Proceedings of the 8th International Conference on Economic Management and Green Development
DOI: 10.54254/2754-1169/126/2024.17811

The Impact of E-commerce Development on Regional Economy, Household Income, and Population Mobility: An Empirical Study Based on Zhejiang Province from 2000 to 2021

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Abstract: This study explores the impact of e-commerce development on regional economic growth, household income, and population mobility in Zhejiang Province from 2000 to 2021. Using a dynamic panel data model, the paper analyzes the influence of e-commerce, measured by Taobao Villages, on economic performance and migration patterns across counties. The results reveal a significant negative correlation between e-commerce development and economic growth, suggesting that in the short term, the increase in operational costs may outweigh the benefits. However, e-commerce significantly enhances the income of both urban and rural residents and indirectly influences population mobility by attracting labor back to small and medium-sized cities and rural areas. This study provides critical insights for policymakers in balancing the economic impacts of e-commerce and addressing population dynamics.

Keywords: E-commerce, Regional Economic Growth, Household Income, Population Mobility, Zhejiang Province.

1. Introduction

With the rapid development of e-commerce, studying its impact on regional economic and social development has become increasingly important. By systematically reviewing relevant literature, this paper discusses the roles and mechanisms of e-commerce in promoting economic growth, increasing household income, and influencing population mobility. The aim is to provide a theoretical foundation for studying the impact of e-commerce development on the economy and population dynamics in Zhejiang Province's counties from 2000 to 2021.

2. Literature Review

2.1. The Impact of E-commerce on County-level Economic Development

2.1.1. Pathways through Which E-commerce Promotes Economic Development

E-commerce promotes local economic development through multiple pathways. Some studies suggest that e-commerce challenges the central role of large cities by promoting equal opportunities,

DOI: 10.54254/2754-1169/126/2024.17811

thus bringing new opportunities for county-level economic development[1]. The development of e-commerce also drives the advancement of modern logistics and promotes urbanization through industrial clustering effects[2]. These studies indicate that e-commerce not only promotes economic development through direct commercial activities but also indirectly boosts the overall regional economy by fostering the development of related industries.

2.1.2. Regional Heterogeneity in the Economic Impact of E-commerce

The positive impact of e-commerce on economic development exhibits regional heterogeneity. Studies have pointed out that in regions with high transportation development levels, such as eastern China, the development of e-commerce significantly promotes economic growth. In contrast, in central and western regions, where infrastructure is relatively underdeveloped, the economic benefits of e-commerce are limited. This regional disparity mainly stems from differences in infrastructure, where the well-developed logistics and supply chain systems in the eastern region enable e-commerce to more effectively reduce costs and improve efficiency, thereby promoting greater economic development[3].

2.1.3. Contrasting Views and Their Rationale

While most studies support the notion that e-commerce promotes economic development, some scholars present opposing views.[4] argue that government support for e-commerce in small regions may lead to increased business costs, raising the prices of factors such as land and labor, thereby dampening firms' production incentives. Moreover, Chen Ying suggests that while e-commerce can narrow the urban-rural income gap in the short term, it may widen this gap in the long term, which could be detrimental to sustainable economic development[5]. These opposing views provide alternative perspectives for comprehensively understanding the impact of e-commerce on economic development.

2.2. The Impact of E-commerce on Household Income

2.2.1. Pathways for Increasing Household Income

E-commerce not only fosters economic growth but also significantly increases household income. Studies have shown that e-commerce boosts household income by creating job opportunities, enhancing labor productivity, and promoting consumption[6,7]. The research by Zhan Jintao also confirms that the development of e-commerce can contribute to achieving common prosperity by increasing rural household income[8]. These studies highlight the significant role of e-commerce in enhancing household income, particularly in rural areas.

2.2.2. The Expansion of the Income Gap

Although e-commerce can raise overall income levels, its impact on income inequality remains contentious. Chen Ying notes that while e-commerce can narrow the urban-rural income gap in the short term, it may widen this gap in the long term, leading to imbalanced economic development[5]. This perspective provides a necessary supplement for comprehensively understanding the impact of e-commerce on income distribution.

