(2026) 56, 84–123

The Review of Regional Studies

The Official Journal of the Southern Regional Science Association

The Consumption Dividend of Regional Integration: Evidence from the Enlargement of Yangtze River Delta Urban Agglomeration, China*

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Abstract: Applying the time-varying Difference-in-Differences (DID) method, this study explores the impact of the quasi-natural experiment of the two-wave enlargements of the Yangtze River Delta urban agglomeration from 2003 to 2017 in China. We find a positive empirical effect of the enlargement as measured by the increase in a city's consumption. The enlargement creates an increase in consumption by 18.1% in cities within the cluster relative to their non-cluster counterparts. For entrants and incumbents, we find an increase in consumption by 18.7% and 14.6%, respectively. The effect of the enlargement has temporal and city heterogeneities: the entrants benefit prior to the incumbents; cities with better infrastructure, larger scale, and proximity to regional central cities experience greater benefits from the enlargement. Our findings reveal that the enlargement enhances consumption by reducing the three types of administrative border barriers— city, province, and cluster—thereby increasing consumption in cities located along these borders. This study highlights the crucial role of integration in stimulating consumption and provides recommendations for policymakers to unify the domestic market by reducing administrative barriers and encouraging autonomous local practices.

Keywords: enlargement, consumption, border barrier, market segmentation

JEL Codes: F15, R11, R12

1. INTRODUCTION

A number of urban issues, including air pollution, traffic congestion, inefficient land use, and industrial homogenization, have been left behind by China's fast urbanization during the last 40 years, which has seen a significant migration of people from rural to urban regions (Ding and Li, 2022). The Chinese government has used the urban agglomeration plan as a key tactic

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ISSN 1553-0892, 0048-49X (online)

www.srsa.org/rrs

to alter the conventional urbanization pattern (Feng et al., 2023). A collection of nearby cities encircling two or more main cities is sometimes referred to as an urban agglomeration (Hall and Pain, 2006). The cluster's cities are intricately linked by population agglomeration, transit connectivity, and industrial synergy. Overcoming administrative border barriers that have long impeded the creation of a domestic united market, China's cross-regional urban agglomeration design has even evolved into a purposeful policy tool rather than a natural progression toward regional integration.[1]

An important part of the Yangtze River Delta's integration project is the Urban Economic Coordination Committee (UECC), a regional economic coordination agency created by local governments (Zhao et al., 2021). The tremendous enlargement of the UECC offers a fresh assessment of integration and a great platform to investigate its consequences, despite the fact that the integration process is hard to detect due to its continuity and durability, offering a serious difficulty for empirical study.

The shrinking of overseas market demand, rising trade frictions, and fierce geopolitical competition between China and the U.S. have led the Chinese government to recognize the importance of leveraging the domestic market's potential. Stimulating domestic consumption is regarded as an optimal replacement for the overseas market; however, the existence of domestic market segmentation due to administrative divisions largely prevents the enhancement of consumption. A systematic examination of whether the force of regional integration increases consumption is of great value for both policymakers and market participants.

The current studies have explored the drivers of regional consumption in terms of economic growth, liquidity constraints, and population structure (Gross and S., 2002; Modigliani and Cao, 2004; Horioka and Wan, 2007), and household consumption from fertility intervention, mitigation choice, and social network (Yang et al., 2021; Hao and Tang, 2023; Vatsa et al., 2023). However, the determinants of consumption regarding regional market access are limited. As a main driver of market segmentation, the border barrier widely exists and contributes to a key obstacle for regional economic development (Obstfeld et al., 2000). The border barrier increases trade costs and suppresses cross-regional business, leading to an expansive disparity between regions (Ahlfeldt et al., 2015). In response to eliminate this barrier, the integration policy has been widely adopted in practice. Relevant studies have examined the economic effect of integration pushed by multinational organizations in participating countries (Moritz and Gröger, 2007; Braakmann and Vogel, 2011; Brakman et al., 2012). However, the border barrier within a country presents an additional challenge. Notably, local protectionism measures are widely conducted by local governments in China due to horizontal competition, leading the administrative border barrier to be a major obstacle to a domestic unified market (Yang and Ye, 2016).

To address market segmentation and stimulate domestic consumption, both central and local governments implemented a series of regional integration policies. Several empirical studies have demonstrated that certain integration policies influence regional economic growth and enterprise production activity (Ke, 2015; Hong et al., 2019; Gunessee and Zhang, 2022; Tu et al., 2023). However, the effect of integration on consumption growth remains un-

[1]In 2000, the proportion of the urban population in China was 36.2%, while by 2021 it reached 64.7%, with an average annual growth rate of 2.8%. Data source: China National Bureau of Statistics.

clear, and the role of urban agglomeration enlargement in the integration process has received limited attention. The most relevant studies to this work are Liu and Chang (2021). While they examined the impact of integration on specific economic aspects in the Yangtze River Delta, such as land use and innovation, they did not investigate its effect on consumption or the importance of reducing border barriers for consumption stimulation.

In this paper, based on the quasi-natural experiment of the enlargement of the UECC and employing the time-varying difference-in-differences (DID) method, we examine the effect and mechanism of integration on consumption in the Yangtze River Delta from 2003 to 2017. Our findings indicate that the enlargement leads to an 18.1% increase in consumption for cities within the cluster compared to their non-cluster counterparts. For entrants and incumbents, we observe consumption increases of 18.7% and 14.6%, respectively. The effect of the enlargement exhibits temporal and city-level heterogeneity: entrants benefit prior to the incumbents, while cities with better infrastructure, larger scale, and proximity to regional central cities experience greater benefits from the enlargement. Our results demonstrate that the enlargement promotes consumption by successfully reducing three types of administrative border barriers—province, region, and city—thereby stimulating consumption in cities located along these borders.

Given the focus on the Yangtze River Delta, we also contribute to the literature favoring the causes and sources of integration by taking the enlargement of urban agglomeration as a real integration process. Different from studies focusing on the effects of integration across countries, we explore the welfare effects of domestic integration. As urban agglomeration has become a new pattern of regional integration in China, its diverse outcomes remain to be further explored.

Finally, our work sheds light on the connection between integration and economic performance from a novel perspective of three types of administrative border barrier reductions. The natural border barrier, like distance, has been analyzed by previous studies. However, we propose that the administrative border contributes to regional market segmentation with the dimensions of cluster, province, and city, and we examine the impact of integration on administrative border barriers by observing the variation of either price or consumption in cities located at these borders. Numerous measurements have been applied to calculate the border barrier and market segmentation (Gunessee and Zhang, 2022). However, there is still a lack of quantitative evidence directly providing the causality between integration and administrative border barriers, and whether consumption will increase with border barrier reduction remains unclear. In the context of China, known for its widespread existence of administrative border barriers, it is attractive for scholars to examine the benefits measured by an increase in consumption due to the barrier dropping.

The remainder of this paper is structured as follows. Section 2 summarizes the policy background of the UECC's enlargement. Section 3 presents a theoretical framework to analyze the causal relationship between integration and consumption. Section 4 introduces the primary empirical specification. Section 5 discusses the estimation results. Section 6 concludes and offers policy recommendations.

2. POLICY BACKGROUND

The Yangtze River Delta region encompasses four provinces/municipalities (Shanghai, Jiangsu, Zhejiang, and Anhui) situated in the estuary delta of the lower Yangtze River basin, exhibiting the highest levels of urbanization, industrialization, population density, and regional integration. However, its current high degree of integration results primarily from policy orientation rather than natural evolution. In reality, market segmentation has persisted in the Yangtze River Delta for an extended period, creating challenges for transport infrastructure development in border areas.

For instance, Yixing, a county-level city under the jurisdiction of Wuxi, is not geographically contiguous with Wuxi. The highway connecting them passes through Wujin, a district administered by Changzhou. Observations indicate that the road quality in the Wujin section is markedly inferior to that in the Wuxi section. Similarly, a segment of the highway linking Changzhou and Zhangjiagang (a county-level city under Suzhou) traverses Jiangyin (a county-level city under Wuxi), where the road quality is also notably substandard.

As the leading city in the Yangtze River Delta, Shanghai faces competitive pressures from Zhejiang and Jiangsu, with Suzhou emerging as its strongest rival. In 2003, Shanghai established three industrial parks in its southern region (adjacent to Suzhou) under the "173 Plan," implementing preferential policies in these areas. This initiative was widely perceived as a defensive measure to prevent investment projects from relocating to Suzhou. In response, Suzhou proposed enhancing business service capabilities in its subordinate regions—Kunshan, Taicang, and Wujiang (all adjacent to Shanghai)—and positioning these areas as "bridgeheads" to compete with Shanghai.

Local governments began spontaneously exploring integration pathways in 1992. An economic cooperation committee was established by 14 cities to promote regional cooperation, assistance, and governance. In 1997, these cities, along with the newly established Taizhou (Jiangsu), formed a new cross-regional coordination organization: the UECC. In 2003, Taizhou (Zhejiang) was admitted as a new member, bringing the UECC's membership to 16, where it remained stable until 2010.

In 2010, the UECC underwent its first large-scale enlargement, admitting six new member cities. Prior to this expansion, the UECC had only included cities within Shanghai, Zhejiang, and Jiangsu; however, this wave incorporated two entrants from Anhui (Hefei and Ma'anshan). In 2013, the UECC expanded again, admitting eight additional cities, increasing its membership to 30. Further enlargements occurred in 2018 and 2019, ultimately encompassing all cities within the four provinces/municipalities (see Figure 1 and Table 1).

The UECC aims to reduce regional market segmentation and enhance economic development among its member cities. Its operational model reflects an integration mechanism consisting of four key forms:

a) Holding an annual meeting convening all members to discuss a hot topic.

b) Establishing regular themes to provide guidance for regional cooperation.

c) Establishing cutting-edge topics to provide direction for future economic cooperation.

d) Signing cooperation agreements between members to implement cooperative projects.

For instance, the theme of the 13th meeting in 2013 focused on "New dividends of integrated development in the Yangtze River Delta urban agglomeration: innovation, green, and convergence". The 10th meeting in 2010 introduced three new themes: medical insurance cooperation, financial cooperation, and development cooperation. At the 12th meeting in 2012, ten topics were established, including the patent application cooperation system. At the 15th meeting in 2015, the Agreement on Urban Cooperation in the Yangtze River Delta Region (Ma'anshan) was signed. The operational mechanism emphasizes consultation and collaboration among the member regions, institutionalizing cooperation through a stable organizational framework. These mechanisms are expected to positively influence integration, significantly mitigating the risk of zero-sum competition. Consequently, we consider the members of the UECC as the delineation of the Yangtze River Delta urban agglomeration.

