

# Regional Heterogeneous Impact of Cross-Border E-Commerce on Economic Recovery in China

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**Abstract.** This research examines the variations in economic rebound across different regions in China, as affected by the revival of cross-border electronic commerce following the pandemic. Employing fixed effects models and heterogeneity analysis, it investigates the variances in the economic recovery across different Chinese regions facilitated by cross-border e-commerce. The findings reveal a positive influence of cross-border e-commerce on the nation's economic rebound, albeit with noticeable regional variations. Western China experiences a lesser impact, Central China benefits significantly, and Eastern China sees moderate gains. The research underscores the necessity for targeted regional strategies to optimize the benefits of international e-commerce. For Western China, it suggests an aggressive expansion of transportation and infrastructure. For Central China, it advocates for enhanced governmental incentives and regulation of e-commerce enterprises. Lastly, for Eastern China, the paper recommends the integration of cross-border e-commerce with traditional industries like light manufacturing, textiles, and agriculture to foster sustainable development. These insights aim to guide both policy formulation and enterprise growth in the evolving landscape of digital commerce.

**Keywords:** Post-pandemic era; regional heterogeneity analysis; cross-border e-commerce; economic recovery.

## 1. Introduction

Cross-border e-commerce has greatly changed everyone's lifestyle since its birth. In the past, an Asian who wants to buy a special health product in Europe needs to pay a high amount of money to have the Daigou (a person who specializes in buying goods from overseas) travel across the ocean. With international e-commerce, everyone only needs to use a mobile phone to buy goods from all over the world. Before the COVID-19 pandemic, international e-commerce had become an important form of international trade [1]. It not only promoted China's international trade, broadened the overseas market of Chinese enterprises, but also helped many small and medium-sized enterprises in China develop rapidly [2-4]. The study of China's oversea e-commerce trade is not only conducive to promoting the development of China's international e-commerce but also helping other countries explore a cross-border e-commerce development path that suits their national conditions [5].

During the pandemic, as individual travel was restricted, it was difficult for a Chinese to go abroad to buy goods in other countries. Therefore, during the pandemic, cross-border e-commerce is essential for every Chinese. It not only ensures that every Chinese can buy the foreign goods they need, but also greatly eases the economic pressure during the pandemic and promotes the growth of China's economy [6]. Cross-border e-commerce economy is an important part of China's economy, but in different regions, international e-commerce is differently affected by the pandemic and has various effects on the economy. Therefore, the development strategies of cross-border e-commerce in different regions are also diverse [7]. Studies in the past have found that the development of cross-border e-commerce has similar effects on the economy in China's provinces and cities, but as Eastern China pays more attention to international e-commerce than Western China, international e-commerce develops better [8-9]. As early as 2012, Hangzhou established China's first cross-border e-commerce industrial park, which served as a blueprint and propelled the growth of the international e-commerce sector throughout the East China [10]. Simultaneously, the advancement of international e-commerce transactions is also affected by multiple factors such as the distribution of pilot zones,

urban hierarchy and regional policies, which additionally suggests that the impact of international e-commerce on economic recovery post-pandemic might vary across different regions in China [11].

This paper uses overall economic performance as the main indicator of economic recovery and uses per capita income as a supplementary indicator to better quantify economic recovery. In order to explore whether there are differences in the role of cross-border e-commerce in different regions of China in the post-pandemic economic recovery, this paper collects the Gross Domestic Product (GDP), cross-border e-commerce volume (ET), urbanization rate and per capita income data of 30 provinces and cities in China, covering the time span before and after the pandemic, and uses baseline regression, fixed effect model and heterogeneity analysis. This study finds that cross-border e-commerce has a weak correlation with the economic recovery in Western China. However, it significantly contributes to the recovery of economic aggregate and resident income in Central China and has a promoting effect on the recovery of resident income in Eastern China but has a weak promoting effect on the economic aggregate's recovery. Based on the study, local governments in different regions are able to formulate policies in a more targeted way, and cross-border e-commerce related enterprises are also able to select development strategies more easily.

