

## On the E-commerce Simulation Analysis of Northwest Ethnic Regions in China

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**Abstract:** E-commerce is a new type of economic activity that is highly integrated with modern information technology and business activities. It has become an important force to lead the transformation of production and lifestyle in ethnic areas. Based on the theory of system dynamics, this paper uses Vensim PLE software to construct the e-commerce industry development system dynamics model, and simulates the development of e-commerce industry from 2005 to 2015. By the validity and applicability of the data verification, this paper systematically analyzes the main influencing factors and trend characteristics of the development of e-commerce industry in the northwestern minority areas in China. Finally, according to the results of simulation and operation, combined with the current situation of e-commerce industry in China's ethnic regions, it provides corresponding countermeasures and suggestions for the development of e-commerce industry.

### 1. Introduction

In recent years, e-commerce has developed rapidly and has become an important part of China's strategic emerging industries. It has penetrated into various industries and market demand is growing. It is an important tool for realizing the "Internet +" strategy. Structural adjustment and other aspects have played a key role and have increasingly become an important engine for promoting China's economic transformation and upgrading. At the same time, China's e-commerce development still faces contradictions and problems such as unregulated market system, imperfect legal system and imperfect logistics support. The development lacks effective long-term mechanism and support guarantee. For this reason, it is necessary to analyze the development of e-commerce in depth. Dynamic mechanism provides targeted countermeasures for the sustainable and healthy development of e-commerce in China.

System dynamics is widely used to study economic management problems, and it is also effective in solving problems in the field of e-commerce. Yu and Yang (2013) used the analysis theory of system dynamics to construct a model of agricultural e-commerce development dynamic system and explored the influencing factors of agricultural e-commerce development. Zhang and Tang (2013) used system dynamics to simulate the operation of the mobile e-commerce industry chain, and deeply analyzed the constraints of mobile e-commerce payment problems. Zhang (2014) used the system dynamics method to model and analyze e-commerce third-party logistics, and simulated the model of Taobao historical data. Xu (2015) applied the theory of system dynamics to study the dynamic mechanism of agricultural e-commerce development. On this basis, the evaluation index of agricultural e-commerce development was constructed to provide theoretical support for the research of e-commerce development level. Ma (2015) uses system dynamics to establish a dynamic model of word-of-mouth and purchase intention in online shopping, and analyzes the importance of e-commerce consumer experience and word of mouth. Wu (2016) used the system dynamics method to evaluate the online shopping express logistics service, explored the influencing factors affecting the logistics service level and proposed corresponding countermeasures. Tang and Wu (2018) applied the principle of system dynamics to discuss the factors in the process of promoting the

development of e-commerce, and analyzed the influence mechanism of e-commerce. Xu et al. (2018) constructed a system-based quantitative model of e-commerce knowledge management based on information ecological chain, and simulated and sensitivity analysis of the model. E-commerce is a dynamic development system, in which the elements change with time and space. System dynamics is used in the research industry development system to prove its unique superiority. It is feasible to use system dynamics to study the development of e-commerce industry.

## **2. System Dynamics Modeling Steps**

### **2.1 System Analysis.**

First of all, we must conduct in-depth and extensive analysis and research on the research objects, and clarify the system needs. The problem to be solved, confirm the system objectives, collect relevant data, and define the main variables of the system.

### **2.2 Drawing System Causality Diagram.**

According to the characteristics of the system, the system is divided into several subsystems to determine System boundary, analyze and define various variables within the system, clarify the causal relationship between variables, and find out the system's flaws Feedback structure and plot causality.

### **2.3 Establishing System Dynamics Model.**

Through system analysis, on the basis of causality diagram, describe the dynamic equation of the system, clarify the types of variables in the feedback loop, and use the relevant simulation software to build the model.

### **2.4 Verify the Validity.**

The model is tested by simulation, the validity and sensitivity of the model are tested, and the model parameters and structure are optimized based on the model results. □□

### **2.5 Policy Analysis.**

By changing the model parameters and model structure to analyze the impact level of certain policies, we seek a policy plan that can solve the real problems of the system.

## **3. Model and Description**

System dynamics is a systematic analysis of socio-economic problems by combining qualitative and quantitative methods. Causality diagram is a qualitative description of the internal structure relationship of the system, which can reflect the relationship between various variables in the model, which is the basis of system dynamics modeling. According to the above steps of the e-commerce industry development system subsystem, this paper intends to conduct a deeper causal relationship analysis of the system. The following is the analysis of the causal feedback relationship of the four subsystems of the system as shown in Table 1.

