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From Digital Marketplace to Economic Resilience: Evidence from China's National E-Commerce Demonstration Cities

Yiming Chen

Shanghai University of International Business and Economics, Shanghai, China
23089018@suibe.edu.cn

Abstract. Leveraging panel data of 281 Chinese prefecture-level cities from 2006 to 2022, this study frames the designation of National E-commerce Demonstration Cities (NEDC) as a quasi-natural experiment, aiming to investigate the impact of e-commerce policies on urban economic resilience (UER). We employ a staggered difference-in-differences (DID) model, with propensity score matching-DID (PSM-DID) and Double Machine Learning (DML) as robustness checks to ensure result reliability.The findings reveal that the policy significantly enhances UER, with an average effect of approximately 8.8%, reaching its peak in the third year after implementation. Mechanism analysis indicates that the policy operates through three key channels: improving green total factor productivity(GTFP), strengthening regional innovation capacity (RIC), and promoting industrial structure upgrading(ISU). Heterogeneity analysis further shows that the policy's positive effects are more prominent in non-resource-based cities (coefficient = 0.073, $p < 0.05$) and non-national hub cities (coefficient = 0.096, $p < 0.01$). In contrast, resource-based cities rely more on fiscal support and industrial specialization, while national hub cities experience diminishing marginal returns due to their well-developed foundations. This study fills an empirical gap and provides evidence for differentiated approaches to digital governance.

Keywords: National E-commerce Demonstration Cities, Urban Economic Resilience, Difference-in-Differences (DID), Quasi-natural Experiment

1. Introduction

Against the backdrop of increasing global economic instability, frequent geopolitical conflicts, and recurring public health crises, UEB—the capacity of a city to maintain its core functions, recover rapidly, and adapt to new conditions following external shocks—has become a central concern for both policymakers and scholars [1]. However, existing studies rarely explore how digital technology channels translate into "resilience dividends" for the real economy, nor through which institutional and industrial mechanisms such transformation occurs.

As a representative interface between the digital and real economies, e-commerce not only reduces transaction costs and time while expanding market boundaries, but also embeds data elements into production, logistics, and consumption through platform ecosystems. This integration provides a rapid response mechanism for matching supply and demand during crises. Theoretically, e-commerce plays a dual role as both a buffer and an amplifier: online platforms can offset losses from offline

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disruptions, directly enhancing firms' risk resistance; meanwhile, real-time transaction data accumulated on these platforms optimize inventory and logistics configurations, shorten industrial recovery cycles, and indirectly strengthen urban economic resilience. Nevertheless, empirical studies employing large-sample causal identification to assess whether and how e-commerce policies enhance urban resilience remain limited.

This study leverages China's phased implementation of the NEDC initiative since 2011 as a quasi-natural experiment. This policy, implemented at the city level, provides fiscal incentives, tax benefits, infrastructure support, and talent introduction measures, effectively lowering entry barriers, reducing resource consumption, and decreasing transaction costs for local small and medium-sized enterprises (SMEs). Utilizing this exogenous policy shock, we construct a balanced panel of 281 prefecture-level cities from 2006 to 2022 and employ a multi-period DID model to identify the causal impact of the e-commerce pilot program on urban economic resilience. Furthermore, we test three potential mechanisms: GTFP regional technological innovation, and ISU.

The main contributions of this paper are threefold.(1) It is the first to integrate e-commerce policy and UER within a unified analytical framework, bridging the empirical gap between the "digital trade divide" and "resilience dividends."(2) By incorporating event-study analysis, PSM-DID, DML, and placebo tests, the study provides robust and causal evidence of the policy's effects.(3) It uncovers three specific pathways—green efficiency improvement, innovation expansion, and industrial servicization—through which e-commerce strengthens resilience, and further reveals that the policy's positive effects are more prominent in non-resource-based cities and non-hub cities. These findings offer micro-level evidence for differentiated approaches to digital governance.

2. Literature review and theoretical framework

2.1. Literature review

China's e-commerce surge drives digital GDP [2], cuts costs, boosts industry, jobs, innovation and rural revival [3-7].

Urban e-commerce resilience—resistance, recovery, adaptation [1,8]—needs localized proof [9]; COVID-19 shows digitalization helps [10], yet inclusive digital-trade dividends remain untested.

2.2. Theoretical analysis

2.2.1. E-commerce and GTFP

E-commerce promotes GTFP by shortening information transmission time and improving coordination along supply chains. This optimization effectively reduces empty runs and mismatches in logistics, enhances inventory turnover efficiency, and thereby decreases carbon emissions during transportation while improving overall economic efficiency.