## 2. Methodology

### 2.1. Data Collection

This paper selects the time span from 2017 to 2023 to ensure that it covers the period before, during and after the pandemic. To investigate if the influence of cross-border e-commerce transactions on China's post-pandemic economic revival differs across various regions, this paper selects the GDP of different provinces and cities to measure the overall economic situation of the local area, and the volume of international e-commerce to assess the level of development of international e-commerce within the region. With the aim of making the research conclusion more credible, this paper also selects the urbanization rate as the control variable of the study and collects the data of per capita income to further measure the economic development of different regions. Considering regional variations, given the limited development of cross-border e-commerce in Tibet, this study excludes Tibet's data. Instead, it focuses on a sample comprising 30 diverse provinces and cities across China to minimize sampling errors.

### 2.2. Empirical Strategies

In this paper, the Pearson correlation coefficient matrix test is firstly conducted. The findings are displayed in the following Table 1. The examination uncovers a significant positive connection between the key explanatory factor, cross-border e-commerce transaction volume, and GDP, which is consistent with the anticipated hypothesis. Moreover, among the control variables, Urban exhibits a significant association with GDP, at a significance threshold of 1% or higher. However, it is essential to recognize that the correlation coefficient matrix primarily evaluates the association between two variables and does not consider the impacts of control or potential variables. Furthermore, assessing whether the absolute value of the correlation coefficient among explanatory variables exceeds 0.9 allows for an initial determination of the likelihood of multicollinearity.

**Table 1.** Correlation coefficient matrix

|       | GDP      | ET       | Urban |
|-------|----------|----------|-------|
| GDP   | 1.000    |          |       |
| ET    | 0.839*** | 1.000    |       |
| Urban | 0.293*** | 0.455*** | 1.000 |

\*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$

To ascertain the absence of collinearity among the data utilized in this research, a multicollinearity examination is performed. Commonly, the variance inflation factor (VIF) serves as the metric to

identify the presence of multicollinearity. Consequently, the VIF for the model is evaluated in this document. Table 2 below presents the results from the multicollinearity evaluation of the model. The data show that the VIF values for all variables are under 10, suggesting that the variables selected for this analysis overall do not demonstrate collinearity.

**Table 2.** Collinearity test

|          | VIF   | 1/VIF |
|----------|-------|-------|
| ET       | 1.261 | 0.793 |
| Urban    | 1.261 | 0.793 |
| Mean VIF | 1.261 | 0.793 |

For panel data analysis, identifying the appropriate model for evaluation is crucial. Generally, mixed effect model, fixed effect model and random effect model are used to analyze the panel data. This paper primarily utilizes the Hausman test and F test to ascertain the appropriate model for data analysis. The outcomes of these tests are presented in Table 3.

**Table 3.** Hausman test & F test

| Hausman test               |         |        |
|----------------------------|---------|--------|
| chi <sup>2</sup> Statistic | p-Value | Result |
| 68.13                      | 0.000   | Reject |
| F test                     |         |        |
| chi <sup>2</sup> Statistic | p-Value | Result |
| 284.01                     | 0.000   | Reject |

The findings from the Hausman test and F test strongly reject the null hypothesis, prompting the selection of the fixed effect model for further analysis of the data in this research. The formula for the model is provided below.

$$GDP_{i,t} = \alpha_0 + \alpha_1 ET_{i,t} + \alpha_2 Urban_{i,t} + \gamma_i + \lambda_t + \varepsilon_{i,t} \quad (1)$$

In the equation (1),  $\alpha_0$  refers to Constant term;  $\alpha_1$  and  $\alpha_2$  refer to Coefficient of each explanatory variable;  $\gamma_i$  refers to Individual fixation effect.  $\lambda_t$  refers to Time-fixed effect;  $\varepsilon_{it}$  refers to Random disturbance term.

Now it is clear that the fixed effects model should be selected as the model. In addition, for the sake of enhancing the reliability of the findings, this paper employs stepwise regression analysis to validate the hypothesis. Before further analyzing the regional heterogeneity of this restoration effect, in order to determine the causal relationship between ET and GDP, this article also needs to conduct an endogeneity test. If the outcomes of the endogeneity test align with predictions, a heterogeneity analysis may be employed to investigate potential variations in the relationship between independent and dependent variables across samples from various regions. In the heterogeneity test, while using GDP and ET for regression, regression of per capita income and ET is also of great significance as a supplement to the analysis results.

