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E-COMMERCE POLICY, MARKET INTEGRATION AND REGIONAL ECONOMIC DISPARITIES: EVIDENCE FROM CHINA'S NATIONAL E-COMMERCE DEMONSTRATION CITIES

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Abstract. Using panel data of 284 cities at prefecture level and above in China from 2003 to 2022, this paper takes the National E-commerce Demonstration Cities (NEDC) as a quasi-natural experiment, employs the staggered difference-in-difference (DID) model to examine the impact of the NEDC policy on regional economic disparities (RED), and explores the mediating roles of factor and commodity market integration. The main findings are as follows: First, the NEDC policy significantly narrows RED, which still holds after a series of robustness tests. Second, the mechanism analysis demonstrates that the NEDC policy mitigates RED by fostering both factor and commodity market integration. Third, the inhibitory effect of the NEDC policy on RED is more pronounced in non-eastern cities, southern cities, commercial-based cities, ordinary prefecture-level cities and good business environment cities. Fourth, the NEDC policy exhibits a significant synergistic inhibitory effect on RED within 150 km radius of the demonstration cities. Moreover, the inhibitory effect of the NEDC policy becomes more pronounced at lower quantiles of RED. This study elucidates the role of e-commerce policy in narrowing RED and provides valuable policy insights for achieving coordinated regional economic development in the new era.

Keywords: e-commerce policy, National e-commerce Demonstration Cities (NEDC), regional economic disparities (RED), staggered DID model, market integration.

JEL Classification: M21, R12, R58.

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1. Introduction

Regional economic disparities (RED) are a long-standing concern for both the Chinese government and academia. The Chinese government has been committed to fostering balanced regional development, adhering to the implementation of coordinated regional development strategies, optimizing the spatial distribution of productive forces, and constructing a regional economic landscape characterized by complementary advantages and high-quality development (Deng et al., 2022). China increasingly emphasizes the coordination between economic quantity and quality, aiming to accelerate the realization of high-quality economic growth (Ul-Haq et al., 2024). Furthermore, RED directly reflects China's primary challenge of unbalanced and inadequate development, highlighting the urgent need for resolution. To mitigate these disparities, the Chinese government has implemented various regional coordinated development strategies, guiding the systematic transfer of factors and industries from eastern to hinterland areas (Cranea et al., 2018; Wei et al., 2020). As a critical issue influencing regional coordinated development and efforts toward common prosperity, RED further underscores the practical and policy significance of this study.

With the increasing prevalence of global inequality, the issue of regional economic inequality at different scales has attracted the attention of scholars and occupied an important position in the field of social sciences (Nijman & Wei, 2020). Recent studies have extensively explored the influencing factors of China's RED from different perspective, mainly including urban spatial structure (Wei & Ewing, 2018), place mobility (Wei et al., 2020), infrastructure (Liu et al., 2020), technological innovation (Zhang, 2021), domestic capital investment (Zheng et al., 2021), institutional environment (Xie et al., 2022), environmental regulation (Wang et al., 2023), Internet penetration (Wu et al., 2021), digital finance (Lv et al., 2022), digitalization (Liu et al., 2024), and financial technology (Yang & Zhou, 2024). Furthermore, some scholars examine the impact of specific policies on RED in China, such as the special economic zones (Cranea et al., 2018), migration policy (Hao et al., 2020), urban agglomeration (Li et al., 2022a), and balanced regional development policies (Deng et al., 2022). However, the impact of e-commerce policy on RED remains underexplored, offering a novel perspective to enrich existing scholarship.

The rapid growth of digital technology and the digital economy in China has amplified the role of e-commerce activities and policies in shaping regional economic patterns. Concurrently, e-commerce is rapidly integrating into China's economic and social structures, reshaping business models, transforming consumer patterns and transaction modes, and influencing regional economic coordination (Cao et al., 2021; Yao & Qiu, 2024). Some scholars posit that e-commerce offers opportunities to achieve economic equality in China (Couture et al., 2018), effectively promote economic growth and performance (Sun, 2023; Yang et al., 2024), thereby leading to regional economic convergence (Zhang, 2019; Ma et al., 2021). However, some studies find that e-commerce may widen regional inequality due to the digital divide and the uneven distribution of e-commerce enterprises (Alizadeh et al., 2023; Zhang et al., 2022a). This divergence highlights the unclear causal relationship between e-commerce and RED, while overlooking the intended implementation objectives of e-commerce policy. E-commerce policy reshapes the regional economic layout, and its impact on RED can be accurately identified through pilot policy (Yao & Qiu, 2024).

Since 2009, the Chinese government has implemented a pilot policy for the National E-commerce Demonstration Cities (NEDC) to accelerate e-commerce development. The NEDC policy aims to foster a high-quality e-commerce model, stimulate market demand and consumption, and optimize the regional economic spatial distribution. Moreover, China's active promotion of the digital economy and a unified market aims to achieve coordinated regional development (Yuan et al., 2024). Enhanced market integration facilitates regional economic convergence (Hong et al., 2019), thereby mitigating RED. E-commerce, in particular, can smooth the flow of goods and factors of production between cities, further promoting market integration (Qian & Chen, 2023). Given the ongoing development of a unified market, this study investigates the impact of the NEDC policy on RED from the perspective of commodity market integration and factor market integration.

Furthermore, numerous studies have employed the difference-in-differences (DID) method to investigate the effects of the NEDC policy. From an enterprise perspective, some studies indicate that the NEDC policy significantly enhances total factor productivity (Zhou & Jiang, 2024), facilitates digital transformation (Chen et al., 2024), and boosts green innovation performance (Fan et al., 2024). From an industry perspective, some studies believed that the NEDC policy significantly promotes the spatial agglomeration of the service industry (Pan & Zhou, 2023), achieves high-quality development in agriculture (Zhong et al., 2024), and mitigates agricultural non-point source pollution (Wang et al., 2022; Han et al., 2023). From an urban perspective, some literature shows that the NEDC policy not only significantly promote economic growth and resilience (Sun, 2023; Yang et al., 2024; Zhang et al., 2024), but also improves the level of innovation (Zhou & Li, 2023; Li et al., 2022b). Meanwhile, some studies has investigated the urban environmental effects, primarily focusing on environmental pollution (Zhang et al., 2022b), carbon emissions (Jiang et al., 2024; Liu & Qiu, 2023), and improvements in energy conservation (Liu et al., 2023). The above literature has made significant contributions to assessing the effects of the NEDC policy, and provides a reliable basis for the empirical analysis in this paper.

In summary, this paper employs the staggered DID model to examine the impact of the NEDC policy on RED, and identify the mediating role of market integration. In comparison to existing research, the contribution of this paper is primarily demonstrated through three aspects:

Firstly, from the perspective of the NEDC policy, this study empirically examines its impact on RED, thereby expanding the understanding of both the determinants of RED and the economic consequences of e-commerce policy. To identify a causal relationship between e-commerce policy and RED, we employ the staggered DID model, conduct numerous robustness tests to strengthen our baseline findings, mainly including the heterogeneous treatment effects, placebo tests, PSM-DID, instrumental variable, synthetic DID estimation. This battery of robustness tests increases the reliability of our results and provides valuable insights for the literature on RED.

Second, based on the core-periphery theory, this study develops a theoretical framework to explain how e-commerce policy influences RED through the mechanisms of market integration. This framework synthesizes the policy objectives of the NEDC with market integration theory, enhancing its analytical rationality. We then analyze the transmission effects of factor and commodity market integration, exploring how e-commerce policy impacts RED through production and consumption channels respectively. Our analysis elucidates the specific pathways by which e-commerce policy affect RED, thereby providing empirical insights into the positive role of the NEDC policy in promoting balanced regional development.

Thirdly, this paper conducts a series of empirical discussions to provide targeted policy guidance for the NEDC policy. Specifically, we examine the heterogeneous effects across geographical locations, commercial attractiveness, administrative ranks, and business environments. Then, we construct a new NEDC policy variable that incorporates geographical distance, and assess its synergistic inhibitory effect and spatial scope on RED in nearby non-demonstration cities, thus delineating the spatial boundary of the policy's convergence effect. Finally, using a panel quantile regression model, we analyze the effect of policy at different quantiles, providing an empirical basis for targeted policy design.

