



Does the Carbon Emissions Trading Scheme Affect Corporate Cash Holding Levels? Evidence from China's A-Share Market

Menglin Li

Central University of Finance and Economics, School of Finance, Beijing, China
limenglin@cuef.edu.cn

Abstract. Leveraging China's carbon emissions trading scheme (ETS) as a quasi-natural experiment, this study employs a difference-in-differences (DID) design with data from A-share listed firms (2009–2020). Contrary to existing evidence from developed markets, we find that ETS reduces corporate cash holdings, with robustness confirmed by alternative measures and PSM-DID. Heterogeneity analyses show stronger effects for firms with higher financing constraints, higher financial risk, and lower financialization levels, highlighting liquidity vulnerability as a key factor. Our findings uncover contextual heterogeneity in environmental regulation outcomes and provide policymakers with actionable insights for designing differentiated ETS mechanisms in developing economies.

Keywords: carbon emissions trading scheme, DID, cash holding, Porter hypothesis

1 Introduction

Global climate governance has spurred a shift from government-led interventions to market-based environmental incentives. As a core mechanism, carbon emissions trading schemes (ETS) have garnered widespread attention globally. The United States implemented the Regional Greenhouse Gas Initiative (RGGI) to reduce emissions in the power sector through cap-and-trade [7]. Meanwhile, the EU ETS, as the world's largest carbon market, has driven widespread emission reductions across industries [4]. As the largest carbon emitter, China launched ETS in seven provinces in 2011, offering a quasi-natural experiment to assess microeconomic effects [15].

Amid the global promotion of ETS, its policy impacts have become a research hotspot. Existing literature predominantly examines the 'double dividend' hypothesis of environmental regulation, emphasizing synergies between environmental and economic gains. ETS is shown to reduce carbon emissions and improve emission efficiency at the environmental level [5,11], while also enhancing broader ecological and energy efficiency [13,16]. Economically, ETS influences innovation, productivity, and investment efficiency [3,17]. Emerging studies further explore social dimensions,

including the share of labor factor income [15] and corporate executive compensation [18].

However, the financial implications of ETS remain contentious. Some scholars argue that ETS enhances corporate credit access through improved green credentials [14], while others contend that ETS adversely affects financing constraints by reducing firms' stock and bond market performance, potentially crowding out productive investments [19]. Additionally, compliance costs may be passed on to consumers [2].

To clarify the financial impacts of ETS, we focus on corporate cash holdings. The primary theories of corporate cash holdings (trade-off, pecking order, and agency theories) provide critical frameworks for analysis. Specifically, the trade-off theory [10] posits that firms optimize cash by weighing benefits against costs, with higher levels in high-growth or volatile firms. The pecking order theory [9] emphasizes internal financing under information asymmetry, supported by evidence that constrained firms retain cash flows [1]. Agency theory further suggests poor governance leads to cash hoarding and value destruction [6].

Despite these theoretical foundations, research directly linking ETS to cash holdings remains scarce and contradictory. Evidence shows that increased cash holdings under ETS are observed among Chinese firms [8], whereas this effect is confined to developed markets in other studies [12], highlighting unresolved contextual heterogeneity.

To reconcile these inconsistencies, this study leverages China's pilot carbon markets (operational since 2014) as a quasi-natural experiment. Employing a DID design with annual data from non-financial A-share firms (2009–2020), we investigate how ETS uniquely shapes cash management in emerging economies.

The study offers following contributions: (1) It enriches the literature on ETS financial effects by revealing a reducing effect on corporate cash holdings, contrasting with prior findings. (2) Heterogeneity analyses centered on corporate liquidity show that ETS exerts stronger effects on firms with higher financing constraints, greater financial risks, and lower financialization levels. (3) The findings provide critical insights for regulators in developing economies to assess how environmental regulations like ETS shape corporate behavior.