### 3. Results

#### 3.1. Descriptive Statistics

As shown in Table 4, China's GDP, ET, urbanization rate and per capita income have all shown an upward trend since 2017. Although the growth rate has declined during the pandemic period, the overall economy is still developing rapidly. Compared with the other three indicators, the variance and range of the urbanization rate are relatively small, proving that the overall differences in urbanization development in different provinces and cities in China are small. The dispersion and

span of GDP and ET data are notably broad, indicating a significant disparity in economic size and cross-border e-commerce development levels among various provinces and cities within China.

**Table 4.** Descriptive Statistics

|                                                | 2017     | 2018     | 2019     | 2020     | 2021     | 2022     | 2023     | Overall  |
|------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|
| <i>Panel A: Gross Domestic Product</i>         |          |          |          |          |          |          |          |          |
| Mean                                           | 26799.35 | 29496.35 | 31698.04 | 32585.56 | 36861.24 | 38588.37 | 40337.04 | 33766.56 |
| SD                                             | 22010.46 | 23965.07 | 25677.71 | 26492.04 | 29867.61 | 31025.69 | 32604.54 | 27377.58 |
| Max                                            | 91600    | 99900    | 108000   | 111200   | 124700   | 129500   | 135700   | 114371   |
| Min                                            | 2465.1   | 2748     | 2941     | 3009.8   | 3385.1   | 3623.3   | 3799.1   | 3138.77  |
| <i>Panel B: Cross-border E-commerce Volume</i> |          |          |          |          |          |          |          |          |
| Mean                                           | 985.94   | 1162.11  | 1377.29  | 1392.14  | 1559.01  | 1629.82  | 1682.66  | 1398.42  |
| SD                                             | 1287.79  | 1442.33  | 2133.87  | 2322.53  | 2630.86  | 2732.35  | 2837.75  | 2198.21  |
| Max                                            | 5207.2   | 5645.2   | 9097.88  | 9958.51  | 11269.57 | 11927.89 | 12539.12 | 9377.91  |
| Min                                            | 14.48    | 19.84    | 23.1     | 21.8     | 22.12    | 22.35    | 24.19    | 21.13    |
| <i>Panel C: Urbanization Rate</i>              |          |          |          |          |          |          |          |          |
| Mean                                           | 0.6      | 0.61     | 0.62     | 0.65     | 0.65     | 0.66     | 0.66     | 0.64     |
| SD                                             | 0.11     | 0.11     | 0.1      | 0.1      | 0.1      | 0.09     | 0.09     | 0.10     |
| Max                                            | 0.88     | 0.88     | 0.88     | 0.89     | 0.89     | 0.89     | 0.89     | 0.89     |
| Min                                            | 0.46     | 0.48     | 0.48     | 0.5      | 0.51     | 0.52     | 0.52     | 0.50     |
| <i>Panel D: Per Capita Income</i>              |          |          |          |          |          |          |          |          |
| Mean                                           | 2.61     | 2.85     | 3.1      | 3.24     | 3.53     | 3.69     | 3.91     | 3.28     |
| SD                                             | 1.01     | 1.15     | 1.24     | 1.27     | 1.37     | 1.4      | 1.48     | 1.27     |
| Max                                            | 5.9      | 6.42     | 6.94     | 7.22     | 7.8      | 7.96     | 8.48     | 7.25     |
| Min                                            | 1.6      | 1.75     | 1.91     | 2.03     | 2.21     | 2.33     | 2.5      | 2.05     |

### 3.2. Test Results

At the outset, this research endeavors to determine the impact of international e-commerce on driving China's economic recovery following the pandemic. The baseline regression findings are detailed in Table 5.

**Table 5.** Regression results

|                        | (1)      | (2)      |
|------------------------|----------|----------|
| Variables              | GDP      | GDP      |
| ET                     | 0.051*** | 0.017*** |
|                        | (3.49)   | (4.25)   |
| Urban                  |          | 5.120*** |
|                        |          | (15.33)  |
| Observations           | 210      | 210      |
| R-squared              | 0.0212   | 0.788    |
| Number of observations | 210      | 210      |

t-statistics in parentheses, \*\*\* p<0.01, \*\* p<0.05, \* p<0.1

In the first column, the key explanatory variable ET shows a strongly positive association with the dependent variable, GDP, at a significance level of 1%. The coefficient value is 0.051, indicating that for each unit increase in ET, GDP experiences a comparable increase of 0.051 units, provided that all other variables remain unchanged. The second regression analysis also demonstrates a positive association between ET and GDP at a significance level of 1%, affirming a persistent positive relationship between the volume of international e-commerce transactions and the GDP of various provinces and cities from 2017 to 2023. Moreover, the equation's R-squared value exceeds 0.7, indicating the model's robust fit and significant explanatory capacity. This underscores the strong positive correlation between cross-border e-commerce transaction volumes and GDP across each province and city.