### **3.1 Technology Advancement**

The technology advancement subsystem is a subsystem based on electronic payment technology innovation, business model innovation and logistics technology innovation, and is the core driving force for the development of e-commerce industry. The technology advancement subsystem indicates that the improvement of the level of e-commerce technology innovation can continuously improve the development level of the e-commerce industry. A good user experience comes from superior technology. The human-computer interaction of e-commerce websites depends on technology, and both conversion rate and stickiness require technology. At the same time, technology is the cornerstone of precision marketing and the need for lean management. Technology runs through all aspects of e-commerce. The development of the e-commerce industry will

encourage the government to increase capital investment and personnel training for the e-commerce industry. At the same time, because technological innovation can bring about an increase in profits, e-commerce companies will also increase investment in technology research and development, and industry-university-research cooperation will further enhance the level of industrial technology innovation.

Table 1 Model and variable descriptions

Subsystem	Variable	Subsystem descriptions
Technology Advancement	Gross agricultural output	Technological progress; E-commerce industry development; E-commerce strategic position; Government support; R&D investment; Industry-university-research cooperation; government support; E-commerce talent training; corporate profit
	Per capita income of rural residents	
	Rural E-commerce supplier output	
Market Demand	Rural E-commerce fixed asset investment	Market demand; E-commerce transaction volume; E-commerce industry development; contribution coefficient of E-commerce to GDP; GDP per capita; per capita consumption expenditure; E-commerce consumer expenditure; government policy; information literacy
	Rural E-commerce fixed asset investment postpone	
	National poverty alleviation conversion coefficient	
	Agricultural financial subsidy	
Economic Development	Rural E-commerce education investment postpone	economic development level; government support; E-commerce transaction volume; E-commerce industry development; E-commerce contribution coefficient to GDP; GDP per capita; market demand; GDP
	Rural E-commerce education investment	
Industrial Environment	Rural e-commerce lag factor	Government support; financial support; E-commerce industry development; E-commerce transaction volume; E-commerce industry strategic position; talent support; E-commerce contribution rate to GDP; laws and regulations
	Logistics cost impact factor	
	Ethnic lag factor	

### 3.2 Market Demand

As the income level of residents increases, e-commerce consumption also increases. Online shopping has a huge consumer market because of its convenience and time-saving for consumers. At the same time, with the improvement of information literacy for all people, more and more people have learned to shop through mobile phones and computers, and the popularity of e-commerce is getting higher and higher. At the same time, in order to promote the development of the e-commerce industry, the government will also encourage relevant government departments to implement online procurement, and the market demand for e-commerce will be further expanded. The market demand subsystem reflects the following three main implications.

First, economic development has increased the income of residents. The increase in per capita income will promote the increase of consumer demand. To a certain extent, the proportion of e-commerce channel consumption will increase accordingly, thus stimulating the demand of e-

commerce market and promoting the development of e-commerce industry. The role of e-commerce as a new impetus for economic development has been strengthened, thereby promoting faster economic development. Second, the improvement of the level of economic development, the level of national informatization is getting higher and higher, the government will strengthen the informationization propaganda and education work to improve the information literacy of residents, increase the penetration rate of the Internet, and the scale of online shopping users will increase, thus driving the electronic Business market demand, promote the development of e-commerce industry and enhance the level of economic development. Third, in order to promote the development of e-commerce, the government will encourage relevant government departments to conduct online procurement, thereby stimulating the demand of the e-commerce market, promoting the development of e-commerce industry, and raising GDP.

### **3.3 Economic Development**

The e-commerce industry has become a new impetus for economic growth, mainly reflected in its contribution to GDP growth. The increase of GDP will promote the increase of per capita income of residents, and the increase of per capita income of residents can promote the increase of e-commerce consumption expenditure of residents, and then promote the consumption demand of e-commerce market. At the same time, with the strong effect of e-commerce on economic development, the government will support the development of e-commerce, and the development of e-commerce industry and the promotion of economic development will promote the continuous development of both.

The economic development subsystem indicates that economic development will promote the development of e-commerce industry. At the same time, the development of e-commerce industry will promote economic development, and the two promote each other. The development of e-commerce industry has not only created new consumer demand, but also opened up employment channels, and e-commerce is accelerating the integration with the manufacturing industry, promoting the transformation and upgrading of the service industry, and becoming a new driving force for economic development. At the same time, the promotion of e-commerce strategic status will encourage the government to vigorously promote industrial policy support, improve the e-commerce development environment, further stimulate the development momentum of e-commerce innovation, accelerate the adjustment of economic structure, and achieve economic upgrading and efficiency upgrading.