The remainder proceeds as follows: Section 2 describes the empirical design and data; Section 3 presents baseline regression and robustness tests; Section 4 examines heterogeneity; Section 5 concludes.

2 Research Design

2.1 Research Framework

As shown in Fig. 1, the technical roadmap is as follows:

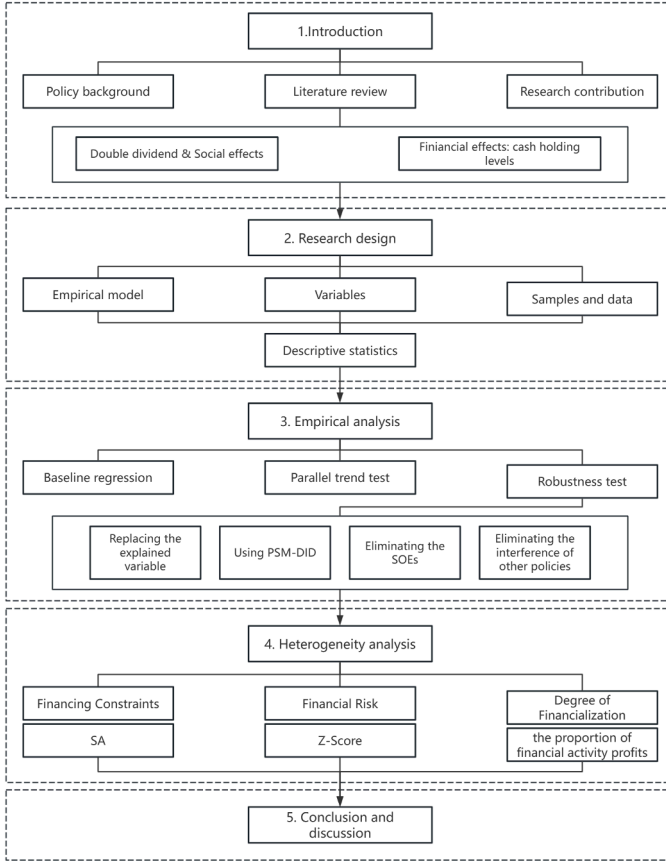


Fig. 1. Technical Roadmap Flowchart.

2.2 Empirical Model

We employ a DID model to examine the impact of the ETS on corporate cash holding levels. The regression model is specified as follows:

$$Y_{it} = \beta_0 + \beta_1 \text{treat}_i \times \text{post}_t + \text{Controls}_{it} + \text{prov}_i + \text{year}_t + \varepsilon_{it} \quad (1)$$

where i represents the provinces, t represents the years. The dependent variable is the firm's cash holding level. treat_i and post_t are dummy variables. treat_i equals 1 if the firm is in the 7 provinces and municipalities^a covered by the ETS; otherwise, it equals 0. post_t equals 1 after 2014; otherwise, it equals 0. Controls_{it} contains a set of control variables. Detailed definitions of all variables are provided in the Variables section. prov_i and year_t absorb variations from province- and time-specific factors respectively. ε_{it} is the idiosyncratic error term.

^a The pilot areas are Beijing, Shanghai, Tianjin, Chongqing, Hubei, Guangdong and Shenzhen.

2.3 Variables

Refer to existing research [10], we define variables as summarized in Table 1, ensuring comparability with prior work on cash holdings.

2.4 Samples and Data

The study utilizes data encompassing all A-share listed firms from 2009 to 2020. We applied the following screening criteria to refine the sample: (1) Excluding companies with ST, *ST, and PT; (2) Eliminating financial sector entities; (3) Removing firms with severe data deficiencies; All data are sourced from the CSMAR .

2.5 Descriptive Statistics

Table 2 provides descriptive statistics. The average value of the explained variable *cashhold01* is 0.273, indicating that cash and cash equivalents account for 27.3% of total assets excluding equivalents. The mean of *cashhold01* is greater than the median, the data distribution is right-skewed, and the standard deviation is 0.339. In addition, the average size of the sample companies is 22.177, the average asset-liability ratio is 39.2%, and the average shareholding ratio of the largest shareholder is 35.34%, all of which are similar to relevant studies.