After completing the baseline regression, this article can initially draw a conclusion: international e-commerce can promote China's economic recovery after the pandemic. In the endogeneity test, this paper uses the more efficient system Gaussian Mixture Model (GMM) method for estimation to enhance the credibility of the findings and address potential issues of endogeneity. The model equation is as follows.

$$GDP_{i,t} = \beta_0 + \beta_1 GDP_{i,t-1} + \beta_2 GDP_{i,t-2} + \beta_3 ET_{i,t} + \beta_4 Urban_{i,t} + \varepsilon_{i,t} \quad (2)$$

The outcomes of the tests are presented in Table 6.

**Table 6.** Endogeneity test (Variables: GDP)

|              | SYS-GMM              |
|--------------|----------------------|
| L.GDP        | 0.644***<br>(41.41)  |
| L2.GDP       | 0.310***<br>(25.61)  |
| ET           | 0.025***<br>(7.41)   |
| Urban        | -0.168***<br>(-3.92) |
| AR (1)       | 0.000                |
| AR (2)       | 0.072                |
| Sargan       | 0.992                |
| Observations | 150                  |
| Number of id | 30                   |

z-statistics in parentheses, \*\*\* p<0.01, \*\* p<0.05, \* p<0.1

From the Autoregression (AR) sequence autocorrelation test results, it can be revealed that the absence of second-order or higher high-order autocorrelation in the disturbance terms, aligning with the foundational assumption of GMM regression. Furthermore, the outcomes of the Sargan over-identification test affirm the null hypothesis that "all instrumental variables are valid", confirming the suitability of the model. The regression analysis reveals a notable positive link between the regression dependent variable's first-order lag and the present period, showcasing the dependent variable's inherent "time stickiness". This reinforces the capability of the GMM method to effectively address this issue. Through the test of GMM regression, this article eliminates potential endogeneity problems. On this basis, this article can conduct further research on the heterogeneity of regional economic recovery.

In the heterogeneity analysis, regional heterogeneity regression is significant. This paper first uses GDP to approximately represent the degree of regional economic development. The total cross-border ET is used to represent the degree of development of regional international e-commerce, and group

regression is used to conduct research. The outcomes of the regression analysis are displayed in Table 7.

ET in the Eastern region exhibits an inverse relationship with GDP at the 1% significance level. The possible reason is that the real economy and light industry of the provinces and cities in the East are fairly advanced, and the foreign economy is more dependent on traditional maritime trade of goods. Therefore, overseas e-commerce accounts for a smaller proportion in economic development compared with other regions.

**Table 7.** Heterogeneity analysis

|                  | Western             | Central             | Eastern              |
|------------------|---------------------|---------------------|----------------------|
| Variable         | GDP                 | GDP                 | GDP                  |
| ET               | 0.023<br>(1.74)     | 0.043***<br>(5.72)  | -0.021***<br>(-4.37) |
| Urban            | 4.891***<br>(13.33) | 4.865***<br>(18.96) | 6.631***<br>(15.39)  |
| Observations     | 77                  | 56                  | 77                   |
| R-squared        | 0.851               | 0.804               | 0.740                |
| Number of groups | 11                  | 8                   | 11                   |

t-statistics in parentheses, \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$

Take Fujian Province as an example. Fujian Province stands at the forefront of China in the aggregate of international e-commerce transactions, yet the mainstays of its economy are maritime commerce in light industry and textiles. Therefore, the economic recovery benefits brought by cross-border e-commerce trade to Fujian in a short period of time may not be very significant. In the Central region, ET is positively correlated with GDP, significant at the 1% level, indicating that in Central cities, international e-commerce trade has a positive correlation with GDP. A notable positive relationship exists between the overall transaction volume of international e-commerce and economic resurgence following the pandemic, while the correlation between ET and GDP in the Western region is not significant. This article believes that the reason is that compared with cities in other regions, cities in Western China are relatively less developed. It is lagging behind, with transportation facilities still under construction and many areas still in the development stage, so the economy has little reliance on international e-commerce.

