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From the Editors

Governing Transformation in China: Institutions, Technology, and Global Collaboration

Wenjing Han

The context in which public policy is made has become increasingly complex, shaped by rapid changes in institutions, technologies, and social and economic relationships. In this changing environment, understanding public policy requires us to look beyond how governments design and implement policy. We also need to ask how authority is being reorganized, how new technologies are changing professional judgment and market behavior, who benefits from policy change, and how knowledge travels across national and disciplinary boundaries. China provides a particularly rich context for examining these questions. Its enormous scale, multilevel system of government, regional diversity, and rapid socioeconomic transformation make many of the opportunities and challenges of policy change particularly visible.

The value of policy research on China lies not in presenting China as either an exception to broader patterns or a model to be readily emulated elsewhere. Rather, it lies in using close knowledge of Chinese institutions and policy practice to identify mechanisms, test the limits of existing theories, and bring locally grounded policy insights into conversation with global scholarship. Doing so requires attention to both policy achievements and trade-offs or unintended consequences that may accompany them. Reforms can shift bargaining power in unexpected ways; targeted interventions may improve some aspects of well-being more than others; technologies that appear neutral on the surface can how discretion is excised, how professional judgments are made, and who has access to information. The most valuable China policy research helps us see these processes more clearly and, in doing so, deepens not only our understanding of China, but also of policy change more broadly.

The five articles in this issue of *China Policy Journal* explore these broader questions from a range of perspectives. Together, they examine multidimensional poverty, the informational foundations of carbon markets, artificial intelligence in frontline public services, intergovernmental relations, and the international production of policy knowledge. They also bring together a broad range of methods: longitudinal household data and quasi-experimental designs, city-level policy evaluation, in-depth interviews, county-level survival analysis, and bibliometric and social network analysis. Although the topics and methods vary, the articles share an important insight: policy change does not translate automatically into

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policy outcomes; its effects depend on institutions, incentives, information, professional agency, and the relationships through which policy is interpreted and enacted.

The issue opens with Wenguang Zhang, Yifang Zhou, Wenjing Han, and Yu Pang's article, "Towards Multidimensional Poverty Reduction: An Empirical Assessment on the Effectiveness of China's Targeted Poverty Alleviation Strategy." Rather than measuring poverty through income alone, the authors construct a rural multidimensional poverty index based on the Food and Agriculture Organization's 2021 Rural Multidimensional Poverty Index framework. They analyze four waves of the National Rural Fixed Observation Point survey, from 2012, 2014, 2018, and 2020, using ordinary least squares and a propensity-score-matched difference-in-differences design to assess the effects of Targeted Poverty Alleviation, with particular attention to households in officially designated poor villages.

By applying the multidimensional method developed by Alkire and Foster (2011) to longitudinal rural data, Zhang and colleagues make it possible to see where a national poverty-reduction strategy has been most effective and where deprivation endures. They find a significant reduction in multidimensional poverty, with especially marked gains in household income and living standards. Yet deprivation persists in food security, nutrition, access to resources, and the sustainability of rural livelihoods. The findings treat the elimination of absolute income poverty as a foundation for a broader welfare agenda, not as its completion. The study thus speaks to a wider challenge in development policy—how to turn time-bound, target-driven interventions into durable capabilities and resilience.

The second article turns from rural households to the informational architecture of environmental markets. Jianxian Wu, Hui Jin, and Yaping Luo address this theme in "Smarter Market Signals: Artificial Intelligence as a Policy Signal Accelerator for Carbon Market Decarbonization in China." Drawing on signaling theory and market microstructure research, they conceptualize AI as a policy signal accelerator—an information-processing layer that can reduce the delay and distortion between the production of a regulatory signal and its incorporation into market prices. They identify two pathways, faster translation of overnight policy information into opening prices and more effective filtering of non-informational noise from intraday movements.

The article gives an institutional application to a classic problem in market theory. If price informativeness depends on the costs and incentives involved in acquiring and processing information (Grossman & Stiglitz, 1980), AI matters insofar as it changes those costs. Wu, Jin, and Luo test this proposition by exploiting the staggered introduction of China's carbon trading pilots across 288 cities. Their triple-difference analysis indicates that AI amplifies the emissions-reduction effect of carbon trading by about 2.1 percentage points, while the mechanism analysis points to an improvement in the price efficiency ratio. Digital capacity, on this

account, matters not only because it automates production or enforcement, but because it changes how policy information is processed. The authors are careful not to substitute technology for institutional design— AI may transmit a coherent signal more effectively, but it cannot repair ambiguous rules or inconsistent commitments.

The third article examines artificial intelligence not as an abstract technological force, but as an intervention in organizational and informational relationships. Junwei Lin, Zihan Zhang, Zinuo Meng, and Huan Zhang's article titled "Understanding the Agitation Adopting Artificial Intelligence in Frontline Public Service Delivery: A Context-Value-Behavior Framework" starts from an observation often lost in accounts of seamless digital transformation—frontline adoption can remain unsettled, selective, and subject to continuing negotiation. Based on 19 in-depth interviews with frontline public service providers in social-service settings across five Chinese cities, the authors use "agitation" to describe an enduring condition of uncertainty and adjustment that cannot be reduced to either acceptance or resistance.

Lin and colleagues bring a long-standing challenge in digital administration into sharper focus—new technologies may relocate administrative discretion rather than remove it (Bovens & Zouridis, 2002; Bullock, 2019). Their Context-Value-Behavior framework shows how resource disparities, organizational pressures, and regulatory uncertainty shape frontline judgments of AI, activating trade-offs among efficiency, professional discretion, equity, accountability, and human-centered service. Workers respond through deep integration, instrumental limitation, or deliberate disengagement; those responses, in turn, reshape the conditions of use. By treating adoption as a recursive process of human-technology co-evolution, the study restores professional agency to the analysis of digital governance and offers a more realistic basis for designing public-sector AI reforms.

Christopher Heurlin's "Province Administers County Reforms and Administrative Urbanization in China" turns from frontline public services to the territorial organization of the state. It examines the conversion of counties and county-level cities into urban districts, a change that does far more than alter an administrative label. Conversion redistributes fiscal authority, land control, and political leverage among provinces, prefectural cities, and counties. Using an original county-level dataset for 2000–2019 and survival analysis, Heurlin asks why conversions occur and why some counties are more exposed than others. He places the Province Administers County reforms at the center of the explanation, linking administrative division adjustment to changes in China's intergovernmental fiscal relations.

Research on China's Province-Administers-County reform has shown that reducing hierarchical layers can ease delays and expropriation in fiscal transfers while also weakening upper-level coordination and overall county economic per-

formance (Li et al., 2016). Heurlin demonstrates that the same reordering of intergovernmental relations also changes counties' exposure to administrative incorporation. Whether a county is itself included in the reform does not, on average, alter its probability of conversion. Once a province has launched the reform, however, fiscally weaker counties become more likely to be converted into districts, while stronger counties become less likely to be converted. Fiscal decentralization therefore changes the bargaining positions of local governments with different resource endowments rather than simply transferring authority upward or downward. The analysis connects administrative urbanization, intergovernmental finance, and local political bargaining, and shows how a common institutional reform can generate uneven and partly unintended consequences.

The final article broadens the discussion by examining the evolution of China policy research as an increasingly international field of inquiry. Yu Xiao, Aaron Ley, and Ping Xu's "The Rise of Global Collaboration in China Policy Research: Evidence from Bibliometric Network Analyses, 2000–2025" traces the movement of China policy scholarship from predominantly external observation toward the international co-production of knowledge. Drawing on 326 articles published in 20 high-impact political science journals, the authors use bibliometric and social network analysis to map changes in research topics and collaboration over a quarter century. They identify a shift from a fragmented network centered largely on Western institutions to a dual-hub structure anchored in Mainland China and the United States. Major universities in Mainland China now take central positions in the collaboration network, while institutions in Hong Kong serve as important bridges for international collaboration.

Xiao, Ley, and Xu place China policy studies within the broader movement toward more networked and globally distributed science (Adams, 2013; Wagner et al., 2017). In their account, co-authorship is more than an output measure. It is part of the field's intellectual infrastructure, linking contextual access, theoretical perspectives, methodological expertise, and publication networks. Their article also reveals the value of conferences, professional associations, journals, and durable university partnerships at a time when geopolitical tensions place scholarly exchange under strain. The international relevance of China policy research depends not only on work about China, but also on the relationships through which that work is jointly produced.

Taken together, the five articles in this issue trace policy transformation across a diverse range of settings: from rural households and carbon markets to frontline organizations, government jurisdictions, and scholarly institutions. Rather than treating policy inputs as self-executing, they show how overlapping deprivations, information processing, professional value conflicts, intergovernmental bargain-

ing, and collaboration networks mediate outcomes. The methodological diversity of these studies is equally valuable: large-scale data and quasi-experimental designs help us identify policy effects, while interviews and network analysis reveal relationships, perceptions, and institutional dynamics that may be difficult to capture through aggregate measures alone. Together, these approaches reflect the kind of scholarship *China Policy Journal* seeks to promote research that is grounded in the Chinese context, attentive to the mechanisms that shape policy outcomes, transparent in its empirical analysis, and connected to broader conversations in global public policy scholarship.

We are pleased to present these articles to our readers and hope they will inspire further research and discussion on institutional change, technological governance, and the international production of policy knowledge. We are grateful to the authors for entrusting their work to our journal, to our reviewers for their thoughtful and careful assessments, and to our editorial board for their continued guidance and support. As *China Policy Journal* continues to grow, we remain committed to providing an open forum for rigorous scholarship that connects the study of China with the broader theoretical and practical questions shaping public policy around the world.

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Towards Multidimensional Poverty Reduction: An Empirical Assessment on the Effectiveness of China's Targeted Poverty Alleviation Strategy

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Abstract

From 2015 to 2020, under the implementation of the Targeted Poverty Alleviation (TPA) strategy, China eliminated absolute poverty, making a notable contribution to global poverty reduction efforts. This study develops a multidimensional poverty measurement system for rural households in China, based on the FAO's 2021 Rural Multidimensional Poverty Index (R-MPI). Utilizing data from a national household survey across 2012, 2014, 2018, and 2020, this study evaluates the performance of multidimensional poverty reduction in rural China. By employing OLS, PSM, and DID methods, this study systematically assesses the effectiveness of China's TPA strategy in reducing multidimensional poverty. Findings reveal that the TPA strategy has made significant strides in reducing multidimensional poverty among rural households, particularly in impoverished villages. The strategy effectively improved living standards and income, contributing to substantial progress in alleviating multidimensional poverty. However, challenges remain in ensuring food security, enhancing nutritional status, and promoting the sustainability of rural livelihoods. These insights not only deepen the understanding of multidimensional poverty in rural China but also provide valuable lessons for other developing countries facing similar challenges in poverty alleviation.

Keywords: multidimensional poverty; poverty reduction; Targeted Poverty Alleviation strategy; PSM-DID; rural China

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Hacia la reducción multidimensional de la pobreza: una evaluación empírica sobre la eficacia de la estrategia china de alivio de la pobreza focalizada

Resumen

Entre 2015 y 2020, gracias a la implementación de la estrategia de Alivio de la Pobreza Dirigida (APD), China erradicó la pobreza absoluta, contribuyendo notablemente a los esfuerzos mundiales de reducción de la pobreza. Este estudio desarrolla un sistema de medición de la pobreza multidimensional para los hogares rurales de China, basado en el Índice de Pobreza Multidimensional Rural (IPMR) de la FAO de 2021. Utilizando datos de una encuesta nacional de hogares realizada en 2012, 2014, 2018 y 2020, este estudio evalúa el desempeño de la reducción de la pobreza multidimensional en la China rural. Mediante los métodos de mínimos cuadrados ordinarios (MCO), muestreo por puntuación de propensión (MPP) y diferencias en diferencias (DID), este estudio evalúa sistemáticamente la efectividad de la estrategia APD de China para reducir la pobreza multidimensional. Los resultados revelan que la estrategia APD ha logrado avances significativos en la reducción de la pobreza multidimensional entre los hogares rurales, especialmente en las aldeas más pobres. La estrategia mejoró eficazmente los niveles de vida y los ingresos, contribuyendo a un progreso sustancial en el alivio de la pobreza multidimensional. Sin embargo, persisten desafíos para garantizar la seguridad alimentaria, mejorar el estado nutricional y promover la sostenibilidad de los medios de vida rurales. Estos hallazgos no solo profundizan la comprensión de la pobreza multidimensional en la China rural, sino que también brindan valiosas lecciones para otros países en desarrollo que enfrentan desafíos similares en la reducción de la pobreza.

Palabras clave: pobreza multidimensional; reducción de la pobreza; estrategia de Alivio de la Pobreza Dirigida; PSM-DID; China rural

迈向多维减贫：中国精准扶贫战略的有效性评估

摘要

2015年至2020年，在精准扶贫战略实施背景下，中国消除了绝对贫困，为全球减贫事业作出了重要贡献。本文基于联合国粮农组织2021年提出的农村多维贫困指数（R-MPI），构建了中国农村家庭多维贫困测度体系，并利用2012年、2014年、2018年和2020年全国住户调查数据，评估中国农村多维减贫绩效。本文采用普通最小二乘法（OLS）、倾向得分匹配法（PSM）和双重差分法（DID），系统评估中国精准扶贫战略在降低多维贫困方面的有效性。研究发现，精准扶贫战略在降低农村家庭多维贫困方面取得了显著成效，尤其是在贫困村表现更为突出。该战略有效改善了农村家庭生活水平和收入状况，为缓解多维贫困作出了重要贡献。然而，在保障粮食安全、改善营养状况和促进农村生计可持续性方面仍面临挑战。本文不仅深化了对中国农村多维贫困问题的理解，也为其他面临类似减贫挑战的发展中国家提供了有益经验。

关键词：多维贫困；减贫；精准扶贫战略；倾向得分匹配-双重差分法；中国农村

1. Introduction

Following the United Nations' success in halving global extreme poverty by 2015, the eradication of poverty was reaffirmed as a central objective of international development under the Sustainable Development Goals (SDGs). In developing countries, rural poverty remains a persistent challenge (Singh & Chudasama, 2020). Poverty has traditionally been defined in monetary terms, based primarily on income levels (Ward, 2016; Liu et al., 2017). However, evolving development paradigms have led scholars to increasingly adopt a broader, multidimensional perspective that incorporates capability deprivation and social inequality (Sen, 1976; Gallardo, 2020; Zhou et al., 2023; Liu et al., 2023). Consequently, poverty is now widely understood not merely as insufficient income, but as a deprivation of the essential capabilities required to lead a valued life (Sen, 1999; Nussbaum, 2011).

As the world's largest developing country, China has experienced considerable changes in poverty reduction since the reform and opening-up in 1978. A notable adjustment in poverty governance has been the shift from broad welfare distribution to targeted interventions, represented by the Targeted Poverty Alleviation (TPA) strat-

egy launched in 2013. Through operational measures such as the "Five Batch Initiatives"—which include industrial development, relocation, ecological compensation, education support, and social security—the TPA strategy sought to tailor poverty alleviation resources to the specific needs of rural households (World Bank, 2019). By 2020, 99 million rural residents in China had escaped poverty, placing China among developing countries that attained the SDG poverty reduction target ten years in advance (Yang & Liu, 2021).

Although existing studies have begun to examine the institutional innovations and heterogeneous effects of the TPA campaign (Liu et al., 2020; Zhou et al., 2018), a significant research gap remains in the rigorous causal evaluation of its impact on poverty reduction, particularly within a multidimensional framework. Most research relies either on descriptive analysis or on simple correlational methods such as OLS regression, which cannot adequately isolate the policy's effect from confounding factors or construct a reliable counterfactual for treated villages (Yu et al., 2023; Davie et al., 2021).Some scholars have also pointed out the need to shift policy research toward a broader perspective, such as learning from unintended negative policy outcomes, in order to advance collective solutions to public issues (Arnold, 2025). Specifically, there is a lack of studies that apply a standardized multidimensional poverty index within a rigorous quasi-experimental design to estimate the net effect of TPA village designation on household multidimensional poverty.

Against this research gap, we conduct empirical analysis to complement both theoretical and empirical deficiencies in existing studies. This study aims to empirically assess the extent to which China's Targeted Poverty Alleviation (TPA) strategy has reduced multidimensional poverty in rural areas, with particular attention to non-income dimensions. To this end, we adopt the Rural Multidimensional Poverty Index (R-MPI) proposed by the Food and Agriculture Organization (FAO) in 2021 to construct a comprehensive evaluation framework for rural households. Our analysis draws on nationally representative panel data from household surveys conducted in 2012, 2014, 2018, and 2020 by China's Ministry of Agriculture and Rural Affairs (MARA)—the country's highest authority in agricultural and rural policymaking. Using a combination of econometric methods—including Ordinary Least Squares (OLS), Propensity Score Matching (PSM), and Difference-in-Differences (DID)—we rigorously assess the impact of the TPA strategy.

This study extends the application of standardized multidimensional poverty assessment to the field of policy evaluation, and improves the theoretical interpretation of how targeted institutional arrangements shape rural household welfare beyond single income dimension. Meanwhile, it provides generalized theoretical implications for multidimensional poverty governance research across regions with similar institutional backgrounds. Methodologically and empirically, by integrating internationally recognized

poverty metrics, authoritative national survey data and a rigorous quasi-experimental design, this paper also delivers novel empirical evidence on how precision-targeted institutional interventions improve comprehensive welfare and substantive living standards of rural populations.

2. Research Context and Literature Review

2.1 Targeted Poverty Alleviation (TPA) strategy practices

In 2015, the Chinese government launched the Targeted Poverty Alleviation (TPA) strategy, representing an important stage in the nation's poverty reduction efforts. It is noteworthy that this policy was not implemented simultaneously in all impoverished villages in 2015, but rather followed a sequential coverage process based on a precise identification mechanism. The relevant policy framework was established between 2014 and 2015 and implemented nationwide in phases. Its target scope gradually refined from regions to villages, and ultimately detailed down to households through the establishment of a national poverty alleviation information system. Specifically, by 2015, the strategy targeted 832 impoverished counties and 128,000 villages, covering approximately 56.3 million people (Wu et al., 2022). Building on this foundational identification, the strategy advanced into a comprehensive implementation phase (2016–2020). During this period, local governments deployed a suite of targeted measures, including industrial revitalization, financial aid, education, and healthcare (Zhou et al., 2023; Guo et al., 2022), which were designed to enhance public services and support the self-reliance of recipients (Liu et al., 2020).

By the end of 2020, China eliminated absolute poverty under national standards, removing all impoverished counties from the official list and completing regional poverty elimination. Despite the international poverty line rising from US$1.25/day to US$1.9/day in 2015, the proportion of people living below this higher threshold decreased significantly between 2010 and 2022 (Table 1, Figure 1). Meanwhile, rural well-being improved markedly in areas such as education, healthcare, housing, and access to safe drinking water. According to the official report released by State Council of China, the disposable income for residents of rural areas classified as impoverished increased significantly from RMB 6,079 in 2013 to RMB 12,588 by 2019 (The State Council, 2019).

However, the execution of this targeting mechanism at the household level fell short of perfect precision. Empirical research confirms the presence of both inclusion errors, defined as the allocation of benefits to non-poor households, and exclusion errors, which refer to the omission of eligible poor households (Cheng, Wang, & Chen, 2022). Consequently, despite the broad gains in income and infrastructure, progress in alleviating multidimensional poverty has consistently lagged behind these advances.

Table 1. Proportion of population below international poverty line in China

Year	Poverty headcount ratio (%)	Standard
2010	13.9	$1.25/day
2011	10.2	$1.25/day
2012	8.5	$1.25/day
2013	2.9	$1.25/day
2014	2.1	$1.25/day
2015	1.2	$1.9/day
2016	0.8	$1.9/day
2017	0.7	$1.9/day
2018	0.4	$1.9/day
2019	0.2	$1.9/day
2020	0.2	$1.9/day
2021	0.2	$1.9/day
2022	0.1	$1.9/day
2023	0.8	$2.15/day

Notes: The data are sourced from Department of Economic and Social Affairs Statistics, United Nations (https://unstats.un.org/sdgs/dataportal/countryprofiles/chn)

2.2 Studies on multidimensional poverty measurement

Poverty remains a major barrier to growth and development, attracting extensive scholarly attention (Debebe & Wuletaw, 2022; Barati et al., 2022; Hamago et al., 2023; Long et al., 2021). The concept of poverty has gradually expanded from a one-dimensional to a multidimensional perspective (Kakwani & Son, 2026). Amartya Sen's concept of multidimensional poverty (1976) has become central to poverty research, leading to various measurement approaches, including the income-consumption criterion (Ravallion et al., 1991) and the Human Development Index (UNDP, 2010). Among these, the Alkire-Foster (A-F) method (Alkire & Foster, 2011) is widely recognized for assessing multidimensional poverty by capturing deprivations in health, education, and living standards. Unlike income-based measures, the A-F method provides a holistic view of poverty by aggregating multiple deprivations.

The Multidimensional Poverty Index (MPI), developed by the UNDP and Oxford Poverty and Human Development Initiative (OPHI), offers a rigorous alternative to traditional income metrics. Extensively used in developing countries, MPI supports poverty assessments and policy decisions (Alkire & Santos, 2014). Many nations have adapted MPI for rural poverty evalu-

ation, such as studies on multidimensional poverty trends in Sub-Saharan Africa (Alkire & Housseini, 2014), poverty comparisons in China, Japan, and South Korea (Kayo Nozaki & Takashi Oshio, 2016), and links between poverty and disability in Cameroon and Guatemala (Pinilla-Roncancio et al., 2020). By 2018, 14 countries had established national multidimensional poverty indices to guide anti-poverty strategies (Shen & Zhan, 2018).

Despite MPI's widespread use, the Global Sustainable Development Index (UNDP, 2010) has been criticized for failing to account for rural household economies (OPHI, 2020). To address this, the UN's Food and Agriculture Organization (FAO) and OPHI introduced the Rural Multidimensional Poverty Index (R-MPI) in 2021. Incorporating dimensions like health, education, living standards, and rural livelihoods, R-MPI provides a more precise assessment of rural poverty, improving policy guidance and intervention strategies tailored to rural populations.

2.3 Studies on the Effects of the TPA Strategy

Targeted poverty alleviation, as a recent development in China's poverty reduction efforts and a key innovation in the poverty governance system, effectively tackles challenges such as the uneven distribution of the poor, the growing diversity of their needs, and the misalignment of targeting. It has comprehensively enhanced poverty reduction outcomes in terms of the actors involved, the scope of interventions, and the methods employed (Sun et al., 2019).

Scholars have examined China's poverty reduction from multiple perspectives, including fiscal policy allocation (Liu et al., 2019; Wang et al., 2020), insurance coverage (Huang, 2019), healthcare utilization (Sun et al., 2022; Xia et al., 2021), and access to credit (Zulher & Ratnasih, 2021). Huang and Zhu (2021) employed micro-level panel data on impoverished households to conduct a multidimensional evaluation of the targeted poverty alleviation policy. Their findings indicate that the policy exerts significant poverty reduction effects across multiple dimensions, with particularly pronounced improvements in income, labor capacity, and quality of life. Cai et al. (2021) further demonstrate that, beyond its direct benefits for impoverished populations, targeted poverty alleviation generates spillover effects on non-impoverished groups through improvements in infrastructure, the accumulation of social capital, and shifts in relative income positions. However, these studies typically focus on single-policy dimensions, lacking a holistic, multidimensional evaluation framework. Moreover, studies using large-scale, nationally representative household data remain limited.

3. Research Design

3.1 Data description

This study draws on empirical data from the National Rural Fixed Observation Point (NRFO) survey, administered by the Ministry of

Agriculture and Rural Affairs. As China's largest longitudinal household-level survey, initiated in 1986, the NRFO dataset offers several key advantages: (1) coverage of 375 villages across 31 provincial-level administrative units; (2) tracking of over 20,000 rural households with high-frequency data collection; and (3) inclusion of 136 core variables across 12 modules, including demographics, agricultural production, and household income-expenditure profiles. Given its extensive temporal span (1986–2022), panel structure, and comprehensive multidimensional poverty indicators-particularly those related to nutritional security, such as grain output and animal product consumption—this study selects four survey waves (2012, 2014, 2018, and 2020) to assess the poverty reduction effects of the Targeted Poverty Alleviation (TPA) strategy through a multidimensional poverty framework.

The data cleaning process followed these steps: (1) exclusion of households with missing values in key explanatory variables (TPA participation) or outcome variables (multidimensional poverty indicators); (2) removal of atypical households, such as those headed by students. The final analytical sample consists of an unbalanced panel dataset of 15,201 households across 375 villages, resulting in 34,738 observations across the four survey rounds.

3.2 Measurement of multidimensional poverty

The construction of the multidimensional poverty index in this study is guided by three interrelated principles to ensure theoretical rigor, international comparability, and empirical feasibility. First, it is grounded in Sen's capability approach, which conceptualizes poverty as the deprivation of essential capabilities rather than merely a lack of income. Accordingly, the index transcends a unidimensional, income-based perspective and captures deprivation across multiple domains, thereby reflecting the inherent complexity of rural poverty.

Second, to enhance comparability and methodological robustness, this study draws on the Rural Multidimensional Poverty Index (R-MPI), jointly developed by the FAO and OPHI, which is widely recognized as a standard framework for measuring rural poverty. This study employs the Rural Multidimensional Poverty Index (R-MPI) to measure rural poverty in China due to three main reasons. First, R-MPI integrates multiple dimensions, such as food security and nutrition, rural livelihoods and resources, living standards, and income, allowing for a more comprehensive reflection of the complexity and diversity of poverty. Second, the comprehensive nature of R-MPI enables the identification of different types and levels of poverty, thus providing a solid basis and direction for formulating more precise poverty alleviation policies. By focusing on health and living conditions, R-MPI not only takes economic factors into account but also reflects the intricate relationships among various socio-economic indicators, thereby revealing potential impacts of structural poverty. This provides sufficient evidence and support for

evaluating rural poverty in China, ensuring that the research findings possess a certain degree of representativeness and policy relevance. Finally, as an internationally recognized measurement tool, R-MPI facilitates comparisons and learning between China and other countries regarding poverty alleviation practices and policy designs, thereby enhancing dialogue on poverty reduction experiences with other developing nations.

Third, the selection of dimensions and indicators is constrained by data availability from China's national rural fixed observation point survey; thus, all variables are required to be directly observable or reliably derived from the dataset, with proxy indicators employed where exact measures are unavailable.

Based on these principles, several context-specific adjustments are made to the original R-MPI framework. While the original framework comprises five dimensions—food security and nutrition, education, living standards, rural livelihoods and resources, and risk exposure—the education dimension is excluded in this study. This is because China had achieved near-universal compulsory education coverage by 2010 (MOE, 2012), and the effects of educational deprivation typically manifest with a substantial intergenerational lag. In addition, aligning with China's "Two Assurances and Three Guarantees" strategy (The State Council, 2015), we omit risk and introduce an income dimension, drawing on multidimensional poverty metrics validated by Chinese scholars (Liu et al., 2023). Consequently, the revised R-MPI comprises: food security and nutrition, living standards, rural livelihoods and resources, and income, totaling 13 poverty indicators (Table 2).

In terms of threshold setting, most existing studies set 0.4–0.6 times the median per capita income as the relative poverty line (Chauvel 2013; Peichl et al. 2010; Eisenhauer 2011). The median reflects the central tendency of income distribution, whereas the lower quartile directly corresponds to the bottom 25% of the population in terms of income and welfare. Adopting the lower quartile as the threshold allows for more direct and stable identification of disadvantaged groups at the tail of the distribution. This approach also avoids the measurement bias, where the median itself is prone to distortion by extreme values and the overall distribution.

3.3 Empirical Strategy

3.3.1 Baseline regression model

China's targeted poverty alleviation strategy, launched in 2015, designated impoverished villages as priority units for coordinated interventions. Consequently, the assistance provided to farmers in impoverished and non-impoverished villages showed significant disparities in areas such as fiscal support, project supply, and human capital allocation. Therefore, this study designates farmers in impoverished villages as the experimental group and farmers in non-impoverished villages as the control group, in order to evaluate the TPA strategy.

Table 2. Multidimensional poverty index of rural households

Dimensions	Indicator	Deprived if	Weight
Food security and nutrition (1/4)	Food insecurity	The annual total household grain production is lower than the lower quartile of the overall population.	1/8
	malnutrition	The annual household primary food consumption of pork, beef, mutton, milk (cow and sheep), poultry, eggs, fish and shrimp, and fruits is lower than the lower quartile of the overall population.	1/8
Living standards (1/4)	Improved sanitation	If the sanitation facilities are not indoor toilets or outdoor toilets.	1/28
	Electricity	The household has no electricity energy.	1/28
	Drinking water	The household lacks access to potable drinking water sources, including piped water, water from deep wells, and water from shallow wells.	1/28
	Cooking fuel	The household uses firewood or coal for cooking.	1/28
	Internet	The household is devoid of internet connectivity.	1/28
	Housing	The housing is not a multistory building or brick bungalow.	1/28
	Assets	The household does not possess any two out of the 22 durable goods.	1/28
Rural livelihoods and resources (1/4)	Agricultural assets adequacy	The share of agricultural income in the total income of the household is equal to or exceeds 30%.	1/12
	Low wage	The family is officially recognized as a households covered under the Five Guarantees program*.	1/12
	Social protection	The household has no insurance expenses throughout the year	1/12
Income (1/4)	Annual household income	The household annual income is lower than the lower quartile of the overall population.	1/4

Note: *Five Guarantees Households refers to a specific social security system in rural China aimed at assisting individuals facing extreme poverty and lacking support. The Five Guarantees program is designed to help impoverished and vulnerable rural populations, ensuring basic guarantees in terms of survival, healthcare, housing, and education.

Firstly, we estimate a baseline Ordinary Least Squares (OLS) regression to examine the impact of residence in impoverished villages on rural households' multidimensional poverty. The model specification is:

$$Y_{it} = \alpha + \beta Poverty + \gamma X_{it} + \mu_i + \nu_t + \omega_{it} \quad (1)$$

In the regression model (1), Yit is the multidimensional poverty of rural households, indicates whether the village is identified as a impoverished village by Ministry of Civil Affairs of the People's Republic of China; Xit represents other control variables at village level, household level and household head level that change over time and affect the multidimensional poverty of farmers; μi represents the fixed effect of farmers' individuals; νt represents the fixed effect of years, and ωit is a random error term. In the empirical analysis, we utilized regression equation (1) to explore how various control variables impact the multidimensional poverty of rural households in impoverished villages compared to those in non-impoverished villages. The variables are described in Table 3.

Table 3. Variables description

Variable type	Variable name	Variable description	N	Mean	SD	Min	Max
Dependent variable	R-MPI	Multidimensional poverty index for households, range 0-1	35647	0.190	0.152	0	0.790
Independent variable	Poverty	1 if the household's village is a designated impoverished village; otherwise, 0	35647	0.100	0.300	0	1
Control variables	Edu	Years of education received by the household head	36448	7.020	2.449	0	18
	Gender	Gender of the household head, 1 if male, 2 if female	36844	1.049	0.215	1	2
	Labor	Number of working members in the household	36186	5.359	0.068	0	10
	Township	Whether the village hosts the township government: 1 if yes, 2 if no	36824	1.871	0.335	1	2
	Village PCI	Village level per capita income, measured in RMB	35833	10801.48	12091.27	0.758	181230

3.3.2 Robustness test with the propensity score matching method

Given the vast geographical disparities and significant differences in economic development levels across regions in China, and considering that the impoverished village designation involves some provincial autonomy, this study uses the propensity score matching method (PSM) (Heckman and Todd, 1997), alongside Rosenbaum and Rubin's (1983) research for supplemental improvements to the DID method. Specifically, this study calculated the conditional probability $P(D_i=1|X_i)$—the propensity score—that a household's village is designated as impoverished using a logit model based on characteristics at the village, household, and household head levels, along with whether the village is officially recognised as impoverished. For this study, comparable households from the treatment and control groups were paired together with careful consideration of their propensity scores.

Here, Treatment = 1 indicates that the household is from an impoverished village impacted by TPA strategy, representing the treatment group. Conversely, Treatment = 0 indicates households from non-impoverished villages, representing the control group. Therefore, we can evaluate how the targeted strategy to alleviate poverty affects the overall poverty of households in impoverished villages by using the following equation (2):

$$ATT = E(Y_1 \mid T = 1) - E(Y_0 \mid T = 1) = E(Y_1 - Y_0 \mid T = 1) \quad (2)$$

3.3.3 DID model

Examining the poverty reduction effects of the TPA strategy on rural households in impoverished areas requires comparing the differences in multidimensional poverty among rural households in impoverished villages before and after the implementation of these policies. In the data processing, we observed that after the implementation of the TPA strategy, the number of impoverished villages increased year by year due to precise identification. Therefore, we defined the treatment variable as residence in designated impoverished villages and adopted the criterion that villages initially identified as impoverished in 2012 were classified into the treatment group. Meanwhile, we distinguish the status effect from the inherent endowments of impoverished villages from TPA's actual implementation effect, and clarify that the estimated effect essentially captures the average effect of place-based bundled pro-poor policies. However, rural households' multidimensional poverty is influenced not only by TPA but also by time changes. The academic consensus supports using the difference-in-differences (DID) methodology to isolate "time effects" from "policy effects," minimizing evaluation bias (Abadie, 2010). Our study constructs the treatment group's counterfactual state using the control group and compares changes in the multidimensional poverty index between affected and unaffected rural households.The DID model established in this study is described as follows:

$$Y_{it} = \alpha + \beta_1 Poverty_i + \beta_2 Time_t + \beta_3 Poverty_i \times Time_t + \gamma X_{it} + \mu_i + \nu_t + \omega_{it} \quad (3)$$

In DID model (3), $_i$ represents the household, $_t$ represents time, and Y_{it} is the multidimensional poverty status of household $_i$ in year $_t$. $Poverty_i Time_t$ is the independent variable of this study, assigned a value of 1 if the household's village is designated as impoverished and the TPA strategy has been implemented in that year; otherwise, it is 0. During TPA strategy's implementation process, the official policy directive issued by China's Central Committee and State Council emphasized maintaining the status quo regarding poverty alleviation strategies for counties that had previously escaped the poverty trap. Additionally, they urged the formulation of post-alleviation national assistance policies to ensure sustained progress. Therefore, in subsequent years, the treatment group includes samples from villages that have successfully overcome poverty, meaning once a village is classified as impoverished, $Poverty_i Time_t = 1$ in subsequent years. The coefficient β to be estimated represents the poverty reduction effect of the targeted assistance strategy. X_{it} denotes additional control variables that vary over time and influence the multidimensional poverty status of households, μ_i denotes individual fixed effects of the household, ν_t represents fixed effects for the year, and ω_{it} is the random error term.