The remainder of this paper is structured as follows. Section 2 elucidates the policy background and the theoretical hypothesis. Section 3 details the empirical model and data sources. Section 4 presents the basic empirical results. Section 5 reports the further empirical discussions. Section 6 summarizes the conclusions and discussion.

2. Policy background and theoretical hypothesis

2.1. Policy background

Since the early 21st century, the rapid development of the Internet and information technology in China has progressively transformed consumer behavior and business operations, stimulating local market activity and driving economic growth. However, the early stage of e-commerce in China also encountered significant challenges, including transaction and information security issues, a shortage of professional talent, and an imperfect environment. Consequently, the Chinese government adhered to the principle of "*pilot first*, *gradual promotion*" and conducted four rounds of NEDC pilots. In March 2011, the National Development and Reform Commission and the Ministry of Commerce jointly issued the "*Guiding Opinions on the Construction of National E-commerce Demonstration Cities*" (hereinafter, the "*Guiding Opinions*"). This document outlined the specific requirements and tasks for establishing NEDC, emphasized the importance of phased assessments. Finally, there are 71 cities had become NEDCs before 2023.

The primary objective of the NEDC policy is to address the remaining inconsistencies and challenges in the advancement of e-commerce, fostering a conducive environment for its expansion. The NEDC policy aims to promote the healthy and rapid development of e-commerce, positioning it as a catalyst for urban economic growth. The NEDC policy is seeks to facilitate market integration, enhance inter-regional economic cooperation and market integration, thereby enabling coordinated development. Thus, the NEDC policy provides a compelling quasi-natural experimental setting for this study, presents a valuable opportunity to investigate the causal relationship and mechanisms between e-commerce policy and RED.

2.2. Theoretical hypothesis

The "Guiding Opinions" stated that a key objective of the NEDC is to "promote the establishment and improvement of a unified national market, facilitate the flow of commodities and various factors, better realize the market's fundamental role in resource allocation, and enhance the overall quality and efficiency of the national economy's operation." Thus, the NEDC policy is implemented more deeply, it will have a profound impact on market integration, thereby driving important changes in RED. As the scope of policy implementation expands, the NEDC policy gradually optimizes the spatial allocation of regional economic development and mitigated RED (Yao & Qiu, 2024). Moreover, Lu and Hong (2023) confirms that the E-commerce penetration has strengthened the connection and cooperation between demonstration cities and the national market, fully leveraging the spillover effect of urban economic activities and providing substantial support for the coordinated development.

According to the information economy theory, Leff (1984) argue that the network externalities of ICT can accelerate the innovation and diffusion of technology, exert a significant positive spillover effect on market integration. Digital economic activities can effectively reduce costs and improve efficiency, resolve information asymmetry, and ultimately help diminish market segmentation (Yuan et al., 2024). With reduced market segmentation, the level of market integration continuously improves, which is conducive to both economic growth and economic convergence (Hong et al., 2019). Meanwhile, e-commerce fosters the deep integration of online and offline markets, leading to a transformative shift in the patterns of regional factor and commodity flows (Qian & Chen, 2023). Couture et al. (2021) also confirm that e-commerce narrow regional price differentials, help to construct unified market. Meanwhile, leveraging the unique attributes of online platforms, the rapid expansion of e-commerce is conducive not only to broadening consumer and product demand in less developed areas, but also to jointly boosting regional economic growth (Sun, 2023; Yang et al., 2024). E-commerce activities are also beneficial for fostering trade and productivity growth in less developed regions, achieving balanced regional economic growth (Ma et al., 2021), and creating opportunities for China to achieve economic equality (Couture et al., 2018). Therefore, the NEDC policy can mitigate RED through market integration.

2.2.1. Factor market integration

The NEDC policy promoting efficient matching of supply and demand in factor markets, ultimately driving the integration and unification of regional factor markets. In the labor market, the NEDC policy fosters e-commerce participation across diverse labor groups, enhancing skill training and attracting skilled technology professionals (Li et al., 2022b). This integration of the real and digital economies creates new employment opportunities, improves labor market dynamism and inclusivity through digital innovation, and guides labor force participation toward skill-intensive digital sectors (Bănescu et al., 2022). Such labor mobility reduces regional disparities through catch-up, income, and learning-by-doing mechanisms. Simultaneously, the NEDC policy provides targeted financial support to demonstration cities, alleviating financing constraints for e-commerce firms and influencing capital allocation. In the technology market, e-commerce leverages internet platforms and digital technologies for spatial diffusion, reshaping China's unbalanced digital technology application pattern (Song et al., 2020; Wang et al., 2021). With the expanding NEDC policy, inter-regional factor flows help to achieve economic growth in the undeveloped regions, contributes to the development of a unified factor market and demonstrably contributes to narrow RED.

The improvement of factor market integration will make the diffusion effect of economic activities stronger than the agglomeration effect, thereby narrowing RED. Specifically, when factor market integration is small, barriers to factor mobility lead to asymmetric flows of factors towards developed regions due to localized market and living cost advantages (Krugman, 1991). This results in a lack of growth momentum in underdeveloped regions, and widening RED under the influence of the cycle of cumulative causation. However, as factor market integration improves, the excessive factor agglomeration in developed areas generates congestion and diminishing marginal returns, prompting factors to flow back towards underdeveloped areas, thereby strengthening the diffusion effect. Technology diffusion enables significant scale economies in underdeveloped regions, fostering faster economic growth through imitation-based innovation and leveraging latecomer advantages, which achieve regional economic convergence (Chan, 2021). Additionally, factor market integration promotes industrial upgrading and a deepened division of labor, establishes more complete industrial systems, and improves overall productivity (Mayer et al., 2021), providing new growth impetus for less developed regions and narrowing economic disparities with developed areas.

2.2.2. Commodity market integration

The NEDC policy enhances e-commerce development in demonstration cities through policy support, infrastructure improvements and service system upgrades, promotes commodity market integration, so as to reduces RED. In terms of commodity circulation, e-commerce platforms enhance commodity circulation by reducing the temporal and spatial limitations inherent in offline transactions, mitigating information asymmetry, gradually dismantling geographical and trade barriers, and facilitating the expedited cross-regional movement of commodities (Qian & Chen, 2023). Simultaneously, e-commerce lowers fixed market entry costs, which allowing a greater number of firms to engage in online transactions, reduces operational costs and trade costs, and facilitates the integration of remote regions into the digital marketplace (Fan et al., 2018). In terms of supply and demand matching, e-commerce platforms facilitate supply and demand matching by expanding choices for both consumers and sellers, creating positive competitive externalities (Jullien & Sand-Zantman, 2021), accurately connecting demand and supply, and streamlining supply-demand relationships (Miao et al., 2019). This, in turn, strengthens inter-regional labor specialization and collaboration, improves the efficiency of supply chains and the quality of goods, caters to diverse consumer preferences, reduces price disparities across regions, and further enhances commodity market integration.

Historical experience demonstrates the importance of a unified national markets and a robust market economy for driving economic growth. With increased commodity market integration, geographical border effects and local protectionist measures are weakened, facilitating more efficient commodity flows and spatial resource allocation, thereby creating a foundation for reducing RED. Infrastructure and e-commerce systems can generate multiple comparative advantages for less developed regions, increasing trade benefits and mitigating the economic distance between developed regions (Fan et al., 2018; Hong et al., 2019). Commodity market integration promotes industries from developed to undeveloped inland regions, strengthening trans-regional industrial cooperation and accelerating the convergence of regional economic growth (Chan, 2021). Core-periphery theory suggests that when production activities and commodity resources concentrate excessively in core areas, rising production costs incentivize firms to relocate production to less developed peripheral areas. Through industrial transfers facilitated by e-commerce platforms, less developed regions can leverage latecomer advantages, deepen regional specialization and cooperation, expanding production and sales, achieve faster growth, and thus narrowing RED.