More importantly, through the deep integration of data elements, e-commerce platforms utilize pre-sale mechanisms and real-time demand analytics based on big data to achieve more accurate supply–demand matching. Compared with traditional sales models, this approach mitigates overproduction at the source and promotes resource efficiency. Moreover, by increasing market transparency, e-commerce platforms guide consumers toward green and environmentally friendly products. This shift in consumer preference encourages upstream enterprises to increase investment in green technology development and eco-innovative product design, thereby forming a self-reinforcing cycle of sustainable production and consumption.

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2.2.2. E-commerce and RIC

E-commerce also enhances RIC through both information integration and entrepreneurial stimulation. On the one hand, by leveraging cloud-based data integration and high-speed information networks, e-commerce platforms can disseminate real-time information on market demand, technological trends, and financial support policies to small and medium-sized enterprises (SMEs). This reduces their costs of information searching, evaluation, and decision-making, thereby creating a continuous stream of entrepreneurial opportunities. The improved information flow also facilitates cross-sector collaboration and the commercialization of innovative outcomes, which in turn boosts local entrepreneurial dynamism and innovation performance [11].

On the other hand, in regions where e-commerce ecosystems are more mature, platform providers offer extensive support services such as training, digital marketing, and supply chain finance. These services enhance managerial capabilities, strengthen profit expectations, and attract venture capital concentration.

2.2.3. E-commerce and ISU

E-commerce integrates the entire “demand–data–capacity” chain into a unified digital platform, leading to the continuous blurring and reorganization of traditional industrial boundaries. Real-time consumption data from e-commerce platforms decompose end-user demand into identifiable, labeled, and highly customized micro-orders, driving manufacturing enterprises to transition from large-scale, standardized production toward small-batch, high-responsiveness flexible manufacturing.

In the circulation sector, the rise of integrated warehousing–distribution systems and same-city instant delivery networks has significantly compressed redundant links in the traditional multi-tier wholesale and distribution structure. As a result, production-related services such as logistics, payment, and marketing have been separated and developed into rapidly growing new industries.

On the sales side, emerging models such as livestream e-commerce and online content communities have embedded functions such as marketing, training, design, and even R&D into consumption scenarios. This integration has driven the rapid expansion of knowledge-intensive service sectors, including brand management, data analytics, and content creation. Consequently, e-commerce not only promotes the servicification of manufacturing and the digitalization of trade but also accelerates the overall upgrading of industrial hierarchies, facilitating the transition toward a more innovation-driven and service-oriented urban economy.

3. Research design

3.1. Model specification

To identify the causal effect of the NEDC policy, this study employs a staggered DID framework. Because the policy was implemented in multiple batches over time, the cities approved as demonstration sites are regarded as the treatment group, while the remaining cities serve as potential control groups. Based on city–year panel data, the following two-way fixed effects (TWFE) baseline model is estimated:

$$RES_{i,t} = \alpha + \beta ECP_{i,t} + \gamma_1 GDP_{i,t} + \gamma_2 LFDI_{i,t} + \gamma_3 Fiscal_{i,t} + \gamma_4 KSI_{i,t} + \mu_i + \lambda_t + \varepsilon_{i,t} \quad (1)$$

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where $RES_{i,t}$ represents the centralized urban economic resilience index of city i in year t; $ECP_{i,t}$ is the core explanatory variable, a policy dummy that equals 1 for cities designated as NEDC in year t and subsequent years, and 0 otherwise.

This specification follows the standard staggered DID framework [12], enabling the estimation of the average treatment effect of the policy while accounting for potential heterogeneity in treatment timing and city characteristics.

3.2. Data sources

The data used for constructing the core variables are obtained from the CSMAR Regional Economic Research Database. Additional city-level control variables—including GDP, fiscal revenues and expenditures, FDI, patent data, and industrial structure—are collected from the corresponding years' provincial and prefecture-level statistical yearbooks. Missing values are linearly interpolated from adjacent years.

The sample period covers 2006–2022, resulting in a balanced panel of 281 prefecture-level cities and 7,502 city–year observations. This time span adequately captures both pre-treatment and post-treatment dynamics of the NEDC policy, which was implemented progressively beginning in 2011.

4. Empirical results and analysis

4.1. Baseline regression

Table 2 shows the regression results examining the effect of the NEDC policy on urban economic resilience. Column (1) reports the baseline DID estimates controlling for city and year fixed effects. The coefficient of ECP is 0.0884 and statistically significant at the 1% level, indicating that the implementation of the NEDC policy has a significant positive impact on UER.