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2.3. The Impact of E-commerce on Population Mobility

2.3.1. Mechanisms for Promoting Population Return

Some domestic scholars believe that the development of e-commerce can attract labor back to local areas by driving local economic growth and improving employment conditions. Wang Ling, from the perspective of new economic geography, proposes that e-commerce can alter the supply structure of goods and services between large cities and small and medium-sized cities, reducing the attractiveness of large cities and increasing the appeal of small and medium-sized cities to the population[9]. Additionally, the rise of Taobao Villages is seen as a crucial factor in promoting population return, attracting more labor back to rural areas for entrepreneurship through its impact on industrial structure[10].

2.3.2. The Existence of Regional Heterogeneity

Existing studies suggest that in underdeveloped regions such as the central and western areas, where reliance on agricultural products is high, e-commerce is more likely to attract labor back by expanding market demand and job opportunities[10]. These viewpoints help in understanding the potential impact of e-commerce on population mobility across different regions.

2.3.3. Supplement from Foreign Studies

Foreign scholars have conducted relatively few studies on the relationship between e-commerce and population mobility in China. The existing research mainly focuses on explaining the economic mechanisms of population mobility, such as the Free Capital Model proposed by Martin and the Free Entrepreneur Model by Ottaviano, which reveal the mechanisms of population mobility under asymmetric population scales and transaction costs[11,12]. However, empirical studies directly linking e-commerce to population mobility remain scarce.

2.4. Research Gaps and Future Directions

In summary, although many studies have explored the impact of e-commerce on economic development, the mechanisms through which it affects population mobility via economic growth and household income are not yet clear. Most existing research focuses on underdeveloped regions, neglecting the particularities of developed regions. This study examines the counties of Zhejiang Province from 2000 to 2021, representing a developed region, thereby partially addressing the research gap primarily focused on underdeveloped areas. Therefore, this paper proposes the following research hypotheses:

- Hypothesis 1: The level of e-commerce development does not directly influence population mobility.
- Hypothesis 2: The level of e-commerce development affects county-level economic development and household income. Specifically, the level of e-commerce development is negatively correlated with economic growth and positively correlated with household income.
- Hypothesis 3: Economic growth is negatively correlated with population mobility, and household income is positively correlated with population mobility.
- Hypothesis 4: Although the level of e-commerce development does not directly influence population mobility, it indirectly affects population mobility by influencing county-level economic development and household income.

DOI: 10.54254/2754-1169/126/2024.17811

3. Research Methodology

3.1. Model Specification

This study employs a dynamic panel data model to analyze the impact of e-commerce development on local economies, household income, and population mobility across counties in Zhejiang Province from 2000 to 2021. The dynamic panel data model has several advantages: it can handle autocorrelation issues in time series data, control for unobservable individual effects, and address endogeneity problems.

To ensure the robustness of the estimates, this study incorporates time effects and individual effects into the model and uses the System Generalized Method of Moments [System GMM] for estimation. The System GMM approach constructs instrumental variables to effectively address endogeneity issues.

The basic model is specified as follows:

$$\begin{aligned}\text{Population\_Flow\_Rate}_{it} &= \alpha + \beta_1\ \text{TB\_Villages}_{it} + \beta_2\ \text{GDP}_{it} + \beta_3\ \text{Urban\_Inc}_{it} + \beta_4\ \text{Rural\_Inc}_{it} \\ &+ \beta_5\ \text{Ind\_Structure}_{it} + \beta_6\ \text{Fiscal\_Exp}_{it} + \beta_7\ \text{Ind\_Enterprises}_{it} \\ &+ \beta_8\ \text{MS\_Students}_{it} + \beta_9\ \text{Hosp\_Beds}_{it} + \lambda_t + \mu_i + \epsilon_{it}\end{aligned}$$

Where α is the constant term, $\beta 1, \beta 2, \ldots, \beta 9$ are the parameters to be estimated, λt represents time effects, μi represents individual effects, and ϵit represents the random error term.

Additionally, to test the mediating effects of e-commerce development on economic growth and household income, this study conducts a mediation analysis using stepwise regression. The specific steps are as follows:

1. Regression analysis of the impact of e-commerce development on economic growth and household income.
2. Analysis of the impact of e-commerce development on population mobility, controlling for economic growth and household income.
3. Testing the significance of the mediating variables in the above models to determine the existence of mediation effects.

3.2. Variable Descriptions

3.2.1. Dependent Variables

The dependent variables of this study are the population flow rate [Population_Flow_Rate] and the annual difference in the population flow rate [Population_Flow_Rate_Diff].