4. Descriptive Results

Table 4 & Figure 1 offers a synoptic view of the descriptive statistics associated with the core variables analyzed in the current research. The dataset encompasses observations from the years 2012, 2014, 2018, and 2020, comprising 34,738 samples, with 5,696 in the treatment group and 29,042 in the control group.

Table 4. Descriptive statistics

Variable Name	Definitions	N	Mean	SD	Min	Max
R-MPI	Multidimensional poverty index for households	34738	0.180	0.140	0	0.762
Food security and nutrition	Conditions of food insecurity and malnutrition in households	34738	0.198	0.287	0	1
Living standards	Poverty conditions related to household living standards	34738	0.219	0.118	0	0.857
Rural livelihoods and resources	Poverty conditions related to rural livelihood and resources	34738	0.149	0.169	0	1
Income	Poverty conditions related to annual total income for households	34738	0.154	0.361	0	1

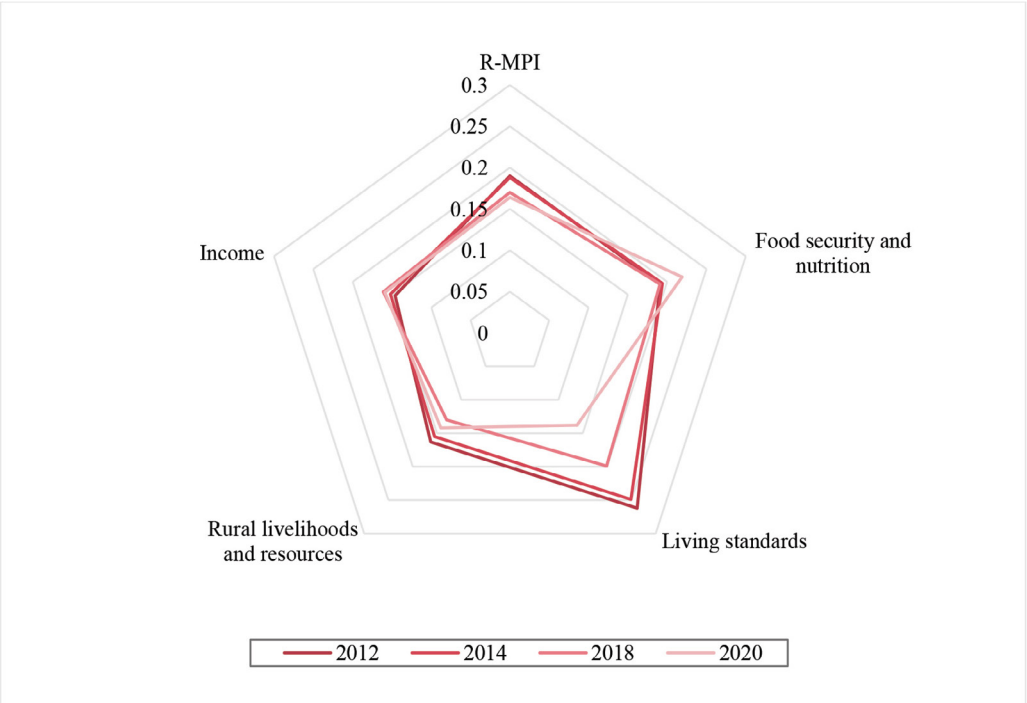

Figure 1. Changes in multidimensional poverty index across different dimensions

Table 5 lists the comparisons between the number of impoverished and non-impoverished villages identified in different years. The results show that the increasingly precise identification of poverty has led to a yearly increase in the number of impoverished village samples, particularly marked after the implementation of the registration and card system for targeted poverty alleviation in 2015, showing significant growth compared to the years 2012 and 2014.

Table 5. The number of households: impoverished vs. non-impoverished villages

Variable name	Number of households in impoverished villages	Number of households in non-impoverished villages	total
2012	1193	9036	10229
2014	1176	8191	9367
2018	1707	6368	8075
2020	1620	5447	7067
total	5,696	29042	34,738

Figure 2 illustrates the evolution of the R-MPI among households in impoverished villages, showing a decrease from 0.2162 in 2012 to 0.1816 by 2020. In contrast, the R-MPI for non-impoverished households demonstrates a more consistent downward trend, decreasing from 0.187 in 2012 to 0.1592 by 2020. Notably, the R-MPI for impoverished households consistently re-

mained above 0.2 until 2018, while the R-MPI for non-impoverished households fell below this threshold in 2016. Before the TPA strategy was introduced in 2015, the R-MPI for households in impoverished villages exhibited stagnation with a slight increase. However, following the implementation, a notable downward trend in the R-MPI became apparent. In contrast, the R-MPI for households in non-impoverished areas displayed a steady decreasing trend over the years, indicating minimal impact from the TPA strategy.

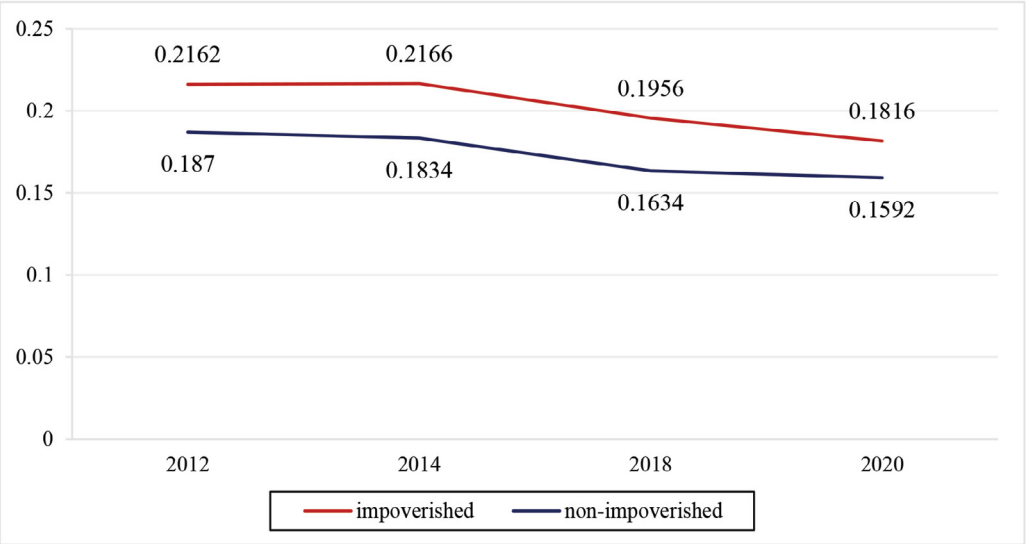

Figure 2. R-MPI change: impoverished vs. non-impoverished villages

Figure 3 reveals significant disparities in poverty across different dimensions between households in impoverished and non-impoverished villages. Households in impoverished villages notably face higher poverty levels in food security, nutrition, income, and living standards, with food security and nutrition showing the most pronounced gap, thereby reflecting the adverse impact of natural disasters and other risks (Hallege et al., 2020). Meanwhile, the lower R-MPI in rural livelihood and resources among impoverished households may stem from government agricultural subsidies targeting non-impoverished villages during the TPA period. Policies such as direct grain and agricultural input subsidies have contributed significantly to household income in impoverished villages, yet short-term agricultural earnings remain low. Additionally, the per capita net income of these households is less than 60% of the provincial average, which limits their disposable income and constrains ability to afford social insurance.

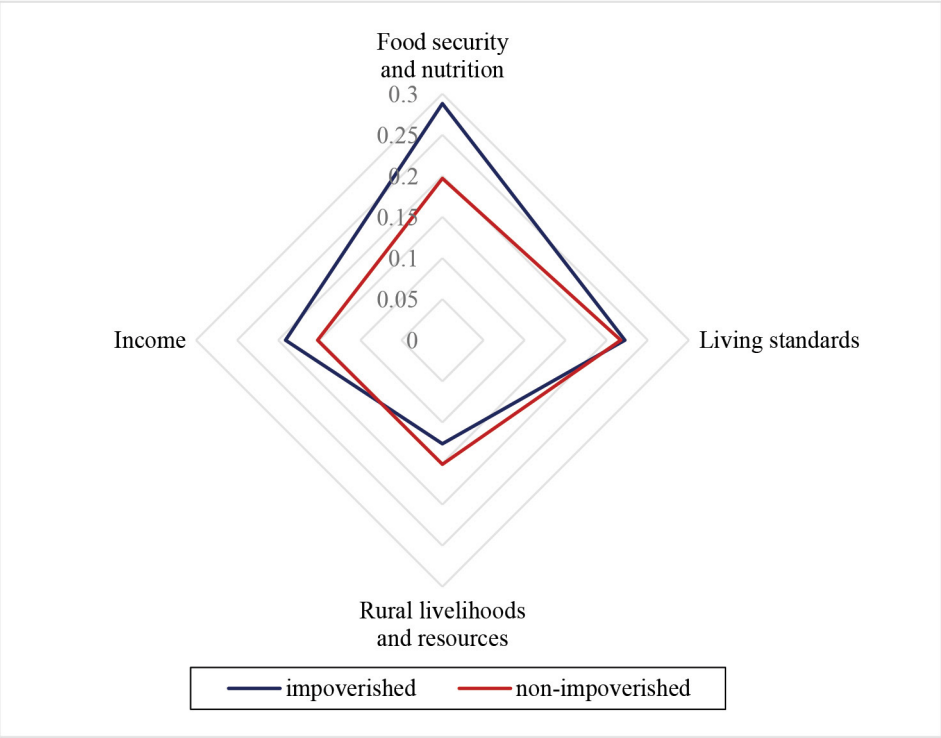

Figure 3. Poverty dimensions comparison: impoverished vs. non-impoverished villages

5. Empirical Results and Discussion

5.1 Baseline regression results

Table 6(a) details the control variables selected for this study and their differing impacts on the multidimensional poverty index-(R-MPI) of households in impoverished and non-impoverished villages. Notably, in Column (1), the gender of the household head, the number of family labor force members, and whether the township government provides assistance significantly influence the multidimensional poverty index of households in non-impoverished villages. Furthermore, in Column (2), it is evident that the township government's assistance and village per capita income have a substantial effect on the multidimensional poverty index of households in impoverished villages. These findings underscore the importance of such variables in understanding the dynamics of poverty across different village types.

Table 6(b) examines the influence of accounting for village-level, family, and household leadership attributes on the distinct components of poverty within households residing in impoverished communities. The analysis reveals pronounced disparities in the manner in which control variables exert their effects across the various aspects of multidimensional poverty within this demographic. Firstly, the number of family labourers significant-

Table 6. Baseline regression results

(a) All households

Variable name	(1) R-MPI (impoverished)	(2) R-MPI (non-impoverished)
Gender	0.0120 (0.0045)	0.0289*** (0.0108)
Labor	-0.0033 (0.0050)	-0.0083*** (0.00086)
Edu	-0.0008 (0.0012)	-0.0014 (0.0009)
Township	0.0400*** (0.0093)	0.0276*** (0.0054)
Village PCI	-0.00001*** (0.00001)	0.00001 (0.00001)
Constant	0.1728*** (0.0304)	0.1552*** (0.0122)
Controls	YES	YES
Individual FE	YES	YES
Year FE	YES	YES
Observations	5572	28817
R-squared	0.0460	0.0420

***p<0.01, **p<0.05, *p<0.1

ly negatively impacts living standards poverty and income poverty. Secondly, our analysis demonstrates the presence of township governments significantly influences farmers' food security and nutrition, as well as their overall living standards. The township government office typically functions as a central nexus for the concentration of administrative resources, where policy implementation tends to be more efficient and effective. Local governments are better positioned to directly deliver agricultural support to farmers, including subsidies, agricultural technical training, and access to agricultural loans. The enthusiasm and capacity for policy execution at the local level can have a direct impact on farmers' agricultural productivity, thereby influencing their food security. The timeliness and precision of policy implementation are pivotal in determining whether farmers receive timely support, which, in turn, affects their productive capacity and overall living standards.

(b) Impoverished village households

Variable name	(1) R-MPI	(2) Food security and nutrition	(3) Living standards	(4) Rural livelihoods and resources	(5) Income
Gender	0.0120 (0.0045)	0.0239 (0.0477)	-0.0048 (0.0190)	0.0111 (0.0248)	0.0178 (0.0638)
Labor	-0.0033 (0.0050)	0.0192*** (0.0055)	-0.0045** (0.0021)	-0.0029 (0.0029)	-0.0251*** (0.0073)
Edu	-0.0008 (0.0012)	-0.0064 (0.0040)	-0.0021 (0.0014)	0.0009 (0.0020)	0.0043 (0.0053)
Township	0.0400*** (0.0093)	0.4234*** (0.0199)	0.0615*** (0.0022)	-0.3445*** (0.0092)	0.0197 (0.0261)
Village PCI	-0.00001*** (0.00001)	-0.00001*** (0.00001)	-0.00001 (0.00001)	0.00001** (0.00001)	0.00001** (0.00001)
Constant	0.1728*** (0.0304)	-0.5239*** (0.0658)	-0.1998*** (0.0227)	0.7646*** (0.0316)	0.2506*** (0.0871)
Controls	YES	YES	YES	YES	YES
Individual FE	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES
Observations	5572	5572	5572	5572	5572
R-squared	0.0460	0.0020	0.1453	0.0029	0.0438

***p<0.01, **p<0.05, *p<0.1

Table 6(c) presents the effects of accounting for characteristics specific to villages, families, and household heads on the multidimensional poverty status of households residing in non-impoverished villages. Firstly, compared to households in impoverished village areas, household head's gender characteristics significantly impact households in non-impoverished villages. Meanwhile, whether the village hosts the township government is also a key factor affecting poverty issues among households in non-impoverished villages. Secondly, the number of family labourers also significantly negatively impacts the overall multidimensional poverty, living standards poverty, rural livelihood and resources poverty, and income poverty of households in non-impoverished villages. Lastly, the years of education of the household head have an impact on the income of families in non-impoverished villages.

Specifically, the longer the household head's education, the more likely it is to reduce income poverty, which provides some empirical support for the significant positive role of increasing the educational level of household heads in alleviating rural household poverty (Bigsten et al., 2003).

(c) Non-impoverished village households

	(1)	(2)	(3)	(4)	(5)
Variable name	R-MPI	Food security and nutrition	Living standards	Rural livelihoods and resources	Income
Gender	0.0289***	0.0297	-0.0041	-0.0025	0.0922***
	(0.0108)	(0.0192)	(0.0072)	(0.0101)	(0.0274)
Labor	-0.0083***	0.0001	-0.0025***	-0.0051***	-0.0257***
	(0.00086)	(0.0055)	(0.0008)	(0.0011)	(0.0022)
Edu	-0.0014	-0.0009	-0.0011	0.0007	-0.0044*
	(0.0009)	(0.0018)	(0.0008)	(0.0009)	(0.0088)
Township	0.0276***	0.0411***	0.0152**	0.0305***	0.0237*
	(0.0054)	(0.0199)	(0.0064)	(0.0067)	(0.0129)
Village PCI	0.00001	0.00001	0.00001***	-0.00001	0.00001
	(0.00001)	(0.00001)	(0.00001)	(0.00001)	(0.00001)
Constant	0.1552***	0.0925***	-0.2390***	0.1232***	0.1661***
	(0.0122)	(0.0249)	(0.0137)	(0.0147)	(0.0302)
Controls	YES	YES	YES	YES	YES
Individual FE	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES
Observations	28817	28817	28817	28817	28817
R-squared	0.0420	0.0002	0.1661	0.0192	0.0431

***p<0.01, **p<0.05, *p<0.1

5.2 Results of the PSM method

To construct potential outcomes similar to those of the treatment group, the PSM method was employed to extract observations from the common support region, which is the overlapping area of the propensity scores (PS). Initially, the PS, the predicted probability of being included in the treatment group, was calculated for households in impoverished villages. Given the results of the baseline regression, variables such as whether the village hosts the township government, number of family labour-

ers, and the gender, and education of the household head were identified as good predictors. Therefore, employing a logistic regression analytical framework, we construct the PS by incorporating above variables.

The retention rate of 99.97% (34,388 / 34,389) significantly surpasses the 95% threshold for robust causal inference in observational studies (Caliendo and Kopeinig, 2008) (See Appendix Table 1). Furthermore, as shown in Table 7, the pseudo R^2 for the matched data decreased to 0 ($p = 0.999$), indicating that the matched data distribution achieved a high level of model fit. The mean bias was significantly reduced, dropping from 17.5% to 0.4%, which not only falls far below the 5% bias threshold but also provides robust evidence of effective control over sample selection bias. Additionally, the standardized bias was optimized from 55.1 to 1.01, satisfying Rubin's criterion for approximate normality of the matched distribution ($B < 1.25$) (Rubin, 2001). These results demonstrate that the PSM method performs exceptionally well in controlling sample selection bias and enhancing the robustness of causal effect estimation, thereby providing a reliable foundation for subsequent causal inference.

Table 8 presents the estimated results for the Average Treatment Effect on the Treated (ATT). The results show that the impoverished village exerts a significant positive effect on the outcome variable R-MPI, which aligns with the baseline results. Specifically, villages classified as impoverished, as indicated by a higher R-MPI, experience a deeper level of poverty.

Table 7. Comparative statistical analysis by group: unmatched vs matched

Sample	PsR2	LRchi2	p>chi2	Mean Bias	Med Bias	B	R	%Var
Unmatched	0.046	1405.06	0.000	17.5	14.8	55.1*	1.36	67
Matched	0.000	0.38	0.999	0.4	0.4	1.01	0	

*if B>25%, R outside [0.5;2]

Table 8. ATT estimation results

Sample	Treated	Controls	Difference	S.E.	T-stat
Unmatched	0.1991	0.1756	0.0235	0.0020	11.44
ATT	0.1991	0.1869	0.0122	0.0172	0.71

5.3 Results of the effectiveness of TPA strategy

After completing the sequence matching process, we proceeded with a difference-in-differences (DID) analysis of the sample data, adhering to the research design outlined previously. Furthermore, we conducted rigorous robustness checks, including parallel trend validation and placebo tests, to ensure

the reliability of our difference-in-differences (DID) estimates. Specifically, the parallel trend assumption was validated through a dynamic event study approach, while placebo tests were implemented by randomly assigning pseudo-treatment timing across 1,000 iterations. Both procedures confirmed the absence of pre-treatment divergence and spurious policy effects, thereby reinforcing the robustness of our causal inferences (See Appendix Figure 1 & 2).

Table 9 summarises the findings of the regression analysis. The significantly negative coefficient of the DID items in columns (1) and (2) of Table 9 indicates that TPA strategy successfully reduced the R-MPI for households in impoverished areas. This finding provides strong evidence of the strategy's positive impact on poverty reduction and the improvement of living conditions for these vulnerable communities. Similarly, the results in Columns (4), and (6), like those in Column (1), show that the DID items is also significantly negative, reflecting significant enhancements in living standards and income as a result of the TPA strategy. This aligns with findings by Yin & Guo (2021), who observed that TPA strategy's effects as a whole on improving the poor's material living standards.

The data in Columns (3) and (5) show that the poverty reduction approach aimed at specific targets actually worsened the situation for those in poverty, particularly concerning food security, nutrition, and the living conditions and resources of life in rural areas for families living in impoverished villages. This does not imply that the TPA strategy failed to implement grain production support; on the contrary, during this period, local finance invested substantial funds in grain-producing households to ensure national food security. However, most households in impoverished villages in China operate on a small, dispersed scale, and grain production is less profitable compared to cash crops and external employment. The contradiction between increasing grain production and promoting income growth among farmers is a key factor exacerbating the multidimensional poverty in food security and nutrition dimensions.

Additionally, considering that the main strategy goal during China's TPA strategy implementation period was to eliminate absolute poverty with a focus on industrial and social security poverty alleviation, aiming to provide a safety net for impoverished households, as shown in Column (6), the TPA strategy significantly narrowed the income disparity between households in impoverished and non-impoverished villages. The overall income increases among impoverished village households mainly stemmed from the development of local speciality industries, agricultural processing, and rural tourism, which boosted non-agricultural income for these households, while significant growth in agricultural income was not achieved. In the dimension of rural livelihood and resources, people in disaster-prone impoverished areas are more likely to rely on the government to cover losses, showing a lack of insurance awareness and a low willing-

ness to spend on insurance (Wang et al., 2012), increasing the likelihood that households go through a year without any insurance expenditure.

Table 9. The effectiveness of TPA strategy with PSM-DID method

Variable name	(1)	(2)	(3)	(4)	(5)	(6)
	R-MPI (1)	R-MPI (2)	Food security and nutrition	Living standards	Rural livelihoods and resources	Income
DID (Poverty*Time)	-0.0070** (0.0035)	-0.0093*** (0.0035)	0.0327*** (0.0076)	-0.0161*** (0.0029)	0.0132*** (0.0040)	-0.0576*** (0.0094)
Constant	0.16262*** (0.0114)	0.1839*** (0.0010)	0.0989*** (0.0238)	0.2426*** (0.0126)	0.1224*** (0.0137)	0.1867*** (0.0282)
Control	YES	NO	YES	YES	YES	YES
Individual FE	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES
R-squared	0.0425	0.0022	0.0025	0.1543	0.0192	0.0472

***p<0.01, **p<0.05, *p<0.1

6. Discussion

Our analysis reveals two key features in rural China's multidimensional poverty transformation. First, households in impoverished villages experience more severe multidimensional poverty than those in non-impoverished villages. Second, the R-MPI in economically disadvantaged communities has declined significantly since the introduction of the TPA strategy in 2015, indicating stronger poverty-reducing effects where need is greatest. When examining specific dimensions, we found poverty remains highest in income, living standards, food security and nutrition, while dimensions such as rural livelihoods and resource access showed comparatively smaller gains. This discrepancy aligns with Bellon et al. (2020), who attribute persistent deprivation to geographical isolation and low agricultural output, especially in remote, mountainous areas.

OLS regression results indicate that in non-impoverished villages, household factors—such as the number of laborers, village administrative status, and the gender of the household head—significantly influence multidimensional poverty outcomes. In contrast, in impoverished villages, only village administrative status remains statistically significant, suggesting that at high poverty levels, institutional or governance characteristics are the dominant drivers—a finding echoing Ma et al. (2018). Applying a PSM-DID approach,

we confirm that TPA has significantly reduced multidimensional poverty, particularly in terms of living standards and income. This is consistent with findings from Liu et al. (2023) on relocation-based poverty relief. Moreover, our results are consistent with similar targeted interventions abroad: Mexico's Community Forestry Program, which seeks to build local capacity, has also improved incomes in forest communities (Torres-Rojo et al., 2019), Rwanda's plant clinic model has enhanced food security and reduced poverty (Tambo et al., 2020), and India's National Rural Employment Guarantee Act (NREGA) provided a legal guarantee for wage employment, which improved rural household income and food security (Klonner & Oldiges, 2022).

However, we also observe that TPA's impact on food security, nutrition, rural livelihoods and resource access is comparatively limited. As pre-TPA policies emphasized grain subsidies (Liu et al., 2023), and TPA subsequently focused on increasing income level through industrialization and social security (Yang et al., 2020), agricultural livelihoods have remained structurally constrained, particularly for smallholder farmers. Additionally, China's reliance on small-scale farming means that while TPA's employment assistance programs offer higher-income non-agricultural jobs, their effect on diversifying rural livelihoods remains constrained (Lei et al., 2016; Wang et al., 2019). This pattern can be further explained by examining regional disparities in household income structure and agricultural production models. Previous studies also reveal significant regional differences in rural household income composition across China, Zhang et al. (2025) based on CFPS data found that the poverty reduction effects of different income sources vary considerably by region, with operating income demonstrating the most pronounced impact on poverty alleviation across all areas. And the income sources of farmers in central and western China are relatively more homogeneous and exhibit greater dependence on household operating income compared to eastern region (Shi & Huang, 2023). This process has direct consequences for food security and nutrition, when households reduce their engagement in food production, they will lose the buffer provided by home-grown food stocks, the increase in income may not indicate on improvement in the overall living conditions. This trade-off between income growth and food security is not unique to rural China; in many sub-Saharan African countries, agricultural interventions that prioritized cash crops or off-farm employment over staple food production have inadvertently exacerbated household food insecurity, as smallholders allocate less labor and land to subsistence crops (Nyambo, P. et al., 2022). These domestic and international experience suggest that the trade-off between income growth and food security is a structural challenge in contexts where smallholder agriculture predominates and safety nets for nutrition are weak. Addressing it requires deliberate policy design that integrates nutrition-sensitive agriculture with income support, rather than

only considering income growth. In addition, the long-term sustainability of poverty reduction should be linked to broader agricultural transformation, since low-carbon and resource-efficient agricultural development can help reconcile livelihood improvement, food security, and environmental resilience in rural China (Wu et al., 2024).

By revealing the TPA's uneven effects—stronger in income and living standards but weaker in food security and rural livelihood sustainability. Our study highlights the urgent need for context-sensitive, integrated poverty interventions that address the full breadth of rural poverty.

7. Conclusion, Implications and Limitations

7.1 Conclusion

By 2021, China had eradicated absolute poverty, marking a significant achievement among developing nations (Chen et al., 2021). This accomplishment reflects the effectiveness of institutionalized strategies like Targeted Poverty Alleviation (TPA), which have reshaped China's approach to poverty governance. This study, using a multidimensional poverty perspective and the UNFAO's R-MPI framework, analyzed rural panel data from 2012, 2014, 2018, and 2020 through PSM-DID. Our results reveal a complex picture: the TPA strategy significantly alleviated multidimensional poverty in officially designated impoverished villages. However, its effects were more pronounced in improving income and living standards than in addressing persistent deprivations such as food security, nutrition, and livelihood sustainability.

7.2 Implications

Based on these findings, we propose the following policy recommendations. First, poverty alleviation strategies should move beyond income-centered approaches toward a more comprehensive welfare framework. While TPA has significantly improved income and living standards, its negative effects on food security and nutrition highlight critical shortcomings in non-income dimensions. In the context of rural revitalization, policy design should incorporate multidimensional poverty indicators to guide resource allocation and project implementation, with particular emphasis on integrating food security and nutrition monitoring into evaluation systems.

Second, policy priorities should shift from short-term poverty reduction to long-term resilience and livelihood sustainability. The limited impact of TPA on rural livelihoods and resources in impoverished villages, suggests that current interventions remain insufficient for building endogenous development capacity. Future policies should strengthen productive capabilities through targeted agricultural support, expanded access to subsidized insurance, and the promotion of diversified livelihood strategies, including high-value agriculture, cooperative development, and rural entrepreneurship.

Third, differentiated and capac-

ity-oriented interventions should replace uniform policy approaches. The results indicate that multidimensional poverty in impoverished villages is primarily shaped by structural and governance factors, whereas in non-impoverished villages it is more closely associated with household-level characteristics. Accordingly, policy design should adopt a stratified approach: that prioritizes improvements in institutional capacity and governance in severely impoverished areas, while focusing on human capital accumulation and labor mobility support in relatively better-off regions.

7.3 Limitations

This study is subject to several limitations. First, data constraints pose a fundamental limitation. The use of confidential data restricts the sample period to 2020 and limits the inclusion of potentially important confounding variables, which may affect both the assessment of long-term policy effectiveness and the robustness of causal identification. Future research should leverage updated panel data and incorporate richer contextual variables to strengthen empirical inference. Second, the measurement of multidimensional poverty remains imperfect. Although the R-MPI framework is refined, data limitations may hinder its ability to fully capture the complexity and heterogeneity of rural poverty. Further improvements in indicator design and dimensional coverage are therefore needed. Third, the analysis focuses on average treatment effects and does not sufficiently explore heterogeneity across household groups and policy implementation modes. Future studies should adopt a more disaggregated approach to uncover the differentiated impacts of TPA across regions, household structures, and intervention types.

Disclosure Statement

There are no conflicts of interest to declare.

Data Availability

The data supporting this study were obtained from the Ministry of Agriculture and Rural Affairs of China and contain confidential information. Due to legal restrictions, the raw data cannot be publicly disclosed.

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Smarter Market Signals: Artificial Intelligence as a Policy Signal Accelerator for Carbon Market Decarbonization in China

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Abstract

Market-based climate policies such as carbon emission trading systems transmit regulatory price signals to guide firm-level abatement behavior, yet their effectiveness is frequently attenuated by signal lag, signal noise, and systematic mispricing arising from the structural complexity of climate policy information. Grounded in signaling theory and market microstructure scholarship, this study conceptualizes artificial intelligence (AI) not as an algorithmic trading tool but as a policy signal accelerator—an information-processing layer that compresses the time and informational loss between policy signal generation and price-level internalization. We develop a theoretical framework identifying two causal pathways through which AI improves carbon market price discovery—accelerating overnight signal instantiation into opening prices and filtering non-informational noise from intraday price movement. Exploiting the staggered rollout of China's carbon trading pilots across 288 cities, we employ a quasi-experimental design to estimate the causal effect of AI adoption on policy-driven emission reductions. Results show that AI amplifies the carbon trading emission-reduction effect by 2.1 percentage points. Mechanism analysis confirms that AI significantly raises the price efficiency ratio, indicating that carbon permit prices move more decisively in the direction of net informational content. These findings provide

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evidence that AI structurally enhances the signaling architecture of market-based climate policy.

Keywords: artificial intelligence; carbon emission trading; signaling theory; policy signal accelerator; price efficiency

Señales de mercado más inteligentes: la inteligencia artificial como acelerador de señales políticas para la descarbonización del mercado del carbono en China

Resumen

Las políticas climáticas basadas en el mercado, como los sistemas de comercio de emisiones de carbono, transmiten señales de precios regulatorios para guiar el comportamiento de reducción a nivel empresarial; sin embargo, su efectividad se ve frecuentemente atenuada por el retraso de la señal, el ruido de la señal y la fijación errónea sistemática de precios que surge de la complejidad estructural de la información sobre políticas climáticas. Basado en la teoría de la señalización y la investigación sobre la microestructura del mercado, este estudio conceptualiza la inteligencia artificial (IA) no como una herramienta de negociación algorítmica, sino como un acelerador de señales de política: una capa de procesamiento de información que comprime el tiempo y la pérdida de información entre la generación de la señal de política y la internalización del nivel de precios. Desarrollamos un marco teórico que identifica dos vías causales a través de las cuales la IA mejora el descubrimiento de precios en el mercado del carbono: acelerando la instanciación de la señal nocturna en precios de apertura y filtrando el ruido no informativo del movimiento de precios intradiario. Aprovechando el despliegue escalonado de los programas piloto de comercio de carbono de China en 288 ciudades, empleamos un diseño cuasiexperimental para estimar el efecto causal de la adopción de la IA en las reducciones de emisiones impulsadas por políticas. Los resultados muestran que la IA amplifica el efecto de reducción de emisiones del comercio de carbono en 2,1 puntos porcentuales. El análisis del mecanismo confirma que la IA aumenta significativamente el índice de eficiencia de precios, lo que indica que los precios de los permisos de carbono se mueven de manera más decisiva hacia el contenido informativo neto. Estos hallazgos demuestran que la IA mejora estructuralmente la arquitectura de señalización de las políticas climáticas basadas en el mercado.

Palabras clave: inteligencia artificial; comercio de emisiones de carbono; teoría de la señalización; acelerador de señales políticas; eficiencia de precios

更智慧的市场信号：人工智能作为中国碳市场脱碳的政策信号加速器

摘要

以碳排放权交易为代表的市场型气候政策，通过传递规制性价格信号引导企业层面的减排行为；然而，气候政策信息的结构复杂性所引致的信号滞后、信号噪声与系统性定价偏误，常使其政策效力受到削弱。本文立足信号传递理论与市场微观结构研究，将人工智能（AI）界定为“政策信号加速器”，而非单纯的算法交易工具——它作为一个信息处理层，能够压缩政策信号从生成到内化于价格之间的时间损耗与信息损耗。本文构建理论框架，识别出AI改善碳市场价格发现的两条因果路径：其一，加速隔夜信号向开盘价的转化；其二，过滤日内价格波动中的非信息性噪声。利用中国碳排放权交易试点在288个城市间推开所构成的准自然实验，本文估计了AI应用对政策驱动型减排的因果效应。结果表明，AI使碳交易的减排效应放大2.1个百分点。机制分析证实，AI显著提升了价格效率比率，表明碳配额价格能够更加果断地沿净信息含量方向变动。上述发现为AI从结构层面强化市场型气候政策的信号架构提供了经验证据。

关键词：人工智能；碳排放权交易；信号传递理论；政策信号加速器；价格效率

1. Introduction

Climate change ranks among the most urgent challenges confronting the global community, with far-reaching implications for ecosystems, economic development, and social stability (Jang and Yi, 2022; Xiao and Yi, 2025; Yi and Yuan, 2023). In response, governments worldwide have increasingly turned to market-based climate policies—including carbon emission trading systems, carbon taxes, carbon border adjustment mechanisms, renewable energy subsidies, and green financial instruments—to steer firms and consumers toward low-carbon behavior. Yet the effectiveness of these instruments hinges critically on the precision of their design, the responsiveness of market participants, and the efficiency with which they are implemented. In practice, conventional policy tools often fall short of their theoretical potential because of persistent information

asymmetries, elevated transaction costs, and behavioral biases among regulated entities, all of which attenuate the price signals on which market-based mechanisms depend (Bellassen and Shishlov, 2017; Falkner et al., 2021; van der Heijden, 2020).