Particularly, the composition of the UECC members adheres to the principles of geographical proximity. Furthermore, the spatial process of the UECC enlargement progresses sequentially from central cities, such as Shanghai, Nanjing, and Hangzhou, to peripheral areas. Despite the higher economic development levels of some cities, such as Wenzhou and Lianyungang, they were not included in the UECC during the first wave of enlargement. In summary, geographic location, rather than economic performance, determines membership status. Therefore, we utilize the two enlargements in 2010 and 2013 as a quasi-natural experiment to examine the impact of integration on urban consumption. Moreover, we analyze the heterogeneous effects of enlargement on consumption. Additionally, we investigate the mechanism of enlargement by exploring the relationship between the reduction of border barriers—measured at the provincial, cluster, and city levels—and consumption.

Figure 1: The Enlargement Process of the UECC

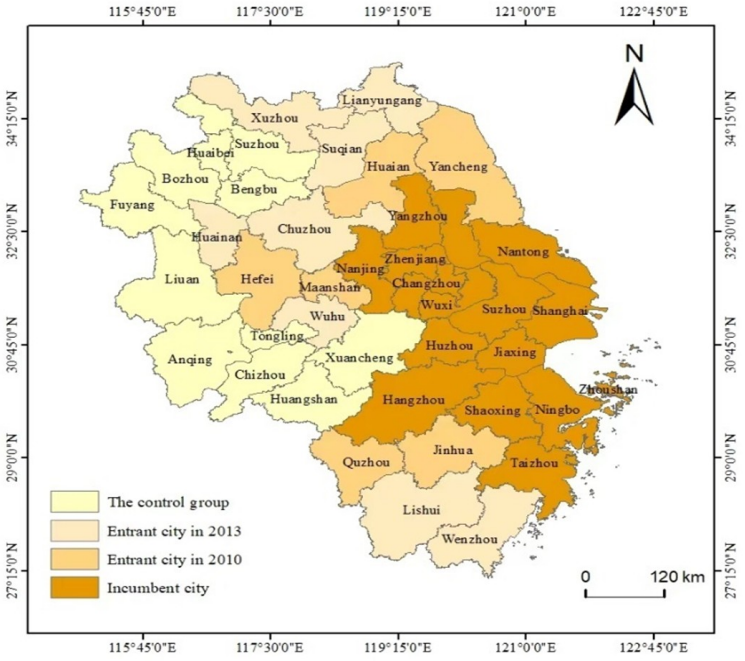


Table 1: Four Waves of the UECC Enlargement

Waves	Year	Number of cities: List of cities
0th	2003	16 : Shanghai, Wuxi, Changzhou, Nantong, Hangzhou, Jiaxing, Huzhou, Ningbo, Shaoxing, Zhoushan, Yangzhou, Nanjing, Zhenjiang, Taizhou (Jiangsu), Taizhou (Zhejiang), Suzhou (Jiangsu)
1st	2010	6 : Hefei, Yancheng, Ma'anshan, Jinhua, Huai'an, Quzhou
2nd	2013	8 : Wuhu, Xuzhou, Chuzhou, Huainan, Lishui, Suqian, Wenzhou, Lianyungang
3rd	2018	4 : Anqing, Chizhou, Tongling, Xuancheng
4th	2019	7 : Huangshan, Bengbu, Lu'an, Huaibei, Bozhou, Fuyang, Suzhou (Anhui)

3. THEORETICAL FRAMEWORK

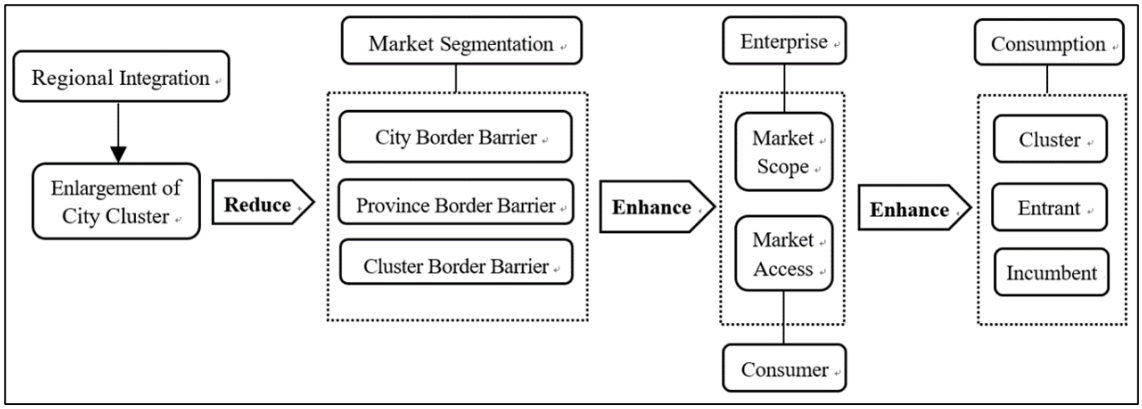
The new geographical economics theory emphasizes the role of location choice in firms' cross-regional decision-making (Helpman, 1998; Redding and Sturm, 2008). Location choice entails distinct costs, resulting in significantly different economic activities on either side of a border (Wolf, 2000; Eberhardt et al., 2016). Previous studies on trade liberalization demonstrate the positive implications of reducing borders between countries; however, the persistent existence of border effects within a country remains a notable phenomenon. Internal border barriers increase trade costs for firms operating across regions and constrain the diversification of consumption choices (Gunessee and Zhang, 2022). These barriers contribute to market segmentation and limit consumption potential. In the context of China, urban agglomeration designs—encompassing multiple provincial administrative regions—provide an effective solution for integration. This approach is expected to reduce administrative border barriers across multiple dimensions, including clusters, provinces, and cities.

The reduction of border barriers stimulates domestic consumption through two micro-mechanisms: (1) expanding the market scope for enterprises engaged in cross-regional operations, and (2) increasing consumer market access. First, border barriers prevent enterprises from selling their products to potential new markets. As a typical barrier, local protectionism restricts the activities of non-local firms through a series of discriminatory practices. Consequently, enterprises lose potential new markets due to limited market scope. Eliminating border barriers benefits cross-regional enterprises by expanding their market reach.

Second, consumer market access increases as border barriers are reduced. Consumers benefit from greater product diversity resulting from reduced barriers, while more goods produced by non-local enterprises enter local markets, leading to lower prices due to intensified competition. Ultimately, enhanced market access benefits local consumers by expanding product variety and reducing transaction costs.

Specifically, we propose that the enlargement can reduce three types of administrative border barriers, ultimately enhancing consumption (see figure 2). First, as a basic goal, it reduces border barriers between cities through various policy arrangements among local governments. Thus, the trade cost of inter-city transactions decreases for enterprises and fa-

Figure 2: Theoretical Framework



cilitates cross-city consumption for consumers. Second, it reduces provincial border barriers. Since urban agglomerations span multiple provincial administrative regions, coordination mechanisms and policy synergies will help reduce market segmentation across provinces. Cities located at provincial borders are expected to benefit from the reduction of provincial border barriers due to the enlargement. Third, the enlargement reduces cluster border barriers. Although the formation of an urban agglomeration creates a cluster border, the Yangtze River Delta urban agglomeration has experienced four enlargement waves, continually absorbing cities outside the cluster. The original cluster border disappears with the enlargement, and cities located at this border are particularly expected to benefit from it. Hypotheses 1–3 are proposed as follows.

Hypothesis 1 The enlargement reduces city border barriers and enhances consumption in cities within the cluster relative to their non-cluster counterparts.

Hypothesis 2 The enlargement reduces provincial border barriers, and consumption in cities located at provincial borders is expected to increase.

Hypothesis 3. The enlargement reduces cluster border barriers, and consumption in cities located at cluster borders is expected to increase.

The center-periphery theory posits that agglomeration forces increase the disparities between central and peripheral cities, whereas spreading forces reduce these disparities. Consequently, the welfare outcome of integration is determined by the relative benefits experienced by central and peripheral cities (Krugman, 1991; Krugman and Venables, 1995). Spreading forces lead to consumption creation, resulting in an expansion of consumption flows for both entrants and incumbents, while agglomeration forces cause consumption transfer, increasing consumption flows for incumbents but reducing them for entrants. Hypothesis 4 is proposed as follows.

Hypothesis 4. The creation effect resulting from the enlargement enhances consumption in both entrants and incumbents, whereas the transfer effect reduces consumption in entrant cities and increases it in incumbent cities.

4. METHODOLOGY

4.1. Empirical model

We examine the impact of the UECC's enlargement on consumption by employing the time-varying difference-in-differences (DID) method. The estimation equation is specified as Equation (1), where C_{it} represents the scale of consumption in city i during year t. This indicator measures the consumption level within each city and directly reflects changes in regional market segmentation and border barriers, making it a suitable variable for analyzing the effects of economic integration. The dummy variable Enl_{it} denotes the treatment group after the enlargement shock. Both the 16 incumbent cities and the 14 entrant cities are classified as the treatment group. Specifically, $Enl_{it} = 1$ if a city belongs to the treatment group after enlargement, whereas $Enl_{it} = 0$ for cities outside the enlargement scope or during the pre-enlargement period.

The vector X_{it} includes a set of city-level control variables. δ_i represents city fixed effects, capturing time-invariant city-specific characteristics, while δ_t represents year fixed effects, accounting for time-specific trends common across cities. α is the constant term, and ε_{it} is the stochastic error term, capturing the influence of unobserved factors. The primary coefficient of interest is β, which, consistent with the theoretical hypothesis, is expected to be statistically significant and positive.

$$C_{it} = \alpha + \beta\, Enl_{it} + \gamma X_{it} + \delta_i + \delta_t + \varepsilon_{it} \tag{1}$$

4.2. Variables

4.2.1. Core independent variable

As Enl_{it} is the core independent variable, the value of this binary indicator is determined by the actual enlargement process of the UECC. In 2010 and 2013, the UECC underwent its first two waves of enlargement; by 2017, it included a total of 30 cities (and 41 cities in the broader Yangtze River Delta region). We treat the first two enlargement waves as a quasi-natural experiment to examine the effects of integration policy.

The UECC was established in 1998. After Taizhou (Zhejiang) joined in 2003, its membership remained stable at 16 cities until the first enlargement in 2010. Thus, we classify these 16 cities as the incumbent members. In 2010 and 2013, 6 and 8 cities were added to the cluster, respectively, and these 14 cities are designated as the entrant members. In the empirical design, both incumbent and entrant cities are assigned to the treatment group, while the remaining 11 cities not included in either enlargement wave serve as the control group.

4.2.2. Dependent variable

The city's consumption (C) is measured by the total retail sales of consumer goods. This indicator effectively captures the transaction activity of tradable goods within a region and is widely recognized as a proxy for the scale of consumption (Ding and Li, 2022). We calculate

both the natural logarithm and per capita values of this measure. For robustness testing, sales from wholesale and retail trade above the designated threshold serve as an alternative proxy indicator of consumption. This measure includes enterprises engaged in wholesale and retail activities with annual business revenues exceeding 5 million RMB.