Table 1. Main Variables and Their Definitions.

Category	Symbol	Definition
Dependent Variable	<i>cashhold01</i>	$\text{cashhold01} = \text{cash \& equivalents} / (\text{Total assets} - \text{cash \& equivalents})$
	<i>cashhold02</i>	$\text{cashhold02} = \text{cash \& equivalents} / \text{Total assets}$
Key Explanatory Variable	$\text{treat}_i \times \text{post}_t$	<i>treat</i> : 1 for firms in pilot provinces, 0 otherwise. <i>post</i> : 1 for years after the policy implementation, 0 otherwise.
	<i>lnage</i>	Firm age, = $\ln(\text{Current fiscal year} - \text{IPO year})$
Control Variables	<i>lnsize</i>	Firm size, = $\ln(\text{Total assets})$
	<i>lev</i>	Asset-liability ratio
	<i>nwc</i>	Net working capital
	<i>cashflow</i>	Cash flow per share
	<i>TQ</i>	Tobin's Q (Proxy for firm growth)
	<i>top1</i>	Shareholding ratio of the largest shareholder
	<i>dual</i>	CEO duality dummy, 1 if CEO and chairperson roles are combined, 0 otherwise

Table 2. Descriptive Statistics.

Variable	Obs	Mean	SD	Min	Median	Max
cashhold01	20147	0.273	0.339	0.015	0.158	2.039
cashhold02	20147	0.179	0.140	0.015	0.137	0.671
lnage	20147	2.774	0.378	0.000	2.833	4.190
lnsize	20147	22.177	1.332	19.350	21.940	28.540
lev	20147	0.392	0.197	0.008	0.383	1.687
nwc	20147	0.268	0.252	-1.177	0.262	0.972
cashflow	20147	0.588	1.233	-11.772	0.406	41.131
TQ	20147	2.256	2.126	0.041	1.662	33.232
top1	20147	35.340	15.078	1.837	33.605	89.991

3 Empirical Analysis

3.1 Baseline Regression

The regression results presented in Table 3 consistently demonstrate statistically significant negative coefficients for the DID interaction term across all model specifications, indicating that the emissions trading pilot policy meaningfully reduces corporate cash holdings.

Our key findings demonstrate three clear patterns. First, the DID term coefficients are negative and statistically significant: those in columns (1) and (2) are significant at the 5% level. Second, coefficients in columns (3) and (4) show stronger significance at the 1% level. Third, Adjusted R^2 values increase substantially in models with firm fixed effects. This confirms significant entity-level heterogeneity systematically influencing cash holdings and justifies our baseline specification. Furthermore, the coefficients in columns (2) and (4) remain significant with increased magnitudes after adding control variables; model fit also improves. These results consistently underscore the robustness of our findings and the superior explanatory power of the full model.

Table 3. Benchmark Regression.

	(1)	(2)	(3)	(4)
	cashhold	cashhold	cashhold	cashhold
did	-0.0553** (0.0223)	-0.0357** (0.0166)	-0.0934*** (0.0212)	-0.0604*** (0.0151)
treat	0.1189*** (0.0237)	0.0761*** (0.0170)		
time	-0.0612** (0.0190)	-0.1169*** (0.0164)		
lnage		-0.0427*** (0.0127)		-0.2666*** (0.0439)
lnsize		-0.0022 (0.0035)		0.0061 (0.0100)

