

Research Article

Research on the Operation of e-Commerce Enterprises Based on Blockchain Technology and Bilateral Platforms

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E-commerce platform enterprises have typical bilateral market characteristics. The e-commerce platform provides real-time communication services for buyers and sellers. Different buyers and sellers form crossnetwork characteristics. The formulation and implementation of bilateral strategies affect both the merchants and consumers' choice of platform and registration transactions. This impact will directly lead to the transaction value of the platform. Then, the article builds an econometric model and empirically analyses the impact of e-commerce platforms. The e-commerce chain is a complex structure that consists of logistics, information flow, and capital flow and connects suppliers, manufacturers, distributors, and users in the industry together. Blockchain technology can be used as a large-scale collaboration tool to adapt to supply chain management, the main factor that drives the market power of the enterprise. The research results show that the input costs of advertising, research and development, and employee training and the impact of long-term investment and taxation on market forces are quite different in different industries, both positive and negative, and subsidies, inventory, and state-owned holdings have a negative impact on the market power of companies in all industries. Finally, the competition strategy of e-commerce platform enterprises is summarized. On the basis of the conclusions of the theory and case study, the paper puts forward specific suggestions and countermeasures for the competition strategy of e-commerce platform enterprises in the bilateral network environment.

1. Introduction

The bilateral market theory is a broad concern of the economics community since the 21st century. It is based on the multiproduct theory and the network external protection theory and the emerging market theory with the network market as the main research position. Whether it is emerging online shopping, online payment, "computer industry, or traditional intermediary or media industry, there are significant bilateral market characteristics." The existing basic research analysis shows that, for companies in this type of industry, such as product quantity, price positioning and compatibility positioning, quality positioning, etc., the government's policies and regulations on these contents are difficult to explain with traditional market analysis theories [1].

The bilateral market provides a place and opportunity for both parties to complete the transaction theme. The

platform is the core of the bilateral market. The platform provides unique products for the transaction entity to achieve an effective contact with the transaction entity, complete the transaction, and obtain the transaction from the transaction entity.

1.1. Profit. The traditional unilateral market only includes buyers and sellers of commodity transactions, but the bilateral market is different from it. To form a bilateral market, one must meet three conditions: first, the transaction subject must be different and there are two or more groups. Second, there is an effective association between different entities or the implementation of coordinated externalities [2]. Third, there is an institution that transforms the externalities created by a group of subjects into internalized ones [3].

Platform enterprises play an important role in networked market economy and trade activities. These platform

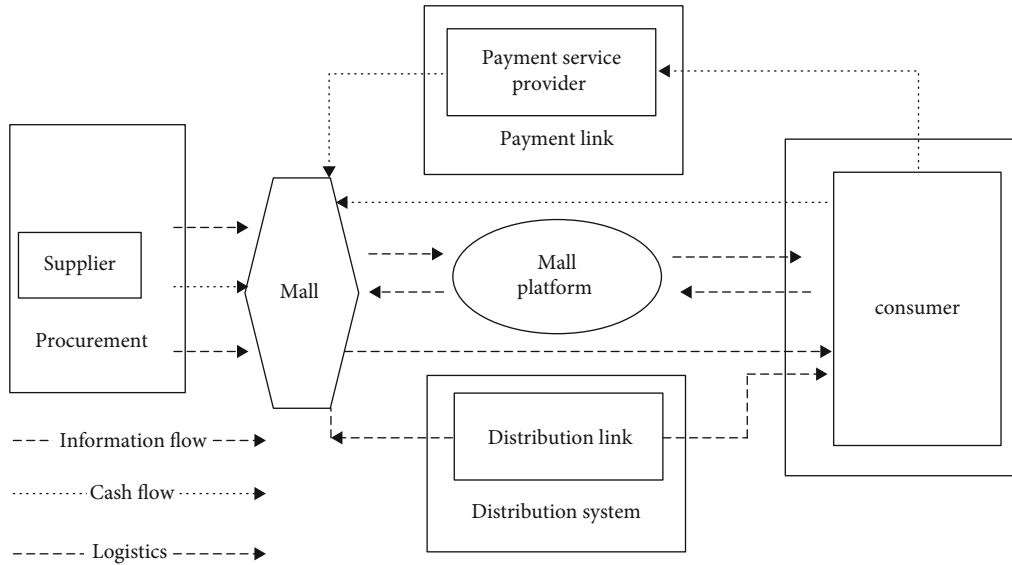


FIGURE 1: Schematic diagram of bilateral market characteristics.

enterprises provide targeted products or services to both parties of the transaction or to multiple users of the transaction. Through differentiated pricing strategies, different users can implement commodity delivery through the platform which has the characteristics of a bilateral market. By definition, it can be concluded that the bilateral market has obvious market characteristics compared with the unilateral market [4].