Column (2) reports the PSM-DID estimates, which account for potential selection bias by matching treated and control cities based on observable characteristics. The detailed methodology and robustness checks for PSM-DID will be discussed in the following sections.

Table 1. The impact of NEDC on economic resilience

	(1)	(2)
Variable	Cen_RES	Cen_RES
NEDC	0.0884***	0.0591**
	(0.0267)	(0. 0293)
GDP	0.0155	0.0091
	(0.0071)	(0. 0089)
FDI	0.0531***	0.0500***
	(0.0114)	(0.0167)
FS	0.7428***	0.2965
	(0.1357)	(0.2003)
KSI	0.0835	0.1716**
	(0.0799)	(0.0781)
Constant	-0.6581***	-0.5198***
	(0.0894)	(0. 1670)

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Table 1. (continued)

Firm FE	YES	YES
Year FE	YES	YES
Observations	3,502	1,457
R-squared	0.3815	0.4117

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

4.2. Dynamic effects and parallel trend test

To ensure that the estimated impact of the NEDC policy reflects the policy itself rather than pre-existing disparities between treatment and control groups, this study performs an event-study analysis referencing Jacobson et al. [13] Specifically, we define the year when a city is approved as a NEDC pilot as $t = 0$, then construct relative-year dummy variables d_k ($k = -7, \ldots, -2, -1, \text{current}, +1, \ldots, +5$) are constructed, with $k = -1$ as the baseline period. The estimation equation is:

$$RES_{i,t} = \alpha + \sum_{k \neq -1} \beta_k \left(d_k \times Treat_i\right) + X'_{i,t}\gamma + \mu_i + \lambda_t + \varepsilon_{i,t} \tag{2}$$

where $Treat_i$ is a dummy variable for pilot cities; μ_i and λ_t denote city-fixed effects and year-fixed effects, respectively; standard errors are clustered at the city level.

Figure 1 reports the estimated coefficients β_k and their 90% confidence intervals. The results show that all lead-period estimates prior to policy implementation ($k = -7$ to -2) are statistically insignificant (not different from zero), confirming that pilot and non-pilot cities satisfy the parallel trends assumption (PTA) prior to the policy shock. In contrast, coefficients for the policy year and subsequent lag periods ($k \geq 0$) are all significantly positive, peaking in the third year ($k = +3$), indicating that the policy effect gradually strengthens and reaches its maximum around $t + 3$.

Overall, the event-study results both validate the PTA and reinforce confidence in the causal interpretation of the baseline DID estimates.

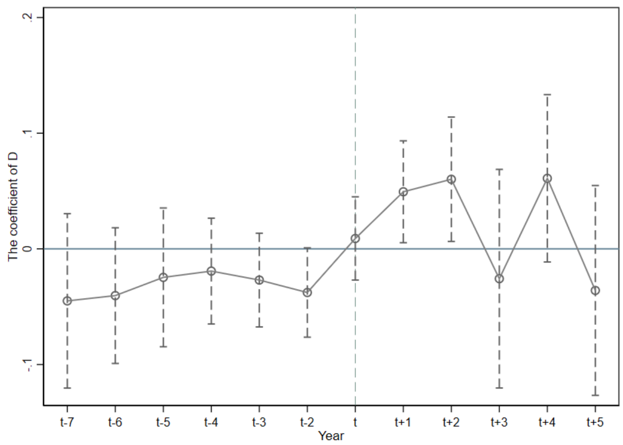

Figure 1. PTA test

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4.3. Robustness checks

4.3.1. Placebo test

To rule out the possibility that the baseline estimates reflect unobserved confounding factors rather than the true policy effect, this study conducts a placebo test following Li et al. [14]. Under the premise of keeping the number of pilot cities and batch timing unchanged, the "e-commerce pilot" status is randomly reassigned to cities. At period (i), if there are (N_i) demonstration cities, (N_i) cities are randomly selected as a pseudo-treatment group, and the remaining batches are treated similarly;The policy coefficient is re-estimated using the exact same model specification as the baseline regression (two-way fixed effects and city-level clustered robust standard errors);The pseudo-policy coefficients are recorded.

This process is repeated 500 times. Figure 2 shows the distribution of the placebo coefficients, with a vertical line indicating the actual estimated value of 0.063. Almost all pseudo coefficients are concentrated around zero, and the two-sided p-value for the actual estimate is less than 0.01, lying far in the right tail of the permutation distribution.