	(1)	(2)	(3)	(4)
	cashhold	cashhold	cashhold	cashhold
lev		-0.0136 (0.0247)		0.3629*** (0.0415)
nwc		0.7053*** (0.0239)		1.2298*** (0.0379)
cashflow		0.0372*** (0.0031)		0.0356*** (0.0028)
TQ		0.0086*** (0.0024)		-0.0016 (0.0023)
top1		0.0003 (0.0003)		-0.0008* (0.0005)
dual		0.0017 (0.0077)		0.0130 (0.0082)
_cons	0.3030*** (0.0188)	0.2791*** (0.0771)	0.4467*** (0.0153)	0.4228* (0.2266)
N	2.0e+04	2.0e+04	2.0e+04	2.0e+04
r2_a	0.0674	0.3921	0.1607	0.4405
F	43.1359	92.4675	50.5751	89.4055

Standard errors in parentheses * $p < 0.1$, ** $p < 0.05$, *** $p < 0.001$

3.2 Parallel Trend Test

To test for parallel trends, we employ an event study approach with bidirectional time dummies over 10 years around the policy, ensuring comparable pre-trends in cash holdings between treatment and control groups. As shown in Fig.2, coefficients are insignificant pre-policy but become significant post-implementation, confirming parallel trends

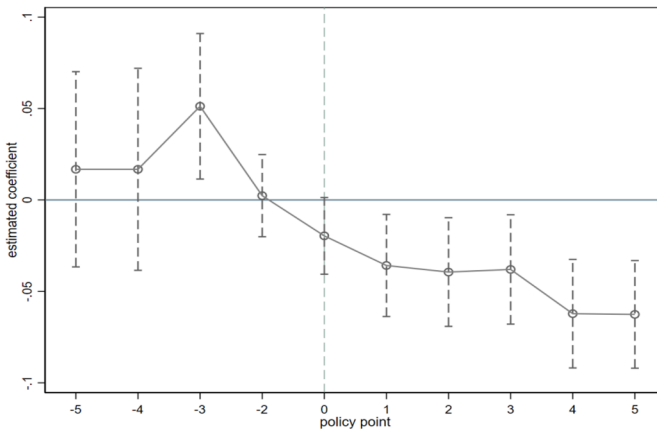


Fig. 2. Parallel Trend Test.

3.3 Robustness Test

This paper also conducts the following robustness test on the impact of the carbon emissions trading pilot policy on the cash holding level of enterprises (see Table 4).

First, refer to existing research [6,10], we substitute the dependent variable with cashhold02 (cash equivalents / total assets).

Second, based on covariates such as enterprise age, asset size, and financial leverage, the PSM-DID is used for robustness tests. The regression results show that the coefficient remains significantly negative.

Thirdly, to mitigate confounding effects, we excluded other environmental regulatory policies that may affect the cash holding level of enterprises. The regression results show that whether the pilot projects of SO₂ rights^b or water rights^c are excluded separately or both are excluded simultaneously, the results are significantly negative, verifying the robustness of the model.

Table 4. Robustness Test.

	Replacing the explained variable	Using PSM- DID	Eliminating the SOEs	Eliminating the interference of other policies		
	(1)	(2)	(3)	(4)	(5)	(6)
	cashhold02	On Support	NSOE	SO ₂ ETS	Water	Both
did	-0.0117** (0.0050)	-0.0603*** (0.0151)	-0.1015*** (0.0244)	-0.0743*** (0.0178)	-0.0652*** (0.0189)	-0.0748*** (0.0214)
lnage	-0.0774*** (0.0125)	-0.2661*** (0.0439)	-0.2467*** (0.0647)	-0.2633*** (0.0543)	-0.2331*** (0.0449)	-0.2265*** (0.0536)
lnsize	-0.0001 (0.0035)	0.0070 (0.0099)	0.0263** (0.0130)	0.0040 (0.0131)	0.0019 (0.0111)	-0.0049 (0.0147)
lev	0.1277*** (0.0160)	0.3573*** (0.0412)	0.4293*** (0.0559)	0.4023*** (0.0538)	0.3909*** (0.0472)	0.4495*** (0.0623)
nwc	0.5073*** (0.0122)	1.2309*** (0.0379)	1.2912*** (0.0472)	1.3028*** (0.0502)	1.2355*** (0.0427)	1.3056*** (0.0579)
cashflow	0.0146*** (0.0014)	0.0355*** (0.0028)	0.0424*** (0.0065)	0.0346*** (0.0033)	0.0370*** (0.0028)	0.0366*** (0.0031)
TQ	-0.0001 (0.0007)	-0.0018 (0.0023)	-0.0056** (0.0025)	-0.0004 (0.0031)	-0.0011 (0.0024)	0.0009 (0.0034)
top1	-0.0003 (0.0002)	-0.0008* (0.0005)	-0.0016** (0.0007)	-0.0013** (0.0006)	-0.0013** (0.0005)	-0.0016** (0.0007)
dual	0.0048* (0.0002)	0.0129 (0.0005)	0.0156 (0.0007)	0.0133 (0.0006)	0.0120 (0.0005)	0.0142 (0.0007)