In the analysis of regional heterogeneity, this article can preliminarily conclude that international e-commerce has a limited impact on the post-pandemic economic recovery in Western China, a more significant recovery effect on Central China, and a more significant impact on the recovery of Eastern China which played a certain negative role. GDP can measure the overall economic development of a region, but it is one-sided and cannot cover all indicators of economic life, such as the income and living conditions of residents. Therefore, in order to make the analysis process more comprehensive, this article will use the per capita income of different regions to represent the living conditions of residents in different regions and perform regression with the volume of transactions in international e-commerce. The findings from the regression analysis are available in Table 8.

**Table 8.** Supplementary heterogeneity regression

|                        | Western              | Central              | Eastern            |
|------------------------|----------------------|----------------------|--------------------|
| Variables              | Income               | Income               | Income             |
| ET                     | 0.131***<br>(5.96)   | 0.072**<br>(3.28)    | 0.063<br>(1.35)    |
| Urban                  | 23.022***<br>(17.28) | 13.160***<br>(13.68) | 6.525***<br>(7.91) |
| Observations           | 77                   | 56                   | 77                 |
| R-squared              | 0.593                | 0.865                | 0.500              |
| Number of observations | 77                   | 56                   | 77                 |

t-statistics in parentheses, \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$

As indicated in Table 8, in Western China, the correlation between the volume of transactions in international e-commerce and residents' per capita income is still not significant, further proving the previous hypothesis of this article. The influence of international e-commerce on Western China's economic revival following the pandemic is limited. In contrast, Central China experiences a substantial positive influence from cross-border e-commerce transactions on the per capita income of residents, highlighting the enhanced importance of cross-border e-commerce in the economic recuperation of Central China. Similarly, in Eastern China, cross-border e-commerce transactions significantly boost residents' per capita income, diverging from GDP regression outcomes. This discrepancy may stem from cross-border e-commerce enhancing employment for residents in the East, aiding economic recovery, albeit the primary driver of economic revival in the East may not be international e-commerce.

#### 4. Discussion

In order to explore the regional heterogeneity of cross-border e-commerce on China's economic recovery after the pandemic, this article uses a total of two regression models for analysis. In the analysis of Western China, this paper finds that whether it uses GDP and ET for regression or residents' per capita income and ET for regression, the results are not significant. This is more consistent with reality, because Western China is relatively underdeveloped, which does not have a developed transportation network to devote to the cross-border e-commerce and lacks investment from large enterprises. Therefore, the influence of international e-commerce on Western China's financial revival is so small that it can be ignored.

In the analysis of Central China, this paper finds that whether it is regression between GDP and ET or per capita income of residents and ET. The results are significantly positive. This can prove that international e-commerce has a very strong role in promoting the economic recovery after the pandemic in Central China. On the one hand, this role is reflected in the promotion of the overall economy, and on the other hand, it is reflected in the improvement of residents' living standards.

In the analysis of Eastern China, this article found that the result of using GDP and ET regression is a weak negative correlation, while using the per capita income of residents and the result of ET regression is a significant positive correlation. This may be related to the unique industrial structure of Eastern China. The economy of Eastern China is relatively developed, and most cities rely on light industry, textile industry, and agriculture as the main economic pillars. Therefore, although international e-commerce has developed well in Eastern China, its proportion of the total economic output is significantly smaller than that of the Central region. Therefore, for the role of promoting the recovery of economic aggregate after the pandemic is not obvious. Nevertheless, given Eastern China's strong emphasis on cross-border e-commerce, both government and businesses have generated a considerable number of employment opportunities within this sector. Consequently, the advancement of international e-commerce significantly contributes to job creation for residents in Eastern China. This contribution is evident in the positive impact of ET on the per capita income of residents. Hence, broadly speaking, international e-commerce exerts a substantial influence on facilitating economic revival in Eastern China following the pandemic.