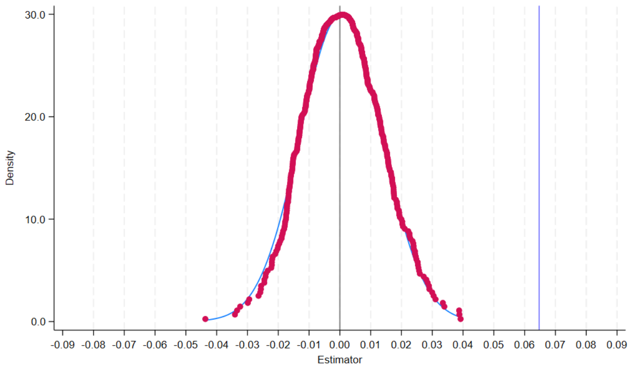

Figure 2. Placebo test

4.3.2. Propensity Score Matching–Difference-in-Differences (PSM-DID)

Table 2 presents the regression results of the e-commerce pilot policy on economic resilience under different matching conditions. Column (1) reports the baseline DID estimates controlling for city and year fixed effects, without performing sample matching. Column (2) first applies 1:1 nearest-neighbor propensity score matching (PSM) to exclude non-comparable cities, and then runs the same DID model on the matched subsample to mitigate selection bias caused by cities' voluntary participation in the pilot program.

The results show that in the matched sample (Column 2), the policy effect remains significant at the 5% level. The coefficient decreases to 0.059 compared with Column (1).

4.3.3. DML

The DML framework leverages algorithms such as gradient boosting to automatically capture nonlinearities and interaction effects in high-dimensional covariates.

This study applies DML to further evaluate the policy. As shown in the table 3, the coefficient of ECP in Column (1) is 0.066 and statistically significant, indicating that even after controlling for high-dimensional or complex correlated covariates, the e-commerce pilot policy still has a significant

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positive causal effect on centralized economic resilience—i.e., the policy significantly promotes urban economic resilience.

Table 2. The result of DML

	(1)
Variable	Cen_RES
NEDC	0.066**
	(0.029)
constant term	-0.000
	(0.002)
Controls	YES
Firm FE	YES
Year FE	YES
Observations	3,538

* p<0.10, ** p<0.05, *** p<0.01

5. Mechanism tests and heterogeneity analysis

5.1. Mechanism tests

To examine whether the NEDC policy affects regional economic development through the "GTFP → RIC → ISU" pathway, this study first conducts direct effect tests on three potential mediating variables to verify whether the policy shock significantly alters their levels.

Specifically, the dependent variables are sequentially set as: GTFP, logarithm of per capita authorized patents (Patents), and the ratio of tertiary to secondary industry added value (Ind_ratio). In each regression, the core explanatory variable is the NEDC policy dummy. City and year fixed effects, as well as relevant socioeconomic control variables, are included, and standard errors are clustered at the city level.

Table 3. The result of mechanism tests

	(1)	(2)	(3)
Variables	GTFP	Patents	Ind_ratio
NEDC	0.0236**	0.1267***	0.0593**
	(0.0102)	(0.0396)	(0.0268)
Controls	Yes	Yes	Yes
City FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Observations	3,492	3,492	3,492
R-squared	0.730	0.952	0.861

* p<0.10, ** p<0.05, *** p<0.01

The table 4 shows that the NEDC policy exerts a significantly positive impact on all three mediating variables. In Column (1), the estimated coefficient of NEDC on GTFP is 0.0236, significant and positive, indicating that the pilot policy substantially enhances urban GTFP. This

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reflects that the policy can improve upstream–downstream information coordination, achieve precise supply–demand matching, increase industry transparency, and guide consumers toward green products, thereby accelerating GTFP growth. Enhanced GTFP promotes sustainable economic development and mitigates the impact of resource price volatility or depletion under the "resource curse," further strengthening the economic system's resilience [15].

Column (2) shows that the coefficient on the logarithm of per capita authorized patents reaches 0.1267, significant at the 1% level, indicating that the policy significantly stimulates regional innovation output. E-commerce lowers information costs and strengthens service support, continuously activating regional innovation. Innovation, in turn, enhances regional adaptability, industrial diversity, and firm flexibility, enabling the economic system to respond and recover more quickly during crises [16].

Column (3) reports that the ratio of tertiary to secondary industry added value (Ind_ratio) increases by 0.0593 following the policy shock, significant at the 5% level, indicating industrial upgrading toward service and high-end sectors. Industrial upgrading, through both optimized resource allocation and technological innovation, significantly enhances urban cluster economic resilience [17].