4.2.3. Control variables

According to recent studies (Ding and Li, 2022; Yang and Wang, 2023), the control variables are established as follows: (1) Population density (Den), which measures market potential and directly influences consumption, is expressed as the number of inhabitants per unit of administrative area. (2) Per capita output (GDP), which measures the economic development level, is represented by per capita real GDP. (3) Investment (Inv) enhances consumption potential by stimulating economic growth, though a substitution effect between investment and consumption exists. This indicator is fixed asset investment, used to measure infrastructure development. (4) Fiscal expenditure (Fis) captures the effect of public sector purchases on consumption and is represented by general government budget expenditures. (5) Employee wage level (Wag) influences consumption through its effect on resident income and is calculated as the average staff wage.

In examining the heterogeneous effects of integration, we focus on urban structure by using infrastructure, city size, and distance to regional central cities as proxy indicators (Section 5.3). To assess the impact of enlargement on city border barriers, we construct an index of market segmentation between cities (Seg), discussed in detail in Section 5.4.3.[2]

4.3. Data

The dataset is derived from the *China City Statistical Yearbook*, the statistical yearbooks of individual cities, and the statistical bulletins issued by local governments. Information regarding the enlargement waves of the UECC is obtained from news releases by official media sources. After incorporating Taizhou (Zhejiang) in 2003, the membership of the UECC remained unchanged until 2010; therefore, the starting point of the sample is set at 2003. In 2018 and 2019, the UECC underwent its final two waves of enlargement. Following the 2019 enlargement, the UECC encompassed all cities in the Yangtze River Delta, resulting in the disappearance of the control group. The sample cutoff is set at 2017 to ensure an adequate number of control samples for observation, while also allowing for the effects of the second enlargement wave in 2013 to be observed for at least five years post-enlargement. All nominal price indicators are uniformly adjusted to real prices using city-level consumer price indices (CPI), with 2003 as the base period.

4.4. Descriptive statistics

The summary descriptive statistics of the variables are presented in Table 2. The variable correlation matrix is displayed in Table 3. The correlations between the dependent variables and the main control variables remain significant at the 1% level. This indicates that the control variables provide a robust explanation for the dependent variable, facilitating the

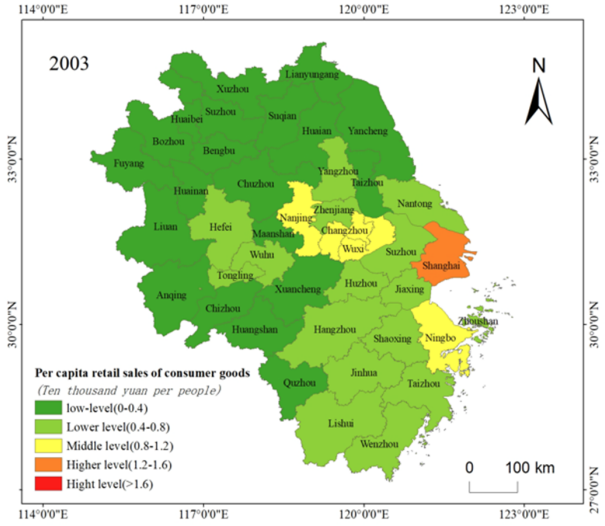
[2]The cities in the control group include Bengbu, Huaibei, Tongling, Anqing, Huangshan, Fuyang, Suzhou (Anhui), Lu'an, Bozhou, Chizhou, and Xuancheng. All of these cities are located in Anhui Province.

identification of the net effect of the core independent variable. The general spatial relationship between enlargement and consumption in the Yangtze River Delta is shown in Figure 3.

To control for the contribution of population growth, we use per capita total retail sales of consumer goods as the indicator of the consumption level. Four key years are selected for observation: 2003, 2010, 2013, and 2017. The spatial distribution of consumption is categorized into five levels: low, lower-middle, middle, upper-middle, and high, where darker colors represent higher consumption levels.

Although the initial consumption level was low in most cities except Shanghai in 2003, a significant increase occurred within the urban cluster during the enlargement process in 2010 and 2013. Notably, the spatial expansion pattern of consumption is largely consistent with the enlargement of the UECC. By 2017, the consumption level had reached a high level within the cluster, while most cities with lower consumption levels were located outside the cluster. These spatial dynamics suggest a positive effect of the UECC enlargement on consumption, which will be systematically examined in the following section.

Figure 3a: Distribution of Consumption in 2003



5. EMPIRICAL RESULTS

5.1. Benchmark test

We first examine the impact of the UECC's enlargement on consumption within the cluster. Subsequently, we analyze sub-samples of entrant and incumbent cities. Using Equation 1 for estimation, the results are presented in Table 4. Columns (1)–(3) report estimates without control variables, while Columns (4)–(6) include control variables. All estimates incorporate year and city fixed effects. The results in Column (4) indicate that, compared with cities outside the cluster, the enlargement significantly increases consumption within the cluster,

Table 2: Summary of Variables

Variable	Definition (unit)	Obs.	Max.	Min.	Ave.	Std.
lnC1	Total retail sales of consumer goods in natural logarithm (100 million CNY)	615	9.021	3.212	5.961	1.109
perC1	Per capita total retail sales of consumer goods (10,000 CNY/person)	615	4.496	0.119	1.208	0.848
lnC2	Sales of wholesale and retail trade above the quota in natural logarithm (100 million CNY)	615	11.107	2.213	5.964	1.667
C3	Number of enterprises engaged in wholesale and retail trade above the quota (1,000)	615	7.410	0.008	0.758	1.120
Enl	Enlargement of the UECC (dummy variable)	615	1	0	0.351	0.477
Border_1	Whether a city is located at the provincial border (1=yes, 0=no)	615	1	0	0.488	0.500
Border_2	Whether a city is located at the cluster border (1=yes, 0=no)	615	1	0	0.463	0.499
Den	Population per unit of administrative area (10,000 persons/km^2)	615	0.383	0.012	0.070	0.051
lnGDP	City's gross domestic product in natural logarithm (CNY)	615	11.618	7.861	10.189	0.753
lnInv	Amount of fixed asset investment in natural logarithm (100 million CNY)	615	8.530	3.593	6.532	1.066
lnFis	Government general budget expenditures in natural logarithm (100 million CNY)	615	8.571	2.219	4.937	1.084
lnWage	Average wage of staff in natural logarithm (CNY)	615	11.423	8.987	10.270	0.470
Seg	Market segmentation index	615	0.007	0.000	0.002	0.001
Inf	Density of highway (km/km^2)	615	2.249	0.257	1.172	0.428
lnSca	Total permanent population in natural logarithm (10,000 persons)	615	7.794	4.248	6.039	0.660
Dis	Reciprocal of distance to central cities (100 km)	570	2.164	0.290	0.801	0.482

Note: Each column displays the number of observations, maximum value, minimum value, mean, and standard deviation.

Table 3: Variable Correlation Matrix

Variables	lnC1	lnC2	Den	lnGDP	lnInv	lnFis	lnWage	Inf
lnC2	0.950***							
Den	0.546***	0.590***						
lnGDP	0.748***	0.781***	0.376***					
lnInv	0.931***	0.895***	0.447***	0.833***				
lnFis	0.934***	0.897***	0.536***	0.738***	0.934***			
lnWage	0.698***	0.699***	0.290***	0.832***	0.787***	0.798***		
Inf	0.514***	0.488***	0.486***	0.563***	0.613***	0.580***	0.606***	
lnSca	0.728***	0.640***	0.509***	0.130***	0.566***	0.643***	0.133***	0.227***

Note: ***, **, * denote significance at the 1%, 5%, and 10% levels, respectively.

Figure 3b: Distribution of Consumption in 2010

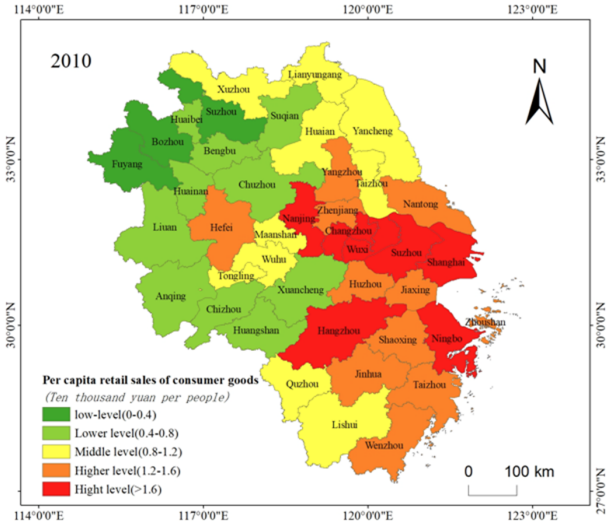


Figure 3c: Distribution of Consumption in 2013

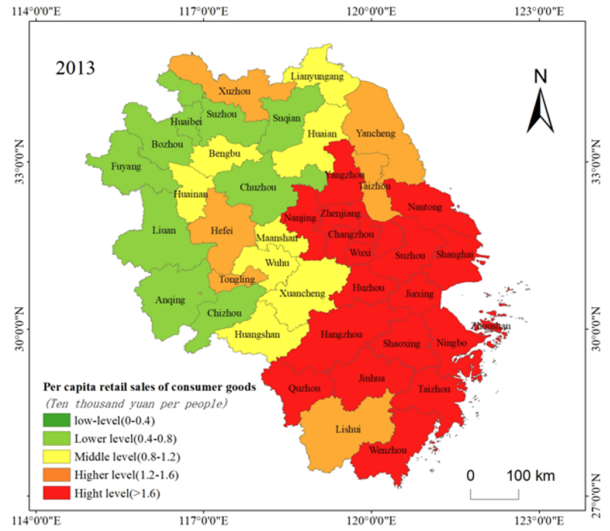
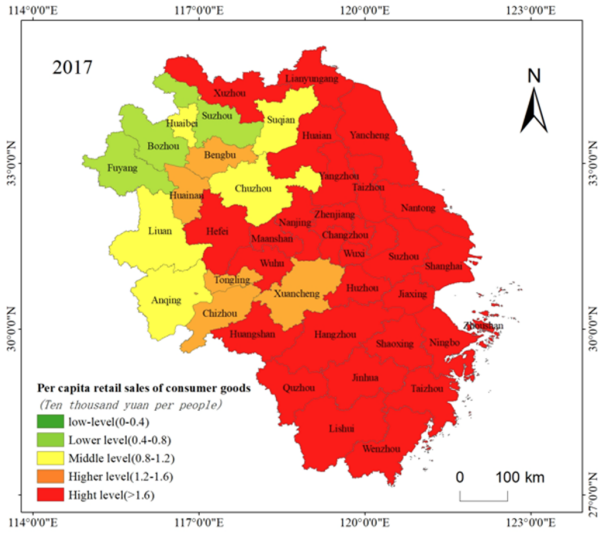


Figure 3d: Distribution of Consumption in 2017



demonstrating that integration fosters greater consumption. Columns (5)–(6) show that this positive effect applies to both entrant and incumbent cities, with no evidence of consumption transfer between them. In the absence of absolute agglomeration or spreading forces, participants broadly benefit from increased consumption resulting from the enlargement.