^bIn 2007, the Chinese government approved 11 provinces including Tianjin, Hebei, Shanxi, Inner Mongolia, Jiangsu, Zhejiang, Henan, Hubei, Hunan, Chongqing and Shaanxi to carry out pilot projects of SO₂ rights.

^cIn 2014, the Chinese government deployed and carried out pilot work of water rights in seven provinces, namely Ningxia, Inner Mongolia, Guangdong, Henan, Gansu, Jiangxi and Hubei.

	Replacing the explained variable	Using PSM- DID	Eliminating the SOEs	Eliminating the interference of other policies		
	(1)	(2)	(3)	(4)	(5)	(6)
	cashhold02	On_Support	NSOE	SO ₂ ETS	Water	Both
	(0.0029)	(0.0082)	(0.0104)	(0.0107)	(0.0091)	(0.0122)
_cons	0.2204**	0.4051*	0.0117	0.4631	0.4494*	0.5725*
	(0.0795)	(0.2260)	(0.3032)	(0.2976)	(0.2459)	(0.3196)
N	20147	20145	12844	12286	16500	9482
r2_a	0.4920	0.4411	0.4976	0.4530	0.4400	0.4526
F	184.3073	89.9763	84.7634	58.9875	77.3417	50.2343

Standard errors in parentheses * p < 0.1, ** p < 0.05, *** p < 0.001

Table 5. Heterogeneity analysis.

	Financing Constraints		Financial Risk		Degree of Financialization	
	(1)	(2)	(3)	(4)	(5)	(6)
	High SA	Low SA	High ZScore	Low ZScore	High financial activity profits	Low financial activity profits
did	-0.0530**	-0.0221	-0.0759**	-0.0133	-0.0032	-0.1087***
	(0.0219)	(0.0203)	(0.0259)	(0.0099)	(0.0133)	(0.0217)
lnage	-0.2410***	0.0984	-	-0.0882**	-0.2326***	-0.2096***
			0.3255***			
	(0.0556)	(0.1802)	(0.0733)	(0.0292)	(0.0583)	(0.0560)
lnsize	0.0452**	-0.0189	0.0317*	-0.0068	-0.0066	0.0166
	(0.0149)	(0.0124)	(0.0191)	(0.0076)	(0.0094)	(0.0140)
lev	0.5648***	0.1825***	0.5483***	0.1086***	0.1862***	0.4842***
	(0.0628)	(0.0462)	(0.0749)	(0.0294)	(0.0436)	(0.0613)
nwc	1.4949***	0.7558***	1.6214***	0.6209***	0.7245***	1.4716***
	(0.0548)	(0.0417)	(0.0590)	(0.0306)	(0.0415)	(0.0506)
cashflow	0.0332***	0.0301***	0.0533***	0.0198***	0.0213***	0.0378***
	(0.0043)	(0.0027)	(0.0079)	(0.0025)	(0.0025)	(0.0042)
TQ	-0.0076**	0.0047	-0.0047*	0.0186***	0.0084**	-0.0115***
	(0.0033)	(0.0030)	(0.0026)	(0.0041)	(0.0029)	(0.0030)
top1	-0.0005	-0.0004	-0.0017*	-0.0004	-0.0013**	-0.0009
	(0.0008)	(0.0006)	(0.0010)	(0.0004)	(0.0005)	(0.0007)
dual	0.0233*	0.0059	0.0097	0.0058	0.0053	0.0074
	(0.0137)	(0.0083)	(0.0138)	(0.0066)	(0.0093)	(0.0117)
_cons	-0.6453*	0.1764	-0.0565	0.3959**	0.7384**	0.0501
	(0.3391)	(0.5396)	(0.4224)	(0.1762)	(0.2310)	(0.3171)
N	10073	10074	10073	10074	10073	10074
r2_a	0.4797	0.2433	0.5230	0.3288	0.2274	0.5376
F	62.6790	25.4493	81.9174	31.5205	23.9952	77.2024