The rapid advancement of artificial intelligence (AI) has opened a promising frontier for overcoming these constraints (Kaack et al., 2022; Luers et al., 2024; Plésiat et al., 2024; Salekpay et al., 2024; Wu, 2025; Wu, 2026). Through big-data analytics, machine learning, and intelligent decision-support systems, AI can enhance the informational architecture underlying market-based climate policy in at least three ways: refining the design parameters of policy instruments, reshaping the decision-making processes of market participants, and improving the operational efficiency of policy implementation. In the specific context of carbon pricing, for example, AI-enabled forecasting and high-frequency information aggregation may allow carbon permit prices to incorporate new information more rapidly and accurately, thereby transmitting cleaner cost signals that strengthen firm-level abatement incentives. Despite growing enthusiasm for these possibilities, the existing literature lacks both a systematic theoretical framework and rigorous quasi-experimental evidence on whether—and through what channels—AI tangibly enhances the decarbonization potential of market-based climate policy.

This study aims to fill that gap. We first develop a theoretical framework articulating how AI can empower market-based climate policy through the lens of signaling theory. We then exploit China's staggered rollout of its carbon emission trading system pilot programs across 288 cities over nearly two decades to construct a quasi-experimental research design, enabling us to estimate the causal effect of AI adoption on policy-driven decarbonization.

Our findings yield three principal contributions. First, the baseline results demonstrate that AI adoption significantly amplifies the emission-reduction effect of the carbon emission trading systems. Relative to the control group, pilot cities in the treatment group experienced a statistically significant reduction in carbon emissions of approximately 2.1 percentage points —an effect that remains robust across a battery of specifications with progressively richer sets of city-level controls. Second, a mechanism analysis reveals that AI enhances the price efficiency of carbon trading markets: within pilot cities, greater AI penetration is associated with a significantly higher price efficiency ratio, indicating that carbon permit prices move more decisively in the direction of net informational content and are less distorted by noise trading. This improved price discovery transmits more credible abatement cost signals to regulated firms, thereby strengthening their incentive to invest in low-carbon technologies and production processes. Third, by situating these empirical results within an integrated theoretical framework, we provide one of the first pieces of quasi-experimental evidence that AI serves not merely as a techno-

logical convenience but as a structural enhancer of the informational and incentive architecture on which market-based climate policy relies.

Taken together, these results carry important implications for policymakers seeking to harness digital technologies in the pursuit of climate goals. As jurisdictions around the world expand or refine their carbon pricing instruments, understanding how AI can sharpen the market signals embedded in these mechanisms is essential for unlocking their full decarbonization potential.

2. Theoretical Framework

2.1 Theoretical Foundation: Signaling Theory in a Public Policy Context

Signaling theory, as originally formulated by Spence (1973) in the context of labor markets, addresses a fundamental problem of information asymmetry—when one party holds private information that another party cannot directly observe, observable and differentially costly actions can serve as credible signals capable of closing the informational gap. Since its introduction, the framework has been extended across organization theory, financial economics, and, more recently, public administration scholarship, where it is deployed to analyze how governments use policy instruments as signals to shape governance behavior (Zhu and Wang, 2025).

The application of signaling theory to emissions trading systems is institutionally well-grounded. A carbon market operates, at its core, as a mechanism through which government authorities transmit signals about the regulatory price of carbon over a forward-looking policy horizon (Wu et al., 2024). The cap-and-trade architecture—comprising total quantity limits, allocation rules, and compliance schedules—encodes a sequence of policy commitments that market participants must continuously interpret and price. Carbon prices, therefore, are not merely the outcome of supply-and-demand equilibria; they are the market's running valuation of policy credibility, regulatory intent, and abatement cost expectations (Hintermann, 2010). The accuracy and timeliness with which prices incorporate new policy information constitutes the primary measure of how effectively the signaling mechanism is functioning.

Yet a fundamental tension arises when signaling theory is transported into the carbon market context. Unlike private market signals—which are often standardized, numerically expressed, and rapidly disseminated—climate policy signals are structurally complex, textually dense, and institutionally embedded. Legislative amendments, regulatory guidance documents, international negotiation outcomes, and enforcement decisions are overwhelmingly non-structured in form, requiring interpretation against deep technical and jurisdictional background knowledge. Market participants face systematic cognitive constraints in processing this informational complexity, producing characteristic inefficiencies: delayed

signal incorporation (signal lag), distortion through heterogeneous interpretation (signal noise), and systematic mispricing relative to policy fundamentals. It is against this background that the present study poses the core explanatory framework illustrated in Figure 1.

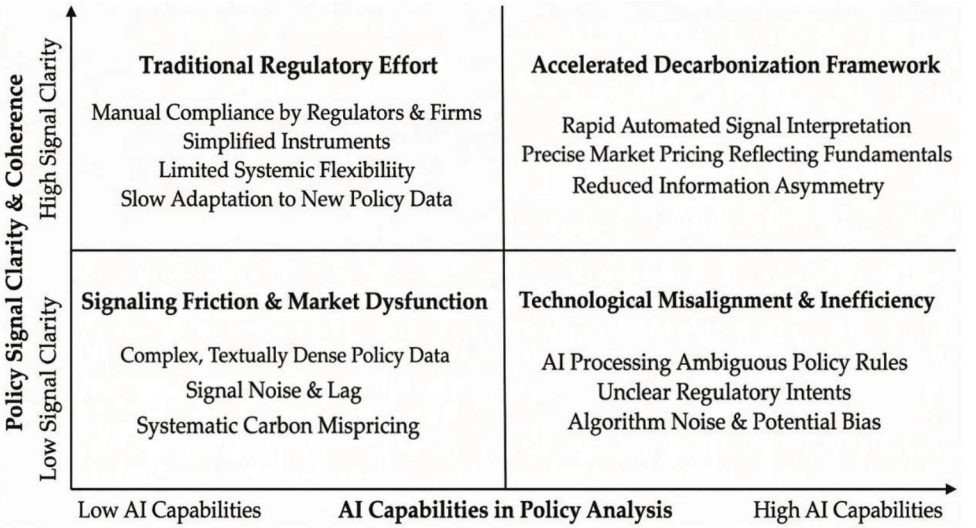

Figure 1. Theoretical framework

2.2 Core Conceptual Contribution: AI as a Policy Signal Accelerator

This study conceptualizes the function of artificial intelligence in carbon markets not as an algorithmic trading tool but as a policy signal accelerator—an information processing layer that compresses the time and informational loss between policy signal generation and complete price-level internalization.

This conceptualization draws on two complementary bodies of scholarship. From the public policy tradition, Majone (1989) argues that the effectiveness of any policy instrument depends critically on the legibility of the signals it encodes—the degree to which the target audience can decode the policy message with accuracy and low ambiguity. When legibility is low, even a well-designed instrument fails to produce the behavioral responses it intends. From the market microstructure tradition, Grossman and Stiglitz (1980) demonstrate that the allocative efficiency of any price-based mechanism depends on the capacity of informed traders to arbitrage informational gaps, a process that is itself bounded by the cost and difficulty of information acquisition and processing.

The theoretical bridge between these two traditions is provided by AI's differential advantage in processing non-structured, high-dimensional policy information (Schiff and Schiff, 2023; Wellstead et al., 2024). Natural language processing capabilities allow AI systems to parse regulatory an-

nouncements, legislative records, and multilateral agreement texts at a speed and scale that is categorically inaccessible to human analysts or conventional quantitative tools. Real-time sentiment and policy stance monitoring systems can continuously update market participants' policy priors without the latency inherent in human review cycles. And multi-source information fusion algorithms can synthesize signals across jurisdictional boundaries—a capacity of particular relevance in carbon markets that are increasingly integrated across regulatory regimes.

2.3 Causal Mechanisms: Two Pathways of Price Discovery Improvement

The theoretical framework generates two distinct but complementary causal pathways through which AI-augmented information processing improves carbon market price discovery. These pathways differ in their temporal locus—one operates primarily at the boundary between the overnight non-trading period and the market open, the other operates across the full intraday price formation process—and in the aspect of signal quality they most directly address.

2.3.1 Signal Instantiation and Intraday Price Correction

The first pathway concerns the speed and completeness with which policy signals are incorporated into opening prices. In carbon markets, the overnight non-trading period is a particularly information-rich interval: regulatory announcements, court rulings on compliance decisions, legislative committee proceedings, and international negotiating updates routinely accumulate during hours when no trading is possible. The degree to which these signals are reflected in the opening price, rather than generating protracted intraday drift as traders process and arbitrage the informational gap, is a direct measure of the market's signal instantiation capacity.

AI improves this capacity through two sub-mechanisms. First, by enabling near-real-time automated parsing of overnight policy documents, AI-assisted platforms allow market participants to arrive at the open with substantially more complete policy priors, reducing the structural informational asymmetry between informed and uninformed traders that drives mispricing at the open (Admati and Pfleiderer, 1988). Second, by generating continuous monitoring outputs that update directional policy stance estimates throughout the overnight period, AI narrows the confidence intervals around policy expectations (Silva, 2025), reducing the uncertainty premium that otherwise inflates intraday correction activity. The net result is a compression of the gap between opening and closing prices that reflects genuine informational updating rather than liquidity-driven noise—a compression that is theoretically measurable through the intraday price correction magnitude indicator.

2.3.2 Noise Filtering and the Price Efficiency Ratio

The second pathway operates through the composition of intraday price movement rather than its overall mag-

nitude. Even in markets with robust overall liquidity, a significant share of intraday price volatility reflects non-informational forces: liquidity shocks, short-term speculative positioning, herding behavior among retail participants, and the mechanical responses of algorithmic strategies to price-level triggers rather than fundamental signals. When these noise components are large relative to information-driven price movement, the price path becomes directionality-poor—prices traverse a wide range intraday but close near their opening level, suggesting that most of the recorded movement was ultimately reversed and carried no policy-informational content.

AI addresses this problem by improving the signal-to-noise ratio in the information environment available to market participants—a concept directly continuous with Grossman and Stiglitz's (1980) foundational formulation. By enabling sophisticated participants to more precisely discriminate between policy-relevant signals and market microstructure noise, AI-assisted information processing raises the proportion of price movement that is directionally informed (Wang et al., 2024). Critically, this effect is amplified in carbon markets by the structural opacity of climate policy signals—the same regulatory development that is immediately legible to an AI-assisted analyst may remain ambiguous to a conventional market participant for several hours, creating temporary informational wedges that noise traders can exploit. As AI adoption increases market-wide, these wedges narrow, and the ratio of directional to total intraday price movement should rise correspondingly—a dynamic captured by the price efficiency ratio.

2.4 Research Hypotheses

Building on these theoretical foundations, this study advances two research hypotheses:

Hypothesis 1: AI adoption facilitates accelerated decarbonization under climate policy, particularly within carbon emission trading markets.

Hypothesis 2: AI accelerates policy-driven decarbonization through a signaling effect mechanism.

3. Methods

Section 3 outlines the research methods and data. Section 3.1 presents the modeling of the benchmark estimation model, including the key variables and data. Section 3.2 provides the modeling of the event study model and the descriptive statistics of the key variables.

3.1 Baseline Estimation Model

Drawing on annual panel data from 288 Chinese cities, this study constructs a triple-difference model to quantify the impact of AI on the decarbonization potential of carbon emission trading systems.

$$Y_{it} = \beta_1 AI_{it} \times CETS_{it} + \beta_2 AI_{it} + \beta_3 CETS_{it} + \gamma X_{it} + \delta_i + \eta_t + \in_{it} \quad (1)$$

where the core explanatory variable is the interaction term $AI_{it} \times CETS_{it}$, which captures the policy effect of AI in pilot cities i under the carbon emission trading system in year t. Specifically, AI_{it} is a continuous variable measured by the logarithm of the number of AI-related invention patent applications. Patent data are sourced from the National Intellectual Property Administration. $CETS_{it}$ is a dummy variable indicating the implementation of the carbon emission trading system; it takes the value of 1 for cities designated as pilot regions for the market-based climate policy from 2013 onward, and 0 otherwise. Policy implementation data are derived from the National Energy Administration, with detailed information on the treatment group presented in Appendix Table A1[1].

The dependent variable Y_{it} denotes the logarithm of carbon emissions for city i in year t. Raw carbon emission data are obtained from the Carbon Emission Accounts and Datasets (CEADs) and matched to city-year observations spanning 2000 to 2016 (Chen et al., 2020). For robustness testing, we employ an alternative dataset from the Emissions Database for Global Atmospheric Research, which covers the period from 2000 to 2022, to re-examine our findings (Crippa et al., 2023). To mitigate omitted variable bias, the analysis controls for key city characteristics such as gross domestic product (GDP), population size, industrial output, and infrastructure (e.g., airports and high-speed rail).

The reasons for controlling these variables are as follows: GDP reflects economic development levels and resource accessibility, which are closely related to energy consumption and carbon emissions; population size represents the fundamental scale effect of energy demand; industrial output directly affects energy structure and emission intensity; airports and high-speed rail represent transportation infrastructure, which is related to urban energy consumption patterns, technological diffusion, and AI application environments. Previous research indicates that these variables are important determinants of carbon emissions, and neglecting them may lead to omitted variable bias (Hickel and Kallis, 2020; Lin et al., 2021; Pu and Xia, 2025; Sibanda and Ndlela, 2020; Whitmarsh et al., 2020), thereby affecting the accuracy of the causal relationship between AI and market-based climate policy.

To address the issue of unobserved factors and potential omitted variable bias, the study further controls for city fixed effects δ_i and year fixed effects η_t. In terms of estimation coefficients, β_1 captures the contribution of AI to the decarbonization potential of the carbon emission trading system. If the estimated coefficient β_1 is negative and statistically significant, it indicates that AI contributes to enhancing the decarbonization potential of the carbon emission trading system. The estimation uses ordinary least squares with robust standard errors to conduct valid statistical inference.

1 All supporting materials can be obtained through the following channels: https://doi.org/10.13140/RG.2.2.27808.34563

3.2 Event Study Model

Additionally, the validity of the baseline model estimation relies on the assumption that the carbon emission trends of the treatment and control groups are similar prior to the quasi-experimental intervention. If the carbon emission differences between the treatment and control groups are not statistically significant before the policy implementation, the baseline estimate can be interpreted as the causal effect of the intervention. This assumption is known as the parallel trends assumption (Liu et al., 2024). Given that the AI variable is originally continuous, and to facilitate the use of an event study framework, this study transforms it into a binary indicator. Specifically, cities with AI levels above the median are assigned a value of 1 (high AI group), and cities with AI levels below the median are assigned a value of 0 (low AI group). This transformation ensures that the interaction term in the model becomes binary, thus meeting the identification requirements of the event study design. The corresponding econometric specification is constructed as follows:

$$Y_{it} = \sum_{k\geq -5, \neq -1}^{4} \vartheta_k AI_dummy_{ik} \times CETS_{ik} + \rho_1 AI_dummy_{it} + \rho_2 CETS_{it} + \gamma X_{it} + \delta_i + \eta_t + \epsilon_{it} \quad (2)$$

where the interaction term captures the variation in carbon emission trends between the treatment and control groups before and after the quasi-experimental intervention. When k is less than 0 and the estimated coefficient is not statistically significant, it indicates that there are no systematic differences in carbon emissions between the treatment and control groups prior to the quasi-experimental intervention. When k is greater than or equal to 0 and the estimated coefficient is negative and statistically significant, the reduction in carbon emissions in the treatment group relative to the control group can be interpreted as the net effect of the quasi-experimental intervention. The other variables remain consistent with the baseline estimation model. Table A2 reports the descriptive statistics of the main variables.

4. Empirical Results

Section 4 presents the empirical results in detail. Section 4.1 reports the baseline estimation results, Section 4.2 provides the mechanism analysis results, and Section 4.3 presents the robustness check results.

4.1 Baseline Results

Table 1 reports the baseline impact of incorporating AI into the carbon emission trading system on carbon reduction. Column (1) controls for the main effects, city fixed effects, and year fixed effects, showing that compared to the control group, AI reduces carbon emissions in the treatment group by 2.53%, which is statistically significant at the 1% level. To further mitigate the impact of omitted variables, columns (2) to (6) progressively add control variables related to city characteristics. The base-

line estimated coefficient of the carbon emission trading system's impact on carbon reduction gradually decreases to 2.1%, still statistically significant at the 1% level. These baseline estimation results provide preliminary support for *Hypothesis 1*, indicating that AI contributes to enhancing the decarbonization potential of the carbon emission trading system.

Regarding the control variables, GDP, industrial output, and airports all significantly increase carbon emissions at the statistical level, while high-speed rail significantly reduces carbon emissions. The relationship between population and carbon emissions is not statistically significant. The estimated coefficients for most control variables align with expectations. However, it should be noted that since the quasi-experimental intervention focuses on the core explanatory variable, and the control variables serve to enhance the accuracy of the quasi-experimental intervention estimates, the coefficients for these control variables do not require extensive interpretation.

Table 1. Baseline estimation of AI's role in promoting decarbonization in carbon emission trading system

	Dependent variable: Carbon emissions (logged)					
	(1)	(2)	(3)	(4)	(5)	(6)
AI×CETS	-0.0253***	-0.0271***	-0.0267***	-0.0214***	-0.0215***	-0.0210***
	(0.0038)	(0.0039)	(0.0039)	(0.0038)	(0.0037)	(0.0037)
GDP		0.2316***	0.2363***	0.1586***	0.1512***	0.1503***
		(0.0161)	(0.0166)	(0.0208)	(0.0203)	(0.0202)
Population			-0.0333	-0.0101	-0.0026	-0.0009
			(0.0282)	(0.0263)	(0.0258)	(0.0259)
Industry output				0.0663***	0.0685***	0.0680***
				(0.0077)	(0.0077)	(0.0077)
Airport					0.0537***	0.0517***
					(0.0102)	(0.0102)
High-speed rail						-0.0149***
						(0.0051)
Main effects	Yes	Yes	Yes	Yes	Yes	Yes
City fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	4447	4445	4445	4438	4438	4438
Adjusted R^2	0.9856	0.9873	0.9873	0.9877	0.9878	0.9878

Note: This table reports the baseline estimation of AI's role in promoting decarbonization in carbon emission trading system. The dependent variable is carbon emissions (logged), and the core explanatory variable is AI×CETS, which represents the degree to which AI is integrated into the carbon emission trading system. The control strategy includes main effects, city control variables, city fixed effects, and year fixed effects. Numbers in parentheses represent robust standard errors. ***, **, * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

4.2 Mechanism Investigation

To illuminate the pathway through which AI adoption translates into reduced carbon emissions within pilot regions, this study posits that AI enhances the information efficiency of carbon trading markets, thereby strengthening the price signal that disciplines firm-level abatement behavior. We follow the structure of the baseline specification in Equation (1) and substitute the primary outcome variable with the price efficiency ratio (Barclay et al., 2008), defined as . This ratio, derived from daily carbon market transaction records sourced from the China Stock Market & Accounting Research (CSMAR) database and aggregated from the daily city level to the annual city level, captures the degree to which intraday price movement reflects net directional information rather than random noise. A value approaching unity indicates that prices move decisively from open to close relative to the full daily range—signaling that informed trading dominates and that market participants are efficiently incorporating new information into price discovery. Conversely, lower values reflect greater mid-session price reversals, consistent with elevated noise trading and diminished informational content.

The estimation sample is restricted to cities covered by the carbon emission trading system pilot programs, and the key explanatory variable remains the city-level AI patent number. Results are presented in Figure 2, which reports the estimated coefficient on AI under both the baseline specification without additional controls and the fully controlled specification. The estimated coefficient on AI is positive and statistically significant in both specifications, with point estimates of approximately 0.116 in each case and 95% confidence intervals lying largely above zero. This finding indicates that greater AI adoption is associated with a measurable improvement in carbon market price efficiency, specifically a higher price efficiency ratio, within carbon emission trading system pilot cities. These results lend empirical support to *Hypothesis 2*. AI technologies deployed by market participants, including machine learning-based forecasting models, high-frequency information aggregation, and automated trading systems, appear to reduce the share of noise-driven transactions and enhance the extent to which carbon permit prices reflect underlying supply and demand fundamentals. As market prices become more informationally efficient, they transmit cleaner and more credible cost signals to regulated entities, strengthening the incentive to invest in abatement technologies and low-carbon production processes.

4.3 Robustness Checks

4.3.1 Parallel Trends Test

Figure 3 reports the results of the parallel trends test based on the event study specification in Equation (2). Prior to the quasi-experimental intervention, the differences in carbon emissions between the treatment and control groups are not statistically significant. However, following the intervention, a noticeable decline in carbon emissions is ob-

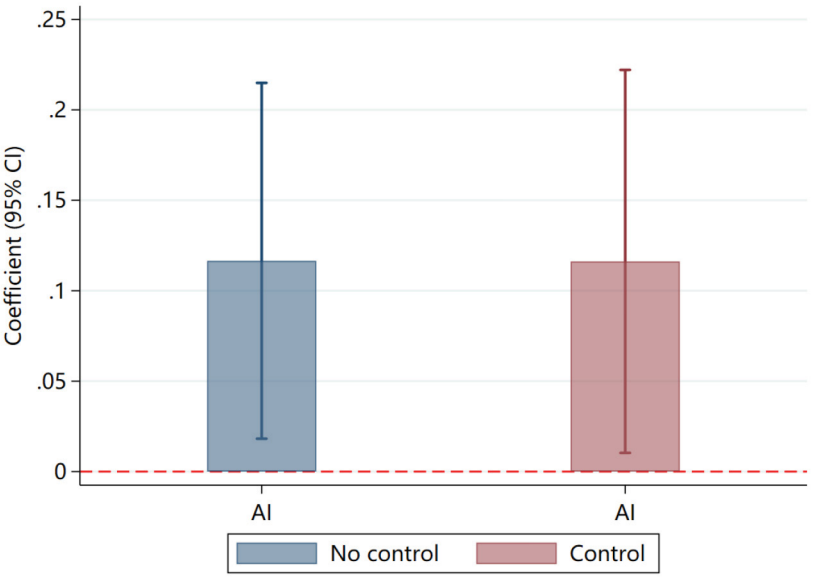

Figure 2. Mechanism analysis results

Note: The two sets of estimates differ in that the former excludes control variables and fixed effects, whereas the latter incorporates the full set of controls and fixed effects.

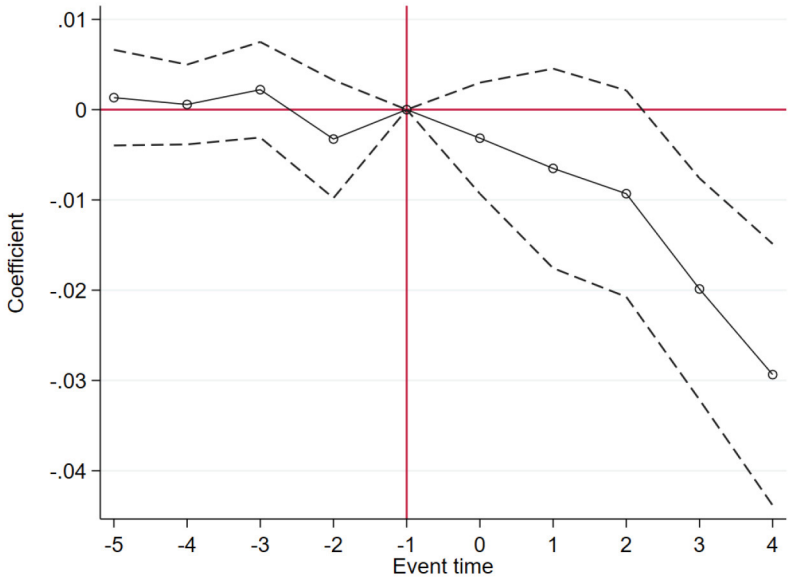

Figure 3. Dynamic effect estimation

Note: This figure reports the dynamic effect estimation of AI on decarbonization in carbon emission trading system. The horizontal axis represents the event time, relative to the year of the quasi-experimental shock. The vertical axis represents the estimated coefficients, showing the difference in carbon emissions (logged) between the treatment and control groups. The control strategy includes main effects, city control variables, city fixed effects, and year fixed effects, along with the 95% confidence intervals.

served in the treatment group relative to the control group. These post-intervention differences, compared with the pre-intervention differences, provide evidence consistent with the parallel trends assumption, suggesting that the observed reduction in carbon emissions in the treatment group is attributable to AI's integration into the carbon emission trading system rather than to pre-existing differences between the two groups.

4.3.2 Propensity Score Matching Estimation

Figure A1 reports the reduction in bias of city-level characteristic variables before and after 1:1 nearest-neighbor matching, showing that the average bias decreases to below 25%, indicating a satisfactory matching quality. After removing samples with substantial differences between the treatment and control groups, the baseline model is re-estimated. The specification remains consistent with the baseline estimation, incorporating main effects, city fixed effects, year fixed effects, and city-level characteristic variables. As shown in Table A3, the propensity score matching estimate is robust, with AI contributing to a 2.7% reduction in carbon emissions in the treatment group relative to the control group, statistically significant at the 1% level.

4.3.3 Placebo Test and Controlling for Other Climate Policies

Figure A2 presents the results of 100 placebo test re-estimations, indicating that the vast majority of placebo effects are smaller than the estimated coefficient for the treatment group. This provides preliminary evidence that omitted variables pose limited threats to the validity of the results. We further control for three climate policies that may confound the baseline estimation: the low-carbon city pilot program, pollution information disclosure, and central environmental inspections. These policies are coded as binary variables, assigned a value of one for the specific cities and years in which they were implemented and zero otherwise, and are included as control variables in the baseline model. As shown in Table A4, after controlling for the effects of these additional policies, AI contributes to a 2.09% reduction in carbon emissions in the treatment group relative to the control group, statistically significant at the 1% level.

4.3.4 Alternative Indicators and Extended Time Period Tests

We examine the sensitivity of the results using alternative indicators, including the logarithm of AI-related utility model patent applications, the number of authorized invention patents, and the number of authorized utility model patents. Tables A5 through A7 show that, even when employing different measurement indicators, AI contributes to reducing carbon emissions in the treatment group by 2.3%, 1.99%, and 2.42%, respectively, all statistically significant at the 1% level. Furthermore, the baseline model is re-estimated using the most recent carbon emission data from the Emissions Database for Global Atmospheric Research, extend-

ing the analysis through 2022 (covering the full period from 2000 to 2022). The results remain consistent with the main findings, as demonstrated in Figure A3, thereby providing additional support for the robustness of the study's conclusions.

4.3.5 Additional Robustness Checks

Entropy Balancing. A potential threat to the baseline estimates arises from pre-treatment differences between AI-adopting and non-adopting cities that may confound the estimated effect of $AI \times CETS$. To address this, we implement entropy balancing, a covariate-balancing preprocessing technique that reweights control-group observations so that the weighted moments of key covariates—GDP, population, industry output, airport infrastructure, and high-speed rail access—match those of the treatment group. Table A8 reports the covariate distributions before and after balancing. After reweighting, the means, variances, and skewness statistics of all five covariates are closely aligned across the treatment and control groups, confirming that systematic pre-treatment heterogeneity has been effectively eliminated. As shown in Column (1) of Table A9, re-estimating the baseline specification on the entropy-balanced sample yields a coefficient on $AI \times CETS$ of −0.0175 ($p < 0.01$), consistent in sign, magnitude, and statistical significance with the baseline result. This finding confirms that the main effect is not an artifact of pre-existing compositional differences between cities.

Instrumental Variable (IV) Estimation. Two interrelated concerns motivate an IV approach. First, using AI-related invention patent applications as a proxy for actual AI adoption introduces measurement error: patents capture innovative activity rather than deployment, and a substantial share of filed patents may never translate into operational applications in climate governance contexts. Second, a reverse causality concern exists whereby cities confronting more severe carbon emission pressure may proactively invest in AI technology, conflating the proposed causal pathway (AI adoption → emissions reduction) with its reverse. To jointly address these issues, we instrument for $AI \times CETS$ using the interaction between the number of post offices per million inhabitants in 1984 and the one-year lagged value of the core explanatory variable. Historical postal infrastructure serves as a plausible instrument because it predicts the early diffusion of information and communication technologies, and by extension contemporary AI capacity, while being otherwise unrelated to current carbon emission levels conditional on the included controls. The Cragg–Donald Wald F-statistic of 1,093.532 substantially exceeds conventional weak-instrument thresholds, validating instrument relevance. Column (2) of Table A9 reports the IV estimates; the coefficient on $AI \times CETS$ is −0.0141 ($p<0.1$), confirming that the negative effect of AI-enabled policy enforcement on carbon emissions is not driven by measurement error in the proxy variable or by reverse causality.

Additional Control Variables. Omitting determinants of carbon emissions that are correlated with both AI adoption and carbon market participation risks biasing the estimated interaction effect. Two such confounders are of particular concern: energy structure and environmental regulatory intensity. We therefore augment the baseline specification with province-year level coal consumption (sourced from the Chinese Research Data Services Platform and merged to the city-year panel) as a measure of energy mix, and with the annual count of environmental administrative penalty cases at the city level (sourced from the Peking University Law database) as a proxy for regulatory enforcement stringency. Column (3) of Table A9 reports the results. The coefficient on $AI \times CETS$ remains negative and statistically significant at −0.0126 ($p < 0.01$), while GDP, industry output, and airport infrastructure continue to exhibit positive and significant associations with carbon emissions, consistent with prior expectations. The stability of the core estimate after the inclusion of these additional controls suggests that omitted variable bias is unlikely to account for the main findings.

5. Discussion

5.1 AI as a Complement to, not a Substitute for, Policy Design

The findings of this study speak to a central question in the public policy literature: what determines whether a policy instrument achieves its intended behavioral effects? As Capano and Howlett (2020) argue, the success of any instrument depends not only on its technical architecture—the precision of its targets, the stringency of enforcement, the clarity of compliance schedules—but also on the design attributes that shape how target populations perceive and respond to the policy. Among these attributes, policy legibility (Chen and Greitens, 2022) and credibility (Fan et al., 2021) are especially consequential—a well-designed regulatory instrument that is opaque in communication or inconsistent in enforcement will fail to elicit the behavioral responses it intends.

Our results suggest that AI functions as an amplifier of these design attributes within the carbon emission trading system. By enabling near-real-time parsing of regulatory texts and policy announcements, AI-assisted information systems reduce the cognitive cost that market participants must incur to decode carbon market signals. This does not simplify the underlying regulatory content; rather, it lowers the barrier to understanding it. At the same time, the improvement in the price efficiency ratio documented in our mechanism analysis indicates that policy commitments are reflected in carbon prices more rapidly and completely. When market participants observe that prices respond coherently to new policy information, confidence in the regulatory regime's forward-looking commitments is reinforced, strengthening incentives for long-horizon abatement investment.

This interpretation carries an important implication: AI does not render

good policy design irrelevant; it raises the returns to it. A poorly designed carbon market—one with opaque allocation rules, inconsistent enforcement, or politically driven cap adjustments—would generate noisy and contradictory signals that even sophisticated AI systems could not coherently synthesize. The emission reductions documented here are therefore best understood as a joint product of institutional design quality and technological information-processing capacity, not as evidence that technology can substitute for institutional quality.

5.2 Market Participation and Price Discovery

Our mechanism evidence also sheds light on how AI affects the quality of market participation. The improvement in the price efficiency ratio indicates that a larger share of intraday price movement in AI-augmented pilot cities reflects genuine informational updating rather than noise or liquidity-driven reversals. This pattern is consistent with a market in which informational barriers between informed and uninformed participants have been reduced, enabling a broader set of actors to engage with policy-relevant information when making trading decisions. The finding connects to Grossman and Stiglitz's (1980) foundational insight that the allocative efficiency of price-based mechanisms is bounded by the cost of information acquisition—by reducing this cost, AI tilts the composition of market activity toward fundamentals-driven participation. In practical terms, AI appears to shift the margin of market engagement from minimal compliance toward more informed trading behavior, thereby strengthening the price discovery function that gives emissions trading its dynamic efficiency advantage over command-and-control alternatives.

5.3 Contextualizing the Magnitude of Effects

The estimated reduction of approximately 2.1 percent in carbon emissions, while modest in absolute terms, should be interpreted against two benchmarks. First, it represents an incremental gain layered on top of an already functioning cap-and-trade system—a marginal efficiency improvement that compounds over time as AI adoption deepens. Second, the estimate captures only the informational channel of AI's impact; the full decarbonization potential of AI, encompassing direct applications in energy management, industrial process optimization, and grid coordination, is likely substantially larger. The modesty of the estimated effect is a feature of the identification strategy, which isolates one theoretically precise mechanism, rather than a limitation of the analysis.

6. Conclusion

6.1 Summary of Findings

This study investigates whether and how AI accelerates decarbonization within China's carbon emission trading system. Drawing on signaling theory transposed into a public policy context, we conceptualize AI as a policy signal accelerator—an information-processing layer that compresses the temporal and cognitive dis-

tance between the generation of climate policy signals and their internalization into carbon market prices. The empirical analysis exploits a quasi-experimental design in which the staggered rollout of carbon emission trading system pilots across Chinese cities provides plausibly exogenous variation in exposure to AI-augmented carbon trading infrastructure.