Based on those analysis, the following theoretical Hypothesis are proposed:

H1: *The NEDC policy effectively narrow RED.*

H2: *The NEDC policy narrow RED through promoting the factor market integration and commodity market integration.*

3. Empirical design and data sources

3.1. Empirical model

Follow Cao et al. (2021), this study apply the staggered DID model to examine the impact of the NEDC policy on RED, and construct the following baseline model:

$$RED_{it} = c_0 + \theta NEDC_{it} + \boldsymbol{\rho} \boldsymbol{CV}_{it} + \varphi_i + \tau_t + \omega_{it}, \tag{1}$$

where, i and t denote the city and year respectively, and c_0 is the constant. RED_{it} is regional economic disparities. $NEDC_{it}$ is the NEDC policy. The coefficient θ reveals the impact of the NEDC policy on RED, and it is theoretically negative. The vector of coefficients $\boldsymbol{\rho}$ reveals the estimated value of the vector of control variables $\boldsymbol{CV}_{it}$, and ω_{it} is the random error term. Meanwhile, we control the two-way fixed effects, the city fixed effects φ_i and year fixed effects τ_t , respectively.

3.2. Variable measurement

3.2.1. Explained variable

Inter-urban economic disparities are a crucial element of broader RED (Nijman & Wei, 2020). Distinct from most existing studies, we introduce a novel measure of inter-city economic disparities constructed through the application of data standardization via min-max scaling. The specific calculation equation is:

$$RED_{it} = \frac{\left(PG_t\right)_{\max} - PG_{it}}{\left(PG_t\right)_{\max} - \overline{PG_t}}, \tag{2}$$

where PG_{it} is the per capita GDP of city i in year t, and $\left(PG_t\right)_{\max}$ is the maximum of per capita GDP in year t, and $\overline{PG_t}$ is the sample average of per capita GDP in year t. The RED value below 1 indicates that city i's disparity relative to the most developed city is lower than the average disparity, and vice versa.

3.2.2. Core explanatory variable

The variable of NEDC is a policy dummy variable, which takes the value 1 if the city was selected in the construction of the NEDC in year t and 0 otherwise. We found that by the end of 2022, 68 cities in China had been selected as the NEDC samples. Thus, we divided these 68 cities into treatment group, and the remaining sample cities were divided into control group.

3.2.3. Control variables

According to Wu et al. (2021), Zhang (2021), Yang and Zhou (2024), we have chosen the following variables as the control variables for this article.

(1) *Human capital* (*HC*): The number of college students divided by the total resident population. In general, the human capital helps to narrow the RED.

(2) *Scientific and technological input* (*ST*): The proportion of fiscal expenditure on science and technology in GDP. With the ratio increase, it helps to narrow the RED.

(3) *Industrial structure* (*IS*): the value-added of the secondary industry as a share of GDP. It is theoretically negatively related to RED.

(4) *Transportation infrastructure* (*TI*): The proportion of road area in urban area. It generally contributes to regional balanced development.

(5) *Internet penetration* (*IP*): The ratio of Internet broadband users to the resident population. It provides important support for narrowing RED.

(6) *Financial development* (*FD*): The logarithm of per capita RMB deposits and loans. It is theoretically negatively related to RED.

(7) *Trade opening* (*TP*): The total value of merchandise trade divided by GDP.

3.3. Data sources

This paper includes 284 Chinese cities at the prefecture level and above from 2003 to 2022. Data on the NEDC policy were collected from the official websites of China's government and official media reports. Other data were compiled from the China City Statistics Yearbook and China Urban Construction Statistics Yearbook. Descriptive statistics for all variables are presented in Table 1.

Table 1. Descriptive statistics

Name	Unit	Obs	Mean	Std. Dev.	Min	Max
RED	level	5680	1	0.2147	0	1.4003
NEDC	dummy	5680	0.1107	0.3138	0	1
HC	%	5680	1.2026	0.2584	0.1670	3.1640
ST	%	5680	0.2123	0.2534	0.0020	6.9910
IS	%	5680	46.2830	11.3652	10.6800	90.9700
TI	10^4 M^2/KM^2	5680	0.2387	0.5409	0.0009	7.4422
IP	%	5680	17.7820	15.0291	0.1000	103.5770
FD	yuan/person	5680	11.0777	1.0669	8.1918	14.1580
TP	%	5680	19.7571	35.6312	0.0020	462.1770

4. Empirical results

4.1. Benchmark estimates

Table 2 reports the benchmark estimation results. With the support of DID estimation method, column (1) present the result of pooled regression estimation, and column (2)–(5) report panel data model regression estimation of fixed effects (FE) model.

In column (1), without the fixed effects and control variables, the estimated coefficient of NEDC is significantly negative. When the model incorporates the fixed effects and control variables, the column (2)–(4) show that the estimated coefficient of NEDC is always significantly negative. The column (5) reveals that the estimated coefficient of NEDC is significantly negative (–0.0395). It means the NEDC policy mitigates RED and verify the first Hypothesis (H1).

From the result of control variables, the estimated coefficients of human capital (*HC*), science and technology input (*ST*), transport infrastructure (*IS*), internet penetration (*IP*), and financial development (*FD*) are significantly negative coefficients. Conversely, trade openness (*TP*) is significantly positive, thereby increases RED.

Table 2. The result of benchmark regression

Variables	(1)	(2)	(3)	(4)	(5)
NEDC	–0.2142***	–0.0322***	–0.0286***	–0.0327***	–0.0395***
	(0.0103)	(0.0053)	(0.0053)	(0.0050)	(0.0050)
HC			–8.0043***	–6.9095***	–4.1332***
			(0.9789)	(0.8818)	(0.9166)
ST			–5.0373***	–4.5208***	–3.8318***
			(1.5692)	(1.5312)	(1.4172)
IS				–0.5027***	–0.4753***
				(0.0210)	(0.0217)
TI				–0.0485***	–0.0531***
				(0.0106)	(0.0108)
IP					–0.1689***
					(0.0188)
FD					–0.0562***
					(0.0085)
TP					0.0196**
					(0.0094)
Constant	1.0241***	1.0036***	1.1102***	1.3407***	1.9433***
	(0.0028)	(0.0011)	(0.0120)	(0.0141)	(0.0886)
City FE	NO	YES	YES	YES	YES
Year FE	NO	YES	YES	YES	YES
Obs	5,680	5,680	5,680	5,680	5,680
R^2	0.0993	0.8947	0.8985	0.9116	0.9158

Notes: ***, **, and * represent significance levels of 1%, 5%, and 10%, respectively. The values in brackets are robust standard errors clustered at the city and year level.

4.2. Robustness tests

4.2.1. Parallel trend test

Based on the model (1), this paper use the panel event-study specification, and set up the following model:

$$RED_{it} = c_0 + \sum_{\sigma \geq -6}^{9} \vartheta_\sigma NEDC_{it}^{\sigma} + \boldsymbol{\rho CV}_{it} + \varphi_i + \tau_t + \omega_{it}, \quad (3)$$

where $NEDC_{it}^{\sigma}$ is the implementation year dummy variable for the NEDC policy, the estimated coefficient ϑ_σ is the impact of the NEDC on RED in different year. In order to avoid multicollinearity issues, the time span (σ value) is defined as a period of ranging from six years before (–6) and nine years after (–9). When the value of σ is less than 0, and the estimated coefficient ϑ_σ doesn't pass the significance test, it indicates the parallel trend hypothesis is valid.

According to Figure 1, before the implementation, the coefficients of NEDC are all insignificant, which supports the parallel trends hypothesis. To ensure the reliability of the parallel trend result, following the practise of Roth (2022), we conduct a joint F test for the pre-trend test. We find that the P-value is 0.1683 (>0.1), which indicates that the parallel trend test is reasonable and effective. Furthermore, the dynamic effects reveals that the

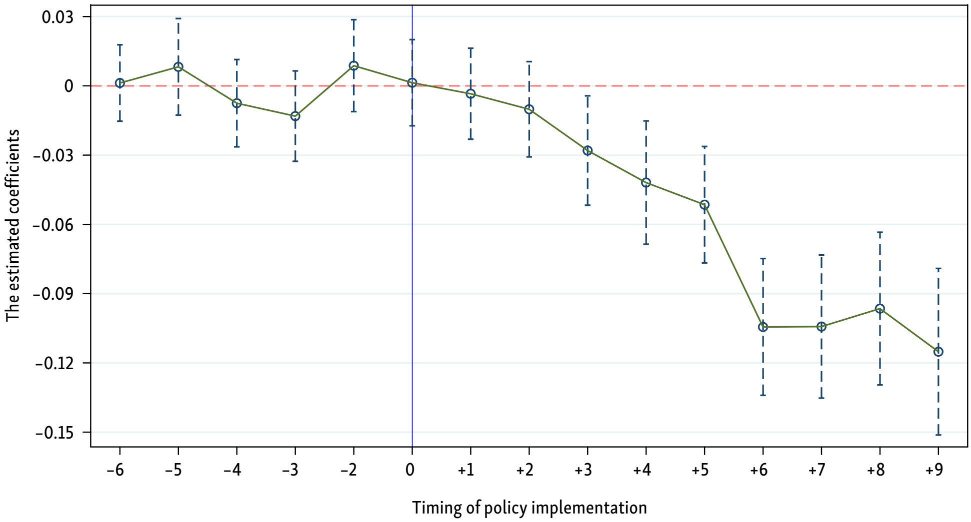

Figure 1. The parallel trend test

estimated coefficient becomes statistically significant three years after policy implementation, and the absolute value of the coefficient exhibits an increasing trend. Thus, the influence of the NEDC policy on reducing RED gradually strengthens, beginning in the third year after implementation.