### **3.4 Industrial Environment**

The environmental system is the general policy of industrial policies, laws and regulations that support and guarantee the development of the e-commerce industry, and is the basis for obtaining resources such as funds and talents. The environmental system directly or indirectly affects the development of the e-commerce industry through various types of funds, talents, and logistics services. In the industrial environment subsystem, it mainly studies the impact of industrial policies, laws and regulations on the development of e-commerce industry.

The industrial environment subsystem indicates that the government has increased the financial support, strengthened the training of e-commerce talents, improved the e-commerce laws and regulations, etc., created a good e-commerce environment, enhanced the trust of consumers and sellers, and enhanced the online shopping viscosity of consumers. The amount of e-commerce transactions increases the contribution rate of e-commerce to the economy. With the strategic status of e-commerce, the government will further promote the development of e-commerce.

### **3.5 Variable Determination and Model Construction.**

The system dynamics construction model emphasizes the composition of the model. This paper selects 2005-2015 as the research period, the data mainly comes from China Statistical Yearbook, 2009-2014 China E-commerce Development Report, 1997-2009 China E-commerce 12-year Survey Report, research Announced the China E-commerce Industry Development Report and China Science and Technology Statistical Yearbook.

### 3.6 Model Validity Test.

In order to verify the validity and reliability of the model and ensure that the operational data of the model can accurately reflect the actual situation, it is necessary to compare the simulation data of the model with historical data. The paper selects the total GDP as the test variable, and compares the simulated value of the model with the actual value from 2005 to 2014. The relative error of the important parameters is calculated. The analysis model has good simulation effect. The test data is as shown in the Table 2 as following

Table 2 Comparison of actual GDP data with simulation data

year	GDP real values (hundred million)	GDP simulated values (hundred million)	Relative Error (%)
2005	184.937	184.957	0.01
2006	216.315	217.541	0.34
2007	265.71	259.591	2.34
2008	314.257	314.548	0.13
2009	340.597	360.478	4.74
2010	401.625	382.641	4.62
2011	473.104	460.214	2.74
2012	519.547	525.478	1.22
2013	564.217	547.369	3.47
2014	634.154	636.485	0.02
2015	638.547	647.214	0.01

It can be seen from the data in the table that the relative error between the simulated value and the actual value of the model is 4.74%, the minimum value is 0.02%, and the error is less than 5%, which is within the allowable range, indicating the simulation results of the model. The actual value has a good fitting degree and has certain authenticity and validity, which can be used to judge the future development trend of the system.

### 4. Model Results and Policy Analysis

According to the analysis in the previous chapters, the system dynamics model of E-commerce industry development constructed in this paper can better simulate the interaction between China's E-commerce industry and economic development. The simulation results of the main variables of the model show the trends of GDP, E-commerce output value. According to the simulation results, the following conclusions can be drawn:

(1) According to the China Statistical Yearbook, China's GDP has maintained steady and rapid growth during the period from 2005 to 2015, and the model simulation results are in line with the actual situation. It is predicted that China's GDP will continue to grow steadily from 2015 to 2020, which is in line with experts' predictions about the future economic development. The government should gradually increase investment in the E-commerce industry and provide strong financial and policy support for the development of the industry.

(2) From 2005 to 2020, China's E-commerce output value will continue to rise steadily. After the exploration and rational adjustment during the 10th Five-Year Plan period, China's E-commerce began to enter the track of pragmatic development. In 2005, the E-commerce transaction volume was 74 million yuan. In 2008, the scale of E-commerce transactions exceeded 10 billion. In 2010, the number of SME users using third-party E-commerce platforms in China has exceeded 1.4 million, compared with 55% in 2008. In 2015, China's E-commerce transaction volume reached 1.8 trillion yuan. According to the simulation trend simulation, China's E-commerce transaction volume will exceed 2.2 trillion yuan in 2020.

### 5. Conclusions

The biggest advantage of the system dynamics model is that the variable coefficients which can

be adjusted for simulation experiments, and the influencing factors of system changes can be understood by simulating the behavior changes of real systems under different strategies, and then the complex problems can be analyzed and designed. Among them, government guidance, logistics level and technological progress can have a greater positive effect on the development of E-commerce industry, and the government guidance coefficient is the most sensitive policy variable in industrial development, and the sensitivity of logistics level is higher than the level of technological progress.

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