Table 4: Benchmark Tests

Variables	(1) cluster	(2) entrant	(3) incumbent	(4) cluster	(5) entrant	(6) incumbent
Encl	0.966***	1.015***	0.925***	0.181***	0.187***	0.146***
	(0.022)	(0.038)	(0.020)	(0.032)	(0.034)	(0.036)
Control	N	N	N	Y	Y	Y
Year FE	Y	Y	Y	Y	Y	Y
City FE	Y	Y	Y	Y	Y	Y
R^2	0.521	0.398	0.423	0.959	0.960	0.965
Obs.	615	375	405	615	375	405

Note: Significant at *** 1%, ** 5%, and * 10%; robust standard errors clustered at the city level are reported in parentheses. Year FE denotes year fixed effects, and City FE denotes city fixed effects. The dependent variable is calculated as the natural logarithm of total retail sales of consumer goods. The same applies below.

5.2. Robustness tests

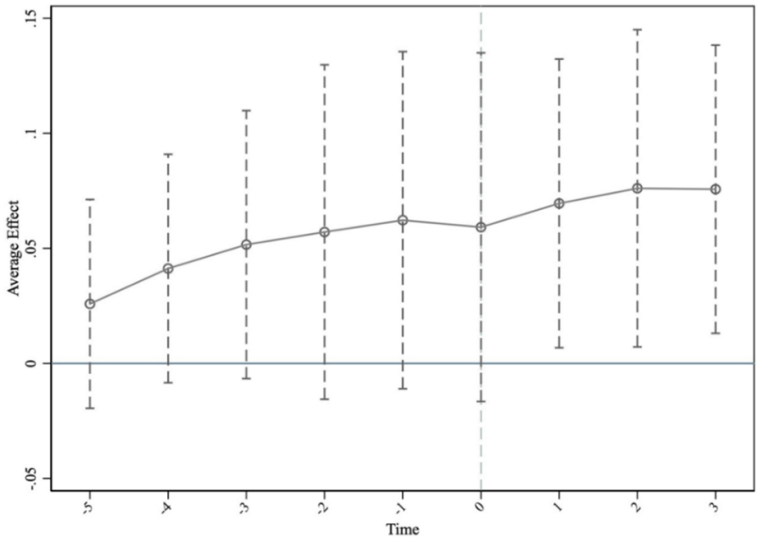
5.2.1. Parallel trends test and sample self-selection

The parallel trends test is presented in Figure 4, which largely satisfies the assumption. Additionally, if the enlargement resulted from self-selection, it could introduce estimation bias. However, the enlargement constitutes an exogenous shock unrelated to consumption

transfer. As the UECC establishes a geographical proximity principle for entrant admission requirements, the actual enlargement direction aligns with geographical proximity.

Another consideration is that entrants located near the three major regional central cities—Shanghai, Hangzhou, and Nanjing-may exhibit higher consumption levels due to spillover effects. Conversely, potential agglomeration forces could divert consumption toward these central cities, reducing consumption among entrants. Thus, proximity to incumbents does not necessarily lead to an increase or decrease in consumption. Overall, there is no substantial evidence of sample self-selection in the enlargement process.[3]

Figure 4: Parallel Trend Test Diagram (Significant at 1%).



5.2.2. Alternative Variables

We adjust the dependent variable to the logarithm of wholesale and retail trade sales above the quota and the number of enterprises engaged in wholesale and retail trade, respectively. These two indicators measure the scale of consumption driven by large-scale enterprises. The estimation results are presented in Table 5a. The enlargement increases consumption measured by sales above the quota for both the cluster and incumbent firms, and it also raises the number of enterprises engaged in consumption within the cluster, entrant, and incumbent categories.

Additionally, we use per capita total retail sales of consumer goods and their proportion to GDP as dependent variables. The former indicator measures consumption levels after controlling for population size. The latter dependent variable, expressed as a proportion of GDP, examines the impact of enlargement on consumption's contribution to total output. The estimation results are presented in Table 5b. The enlargement significantly enhances per capita consumption growth within the cluster, entrant, and incumbent categories; it also increases the share of consumption in total output for both the cluster and entrant firms.

[3]The estimation model for this parallel trend test is presented in Appendix A

These results align with the benchmark estimation.[4]

Table 5a: Alternative Dependent Variables (I)

Variables	(1) Cluster	(2) Entrant	(3) Incumbent	(4) Cluster	(5) Entrant	(6) Incumbent
Enl	0.145**	0.104	0.163**	0.340***	0.297***	0.388**
	(0.060)	(0.076)	(0.077)	(0.095)	(0.085)	(0.178)
Control	Y	Y	Y	Y	Y	Y
Year FE	Y	Y	Y	Y	Y	Y
City FE	Y	Y	Y	Y	Y	Y
R^2	0.864	0.845	0.861	0.499	0.404	0.545
Obs.	615	375	405	615	375	405

Note: The dependent variables in columns (1)–(3) are measured as the logarithm of sales from wholesale and retail trade establishments exceeding the designated threshold. The dependent variables in columns (4)–(6) are measured as the count of enterprises engaged in wholesale and retail trade that surpass the threshold.

Table 5b: Alternative Dependent Variables (II)

Variables	(1) Cluster	(2) Entrant	(3) Incumbent	(4) Cluster	(5) Entrant	(6) Incumbent
Enl	0.181***	0.187***	0.146***	0.026***	0.028**	0.018
	(0.032)	(0.034)	(0.036)	(0.009)	(0.013)	(0.012)
Control	Y	Y	Y	Y	Y	Y
Year FE	Y	Y	Y	Y	Y	Y
City FE	Y	Y	Y	Y	Y	Y
R^2	0.959	0.960	0.965	0.421	0.385	0.460
Obs.	615	375	405	615	375	405

Note: Dependent variables in columns (1)–(3) are per capita total retail sales of consumer goods in logarithm. Dependent variables in columns (4)–(6) are the proportion of total retail sales of consumer goods to GDP.

5.2.3. Alternative control group

Based on geographical proximity and comparability, we initially used 11 cities in Anhui Province as the control group in our baseline test, as they generally conform to the criteria of geographical proximity and similar economic development levels. In this section, we employ 11 cities in Jiangxi Province as the control group. This adjustment offers several advantages for identification. First, cities in Jiangxi have been largely unaffected by urban agglomeration policy shocks. Among neighboring provinces of the Yangtze River Delta, Shandong implemented the Shandong Peninsula urban agglomeration plan in 2011, designating Qingdao and Jinan as central cities. Fujian launched the West Coast of the Strait urban

[4]Additional robustness tests employing the staggered difference-in-differences method following Callaway and Sant'Anna (2021) presented in Appendix B.

agglomeration in 2009, with Fuzhou and Xiamen as central cities. Hubei proposed its urban agglomeration plan centered around Wuhan in 2007. Although the central government's 2015 Middle Reaches of the Yangtze River urban agglomeration plan included some Jiangxi cities, this top-down design may not have elicited strong local government response. Furthermore, Jiangxi cities remained unaffected by this policy for most of our sample period. Second, Jiangxi demonstrates strong comparability with Anhui in terms of economic development level, population size, and administrative structure. These factors suggest that Jiangxi cities largely satisfy the requirements for an appropriate control group. The estimation results are presented in Table 6, showing that the enlargement has a significant positive effect on consumption for both cluster participants and non-participants. Additional robustness tests using different spatial buffers are provided in Appendix 6.

5.2.4. Deleting the regional central cities

Since regional central cities have advantages in obtaining better resources than others, there is a tendency for core economic resources—such as population, employment, and industry—to be disproportionately allocated toward these cities, though quantifying this effect is challenging. To examine whether the observed impact of enlargement is primarily driven by regional central cities, we sequentially remove four cities from the sample. The excluded cities are Shanghai, Nanjing, Hangzhou, and Hefei, all of which are either provincial capitals or municipalities directly under the central government. Shanghai is first excluded from the estimation, followed by Nanjing, Hangzhou, and Hefei. As shown in Table 7, after removing these regional central cities, the effect of enlargement on consumption remains stable compared to the benchmark results. This finding also indicates that the impact of integration is not confined to regional central cities.

Table 6: Alternative Control Group

	(1)	(2)	(3)	(4)	(5)	(6)
Variables	Cluster	Entrant	Incumbent	Cluster	Entrant	Incumbent
Enl	0.191***	0.190***	0.146***	0.535***	0.425***	0.710***
	(0.031)	(0.031)	(0.028)	(0.063)	(0.065)	(0.091)
Control	Y	Y	Y	Y	Y	Y
Year FE	Y	Y	Y	Y	Y	Y
City FE	Y	Y	Y	Y	Y	Y
R^2	0.964	0.966	0.974	0.791	0.818	0.811
Obs.	615	375	405	615	375	405

Note: The dependent variables in columns (1) to (3) are measured as the natural logarithm of total retail sales of consumer goods in. The dependent variables in columns (4) to (6) are measured as per capita total retail sales of consumer goods.

Table 7: Deleting the Regional Central Cities

Variables	(1) Cluster	(2) Incumbent	(3) Cluster	(4) Entrant	(5) Incumbent
Enl	0.179***	0.113**	0.179***	0.184***	0.116**
	(0.035)	(0.042)	(0.036)	(0.036)	(0.044)
Control	Y	Y	Y	Y	Y
Year FE	Y	Y	Y	Y	Y
City FE	Y	Y	Y	Y	Y
R^2	0.959	0.968	0.960	0.960	0.968
Obs.	600	390	555	360	360

Note: The estimations in columns (1)–(2) exclude Shanghai and only include the cluster and incumbent cities, as Shanghai belongs to the incumbent group. The estimations in columns (3)–(5) exclude Shanghai, Nanjing, Hangzhou, and Hefei. The dependent variables are calculated using the logarithm of the total retail sales of consumer goods.

5.3. Heterogeneous effect

5.3.1. Temporary heterogeneity

In this section, we examine the heterogeneous impact of the enlargement process on consumption. The core explanatory variable is categorized by assuming that the enlargement persists for 4–7 years, respectively. The positive effect of enlargement on consumption emerges after entrants spend 5 years (as shown in Table 8) and continues to increase annually, which is notably earlier than for incumbents, who require 7 years to benefit (as shown in Table 9). Although all cities within the cluster experience consumption growth due to the enlargement, the increase occurs earlier in entrant cities than in incumbent cities.