4.2.2. Heterogeneous treatment effects test

To mitigate the problem of heterogeneous treatment effects (HTE), we follow Goodman-Bacon (2021), and decompose the baseline treatment effect into three components, focusing on the weight of the "Late_v_Early" component, which represents the source of potential bias. The results of Bacon decomposition reveal that the "Late_v_Early" component accounts for only 2.735% of the total weight, while other components constitute 97.265%. Therefore, the baseline results are unlikely to be significantly affected by HTE.

4.2.3. Placebo test

To overcome the issues of unobservable factors, we conduct a placebo test. Based on 3000 times of simulation, this paper randomly generates the false data of the NEDC dummy variable, and uses staggered DID to re-estimation false sample. Figure 2 shows the distribution of the false estimated coefficients and its p-values, where the blue dotted line on the left is the baseline result in this paper. It can be observed that the kernel density estimate of coefficients is normally distributed around zero and does not overlap with the baseline result. So, it supports the reliability of our baseline results.

4.2.4. PSM-DID estimation

This paper employ PSM and the nearest neighbor approach to reconstruct our sample and then re-estimate our model by using DID estimation. According to Figure 3, compared with the situation before matching, the features between the NEDC and non-NEDC after matching

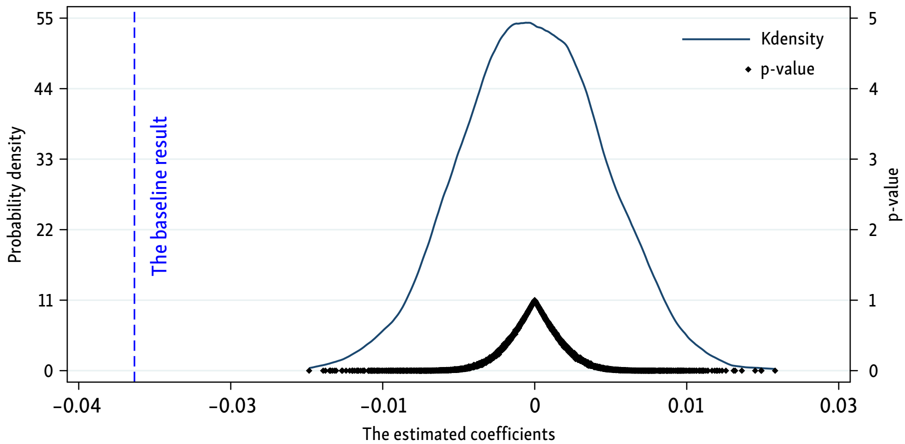

Figure 2. Placebo test

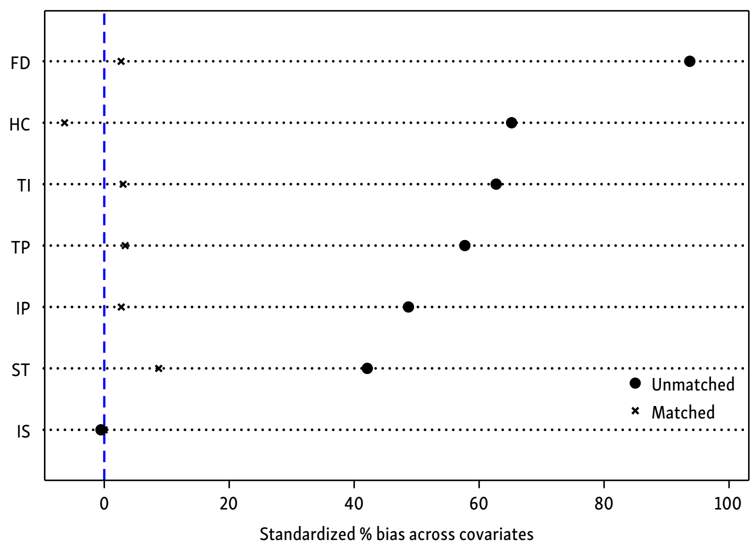

Figure 3. The balance test

are generally close, and the standardization deviation of variables is significantly reduced. This result indicates that those variables after PSM have a good balance between the two groups, supporting the requirements of balance test. In column (1) of Table 3, the coefficient of the matched policy is significantly negative (–0.0354), which is consistent with the baseline result.

4.2.5. Instrumental variable estimation

To mitigate endogeneity concerns, this paper employ an instrumental variable (IV) approach, the corresponding results are presented in columns (2) and (3) of Table 3.

Drawing from Cao et al. (2021), we use the interaction between cross-sectional variable and year trend to construct instrumental variables. Firstly, *FTIV* is the interaction between the logarithm of the number of fixed telephones in a city in 1984 and the year trend. Secondly, *MCIV* is the interaction between the number of Ming dynasty courier stations in a city and the year trend. These instrumental variables satisfy both the correlation and exogeneity requirements. Cities with better information and logistics infrastructure in 1984 (measured by fixed telephone) and during the Ming dynasty (measured by the number of courier stations) were more likely to be early adopters of e-commerce and thus were more likely to be chosen for the NEDC program. Moreover, these historical variables, fixed telephone lines in 1984 and Ming dynasty courier stations, can only affect current RED through their influence on the implementation of the NEDC policy.

In the first stage, the result in column (2) of Table 3 show that the estimated coefficients of *FTIV* and *MDIV* are both significantly positive, which verifies the positive correlation between IV and the NEDC policy. In the second stage, the result in column (3) of Table 3 show that, the p-value of the Hansen *J* statistic is 0.3828, and the Cragg-Donald Wald F statistic is 357.785, which is larger than the critical values at 10% level (19.93). Thus, those IV satisfy the requirement of exogeneity and relevance. Finally, the coefficient of NEDC is significantly negative, which is still consistent with the baseline result.

Table 3. Robustness tests: the estimations of PSM-DID, IV and SDID

Variables	(1)	(2)	(3)	(4)	(5)
	PSM-DID	IV TSLS		Synthetic DID	
		First	Second	Arkhangelsky	Kranz
NEDC	–0.0354***		–0.1667***	–0.0444***	–0.0414***
	(0.0062)		(0.0177)	(0.0102)	(0.0135)
FTIV		0.0103***			
		(0.0004)			
MCIV		0.0064***			
		(0.0009)			
Control variables	YES	YES	YES	YES	YES
Constant	1.9675***		1.8739***		
	(0.0941)		(0.114)		
Hansen *J* statistic		0.3828			
Cragg-Donald Wald F statistic		357.785			
City FE	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES
Obs	5,169		5,680	5,680	5,680
R^2	0.9051		0.9015		

Notes: ***, **, and * represent significance levels of 1%, 5%, and 10%, respectively. The values in brackets in column (1)–(4) and (4)–(5) are bootstrap errors and robust standard errors clustered at the city and year level, respectively.

4.2.6. Synthetic DID (SDID) estimation

The synthetic DID provides a more versatile approach to analyzing the dynamic impact of quasi-natural experiments, handles the complexity of multiple policy shock phases and enhances the accuracy and reliability of policy evaluations. Refer to Arkhangelsky et al. (2021) and Kranz (2022), we adopt the synthetic DID estimation to check the baseline result. In column (4)–(5) of Table 3, the average treatment effect of the NEDC policy are still significantly negative, still consistent with the baseline result.