Overall, the e-commerce pilot policy not only directly improves green productivity but also establishes a solid mechanism foundation for subsequent economic resilience enhancement by stimulating technological innovation and promoting industrial structure optimization, consistent with theoretical expectations.

5.2. Heterogeneity analysis

5.2.1. Resource endowment heterogeneity

Based on the Chinese State Council's classification of resource-based cities [18], prefecture-level cities are divided into resource-based and non-resource-based. For resource-based cities, the coefficient of e-commerce on economic resilience is 0.024, positive but not significant, indicating limited impact. In these cities, the coefficients of fiscal self-sufficiency and the Krugman specialization index (KSI) are significant at the 1% and 5% levels, respectively, suggesting that resilience improvement relies more on fiscal independence and industrial specialization.

Conversely, in non-resource-based cities, the coefficients for the e-commerce pilot and foreign direct investment (FDI) are significantly larger, indicating that market-driven factors contribute more to enhancing economic resilience. These results reveal distinct resilience pathways: resource-based cities require internal shock absorption through fiscal capacity and industrial optimization, whereas non-resource-based cities can gain greater benefits from e-commerce and external capital, achieving external empowerment.

5.2.2. Transport hub heterogeneity

Based on the State Council's classification of national hub cities [19], prefecture-level cities are divided into national hub and non-national hub cities. For national hub cities, the e-commerce coefficient is 0.007 and not significant, whereas for non-national hub cities, it reaches 0.096 and is significantly positive. This indicates that in national hubs, which already possess highly diversified industrial structures and well-developed infrastructure and logistics networks, the marginal impact of e-commerce on economic resilience is limited. By contrast, non-national hub cities, characterized by a higher share of traditional industries, limited market coverage, and weaker infrastructure, rely more on e-commerce as a development lever.

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Table 4. The result of heterogeneity analysis

Cen_RES	Resource-based cities	Non-resource-based cities	National hub cities	Non-national hub cities
NEDC	0.024	0.073**	0.007	0.096***
	(0.087)	(0.030)	(0.081)	(0.033)
GDP	0.007	-0.000	0.006	0.001
	(0.009)	(0.005)	(0.009)	(0.005)
FS	1.111***	0.339**	-0.063	0.787***
	(0.232)	(0.162)	(0.247)	(0.149)
FDI	0.042***	0.069***	0.076**	0.049***
	(0.015)	(0.016)	(0.034)	(0.011)
KSI	0.335**	-0.058	0.212	0.095
	(0.142)	(0.079)	(0.158)	(0.086)
Constant	-0.757***	-0.550***	-0.593	-0.631***
	(0.129)	(0.126)	(0.355)	(0.092)
Observations	1,403	2,089	262	3,230
R^2	0.329	0.309	0.481	0.299

Standard errors in parentheses

Controls, city and year FE included.

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

6. Conclusion and policy implications

Amid rising global economic uncertainty and the overlapping shocks of the COVID-19 pandemic, enhancing UER through the digital economy has become a key issue in shaping a new development paradigm. This study uses panel data from 281 Chinese prefecture-level cities(2006-2022), treating the NEDC initiative as a quasi-natural experiment. We employ a staggered DID model to identify the causal effect of e-commerce policies on urban economic resilience. Robustness checks are conducted using PSM-DID, DML, and event-study methods.

Findings indicate that the NEDC policy significantly elevates UER, with an average effect of approximately 8.8%, and the dynamic effect peaks about two years after policy implementation. Mechanism analysis shows that the policy operates through three channels: improving GTFP, enhancing RIC, and promoting ISU. Moreover, the policy benefits are more pronounced in non-resource-based cities and non-transport hub cities, reflecting differentiated patterns of “external empowerment” and “internal shock absorption.”

From a policy standpoint, extending the NEDC pilot to non-resource-based and non-national hub cities could yield greater marginal benefits. For resource-based cities, the resilience gains of digital policies are likely to materialize only with support for fiscal capacity building and industrial specialization strategies. Quantitatively, the pilot cities show an average increase of 2.4% in GTFP, 12.7% in per capita authorized patents, and a 5.9 percentage-point increase in the tertiary-to-secondary industry value-added ratio. Accordingly, future central fiscal allocations for demonstration city rewards should set “growth in green patent share” and “industrial structure service-oriented index" as rigid evaluation criteria, rather than relying solely on total patents or e-commerce transaction volume.

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