- Population Flow Rate [Population_Flow_Rate]:

$$\text{Population\_Flow\_Rate} = \frac{\text{Tot\_Pop} - \text{Hukou\_Pop}}{\text{Hukou\_Pop}}$$

This variable reflects the mobility of the population within a county, i.e., the ratio of the total population at the end of the year to the registered population.

- Annual Difference in Population Flow Rate [Population_Flow_Rate_Diff]:

$$\text{Population\_Flow\_Rate\_Diff} = \text{Population\_Flow\_Rate}_{t} - \text{Population\_Flow\_Rate}_{t-1}$$

DOI: 10.54254/2754-1169/126/2024.17811

This variable measures the change in the population flow rate from one year to the next, reflecting the dynamic characteristics of population mobility.

3.2.2. Independent Variables

The independent variable is the level of e-commerce development, measured by the number of Taobao Villages [TB_Villages]. TB_Villages is a binary variable, with counties without Taobao Villages coded as 0, and counties with Taobao Villages coded as 1. The number of Taobao Villages directly reflects the level of e-commerce development within a county and has a significant impact on the local economy and population mobility.

3.2.3. Control Variables

To control for other factors affecting the dependent variables, this study introduces the following control variables:

- Economic Growth [GDP]:
  Regional Gross Domestic Product [in ten thousand yuan] is a crucial indicator of the level of economic development within a county.
- Household Income [Urban_Inc and Rural_Inc]:
  Urban per capita disposable income [in yuan] and rural per capita disposable income [in yuan] reflect the income level and quality of life of residents.
- Industrial Structure [Ind_Structure]:
  This variable reflects the characteristics of the county's industrial structure, with the ratio of tertiary to the secondary industry-added value indicating the level of economic development and industrial upgrading.
- Local Government Expenditure [Fiscal_Exp]:
  Local government budgetary expenditure [in ten thousand yuan] reflects the level of local government investment in public services and infrastructure.
- Number of Local Enterprises [Ind_Enterprises]:
  The number of industrial enterprises above a designated size reflects the number and scale of industrial enterprises within a county, which has a significant impact on local economic development.
- Human Resources [MS_Students]:
  The number of students enrolled in regular secondary schools reflects the supply of human resources and the level of education within a county.
- Public Services [Hosp_Beds]:
  The number of hospital and health center beds reflects the level of public services and the supply of medical resources within a county.

Table 1: Descriptive statistics

	N	mean	sd	min	max
Population_Flow_Rate_Diff	1,957	0.000	0.040	-0.400	0.410
TB_Villages	1,958	0.250	0.430	0.000	1.000
GDP	1,958	3.24e+06	3.20e+06	81600.000	3.05e+07
Urban_Inc	1,958	30929.960	14046.900	6461.000	98402.290
Rural_Inc	1,958	15528.470	8727.760	1410.000	54802.820
Fiscal_Exp	1,958	3.83e+05	3.73e+05	9372.000	4.14e+06
Ind_Enterprises	1,958	473.020	394.730	9.000	3159.000

DOI: 10.54254/2754-1169/126/2024.17811

Table 1: (continued).

MS_Students	1,958	27474.820	16331.320	1800.000	93027.000
Hosp_Beds	1,958	1868.450	1363.380	112.000	17062.000
Ind_Structure	1,958	0.900	0.470	-2.260	6.310

4. Results and Conclusion

4.1. Impact Analysis

Table 2: Impact Analysis

	(1)
Population Flow Rate Diff	
L.Population Flow Rate Diff	-0.500***
	(0.00473)
TB Villages	0.000263
	(0.00400)
Ind Structure	-0.00576
	(0.00350)
Fiscal Exp	3.20e-08**
	(1.27e-08)
Ind Enterprises	-0.00000545
	(0.00000498)
MS Students	0.000000620**
	(0.000000285)
Hosp Beds	-0.00000179
	(0.00000200)
cons	-0.0186**
	(0.00932)
N	1779

Using the Arellano-Bond dynamic panel data model for impact analysis, the results indicate that the number of Taobao Villages does not have a significant impact on the annual difference in population flow rate [coefficient 0.0002631, p = 0.948]. This result confirms Hypothesis 1: E-commerce development does not directly affect population mobility.