Additionally, we employ an event study to illustrate the dynamics of the treatment effect, with results presented in Appendix 6. Comparing different cohorts reveals that the positive effect of enlargement on consumption is greater in entrant cities than in the cluster as a whole. This finding carries significant policy implications. Given that incumbent cities exhibit higher levels of economic development than entrant cities, the latter's greater benefits may facilitate coordinated regional development and provide stronger internal momentum for regional integration.

5.3.2. City character heterogeneities

The fundamental structures of cities contribute to the drivers of consumption. However, it remains uncertain which role these basic structures play in the causal relationship between integration and consumption. Therefore, we examine the heterogeneous effects of three fundamental structures in this section.

We use highway density (Inf), calculated as the ratio of highway mileage to a city's land area, as a proxy indicator for infrastructure quality. Higher infrastructure quality may promote consumption by reducing transportation costs. The second factor is city scale (Sca), measured by the logarithm of permanent population. A larger city has greater market

Table 8: Temporal Heterogeneity of Entrants

Variables	(1) 4th year	(2) 5th year	(3) 6th year	(4) 7th year
Enl	0.041	0.083**	0.106***	0.138***
	(0.025)	(0.032)	(0.029)	(0.028)
Control	Y	Y	Y	Y
Year FE	Y	Y	Y	Y
City FE	Y	Y	Y	Y
R^2	0.952	0.954	0.955	0.957
Obs.	375	375	375	375

Table 9: Temporal Heterogeneity of Incumbents

Variables	(1) 4th year	(2) 5th year	(3) 6th year	(4) 7th year
Enl	-0.015	0.011	0.029	0.066**
	(0.018)	(0.017)	(0.019)	(0.024)
Control	Y	Y	Y	Y
Year FE	Y	Y	Y	Y
City FE	Y	Y	Y	Y
R^2	0.960	0.960	0.960	0.961
Obs.	405	405	405	405

potential, which is associated with consumption growth. The third factor is the reciprocal of distance to regional central cities (Dis), represented by the geographic distance between each city and the three regional central cities (Shanghai, Nanjing, and Hangzhou).

Importantly, these fundamental structures change slowly or remain constant during the sample period, suggesting they are largely unaffected by integration shocks. Thus, we incorporate interaction terms between enlargement and the three fundamental structures ($Enl \times Inf$, $Enl \times Sca$, $Enl \times Dis$) into Equation (2) to measure these heterogeneous effects:

$$C_{it} = \alpha + \beta Enl_{it} \times H_{it} + \gamma X_{it} + \delta_i + \delta_t + \varepsilon_{it} \tag{2}$$

where H quantifies the heterogeneous type of city; other variables are set the same in Equation 1. As shown in Table 10- Table 11-Table 12, the interaction coefficients are significantly positive. The effect of the enlargement on consumption is stronger in cities with better infrastructure, larger scale, and closer proximity to regional central cities. However, infrastructure conditions may change more easily relative to population and geography, which could introduce collinearity and threaten the validity of our estimates. We further examine the potential causal effect of the enlargement on infrastructure. The results are presented in Tables E1of Appendix 6. These results indicate that the enlargement does not directly contribute to the expansion of infrastructure construction or enhance the utilization ratio of infrastructure. The reason lies in the fact that infrastructure construction often requires

a long time, making it less susceptible to short-term shocks such as integration. This also suggests that consumption in the Yangtze River Delta is primarily constrained by administrative border barriers rather than poor transportation, although the latter is commonly perceived as a determinant due to cognitive bias in existing studies.

Table 10: Heterogeneous Effect: Infrastructure

Variables	(1) Cluster	(2) Entrant	(3) Incumbent
Enl × Inf	0.120***	0.155***	0.072***
	(0.024)	(0.024)	(0.024)
Control	Y	Y	Y
Year FE	Y	Y	Y
City FE	Y	Y	Y
R^2	0.959	0.962	0.963
Obs.	615	375	405

Note: The dependent variables are calculated using the logarithm of total retail sales of consumer goods.

Table 11: Heterogeneous Effect: City Scale

Variables	(1) Cluster	(2) Entrant	(3) Incumbent
Enl × Sca	0.030***	0.030***	0.025***
	(0.005)	(0.006)	(0.006)
Control	Y	Y	Y
Year FE	Y	Y	Y
City FE	Y	Y	Y
R^2	0.960	0.960	0.965
Obs.	615	375	405

Note: The dependent variables are calculated using the logarithm of total retail sales of consumer goods.

5.4. Mechanism: enlargement and border barrier

We examine whether the enlargement helps eliminate the three border barriers in this section. The scholars have applied a serious method to calculate the border barrier, including trade flows-related, capital flows-related, and price-related (Gunessee and Zhang, 2022), but they still fail to quantify the specific benefits from administrative border barrier reduction. Although this border barrier is invisible, the welfare can be observed by the benefits variation of entities located at the border, who should be the direct beneficiaries of integration. Following this guide, we check the consumption variation of cities located at provincial borders and cluster borders, respectively. Then, the two-step method is applied to examine the impact of integration on city border barriers.

Table 12: Heterogeneous Effect: Distance to Regional Central Cities

Variables	(1) Cluster	(2) Entrant	(3) Incumbent
Enl × Dis	0.136***	0.152**	0.079**
	(0.033)	(0.057)	(0.032)
Control	Y	Y	Y
Year FE	Y	Y	Y
City FE	Y	Y	Y
R^2	0.958	0.957	0.967
Obs.	570	375	360

Note: The dependent variables are calculated using the logarithm of total retail sales of consumer goods.

5.4.1. Provincial border barrier

Since the varying-time triple-differences method effectively addresses the potential parallel trends that may exist in the traditional difference-in-differences (DID) approach, we employ the triple-differences method to examine provincial and cluster border barriers. Building on Equation 1, we introduce a dummy variable, $Border$, to construct the triple-differences estimation. This dummy variable represents either the provincial border ($Border_1$) or the cluster border ($Border_2$). If a city is located at a provincial border, $Border_1 = 1$; otherwise, $Border_1 = 0$. Similarly, if a city is located at a cluster border, $Border_2 = 0$; otherwise, $Border_2 = 0$. The equation is specified as follows.

$$C_{it} = \alpha + \beta \left(Enl_{it} \times Border_{it} \right) + \gamma X_{it} + \delta_i + \delta_t + \varepsilon_{it} \tag{3}$$

It should be noted that the location at the provincial border remains stable, while the location at the cluster border changes with the enlargement process. The purpose of employing the triple-differences method in this study is to identify the net effect of the enlargement on consumption in the two types of border cities compared to non-border cities or those outside the enlargement area. Specifically, given that border barriers hinder consumption growth, we adopt the concept of "reverse social engineering" by examining consumption increases in border cities where consumption has been severely constrained by border barriers.

As illustrated in Figure 6, although the provincial border restricts consumption flows in border cities **a** and **b**, integration incorporates these cities into the cluster, thereby eliminating the provincial border. The estimation results, presented in Table 13, demonstrate that the effect of the enlargement on consumption in provincial border cities is significantly positive within the cluster, for both entrant cluster fort cities. This finding indicates that the enlargement stimulates consumption by reducing provincial border barriers, with particularly pronounced benefits for cities located at provincial borders.

Figure 5: Enlargement and Provincial Border

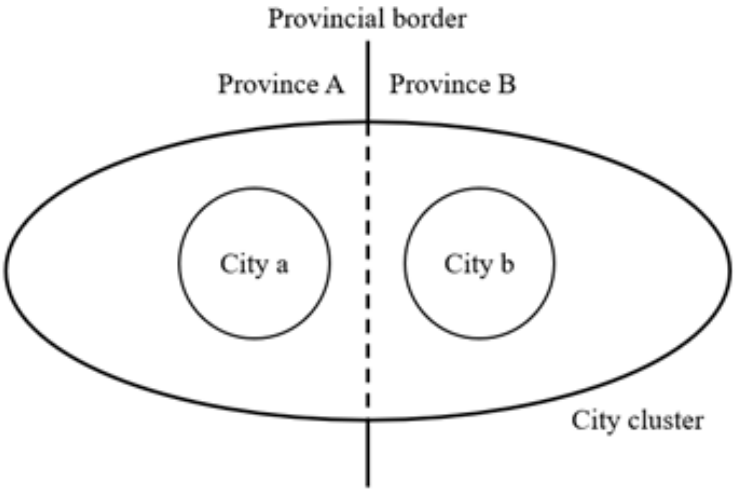


Table 13: Test on Provincial Border Barrier

Variables	(1) cluster	(2) entrant	(3) incumbent	(4) cluster	(5) entrant	(6) incumbent
Enl × $Border_1$	0.134***	0.129**	0.109**	0.394***	0.221*	0.593***
	(0.046)	(0.057)	(0.046)	(0.112)	(0.128)	(0.139)
Control	Y	Y	Y	Y	Y	Y
Year FE	Y	Y	Y	Y	Y	Y
City FE	Y	Y	Y	Y	Y	Y
R^2	0.954	0.954	0.962	0.751	0.750	0.772
Obs.	615	375	405	615	375	405

Note: The dependent variables in columns (1) to (3) are measured by the logarithm of total retail sales of consumer goods. The dependent variables in columns (4) to (6) are measured by per capita total retail sales of consumer goods.

5.4.2. Cluster Border Barrier

As shown in Table 14, compared to cities outside the scope of enlargement or non-border cities, the net effect of enlargement on consumption in cities located on both sides of the cluster border is significantly positive, which holds true within clusters, entrants, and incumbents. Figure 6 illustrates this process, where City **a** is located within the cluster while City **b** is located outside the cluster. The urban agglomeration design creates a border between City **a** and City **b**, and the enlargement process subsequently eliminates this original border. With the disappearance of the former cluster border, consumption flows in cities on both sides of the border expand. Particularly for cities located on both sides of the cluster border, their consumption levels are successfully stimulated by the enlargement.