Three principal findings emerge. First, triple-difference estimates indicate that AI integration into the carbon emission trading system reduces carbon emissions in treatment-group cities by approximately 2.1 percent relative to control-group cities, a result that is statistically significant at the one percent level and robust across a comprehensive battery of sensitivity checks. Second, mechanism analysis reveals that AI adoption is associated with a statistically significant increase in the price efficiency ratio within carbon trading pilot cities, indicating that AI compresses the share of noise-driven transactions in intraday price movements. Third, these findings validate the study's two core hypotheses: AI contributes to accelerating decarbonization through the carbon emission trading system (Hypothesis 1), and it does so via a signaling-efficiency mechanism that improves market price discovery (Hypothesis 2).

6.2 Policy Implications

The findings yield several actionable implications. First, governments should invest in the digital information infrastructure surrounding carbon markets, not only in market architecture itself. The evidence that AI improves the price efficiency ratio—and that this improvement translates into emission reductions—implies that policies promoting AI-assisted market monitoring and real-time regulatory text analysis can complement conventional cap-and-trade design parameters. Public investment in open-access, AI-powered policy information platforms could help democratize informational advantages that currently accrue to technologically advanced participants.

Second, the finding that AI amplifies the returns to good policy design underscores the importance of regulatory clarity. In an environment where AI systems continuously parse and price regulatory signals, ambiguity or politically motivated deviations from announced policy trajectories will be identified and priced more rapidly than in a pre-AI regime. Well-communicated commitments will be rewarded with faster market adjustment and stronger abatement incentives; policy reversals will be penalized more swiftly.

Third, as carbon markets expand—including through the ongoing national rollout of China's emission trading system—policymakers should proactively address the distributional implications of AI-augmented information processing. This may involve establishing minimum digital infrastructure standards for market participation, providing technical assistance to smaller emitters, and designing surveillance mechanisms capable of detecting whether AI-driven informational advantages produce systematic patterns of market power.

6.3 Limitations and Future Research

This study is subject to several limitations. First, the measurement of AI adoption relies on patent-based indicators at the city level—a proxy that captures the intensity of technological activity but does not directly observe the deployment of specific AI applications within carbon trading operations. Future research employing firm-level data on AI tool adoption, or exploiting natural experiments associated with the rollout of specific AI-powered trading platforms, would permit more granular identification.

Second, the analysis is confined to the Chinese carbon emission trading system, which operates within a distinctive institutional context characterized by strong state capacity and centralized regulatory authority. While the theoretical framework is generalizable in principle, the empirical magnitudes may differ in systems with different institutional configurations, such as the EU Emissions Trading System or nascent carbon markets in developing economies. Cross-country comparative research is needed to assess external validity.

Third, the study documents an average treatment effect without disaggregating across firm types, industrial sectors, or regional development levels. As noted in the discussion, the distributional dimension of AI-augmented market efficiency is both theoretically important and policy-relevant, and heterogeneous treatment effect analysis should be a priority for future work.

Fourth, the temporal scope of the analysis does not capture the most recent advances in generative AI and large language models, which have dramatically expanded the capacity of AI systems to process complex, unstructured policy information. As these technologies diffuse into carbon market operations, their effects on price discovery may be qualitatively different from those estimated here. Longitudinal research tracking the co-evolution of AI capabilities and carbon market performance will be important.

Finally, this study focuses on the informational channel but does not examine potential feedback effects between AI-augmented price discovery and the political economy of cap-setting. If improved price signals make it easier for regulators to tighten caps by demonstrating that abatement is cost-effective, the long-run impact of AI integration may exceed what the current estimates suggest. Exploring these recursive dynamics between technology, market efficiency, and policy ambition represents a productive frontier for research at the intersection of public policy, environmental economics, and computational social science.

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Understanding the Agitation Adopting Artificial Intelligence in Frontline Public Service Delivery: A Context-Value-Behavior Framework

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Abstract

While Artificial Intelligence (AI) is frequently championed as a transformative tool for public services, its frontline implementation is often characterized by "agitation" rather than seamless integration. Moving beyond the cognitive appraisal of Technology Acceptance Model, this study investigates the sustained state of uncertainty and negotiation among frontline public service deliverers. Drawing on 19 in-depth interviews with frontline public service deliverers in China, this study develops a Context-Value-Behavior framework to deconstruct this complexity. Our findings reveal a fundamental tension: the algorithmic logic of AI, which prioritizes standardized efficiency, directly clashes with the professional logic of frontline public service deliverers, which is rooted in contextual intelligence and human-centric directions. They employ a range of behavioral strategies—from deep integration to deliberate disengagement—while constantly wrestling with the trade-offs between systemic efficiency and core professional values under constrained resources. The primary contribution of this study is to extend the Technology Acceptance Model by situating it within the messy realities of frontline service delivery, demonstrating that technology adoption is an ongoing, agentic process of co-evolution. We conclude that for AI to be truly enabling, policy must recognize, actively engage with, and adapt to the lived experience of frontline agitation.

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Keywords: Frontline public service deliverers, Artificial Intelligence, Agitation, Context-Value-Behavior Framework, Technology Acceptance Model

Comprender la agitación que genera la adopción de la inteligencia artificial en la prestación de servicios públicos de primera línea: un marco de contexto, valor y comportamiento

Resumen

Si bien la Inteligencia Artificial (IA) se suele presentar como una herramienta transformadora para los servicios públicos, su implementación en primera línea a menudo se caracteriza por la incertidumbre en lugar de una integración fluida. Más allá de la evaluación cognitiva del Modelo de Aceptación de la Tecnología, este estudio investiga el estado persistente de incertidumbre y negociación entre los profesionales que prestan servicios públicos en primera línea. A partir de 19 entrevistas en profundidad con profesionales de estos servicios en China, este estudio desarrolla un marco de Contexto-Valor-Comportamiento para desglosar esta complejidad. Nuestros hallazgos revelan una tensión fundamental: la lógica algorítmica de la IA, que prioriza la eficiencia estandarizada, choca directamente con la lógica profesional de los profesionales que prestan servicios públicos en primera línea, la cual se basa en la inteligencia contextual y en un enfoque centrado en el ser humano. Estos profesionales emplean diversas estrategias de comportamiento —desde la integración profunda hasta el distanciamiento deliberado— mientras lidian constantemente con las compensaciones entre la eficiencia sistémica y los valores profesionales fundamentales en un contexto de recursos limitados. La principal contribución de este estudio radica en ampliar el Modelo de Aceptación Tecnológica, situándolo en la compleja realidad de la prestación de servicios en primera línea. Esto demuestra que la adopción de tecnología es un proceso continuo y participativo de coevolución. Concluimos que, para que la IA sea realmente transformadora, las políticas deben reconocer, abordar activamente y adaptarse a la experiencia vivida de la agitación en primera línea.

Palabras clave: Prestadores de servicios públicos de primera línea, Inteligencia artificial, Agitación, Marco de contexto-valor-comportamiento, Modelo de aceptación de la tecnología

理解一线公共服务中采用人工智能的躁动：一个情境-价值-行为框架

摘要

尽管人工智能常被誉为公共服务的变革性工具，但在实际的一线应用中，其特征往往是“躁动”，而非无缝衔接。本研究超越了传统技术接受模型的认知评估视角，深入探讨了一线公共服务人员在人工智能应用中持续存在的这种躁动状态。通过对中国19位一线公共服务递送者的深度访谈，本研究构建了一个“情境-价值-行为”框架来解构这一复杂性。研究发现，AI的应用引发了一种根本性的张力：优先考虑标准化效率的“算法逻辑”，与扎根于情境智慧和以人为本的“专业逻辑”之间存在直接冲突。 一线公共服务递送者并非消极地接受技术，而是在一个动态过程中进行博弈：他们采用了一系列行为策略——从深度整合到刻意脱离——同时在资源有限的情况下，不断地在系统效率和核心专业价值之间进行权衡。本研究的主要贡献在于通过将技术接受模型置于一线服务的复杂现实场域中，对其进行了扩展，证明了技术采纳是一个持续的、具有主体性的共演过程。我们得出结论：若要使人工智能真正发挥赋能作用，政策必须承认、积极应对一线公共服务递送者在实践中所经历的这种“躁动”。

关键词：一线公共服务递送者；人工智能；躁动；“情境-价值-行为”框架；技术接受模型

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1. Introduction

Artificial Intelligence (AI) is profoundly reshaping frontline public service delivery, particularly for street-level bureaucrats such as police officers, social workers and nonprofit organization employees, improving their decision-making process and enhancing the quality of service provided (An et al. 2025; Selten et al. 2023; Schiff et al. 2025; Young et al. 2019; Zhang et al. 2025). However, a more complex and unsettled reality is emerging. Beyond the grand narrative of technological empowerment, empirical observations reveal a landscape marked by palpable “agitation”—a widespread sense of uncertainty and underlying tensions among frontline public service deliverers (FPSDs), which seems completely different from previous adoption of new technologies such as computers or mobile communications (Golgeci et al. 2025; Raisch and Krakowski 2021). This agitation stems from a core dilemma that distinguishes AI from previous technologies—it directly augments, and at times supplants, the core discretionary and judgmental processes that de-

fine professional expertise (Jones 2024; Spring et al. 2022). Unlike resistance, which implies outright opposition to technology (Kruger 2025), or ambivalence, which captures the coexistence of positive and negative attitudes toward an innovation (Dagtekin and Kabakus 2025), and distinct from motivated skepticism, understood as a form of defensive bias to protect existing beliefs (Bhattacherjee and Premkumar, 2004), "agitation" refers to a sustained, unsolved oscillatory state characterized by alternating attraction and hesitation. Analytically, it comprises two constitutive dimensions—a behavioral dimension of vacillation between adoption and disengagement, and a value dimension of irresolvable tension among competing professional commitments. These two dimensions are mutually reinforcing—value tensions manifest as behavioral vacillation, while behavioral oscillation, in turn, deepens the underlying value conflicts. Accordingly, these responses are fragmented and often contradictory, manifesting as a spectrum from eager adoption to strategic avoidance, reflecting a state of unresolved tension rather than a clear path forward (Meijer et al. 2021; Selten et al. 2023). This phenomenon of agitation is continuing and expanding, which is quite different from the impact of the emergence of other new technologies such as the Internet or mobile Internet on public service delivery. Therefore, it is necessary to expand the focus of research from the acceptance of new technologies to more complex directions.

Existing research on AI in frontline public service delivery has predominantly emphasized its impact on the user end, particularly concerning user experience and service outcomes (Chen et al. 2021; Gesk and Leyer 2022; Willems et al. 2023). As a result, there remains a notable scarcity of practical insight into how AI impacts FPSDs (Selten et al. 2023). Technology Acceptance Model (TAM) and its variants provide a starting point but falls short of explaining the complex agitation. The TAM, which posits that adoption is primarily driven by perceived usefulness and perceived ease of use (Venkatesh and Davis 2000), offers a valuable yet simplistic and decontextualized lens, failing to capture the fundamental tensions with professional logics and public value trade-offs that define public service settings (Cordella and Tempini 2015; Sun and Medaglia 2019). Specifically, a disjuncture becomes critical when an algorithmic logic of standardization and efficiency confronts the deep-rooted professional logic of street-level bureaucrats, which is grounded in professional discretion, contextual ethics, and empathy (Møller et al. 2022; Selten et al. 2023). Therefore, TAM might predict whether a tool is seen as useful or easy to use in a vacuum, but it cannot adequately explain why a FPSD who finds AI useful might resist it to protect their professional discretion, or why another might be forced to use an AI they perceive as ethically risky. In short, TAM illuminates the initial pull of technology but is silent on the push-and-pull of daily practice that generates sustained agitation.

To address this gap, our study moves from predicting acceptance to

understanding agitation. We pose the following research question: What constitutes the FPSDs' agitation surrounding AI adoption, and how is this state produced by the complex interplay of contextual constraints, value-based reasoning, and behavioral adaptations? To investigate this issue, we conducted in-depth interviews with 19 FPSDs from China's social service sectors, where the tension between algorithmic recommendations and professional discretion is particularly salient due to the requirement for high-stakes, contextualized professional judgment. Notably, we focus specifically on social workers, non-profit organizations' employees and other service deliverers in China for three interrelated reasons. First, China offers a uniquely revealing context for studying frontline agitation. FPSDs in China operate at the nexus of stringent top-down policy directives and substantial on-the-ground discretion (Lu et al. 2025). This convergence of rapid technological advancement and the inherent adaptability of frontline practice make them especially sensitive to the tensions between efficiency mandates and the relational, trust-based nature of their work, offering an ideal setting to observe how agitation unfolds and evolves. Second, the essence of social work lies in high-stakes, contextualized professional judgment, making it an ideal context to observe the core tension between algorithmic recommendations and professional logics. Third, within China's public service ecosystem, numerous services are delivered through government procurement from qualified social service sectors, a mechanism that tightly couples policy initiatives with localized implementation, further sharpening the contradictions that give rise to agitation.

The primary theoretical contribution of this study is to leverage and extend the TAM perspective by proposing a Context-Value-Behavior (CVB) framework that dissects the inner workings of the agitation. Rather than replacing TAM, our framework explains its limitations in the adoption of AI. We argue that the core TAM constructs are profoundly mediated and reshaped by the situated context, intense value trade-offs involving professional values and public ethics, and the resulting behavioral strategies that characterize frontline public service delivery. It is the dynamic and often conflicting interplay of these three dimensions that co-produces the observed state of agitation. By doing so, this research opens a new agenda for studying AI in public services, one that takes the unsettled reality of frontline practice as its central focus and offers a more nuanced understanding of the journey from technological potential to grounded use.

2. Literature Review

2.1 The Paradox of AI Empowerment and Frontline Agitation

AI is widely championed for its potential to revolutionize public service delivery by enhancing efficiency, accuracy, and consistency, thereby ultimately promising improved outcomes for citizens (Bullock 2019; Wirtz et al. 2019). For FPSDs, it is envisioned as a powerful

tool to alleviate administrative burdens, augment decision-making, and manage complex caseloads (Grimmelikhuijsen 2022). However, this optimistic narrative appears to diverge from the empirical facts observed at the frontline. Rather than seamless adoption, a growing body of studies reveal a landscape characterized by a state of palpable "agitation"—a heterogeneous and often contradictory mix of behavioral responses ranging from active integration to strategic avoidance and outright resistance (Meijer et al. 2021; Selten et al. 2023). This disparity poses a critical puzzle: if AI is so objectively empowering, why does its introduction provoke such widespread and unresolved agitation among the FPSDs?

The research gap becomes increasingly apparent when the focus shifts from merely documenting the diverse patterns of AI usage to explaining the underlying drivers of these behaviors. The persistence of skepticism among FPSDs, who often place greater trust in their professional discretion and practical experience than in AI-generated recommendations, underscores the limitations of purely optimistic, top-down narratives of AI (Kunda 1990; Meijer et al. 2021; Snow 2021; Selten et al. 2023; Taber and Lodge 2006). To unravel this paradox, it is necessary to examine the theoretical lenses offered to explain technology adoption. The TAM, as a dominant framework, provides a foundational starting point by linking adoption to perceived usefulness and ease of use (Davis 1989; Taherdoost 2018). Yet its individualistic and decontextualized nature renders it insufficient for fully capturing the complex realities of frontline public service delivery. The following analysis will critically assess TAM's utility and, crucially, its limitations in explaining the agitation observed in the AI adoption of FPSDs.

2.2 Technology Acceptance Model: A Foundational Yet Incomplete Lens

The TAM stands as a pivotal theoretical framework for explaining and predicting individual acceptance of information technologies. Grounded in an individual-level cognitive perspective, TAM posits that users' behavioral intentions are primarily determined by two core beliefs: perceived usefulness, defined as the degree to which a person believes that using a system would enhance their job performance, and perceived ease of use, referring to the degree of effort associated with the system's use (Davis 1989; Venkatesh et al. 2016). This parsimonious model has demonstrated remarkable predictive power across a wide range of commercial and organizational contexts, where efficiency and usability are often the paramount concerns. Its predictive utility is contingent upon the relative simplicity of the adoption environment, where individual cost-benefit calculations are the primary drivers of behavior.

The robustness of TAM framework is well-established in commercial and organizational contexts that align with its underlying assumptions of individual rational choice and efficiency maximization (Venkatesh et al. 2003). For instance, studies on the adoption

of enterprise resource planning systems or office productivity software within business organizations largely confirm model's core tenets (Venkatesh and Davis 2000). Similarly, e-commerce research typically conceptualizes perceived usefulness in terms of consumer convenience and cost-reduction—a context where the individual user is the primary decision-maker operating with relative discretion (Gefen et al. 2003). In these settings, the dominant logic is efficiency enhancement, process streamlining, and cost-effectiveness, which align seamlessly with TAM's core construct.

However, the translation of TAM to the frontline public service delivery context reveals a fundamental disjuncture. Here, FPSDs are not sovereign consumers or purely efficiency-driven employees. They are street-level bureaucrats whose work is guided by a professional logic that encompasses experiential judgment, ethical reasoning, and empathetic engagement (Møller et al. 2022; Selten et al. 2023). Prior research that has attempted to directly apply TAM to public sector e-government systems often encounters this complexity. For example, studies might find that while perceived usefulness is a significant factor, it is not sufficient to explain adoption, with variables like "trust in government" or "perceived risk" needing to be added as external extensions to the core model (e.g., Bélanger and Carter 2008; Guo et al. 2024). This comparison indicates systematic differences between the two contexts, underscoring that technology adoption in the latter is shaped not only by perceived usefulness but also by a constellation of interrelated normative values. This insight suggests that any framework aiming to explain AI adoption in FPSDs must move beyond TAM's cognition-centered view and treat "Value" as a core analytical dimension.

This observation not only underscores the necessity of integrating a value-oriented dimension but also highlights a fundamental limitation of TAM: its inherently decontextualized and individualistic orientation (Cordella and Tempini 2015; Malatji et al. 2020). Although subsequent extensions of TAM have incorporated facilitating conditions—such as managerial, organizational, and peer support—these factors are conceptualized as perceptions of external control (Venkatesh and Bala 2008), functioning solely as antecedents to perceived ease of use rather than as independent analytical constructs. This limitation renders TAM unable to explain why FPSDs exhibit substantial variation in AI acceptance even under identical facilitating conditions, or why this variation persists over time as sustained "agitation" rather than resolving into acceptance or rejection.

In summary, the explanatory boundaries of the TAM in frontline public service contexts manifest as three persistent theoretical challenges. First, TAM cannot be fully accounted for cases in which FPSDs consciously recognize an AI's system's perceived usefulness and ease of use, yet refrain from adopting it due to normative or ethical concerns, a phenomenon which reflect a systematic decoupling between

cognitive evaluations and behavioral intention. Second, existing extensions of TAM conceptualize contextual factors as exogenous antecedents rather than endogenous components integral to the decision-making process. Consequently, these extensions do not adequately account for how contextual factors dynamically reshape individual's value priorities and recalibrate their behavioral strategies. Third, the explanatory logic of TAM is grounded in an assumption that adoption culminates in a relatively stable endpoint of acceptance or rejection, which offers limited theoretical leverage for capturing the emergence and persistence of "agitation." Collectively, these limitations expose a foundational theoretical gap: current model and frameworks cannot explain how structural conditions, normative commitments, and contextually situated behavioral strategies dynamically interact to generate and sustain "agitation." This gap is fundamentally a question of dynamic interplay rather than static factors. The CVB framework is developed to address this gap, with its three dimensions corresponding respectively to these neglected analytical domains.

2.3 Toward an Integrated Framework: Context, Value, and Behavior

Building on the gaps identified above, the CVB framework is developed around three core dimensions: Context, Value, and Behavior. First, "Context (C)" refers to the external structural conditions that shaped FPSDs access to and engagement with AI. The term of "structural" refers to systematically patterned conditions embedded in organizational hierarchies and policy framework, including resource availability, organizational directives and regulatory ambiguity. It might address TAM's treatment of facilitating conditions solely as antecedents to cognitive beliefs. Beyond enabling or constraining adoption, the contextual conditions play a generative role: they activate and intensify specific value trade-offs that would otherwise remain latent for FPSDs. Second, "Value (V)" reflects the competing professional and ethical considerations that FPSDs navigate, including the tensions among algorithmic efficiency, professional directions, and public service values. These value claims often override purely cognitive assessments of usefulness. Critically, these heightened value conflicts do not merely coexist, they directly guide the selection of behavioral strategies, as FPSDs attempt to provisionally resolve professional dilemmas. Finally, "Behavior (B)" indicates the observable strategies and adaptive practices through which FPSDs negotiate their relationship with AI, ranging from deep integration to strategic resistance. These behaviors are not static outcomes but evolve over time and feed back into "Context" and "Value." It is this self-reinforcing feedback loop that systematically reproduces frontline agitation as a sustained, unresolved state rather than a transient reaction to technological change. This tripartite conceptual framework aligns with core analytical distinctions in organizational research—namely, structural conditions, interpretive frameworks, and enacted practices—while maintaining deliber-

ate theoretical parsimony (Bolman and Deal, 2013).

Collectively, the analytical novelty of the CVB framework resides in the dynamic, reciprocal interplay among these three dimensions. Specifically, contextual conditions activates and intensifies latent value tensions (C→V). These heightened tensions, in turn, shape FPSDs' strategic behavioral response, ranging from selective compliance to active resistance (V→B). Subsequently, such recurring behavioral patterns institutionalize over time, feeding back into the structural environment by reshaping organizational norms, routines, and implementation practices (B→C). Within this loop, agitation is not a separate outcome to be explained; it is the very state that the CVB system exhibits when value conflicts remain unresolved and behavioral vacillation persists—a state sustained by the recursive failure of Context, Value, and Behavior to settle into a stable configuration. This self-reinforcing feedback loop explains how agitation is systematically produced and sustained as a chronic state rather than a transient reaction to technological change, an insight that fundamentally distinguishes the CVB framework from the endpoint-oriented logic of TAM.

3. Methods

This study employs a qualitative, multiple-case study design to investigate the complex and contextualized phenomenon of AI adoption among FPSDs. Given that the AI adoption is deeply embedded in and inseparable from the context of frontline public service delivery, we turned to qualitative methodology, which Yin (2018) defines as an empirical inquiry that investigates a contemporary phenomenon in depth within its real-life context. This approach is therefore particularly appropriate for addressing "how" and "why" questions surrounding the heterogeneous patterns of AI use. Moreover, qualitative methodology, especially case study research, is particularly valuable when a research domain is still in a nascent stage (Benbasat et al. 1987), as is the case with AI implementation in frontline public service. This methodology enables the construction of a richly descriptive analysis grounded in diverse and in-depth sources of information, which is a necessity for capturing the multi-faceted complexity of the phenomenon (Hancock et al. 2021; Merriam and Tisdell 2015). Importantly, this method is deemed optimal for practice-based problems where the experiences of the actors are important, and the context of action is critical (Benbasat et al. 1987).

Our research is guided by an integrated CVB framework, which moves beyond siloed theoretical explanations to capture the dynamic interplay between external constraints, internal reasoning, and situated practices. The research design is uniquely suited to this framework, as it enables an in-depth exploration of how contextual conditions, value trade-offs, and behavioral strategies collectively shape the differential patterns of AI adoption, thereby directly aligning with and addressing our core research questions (R. Subudhi et al. 2019).

3.1 Participant Recruitment

Table 1. Basic Information Table of Interviewees

No.	The Interviewee's Workplace	Age	Length of Service	Service Field	Educational Background
LMH	SWO	25	1.5	Migrant workers	Law
CXK	SWO	26	2	Migrant workers	International Business
LC	F	37	13	Teenagers	Social work
ZYS	CSW	34	4	Community residents	Chinese language
WCL	CSW	31	3	Community residents	Law
HF	SSWS	32	6	Street residents	Social work
XHL	SWO	27	2.5	Women	Social work
WQM	CSW	32	5	Community residents	Psychology
LRN	SSWS	31	4.5	Street residents	Social work
HSQ	SWO	38	15	Children, Family	Social work
MJH	F	42	9	The elderly	Journalism
ZL	CSW	27	7	Community residents	Marketing
WLY	SSWS	29	4	Street residents	Sociology
CTH	SWO	28	3	Migrant women	Human Resources
LZH	F	35	3.5	Teenagers	Social work
LMJ	SWO	43	8	The elderly	Social work
CXY	SWO	27	3.5	Migrant children	Accounting
WCF	SSWS	30	4	Street residents	Sociology
LZX	SWO	27	3	People with disabilities	Social work

**Note: The abbreviation for the interviewee's workplace is defined as follows: SWO stands for Social Work Organization, F stands for Foundation, CSW stands for Community Social Workers, SSWS stands for Street-level Social Work Station. Age and length of service are expressed in whole years.*

Eligibility criteria required participants must be frontline professionals with a minimum of one year of direct service experience and consistent, routine exposure to AI-based tools in their day-to-day professional practice. Meanwhile, guided by the principle of maximum variation (Patton 2015), we purposively sampled participants diverse in geographic coverage, organizational affiliations, service population, and individual demographics. This intentional heterogeneity captures the diverse realities encountered on the front lines. Importantly, participant recruitment was conducted using a dual-strategy sampling approach that integrated purposive and snowball sampling methods. Initial participants were identified through organizational gatekeep-

ers, and subsequent participants were recruited through a snowball sampling strategy, leveraging referrals from previously enrolled participants.

Based on these criteria and strategies, this study selected 19 FPSDs from five types of practitioners within China's public service ecosystem: community social workers, street-level social work stations' workers, social work organizations' workers and foundations employees (As shown in Table 1). Respondents were recruited from five Chinese cities—Beijing, Guangzhou, Xiamen, Zhuhai, and Karamay—spanning eastern, southern, southeastern, and northwestern regions. This selection encompasses both economically advanced coastal metropolises and strategically important inland urban centers, thereby reflecting diverse levels of socioeconomic development, regional policy contexts, and institutional frameworks. The primary beneficiaries of the participants' services include migrant workers, youth, older adults, women, children, persons with disabilities, and general community residents—reflecting a deliberate commitment to serving both historically marginalized groups and populations affected by emerging societal challenges. The participants also vary significantly in key demographic attributes: length of service ranges from 1.5 years to 15 years, forming a clear career development ladder; educational backgrounds range from associate degree to postgraduate level, encompassing a diverse array of academic disciplines; gender composition reflects the gender distribution of the social work profession in China; ages range from 25 to 43, capturing both younger and mid-career perspectives. This combination of breadth and depth satisfies both the "maximum variation" and "typical case" criteria in social science research.

3.2 Data Collection

We collected primary data through in-depth, semi-structured interviews with the 19 selected participants. Semi-structured interviews were conducted both in person and remotely, with duration ranging from 45 to 90 minutes (mean = 65 minutes). The interview protocol was designed around the core dimensions of TAM while remaining attentive to the specificities of frontline public service practice. This allowed participants to provide detailed narratives of their experiences with AI. The interviews followed a semi-structured format with open-ended questions, which provided a flexible yet guided conversational path (Karatsareas 2022). We first asked participants to describe their professional roles, daily responsibilities, and the broader organizational and policy context of their work. We then guided the conversation toward their specific interactions with AI systems, inquiring about typical use scenarios, perceived benefits, and encountered challenges. Finally, we posed probing questions designed to elicit the underlying reasoning and tensions in their practice, such as how they navigated situations where AI recommendations conflicted with their professional judgment. Throughout the process, we encouraged participants to elaborate on their responses and provide concrete examples, ensuring the collection of rich, contextualized data.

3.3 Data Analysis

For data analysis, we employed a mixed deductive-inductive thematic analysis approach, facilitated by Nvivo 15 software (Several of the encoding results are presented in Table 2). First, after speech-to-text conversion and error correction, we imported the transcribed records into Nvivo 15. Drawing on our CVB framework, we conducted first-level deductive coding by initial identifying three broad categories, Context, Value, and Behavior. Next, through second-level deductive coding, we performed line-by-line analysis to extract central statements according to constraint contextual conditions, value tension, and strategy-adaptation. Subsequently, we carried out third-level inductive coding: through iterative analysis we generated 56 first-order analytic units. At this stage, no predetermined theoretical structure was imposed. Through sustained comparison among these emergent units and dialogue with the literature, we recognized that certain recurring code—such as concerns over data security and fears of de-professionalization—could not be adequately accommodated within existing TAM logic. This recognition compelled us to construct an independent Value dimension and to reconfigure the relationships among Context, Value, and Behavior. The three-dimensional CVB structure thus crystallized through this iterative movement between data, emergent codes, and theoretical reflection. For example, initial practitioner concerns, such as "concerns about the erosion of professional competence" and "AI's inability to account for clients' unique contextual circumstances," were systematically aggregated and refined into the higher-order thematic category "threats to professional discretion," which subsequently informed the Value dimension of the CVB framework. Building on this, by engaging with the literature and theoretical dialogue we constructed an analytical framework encompassing technical suspension, regulation and training, reducing the burden of paperwork, value-based exclusion, and instrumental dependence. To enhance coding reliability, a representative subset of transcripts was independently coded by two trained members of the research team. Discrepancies between coders were systematically addressed through consensus meetings, during which code definitions were clarified, boundary case reviewed, and coding guideline refined. The final coding framework from iterative discussion and collective agreement among all team members. Finally, we conducted a saturation check: after coding the 15th transcript, the analytic units stabilized, and by the 19th transcript no new core concepts emerged, indicating that theoretical saturation had been reached.

3.4 Ethical Considerations

This study adhered to the rigorous ethical standards throughout the research process. Firstly, prior to each interview, we obtained informed consent from all participants. We clearly explained the research purpose, procedures, and potential risks and benefits, emphasizing the voluntary nature of their partici-

pation and their right to withdraw at any time without penalty. Secondly, to protect the privacy and confidentiality of all individuals and organizations involved, we anonymized all data during transcription, using pseudonyms for participants and avoiding any identifiable information in subsequent reporting. Third, recognizing that researcher subjectivity is an inherent part of qualitative inquiry, we engaged in critical reflexivity to ensure the trustworthiness of our findings (Guillemin and Gillam 2004). This continuous reflexive practice helped us to challenge our assumptions, consider alternative explanations, and ensure that our emergent themes and conclusions were firmly grounded in the participants' narratives rather than our own biases.

Table 2. Several of the Encoding Results

Core Dimension	Theoretical category	Empirical representation (Three-level coding)	Representative original interview texts (Excerpts)
Contextual Logic	Resource Endowment	Technical Suspension	"The working hours of the workers we serve have been so long that they simply don't have the energy to participate in the activities... This is not a problem we can solve." (Social Work Organization -CXK)
	External Environment	Regulation and Training	"Our organization clearly stipulates that it is not allowed to include service recipients... Upload the document table to the platform, voice-to-text... It must be manually reviewed." (Social Work Organization -LMJ)
Value Logic	Efficiency Gain	Reduce the Burden of Paperwork	"That kind of administrative work is a bit too routine and burdensome... With AI, a lot of pressure from paperwork will be reduced." (Street Social Work Station -WCF)
	Professional Discretion	Value-based Exclusion	"They randomly generate a supervision record... It's just a bit perfunctory... In fact, it is often the case that records provide guidance for a social worker's work." (Social Work Organization -HSQ)
Behavior Logic	Deep Integration Strategy	Instrumental Dependence	"Almost every day, I use AI to check problems for me or polish the text... It saves me the time of looking for it myself." (Social Work Organization -XHL)

4. Findings

Our research has yielded a distinct formation logic, namely the explanatory framework of CVB, which facilitates a comprehensive understanding and allows us to systematically analyze how external structures, internal reasoning, and situated practices interact to co-produce the diverse AI adoption patterns observed at the frontline, thereby directly addressing our core puzzle: Why are they differences?

4.1 Contextual Logic: The Combined Effect of Resources and Environment

4.1.1 The Differentiation of Resource Endowments

During the research process, we observed that most FPSDs do not inherently resist the adoption of AI. Rather, limited access to this technology is primarily attributable to disparities in resource availability and allocation.

> *Our organization aims to establish a more equal and friendly environment ... But now their working hours have become so long that they simply don't have the energy to participate. It's extremely tricky. We are very distressed. This is not a problem we can solve.* (Social Work Organization -CXK)

This suggests that resource constraints and task complexity in frontline settings inherently restrict FPSDs' access to emerging technologies. Their cautious approach to AI adoption is typically not rooted in resistance to technological change, but rather in a pragmatic awareness that resource-scarce environment cannot support its meaningful integration. Moreover, they often lack the sufficient resources and time to develop a comprehensive understanding of AI. This phenomenon can be aptly described as technological suspension—the underutilization of new technologies arising not from intrinsic reluctance, but from structural inequities in resource distribution that produce unequal access to technological advancements.

> *We are a grassroots frontline organization, so we actually don't have too many requirements for data organization or image generation ... Then there would be no need to deliberately organize the data. For instance, image generation is rarely used, so there would be no need to use it very often.* (Social Work Organization -LMH)

> *We are affiliated with a grassroots organization rather than a social work station ... This distinction may stem from the relatively limited resources available to grassroots entities. In contrast, social work stations typically operate with an official institutional background, which enables them to receive formal support and allocated resources. In this case, if the business work itself is not complicated or not much, ai is actually not needed at all.* (Social Work Organization - CXK)

The phenomenon of technological suspension becomes increas-

ingly pronounced when differences in resource endowments are examined through horizontal comparison, as evidenced by the original transcripts of the two interviews. It vividly illustrates the severe resource constraints confronting frontline service settings, leading to the depletion of FPSDs' time and energy, limited complexity in service tasks, and an uneven allocation of service resources. Within this survival mode, the integration of AI technology becomes unfeasible. This pattern reflects a distinctive institutional feature of China's public service ecosystem: the hierarchical resource allocation system, wherein grassroots organizations without official institutional backing face disproportionate resource scarcity compared to government-affiliated entities such as social work stations (Hou 2025). Social work stations, as organizations directly anchored within the official administrative structure, receive systematic policy support and allocated resources, including regular AI training and technology access initiatives. By contrast, grassroots social work organizations operating outside the formal institutional framework confront a markedly different reality, lacking both the organizational mandate and the resource channels to prioritize technological integration.