4.2.7. Other robustness tests

First, to account for the potential lag effect of the NEDC policy, we recode the policy implementation year for cities where the policy took effect after June, shifting to the following year, while leaving other cities unchanged. Then, we construct a new NEDC policy (*NEDC*1). On the other hand, following Akita and Miyata (2010), we adopt the population weighted coefficient of variation to recalculate RED (*RED*1). In columns (1)–(2) of Table 4, the estimated coefficient remains negative after replacing these key variables and consistent with baseline result.

Second, to address potential confounding effects from other related pilot policies, we include controls for the Cross Border E-commerce Comprehensive Pilot Area (*CBECPA*) and the Broadband China Pilot (*BCP*) in our benchmark model. As shown in column (3) of Table 4, the estimated coefficient of *NEDC* remains significantly negative after controlling for these policies and consistent with baseline result.

Table 4. Other robustness tests

Variables	(1)	(2)	(3)
	Core explanatory variable	Explained variable	Eliminate disturbing policies
	NEDC1	RED1	
NEDC		–0.0021**	–0.0428***
		(0.0009)	(0.0052)
NEDC1	–0.0198***		
	(0.0051)		
Control variables	YES	YES	YES
CBECPA	NO	NO	YES
BCP	NO	NO	YES
Constant	2.0345***	–0.0420***	1.8274***
	(0.0907)	(0.0142)	(0.0894)
City FE	YES	YES	YES
Year FE	YES	YES	YES
Obs	5,680	5,680	5,680
R^2	0.9181	0.9021	0.9103

Notes: ***, **, and * represent significance levels of 1%, 5%, and 10%, respectively. The values in brackets are robust standard errors clustered at the city and year level.

4.3. Mechanism analysis

4.3.1. Mechanism model

In the theoretical hypothesis Section, this paper has discussed the transmission role of market integration under the two dimensions of factors and commodities. Moreover, the relationship between market integration and RED has been thoroughly expounded through relevant literature, and its inhibitory effect has been widely recognized. Thus, the paper mainly examines the impact of the NEDC policy on market integration, and set the mechanism model:

$$MI_{it} = c + \beta NEDC_{it} + \boldsymbol{\alpha CV}_{it} + \overline{\varphi}_i + \overline{\tau}_t + \overline{\omega}_{it}, \tag{4}$$

where, the mechanism variable MI_{it} is market integration in city i, which includes the factor commodity market integration. The vector of coefficients β reveals the impact of the NEDC policy on market integration. Additionally, the interpretation of other letters and symbols is consistent with the benchmark model (1).

4.3.2. Measurement of mechanism variables

(1) Commodity market integration. Following Yuan et al. (2024), we select the consumer price indices for eight commodity categories, measure the market segmentation by using the price index method, and then compute commodity market integration (*CMI*) as the square root of the reciprocal of this market segmentation measure. The above data are obtained from the China City Statistical Yearbook and other statistical publications (or reports) at the city and provincial levels.

(2) Factor market integration. While we have gathered data on labor wages, fixed asset investment, and invention patents across 284 cities, the unavailability of price indices for these factors across industries necessitates the use of an alternative method to measure factor market integration. Specifically, drawing on the approach of Xu (2002), we employ the business cycle method to indirectly assess factor market integration. Specifically, following Pyun and An (2016), this study uses the log-difference method with negative absolute value to measure factor market cycle synchronization between cities, which is calculated by the formula $FMCS_{i,j,t} = -\left|FG_{i,t} - FG_{j,t}\right|$. Where $FMCS_{i,j,t}$ is the three factor market cycle synchronizations between cities i and j in year t, $FG_{i,t}$ and $FG_{j,t}$ is the log difference of the level of labor wages, fixed asset investment and the number of invention patents granted between cities. To obtain a measure of each city's overall factor market integration, we aggregate these pairwise synchronizations across all other cities j in year t, using the following formula: $FMI_{i,t} = \sum_j FMCS_{i,j,t}$. A higher calculated value for city i, indicates a greater level of factor market integration.

4.3.3. The results of mechanism test

In column (1)–(3) of Table 5, the results show that the estimated coefficients of NEDC are significantly positive from the three dimensions of factor market integration. Thus, the NEDC policy significantly promote the integration of factor market, enhance the level of market integration in labor, capital and technology between cities, thereby mitigate the economic disparities between cities. From the perspective of commodity market integration, the result in column (4) show that the estimated coefficient of NEDC is also significantly positive. Therefore, the NEDC policy can significantly improve the level of commodity market integration, promotes the integration of less developed cities into the unified national market, thereby narrow RED.

In conclusion, the NEDC policy significantly mitigates RED by fostering factor and commodity market integration, thus providing strong empirical support for the second hypothesis (H2) of this study.

Table 5. The mechanism test result of market integration

Variables	FMI			CMI
	(1) Labour	(2) Capital	(3) Technology	(4) Commodity
NEDC	1.6484**	4.0221***	8.7339**	0.0212**
	(0.6676)	(1.4494)	(4.3618)	(0.0093)
Control variables	YES	YES	YES	YES
Constant	–23.6593*	–52.8748**	–83.7037	2.6754***
	(12.8227)	(21.8734)	(101.5351)	(0.1184)
City FE	YES	YES	YES	YES
Year FE	YES	YES	YES	YES
Obs	5,680	5,680	5,680	5,680
R^2	0.1528	0.4864	0.1891	0.2579

Notes: ***, **, and * represent significance levels of 1%, 5%, and 10%, respectively. The values in brackets are robust standard errors clustered at the city and year level.

5. Heterogeneity analysis and further discussion

5.1. Heterogeneity analysis

5.1.1. Urban location

To analyze heterogeneity based on urban location, this study constructs two dummy variables using China's geographical divisions and the Qinling-Huai River line. The first dummy variable *EST*, equals 1 if a city is located in the eastern region and 0 otherwise. The second dummy variable *TA*, takes the value of 1 if the city is situated in the southern region and 0 otherwise. Then, we construct the interaction term *NEDC*×*EST* and *NEDC*×*STA* into the model (1), then re-conduct the estimation.

In column (1) of table 6, the coefficients of *NEDC* is significantly negative (–0.0391), and the estimated coefficients of *NEDC*×*EST* is insignificantly negative (–0.0010). These results show that, compare to the cities in the eastern regions, the NEDC policy significantly reduce RED in the non-eastern regions, and those inhibitory effect is greater. In column (2) of Table 6, the coefficients of *NEDC*×*STA* is significantly negative (–0.0558), but the coefficients of *NEDC* is insignificantly (–0.0099). Southern cities possess comparative advantages over northern cities in technological innovation and institutional environments, leading to a more developed digital economy (Xie et al., 2022). The NEDC policy will significantly reduce RED between southern cities and the most developed cities, with this inhibitory effect being significantly stronger.

5.1.2. Commercial attractiveness

Utilizing the 2022 urban commercial attractiveness ranking from the *YICAI* China, we construct a dummy variable (*UCC*) to empirically examine the heterogeneous impact of business charm. The dummy variable (*UCC*) equals 1 for cities classified as second-tier and above, and 0 otherwise. Then, we construct the interaction term *NEDC*×*UCC* into the model (1), then re-conduct the estimation. In column (3) of table 6, the coefficients of *NEDC*×*UCC* is significantly negative (–0.0542), but the coefficients of *NEDC* is insignificant negative (–0.0101). Therefore, the NEDC policy significantly reduces RED between commercial-based cities and the most developed cities, indicating a significant inhibitory effect. Cities with limited commercial and economic development are less able to benefit from the NEDC policy, which hinders their capacity to close the economic gap with the most developed cities.

5.1.3. Administrative level

The 284 cities in our sample represent a diverse set of administrative levels, encompassing ordinary prefecture-level cities alongside higher-level cities. Thus, in order to analyze the heterogeneous effect of urban administrative level, this study constructs a dummy variable *UAL* for urban administrative level, which takes the value 1 if the city belongs to the above higher administrative level and 0 otherwise. We construct the interaction term of *NEDC*×*UAL* into the model (1), then re-conduct the estimation. In column (4) of Table 6, the coefficients of *NEDC* and *NEDC*×*UAL* are all significantly negative (–0.0264 and –0.0274 respectively). Thus, the NEDC policy effectively reduces RED across all urban administrative levels. Moreover, the policy exhibits a more pronounced inhibitory effect on economic disparities specifically between ordinary prefecture-level cities and the most developed cities.