Figure 6: Enlargement and Cluster Border

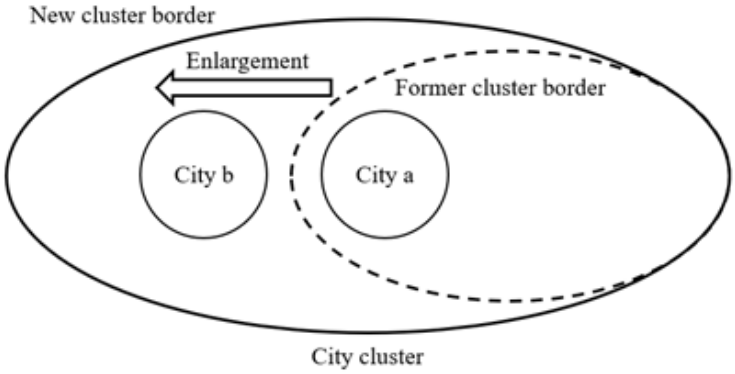


Table 14: Test on Cluster Border Barrier

Variables	(1) Cluster	(2) Entrant	(3) Incumbent	(4) Cluster	(5) Entrant	(6) Incumbent
Enl × $Border_2$	0.145***	0.182***	0.124**	0.363***	0.382***	0.531***
	(0.039)	(0.039)	(0.051)	(0.098)	(0.072)	(0.178)
Control	Y	Y	Y	Y	Y	Y
Year FE	Y	Y	Y	Y	Y	Y
City FE	Y	Y	Y	Y	Y	Y
R^2	0.955	0.959	0.962	0.750	0.798	0.760
Obs.	615	375	405	615	375	405

Note: The dependent variables in columns (1) (3) are measured by the natural logarithm of total retail sales of consumer goods. The dependent variables in columns (4) (6) are measured by per capita total retail sales of consumer goods.

5.4.3. City border barrier

In this section, we construct the market segmentation index (Seg) between cities to represent the city border barrier. This index serves as an intermediary mechanism to examine whether the enlargement promotes consumption by reducing the border barrier. Following the methodology of Morshed (2011) and Elberg (2016), we employ a price-based approach to calculate market segmentation. Based on the law of one price (LOP) and the iceberg cost model, the variance of relative price fluctuations between goods reflects the degree of market segmentation(Poncet, 2006). Although actual price data for various goods at the city level are unavailable, we obtain data on relative price changes for each city. We therefore transform the relative prices logarithmically using the consumer price index (CPI). Due to adjustments in the categories of goods used for CPI calculation during the sample period, we utilize only the composite index as a substitute for the segmented index. The first-order difference of the relative price index ratio between city i and city j in period t is expressed in Equation (4).

$$\begin{aligned}\Delta Q_{(ij,t)} &= \ln\left(\frac{P_{(i,t)}}{P_{(j,t)}}\right) - \ln\left(\frac{P_{(i,t-1)}}{P_{(j,t-1)}}\right) \\ &= \ln\left(\frac{P_{(i,t)}}{P_{(i,t-1)}}\right) - \ln\left(\frac{P_{(j,t)}}{P_{(j,t-1)}}\right)\end{aligned} \tag{4}$$

Since alternating the order of city pairs affects the value of $\Delta Q_{(ij,t)}$, we take the absolute value of $\Delta Q_{(ij,t)}$. Next, we apply $\Delta Q_{(ij,t)}$ for all cities to obtain the average value $\Delta Q^*_{(ij,t)}$; we then subtract $\Delta Q^*_{(ij,t)}$ from $\Delta Q_{(ij,t)}$ to obtain an indicator $q_{(ij,t)}$, which only includes inter-city market segmentation and the random term. We then calculate its variance, $\text{var}(q_{(ij,t)})$, which represents the average market segmentation index between cities in each year, denoted as S_{it}. Because the estimated coefficient is too small to display clearly, we multiply the market segmentation index by 10,000. To avoid collinearity in the standard mediation effect model, we employ a two-step method to examine the mediation mechanism. In the first step, we test the effect of enlargement on market segmentation. In the second step, we examine the effect of market segmentation on consumption. The equations are specified as follows.

$$Seg_{it} = \alpha_1 + \beta_1 Enl_{it} + \gamma_1 X_{it} + \delta_i + \delta_t + \varepsilon_{it} \tag{5}$$

$$C_{it} = \alpha_2 + \beta_2 Seg_{it} + \gamma_2 X_{it} + \delta_i + \delta_t + \varepsilon_{it} \tag{6}$$

Due to the use of price indices to measure market segmentation——with the purpose of eliminating the disturbance of common price variation—the other four control variables adjusted through price indices are excluded in this analysis. Consequently, only population density is controlled. As shown in Table 15, the coefficients of interest, β_1 and β_2, are both significantly negative, indicating the presence of a mediation effect. This effect holds for clusters, entrants, and incumbents. The results reveal that enlargement reduces market segmentation between cities [Columns (1)–(3)], and the decline in market segmentation further enhances consumption [Columns (4)–(6)]. These findings suggest that enlargement indeed enhances consumption by reducing barriers at city borders.

5.5. Discussion: Urban agglomeration plan with autonomous local practices

Experimentation has been widely applied to public policies in China. In particular, the urban agglomeration plan represents a typical top-level design implemented by the central government. The procedure is initially drafted by the National Development and Reform Commission and the Ministry of Land and Resources; subsequently, it is submitted to the State Council for formal approval, which officially marks its implementation. Given that urban agglomerations typically span multiple provinces, it is impractical for a single province or city to plan them independently. Under this top-level design framework, local governments function as policy executors rather than policymakers, and this role misalignment may lead to incentive deficiencies. Although the centrally designed urban agglomeration aims to achieve regional integration, it remains uncertain whether it genuinely aligns with local interests. Clearly, the conflict between central objectives and local demands could undermine the outcomes of such experimentation.

Table 15: Test on City Border Barrier

Variables	(1) Seg Cluster	(2) Seg Entrant	(3) Seg Incumbent	(4) C Cluster	(5) C Entrant	(6) C Incumbent
Enl	-0.167***	-0.151***	-0.177***			
	(0.008)	(0.014)	(0.011)			
Seg				-2.920***	-2.884***	-2.641***
				(0.151)	(0.142)	(0.151)
Control	Y	Y	Y	Y	Y	Y
Year FE	Y	Y	Y	Y	Y	Y
City FE	Y	Y	Y	Y	Y	Y
R^2	0.278	0.166	0.259	0.532	0.560	0.535
Obs.	615	375	405	615	375	405

Note: The dependent variables in columns (1)–(3) are market segmentation indices. The dependent variables in columns (4)–(6) are calculated as the natural logarithm of total retail sales of consumer goods.

Unlike most top-level designs, the enlargement of the UECC represents an integrated policy initiated and promoted by local governments. The scope of the UECC partially overlaps with that of the top-level design, but this coincidence appears to reflect a post hoc endorsement by the central government in response to autonomous local exploration. The Yangtze River Delta urban agglomeration, as delineated by the central government in 2016, included 26 cities—significantly later than the UECC's integration efforts—yet exhibited an 85% overlap with UECC membership in the same year. Consequently, the UECC's enlargement should not be interpreted as central intervention. Within the broader context of policy experimentation, this study demonstrates that the integration has yielded positive outcomes. While the benefits of top-down integration policies should not be dismissed, the potential policy dividends of autonomous local exploration and the incentives driving such initiatives warrant greater attention from both policymakers and researchers.

6. CONCLUSIONS AND RECOMMENDATIONS

The urban agglomeration plan is considered an integrated policy to reduce regional market segmentation in China, which is widespread and significantly hinders consumption growth. Spanning multiple provinces, the cluster is expected to promote consumption by reducing administrative border barriers. We examine the impact of integration on consumption by analyzing the enlargement of the UECC. Our findings indicate that the enlargement generates higher consumption in cities within the cluster compared to those outside it. Furthermore, the entrant cities benefit prior to the incumbent cities, and cities with better infrastructure, larger scale, and proximity to regional central cities experience a stronger positive effect on consumption. Our results also demonstrate that the enlargement successfully reduces three types of administrative border barriers—provincial, cluster, and city—leading to increased consumption in cities located near these borders.

Our findings highlight the crucial role that integration plays in stimulating consumption. We recommend that policymakers implement regional integration through urban agglomeration planning. Currently, expanding domestic demand by boosting consumption has become a priority in the Chinese government's work agenda. As a solution, we propose that, in addition to fiscal and tax policies, regional integration policies should be considered an important tool for stimulating consumption.

Second, it reveals that consumption is enhanced with a unified domestic market, which benefits from the reduction of administrative border barriers. Cross-regional cooperation between local governments should be strengthened through more concrete institutional arrangements. This paper finds that regional economic alliances, represented by urban agglomerations, surpass the policy targets of individual cities and are expected to disrupt the original administrative border barriers.

Third, the fundamental structure, including infrastructure, scale, and proximity to regional central cities, is important for the welfare outcomes of regional integration. To achieve the boosting effect of urban agglomeration enlargement on consumption, different cities should integrate into clusters according to their comparative advantages. Regional central cities should play a leading and driving role, while peripheral cities should develop specialized consumer industries based on their own endowments.

The limitation of this study lies in its research scope, which is confined to the Yangtze River Delta, although this delimitation offers some practical advantages. In practice, whether the integration approach independently explored by local governments can be effectively extended to other regions, as well as whether it can generate comparable welfare benefits, warrants further academic investigation.

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APPENDIX A. THE METHOD OF PARALLEL TREND TEST

We employ Equation (A1) to examine the potential parallel trends:

$$C_{it} = \beta \sum_{t=-5}^{t=3} d_{it} + \gamma X_{it} + \alpha_i + \alpha_t + \varepsilon_{it} \tag{A1}$$

where the actual enlargement period serves as the base period. A series of dummy variables, denoted as $d_{(i,-5)}$–$d_{(i,3)}$, replace Enl_{it} in Equation (1). Here, $d_{(i,-5)} = 1$ if city i was incorporated into the cluster five years prior to year t, and 0 otherwise. The assignment of $d_{(i,-4)}$–$d_{(i,-1)}$ follows the same logic. Similarly, $d_{(i,1)} = 1$ if city i was absorbed into the cluster in the year following t, and 0 otherwise, with $d_{(i,2)}$ and $d_{(i,3)}$ assigned analogously. The definitions of all other variables remain consistent with Equation (1). As shown in Figure 4, the coefficients of the dummy variables remain statistically insignificant prior to the policy but become significantly positive afterward. These results largely support the parallel trend assumption.