4.2. Mediation Mechanism Analysis

Table 3: Mediation Analysis

	(1)	(2)	(3)	(4)	(5)
L.GDP	0.141∗				
	(0.0768)				
GDP				−3.22e−09∗	−3.53e−09∗
				(1.75e−09)	(1.88e−09)
TB_Villages	−281250.4∗∗∗	3509.6∗∗∗	2186.5∗∗∗	−0.00340	
	(105090.5)	(841.1)	(540.2)		
L.Urban_Inc		0.191∗∗∗			
		(0.0597)			

DOI: 10.54254/2754-1169/126/2024.17811

Table 3: (continued).

Urban_Inc				0.00000142∗∗∗	0.00000144∗∗∗
				(0.000000447)	(0.000000460)
L.Rural_Inc			0.182∗∗∗		
			(0.0615)		
Rural_Inc				−0.00000152∗∗	−0.00000148∗∗
				(0.000000615)	(0.000000609)
Ind_Structure	413233.2	1659.5	642.1	−0.00635∗	−0.00636∗
	(424662.8)	(1989.5)	(1373.7)	(0.00369)	(0.00373)
Fiscal_Exp	5.303∗∗∗	0.0146∗∗∗	0.0101∗∗∗	3.10e−08∗∗	3.40e−08∗∗
	(0.710)	(0.00434)	(0.00236)	(1.26e−08)	(1.33e−08)
Ind_Enterprises	650.3∗∗∗	3.407∗	2.432∗∗	−0.00000390	−0.00000315
	(233.9)	(1.799)	(1.114)	(0.00000482)	(0.00000530)
MS_Students	−19.17	−0.625∗∗∗	−0.402∗∗∗	0.000000887∗∗∗	0.000000880∗∗∗
	(13.69)	(0.104)	(0.0599)	(0.000000309)	(0.000000305)
Hosp_Beds	386.9∗∗∗	2.433∗∗∗	1.352∗∗∗	−0.00000159	−0.00000146
	(99.26)	(0.680)	(0.450)	(0.00000235)	(0.00000230)
L.Population_ Flow_Rate_Diff				−0.502∗∗∗	−0.503∗∗∗
				(0.00503)	(0.00500)
____cons	−34953.6	28427.1∗∗∗	15243.5∗∗∗	−0.0361∗∗∗	−0.0369∗∗∗
	(563022.2)	(3713.5)	(2278.5)	(0.0108)	(0.0113)
N	1780	1780	1780	1779	1779

To further examine the mediating effects of e-commerce development on economic growth and household income, this study conducted a stepwise regression analysis.

Step 1: Regression of the Independent Variable on the Mediating Variables

First, the impact of e-commerce on economic growth: E-commerce development is significantly negatively correlated with county-level economic growth. Specifically, an increase in the number of Taobao Villages significantly negatively impacts GDP [coefficient -281250.4, p = 0.007]. This result supports Hypothesis 2: The level of e-commerce development is negatively correlated with economic growth. This contrasts with the findings of Lin and Qin, who highlighted the positive effects of e-commerce by promoting modern logistics and industrial clustering[1,2]. However, the results of this study may reflect the short-term increase in operating costs, such as land and labor costs, associated with e-commerce, which may suppress economic growth. This also echoes the views of Tang and Zhu, who argued that government support for e-commerce in small regions may increase business costs, thereby reducing production incentives[4].

Second, regarding the impact of e-commerce on household income: The results support Hypothesis 2, showing a positive correlation between the level of e-commerce development and household income. Specifically, e-commerce significantly increases the disposable income of both urban and rural residents. The results indicate that the number of Taobao Villages has a significant positive impact on urban per capita disposable income [Urban_Inc, coefficient 3509.6, $p < 0.01$] and rural per capita disposable income [Rural_Inc, coefficient 2186.5, $p < 0.01$]. This finding supports the research of Cao Zengdong and Zhang Peiliei, indicating that e-commerce significantly increases household income by creating job opportunities and improving labor productivity[6,7].

Step 2: Regression of the Dependent Variable on the Mediating Variables

Controlling for GDP, urban per capita disposable income, and rural per capita disposable income, the results show that: First, GDP has a near-significant negative correlation with population mobility [coefficient -3.22e-09, p = 0.066]. Second, urban per capita disposable income has a significant

DOI: 10.54254/2754-1169/126/2024.17811

positive impact on population mobility [coefficient 1.42e-06, p = 0.001]. Finally, rural per capita disposable income has a significant negative impact on population mobility [coefficient -1.52e-06, p = 0.013].