5.1.4. Business environment

Following the business environment classifications in the Business Environment Report of 296 Cities in China, we categorize 284 sample cities into two groups: good business environment (top 142 cities) and poor business environment (cities ranked 143 and below). To examine the heterogeneity effect of business environment, we construct a dummy variable *BBE*, which takes a value of 1 for cities with a good business environment and 0 otherwise. Then, we construct the interaction term of *NEDC*×*BBE* into the model (1), then re-conduct the estimation. In column (5) of Table 6, the coefficients of *NEDC* is significantly positive (0.0459), and *NEDC*×*BBE* is significantly negative (–0.1013). It indicates that the NEDC policy effectively reduces economic disparities between cities with a strong business environment and the most developed cities, but simultaneously exacerbates economic disparities between cities with a weak business environment and the most developed cities. Cities with better business environments, characterized by greater market openness and higher economic activity, are more likely to benefit from market integration, and obtain faster economic convergence under the NEDC policy dividend.

Table 6. The results of heterogeneity analysis

Variables	(1)	(2)	(3)	(4)	(5)
	East area	South area	Commercial	Administrative	Business
NEDC	–0.0391***	–0.0099	–0.0101	–0.0264***	0.0459***
	(0.0060)	(0.0062)	(0.0066)	(0.0066)	(0.0105)
NEDC×EST	–0.0010				
	(0.0092)				
NEDC×STA		–0.0558***			
		(0.0088)			
NEDC×UCC			–0.0542***		
			(0.0088)		
NEDC×UAL				–0.0274***	
				(0.0090)	
NEDC×BBE					–0.1013***
					(0.0115)
Control variables	YES	YES	YES	YES	YES
Constant	1.9438***	1.9335***	1.9679***	1.9559***	1.9556***
	(0.0887)	(0.0886)	(0.0885)	(0.0887)	(0.0884)
City FE	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES
Obs	5,680	5,680	5,680	5,680	5,680
R^2	0.9158	0.9167	0.9166	0.9160	0.9173

Notes: ***, **, and * represent significance levels of 1%, 5%, and 10%, respectively. The values in brackets are robust standard errors clustered at the city and year level.

5.2. The synergistic effect analysis

The benchmark results in this paper focus on the demonstration cities, neglecting the potential influence of the NEDC policy on nearby non-demonstration cities. Given cross-regional factor flows and spatial interactions, it is plausible that the deepening of market integration from the NEDC policy may not only affect economic disparities within demonstration cities, but could also synergistic reduce RED in neighboring cities. Therefore, we construct new policy dummy variables to capture this spatial synergistic effect.

Following the methodology of Gao and Kong (2024), we define neighboring non-demonstration cities as treatment cities when their distance from demonstration cities is within 50, 100, 150, or 200 km, and generates a new NEDC policy dummy variable (*NEDCDIS*) with spatial scope, thereby capture the spatial spillover effects. The result in Table 7 shows that when the spatial distance is within the range of 50, 100 and 150 km, the coefficient of *NEDCDIS* is significantly negative, but not statistically significant at 200 km. It suggests that the NEDC policy not only reduces economic disparities in demonstration cities, but also exerts a significant synergistic inhibitory effect on RED within a 150 km radius of the demonstration cities.

Table 7. The synergistic results of the NEDC policy

Variables	(1)	(2)	(3)	(4)
	50 km	100 km	150 km	200 km
NEDCDIS	–0.0427***	–0.0222***	–0.0053*	0.0048
	(0.0049)	(0.0036)	(0.0031)	(0.0032)
Control variables	YES	YES	YES	YES
Constant	1.9541***	1.9042***	1.8370***	1.8197***
	(0.0887)	(0.0872)	(0.0863)	(0.0862)
City FE	YES	YES	YES	YES
Year FE	YES	YES	YES	YES
Obs	5,680	5,680	5,680	5,680
R^2	0.9161	0.9151	0.9145	0.9145

Notes: ***, **, and * represent significance levels of 1%, 5%, and 10%, respectively. The values in brackets are robust standard errors clustered at the city and year level.

5.3. The quantile effect analysis

This paper employ panel quantile estimation to examine the differential impact of the NEDC policy on RED, the corresponding estimation results are depicted in Figure 4.

As the quantile level increases, the estimated coefficients of NEDC remain statistically significant, while their absolute values exhibit a decreasing trend. Moreover, the estimated coefficients NEDC are significantly smaller than the baseline coefficient at the lowest three quantiles, but significantly larger and stable from the fourth quantile onwards. In terms of economic sense, this suggests that for cities with relatively better economic development and smaller economic disparities with the most developed cities, the NEDC policy has a significantly larger inhibitory effect on those economic disparities. Thus, the smaller the RED quantile, the greater the inhibiting effect of NEDC policy.

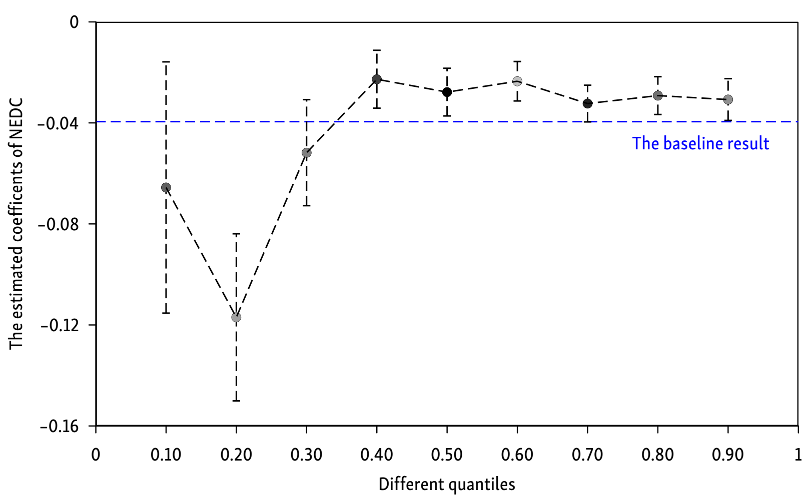

Figure 4. The quantile effect

6. Conclusions and discussions

6.1. Conclusions

The NEDC policy plays a key role in promoting domestic market integration, which is crucial for alleviating RED and fostering balanced regional development. From the perspective of market integration, this paper discusses the theoretical relationships between the NEDC policy and RED. Then, based on the panel data of 284 cities at prefecture level and above in China from 2003 to 2022, we apply the staggered DID model to examine the impact of the NEDC policy on RED, and explore the mechanism of market integration from different dimensions. The basic conclusions are as follows:

Firstly, the NEDC policy significantly narrow RED, thereby confirming the first hypothesis of this study. This baseline result is confirmed by robustness tests, such as the heterogeneous treatment effects test, placebo test, PSM-DID, instrumental variable estimation, synthetic DID, and eliminate disturbing policies. Secondly, the NEDC policy reduces RED by fostering factor market integration and commodity market integration, thereby supporting second hypothesis. Thirdly, the inhibitory effect of the NEDC policy on RED is more pronounced in non-eastern cities, southern cities, commercial-based cities, ordinary prefecture-level cities, and cities with a favorable business environment. Fourthly, the NEDC policy appear a significant synergistic inhibitory effect on RED within 150 km radius of demonstration cities. The inhibitory effect of the NEDC policy becomes more pronounced at lower quantiles of RED.

6.2. Discussions

In light of China's rapid digital transformation and the strategic emphasis on coordinated regional development in China, our findings have significant implications for policy formulation and implementation. Firstly, the policymakers should realize the potential of the NEDC policy in promoting balanced regional growth. Secondly, the policymakers should strategically prioritize resource allocation towards less developed cities, specifically targeting improvements in human capital, technological innovation, industrial upgrading, inclusive financial development, and infrastructure. Thirdly, the pilot program should focus on regions close to existing demonstration cities and cities characterized by non-eastern, southern, and good business environments.