APPENDIX B. ESTIMATION RESULTS OBTAINED USING THE STAGGERED DIFFERENCE-IN-DIFFERENCES METHOD

(1) Estimation of staggered DID

Table B1: Result of Staggered DID Method (Cluster)

	Coef.	Std. Err.	95% Confidence Interval	
Group_2010				
t_2003_2004	0.107	0.002	0.103	0.112
t_2007_2008	0.146	0.010	0.127	0.166
t_2008_2009	0.164	0.006	0.152	0.176
t_2009_2010	0.129	0.004	0.121	0.138
t_2009_2011	0.257	0.020	0.218	0.296
t_2009_2012	0.372	0.021	0.331	0.414
t_2009_2013	0.472	0.023	0.428	0.517
t_2009_2014	0.571	0.029	0.514	0.628
t_2009_2015	0.664	0.039	0.589	0.740
t_2009_2016	0.743	0.040	0.665	0.821
t_2009_2017	0.826	0.042	0.744	0.908
Group_2013				
t_2003_2004	0.100	0.009	0.082	0.119
t_2004_2005	0.126	0.060	0.009	0.243
t_2005_2006	0.097	0.018	0.061	0.132
t_2006_2007	0.105	0.018	0.070	0.140
t_2007_2008	0.103	0.028	0.048	0.158
t_2008_2009	0.123	0.023	0.079	0.167
t_2009_2010	0.100	0.017	0.066	0.134
t_2010_2011	0.115	0.007	0.102	0.129
t_2011_2012	0.117	0.006	0.105	0.128
t_2012_2013	0.103	0.004	0.095	0.110
t_2012_2014	0.266	0.028	0.212	0.320
t_2012_2015	0.383	0.033	0.319	0.447
t_2012_2016	0.480	0.035	0.412	0.548
t_2012_2017	0.558	0.046	0.468	0.649

Note: The dependent variable is represented by the total retail sales of consumer goods. Robust standard errors are clustered at the province level. Coef. denotes coefficient; Std. Err. denotes standard error; columns (4)–(5) present the 95% confidence interval. Variables between t_2004 and t_2007 are omitted. The same applies below.

Table B2: Average Treatment Effect on Treated (ATT) (Cluster)

	Coef.	Std. Err.	95% Confidence Interval	
ATT	0.477***	0.016	0.445	0.509
Group Average	0.465***	0.023	0.421	0.510
Group 2010	0.504***	0.026	0.453	0.556
Group 2013	0.358***	0.028	0.304	0.413

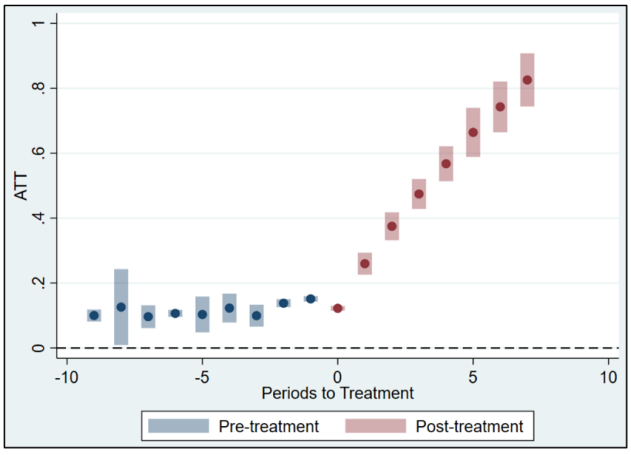
Note: ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

Table B3: ATT by Calendar Period (Cluster)

	Coef.	Std. Err.	95% Confidence Interval	
CAverage	0.455***	0.011	0.434	0.476
T2010	0.129***	0.004	0.121	0.138
T2011	0.257***	0.020	0.218	0.296
T2012	0.372***	0.021	0.331	0.414
T2013	0.374***	0.009	0.357	0.391
T2014	0.490***	0.003	0.483	0.496
T2015	0.589***	0.014	0.562	0.617
T2016	0.673***	0.016	0.641	0.705
T2017	0.754***	0.020	0.715	0.794

Note: ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

Figure B1: Dynamics effect of enlargement (Cluster)



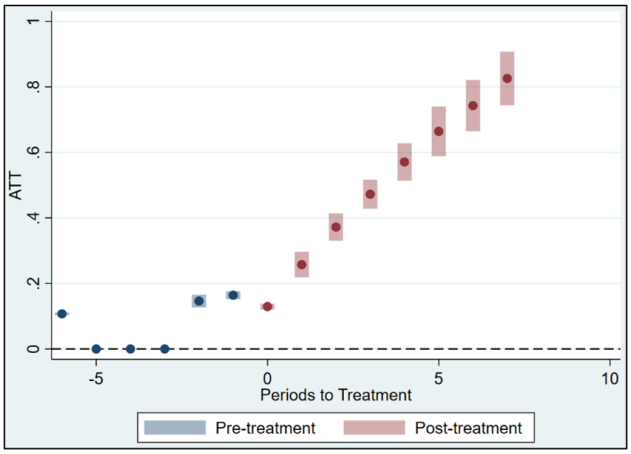
Note: Figure B1 illustrates the consumption differences between cities within the cluster and those outside the cluster before and after the enlargement. We find that prior to the policy shock, there is no significant change in the disparity between the two groups. However, following the policy shock, cities within the cluster exhibit a notable increase in consumption compared to their counterparts, with this effect showing a gradually strengthening trend.

Table B4: Result of Staggered DID Method (Entrant)

	Coef.	Std. Err.	95% Confidence Interval	
Group_2010				
t_2008_2009	0.172	0.009	0.156	0.189
t_2009_2010	0.132	0.007	0.118	0.145
t_2009_2011	0.307	0.055	0.199	0.416
t_2009_2012	0.429	0.059	0.314	0.545
t_2009_2013	0.529	0.065	0.403	0.656
t_2009_2014	0.656	0.075	0.510	0.802
t_2009_2015	0.778	0.098	0.587	0.970
t_2009_2016	0.867	0.100	0.671	1.062
t_2009_2017	0.956	0.104	0.752	1.160
Group_2013				
t_2003_2004	0.100	0.009	0.082	0.119
t_2004_2005	0.126	0.060	0.009	0.243
t_2005_2006	0.097	0.018	0.061	0.132
t_2006_2007	0.105	0.018	0.070	0.140
t_2007_2008	0.103	0.028	0.048	0.158
t_2008_2009	0.123	0.023	0.079	0.167
t_2009_2010	0.100	0.017	0.066	0.134
t_2010_2011	0.115	0.007	0.102	0.129
t_2011_2012	0.117	0.006	0.105	0.128
t_2012_2013	0.103	0.004	0.095	0.110
t_2012_2014	0.266	0.028	0.212	0.320
t_2012_2015	0.383	0.033	0.319	0.447
t_2012_2016	0.480	0.035	0.412	0.548
t_2012_2017	0.558	0.046	0.468	0.649

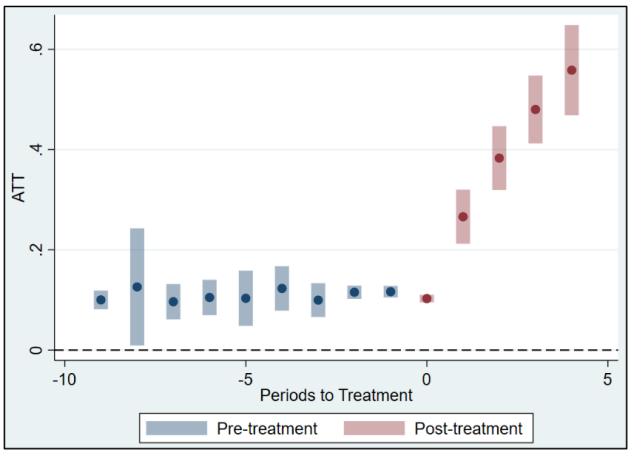
Note: The dependent variable is represented by total social consumer retail. Robust standard errors are clustered at the province level.

Figure B2: Dynamics effect of enlargement in group 2010 (Cluster)



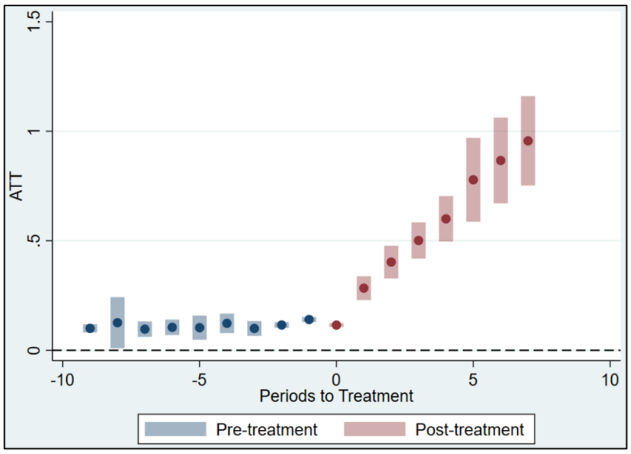
Note: Figure B2 illustrates the consumption differences between cities within cluster and those outside cluster before and after the first enlargement in 2010. We find that prior to the policy shock, there is no significant change in the disparity between the two groups. However, following the policy shock, cities within cluster exhibit a notable increase in consumption compared to their counterparts, with this effect showing a gradually strengthening trend

Figure B3: Dynamics effect of enlargement in group 2013 (Cluster)



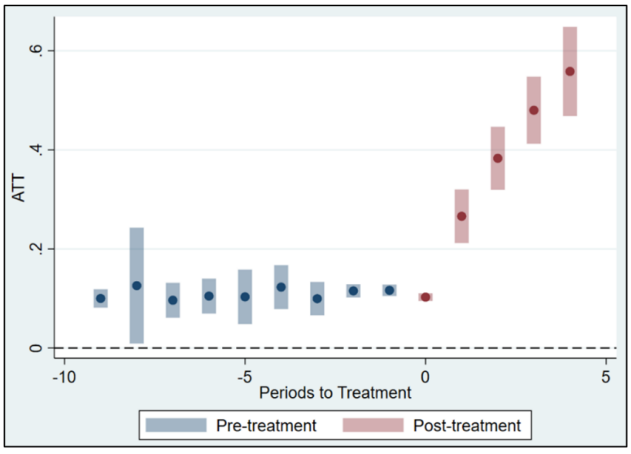
Note: Figure B3 illustrates the consumption differences between cities within cluster and those outside cluster before and after the second enlargement in 2013. We find that prior to the policy shock, there is no significant change in the disparity between the two groups. However, following the policy shock, cities within cluster exhibit a notable increase in consumption compared to their counterparts, with this effect showing a gradually strengthening trend.

Figure B4: Dynamics effect of enlargement (Entrant)



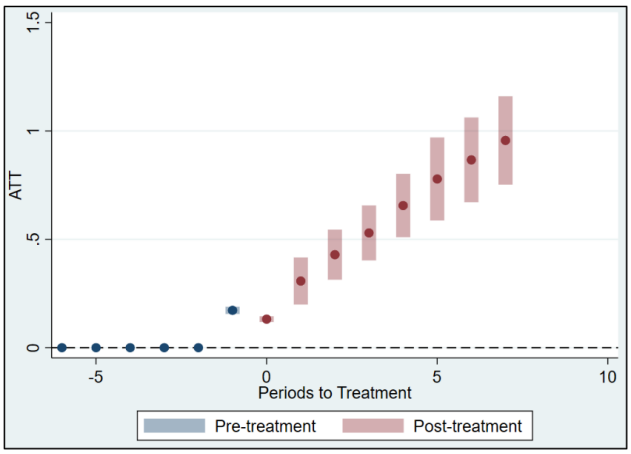
Note: Figure B4 illustrates the consumption differences between entrant cities and non-cluster cities before and after the enlargement. We find that prior to the policy shock, there is no significant change in the disparity between the two groups. However, following the policy shock, entrant cities exhibit a notable increase in consumption compared to their counterparts, with this effect showing a gradually strengthening trend

Figure B5: Dynamics effect of enlargement (Entrant)



Note: Figure B5 illustrates the consumption differences between entrant cities and non-cluster cities before and after the first enlargement in 2010. We find that prior to the policy shock, there is no significant change in the disparity between the two groups. However, following the policy shock, entrant cities exhibit a notable increase in consumption compared to their counterparts, with this effect showing a gradually strengthening trend

Figure B6: Dynamics effect of enlargement in group 2013 (Entrant)



Note: Figure B6 illustrates the consumption differences between entrant cities and non-cluster cities before and after the second enlargement in 2013. We find that prior to the policy shock, there is no significant change in the disparity between the two groups. However, following the policy shock, entrant cities exhibit a notable increase in consumption compared to their counterparts, with this effect showing a gradually strengthening trend.