Standard errors in parentheses * p < 0.1, ** p < 0.05, *** p < 0.001

4 Heterogeneity Analysis

In the previous text, by excluding state-owned enterprises for analysis, it is found that the impact of ETS on the reduction of cash holding levels in non-state-owned enterprises is relatively deeper than that of the entire sample. Given the long-standing liquidity tightness in non-state-owned enterprises, this article will conduct a further analysis from three perspectives: financing constraints, financial risks, and the degree of financialization. The empirical results are shown in Table 5.

In Table 5, columns (1) and (2) show that after group regression based on the median of the financing constraint index (SA), the group coefficient with high financing constraint is negative and significant. This indicates that enterprises with higher financing constraints are more affected by policies, and the obstruction of external financing channels makes it easier for the internal cash reserves of enterprises to be consumed.

Columns (3) and (4) show that after grouping and regression based on the median of financial risk (Z-score), the coefficient of the group with high financial risk is negative and significant. This indicates that under the dual impact of environmental compliance costs and financial difficulties, enterprises with high financial risks are forced to deplete their cash reserves to maintain short-term survival.

Columns (5) and (6) show that after the median group regression based on the degree of financialization (the proportion of financial activity profits), the coefficient of the group with a low proportion of financial activity profits is negative and significant. This might be because enterprises with a low degree of financialization have less non-core business investment income and lack cash replenishment channels.

5 Conclusions and Discussion

This paper uses the annual panel data of non-financial enterprises in China's A-share market from 2009 to 2020 to analyze the impact of ETS on the cash holding level of enterprises. The research results show that the ETS policy pilot has a significant reducing effect on the cash holding level of enterprises in the pilot areas, and a series of robustness tests also support this point. Furthermore, heterogeneity analysis indicates that the effect of ETS policy shock on reducing the cash holding level of enterprises is stronger in enterprises with higher financing constraints, greater financial risks, and lower financialization degrees.

Based on empirical findings, we propose three policy recommendations:

First, enhance carbon market mechanisms by scaling up pilot experiences to broaden coverage, leveraging market-based instruments to incentivize green transition, and strengthening corporate compliance awareness through targeted outreach.

Second, adopt entity-tailored regulations, implementing gradient measures for firms with distinct liquidity vulnerabilities to align emission reduction pressures with financial resilience.

Third, fortify policy support systems through innovation subsidies for green technologies, coupled with robust internal-external monitoring frameworks and a dedicated carbon policy assessment mechanism.