4.1.2 The Pressure of the Environment: Wavering between Calls and Concerns

Although within well-established organizations that possess relatively abundant resources, disparities in AI adoption persist. This observation underscores the need to temporarily set aside disparities in resource endowment to further explore underlying factors—specifically, the intricate psychological dynamics of FPSDs facing external environmental pressures.

> *As for AI, our organization is still actively using it now. We have found that many local governments are proactively integrating ai systems to achieve public service delivery, and we are also making attempts in this regard.* (Foundation - LC)

Therefore, due to sustained government support and policy-driven initiatives, FPSDs are expected to continue actively engaging with and adopting AI technologies. Nevertheless, certain barriers may impede widespread adoption, despite the proactive efforts of some organizations and individuals within this group.

> *The government has not yet regulated this artificial intelligence platform, but people are quite proactive in accepting it ... At least no one has told us what you should pay attention to when using AI.* (Community Social Worker - ZYS)

> *I wanna AI to assist in my community governance, but during the analysis, it may steal my information. So, if I have relevant regulations in the future, what should I do when I trace it back?* (Community Social Worker - WCL)

FPSDs perceive a clear disconnect—while the government actively

promotes AI adoption, they find the practical guidelines for its safe use critically lacking. This misalignment between top-down enthusiasm and on-the-ground support has placed them in a dilemma, which has left them feeling anxious and uncertain. While eager to comply with the organizational directive, FPSDs may remain hesitant to adopt the AI due to serious concerns regarding data security and potential future accountability. More importantly, this concern is explicitly reflected in the organization's internal policies and leadership communications, thereby reinforcing a cautious approach toward AI adoption.

> *Our organization has now clearly stipulated that documents and forms containing service recipients or communities cannot be uploaded to the platform. Light use of voice-to-text conversion must be manually reviewed.* (Social Work Organization - LMJ)

> *Our leader believes that AI can be used, but we should not rely on it completely. If you rely entirely on this AI, you will eventually be replaced by it. Therefore, you need to be flexible in using this thing.* (Social Work Organization - XHL)

These directives and restrictions imposed by upper management have intensified the psychological conflict experienced by FPSDs, who are caught between external pressures to adopt emerging AI and internal organizational caution, resulting in heightened vigilance in their actions and increased psychological unease.

Therefore, from the phenomenon of technological suspension, government promotion, perceived risks and internal organizational regulation and training, it is evident that the internal and external organizational environment play a critical role in shaping the differentiated adoption of AI among FPSDs. First, disparities in resource allocation exacerbate the technological suspension phenomenon, leaving FPSDs or their units at the survival stage unable to access or prioritize technological integration, thereby producing initial differentiation. More significantly, even when organizations progress to a growth or developmental phase, FPSDs continue to confront challenges related to regulatory risk perception and organizational compliance demands, which further contribute to the emergence of new forms of differentiation. These layered constraints collectively form the contextual logic that not only shapes FPSDs' access to AI but also conditions the value trade-off they subsequently confront, thereby setting the stage for the entire CVB cycle.

4.2 Value Logic: The Wavering between Efficiency, Professional Discretion, and Public Values

4.2.1 The Primary Trade-off: Efficiency Gain and the Loss of Localization

In the actual working process, the integration of AI can assist FPSDs in reducing administrative burdens. This reduction in documentation requirements

highlights that AI adoption is primarily driven by the pursuit of operational efficiency.

> *That kind of administrative work is a bit too routine and burdensome ... With AI, a lot of pressure from paperwork will be reduced.* (Street-level Social Work Station - WCF)

> *The materials that social workers are required to produce often entail significant documentation demands. By providing clear instructions, AI can assist in structuring these documents and generating appropriate content accordingly.* (Community Social Worker - WCL)

However, FPSDs have observed that the content generated by AI often lacks contextual relevance and a human-centered perspective. Therefore, the perceived effectiveness of such algorithmic processes is frequently called into question when applied to the complexities of real-world implementation.

> *Some of the event plans he generates will definitely be revised by himself later. You need to localize them, that is, use some of the language or style of that community.* (Social Work Organization - LMH)

It is evident that they are continuously navigating the tension between efficiency improvement and content distortion, cultivating an ambivalent mindset of both reliance and distrust towards AI.

> *In fact, it needs to guide you to answer questions. According to the project, some frameworks may have some questions that need to be answered, but if you put them in for questioning, they actually don't … Because they don't understand the community's information.* (Social Work Organization - CXK)

This reveals a fundamental tension, constituting the primary trade-off in the value assessment of FPSDs: the generalized efficiency offered by AI stands in direct opposition to the localized, intelligence essential to professional social work. FPSDs quickly discover that while AI accelerates tasks, its outputs often lack the specificity and local contextual features. Thus, the promise of algorithmic efficiency is inherently limited by its inability to adapt to context-specific realities, revealing a fundamental and irreconcilable tension between efficiency and local relevance.

4.2.2 The Second Trade-off: The Defense and Adjustment of Professional Discretion

This study observed that the confrontation between algorithmic output and professional discretion often manifests as FPSD's deliberate assertion of their own judgment to safeguard their role in the decision-making process. Despite the improvement in efficiency, they continue to exhibit varied patterns of AI adoption, reflecting their distinct trade-offs and considerations regarding efficiency, which in turn influence their service behaviors.

> *The current supervision records are not well written, and then AI generates a supervision record ... I think they are a bit perfunctory.* (Social Work Organization - HSQ)

> *I'm rather reluctant to use this thing ... Because we are serving the living, it is a warm substance. ... AI might also have some influence. However, the decisive factor still lies in the professional ability of the social worker themselves. They must do a good job in communication between people, which is something that AI can never replace.* (Community Social Worker - WQM)

Addressing the potential de-professionalization associated with the advancement of AI, FPSDs may exhibit resistance toward AI integration. This resistance stems from their emphasis on the irreplaceable value of human expertise in areas such as empathetic care and interpersonal communication. In response to perceived threats to their professional discretion, some FPSDs actively uphold their professional identity and assert their unique contributions, leading to a phenomenon referred to as value-based resistance to AI. During this process, certain FPSDs, influenced by regulations, continue to engage in various trade-offs, ultimately exhibiting a pattern of conditional compliance.

> *Because our institution has been using artificial intelligence for a long time... But we have realized that we should have a boundary for usage.* (Social Work Organization - LMJ)

The defense of professional discretion introduces a second and more profound dimension of trade-off. The core consideration thereby deepens beyond the balance between task efficiency and output relevance, to safeguarding the very dignity of profession, resisting the replacement of human-centered service by algorithmic governance.

4.2.3 The Third Trade-off: Questioning Public Value

Following an examination of efficiency-driven practices and the professional discretion defense orientation, this study has further identified that FPSDs harbor significant concerns regarding the implications of AI-driven efficiency, including issues related to data security, algorithmic fairness, and the risk of occupational displacement.

> *Because in your field of social work, there must be some confidentiality ... How can I guarantee that I won't become part of its dataset?* (Foundation - MJH)

> *At present, it's not yet the case that we can make decisions with AI. But when I use it, I will find that sometimes things about disadvantaged groups or remote areas cannot be found online ... It may exacerbate some inequalities.* (Social Work Organization - LMH)

> *I think AI technology should be used with caution and should not be forced upon the lower-class*

> *working people.* (Social Work Organization - CXK)

Therefore, the adoption of AI forces a third and most fundamental ethical trade-off. At this level, considerations transcend operational efficiency and professional discretion, requiring FPSDs to carefully evaluate AI's benefits against its potential erosion of core public values, such as equity, accountability, transparency and social justice. This highest-order trade-off challenges not merely the methods or identity of public service, but its ultimate purpose and for whom it exists.

Building upon the previous discussion, it is evident that at the level of value dimension, this differentiation originated from proactive government promotion. FPSDs have gradually adopted and experimented with AI tools, recognizing their potential to enhance operational efficiency. However, they are not passive recipients of technology, but active agents engaged in navigating this tripartite value conflict.

The intensity of this value struggle is compounded by institutional features of the Chinese context. First, the semi-institutionalized status of the social work profession heightens the second trade-off: unlike fields such as medicine or law, where professional boundaries are legally codified, social work in China remains in an ongoing process of professionalization, with qualification standards, ethical codes, and jurisdictional claims over core domains not yet firmly established (Ke et al. 2025). In this context, AI's encroachment into core professional tasks is experienced as an existential threat, making the defense of professional discretion a matter of professional survival rather than mere preference. Second, the policy-driven push for AI adoption, coupled with a persistent regulatory lag in data governance, intensifies the third trade-off—FPSDs experience simultaneously the pressure to embrace AI and the anxiety of operating without adequate legal safeguards, sharpening the tension between efficiency pursuit and public ethics concerns. It is within this protracted conflict that the central psychological agitation arises, a tension which, as demonstrated below, manifests externally in specific behavioral responses and helps explain why a technically beneficial tool may still encounter skepticism, resistance, or only conditional acceptance.

4.3 Behavior Logic: Strategic Shift from Deep Integration to Deliberate Disengagement

Finally, we adopted an analysis at the behavioral dimension, as the content of prior contextual and value-related elements is more explicitly and profoundly manifested at this element. Based on our direct engagement in frontline public service delivery, we identified that this differentiated phenomenon can be broadly categorized into three distinct types amidst psychological unease and value instability: deep integration, instrumental limitation, and strategic alienation. These strategies—and the underlying phenomena they represent—are not static, rather, they evolve dynamically, typically manifesting as a process of adaptive practice.

4.3.1 The Strategy of Deep Integration

FPSDs generally perceive AI as a process-oriented and institutionalized tool for alleviating administrative burdens. Its most frequent applications are concentrated in standardized tasks. Interview data indicate that over half of FPSDs use AI to assist in generating application forms and related documents more than three times daily, with cumulative usage exceeding one hour per day, establishing a form of instrumental dependence.

> *AI has really greatly improved my efficiency. Almost every day, I use AI to check problems for me or polish the text ... Sometimes I ask him to generate some application forms for me, which saves me the time of looking for them by myself.* (Social Work Organization - XHL)

> *The development and writing of work plans, as well as the sorting out of some ideas for articles, sometimes we really need ai to generate certain content.* (Community Social Worker - ZYS)

This pattern of deep integration illustrates a specific CVB configuration. The Context, characterized by high administrative workload, standardized task architectures, and institutional imperatives for documentation efficiency, activates the Value of algorithmic efficiency while temporarily attenuating countervailing concerns regarding professional discretion. Such value prioritization shapes Behavior toward instrumental dependence: FPSDs systematically delegate routine, repetitive tasks to AI systems and reallocate cognitive and temporal resources toward higher-order, judgment-intensive interactions. As this delegation becomes institutionalized through repeated practice, it recursively reinforces the Context itself—normalizing AI as an embedded, infrastructural element of everyday work and thereby perpetuating the conditions that enable sustained deep integration. This self-reinforcing dynamic extends Acemoglu and Restrepo's (2020) foundational insight: the CVB framework not only identifies which tasks are displaced by automation but also explicates how displacement is institutionally sustained through recursive interplay among task design, value activation, and behavioral routinization.

4.3.2 The Strategy of Instrumental Limitation

A significant number of FPSDs adopt a posture of instrumental limitation, strategically confining their use of AI to specific, low-risk tasks. This is not outright rejection, but a conscious conditional use that establishes clear boundaries between human and algorithmic domains.

> *For us community workers, our work is more about communicating with residents ... for instance, if a sewer is blocked, we have to figure out how to handle it and coordinate with different parties. These are matters that current AI tools simply cannot replace.* (Community Worker - ZL)

Within the bounded areas where AI is applied, its use is frequently characterized by a process of instructional trial-and-error. FPSDs find they must invest considerable effort in refining their prompts to achieve usable results. This often involves detailed, iterative input, which can itself become a deterrent. During the usage process, they frequently encounter the frustration of debugging instructions.

> *I need to input very detailed and specific descriptions for it to give me specific results ... Sometimes I'd rather just write it myself because the process of adjusting the instructions is too troublesome.* (Social Work Organization - XHL)

This strategy reflects a calculated trade-off, where the potential utility of AI is carefully weighed against the costs to workflow fluidity and the imperative to protect core professional domains from algorithmic encroachment.

4.3.3 The Strategy of Distancing

In response to perceived threats to professional discretion or the integrity of their core values, some FPSDs enact a strategy of strategic alienation. This involves a conscious and deliberate effort to minimize interaction with AI systems. A key behavior here is cautiously controlling contact, driven by the desire to preserve independent critical thinking and professional judgment. This strategic distancing is a form of active resistance, safeguarding the human-centric core of their profession against potential technological determinism.

> *About eighty to ninety percent of my work is written by myself ... I'm afraid that the more I use it, the more my thinking might become rigid. So, I try my best to control my reliance on it and give myself more time to write things in my own way.* (Social Work Organization - XHL).

4.3.4 Adaptive Practices: The Dynamic Response in Agitation

The acceptance of AI by FPSDs extends beyond mere technological adoption; it constitutes a dynamic process of continuous adaptation within structural constraints and psychological tensions. Amid ambivalent attitudes characterized by wanting to use but hesitating to adopt, using without full confidence, and avoiding use while fearing obsolescence, they have developed three distinct coping strategies, engaging in ongoing micro-adjustments such as capability enhancement, procedural reconfiguration, and risk boundary setting in their daily operations.

Several FPSDs are actively engaging in skills development initiatives to enhance their utilization of AI. Rather than passively awaiting training, they actively seek out techniques to strengthen their competence. This self-driven skill acquisition allows them not only to complete tasks more efficiently but also to increase their confidence in using AI tools.

> *I discovered that after using AI, my output was better than that of my older colleagues. I believe it can enhance my work efficiency*

and capability, so I took the initiative to learn some prompt techniques to improve my ability to use AI. (Foundation - MJH).

A colleague used AI to do it. Just today when I asked, he finished it. It can be said that it has already been applied in practice. (Community Social Worker - ZL)

As AI becomes embedded in daily practice, it also triggers subtle yet pervasive shifts in work habits. Many FPSDs unconsciously adjust their routines—turning to AI almost instinctively to brainstorm, outline, or refine content. This reflects not just tool adoption, but a deeper cognitive and procedural shift.

Since many of my colleagues are using it to varying degrees, I've adapted my work habits. For example, when writing articles, I now instinctively turn to AI to broaden my mind or adjust my logic (Social Work Organization - LMJ)

Perhaps the most critical adaptation lies in how FPSDs individually navigate AI-related risks. In the absence of clear regulations, they develop their own informal safeguard—limiting data sharing, avoiding sensitive documents, and controlling how deeply they engage with the AI.

I sometimes worry about data leaks ... Once I found it had collected my name and address, so now I reduce direct document uploads and switch to simple dialogues ... I strictly limit my usage and would never upload files containing community information. (Social Work Organization - XHL)

Importantly, these behavioral strategies do not entail rigid typologies of practitioners; rather, they represent contextually contingent patterns of engagement that frequently co-occur within a single FPSD. For example, the aforementioned social worker (XHL) alternated between deep instrumental reliance on AI and intentional disengagement from it, depending on task characteristics. In routine administrative tasks—characterized by high procedural volume and well-defined regulatory requirements—she leveraged AI primarily as an efficiency-enhancing tool, thereby prioritizing procedural expediency. By contrast, in cases demanding core professional judgment—marked by substantial outcome uncertainty and ethical complexity—she actively withheld endorsement of AI-generated recommendations, foregrounding the primacy of professional discretion. This situational variability demonstrates how contextual features systematically shape value priorities, which in turn inform corresponding behavioral adaptations—even within the practice of a single FPSD. Such intra-individual flexibility reflects the dynamic, reciprocal adaptation between FPSDs and AI systems: the three identified adaptive responses—capability enhancement, procedural reconfiguration, and risk boundary setting—are not static dispositions but responsive, calibratable strategies deployed iteratively as FPSDs

continuously negotiate their evolving relationship with AI. In summary, these adaptive behaviors reciprocally reinforce the structural environment, thereby sustaining the recursive CVB loop that perpetuates sustained agitation—a dynamic elaborated in greater detail in the following section.

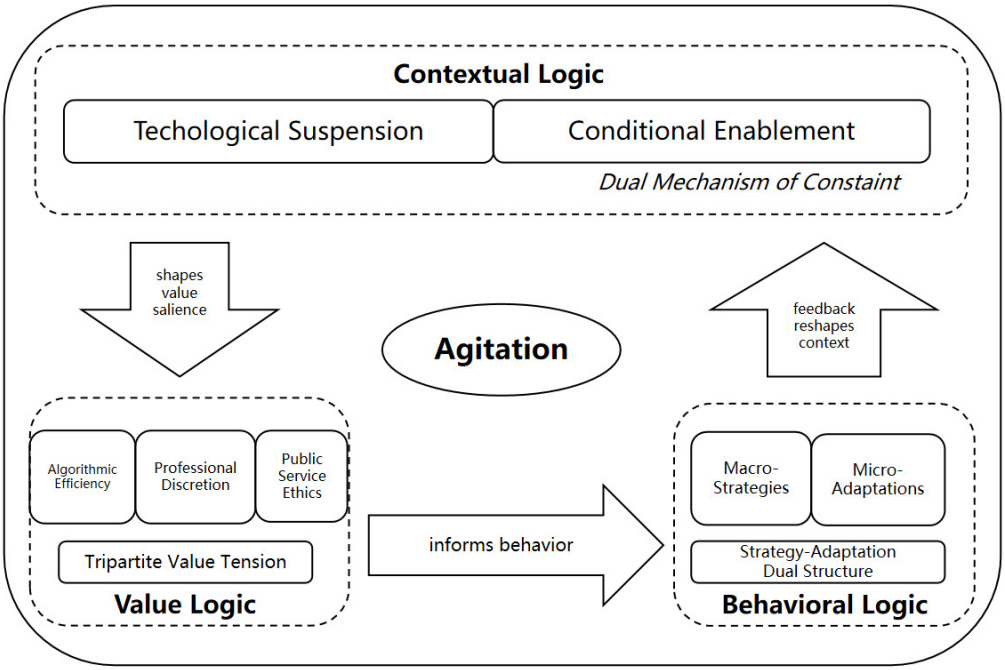

Figure 1. Context-Value-Behavior Operating Mechanism

4.4 The CVB Operating Mechanism: A Recursive System

In summary, the frontline agitation surrounding AI is not a simple reaction, but the product of a dynamic mechanism. As our findings demonstrate, agitation varies both intra-individually and inter-individually. On the one hand, the same FPSD oscillates between behavioral strategies, as illustrated by XHL, who moved between deep instrumental reliance and deliberate distancing depending on the task at hand. On the other hand, agitation takes divergent forms across organizational contexts—FPSDs such as ZYS and WCF gravitated toward instrumental dependence, whereas WQM and CXK leaned toward deliberate distancing. Taken together, this dual-axis variation manifests as sustained behavioral vacillation, rooted in unresolved value tensions—the two constitutive dimensions of agitation. Our findings integrate into the CVB operating mechanism illustrated in Figure 1, which explains how this state is both produced and sustained.

The process originates within the contextual logic. Disparities in resource endowments create a fundamental divide. For organizations in a survival stage, severe resource constraints lead

to technological suspension, where AI is inaccessible. For those in a developmental stage, access to AI has become increasingly possible, yet they operate within a complex and often contradictory environment, characterized by proactive governmental promotion on one hand and significant regulatory uncertainty on the other. This context acts not merely as a passive backdrop, but as an active force that enables, constrains, and triggers the subsequent cognitive and behavioral processes. These external pressures catalyze the core value logic. FPSDs are caught in a persistent trade-off among algorithmic efficiency, professional discretion and public values. Crucially, this value negotiation mediates and often overrides initial perceptions of AI's usefulness, reframing adoption as an ethical and professional dilemma rather than a mere efficiency calculation. Consequently, this internal conflict is provisionally resolved through behavioral logic, manifesting as a spectrum from deep integration to strategic alienation.

A central insight is the dynamic, recursive feedback loop among context, values, and behavior—FPSDs' behavioral adaptations generate new experiences that, in turn, influence their value judgments and collectively reshape the organizational and policy environment over time. Crucially, these three dimensions do not operate in a unidirectional or linear causal sequence. Rather, they constitute an interdependent, self-reinforcing system. Specifically, contextual conditions determine which values become salient; value orientations guide the selection and enactment of behavioral strategies; and behavioral outcomes generate consequential feedback that modifies contextual conditions and recalibrates value priorities across time. Consequently, agitation represents a sustained state of co-evolution, dynamically reproduced through the iterative, reciprocal interactions among context, values, and behavior. To validate the comprehensiveness of the proposed three-dimensional framework, we conducted a rigorous inductive assessment of alternative candidate dimensions, including emotional responses or social influence, to determine whether they constituted empirically distinct analytical categories. Drawing on iterative coding and comparative analysis, we observed that neither dimension attained empirical saturation as an autonomous explanatory construct. Instead, both are consistently embedded within value conflicts or contingent upon contextual conditions and observable behavioral patterns. This confirms that the three identified dimensions collectively represent the core generative mechanism, achieving theoretical coherence and empirical saturation.

5. Discussion

While scholars have recently begun to explore how AI influences street bureaucrats (Duan et al. 2019; Janssen et al. 2020; Selten et al. 2023), the underlying drivers of the pervasive "agitation" in FPSD's adoption behaviors remain poorly understood. This study moves beyond documenting varied usage to explain the systemic production of this

unsettled state. We argue that FPSDs are not merely assessing AI's usefulness, but rather actively navigating a complex interplay of contextual constraints such as resource disparities and regulatory directives, and profound value tradeoff between algorithmic efficiency, professional discretion, and public service ethics. This navigation gives rise to a repertoire of behavioral strategies—from deep integration to strategic resistance—that are contextual, strategic, and dynamic, reflecting an ongoing process of agitation rather than a static decision to accept or reject.

The primary theoretical contribution of this study lies in constructing an integrated CVB analytical framework, which extends the TAM model to better account for the realities of frontline public service. While TAM effectively captures the initial cognitive assessment especially the potential of a technology (Davis 1989; Venkatesh et al. 2016), our CVB framework elucidates how this assessment is subsequently mediated, refracted, and often overridden by the structural and normative complexities of the work environment. Specifically, we find that perceptions of AI's usefulness and ease of use are filtered by the contextual reality of technological suspension and subsequently shaped by a profound tripartite value struggle at the frontline—namely, the tension among efficiency, discretion, and public ethics (Mahroof et al. 2025). This ongoing struggle generates the core psychological agitation, which explains why a technically useful tool may still be met with skepticism or adopted only under conditional terms. By synthesizing the micro-level logic of TAM with the meso-level context of street-level discretion and macro-level environmental pressures, the CVB framework provides a more holistic and systematic explanation for why a technology that is perceived as useful may still be used reluctantly, selectively, or not at all. This study extends the TAM by integrating its core constructs into the dynamic CVB cycle, demonstrating cognitive assessment is not an endpoint but a starting point that is profoundly shaped by situational constraints and value conflicts (Rodriguez et al. 2025). Moreover, this study also extends street-level bureaucracy theory (Lipsky 1980; 2010) in the digital age, emphasizing that FPSDs are not passive recipients but active agents who exercise agency in response to the challenges AI poses to their professional discretion within an evolving context of algorithmic management (Busch and Henriksen 2018; Busch et al. 2018). This aligns with discussions by scholars like Grimmelikhuijsen (2022) on algorithmic trust and the evolution of discretion, clarifying that technology adoption is co-shaped by the external environment and individual agency.

Our findings sound a warning: a top-down, one-size-fits-all approach to AI promotion risks transforming purported empowerment into a tangible burden, potentially exacerbating inequalities and eroding the human-centric core of public service (Binns 2020; Zuiderwijk et al. 2021). This disconnect suggests that any pre-mature, rigid institutional arrangement is likely to be ineffective or even counterproduc-

tive. The central policy implication, therefore, is not to design meticulous, universal plans, but to acknowledge, engage with, and respond to this pervasive state of uncertainty. Policymakers and administrators must shift their mindset from implementing predetermined technological solutions toward fostering a context-sensitive and adaptive evolution (Peeters and Widlak 2018). Specifically, the CVB framework outlines a concrete path for this transformation—one informed by a central insight: for AI to become a sustainable and legitimate component of frontline operations, it is essential to actively facilitate the co-evolution of algorithmic systems and professional practices. This means designing for adaptability rather than standardization (Northcott 2025)—providing differentiated implementation guidelines and targeted capacity-building initiatives tailored to the Chinese context that can be locally configured, rather than imposing monolithic systems, especially given the reality of "technological suspension" and the divergent needs of organizations at different stages. It also necessitates building responsive feedback channels to truly understand the frontline dilemmas and channel collective agitation into constructive, situated exploration (Carreno 2024). Moreover, ensuring inclusive co-evolution requires targeted support to bridge the resource and capability gaps that lead to technological suspension, through targeted measures such as facilitated technology access, skill-building programs, and peer support networks, so that the benefits and burdens of AI transformation are equitably shared across the entire public service ecosystem (Liu et al. 2025). Ultimately, the goal is to move with, rather than against, the currents of frontline practice.

As an exploratory study, this research opens more questions than it resolves, thereby outlining a rich agenda for future inquiry centered on the phenomenon of frontline agitation. Several limitations and corresponding directions emerge. First, while in-depth interviews effectively uncover complex reasoning and situated practices, the proposed Context-Value-Behavior framework requires further empirical substantiation. Future studies could employ large-scale surveys or Q-methodology to prioritize the refinement and validation of the CVB framework and test the causal pathways between these dimensions and their relative explanatory power regarding usage behavior (Venkatesh et al. 2016). Second, the present study offers a cross-sectional snapshot. A critical next step is longitudinal research to trace how agitation evolves as technologies mature and early implementation experiences accumulate. Tracking whether this state resolves, intensifies, or transforms over time is essential for understanding the long-term dynamics of human–AI co-evolution in public service settings (Acemoglu and Restrepo 2020). Finally, although focused on the social service sector in China, the CVB framework invites comparative extension. Future research could examine its applicability across sectors—such as healthcare, education, or administrative agencies—to discern how differing professional logics and regulatory environ-

ments shape AI adoption. Cross-cultural comparisons could further clarify the framework's boundary conditions and refine our understanding of how institutional and cultural contexts moderate the experience of frontline agitation.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Province Administers County Reforms and Administrative Urbanization in China

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Abstract

The past two decades have seen a rapid increase in the number of counties and county-level cities converted to districts through administrative division adjustments. This article argues that fiscal decentralization has led to administrative urbanization—the "upgrading" of rural counties and county-level cities into urban districts. It does so through an examination of the Province Administers County reforms, which remove counties from the jurisdiction of prefectural cities and place them directly under provinces. Survival analysis of an original county-level dataset of conversions to urban districts in 2000–2019 reveals three core findings. First, in the early 2000s, fiscal stress in prefectural cities drove conversions as counties with higher fiscal capacity were more likely to be converted. Second, inclusion of a county in Province Administers County reforms (which became widespread in the 2010s) has no impact on the likelihood of conversion to a district. Third, initiation of Province Administers County reforms within a province made "weak counties" with low fiscal capacity more likely to be converted, while "strong counties" with high fiscal capacity were less likely to be converted. The results suggest that fiscal decentralization has accelerated administrative urbanization but has also enhanced the bargaining power of counties with high fiscal resources to resist administrative urbanization.

Keywords: Administrative division adjustment; fiscal relations; urbanization; province administers county

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La provincia administra las reformas de los condados y la urbanización administrativa en China

Resumen

En las últimas dos décadas se ha observado un rápido aumento en el número de condados y ciudades de nivel de condado convertidos en distritos mediante ajustes en la división administrativa. Este artículo sostiene que la descentralización fiscal ha llevado a la urbanización administrativa: la "mejora" de condados rurales y ciudades de nivel de condado en distritos urbanos. Para ello, examina las reformas de "La Provincia Administra el Condado", que retiran los condados de la jurisdicción de las ciudades prefecturales y los colocan directamente bajo la jurisdicción de las provincias. El análisis de supervivencia de un conjunto de datos original a nivel de condado sobre conversiones a distritos urbanos en 2000-2019 revela tres hallazgos principales. Primero, a principios de la década de 2000, el estrés fiscal en las ciudades prefecturales impulsó las conversiones, ya que los condados con mayor capacidad fiscal tenían más probabilidades de ser convertidos. Segundo, la inclusión de un condado en las reformas de "La Provincia Administra el Condado" (que se generalizaron en la década de 2010) no tiene impacto en la probabilidad de conversión a un distrito. En tercer lugar, la implementación de reformas de administración provincial de condados dentro de una provincia aumentó la probabilidad de conversión de los condados con baja capacidad fiscal, mientras que la de los condados con alta capacidad fiscal disminuyó dicha probabilidad. Los resultados sugieren que la descentralización fiscal ha acelerado la urbanización administrativa, pero también ha fortalecido el poder de negociación de los condados con altos recursos fiscales para resistirla.

Palabras clave: Ajuste de la división administrativa; relaciones fiscales; urbanización; administración provincial de condados

中国省直管县改革与行政型城市化

摘要

过去二十年间，通过行政区划调整撤县（县级市）设区的数量大幅增长。本文提出，财政分权催生了行政型城市化，即县域、县级市通过行政升格转变为市辖区。文章以省直管县

改革为分析载体展开论证：该改革将各县脱离地级市管辖，划归省级政府直接管理。本文基于 2000—2019 年撤县设区原创县级面板数据开展生存分析，得出三项核心结论：第一，21 世纪初，地级市财政压力是推动撤县设区的核心动因，财政实力更强的县更易被改为市辖区；第二，2010 年后全面铺开的省直管县试点政策，本身并不会改变县域撤县设区的发生概率；第三，一省推行省直管县改革后，财政薄弱的“弱县”撤县设区概率显著提升，而财力雄厚的“强县”撤县设区概率反而下降。研究结果表明，财政分权整体推动了行政型城市化进程，但同时也提升了财政资源充裕县域的议价能力，使其得以抵制撤县设区这类行政城市化调整。

关键词：行政区划调整；财政关系；城市化；省直管县

Introduction

China has experienced tremendous urbanization over the past three decades. Urbanization has come in the form of the physical expansion of cities, but it has also come in the form of administrative urbanization—changes in the ranks and governance structures of local governments. In recent years, the most significant changes in administrative structures have come at the county level. County-level governments include counties, county-level cities, and urban districts. The number of counties and county-level cities has declined steadily, while the number of urban districts has increased dramatically. In 1976, there were only 388 urban districts in China (Chung and Lam 2004). By the end of 2022 this number had risen to 977. This stands in contrast to the relative stability in the number of provinces and prefectures (Lam and Lo 2010). These changes in the administrative designation of territorial governments are known as “administrative division adjustments” (ADAs 行政区划调整).

This article asks two questions. First, why have increasing numbers of counties and county-level cities been converted into urban districts? Second, why are some counties and county-level cities converted into districts, while others are not? Conversion of counties into districts proceeded in two distinct waves, one in the late 1990s and early 2000s and a second in the 2010s. Both waves were driven by fiscal decentralization. Conversion to districts in the first wave was driven by the fiscal pressures of prefectural cities. Prefectural governments became more numerous and increasingly administratively powerful in the reform era, while at the same time the partial fiscal re-centralization of the mid-1990s left them with recurrent fiscal deficits. They coped by seizing revenues from county governments and intercepting portions of transfer payments to counties. The emergence of real estate markets presented a more

promising solution to their deficits in the form of land finance, but the land tenure system made gaining control over rural collective land difficult. Conversion of counties and county-level cities into urban districts granted prefectures greater control over both county finances and land.

Provincial governments responded to prefectural predation of county revenues by the 2010s by placing counties under direct provincial administration, effectively moving county tax coffers out of prefectural grasp through a reform known as the "Province Administers Counties" (PAC) program. The PAC reform effectively *further* decentralized the fiscal system, catalyzing a second wave of conversions because it gave prefectural governments even stronger incentives for conversion because districts did not fall under direct provincial administration. This contributed to a boom in conversion to districts in the 2010s. In sum, fiscal decentralization—embodied in China's "fiscal federalism" but deepened by PAC reforms—led to urbanization.

Yet this leaves open the question of why some counties and county-level cities were converted into districts, while others were not. This article approaches this question by constructing a novel county-level dataset of all conversions of counties and county-level cities to urban districts in the period of 2000–2019. Rural industrialization led to the formation of economically powerful county governments. In economic terms, highly developed counties became much "stronger" than the "weak" districts that constituted the urban core of most prefectural cities. These strong counties became tempting targets for conversion. Yet their growing economic clout and frequent opposition to conversion—due to the loss of autonomy that it entails—made them *difficult* targets for conversion. These "strong counties" were the initial targets of PAC reforms.