APPENDIX C. TESTS WITH DIFFERENT SPATIAL BUFFERS

Table C1: Excluding non-cluster members within rings of 50km

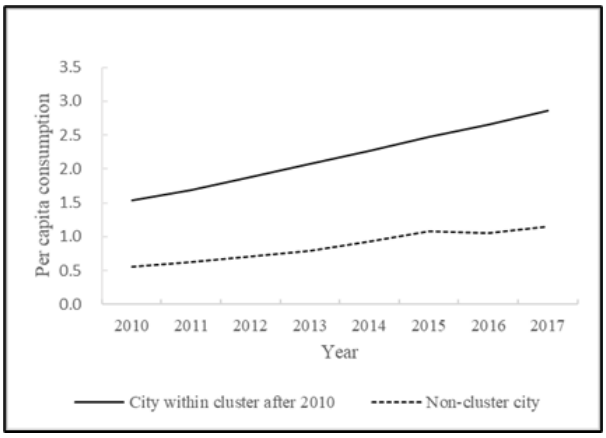
Variables	(1) cluster remove < 50km	(2) entrant remove < 50km	(3) incumbent remove < 50km
Enl	0.180***	0.190***	0.145***
	(0.032)	(0.035)	(0.036)
Control	Y	Y	Y
Year FE	Y	Y	Y
City FE	Y	Y	Y
R^2	0.959	0.960	0.965
Obs.	585	345	375

Note: Significant at *** 1%, ** 5%, and * 10% levels; robust standard errors clustered at the city level are reported in parentheses. Year FE denotes year fixed effects, and City FE denotes city fixed effects. The dependent variable is calculated as the natural logarithm of total retail sales of consumer goods. The same applies below.

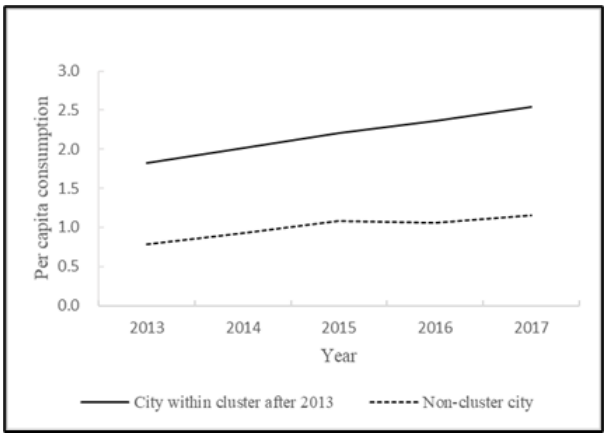
Table C2: Excluding non-cluster members within rings of 100km

Variables	(1) cluster remove < 100km	(2) entrant remove < 100km	(3) incumbent remove < 100km
Enl	0.170***	0.187***	0.113***
	(0.033)	(0.038)	(0.035)
Control	Y	Y	Y
Year FE	Y	Y	Y
City FE	Y	Y	Y
R^2	0.960	0.961	0.970
Obs.	525	285	315

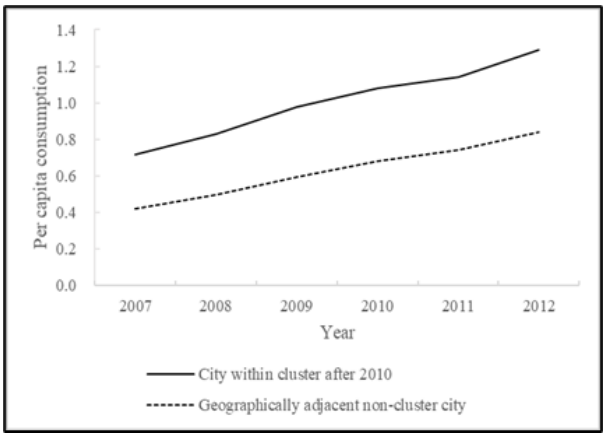
Note: Significant at *** 1%, ** 5%, and * 10% levels; robust standard errors clustered at the city level are reported in parentheses.



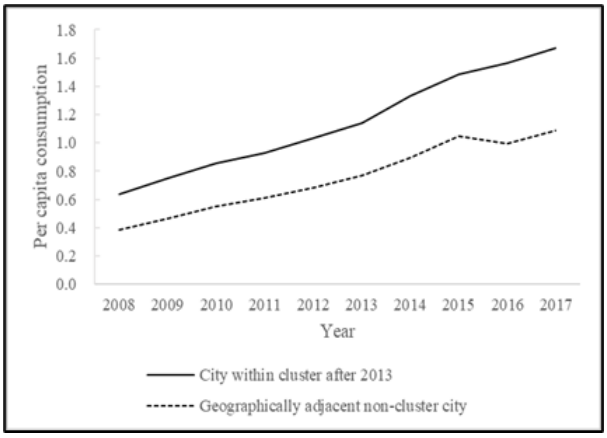
(a)



(b)



(c)



(d)

Figure C1: Effects of enlargement under alternative control paths.

Note: Figure C1 reveals the effects of the enlargement on members relative to a potentially depressed control path.

APPENDIX D. TESTS ON TEMPORAL HETEROGENEOUS EFFECT WITH EVENT STUDY

Table D1: Event Study: Dynamic Effects (Cluster)

	Coef.	Std. Err.	[95% Conf. Interval]
Pre_avg	0.116	0.017	0.083 – 0.149
Post_avg	0.504	0.025	0.455 – 0.553
Tm9	0.100	0.009	0.082 – 0.119
Tm8	0.126	0.060	0.009 – 0.243
Tm7	0.097	0.018	0.061 – 0.132
Tm6	0.107	0.006	0.096 – 0.118
Tm5	0.103	0.028	0.048 – 0.158
Tm4	0.123	0.023	0.079 – 0.167
Tm3	0.100	0.017	0.066 – 0.134
Tm2	0.138	0.006	0.126 – 0.150
Tm1	0.151	0.004	0.143 – 0.160
Tp0	0.122	0.004	0.115 – 0.130
Tp1	0.260	0.017	0.226 – 0.294
Tp2	0.375	0.022	0.332 – 0.418
Tp3	0.474	0.024	0.428 – 0.521
Tp4	0.568	0.028	0.514 – 0.622
Tp5	0.664	0.039	0.589 – 0.740
Tp6	0.743	0.040	0.665 – 0.821
Tp7	0.826	0.042	0.744 – 0.908

Note: Tm denotes years before treatment, and Tp denotes years after treatment. Pre_avg and Post_avg represent the average pre-treatment and post-treatment effects, respectively.

Table D2: Event Study: Dynamic Effects (Entrant)

	Coef.	Std. Err.	[95% Conf. Interval]
Pre_avg	0.112	0.017	0.079 – 0.145
Post_avg	0.563	0.057	0.450 – 0.676
Tm9	0.100	0.009	0.082 – 0.119
Tm8	0.126	0.060	0.009 – 0.243
Tm7	0.097	0.018	0.061 – 0.132
Tm6	0.105	0.018	0.070 – 0.140
Tm5	0.103	0.028	0.048 – 0.158
Tm4	0.123	0.023	0.079 – 0.167
Tm3	0.100	0.017	0.066 – 0.134
Tm2	0.115	0.007	0.102 – 0.129
Tm1	0.140	0.006	0.129 – 0.152
Tp0	0.115	0.004	0.106 – 0.124
Tp1	0.284	0.028	0.229 – 0.338
Tp2	0.403	0.038	0.328 – 0.477
Tp3	0.501	0.042	0.418 – 0.584
Tp4	0.600	0.053	0.496 – 0.704
Tp5	0.778	0.098	0.587 – 0.970
Tp6	0.867	0.100	0.671 – 1.062
Tp7	0.956	0.104	0.752 – 1.160

Note: Tm denotes years before treatment and Tp denotes years after treatment. Pre_avg and Post_avg represent the average pre-treatment and post-treatment effects, respectively.

APPENDIX E. THE CAUSAL EFFECT BETWEEN ENLARGEMENT AND INFRASTRUCTURE

Table E1: The Causal Effect between Enlargement and Infrastructure I

	(1)	(2)	(3)	(4)	(5)	(6)
Variables	cluster	entrant	incumbent	cluster	entrant	incumbent
Enl	-0.011	0.001	-0.049	-0.028	-0.053	0.007
	(0.046)	(0.052)	(0.047)	(0.031)	(0.033)	(0.054)
Control	Y	Y	Y	Y	Y	Y
Year FE	Y	Y	Y	Y	Y	Y
City FE	Y	Y	Y	Y	Y	Y
R^2	0.705	0.749	0.701	0.707	0.745	0.701
Obs.	615	375	405	615	375	405

Note: The dependent variables in columns (1)–(3) represent highway miles within a city. The dependent variables in columns (4)–(6) represent highway density, calculated as highway miles per unit area.

Table E2: The Causal Effect between Enlargement and Infrastructure II

	(1)	(2)	(3)	(4)	(5)	(6)
Variables	cluster	entrant	incumbent	cluster	entrant	incumbent
Enl	-0.280***	-0.389***	-0.376***	-0.275**	-0.440**	-0.310
	(0.100)	(0.139)	(0.132)	(0.133)	(0.182)	(0.235)
Control	Y	Y	Y	Y	Y	Y
Year FE	Y	Y	Y	Y	Y	Y
City FE	Y	Y	Y	Y	Y	Y
R^2	0.695	0.745	0.735	0.191	0.266	0.232
Obs.	615	375	405	615	375	405

Note: The dependent variables in columns (1)–(3) represent highway freight volume within a city (measured in tons). The dependent variables in columns (4)–(6) represent the highway freight utilization ratio within a city, calculated as freight per unit highway mile. These results indicate that freight volume does not increase with the expansion of the UECC, providing further evidence of the non-causal relationship between expansion and infrastructure.