References

1. Almeida, H., Campello, M., Weisbach, M.S., 2004. The cash flow sensitivity of cash. *J. Finance* 59, 1777–1804.
2. Amaddeo, E.; Bergantino, A.S.; Magazzino, C. Who Pays for the EU Emission Trading System? The Risk of Shifting Tax Burden from Firm to Final Consumer. *Energy Econ.* 2025, 143, 108240.
3. Chen, W., Zhang, L., Shi, L., Shao, Y., Zhou, K., 2022a. Carbon emissions trading system and investment efficiency: Evidence from China. *J. Clean. Prod.* 358, 131782.
4. Dechezleprêtre, A., Nachtigall, D., Venmans, F., 2023. The joint impact of the European Union emissions trading system on carbon emissions and economic performance. *J. Environ. Econ. Manag.* 118, 102758.
5. Leroutier, Marion, 2022. Carbon pricing and power sector decarbonization: Evidence from the UK. *J. Environ. Econ. Manag.* 111, 102580.
6. Harford, J., Mansi, S., Maxwell, W., 2008. Corporate governance and firm cash holdings in the US. *Journal of Financial Economics* 87, 535–555.
7. Lessmann, C., Kramer, N., 2024. The effect of cap-and-trade on sectoral emissions: evidence from California. *Energy Policy* 188, 114066.
8. Li, W., Chen, X., Huang, J., Gong, X., Wu, W., 2022. Do environmental regulations affect firm's cash holdings? Evidence from a quasi-natural experiment. *Energ. Econ.* 112, 106151.
9. Myers, Stewart, and Nicholas Majluf, "Corporate Financing and Investment Decisions When Firms Have Information That Investors Do Not Have," *Journal of Financial Economics*, XIII (1984), 187–221.
10. Opler, T., Pinkowitz, L., Stulz, R., Williamson, R., 1999. The determinants and implications of corporate cash holdings. *Journal of Financial Economics* 52, 3–46.
11. Sadayuki, T., Arimura, T.H., 2021. Do regional emission trading schemes lead to carbon leakage within firms? Evidence from Japan. *Energy Econ.* 104, 105664.
12. Sakariyahu, R., Lawal, R., Kwansa, N.A., Ahmed, A., Adamolekun, G., 2023. Emissions trading scheme participation and firms' cash holdings. *Financ. Res. Lett.* 58, 104565.
13. Song, M., Zhao, X., Shang, Y., 2020. The impact of low-carbon city construction on ecological efficiency: empirical evidence from Quasi-natural experiments. *Resour., Conserv. Recycl.* 157, 104777.
14. Wu, Y., Liu, X., Tang, C., 2024b. Carbon Market and corporate financing behavior-From the perspective of constraints and demand. *Econ. Anal. Pol.* 81, 873–889.
15. Yu, F., Zheng, S., Zheng, S., Guo, C., 2024. Does carbon ETS affect the distribution of labor's slice of the factor income pie? From the low carbon transition perspective. *Energy Econ.* 107569.
16. Zhou, C.B., Qi, S.Z., 2022. Has the pilot carbon trading policy improved China's green total factor energy efficiency? *Energy Econ.* 114, 106268.
17. Zhou, F., Wang, X., 2022. The carbon emissions trading scheme and green technology innovation in China: a new structural economics perspective. *Econ. Anal. Policy.* 74, 365–381.

18. Zhang, Z., Zhang, F., Ma, C., 2024. Does carbon emission trading scheme inhibit corporate executives' pursuit of excess compensation? Evidence from a quasi-natural experiment in China. *Energy Econ.* 107870.
19. Zhang, P., Qi, J., 2025. Carbon emission regulation and corporate financing constraints: a quasi-natural experiment based on China's carbon emissions trading mechanism. *J. Contemp. Account. Econ.* 21, 100452.

Open Access This chapter is licensed under the terms of the Creative Commons Attribution-NonCommercial 4.0 International License (<http://creativecommons.org/licenses/by-nc/4.0/>), which permits any noncommercial use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons license and indicate if changes were made.

The images or other third party material in this chapter are included in the chapter's Creative Commons license, unless indicated otherwise in a credit line to the material. If material is not included in the chapter's Creative Commons license and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder.

