 (0.00)	0.000 (0.00)
<i>Eps</i>	0.098*** (0.03)	0.098*** (0.03)	0.000 (0.00)	0.007*** (0.00)
<i>Dps</i>	0.000 (0.00)	0.000 (0.00)	-0.000 (0.00)	-0.000* (0.00)
<i>Firm FEs</i>	Yes	Yes	Yes	Yes
<i>Year Fes</i>	Yes	Yes	Yes	Yes
<i>Observations</i>	25285	25285	25292	25292
<i>R²</i>	0.792	0.792	0.570	0.623

Note: *, ** and *** denote 0.1, 0.05 and 0.01 significance levels, respectively. Standard errors in parenthesis.

We further conduct a series of analyses in Table 6. First, we classify firms into state-owned enterprises (SOEs, Column 1) and non-state-owned enterprises (non-SOEs, including private and foreign-funded firms, Column 2). The results indicate that the reform significantly promotes capital deepening in SOEs, whereas no significant effect is observed in non-SOEs. This is because SOEs are concentrated in capital-intensive sectors such as energy, metallurgy, and public services (Liu, Shen, & Deng, 2022; Naughton, 2017). These industries require large-scale fixed asset investments, allowing SOEs to fully utilize input VAT deductions. In contrast, non-SOEs, which typically operate in asset-light sectors, have limited capital expenditures and therefore benefit less from the reform in terms of capital deepening.

Table 6. Heterogeneity analysis.

	By Ownership Type		By Firm Size		By Industry Competition	
	(1) SOE	(2) Non-SOE	(3) Large	(4) Small	(5) High	(6) Low
<i>Policy</i>	1.933** * (0.50)	0.174 (0.27)	2.317** * (0.59)	0.029 (0.16)	2.080** * (0.61)	0.663** * (0.18)
<i>Far</i>	-6.952 (5.02)	-8.868 (8.03)	-1.683* (0.88)	-6.542 (5.04)	-1.175** (0.48)	-6.574 (4.91)
<i>Tq</i>	- 0.128** * (0.04)	-0.117 (0.11)	-0.047 (0.04)	-0.037** (0.02)	- 0.038** * (0.01)	-0.052* (0.03)
<i>Srl</i>	-0.019* (0.01)	-0.011 (0.01)	-0.002 (0.01)	-0.018** (0.01)	0.003 (0.01)	-0.025** (0.01)

	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
<i>Eps</i>	-0.232*	-0.394	-0.481	-	-0.203**	-0.346**
	(0.12)	(0.30)	(0.35)	0.290**	(0.09)	(0.13)
				*(0.09)		
<i>Dps</i>	0.028**	0.001*	0.021**	0.054**	0.013**	0.041**
	(0.01)	(0.00)	(0.01)	(0.03)	*(0.00)	(0.02)
<i>Firm FEs</i>	Yes	Yes	Yes	Yes	Yes	Yes
<i>Year Fes</i>	Yes	Yes	Yes	Yes	Yes	Yes
<i>Observation</i>	9236	15451	13055	12244	12207	13092
<i>s</i>						
<i>R²</i>	0.743	0.505	0.879	0.997	0.882	0.996

Note: *, ** and *** denote 0.1, 0.05 and 0.01 significance levels, respectively. Standard errors in parenthesis.

Second, we further divide firms into large-scale (Column 3) and small-scale (Column 4) groups based on whether their annual operating revenue is above or below the median of all firms in the same year. The results show that the BT-to-VAT reform has a stronger effect on promoting capital deepening among large-scale firms. Larger firms typically possess stronger financial resources and higher risk tolerance, enabling them to undertake transformation and upgrading more effectively (Josefy, Kuban, Ireland, & Hitt, 2015). Beyond their resource advantages, these firms are also more responsive to policy changes and can quickly adjust their investment and operational strategies accordingly. As a result, they are better positioned to capture the benefits of the VAT reform, which facilitates digitalization and capital upgrading through improved tax incentives and reduced financial constraints.

Third, we further classify industries based on the median value of the Herfindahl-Hirschman Index to measure market competition. Column (5) reports the results for high-competition industries, while Column (6) corresponds to low-competition industries. The results indicate that the VAT reform has a more pronounced effect on capital deepening in highly competitive industries. Firms in highly competitive industries face stronger market pressure to reduce costs and improve efficiency (Lee, 2009). As a result, they are more motivated to reinvest tax savings from the VAT reform into capital upgrading and technological innovation to maintain or enhance their market position. Moreover, the reform reduces the marginal cost of capital investment through input VAT deductions, which provides a stronger incentive for firms operating under intense competition to pursue capital deepening as a strategic response to survive and grow.

6 Conclusions and policy implications

This study investigates the impact of China's BT-to-VAT reform on firms' capital deepening. We employ a staggered difference-in-differences (DID) framework, complemented by propensity score matching (PSM-DID) to address potential selection bias. Our empirical results provide robust evidence that the transition from a business tax to a value-added tax significantly promotes capital deepening across firms.

Theoretically, the VAT system reduces the distortionary effects of output-based taxation by allowing deductions for capital and intermediate input expenditures. This lowers the effective cost of capital and strengthens investment incentives. Consistent with this mechanism, our event-study analysis supports the parallel trends assumption and reveals a significant and sustained increase in capital intensity following the reform. Further mechanism analysis shows that the reform reduces firms' tax burdens and boosts fixed asset investment, thereby facilitating capital accumulation. Moreover, heterogeneity tests reveal that these effects are more pronounced among state-owned enterprises, large-scale firms, and those operating in

highly competitive industries—underscoring how firm characteristics and market environments shape the reform’s impact.

Our paper offers several policy implications. First, for countries that still experience tax redundancies—particularly developing economies—policymakers may consider adopting VAT-style reforms similar to China’s BT-to-VAT transition to promote capital deepening. Second, targeted support for small and medium-sized enterprises is essential to help them overcome financial constraints and fully benefit from the reform. Third, strengthening market competition can amplify the positive effects of reducing cascading taxation by improving resource allocation and investment incentives. Taken together, these measures can better foster capital deepening and sustain high-quality economic growth.

7 References

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