There may still be some shortcomings in this paper, and future research can continue to improve. A more comprehensive investigation of the mechanisms driving the effects of the NEDC policy on RED, beyond those related to market integration, is needed. Meanwhile, the spatial spillover effects of the NEDC policy deserve further investigation using spatial econometric techniques, including the precise quantification of spatial spillover distances.

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Author contributions

All authors made significant contributions to the study. All authors commented on previous versions of the manuscript and read and approved the final manuscript. Zhiping Qiu: conceptualization, design, data collection, methodology, software, formal analysis, visualization, writing (original draft), funding acquisition. Tingting Yao: conceptualization, project administration, resources, supervision, validation, writing (review and editing), funding acquisition. Jianan Chai: validation, writing (review and editing), funding acquisition.

Disclosure statement

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.

References

Alizadeh, T., Helderop, E., Grubesic, T. H., & Ferrers, R. (2024). The multi-technology footprint of the national broadband network in Australia: exploring the urban-regional divide and socio-spatial patterns for inequality. *International Regional Science Review*, *47*(2), 159–181. https://doi.org/10.1177/01600176231168025

Akita, T., & Miyata, S. (2010). The bi-dimensional decomposition of regional inequality based on the weighted coefficient of variation. *Letters in Spatial and Resource Sciences*, *3*, 91–100. https://doi.org/10.1007/s12076-010-0040-x

Arkhangelsky, D., Athey, S., Hirshberg, D. A., Imbens, G. W., & Wager, S. (2021). Synthetic difference-in-differences. *The American Economic Review*, *111*(12), 4088–4118. https://doi.org/10.1257/aer.20190159

Bănescu, C.-E., Țițan, E., & Manea, D. (2022). The impact of e-commerce on the labor market. *Sustainability*, *14*(9), Article 5086. https://doi.org/10.3390/su14095086

Cao, X., Deng, M., & Li, H. (2021). How does e-commerce city pilot improve green total factor productivity? Evidence from 230 cities in China. *Journal of Environmental Management*, *289*, Article 112520. https://doi.org/10.1016/j.jenvman.2021.112520

Chan, S. (2021). Inter-regional development in China: An assessment. *Journal of Infrastructure*, *Policy and Development*, *5*(1), Article 1270. https://doi.org/10.24294/jipd.v5i1.1270

Chen, Z., Wan, J., Liu, F, & Hou, Z. (2024). Driving enterprise digital transformation: Unveiling the significance of e-commerce demonstration city in China. *IEEE Transactions on Engineering Management*, *71*, 5641–5655. https://doi.org/10.1109/TEM.2024.3366450

Cranea, B., Albrecht, C., Duffin, K. M., & Albrecht, C. (2018). China's special economic zones: An analysis of policy to reduce regional disparities. *Regional Studies*, *Regional Science*, *5*(1), 98–107. https://doi.org/10.1080/21681376.2018.1430612

Couture, V., Faber, B., Gu, Y., & Liu, L. (2018). *E-commerce integration and economic development*: *Evidence from China* (NBER Working Paper No. 24384). National Bureau of Economic Research.

Couture, V., Faber, B., Gu, Y., & Liu, L. (2021). Connecting the countryside via e-commerce: Evidence from China. *American Economic Review*: *Insights*, *3*(1), 35–50. https://doi.org/10.1257/aeri.20190382

Deng, X., Liang, L., Wu, F., Wang, Z., & He, S. (2022). A review of the balance of regional development in China from the perspective of development geography. *Journal of Geographical Sciences*, *32*, 3–22. https://doi.org/10.1007/s11442-021-1930-0

Fan, J., Tang, L., Zhu, W., & Zou, B. (2018). The Alibaba effect: Spatial consumption inequality and the welfare gains from e-commerce. *Journal of International Economics*, *114*, 203–220. https://doi.org/10.1016/j.jinteco.2018.07.002

Fan, Z. B., Long, R., & Shen, Z. X. (2024). Regional digitalization, dynamic capabilities and green innovation: Evidence from e-commerce demonstration cities in China. *Economic Modelling*, *139*, Article 106846. https://doi.org/10.1016/j.econmod.2024.106846

Gao, X., & Kong, S. (2024). Cross-border e-commerce reform and entrepreneurial activity in urban services – Evidence from Chinese service industry enterprise registration data. *China* & *World Economy*, *32*(6), 217–258. https://doi.org/10.1111/cwe.12563

Goodman-Bacon A. (2021). Difference-in-differences with variation in treatment timing. *Journal of Econometrics*, *225*(2), 254–277. https://doi.org/10.1016/j.jeconom.2021.03.014

Han, A., Liu, P. Wang, B., & Zhu, A. (2023). E-commerce development and its contribution to agricultural non-point source pollution control: Evidence from 283 cities in China. *Journal of Environmental Management*, *344*, Article 118613. https://doi.org/10.1016/j.jenvman.2023.118613

Hao, T., Sun, R., Tombe, T., & Zhu, X. (2020). The effect of migration policy on growth, structural change, and regional inequality in China. *Journal of Monetary Economics*, *113*, 112–134. https://doi.org/10.1016/j.jmoneco.2020.03.003

Hong, T., Yu, N., Storm, S., & Gao, B. (2019). How much does regional integration contribute to growth? An analysis of the impact of domestic market integration on regional economic performance in China (1997–2011). *Economic Research – Ekonomska Istraživanja*, *32*(1), 3189–3210. https://doi.org/10.1080/1331677X.2019.1592006

Jiang, H., Hu, W., Guo, Z., Hou, Y., & Chen, T. (2024). E-commerce development and carbon emission efficiency: Evidence from 240 cities in China. *Economic Analysis and Policy*, *82*, 586–603. https://doi.org/10.1016/j.eap.2024.04.009

Jullien, B., & Sand-Zantman, W. (2021). The economics of platforms: A theory guide for competition policy. *Information Economics and Policy*, *54*, Article 100880. https://doi.org/10.1016/j.infoecopol.2020.100880

Kranz, S. (2022). *Synthetic difference-in-differences with time-varying covariates*. https://github.com/skranz/xsynthdid/blob/main/paper/synthdid_with_covariates.pdf

Krugman, P. (1991). Increasing returns and economic geography. *Journal of Political Economy*, *99*(3), 483–499. https://doi.org/10.1086/261763

Leff, N. H. (1984). Externalities, information costs, and social benefit-cost analysis for economic development: An example from telecommunications. *Economic Development and Cultural Change*, *32*(2), 255–276. https://doi.org/10.1086/451385

Li, L., Ma, S. J., Zheng, Y., & Xiao, X. Y. (2022a). Integrated regional development: Comparison of urban agglomeration policies in China. *Land Use Policy*, *114*, Article 105939. https://doi.org/10.1016/j.landusepol.2021.105939

Li, J., Yuan, S., & Wu, J. (2022b). A study on the promotional effect and mechanism of national e-commerce demonstration city construction on green innovation capacity of cities. *Urban Science*, *6*(3), Article 55. https://doi.org/10.3390/urbansci6030055

Liu, S., Wan, Y., & Zhang, A. (2020). Does China's high-speed rail development lead to regional disparities? A network perspective. *Transportation Research Part A: Policy and Practice*, *138*, 299–321. https://doi.org/10.1016/j.tra.2020.06.010

Liu, D., & Qiu, Z. (2023). Can e-commerce reduce urban CO_2 emissions? Evidence from national e-commerce demonstration cities policy in China. *Environmental Science and Pollution Research*, *30*, 58553–58568. https://doi.org/10.1007/s11356-023-26657-3

Liu, M., Hou, Y., & Jiang, H. (2023). The energy-saving effect of e-commerce development – A quasi-natural experiment in China. *Energies*, *16*(12), Article 4718. https://doi.org/10.3390/en16124718

Liu, H., Wang, X., Wang, Z., & Cheng, Y. (2024). Does digitalization mitigate regional inequalities? Evidence from China. *Geography and Sustainability*, *5*(1), 52–63. https://doi.org/10.1016/j.geosus.2023.09.007

Lu, S., & Hong M. (2023). Rural e-commerce construction and regional coordinated development: Evidence from China's e-commerce pilots in rural areas. *Economic Review*, (5), 71–88. https://doi.org/10.19361/j.er.2023.05.05

Lv, C., Song, J., & Lee, C.-C. (2022). Can digital finance narrow the regional disparities in the quality of economic growth? Evidence from China. *Economic Analysis and Policy*, *76*, 502–521. https://doi.org/10.1016/j.eap.2022.08.022

Ma, S., Lin, Y., & Pan, G. (2021). Does cross-border e-commerce contribute to the growth convergence? An analysis based on Chinese provincial panel data. *Journal of Global Information Management*, *29*(5), 86–111. https://doi.org/10.4018/JGIM.20210901.oa6

Mayer, T., Melitz, M. J., & Ottaviano, G. I. (2021). Product mix and firm productivity responses to trade competition. *Review of Economics and Statistics*, *103*(5), 874–891. https://doi.org/10.1162/rest_a_00952

Miao, Y., Du, R., Li, J., & Westland, J. C. (2019). A two-sided matching model in the context of B2B export cross-border e-commerce. *Electron Commerce Research*, *19*, 841–861. https://doi.org/10.1007/s10660-019-09361-8

National Bureau of Statistics of China. (2023). *China City Statistics Yearbook*. China Statistics Press.