Three major findings emerge from the statistical analysis. First, during the first wave of conversions (before the PAC reforms) counties with higher fiscal resources were more likely to be converted to districts. This is consistent with conversions fueled by fiscal pressure because high revenue counties could better relieve the fiscal burdens of prefectural cities. Second, county enrollment status in the PAC reforms themselves surprisingly had no impact on the likelihood of conversion to a district. Third, PAC reforms had an environmental impact that varied based on county-level fiscal capacity. Once a province has begun implementation of PAC reforms, counties in the province are at higher risk of conversion to districts (regardless of whether they are enrolled in PAC). This is consistent with speculation that Province Administers County (PAC) reforms have incentivized prefectural cities to convert counties into districts to evade direct provincial administration of counties (Lu and Tsai 2019; He and Jaros 2023). Importantly, the impact of the risk of PAC reforms on the likelihood of conversion to a district is contingent on *revenues.* Once PAC reforms have been implemented in a province (regardless of whether a given county is included in

the reforms) high revenue counties are *less* likely to be converted to districts. By contrast, low revenue counties post-PAC reform are more likely to be converted into districts. This may reflect the desire by provincial and central authorities to prevent prefectural governments from strangling the goose that lays the golden egg, the higher bureaucratic bargaining power of these fiscally wealthy but provincially managed counties, or both. These findings suggest that PAC reforms have enhanced the bargaining power of "strong" counties.

Decentralization, Urbanization and Administrative Division Adjustments

China's fiscal system is highly decentralized (Landry 2008). Local governments, such as prefectural cities, exist in a hierarchy of governments with a delineated scope of authority and primary authority over the economy in their jurisdictions, contributing to a system of "fiscal federalism, Chinese style" (Montinola, Qian, and Weingast 1995). Fiscal decentralization has been found to promote land-based urbanization. Land-based urbanization refers to land conversion from agricultural production to urban development. In brief, fiscal decentralization tightened prefectural cities' budget constraints, while continued political centralization prompted them to pursue stronger economic performance to achieve promotions. This triggered land-based urbanization as prefectural cities sold land rights to developers to relieve fiscal distress (He, Zhou, and Huang 2016). Land leasing also tended to generate future tax revenues through enterprise taxes (Tao et al. 2010).

While the existing literature has focused on how fiscal decentralization creates land-based urbanization, this article demonstrates that it can also generate *administrative urbanization*. I refer to administrative urbanization in a narrow sense as the transformation of the administrative status of a jurisdiction from rural to urban (He et al. 2026). In effect, "rural" counties and county-level cities become "urban" districts. This change in administrative status is important because it has strong institutional implications for taxation and planning authorities, as will be discussed later. PAC reforms can be conceptualized as fiscal delayering (Li, Lu, and Wang 2016) in the sense that reporting levels are removed from the administrative hierarchy as the "county-prefecture-province" chain is replaced by a "county-province" relationship. In this sense, PAC reforms represent an increase in fiscal decentralization that transferred tax and spending authorities from the prefectural cities down to the counties (Ma and Mao 2017).

Prefectural cities, seeking to escape PAC reforms, have administratively urbanized surrounding areas, converting the administrative status of counties and county-level cities into urban districts that no longer fall under the purview of PAC reforms. The finding that further fiscal decentralization has generated administrative urbanization is especially surprising because recent research has found that

PAC reforms hindered *land-based urbanization* by reducing prefectural governments access to revenues to finance land development (Liu, Zhong, and Zhen 2025).

Conversion of counties into districts is formally known as administrative division adjustment (ADA). Research on the politics of ADA has broadly focused on three factors: fiscal pressure, political resources and intergovernmental competition. First, prefectural cities have converted counties into districts to gain more direct control over their fiscal resources due to the fiscal pressures facing prefectural cities. Fiscal decentralization created a large gap between the revenue raising and spending responsibilities of prefectural cities. Districts—unlike counties and county-level cities—were not independent units of fiscal authority giving prefectural cities total discretion over their tax revenues (Chung and Lam 2004). Annexing districts enables prefectural cities to gain control of large swaths of formerly rural land (Cartier 2016). Land-leasing allowed prefectural cities to overcome fiscal deficits. Li, Guo, and Zhang (2022) found that prefectural cities that converted counties into districts received roughly 3.5 billion RMB more in land conveyance revenues than cities that had not converted counties to districts in 2007–2013. Qualitative case studies of county-to-district conversion have similarly found that prefectural cities sometimes push forward conversions in order to gain access to land for manufacturing and real estate development (Chung and Lam 2004).

Second, because demand for converting counties to districts is high among prefectures, more politically powerful cities tend to be more successful at converting their counties. Cities with greater bargaining power—due to their higher bureaucratic status as deputy-provincial cities, provincial capitals, or party secretaries with seats on the provincial party committee—have greater ability to convert counties into districts (He and Jaros 2023). Even more powerful provincial-level cities (such as Beijing and Chongqing) have been very active in converting their counties into urban districts to gain spatial control over their countryside (Ma 2005).

Finally, research has recently highlighted the role of *provincial* governments. Lu and Tsai (2019, p. 100) argue that provincial governments engage in vertical intergovernmental competition with prefectural governments. Provincial governments have sought to administer counties directly using the Provinces Administers Counties reform. At the same time, prefectural cities have continued to try to transform counties into districts. Based on descriptive statistics, they argue that provincial capitals and less developed prefectural cities convert the counties with the highest fiscal revenues.

Surprisingly, however, there has been very little systematic research on the impact of PAC reforms on conversions of counties into urban districts. Most research on PAC reforms has focused on its impact on economic development, land sales and fiscal revenues and expenditures (Li, Lu, and Wang

2016; Liu, Zhong, and Zhen 2025; Jia, Ning, and Zhang 2023; Huang et al. 2017; Ma and Mao 2017). There are good reasons to expect that it might be influential. He and Jaros (2023, p. 936-937), note that "Cities had even stronger incentives to do so [by converting counties] following the rollout after the early 2000s of provincial administration of counties … reforms that placed rural counties under provincial fiscal oversight, depriving prefectural-level cities of a revenue source." Given their focus on the role of prefectural political resources, however, they do not test this proposition. Lu and Tsai have identified the existence of intergovernmental competition between provinces and prefectural cities, but do not analyze 1) how the emergence of PAC reforms within a province affects conversion, or 2) how the inclusion of a county within PAC reforms influences the likelihood of conversion. This article tests for the first time the theoretical prediction that fiscal decentralization accelerates administrative urbanization through its examination of the PAC reforms.

This article builds upon the existing literature on the politics of administrative divisions but departs from it significantly in several ways. First, and foremost, a key contribution of this article is in gathering an original dataset on PAC reforms and testing the impact on the likelihood of conversion of counties to districts. Surprisingly, given the focus on PACs in much of the literature, provincially-administered counties are *not* less likely to be converted. Controlling for the impact of PAC reforms is critically important because implementation of PAC reforms both across and within Chinese provinces has been highly uneven. Second, the analysis in this paper extends the analysis of conversions back to the early 2000s. This is methodologically important because 68 new districts were created in 2000–2009. It is also critical to examine the earlier period before nearly all provinces began to implement PAC reforms. Existing analyses have focused on a shorter period of time (2011–2016 in the case of Lu and Tsai). Third, both He and Jaros and Lu and Tsai used the prefectural city as the unit of analysis. By contrast, this article moves the unit of analysis down to the county-level, enabling identification of how county-level characteristics influence conversion.

In theoretical terms, this article makes two contributions. First, the article identifies fiscal decentralization as an increasingly important driver of administrative urbanization. During the 1990s, fiscal decentralization created fiscal gaps that prompted prefectural governments to engage in administrative urbanization to gain more control over rural fiscal resources. PAC reforms decentralized fiscal authority even further, delayering the fiscal system by removing prefectural cities from the reporting hierarchy and establishing direct links between county and provincial governments. PAC reforms increase fiscal pressure on prefectural counties, strengthening the incentive to administratively urbanize. Conversion of counties into districts (that lack independent budgetary authority) transforms a distributional question of "who

gets what" into a question of "who is what" that maintains prefectural control over county-level revenues. Once counties become districts, they no longer fall under the purview of the PAC reform.

Second, the article identifies county fiscal capacity as an important determinant of administrative urbanization. Fiscal systems are influenced by the relative bargaining power of actors. A key determinant of bargaining power is the ability to raise revenues (Levi 1988). Counties were weak vis-à-vis prefectural cities going into the early 1990s, but their ability to raise revenues increased due to rural industrialization. As fiscal decentralization increased—with the implementation of PAC reforms—the bargaining power of "strong counties" with high fiscal capacity seems to have increased. Strong counties with high fiscal capacity are better able to resist conversion to districts than counties with weak fiscal capacity. This is consistent with PAC reforms increasing the bargaining power of strong counties. While prefectural cities may benefit in bargaining over ADA from their *political* resources, counties benefit from their *fiscal* resources.

County-Level Jurisdictions: Counties, County-Level Cities, and Urban Districts

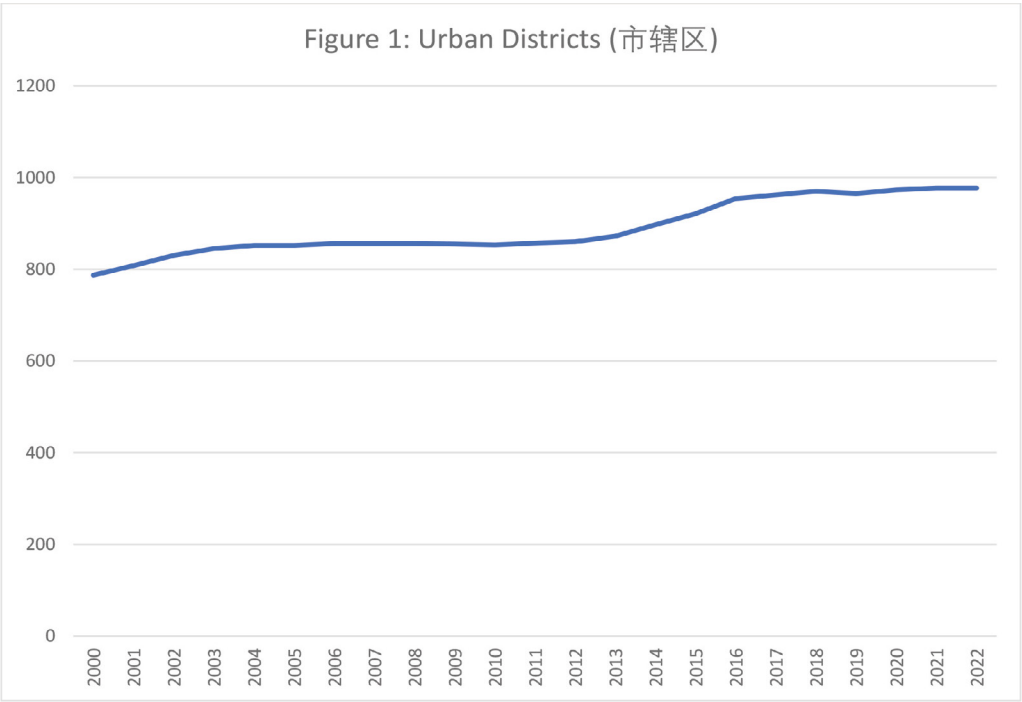
Counties can be divided into three categories: counties, county-level cities, and districts. Counties as a level of government in China have existed since the Qin dynasty. By contrast, the designation of a county-level city first emerged in 1983. County-level cities are an institutional hybrid between a county and a city that combine both urban and rural governance. As such, counties are empowered to establish more agencies and hire more personnel. Broadly speaking, county-level cities have greater autonomy from prefectural-cities than counties and enjoy more financial support from higher levels of government. These jurisdictions are typically small cities that are the product of the rapid growth of township industries and urbanization.

Districts were first established in 1954. They are urbanized areas that are under the jurisdiction of a prefectural-level city. Districts are much more focused on urban governance and providing public services to the urban population. They have the least autonomy of the three county-level jurisdictions and function as an agent of the prefectural city. Districts lack independence in their management of taxes and finances compared to counties but especially compared to county-level cities. Equally importantly, districts lack independence in urban construction planning and land management, with authority on these issues residing in the prefectural-level government. By contrast, county-level cities are far more independent in this regard and counties are relatively independent. Districts generally only have authority over more service-oriented functional departments. Critically, districts are also ineligible to receive fiscal transfers (unlike counties and county-level cities) which are sent instead to the prefectural-lev-

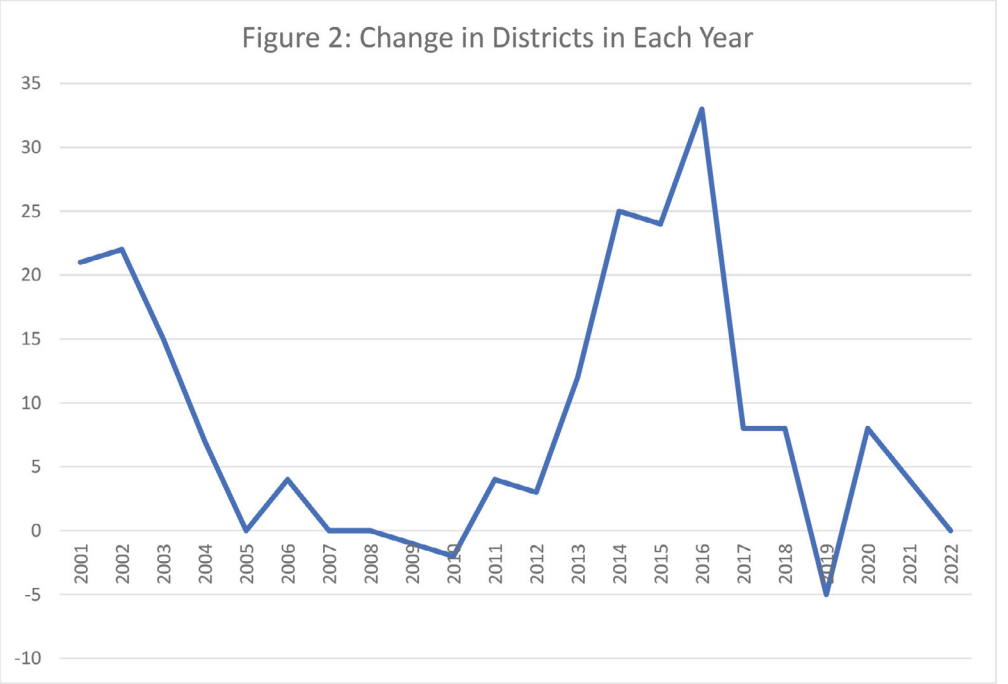
el city (Zhao and Wang 2022). For the sake of convenience, I will henceforth refer to both counties and county-level cities as "counties."

Authority to approve administrative division adjustment rests with the State Council, with the Ministry of Civil Affairs exerting de facto control (Zhao and Wang 2022; Wang and Yeh 2020). In the 1980s and 1990s, prefectural cities focused primarily on the conversion of counties into county-level cities. This contributed to a rapid decline in arable land by the 1990s, leading Beijing to suspend conversion to county-level cities in 1997. With this change, prefectural-level cities once again shifted their focus to converting jurisdictions into districts (Zhao and Wang 2022). Applications to the State Council for changes to administrative rank must be submitted by provinces, placing them in a key gatekeeping role.

The 21st century has seen the number of districts increase by roughly 20%, as seen in Figure 1. The increase in districts has also not been linear, as seen in Figure 2, but rather has occurred roughly in two "waves" of conversion. The first occurred in 2000–2003. This wave likely actually began somewhat earlier, perhaps as early as 1997, when the State Council froze upgrades of county-level cities to prefectural-level city status. Prefectures responded to increasing pressures on the availability of construction land caused by roaring real estate markets to convert counties into urban districts. Between 1997 and 2002, 115 counties or county-level cities were converted into urban districts (华林甫 2022). This wave largely



Source: Ministry of Civil Affairs http://xzqh.mca.gov.cn



Source: Ministry of Civil Affairs http://xzqh.mca.gov.cn

corresponds to the latter years of the Jiang-Zhu administration and is consistent with Jiang's pro-urban bias (He and Jaros 2023). Thereafter the number of districts plateaued throughout the Hu-Wen administration. In 2013–2016, coinciding with Xi's first term, district conversions spiked once again. The number of districts declined in two years (2010 and 2019), reflecting the merger of existing districts.

This second wave of conversions would be consistent with the shift to the Xi-Li administration (He and Jaros 2023). This article argues, however, that the second wave of conversion was caused by a shift in fiscal policies. Specifically, in 2009 the Ministry of Finance mandated that provinces implement the PAC system by 2012. The implication of this was that by 2012 prefectural-level cities faced an increasing risk that they would no longer have access to the revenues of prosperous counties in their jurisdiction unless they converted those counties into districts. The level of permissiveness of the Xi-Li administration in approving conversions no doubt played a role in increasing the "supply" of conversions, but the Province Administers Counties program led to a dramatic increase in "demand" for conversion on the part of prefectures.

Administrative Division Adjustment during the reform period has occurred against the backdrop of three trends that have collectively worked to increase the prevalence of county-to-district conversion. First, prefectural-level cities have risen in importance and administrative and political power beginning in the early 1980s.

Second, the economic power of county-level governments rose in the 1990s with increased rural industrialization, but especially in the 21st century. Finally, fiscal relations became increasingly decentralized at the county level under the PAC system. Taken together, these trends have shaped struggles for control over rural finances between county, prefectural and provincial authorities.

The Causes of the County-to-District Conversion

The Rising Political Power of Prefectural-Level Cities Amidst Fiscal Stress

Beijing decided to focus on cities as the key driver of regional economic growth in 1983. The system of "city administers county" emerged as a means of promoting greater urban and rural integration between prefectures and their surrounding counties. Prefectures merged with prefectural-level cities (with the prefectural-level city made dominant) or were themselves eliminated in favor of county-level cities newly promoted to prefectural-level city status (Ma 2005). The 1980s and 1990s saw a rapid expansion in the number of prefectural-level cities, increasing from only 98 in 1978 to 265 in 2001 (Chung and Lam 2004). Although the central government's emphasis on increasing the power of prefectural cities waned in the early-2000s, the Eleventh Five-Year Plan (2006–2010) and the "National New-Style Urbanization Plan (2014–2020)" placed a stronger emphasis on larger metropolitan regions and the role of prefectural-level cities, respectively (Li, Guo, and Zhang 2022).

Shortly after the conversion or merger of prefectural-level cities in the early 1980s there was a rapid round of conversions of counties into districts (Donaldson 2017). The conversion of counties into districts proceeded most rapidly in provincial-level cities and in deputy-provincial-level cities. Within prefectural-level cities, many counties were initially converted into districts in tandem with the creation of new prefectural-level cities in the 1980s. During this time many of the districts were "not-so-urban counties" redesignated as districts to justify the new prefectural-level status of the cities that governed them.[1] By the 2010s, prefectural demand for conversion far outstripped the "supply" of conversion by the State Council. According to one prefectural planning official, there were 188 pending applications for conversion to district in 2014, but that year only 28 applications (14.3%) were approved (南方周末 [Southern Weekend] 2015).

The Tax-Sharing Scheme reform of 1994 centralized fiscal revenues while decentralizing fiscal expenditure responsibilities to local governments, leaving local governments under-funded and creating fiscal stress. The reform did not formalize sub-provincial fiscal arrangements, allowing prefectural cit-

1 Deputy-provincial cities (副省级城市) are a half-step above prefectural cities and a half-step below provinces and have some of the same authorities as provinces, particularly in approving larger construction projects (Chung and Lam 2004).

ies to exploit county finances. Shortfalls in county revenues were in theory made up for by fiscal transfers from the central government. In practice, however, the nested hierarchy of the Chinese fiscal system meant that "resource hoarding by intermediate levels of government, especially the prefectures, is not uncommon" (Ong 2012, p. 88).

Converting counties into districts offered a means of relieving the fiscal stress of prefectural cities under the conditions of fiscal federalism. Districts—unlike counties and county-level cities—were not independent units of fiscal authority (Chung and Lam 2004). This meant prefectural-level cities had total discretion over the tax revenues raised in districts. The consequence of these dynamics was a rapid strengthening of the relative power and resources of prefectural-level governments vis-à-vis county-level governments in the 1990s (Li and Wu 2014). For newly created districts, fiscal revenues often declined, especially because the new districts were no longer eligible to receive fiscal transfers from the province (Zhao and Wang 2022).

The Emergence of Strong Counties Inside Weak Prefectures

While the administrative status of prefectures was on the rise in the 1980s and 1990s, it was the *economic* status of counties that increased. More specifically, some counties saw their fiscal capacity rise dramatically. Entrepreneurial local governments—particularly in eastern coastal China—harnessed the growth of township-and-village enterprises (TVEs) and private firms to achieve significant economic success (Whiting 2001). This economic dynamism occurred primarily in the more rural counties, as opposed to the urban districts that were dominated by a stagnant or even declining state-owned enterprise sector (Huang 2008).

The emergence of economically powerful counties challenged the administrative power of prefectural-level cities. Rapidly growing counties in Zhejiang, for example, found that they had to seek approval from prefectural-level governments for big investment projects more often as their economies grew. By the mid-2000s, some counties boasted economies that were larger than entire Western provinces. Kunshan, a county-level city in Jiangsu neighboring Shanghai, accounted for 4.7% of China's *national* GDP in 2010. The following year it had a GDP of 2.4 billion RMB, larger than that of Hainan, Tibet, Qinghai, or Ningxia. This became known as "a big foot wearing a small shoe" and referred to the mismatch between a county's lowly administrative status and its outsized economic importance (Chien 2013). High county fiscal capacity in Kunshan was coupled with comparative weakness in its supervising city, Suzhou. The revenues generated in the core urban districts of Suzhou were far lower than those of Kunshan (and the other economically developed counties of Changshu, Taicang, Wujiang, and Zhangjiagang). Suzhou was a "weak heart in a strong city (强市弱心)" in the sense that the economic vitality was outside the urban districts (Cartier 2016).

Because of the central government's focus on the generation of economic growth in cadre evaluation (Whiting 2004; Edin 2003), this uneven spatial pattern of revenue growth had political consequences. The ability of cadres in "strong counties" to mobilize economic development and revenues that are useful to their superiors in the provincial government made strong counties a breeding ground for future leaders. Kunshan's county party-secretary, for example, held a dual appointment on the CCP Jiangsu provincial party committee, a body two administrative levels higher (Chien 2013).

Prefectural-level cities leveraged their administrative power to compete with county leaders for growth and promotions. Understanding that provincial-level authorities would only approve so many infrastructure projects, prefectural leaders reserved room for their own projects and argued for locating larger projects in the prefecture's urban districts, instead of in the increasingly powerful counties. Prefectural officials were afraid that the emergence of strong county economies would put county leaders at a competitive advantage for promotions over prefectural leaders and therefore also had career motivations in constraining the growth of counties (Yu and Gao 2013). By contrast, district officials often feel that they are less powerful than their counterparts in counties (and county-level cities) and that it is much more difficult to get promoted (Zhao and Wang 2022). In strong counties and weak cities administrative division adjustment occurs in the context of political competition between county heads and prefectural heads for career advancement. Converting economically developed counties can therefore allow prefectural leaders to politically sideline and marginalize powerful rivals.

In addition to the reduced autonomy because of the conversion to a district highlighted above, strong counties could also see their informal sources of patronage reduced. In the strong county of Daye, in Huangshi, Hubei, for example, conversion to a district would have given the municipality control over Daye's mineral resources. This would have threatened the ability of Daye officials—who held many shares in local mining companies—to protect their assets (Deng, Yang, and Ma 2021). The loss of authority over control of land transactions would similarly deprive county officials of a lucrative source of bribes. The areas in which local officials lose administrative autonomy (especially finance and land) were generally powerful county agencies in patronage terms. As Hillman showed, "officials in the Land and Resources Bureau could collude with developers to dictate the terms of sale … the majority of land deals were negotiated by the Land and Resources bureau behind closed doors" (2014, p. 102).

This situation can be contrasted with the position of economically "weak" counties in "strong" cities. When the city is at a higher level of development, conversion can be *attractive* for local officials. Once they are made district officials, their salaries and welfare benefits must be elevated to the high-

er level of the prefecture. As Zhao and Wang (2022, p. 35) note, "if the central city has a strong power, the new district will be granted more support of funds, policies and projects so as to promote its medical care and education, social security and employment as well as transport to the urban level." Opposition in such cases is likely to be muted, while at the same time local leaders are likely to enjoy less informal political power. As one report put it, "Aside from some economically strong counties in Zhejiang and Jiangsu, nationally most counties are still willing to 'remove counties and establish districts'" (Wang 2023).

Leaders in strong counties have both stronger incentives and greater ability to prevent prefectural officials from converting their counties into districts. In an admittedly extreme case, the Kunshan party secretary's position on the Jiangsu provincial party committee meant that he held sway in a provincial-level body that made decisions over which applications for conversion of counties into districts should be passed on to the State Council. Indeed, Kunshan has sought to convert not into a district, but a prefectural-level city of its own, which would place it at the same rank as Suzhou (Cartier 2016).

For its part, Suzhou sought to convert a county-level city into an urban district to enhance the power of its urban core. Suzhou, however, failed to convert Kunshan and instead was compensated with the economically weakest of the counties, Wujiang. Wujiang became a district in 2012, alongside a re-organization of three of Suzhou's districts into the new district of Gusu (Cartier 2016). This pattern of strong counties and weak cities is also particularly common in Zhejiang. Yiwu, for example, is another "strong county" within the "weak city" of Jinhua (Sina 2018).

County opposition often takes the form of lobbying superiors in the province through informal ties, petitioning central authorities, or working through local People's Congresses or People's Consultative Conferences. Because these institutions are weak, however, these measures are often ineffective. In extreme cases, county officials may even resort to intentionally facilitating public protests against conversion to a district (Deng, Yang, and Ma 2021). Local officials in Daye county, in Huangshi prefecture, Hubei, and Changxing county, in Huzhou prefecture, Zhejiang, both pursued this strategy. Notably, both Daye and Changxing were the highest revenue counties under their respective cities, while the prefectural cities were relatively weak. As Deng, Yang, and Ma (2021, p. 6) note, "like many other cities in Zhejiang province, the urban center of Huzhou was not as developed as the counties under its jurisdiction, and thus the county had little to gain from becoming a district of the city." Yet mobilizing protesters is risky—the responsible officials in Daye were punished.

In sum, the economic strength of developed counties makes them an inviting target for conversion on the one hand, but also a potentially formidable opponent, on the other. By implication, it may be that only particularly powerful prefectural cities have

the political "muscle" needed to push forward conversions against strong counties. Provincial capitals can prove more effective in this regard (He and Jaros 2023). Because party secretaries of provincial capitals typically also sit on the provincial party committee, they can more effectively lobby for provincial government support. At the same time, provincial capitals are often more economically powerful than the average prefecture because they are often home to more and larger state-owned enterprises (Chung 2003). Case studies of both Hangzhou and Nanjing reveal that they were more effective at pushing through conversions than non-provincial capitals such as Ningbo (Zhang and Wu 2006; Jaros 2023).

Centrally-managed cities (Chongqing, Shanghai, Beijing and Tianjin) have, if anything, even more power because they function effectively as both provincial- and prefectural-level authorities. Even economically strong counties, moreover, may have fewer reasons to oppose conversion by centrally-managed cities. Officials whose counties are converted to districts are compensated with promotion to a higher rank in the administrative hierarchy because districts under provincial-level cities are prefecture-level units in administrative terms (Ma 2005).

The Center and Provincial Governments Attempt to Constrain Prefectural Fiscal Predation through PAC

Prefectural governments' attempts to wrest resources from county governments did not go unnoticed in provincial capitals and Beijing. More broadly, the center was becoming concerned in the early 2000s with rural underdevelopment and tax burdens and saw the local fiscal system through the lens of the "Three Rural Problems" of agriculture, rural areas and peasants (Yu and Gao 2013).

An early attempt at reforming this relationship emerged in Zhejiang in the early 1990s. The origins of Zhejiang's policy seem to have been in promoting economic development in "economically prosperous counties" (what is referred to above as "strong" counties) by granting them enhanced approval authority for economic projects and thereby cutting bureaucratic red tape at the prefectural level. The reform initially focused on approval for infrastructure, technical upgrading and foreign investment projects, but was expanded in 1997 to include fiscal management, among other areas. Prefectural-level governments opposed these reforms, but because provincial-level officials controlled personnel appointments at the prefectural level, the prefectures were forced to accept them (Yu and Gao 2013).

This Zhejiang model evolved into the "Province Administers County" reform of direct provincial management of counties. The province directly settles remission of revenues collected in the county with the county government, while also directly dispatching transfer payments, funds and tax returns to the county government (Liu, Jin, and Zhao 2023). Notably, this eliminates

prefectural-level cities from the nested structure and prevents them from retaining revenues more than those that would be passed along to the province, and retaining transfer funds meant for the county. The success of county-level governments in promoting economic growth, such as Yiwu county, spawned adoption of the model elsewhere in the early 2000s (Luo et al. 2014).

A second wave of adoption of the PAC reform came about at the prodding of the central government. Wen Jiabao promoted PAC reforms in 2005 as part of the Rural-Fee-to-Tax Reform. This central support was followed up in 2009 with a Ministry of Finance directive calling for the experiments to be expanded nationwide by the end of 2012 except in minority areas (Li and Wu 2014). The content of the reforms varies and there is no universal pilot project for Province Administers Counties. Often times reforms cover fiscal management, economic and social administration, or both (Li and Wu 2014).

As noted above, provincial governments often explicitly targeted highly developed counties for inclusion in trials of "PAC" reforms. This was the case in Zhejiang, where "strong" counties such as Xiaoshan, Yuhang, Cixi, Shaoxing and Jiaxing counties were all selected for inclusion in the first round of reforms (Yu and Gao 2013). Aside from Zhejiang "strong counties" (often explicitly described as such) were the focus of initial reforms in the policy documents of Hebei, Heilongjiang, Shandong, and Shanxi. Evidence indicates that PAC reforms reduce the fiscal power of prefectural cities, limiting their ability to fund expansions in land urbanization (Liu, Zhong, and Zhen 2025).

The enhanced autonomy granted to counties under the PAC reforms effectively increases the costs of conversion to a district for county leaders because it results in an even greater loss of autonomy than for counties under prefectural governance. This suggests that counties under provincial administration—particularly strong counties—may be even more opposed to conversion to a district.

Consistent with this argument, the enhanced autonomy granted to counties under this reform has also sparked the opposition of prefectural-level cities (Luo et al. 2014). Some have even gone so far as to refuse to implement the devolution of administrative approval rights (Li and Wu 2014). Indeed, the Zhejiang provincial government was forced to explicitly identify all 443 powers it was delegating to all counties in 2008 and include a list of them as an appendix to the order (Yu and Gao 2013). Li and Wu (2014) report that Nanjing and Suzhou, for example, have merged counties in order to escape the PAC reforms. A Suzhou official confirmed this, explaining "the direct administration of counties by provincial governments is an irrepressible trend. Prefectural-level cities have a strong desire to convert counties into urban districts before counties are taken over by provincial governments" (quoted in Lu and Tsai 2019). Media reports likewise suggest that local officials have

attempted to convert counties to districts to avoid constraints on the development of prefectural cities caused by the Province Administers Counties reform (南方周末 [Southern Weekend] 2015). Notably, the 2012 deadline for implementation of 'Province Administers Counties' reforms nationwide coincides with an upswing in conversion of counties to districts in 2013–2015.

Implementation of the Province Administers Counties reform has been staggered, varying widely both across and within provinces. In some provinces the reforms are immediately extended to the entire province while in others only selected counties are included. The most salient difference in the adoption of PAC reforms has been between Western provinces and the rest of China, with the Western provinces generally implementing reforms later, as seen in Table 1. Notably several minority provinces, such as Xinjiang and Tibet, have not implemented reforms at all. This seems to have fit the intent of Beijing, which explicitly excluded minority provinces from the requirement that reforms be implemented by 2012. This staggered and uneven implementation of the reform offers a perfect opportunity to examine the impact that the reform has had on the conversion of counties to districts.

Table 1: First Year of Implementation of PAC Reforms

East	**Year**	**Northeast**	**Year**
Zhejiang	1992	Heilongjiang	2004
Fujian	2003	Jilin	2005
Shandong	2003	Liaoning	2006
Guangdong	2004		
Hebei	2005	**West**	
Jiangsu	2007	Sichuan	2003
		Gansu	2005
Central		Shaanxi	2006
Hubei	2003	Qinghai	2007
Anhui	2004	Yunnan	2008
Henan	2004	Guangxi	2009
Shanxi	2005	Guizhou	2009
Jiangxi	2005	Ningxia	2009
Hunan	2005	Inner Mongolia	2014
Shaanxi	2006		

Source: Author's Database

Data

Information on the administrative rank of counties was gathered from http//www.xzqh.org, which publishes annual reports on the administrative rank (district/county-level city/county) of each county-level administrative unit. All the observations initially began as a county or county-level city in 2000. The data was coded into a dummy, *district*, measured as a 1 if a jurisdiction is a district, and a 0 if it is a county-level city or county. The scope of the data includes the years 2000 to 2019. The district conversion dataset was paired with data from China Data Online (www.china-data-online.com) for population, GDP, area and revenue. Missing data was handled through listwise deletion, meaning that some counties were not included in the dataset because there was no matching data for independent variables in China Data Online. This constitutes a limitation of the study. Data seemed to be missing most often for rural counties in autonomous regions. This mitigates the limitation somewhat because minority areas were excluded from the central government mandate to implement PAC reforms. In total there were 2,077 county-level jurisdictions in the analysis. Of these 194 (9.3%) were converted to districts in the period of 2000 to 2019. Revenue data is in 100 million RMB and is logged. Population data is in 10,000 persons and is logged. Revenue per capita is in 10,000 RMB per person and is logged. The area of administration 10,000s of square kilometers and is logged. The variable for the PAC policy reforms captures whether a county has been enrolled in the PAC program. The variable for risk of PAC captures whether the province has begun implementation of PAC. Counties in which the provincial government has begun implementation of PAC are coded as "1" while counties in which the provincial government has yet to implement PAC reforms are coded "0." These two variables were hand-coded based upon provincial government policy documents found online that announced the implementation of the reforms and specified the affected counties. The author also coded dummy variables measuring the political status of a county as residing in either a provincial-level city, a deputy-provincial level city or a centrally planned city.