Similar to previous research results, this article found that international e-commerce has a positive impact on the economic advancement of China. This effect was reflected in promoting China's economic development before the pandemic, and after the pandemic in promoting China's economic recovery and creating jobs. Jobs thereby improving the average income and quality of life of residents. Concurrently, in line with earlier studies, Eastern China's international e-commerce sector began its progress early and received substantial investment, leading to its superior progress. Similarly, international e-commerce is thriving in Central China, contributing importantly to the economic rebound. In the west, due to relatively backward conditions in all aspects, international e-commerce accounts for a very limited proportion of the economy.

What has been overlooked in prior research is that, despite the flourishing state of international e-commerce in Eastern China, its contribution to the economy is relatively minor due to the unique economic structure of the region. Consequently, cross-border e-commerce did not significantly contribute to the post-pandemic economic recovery, with its primary influence being in job creation. In contrast, even though the progress of international e-commerce in Central China does not match that of the Eastern region, it receives more focused attention from both the government and the business sector. Furthermore, the international e-commerce sector constitutes a larger share of the Central region's economic fabric compared to the East. Therefore, international e-commerce is important to the economy of the Central region after the pandemic. The recovery effect is very obvious, which is not only reflected in the creation of jobs, but also in promoting the increase of economic aggregate.

## 5. Suggestions

Based on the research results of this article, the following suggestions can be made for the development of cross-border e-commerce in different regions of China. For Western China, due to underdeveloped transportation networks and lack of infrastructure, the development of international e-commerce has been stagnant for a long time. To facilitate the development of international e-commerce and utilize to the fullest extent its role in promoting the economy, this article recommends that the Western region of China speed up the construction of transportation networks, and the government should implement certain incentive policies to attract more international e-commerce companies to settle in the Western China, make full use of this yet-to-be-fully-explored market.

In China's Central region, international e-commerce has been a critical driver of economic growth, underscoring the effectiveness of the region's strategic approach towards the development of international e-commerce. To encourage stronger and superior progress of international e-commerce, this document recommends that the government of Central China increase both incentives for and regulation of cross-border e-commerce enterprises. Such measures are anticipated to support the enduring economic progress of the Central region.

In Eastern China, the international e-commerce sector has reached a level of maturity and has contributed to economic stimulation. To encourage a harmonious economic development in the Eastern region, this paper proposes that Eastern China should integrate the international e-commerce industry with its established sectors, such as the light industry, textile industry, and agriculture. This can ensure the coordinated development of multiple industries and promote the export-oriented economy in the Eastern region.

## 6. Conclusion

This paper investigates how international e-commerce has contributed to China's economic resurgence following the pandemic, focusing on regional differences. Using fixed effects models and multiple regression analyses, it uncovers that the impact varies across regions. In Western China, the analysis shows no significant link between economic volume or per capita income and cross-border e-commerce transactions, likely due to inadequate infrastructure and stagnant development in the sector. Recommendations include enhancing transportation networks to foster growth. Central China's analysis reveals that cross-border e-commerce significantly boosts both total economic output and per capita income, attributed to government and business support. Recommendations for Central China emphasize increasing incentives and oversight for e-commerce businesses. In Eastern China, while a slight negative relationship exists between e-commerce transactions and overall economic size, a notable positive correlation with per capita income is observed, reflecting the region's early investment in and rapid growth of e-commerce. To leverage e-commerce for broader economic benefits, the article suggests integrating it with traditional industries in the East, such as light manufacturing, textiles, and agriculture.

This study academically explores the regional disparities in international e-commerce evolution across China and its link to economic recovery post-pandemic., delving into a topic that has not been extensively researched before. Practically, it assesses regional e-commerce characteristics and their impact on economic revival, offering recommendations for sustainable growth. These insights not only benefit China's diverse regions but also serve as a reference for other countries interested in developing international e-commerce.

Since it has only been more than two years since the pandemic ended, the post-pandemic data samples collected in this article are smaller than those before the pandemic. Therefore, there may be some errors in the process of studying regional heterogeneity, and these errors may have some disturbances on the result. At the same time, different regions in China are affected by the pandemic to varying degrees. Factors like the onset of the pandemic and healthcare circumstances can alter how the pandemic affects the regional economy and cross-border e-commerce, potentially leading to some disruptions in the ultimate outcomes of the experiment. As time goes by, there will be more post-pandemic data samples in the future. At the same time, if the impact of the pandemic in different regions can be quantified and added as a variable to the model and regression, it will be very beneficial for this article to conduct in-depth research on this topic.

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