National Bureau of Statistics of China. (2023). *China Urban Construction Statistics Yearbook*. China Statistics Press.

Nijman, J., & Wei, Y. D. (2020). Urban inequalities in the 21st century economy. *Applied Geography*, *117*, Article 102188. https://doi.org/10.1016/j.apgeog.2020.102188

Pan, X., & Zhou, C. (2023). The impact of e-commerce city pilot on the spatial agglomeration of high-end service industry in China. *International Studies of Economics*, *18*(3), 326–350. https://doi.org/10.1002/ise3.31

Pyun, J. H., & An, J. (2016). Capital and credit market integration and real economic contagion during the global financial crisis. *Journal of International Money and Finance*, *67*, 172–193. https://doi.org/10.1016/j.jimonfin.2016.04.004

Qian, L., & Chen, R. (2023). "Where you live determines how you are treated": E-commerce geography and digital inequality in China. *Eurasian Geography and Economics*, *66*(1), 97–122. https://doi.org/10.1080/15387216.2023.2210596

Roth, J. (2022). Pretest with caution: Event-study estimates after testing for parallel trends. *American Economic Review: Insights*, *4*(3), 305–322. https://doi.org/10.1257/aeri.20210236

Song, Z., Wang, C., & Bergmann, L. (2020). China's prefecture digital divide: Spatial analysis and multivariate determinants of ICT diffusion. *International Journal of Information Management*, *52*, Article 102072. https://doi.org/10.1016/j.ijinfomgt.2020.102072

Sun, J. (2023). How e-commerce support economic growth amid COVID-19: Evidence from Chinese economy. *Environmental Science & Pollution Research*, *30*, 88842–88860. https://doi.org/10.1007/s11356-023-28628-0

Ul-Haq, J., Visas, H., Hye, Q. M. A., Rehan, R., & Khanum, S. (2024). Investigating the unparalleled effects of economic growth and high-quality economic development on energy insecurity in China: A provincial perspective. *Environmental Science and Pollution Research*, *31*, 22870–22884. https://doi.org/10.1007/s11356-024-32682-7

Wang, F., Wang, M., & Yuan, S. (2021). Spatial diffusion of e-commerce in China's counties: Based on the perspective of regional inequality. *Land*, *10*(11), Article 1141. https://doi.org/10.3390/land10111141

Wang, H., Fang, L., Mao, H., & Chen, S. J. (2022). Can e-commerce alleviate agricultural non-point source pollution? – A quasi-natural experiment based on a China's e-commerce demonstration city. *Science of the Total Environment*, *846*, Article 157423. https://doi.org/10.1016/j.scitotenv.2022.157423

Wang, X., Wang, Y., & Liu, N. (2023). Does environmental regulation narrow the north-south economic gap? – Empirical evidence based on panel data of 285 prefecture-level cities. *Journal of Environmental Management*, *340*, Article 117849. https://doi.org/10.1016/j.jenvman.2023.117849

Wei, Y. D., & Ewing, R. (2018). Urban expansion, sprawl and inequality. *Landscape and Urban Planning*, *177*, 259–265. https://doi.org/10.1016/j.landurbplan.2018.05.021

Wei, Y., Wu, Y., Liao, F. H., & Zhang, L. (2020). Regional inequality, spatial polarization and place mobility in provincial China: A case study of Jiangsu province. *Applied Geography*, *124*, Article 102296. https://doi.org/10.1016/j.apgeog.2020.102296

Wu, S., Wang, P. & Sun, B. (2021). Can the Internet narrow regional economic disparities? *Regional Studies*, *56*(2), 324–337. https://doi.org/10.1080/00343404.2021.1942444

Xie, D., Bai, C., & Xiao, W. (2022). Institutional environment, development model transformation and north-south economic disparity in China. *Growth and Change*, *53*(4), 1877–1906. https://doi.org/10.1111/grow.12629

Xu, X. (2002). Have the Chinese provinces become integrated under reform. *China Economic Review*, *13*(2–3), 116–133. https://doi.org/10.1016/S1043-951X(02)00058-5

Yang, Y., Hao, F., & Meng, X. (2024). How does the national e-commerce demonstration city pilot policy boost economic growth? Evidence from China. *Empirica*, *51*, 929–975. https://doi.org/10.1007/s10663-024-09622-2

Yang, T., & Zhou, B. (2024). Local FinTech development, industrial structure, and north-south economic disparity in China. *International Review of Financial Analysis*, *93*, Article 103119. https://doi.org/10.1016/j.irfa.2024.103119

Yao, T., & Qiu, Z. (2024). Can e-commerce narrow regional economic disparities? Evidence from national e-commerce demonstration cities policy in China. *GeoJournal*, *89*, Article 165. https://doi.org/10.1007/s10708-024-11155-x

Yuan, P., Shao, M., & Ma, C. (2024). Unlocking economic unity: The digital economy's impact on market segmentation in China. *Journal of Knowledge Economy*, *15*, 16700–16734. https://doi.org/10.1007/s13132-024-01740-3

Zhang, X. (2019). Investigation of e-commerce in China in a geographical perspective. *Growth and Change*, *50*(3), 1062–1084. https://doi.org/10.1111/grow.12307

Zhang, Y. (2021). The regional disparity of influencing factors of technological innovation in China: Evidence from high-tech industry. *Technological and Economic Development of Economy*, *27*(4), 811–832. https://doi.org/10.3846/tede.2021.14828

Zhang, Z., Zhan, C., Li, Z. & Liu, Y. (2022a). Spatial patterns, dependencies, and disparities of characteristic towns and Taobao towns in China. *Applied Spatial Analysis and Policy*, *15*, 1237–1262. https://doi.org/10.1007/s12061-022-09454-2

Zhang, Z., Sun, Z., & Lu, H. (2022b). Does the e-commerce city pilot reduce environmental pollution? Evidence from 265 cities in China. *Frontiers in Environmental Science*, *10*, Article 813347. https://doi.org/10.3389/fenvs.2022.813347

Zhang, X., Tang, T., & Mo, E. (2024). Can urban e-commerce transformation improve economic resilience? A quasi-natural experiment from China. *PLoS ONE*, *19*(5), Article e0304014. https://doi.org/10.1371/journal.pone.0304014

Zheng, L., Shepherd, D., & Batuo, M. E. (2021). Variations in the determinants of regional development disparities in rural China. *Journal of Rural Studies*, *82*, 29–36. https://doi.org/10.1016/j.jrurstud.2020.08.011

Zhong, Y., Guo, F., Wang, X., & Guo, J. (2024). Can e-commerce development policies promote the high-quality development of agriculture? – A quasi-natural experiment based on a China's e-commerce demonstration city. *PLoS ONE*, *19*(5), Article e0299097. https://doi.org/10.1371/journal.pone.0299097

Zhou, C., & Li, B. (2023). How does e-commerce demonstration city improve urban innovation? Evidence from China. *Economics of Transition and Institutional Change*, *31*(4), 915–940. https://doi.org/10.1111/ecot.12361

Zhou, X., & Jiang, P. (2024). Does e-commerce infrastructure increase enterprise productivity? Evidence from China's e-commerce demonstration city. *International Journal of Finance* & *Economics*, *30*(2), 1758–1784. https://doi.org/10.1002/ijfe.2994