Hypotheses

The emergence of Province Administers Counties reforms may have influenced patterns of conversion. To counteract prefectural predation of counties, provincial governments increasingly enacted Province Administers Counties reforms that, among other things, placed counties under the fiscal supervision of the province instead of the prefectural city. Inclusion of a county in PAC gives a province a vested interest in maintaining the status of a county because provinces directly supervise the county and would lose access to county revenues if the county were converted to a district. This suggests the following hypothesis:

The Provincial Protection Hypothesis: Counties under PAC reforms are less likely to be converted to districts.

Prefectural cities responded to PAC reforms by converting economically powerful counties into urban districts to escape provincial control. Nantong, for example, annexed the highly developed Tongzhou county as a district in 2009 (Luo et al. 2014). As He and Jaros (2023, p. 936-937) have noted, the emergence of provincial administration of counties has given cities "even stronger incentives [to convert counties to urban districts] following the rollout after the early 2000s of provincial administration of counties … reforms that placed rural counties under provincial fiscal oversight, depriving prefectural-level cities of a revenue source." This suggests the following hypothesis:

The Prefectural Predation Hypothesis: Counties under PAC reforms are more likely to be converted to districts

Implementation of PAC reforms within a province may also alter the risk perceptions of prefectural governments. Even if a county that a prefecture would like to convert has not yet been placed under PAC reforms, the implementation of PAC within the broader province may motivate prefectures to intensify their efforts to convert counties ahead of any potential expansion of the pool of counties included in PAC. This suggests the following hypothesis:

The Risk of PAC Hypothesis: Implementation of PAC reforms within the province may increase the likelihood of conversion to a district

Fiscal decentralization may also influence conversion. Strong counties with higher fiscal revenues may may be targeted for conversion so that prefectural governments can gain more control over these resources. Fiscal capacity is measured by revenues per capita (logged). This suggests the following hypothesis

The Fiscal Stress Hypothesis: Counties with high fiscal capacity are more likely to be converted.

The existing literature also highlights the role of administrative rank and political power in facilitating conversion to districts (He and Jaros 2023; Lu and Tsai 2019). Provincial-level cities converted a large number of counties into districts in the early 2000s (Lu and Tsai 2019). Jaros (2023, p. 398) has hypothesized that "we should expect to observe more frequent ADAs in cases where relations between provinces and cities are relatively harmonious" especially deputy-provincial rank capital cities. By contrast, deputy-provincial rank prefectures that are *not* provincial capitals may face a more factitious relationship with provincial authorities jealous of their autonomy. Ningbo officials, for example, long complained of a lack of political support from provincial officials in Hangzhou (Jaros 2023). Similarly, provincial capitals may be more likely to have the political power required to force through conversions of districts (Lu and Tsai 2019). Additionally, the regression includes controls for level of economic development, the physical size (area), population, and population density.

Discussion

I employ Cox proportional hazards survival models to examine the factors that prolong or shorten the

period of time before a county or county-level city is converted into a district. Survival models estimate the time until an event occurs. The dependent variable in the models is the binary variable *district*, capturing whether a particular county was transformed into a district in that year. Hazard ratios measure the instantaneous risk of an event, which in this context is the likelihood of being converted into a district. A hazard ratio of 1 implies no effect, while a hazard ratio above 1 indicates increased risk of conversion to a district, while a hazard ratio of below 1 indicates reduced risk of conversion to a district. The duration variable measures the years that have passed from the beginning of the dataset in 2000. Tests of proportional hazards indicate that the assumption of proportional hazards has not been violated. None of the variables have P-values below 0.05. A survival model is appropriate because of the structure of the data as a discrete-time event history with a one-way absorbing transition (i.e., once counties are converted into districts they are never converted back into counties). In essence, the modeling choice investigates how long jurisdictions "survive" before undergoing a transformation into an urban district. As a robustness check, a discrete-time hazard (logit) model is used in the appendix. The results are substantively identical to Model 4.

A useful first-cut look at the data is to examine the PAC status of counties in the year that they were converted into an urban district. As seen in Table 2, below, most counties (55.2%) were not under PAC the year they were converted to a district, although this figure was not substantially higher than those that were not.

Table 2: PAC Reforms at the Time of Conversion

Province Administers County Reforms	Conversion to Districts
PAC	76 (44.7%)
No PAC	94 (55.2%)

Model 1 in Table 3, below, shows the results of the Cox regression. Inclusion in PAC reforms has no impact on the likelihood of conversion to a district, suggesting that PAC implementation does not protect a county from conversion into a district. Model 2 examines the impact of PAC implementation within the broader province. If PAC reforms have begun within the province, prefectural cities may fear that they will soon lose access to county revenues even if the county is not currently affected by PAC due to future expansions of the policy. However, Model 2 suggests that neither implementation of PAC within the province nor PAC status in a county influence conversion to a district.

Models 1 and 2, however, do not control for confounding variables. Model 3 adds controls for revenue, level of economic development, population and geographical factors, as well as proxies for political resources. Once these factors are controlled for, PAC reforms within the province are surprisingly associated with a *reduced* hazard of conversion to a district, as seen by the hazard ratio that falls below 1. Turning to fiscal strength, counties with higher fiscal resources (as measured by the log of revenue per capita) have a higher likelihood of conversion to a district.

As Model 4 shows, whether a county is included in PAC reforms continues to have no impact on the likelihood of conversion. The impact of the initiation of PAC reforms in the province, however, is contingent on revenues. Counties with high revenues in provinces that implemented PAC reforms are *less* likely to be converted, as seen by the hazard ratio of the interaction term falling below 1. By contrast, counties with low revenues are more likely to be converted in provinces that have implemented PAC reforms. To summarize the findings, fiscally strong

Table 3: Conversion to Urban Districts

	Model 1	**Model 2**	**Model 3**	**Model 4**
PAC Reformed County	1.238 (.239)	1.213 (.248)	.893 (.186)	.938 (.195)
PAC Reform within Province		1.087 (.311)	.533** (.164)	9.235** (9.602)
Revenue per capita (logged)			1.663** (.286)	2.216*** (.429)
Revenue Rank*PAC Reform in Province				.671** (.091)
Population (logged)			1.609*** (.159)	1.647*** (.091)
Population Density			1.000 (.000)	1.000 (.000)
GDP per capita (logged)			1.264 (.252)	1.208 (.242)
Area (logged)			.717*** (.069)	.704*** (.067)
Provincial Capital			1.500* (.353)	1.533* (.362)
Deputy Provincial City			1.667* (.456)	1.680* (.469)

Hazard ratios with robust standard errors in parenthesis, *** indicates p≥.01, ** indicates p≥.05, * indicates p≥.1. Model 1, N=37,028; Model 2 N=37,028; Model 3 N=36,778; Model 4 N=36,678

counties are more likely to be converted to districts in provinces that have yet to begin PAC implementation. Once PAC implementation begins in the province, however, it is the fiscally *weak* counties that are more likely to be converted to districts.

Collectively, these results suggest that the Province Administers Counties policies have had a mixed effect. On the one hand, placing a county under provincial administration has no impact on the likelihood of conversion to an urban district. In this sense, the policy has not prevented prefectural cities from converting counties into urban districts to gain more direct control over their finances. On the other hand, implementation of PAC reforms within a province significantly alters the profile of counties that are converted into districts. The evidence suggests that PAC reforms within a province make it more difficult for prefectures to convert "strong" counties. This may reflect an effort on the part of the provincial government and/or State Council to protect counties with large tax bases from conversion. It may also reflect that counties with large tax coffers in the era of provincial management have greater bargaining power and can more effectively rebuff efforts by prefectural-level cities to bring them under their control.

Conclusion and Implications

Although scholars have heavily focused on land-based urbanization and population-based urbanization, administrative urbanization represents an important and under-studied form of urbanization (Wang and Yeh 2020). Fiscal decentralization has been found to have pushed land-based urbanization (He, Zhou, and Huang 2016). By contrast, this article argues that fiscal decentralization has also accelerated *administrative urbanization*. Within China, county-level governance increasingly takes the form of urban districts. Scholars have only recently begun to unravel the politics of administrative division adjustment in China. Recent works on this topic have emphasized the roles of the prefectural political resources and the increasing involvement of provincial governments. Prefectural cities with stronger formal and informal political resources—particularly those in which the prefectural Party secretary also sits on the provincial Party committee (such as provincial capitals)—are better able to secure approval for converting counties into districts (He and Jaros 2023). Provincial authorities have also implemented direct management of counties in order to gain better access to their revenues and insulate them from prefectural cities (Lu and Tsai 2019). This research has speculated about the impact of PAC reforms on administrative division adjustments, but those hypotheses have not been systematically tested until now.

This article has moved down to the county-level, analyzing how the differing characteristics of counties influence conversion. Special attention has been given to PAC reforms that were intended to protect county revenues. PAC reforms have been revealed to have a complex effect. On the one hand, inclu-

sion of a particular county in PAC reforms has no impact on the likelihood of conversion: they are no more or less likely to be converted. This is surprising given existing research suggesting that insulating county revenues from prefectural city control was a primary motivation for the implementation of the PAC reform. Instead, following the implementation of PAC reforms in a province only high revenue counties are less likely to be converted.

While existing research has focused on the bargaining power of prefectural cities with political ties to provincial or central authorities, the findings presented here point to the importance of county-level fiscal resources. Post-PAC reforms, strong counties with high fiscal resources seem to have enhanced bargaining power with respect to ADA. Provincial authorities—who benefit from robust revenue collection in strong counties that pass directly to provincial coffers—have fewer incentives to risk "killing the golden goose" by approving the conversion of strong counties to urban districts. The statistical evidence presented here does not allow us to affirmatively prove provincial intentions, but the relationships observed are consistent with this interpretation. Why then, have provincial and central authorities allowed the pace of approval of county-to-district conversions to increase in the 2010s? Elite politics may play a role. The Xi administration's New-Type Urbanization plan emphasized the growth of small and medium-sized cities, a trend facilitated by conversion to districts (He and Jaros 2023).

The implication of the conversion patterns observed in this article is that central government and provincial efforts to insulate county government revenues from retention by prefectural cities have only been partially effective. The evidence suggests that strong counties—which already had high revenues—have been protected and their revenue-retention capabilities enhanced. In this sense, the PAC reforms have succeeded at insulating county revenues, making strong counties the primary beneficiary of the reforms. On the other end of the economic spectrum, less economically developed counties are now *more* likely to be converted to urban districts with no control over their revenues—this authority having been ceded to prefectural cities as part of the conversion process. This suggests poorer counties have been harmed by the reform. Equally, prefectural cities are also largely worse off because of the reforms because they are less able to convert economically strong counties. Studies have shown that prefectural city revenues declined after PAC reforms (Liu, Zhong, and Zhen 2025) This pattern may suggest that central and provincial authorities were primarily concerned about protecting the revenues of economically dynamic and powerful counties from prefectural cities, not economically disadvantaged counties.

Research on the impacts of PAC reforms on county finances have suggested that counties included in PAC reforms have higher revenue growth, higher expenditures on education and reduced expenditures on administra-

tion (Jia, Ning, and Zhang 2023; Huang et al. 2017). Conversion of counties into districts, on the other hand, has been shown to reduce economic output, fiscal capacity and public services (Jie et al. 2026). In as much as poorer counties are more likely to be converted in provinces implementing PAC, the combination of the intended impact of PAC reforms and district conversion may exacerbate inequality. This is important because regional income inequality in China has been increasingly driven by county-level differences (Yousaf 2025). Strong counties retain their autonomy and increase their resources, while weaker counties become districts. This suggests that an unintended consequence of PAC reforms amidst continued administrative urbanization is increased income inequality between relatively wealthy county governments and poorer newly emergent urban districts. A policy implication of this is that the central government may need to further its efforts to combat *localized* inequality within regions.

This article also opens questions for future research. Do PAC reforms and district conversions result in increased inequality, as the implications above suggest? How do prefectural city leaders secure the support of county leaders for their expansion plans? Do prefectural leaders—as Cartier (2016) has suggested was the case in Suzhou—secure promotions for former county leaders? Does the building out of the district and street office apparatus offer opportunities for patronage to former county leaders? Future research on PAC reforms and the politics administrative division adjustments could usefully address these questions.

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Appendix

Summary statistics for the variables are seen in Table A.1

Table A.1 Summary Statistics

Variable	Observations	Mean	Standard Deviation	Minimum	Maximum
PAC Reformed County	39,051	.397	.489	0	1
PAC Reform in Province	39,072	.664	.472	0	1
Revenue Per Capita (logged)	39,576	6.408	1.281	1.214	11.616
Population (logged)	39,710	3.515	.943	-.562	5.515
GDP Per Capita (logged)	39,680	9.506	.999	5.572	13.046
Area (logged)	39,688	-1.458	.958	-9.210	3.538
Population	39,688	295.330	354.551	0	41200
Provincial Capital	39,889	0.079	.269	0	1
Deputy Provincial City	39,889	0.030	.170	0	1

As a robustness test, I conducted the analysis using a discrete-time hazard model (logit) with a flexible baseline (year dummy). The substantive results are identical. Inclusion in PAC reforms has no impact on the likelihood of conversion. Once PAC reforms are implemented in a province, the likelihood of conversion increases for all counties. Higher revenue counties are also more likely to be converted. The interaction of risk of PAC reform within the province and revenues, however, is negative: high-revenue counties are less likely to be converted following implementation of PAC reforms in the province. The model includes the same controls and provincial and year fixed effects. The results can be found in Table A.2.

Table A.2 Logistic Regression on Conversion to Urban Districts

	Model 1
PAC Reformed County	-.274 (.248)
PAC Reform within Province	2.256** (1.045)
Revenue per capita (logged)	.958*** (.190)
PAC Reform within Province*Revenue per capita	-.407*** (.124)
Population (logged)	.916*** (.157)
GDP per capita (logged)	.376 (.238)
Area (logged)	-.497*** (.135)
Population Density	-.000 (.000)
Provincial Capital	.174 (.271)
Deputy Provincial City	.631** (.321)

Coefficients with robust standard errors clustered by county in parenthesis. *** indicates p≥.01, ** indicates p≥.05, * indicates p≥.1. Includes fixed effects for year and province. N=30,609 with 1,999 counties.

The Rise of Global Collaboration in China Policy Research: Evidence from Bibliometric Network Analyses, 2000–2025

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Abstract

This study examines the evolution of China policy research and its growing role in global policy scholarship. Using bibliometric and social network analyses of 326 articles published in 20 high-impact political science journals from 2000 to 2025, we trace the field's expansion, identify key thematic concentrations, and document the emergence of robust international collaboration patterns. Cross-national co-authorship networks reveal a clear transition from a fragmented, Western-centered structure to a dual-hub system anchored by Mainland China and the United States, while institution-level networks show that leading Chinese universities have become central collaborators and Hong Kong institutions continue to serve as critical bridges. These patterns illustrate how China policy research has moved from peripheral observation to active co-production of policy-relevant knowledge, demonstrating the critical role of structured international collaboration in generating high-quality, theoretically consequential, and globally relevant scholarship. By highlighting the infrastructure, mechanisms, and partnerships that support this co-production, our study underscores how collaborative networks enable scholars to address complex transnational policy challenges and maintain scholarly engagement even amid geopolitical tensions. Finally, we discuss practical pathways for strengthening field-building through conferences, professional associations (e.g., CAAPA, CPSG), and international-facing publication platforms, offering lessons for fos-

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tering sustainable global research collaboration in public policy more broadly.

Keywords: China Policy Studies, International Collaboration, Bibliometric Analysis, Scientific Collaboration, Institutional Collaboration

El auge de la colaboración global en la investigación de políticas sobre China: evidencia de análisis de redes bibliométricas, 2000-2025

Resumen

Este estudio examina la evolución de la investigación sobre políticas chinas y su creciente papel en la erudición política global. Mediante análisis bibliométricos y de redes sociales de 326 artículos publicados en 20 revistas de ciencia política de alto impacto entre 2000 y 2025, se rastrea la expansión del campo, se identifican concentraciones temáticas clave y se documenta el surgimiento de sólidos patrones de colaboración internacional. Las redes transnacionales de coautoría revelan una clara transición de una estructura fragmentada y centrada en Occidente a un sistema de doble centro anclado por China continental y Estados Unidos, mientras que las redes a nivel institucional muestran que las principales universidades chinas se han convertido en colaboradoras centrales y las instituciones de Hong Kong continúan sirviendo como puentes fundamentales. Estos patrones ilustran cómo la investigación sobre políticas chinas ha pasado de la observación periférica a la coproducción activa de conocimiento relevante para las políticas, demostrando el papel crucial de la colaboración internacional estructurada en la generación de erudición de alta calidad, con relevancia teórica y de alcance global. Al destacar la infraestructura, los mecanismos y las alianzas que sustentan esta coproducción, nuestro estudio subraya cómo las redes de colaboración permiten a los investigadores abordar complejos desafíos políticos transnacionales y mantener el compromiso académico incluso en medio de tensiones geopolíticas. Finalmente, analizamos vías prácticas para fortalecer el desarrollo del campo a través de conferencias, asociaciones profesionales (por ejemplo, CAAPA, CPSG) y plataformas de publicación con proyección internacional, ofreciendo lecciones para fomentar una colaboración de investigación global sostenible en materia de políticas públicas en general.

Palabras clave: Estudios de política china, Colaboración internacional, Análisis bibliométrico, Colaboración científica, Colaboración institucional

中国政策研究中的全球合作演进：基于文献计量与社会网络分析的证据（2000－2025）

摘要

本研究系统考察中国政策研究的发展历程及其在全球政策研究中的地位变迁。基于2000—2025年20种高影响力政治学期刊发表的326篇中国政策研究，本研究采用文献计量与社会网络分析方法，梳理该领域的知识演进脉络、研究主题结构与国际合作格局。国际合作网络显示，该领域已由早期以西方为中心的分散合作结构，逐步转向以中国大陆与美国为核心的“双中心”格局。机构层面的合作网络进一步表明，中国大陆顶尖高校已进入核心合作者序列，中国香港高校持续发挥关键的桥梁与中介作用。上述变化反映出中国政策研究正从“西方外部观察”走向“知识共同生产”，并凸显国际合作在产出高质量、具理论贡献与全球影响的研究中的关键作用。进一步地，本研究揭示支撑知识共同生产的基础设施、运行机制与合作网络，讨论协作关系如何帮助学者应对跨国政策议题，并在地缘政治紧张背景下维系学术交流。最后，本研究提出通过学术会议、专业协会（如CAAPA、CPSG）与国际化学术出版平台推动领域建设的路径，为公共政策领域促进可持续的国际科研合作提供参考。

关键词：中国政策研究；政策过程研究；国际学术合作；知识生产；合作网络；文献计量学；社会网络分析

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1. The Importance of International Collaboration in Public Policy

Global partnerships have become indispensable in public policy in a time when the most pressing challenges of our time are inherently transnational and cannot be effectively addressed within traditional national governmental boundaries (Rittel and Webber 1973; Cairney 2021). Some of these challenges include climate change, AI, pandemics, and poverty, whose causes and consequences routinely transcend national borders and make unilateral action insufficient (King et al. 2023). The mobilization of scientific knowledge through international collaboration enables policymak-

ers and researchers to design strategies and solutions for these complex global issues (Rittel and Webber 1973; Cairney 2021; King et al. 2023; UNESCO n.d.). As policy research becomes increasingly complex and methodologically diverse, it has become necessary to draw from a broader global pool of specialized knowledge and expertise to generate innovative and effective ways to solve today's complex and multifaceted policy challenges (Ribeiro et al. 2018).

A large body of research demonstrates that scientific collaboration broadens access to data and infrastructure, stimulates methodological innovation, enhances productivity and research quality, and amplifies scholarly impact (Abramo and D'Angelo 2015; Adams 2013; Adams and Szomszor 2024; Cheng et al. 2025; Freeman and Huang 2014, 2015; Li et al. 2022; Lyu et al. 2021, 2023; Rosenkopf and Nerkar 2001). Collaboration across institutional, disciplinary, and national boundaries, especially within diverse international teams, is consistently associated with wider diffusion and higher citation impact (Fan et al. 2022; Lyu et al. 2023).

Beyond academic outcomes, scientific collaboration is one of the most effective vehicles for advancing global partnerships and has grown steadily in recent decades (Wagner et al. 2017). It is widely recognized as a key driver of both economic prosperity and sustainable development (U.S. Office of Science and Technology Policy 2000), and it can help sustain dialogue even where political relations are fragile. During the Cold War, for example, scientific ties between the United States and the Soviet Union provided a framework for engagement on nuclear arms and other sensitive issues when diplomatic channels were constrained (Royal Society 2011, 62; UNESCO n.d.).

Today, when tensions between the world's two largest powers, the U.S. and China, intensify through strategic rivalry, trade disputes, and deepening geopolitical mistrust, scientific collaboration between them nonetheless remains robust across many fields. This coexistence of escalating political confrontation and resilient scientific interdependence reveals a striking paradox. It invites us to ask how transnational knowledge networks adapt under geopolitical strain and explain their role in buffering, mediating, or even subtly reshaping conflict. Situated at the intersection of these dynamics, China policy research offers a particularly revealing vantage point and lens for understanding how global scholarly communities reorganize themselves when political relations are fragile.

Against this backdrop, China policy research has emerged as a distinct and increasingly prominent field that both reflects and shapes global scientific collaboration. China's institutional design and policy processes have far-reaching consequences for climate governance, global health, digital regulation, and other domains with worldwide ripple effects. At the same time, the growing volume of China-focused articles in leading journals signals rising theoretical sophistication, practical

salience, and intensifying cross-border collaboration in the study of China's policy system (Cao et al. 2026; Kim et al. 2019; Li and Zhang 2021; Yang and Yi 2023; Xiao and Yi 2024; Zhang et al. 2018).

Yet the evolution of China policy research as a global field has not yet been systematically examined. Existing studies have mostly examined the development of public administration and public policy in China and focused on publication patterns in specialized PA/PP journals (Cao et al. 2026; Li and Zhang 2021; Wu et al. 2013; Wu et al. 2016; Xiao and Yi 2024; Zhang et al. 2018). To date, no study has examined China policy research published in top political science outlets, nor has anyone systematically analyzed how cross-national and cross-institutional collaboration patterns in the field have evolved over time. This gap is especially notable given the interdisciplinary nature of public policy, the growing importance of international collaboration in policy research, and the fact that both public administration and public policy originated within political science and later developed as distinct (sub)fields, with many seminal policy studies published in leading political science journals (e.g., Berry and Berry 1990; Gray 1973; Lowi 1964; Schneider and Ingram 1993; Walker 1969; Wilson 1887). To this day, many public administration and public policy programs remain institutionally embedded within political science departments, and leading political science associations (such as American Political Science Association and Midwest Political Science Association) contain highly active sections dedicated to public policy and public administration.

In China, policy research has developed in close interaction with political science. Previous studies show that China policy research, which was initially institutionalized within political science (Cao et al. 2026), has extensively drawn on political science theories to examine policy processes and develop policy theories (Li 2019). Moreover, political scientists have remained central contributors to Chinese public administration and policy research (Walker et al. 2014), and political science ranks as the most prominent interdisciplinary collaborator in mainland China's public administration research output (Zhang et al. 2018). Restricting analysis to public administration and public policy journals therefore systematically overlooks a substantial body of China policy research that is published in political science outlets.

This study addresses these gaps by tracing the development of China policy research and assessing why it merits attention as a distinct and maturing field. Using bibliometric and social-network analyses of all China policy articles published in the top 20 political science journals from 2000 to 2025, we document the field's temporal growth, journal distribution, and collaboration structures across countries and institutions. The results reveal a stage-based expansion rather than linear growth, with two major stepwise shifts around 2006 and 2020, and a pronounced increase in China-focused publications across leading outlets. We further map

the evolution of international collaboration networks over four phases, showing a transition from a fragmented and Western-centered structure to a more integrated, dual-hub configuration centered on Mainland China and the United States. At the institutional level, we show how collaboration expanded from a small set of Western institutions to a densely connected network in which Mainland Chinese universities emerged as central and influential actors.

By situating China policy research within the broader dynamics of global scientific collaboration, our analysis demonstrates both the field's scholarly significance and its practical importance for understanding and governing transnational policy challenges. The article concludes by outlining future pathways for deepening engagement through conferences, professional associations (e.g., CAAPA, CPSG), and China-based international journals to further support the co-production of policy knowledge in this increasingly central area of public policy scholarship.

2. Methodology

To systematically examine patterns of scientific collaboration in China policy research as reflected in top political science journals, we have selected 20 leading political science journals from the 2023 Journal Citation Reports. As part of our selection process, journals were required to meet the following criteria: (1) they had to be included in the "Political Science" category, (2) they had to be SSCI-indexed and ranked in Q1, and (3) they had to have impact factor levels greater than 4.0 (both five-year and 2023). The final set comprises the following peer-reviewed journals: *American Political Science Review, American Journal of Political Science*, *Political Communication*, *International Organization*, *Policy and Society*, *Journal of Public Administration Research and Theory*, *Environmental Politics*, *Comparative Political Studies*, *Journal of European Public Policy*, *Policy & Internet*, *World Politics*, *British Journal of Political Science*, *Policy Studies Journal*, *Global Environmental Politics*, *Public Administration*, *Political Behavior*, *Journal of Politics*, *Political Geography*, *Policy & Politics*, and *Politics & Society*.

Focusing on these journals, we searched the Web of Science Core Collection (WoS) on January 22, 2026, with the keywords China or Chinese (2000–2025), and excluded book reviews, letters, news items, and editorials, yielding 754 records. The authors manually conducted additional content checks to ensure the substantive relevance of individual journal articles to China policy studies. Through three rounds of inter-coder reliability checks,[1] we established a set of criteria and kept only studies examining identifiable policy domains or government actions in the Chinese context. Using this consistent set of criteria, we then manually

1 We selected random samples of 40, 50, and 50 articles for three rounds of inter-coder reliability checks to determine whether each article qualified as "China policy research." After each round, we held discussions to standardize and clarify the criteria for classifying an article as "China policy research."

screened all 754 articles and determined that 326 articles fit our criteria of "China policy research." Therefore, our dataset includes a total of 326 articles on China policy that were published in the top 20 political science journals from 2000 to 2025. We tracked all the authors, their institutions, and the country/region of their institutional affiliation. When affiliation fields contained missing, inconsistent, or duplicated entries, we followed Si (2022) to manually verify each author's institution and country/region using WoS full records, supplementing with targeted Google checks. We note that the country/region reflects institutional affiliation rather than nationality of authors.

To conduct our analysis, we employed social network analysis (SNA), which can be used to explore scientific collaboration by representing actors as nodes and their joint publications as edges (Liu et al. 2005; Uddin et al. 2012). In our international collaboration network, each node is a country or region, and an undirected edge connects two nodes if scholars from those locations have co-authored one or more articles. In the institutional network, nodes are universities or research organizations, and edges denote institutional co-authorship ties. For example, if one article lists authors from Tsinghua University (Mainland China), Peking University (Mainland China), and The Ohio State University (United States), then this single paper adds one undirected edge between Mainland China and the United States as part of the country/region network (edge weight of 1). In the institutional network it adds three undirected edges to represent Tsinghua–Peking, Tsinghua–Ohio State, and Peking–Ohio State, with each weight = 1. If, later in the same period, a second paper is co-authored by authors from Tsinghua University and The Ohio State University, then the Mainland China–United States edge weight increases to 2, and the Tsinghua–Ohio State edge weight increases to 2, while the Tsinghua–Peking and Peking–Ohio State edges remain at 1. This illustrates how multi-institution papers create multiple pairwise links, and how repeated co-authorship thickens specific ties over time.

To capture collaboration dynamics and trends, we divided our dataset into four publication stages (2000–2005, 2006–2013, 2014–2019, 2020–2025) in terms of publication trends, and constructed separate network graphs for each stage using the netify (Dorff and Minhas, 2025) and bibliometrix packages (Aria and Cuccurullo 2017) in R. For each network, we report node-level degree (number of partners), betweenness centrality (how often a node lies on shortest paths between other nodes in the graph, indicating brokerage), and eigenvector centrality when relevant (connection to well-connected partners, indicating influence), as well as network density (the share of realized ties among all possible ties) and simple summaries of tie weights to distinguish thick recurring partnerships. These procedures ensure the reliability of our data and provide a robust foundation for analyzing temporal trends and the collaborative structures underlying China policy research published in top political science journals. We turn now to our results.

3. Evidence from Top Political Science Journals (2000–2025)

3.1 Temporal Growth Patterns

As shown in Figure 1, China policy research in top political science journals displays four distinct growth phases with two major stepwise shifts. During the initial phase (2000–2005), annual publications were modest, typically one to three articles, indicating that China policy research was still in its infancy and attracted relatively limited scholarly attention in top political science journals. The growth phase (2006–2013) began with a pronounced jump to twelve publications in 2006 and sustained an average of approximately 7.8 articles annually, reflecting rapidly increasing research interest and institutional capacity. In the maturation phase (2014–2019), production settled into a steady band of roughly 9–17 articles per year (mean = 11.2), reflecting both the field's maturation and the consolidation of its research community.

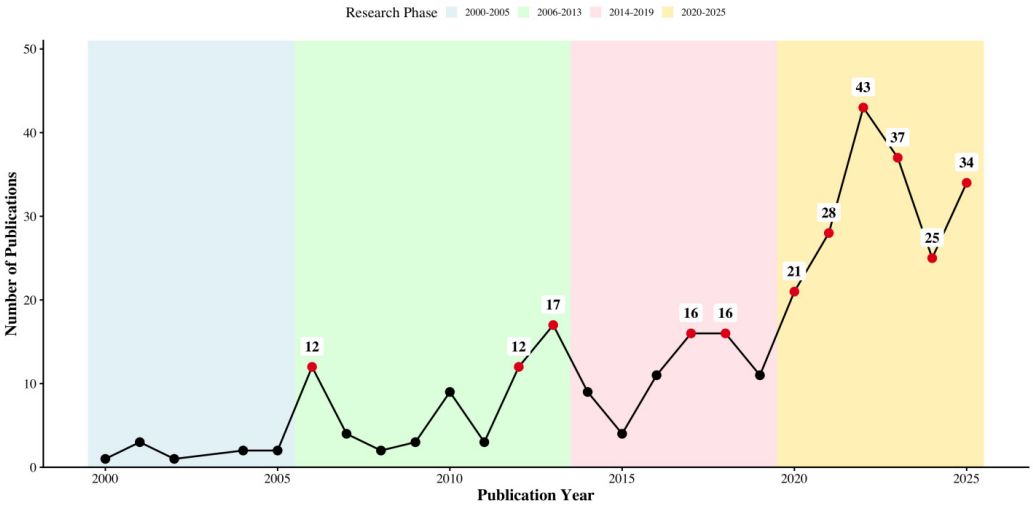

Figure 1. Annual Publication Trend in Top Political Science Journals (2000–2025)

(Red markers denote years with publication counts exceeding 11; colored bands represent distinct development stages.)

The most remarkable expansion began in 2020. Publications climbed from 21 articles in 2020 to a peak of 43 in 2022, an increase of more than 100 percent. This surge was driven by global interest in China's development model, growing demand for policy analysis amid shifting U.S.-China relations, and heightened attention to China's pandemic policy responses. While 2024 saw a slight decrease to 25 articles, the volume quickly rebounded to 34 in 2025. During the consolidation phase (2020–2025), the annual average reached 31.3 articles. This is nearly three times higher than the maturation phase (2014–2019). The consolidation phase (2020–2025) features consistently elevated publica-

tion levels, with China policy research appearing more frequently and more prominently in top political science journals than in any earlier stage. It also reflects sustained scholarly attention and engagement with China policy research during this period.

Overall, publications on China policy in top political science journals have expanded more than forty-fold, rising from one article in 2000 to a peak of 43 in 2022. The trajectory is not a smooth, linear rise but is marked by two stepwise shifts. The first shift occurred around 2006, when the annual average moved from about 1.5 articles during the Initial Phase to about 7.8 during the growth phase. The second occurred around 2020, when the average rose from about 11.2 during the maturation phase to about 31.3 during 2020 to 2025. These shifts indicate that the China policy studies in top political science journals expanded not through linear scaling but through stage-driven resets to higher baselines.

3.2 Journal Distribution

China policy research in top political science journals is highly specialized and thematically concentrated. Environmental politics journals dominate the landscape, with *Environmental Politics* publishing 45 articles and *Global Environmental Politics* contributing 15, underscoring the global academic focus and interest in China's environmental policy. A second cluster centers on policy-specialty journals, with *Policy & Internet* at 33, *Policy & Society* at 21, *Policy Studies Journal* at 19, and *Policy & Politics* at 12, together publishing 85 articles. It demonstrates how China's policy experience fuels theory building in policy studies. High publication counts in *Political Geography* (41 articles) and *Public Administration* (41 articles) highlight the spatial and administrative dimensions of China policy research.