The results of the regression analysis from the dependent variable to the mediating variables indicate that GDP and household income affect population mobility. Specifically, GDP is negatively correlated with population mobility, while household income is positively correlated with population mobility. This result supports Hypothesis 3.

Summary of the Impact Analysis and Mechanism Analysis Results:

While the direct impact analysis shows that the number of Taobao Villages does not significantly affect population mobility, the mediating variables [GDP, urban income, and rural income] significantly influence population mobility, and e-commerce significantly impacts these mediating variables. This suggests that while e-commerce development does not directly affect population mobility, it indirectly influences population mobility by affecting economic growth and increasing household income, thereby altering population mobility patterns to some extent. A possible explanation is that e-commerce may attract more labor back to small and medium-sized cities and rural areas by improving income levels. In conclusion, the mechanism through which e-commerce influences population mobility through mediating variables may exist, partially validating Hypothesis 4.

5. Discussion

The results of this study supplement and extend the existing literature in several ways. First, the negative correlation between e-commerce and economic growth suggests that a more comprehensive consideration of the overall impact of e-commerce on local economies is necessary. Although Lin and Qin emphasized the positive effects of e-commerce, our findings indicate that e-commerce may suppress local economic growth in the short term by increasing factor prices. This finding provides a new perspective for policymakers, suggesting that measures should be taken to reduce business costs and avoid the cost increases associated with excessive competition in the process of promoting e-commerce development[1,2].

Second, the significant positive impact of e-commerce on household income further verifies its positive effects on income distribution and economic equality. Zhang Peili pointed out that e-commerce helps achieve common prosperity in rural areas by increasing job opportunities and improving labor productivity[6]. These findings not only support this view but also reveal the positive impact of e-commerce on urban household income, indicating that e-commerce has significant income-enhancing effects across different regions.

Moreover, the indirect impact of e-commerce on population mobility highlights its potential to alter migration patterns. Wang Ling argued that e-commerce could reduce the attractiveness of large cities and increase the appeal of small and medium-sized cities to the population by altering the supply structure of goods and services[9]. Our findings show that e-commerce significantly influences the annual difference in population flow rate by improving household income, especially urban income. This finding provides policymakers with new ideas, suggesting that developing e-commerce and improving income levels can attract labor back to small and medium-sized cities, thereby alleviating the over-congestion of large cities and the population loss of small and medium-sized cities.

5.1. Policy Implications

Based on the above conclusions, this study offers the following recommendations for policymakers:

1. Comprehensively Assess the Impact of E-commerce on Local Economies:

   In promoting e-commerce development, attention should be paid to its overall impact on local

DOI: 10.54254/2754-1169/126/2024.17811

economies, particularly the potential short-term increase in factor prices. The government should take measures to reduce business costs, such as offering tax incentives and financial subsidies, to encourage businesses to participate in e-commerce activities on a cost-effective basis.

2. Strengthen Policy Support for Different Regions:
   E-commerce has a significant impact on household income, but its effects may vary across different regions. The government should formulate targeted policy measures based on the specific circumstances of different regions, particularly by enhancing support for rural and small and medium-sized cities to promote e-commerce development and achieve income equality and common prosperity.
3. Leverage E-commerce to Promote Population Return:
   E-commerce development has a significant impact on population mobility patterns. The government can attract labor back by developing e-commerce and raising income levels in small and medium-sized cities and rural areas. This can help alleviate the over-congestion of large cities and promote economic development and social stability in small and medium-sized cities and rural areas.

5.2. Research Limitations and Future Directions

Despite the achievements of this study, some limitations remain. First, the research data is limited to Zhejiang Province, which may not fully reflect the situation nationwide. Future research could expand the data scope to further validate the generalizability of the research conclusions. Second, the impact of e-commerce on local economic and social development is a complex process, and future research could consider more variables and mechanisms to explore its impact pathways and mechanisms in greater depth.

In conclusion, this study reveals the multifaceted impact of e-commerce development on local economies, household income, and population mobility through empirical analysis, providing valuable references for policymakers. Future research should further, expand and deepen these findings to more comprehensively understand the role of e-commerce in regional economic and social development.

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