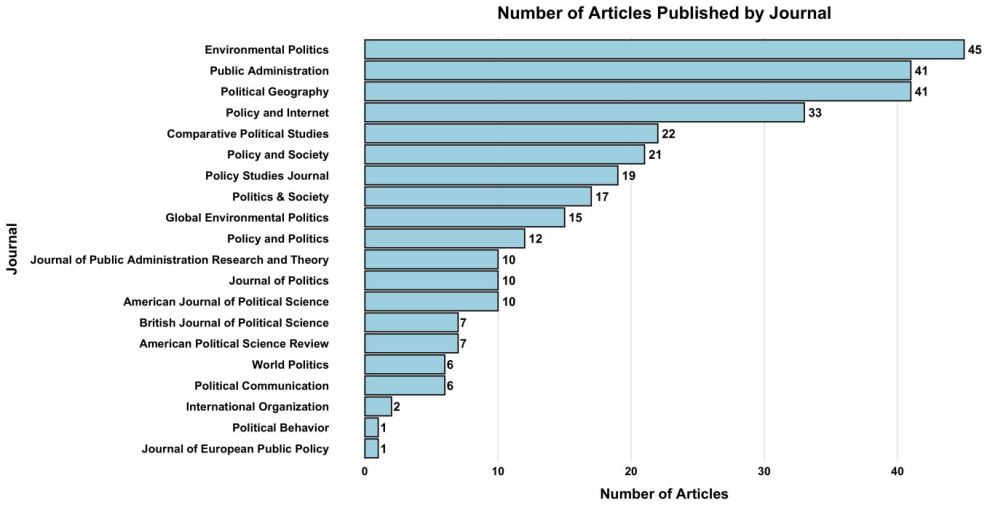

Figure 2. Distribution of China Policy Research Articles Across Leading Political Science Journals

In contrast, generalist flagship journals such as the *American Political Science Review* (7), the *American Journal of Political Science* (10), and the *British Journal of Political Science* (7) feature relatively fewer China policy studies, suggesting selective engagement with region-specific research. Overall, China policy research is anchored by environmental governance, spatial politics, and public administration journals, while generalist outlets maintain a narrower yet representative presence, resulting in a twin-peak distribution with a long tail of specialized publications.

The dominance of environmental political journals can be explained by the long-standing prominence of environmental policy research within China policy studies (Cao et al. 2026; Li and Zhang 2021; Xiao and Yi 2024). This underlying driver of scholarly interest is closely tied to developments in Chinese policy practice. Since the 1990s, environmental degradation linked to rapid economic growth has sustained scholarly attention to environmental policy within China policy research. This attention intensified after 2013, when environmental protection was elevated as a central policy priority (Cao et al. 2026). Environmental policy also offers an empirically visible and theoretically salient domain for examining and developing theories, such as policy adoption, policy diffusion and policy learning (Li and Zhang 2021; Xiao and Yi 2024). These features have positioned environmental political journals as the main publication venues for China policy research.

3.3 International Collaboration Network

The international collaboration network of China policy research published in political science journals expanded substantially in both scale and structural integration. As shown in Figure 3, participating countries/regions rose from 6 to 13 to 14 to 29 across the four periods, with collaborative ties increasing respectively from 2 to 15 to 16 to 46. Although the network became less dense as new participants joined, countries/regions became increasingly connected, with the average number of collaboration partners rising from 0.67 to 2.31, 2.29, and 3.17 per country/region. After 2006, a large and cohesive collaboration core emerged, embedding over three-quarters of countries and accounting for more than 95 percent of total publications.

In the initial phase (2000–2005), international collaboration in China policy research was extremely limited and weakly structured. The network comprised only six participating countries/regions connected by two isolated co-authorship ties, with all collaborations occurring only once. Although the United States accounted for the largest share of publications (six), its publication dominance did not translate into a central role in international collaboration. Overall, the international collaboration network in the initial phase reflects a stage in which China policy research was largely dominated by Western-based scholars, with limited engagement in cross-national collaboration.

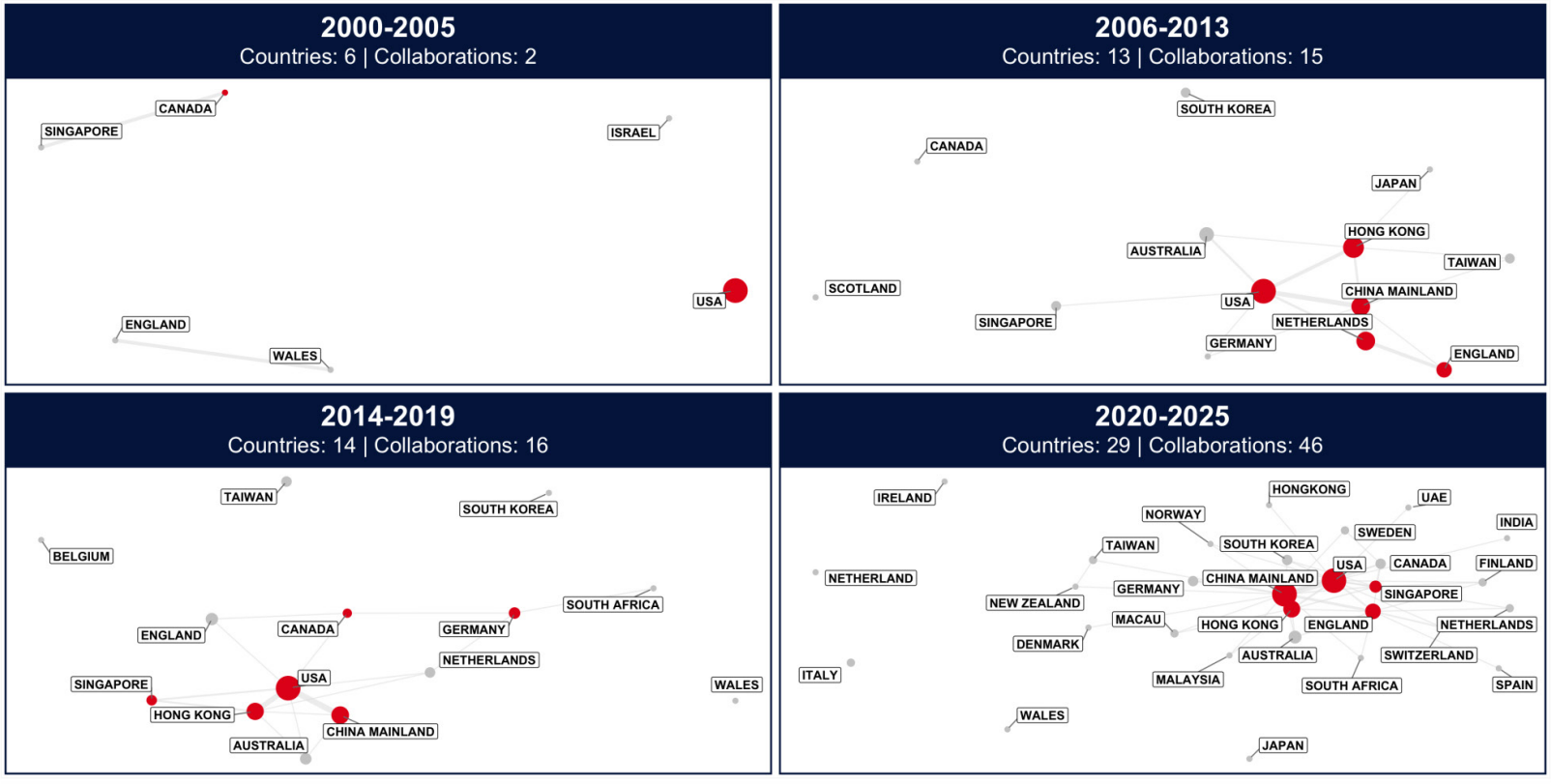

Figure 3. Evolution of International Collaboration Networks in China Policy Research (2000–2025)

(Nodes represent countries/regions; node size reflects total publication counts. Undirected edges denote co-authorship links; edge thickness indicates the number of collaborative papers. Red nodes mark important countries/regions identified by publication volume and network centrality.)

During the growth phase (2006–2013), international collaboration in China policy research became more structurally organized and increasingly centered on a small number of key countries. The United States remained the largest contributor, while Mainland China and Hong Kong emerged as central hubs with comparable levels of connectivity and intermediary roles (degrees of 6, 6, and 5, respectively). The strongest and most recurrent collaboration corridors were concentrated around these actors, most notably Mainland China-Netherlands (five co-authored publications), United States-Mainland China (four), United States-Hong Kong (three), and Netherlands-England (three). European participation also became more visible in this period, particularly through the Netherlands' involvement in multiple strong collaborative ties. These patterns indicate a shift from fragmented early interactions toward a more multi-centered collaboration structure, anchored by the United States, Mainland China, and Hong Kong.

Between 2014 and 2019, international collaboration became more consolidated around a clearly defined core. The United States emerged as the dominant hub, ranking first in degree (7) and total co-authorship volume (21), and exhibiting the strongest bridging role across collaboration ties (betweenness centrality = 0.24). Mainland China (three partners; ten co-authored publications) and Hong Kong (five partners; 12 co-authored publications) remained key partners within the core. At the same time, several European countries, particularly Germany and the Netherlands, played notable bridging roles by connecting multiple otherwise weakly linked partners. Taken together, the network in this period is characterized by a U.S.-centered structure with a small number of strong ties and a wider set of weakly connected partners.

The consolidation phase (2020–2025) is characterized by a clear structural rebalancing toward an asymmetric dual-hub collaboration network, with Mainland China emerging as the dominant hub. Mainland China surpassed the United States in the number of collaboration partners (16 vs. 14), total co-authored publications (60 vs. 47), and bridging role across collaboration ties (betweenness centrality 0.53 vs. 0.29), indicating a shift in network leadership. The strongest and most structurally consequential collaboration corridors were concentrated around Mainland China, most notably Mainland China–United States (23 co-authored publications), Mainland China–Hong Kong (11), and Mainland China–England (eight). While the United States and Hong Kong remained integral components of the network core, their brokerage roles were less pronounced than Mainland China's, as reflected in much lower betweenness centrality and fewer collaboration partners.

Across the four phases, the most salient structural change in the international collaboration network is the rebalancing between Mainland China and the United States. While the United States dominated the first three

phases in publication output, Mainland China reached a comparable level in 2020–2025 (77 publications versus 78 for the United States) and surpassed the United States in network connectivity (degree = 16 vs. 14) and brokerage capacity (betweenness centrality = 0.53 vs. 0.29). In parallel, collaboration intensity increased substantially, rising from two to over one hundred by 2020–2025. The Mainland China–United States partnership evolved into the network's principal bilateral axis, complemented by strengthening ties between Mainland China and Hong Kong and between Mainland China and England. These patterns indicate a transition from a fragmented and Western-centered collaboration structure to a more consolidated network organized around Mainland China.

3.4 Institutional Collaboration Network

Institutional collaboration expanded in parallel with country-level collaboration, but exhibited a different pattern of structural integration. As shown in Figure 4, the number of participating institutions increased sharply from 14 to 62, 77, and 183, while co-authorship links rose from 7 to 37, 64, and 239. As new institutions entered faster than new ties formed, network density declined steadily from 0.077 to around 0.020-0.022 and then to 0.014. Yet this expansion did not imply weak connectivity. On average, institutions collaborated with more partners over time, with the mean number of collaborators rising from 1.00 to 1.19, 1.66, and 2.57 per institution. Structural integration at the institutional level advanced more slowly. The largest group of institutions connected through co-authorship expanded from 21.4% to 57.9% of all institutions, while accounting for a growing but still uneven share of publications, increasing from 21.4% to 73.9%.

In the initial phase (2000–2005), institutional collaboration in China policy research was limited and weakly structured. The network consisted of fourteen institutions connected by seven co-authorship ties, with a relatively high density (0.077) driven by the small network size rather than cohesive structure. Collaboration was episodic and non-cumulative. All co-authorship ties were one-off partnerships, and no institution maintained repeated or expanding collaborative relationships. Collaboration occurred mainly within the United States, within UK constituent-country linkages (e.g., England-Wales). Participation was dominated by U.S. institutions (8 of 14), while Chinese institutions were virtually absent. These patterns indicate that early institutional collaboration was shaped primarily by Western-based institutions, reflecting a Western-centered research orientation at this stage.

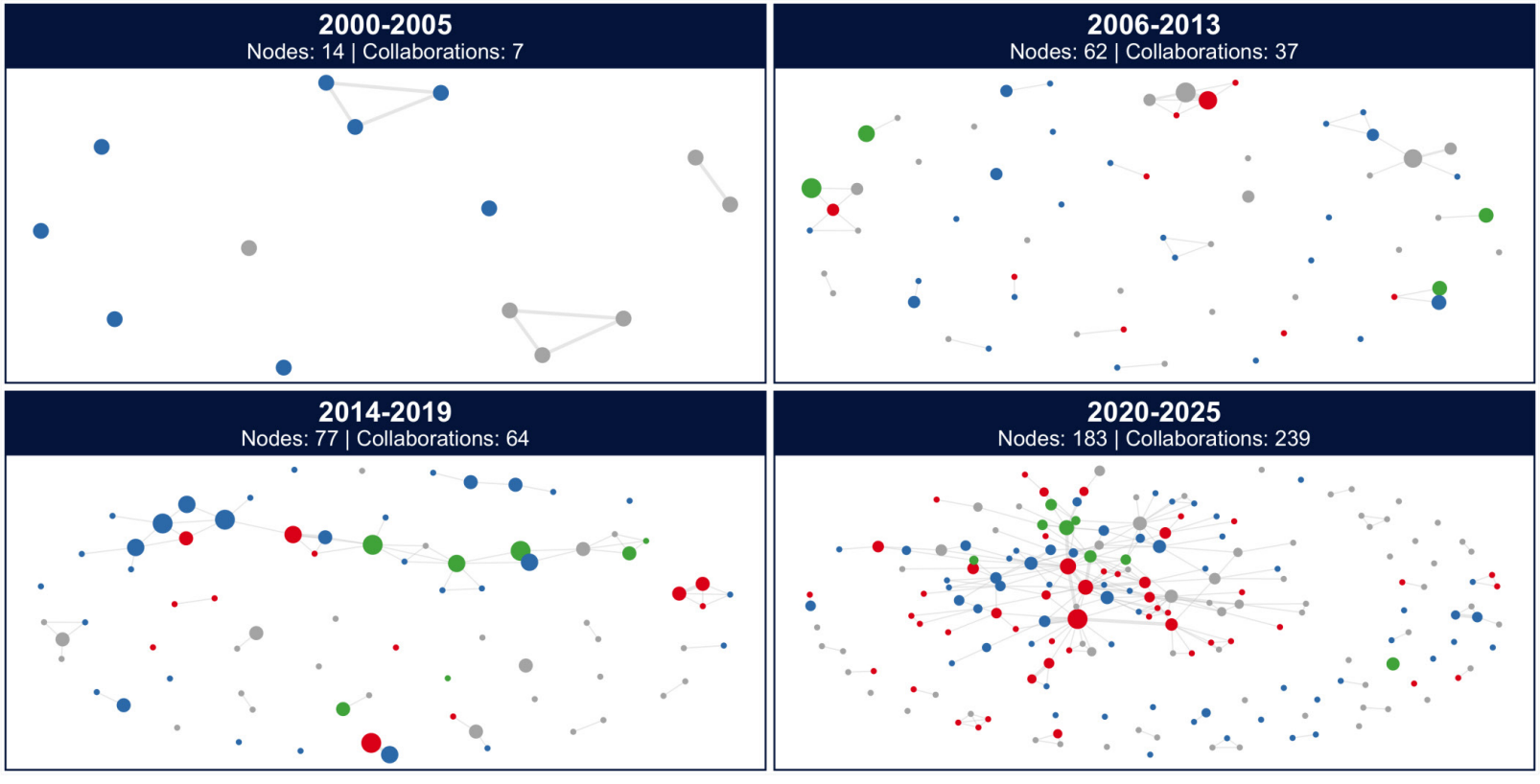

Figure 4. Institutional Collaboration Network in China Policy Research (2000–2025)

(Nodes represent institutions; node size reflects publication count. Undirected edges denote co-authorship links; edge thickness indicates number of joint papers. Node colors denote country/region affiliation: Mainland China (red), USA (blue), Hong Kong (green), Other (gray)).

During the growth phase (2006–2013), institutional collaboration expanded and became more structured, though still fragmented. The network increased to 62 institutions and 37 co-authorship ties, with density declining to 0.0196 as new institutions entered. Although the network remained fragmented, collaboration became more locally concentrated, with several institutions embedded in closely connected partnership groups (transitivity = 0.652; average local clustering = 0.85). Collaboration patterns also shifted from one-off ties toward repeated and cross-regional partnerships. Several collaboration corridors became structurally salient, most notably Delft University of Technology-Harbin Institute of Technology (five co-authored papers) and Hong Kong Polytechnic University-University of Southern California (three co-authored papers). At the actor level, most institutions appeared only once and occupied peripheral positions with limited or no collaborative ties. A small set of institutions, including Delft University of Technology, Harbin Institute of Technology, Wageningen University, and Tsinghua University stood out as repeat collaborators, each maintaining ties with four or more partners. This phase marks a transition from episodic, Western-centered collaboration to a more structured and internationally-connected institutional network, with Chinese institutions entering and participating in cross-regional collaboration for the first time in a meaningful way.

Between 2014 and 2019, institutional collaboration showed clear consolidation around a growing core. The network expanded to 77 institutions and 64 co-authorship links, while density remained low (0.0219), reflecting continued entry of new participants. Structural integration nonetheless improved: the largest connected group increased to 32.5% of institutions and accounted for 43.2% of total publications, indicating rising concentration of collaborative activity. This core was coordinated primarily through Hong Kong institutions. The Chinese University of Hong Kong and City University of Hong Kong exhibited the highest connectivity (degree = 7) and the strongest brokerage positions (betweenness centrality = 0.054 and 0.049), linking U.S. and Mainland Chinese partners. Leading U.S. universities (e.g., UC San Diego, Stanford, MIT) and Mainland Chinese institutions (e.g., Tsinghua University, Nanjing University, Beijing Normal University) were well represented in the core, but their connections were often mediated through Hong Kong-based collaborators, producing a tri-polar structure with Hong Kong as bridge, North America as anchor, and Mainland China as an active participant.

In the consolidation phase (2020–2025), institutional collaboration expanded rapidly and became more structurally integrated. The network grew to 183 institutions and 239 co-authorship links, while density declined to 0.014, reflecting large-scale entry. Unlike earlier phases, expansion was accompanied by strong consolidation: the largest connected group encompassed 57.9% of institutions and accounted for 73.9% of total publications. The core of this period was led by

Mainland China universities—Peking University and Renmin University (degree = 18) and Tsinghua University (degree = 15). Hong Kong institutions were still visible but no longer dominating the brokerage positions (e.g., City University of Hong Kong degree = 9; Chinese University of Hong Kong degree = 8). At the relational level, the strongest repeated partnerships included Tsinghua–Ohio State (co-authored paper = 3). High-bridge connections were also concentrated around Mainland China's leading universities, especially Tsinghua–Peking and Peking–Renmin. The late-stage integration of the network was organized primarily through a Mainland-centered hub structure, with cross-regional links often routed through these hubs.

Overall, the four stages trace a gradual but systematic shift in the institutional collaboration structure of China policy research. The early phase was characterized by sparse, episodic collaborations largely confined to Western institutions, reflecting an external, observation-oriented research paradigm. As the field expanded, collaboration became more geographically diverse but remained weakly integrated, with many new entrants connected through isolated and short-lived ties. From the mid-2010s onward, the network entered a phase of consolidation, marked by the emergence of Hong Kong institutions as key intermediaries linking Mainland China, North America, and other regions. In the most recent stage, institutional collaboration has evolved into a more integrated and multi-centered system, with Mainland Chinese universities becoming regular and influential participants in cross-regional collaboration rather than peripheral contributors. These stages document a transition from Western-centered observation to global co-production, in which brokerage roles persist but leadership and agenda-setting are increasingly shared across regions.

4. Discussion of Collaboration Patterns in China Policy Research

The international collaboration structure of China policy research published in top political science journals has shifted from a predominantly Western-centric pattern to a dual-hub system centered on the United States and Mainland China. The shift is rooted in research feasibility and sustained organizational efforts by Chinese scholars and institutions, and Hong Kong's bridge role. As Lieberthal (2010) noted, Western scholars often face greater barriers in accessing secondary data and fieldwork opportunities in China, whereas Chinese scholars possess structural advantages in data access and contextual knowledge. As China policy research increasingly emphasizes empirically grounded and policy-relevant analysis, this asymmetry has made collaboration with China-based scholars not only desirable but often necessary.

Beyond research feasibility, the maturation and institutionalization of policy studies in China have driven the shift toward a dual-hub system. Chi-

nese scholars have moved beyond ad-hoc collaborations to establish durable, institutionalized platforms for international dialogue, such as China-America Association for Public Affairs (established in 2008), and Chinese Policy Scholars Group (established in 2017). Chinese institutions have further asserted their agency by transitioning from "participants" to "hosts" of global discourse, organizing landmark events like the International Conference on China Policy Studies (ICCPS 2024) and launching dedicated English-language outlets—including the Journal of Chinese Governance and China Policy Journal—to formalize the dissemination of Chinese policy research (Cao et al. 2026). Moreover, a substantial share of core contributors to internationally published China policy research were trained abroad and subsequently embedded in leading Chinese universities, where they maintained durable ties with institutions in the United States, Europe, and Asia. The maturation of Chinese policy scholarship—evidenced by its shift beyond testing imported theories toward theory building grounded in Chinese policy experience—has further facilitated this transition (Li and Zhang 2021; Xiao and Yi 2024; Cao et al. 2026).

Hong Kong played a critical catalytic role as an institutional and intellectual bridge in the evolution of international collaboration in China policy studies. This bridging function was grounded in Hong Kong's early alignment with Western academic standards, its concentration of internationally-trained scholars, and its ability to combine methodological rigor and English-language publishing capacity with privileged access to Chinese policy contexts (Gao 2014; Lieberthal 2010; Zhang et al. 2018). Earlier studies show that mainland scholars frequently relied on Hong Kong collaborators in navigating international publication and collaboration networks (Zhang et al. 2018; Xiao and Yi 2024). Our network results show that Hong Kong remains embedded in the collaboration core across periods, maintaining strong and recurrent ties with Mainland China and major Western partners. This persistence suggests a stable brokerage function that has become a structurally-embedded bridge within the evolving dual-hub system.

Within this collaboration structure, the knowledge being co-produced is not merely additional empirical evidence on China, but analytically generative contributions to policy theory (Cao et al. 2026; Xiang & Yi 2024; Li & Zhang 2021). China-based scholarship increasingly produces new knowledge in three interconnected forms: novel mechanisms, cross-level linkages, and theory extensions grounded in Chinese policy experience (Li and Zhang 2021). Recent studies use Chinese cases to refine and expand existing theories of policy diffusion, innovation, and governance. For example, Zhu and Zhang (2016) introduce officials' political mobility as a mechanism linking micro-level career dynamics to macro-level diffusion outcomes, while Yi, Berry, and Chen (2018) advance diffusion theory by conceptualizing leadership transfer networks as change agents. More recently, Mei (2020) emerged as

the most frequently cited work during the consolidation phase (2020–2025), using China's COVID-19 response to generate theoretically consequential insights into policy design and crisis governance. These contributions illustrate how China policy research participates in the co-production of generalizable policy knowledge, transforming China from a research setting into a driver of theoretical innovation.

We acknowledge at the outset that our analysis focuses on China policy research published in top political science journals and does not include Area Studies or public administration outlets, which may exhibit distinct collaboration dynamics. To our knowledge, this study is among the first to systematically trace the longitudinal evolution of collaboration structures in China policy research. Related studies based on public policy journals have adopted cross-sectional designs. For example, Xiao and Yi (2024) present a cross-sectional portrait of institutional collaboration based on China policy studies published in leading public policy journals. Such snapshots may obscure the important roles played by non-Chinese institutions and international partners in the early stages, particularly before the rapid expansion of international publications in the past decade. Nevertheless, despite differences in journal selection and analytical design, our findings are broadly consistent with prior evidence from both China policy studies published in leading public policy journals and research on Chinese public administration in top public administration outlets. Across these studies, a common trend emerges: Chinese scholars and institutions have become increasingly prominent—and in some cases central—in international research collaboration (Kim et al. 2019; Zhang et al. 2018; Li and Zhang 2021; Xiao and Yi 2024; Cao et al. 2026).

5. Future Directions of International Collaboration for China Policy Studies

Building on our analysis of evolving co-authorship networks, China policy research has moved from the periphery to the center of the international scholarly conversation. This shift is reflected in growing publication output, the rising prominence of Mainland Chinese institutions in collaboration networks, and increasing placement in leading political science journals that reach a broader disciplinary audience than the policy-focused outlets examined in prior research.

Like an epistemic research community organized around shared research agendas and analytical standards (Haas 1992; Davis Cross 2013), the collaborative relationships identified here document China's transition from a "researched subject" to a "research co-producer," with Chinese scholars and universities actively shaping academic inquiry and global dialogue in high-impact political science journals. Publications in these journals transcend disciplinary subfields (e.g., *American Political Science Review*), signaling that China policy research is generat-

ing theoretical contributions of interest beyond policy-specific communities. Together, these findings suggest that sustained and structured international collaboration is critical not only for advancing China policy studies but also for refining general policy theories and enriching the broader global policy research ecosystem.

Beyond co-authorship, China policy scholars and institutions have leveraged multiple platforms to deepen international engagement. Participation in major international conferences enables real-time exchange of ideas and methods, while membership in international associations provides institutional channels for sustained dialogue, including organizations such as the China-America Association of Public Affairs (CAAPA) and the Chinese Policy Studies Group (CPSG). In addition, collaborative special issues in leading journals further extend China's scholarly influence by shaping the research questions, concepts, and standards that define the field.

These patterns of collaboration directly connect to the broader significance of international collaboration that we mentioned in our introduction. As global policy challenges, ranging from climate change to pandemics and AI governance, transcend national borders, co-production of knowledge across countries becomes essential. Our findings show that China policy research exemplifies how international collaboration enhances both research quality and theoretical innovation, producing insights that extend well beyond a single national context. By forming dense networks that bridge Chinese and Western institutions, scholars collectively expand access to data, methods, and comparative perspectives, generating work that is globally relevant and actionable for policy.

Moreover, the evolution of China policy research demonstrates that structured international collaboration can persist even under geopolitical tension. Despite rising U.S.-China strategic rivalry, co-authorship networks remain robust, showing that scholarly partnerships can serve as stabilizing channels for dialogue and knowledge exchange. This supports our emphasis on collaboration as a mechanism not only for producing research but also for fostering transnational cooperation and understanding. These scholarly networks themselves can serve as a form of global infrastructure that supports both theory and practice.

Finally, the trajectory documented here, from fragmented, Western-centered networks to a dual-hub, highly integrated international system, underscores that China policy research has matured into a model for transnational research collaboration. As public policy challenges continue to grow in scale and complexity, the experiences of China policy scholars offer lessons for other areas of global policy research: sustained, institutionally supported collaboration produces higher-quality knowledge, nurtures innovation, and enables scholars to collectively address problems that no single nation can resolve alone.

Looking ahead, strengthening these diverse channels will be vital. Chinese universities are actively establishing and hosting international policy journals that serve as bridges between domestic and global scholarship. A few examples include Tsinghua University's *Journal of Comparative Policy Analysis*; Renmin University's *Performance and Management Review*; Fudan University's *Global Public Policy and Governance*; Zhejiang University's *Journal of Chinese Governance*; Shanghai Jiao Tong University's *Urban Governance*; Sun Yat-sen University's *Chinese Public Administration Review*; and Beijing Normal University in partnership with CPSG's *China Policy Journal*. By supporting these outlets alongside conference series and association activities, China policy researchers can establish and deepen global networks, set research agendas, and foster inclusive, interdisciplinary collaborations that address both national and global policy challenges.

At the same time, future collaboration will unfold under mounting constraints, including U.S.-China "decoupling" strategies, tightening visa regimes, and heightened scrutiny of cross-border funding and data-sharing. These developments may reshape, or even fragment, the network structures we identify, by limiting mobility, constraining fieldwork, and making sustained joint projects harder to maintain. A key intellectual and practical challenge for the field will be to understand how such policy shifts alter patterns of co-authorship, agenda-setting, and to explore adaptive strategies (i.e., diversified partnerships, virtual collaboration infrastructures, and multilateral rather than purely bilateral ties) that can preserve the benefits of international co-production under more restrictive conditions.

These developments point to a future in which China policy research operates not as an isolated domain but as an integral component of global policy scholarship and dialogue. The trajectory from sparse, Western-centered networks to dense, dual-hub collaboration systems illustrates the field's maturation into a truly international enterprise. As scholarly partnerships continue to expand across countries and institutions, the infrastructure for sustained dialogue, joint problem-solving, and knowledge co-production becomes increasingly robust. This evolution mirrors broader trends in global governance, where transnational challenges demand integrated responses that transcend traditional academic and political boundaries. The success of China policy research in achieving this transformation, from peripheral curiosity to co-producer of knowledge, offers valuable lessons for other regional specializations seeking to contribute meaningfully to global policy discourse. By maintaining this momentum through diversified collaboration channels, journal initiatives, and institutional partnerships, China policy scholars are not merely documenting policy processes but actively participating in the co-creation of knowledge frameworks and high-impact scholarship that can address both Chinese domestic challenges and broader global policy problems that require international mobilization.

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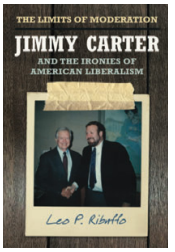

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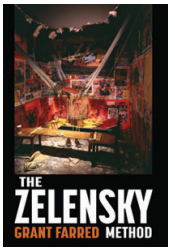

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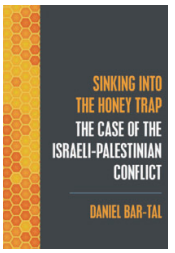

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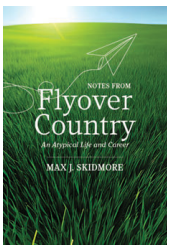

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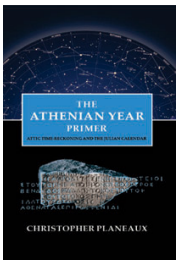

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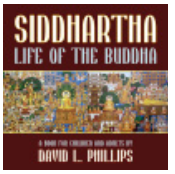

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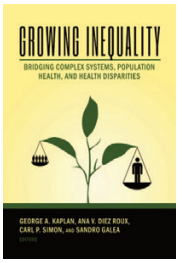

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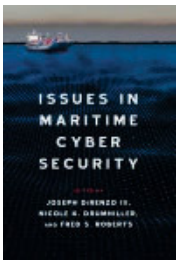

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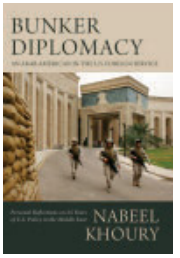

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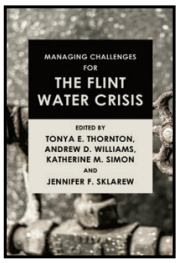

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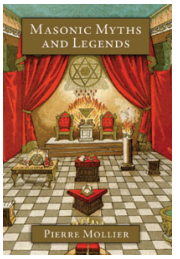
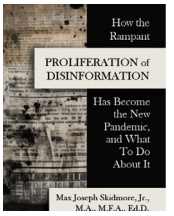
User-Centric Design by Dr. Diane Stottlemyer

User-centric strategy can improve by using tools to manage performance using specific techniques. User-centric design is based on and centered around the users. They are an essential part of the design process and should have a say in what they want and need from the application based on behavior and performance.



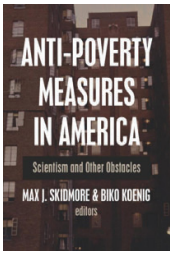
Masonic Myths and Legends by Pierre Mollier

Freemasonry is one of the few organizations whose teaching method is still based on symbols. It presents these symbols by inserting them into legends that are told to its members in initiation ceremonies. But its history itself has also given rise to a whole mythology.



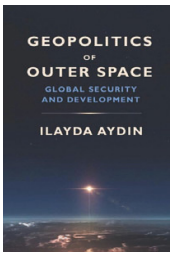
How the Rampant Proliferation of Disinformation has Become the New Pandemic by Max Joseph Skidmore Jr.

This work examines the causes of the overwhelming tidal wave of fake news, misinformation, disinformation, and propaganda, and the increase in information illiteracy and mistrust in higher education and traditional, vetted news outlets that make fact-checking a priority



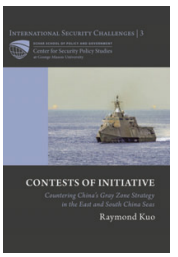
Anti-Poverty Measures in America: Scientism and Other Obstacles
Editors, Max J. Skidmore and Biko Koenig

Anti-Poverty Measures in America brings together a remarkable collection of essays dealing with the inhibiting effects of scientism, an over-dependence on scientific methodology that is prevalent in the social sciences, and other obstacles to anti-poverty legislation.



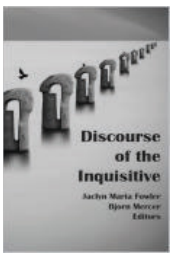
Geopolitics of Outer Space: Global Security and Development
by Ilayda Aydin

A desire for increased security and rapid development is driving nation-states to engage in an intensifying competition for the unique assets of space. This book analyses the Chinese-American space discourse from the lenses of international relations theory, history and political psychology to explore these questions.



Contests of Initiative: Countering China's Gray Zone Strategy in the East and South China Seas
by Dr. Raymond Kuo

China is engaged in a widespread assertion of sovereignty in the South and East China Seas. It employs a "gray zone" strategy: using coercive but sub-conventional military power to drive off challengers and prevent escalation, while simultaneously seizing territory and asserting maritime control.



Discourse of the Inquisitive
Editors: Jaclyn Maria Fowler and Bjorn Mercer

Good communication skills are necessary for articulating learning, especially in online classrooms. It is often through writing that learners demonstrate their ability to analyze and synthesize the new concepts presented in the classroom.

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