The so-called “network externality” means that the utility of one side of the main body on both sides of the platform provider will increase as the number of the other side body increases. Network externalities are an important indicator of whether a market is a bilateral market [5, 6]. We can easily associate with the fact that the more that small businesses involved in the surrounding area provide related products and services to a large enterprise at the same time, the higher the information sensitivity between them and the versatility of parts and services. The more that users use a certain kind of resource sharing software, the more valuable shared resources can serve more users and thus more valuable resources will be available for users; for the software value, the software value and utility are constantly improving [7, 8]. From the perspective of the bilateral market, compared with the network externality existing between the same users, the network externality formed based on the bilateral users of the platform is more critical and the crossnetwork externality can be embodied. The quantity will act on the bilateral users of the platform, which will affect the transaction volume. The transaction volume and quantity of bilateral users will have a greater impact. Crossnetworking plays a very important role in establishing a bilateral market [9].

Based on the transaction process of the bilateral market, the formation of a transaction requires the buyer and the seller and the platform enterprise to participate in the transaction process. The platform enterprise provides services for the good delivery between the buyer and the seller in the transaction process. Therefore, the platform enterprise has a separate allocation to the bilateral purchase and sale [10].

1.2. The Cost of the Fee. The formula for calculating the amount that the platform enterprise collects from both parties or unilateral parties is $P = P_b + P_s$ (P_b is the price of the buyer user and P_s is the price of the seller user). The amount charged is related to the trading volume of the platform users and the revenue of the platform. More importantly, this total price should be reasonably distributed among the bilateral users in the market [11].

The so-called “dependency” means that only when the entities located on both sides of the platform provider have a demand for the products or services provided by the platform vendors that the products or services must have the value provided by the platform vendors, or else, the platforms may be different. The theme of the product is not for the purpose of providing products and services, so these products and services cannot reflect their value. Products and services provided by companies in the bilateral market show high filling and interdependence when driving users on both sides of the market to complete a transaction. The existence of a demand becomes a prerequisite for another demand, and mutual dependence and complementarity are reflected [12]. A schematic diagram of the characteristics of the bilateral market is shown in Figure 1 [13, 14].

2. Estimation of Market Power of e-Commerce Enterprises

For the e-commerce platform, from the perspective of network externality, there is a positive crossnetwork externality between the platform, users, and vendors, that is, the platform will gather popularity and scale effects by a large number of users or vendors [15], to attract the other users to join and ultimately reach the stability of users on both sides of the platform. At the same time, users will also have network externalities, especially in the presale model of goods, with the aggregation of users, thus forming a dominant advantage and controlling the price of the transaction. The externalities between vendors are different due to the different effects in

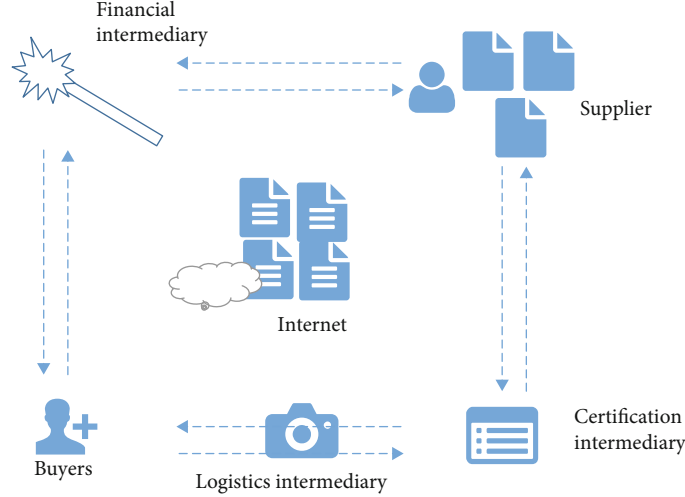


FIGURE 2: E-commerce system structure.

different environments [16]. The externality of the network can be positive or negative. For example, for merchants offering the same kind of goods or services, the greater the number, the more intense the competition and the profit. The more difficult it will be, the lower the willingness of merchants to enter the platform and the negative network externality. For the manufacturers that provide different goods or services, the more manufacturers that join, the stronger the platform will be and the consumption will meet different needs [17]. The ability of the person is stronger, seeing the potential of user purchase, making the manufacturer more willing to enter the platform, which is the positive network externality. Based on the above analysis, we set a parameter t before the parameters of the intragroup network externality between users in the following discussion, in order to specifically consider the C2B which is mainly based on the presale mode and involves the internal and externalities of the user group. The pricing of the e-commerce model is negligible for intergroup network externalities between vendors. The construction of the e-commerce model can be seen in Figure 2 [18].

From the perspective of real experience, manufacturers with seller market power face a large number of consumers in the downstream and can obtain monopoly profits by limiting production and increasing product prices. Consumers can also weaken the vendor's market power by, to a certain extent, freely choosing the purchase channel. In the upstream factor market, manufacturers with buyer market power mainly obtain monopoly profits by lowering factor prices. A large number of scattered sellers make it impossible to choose a transaction object, because consumers have the right to choose merchants. On the other hand, the product storage and transportation costs are high and many products have very strong specialty, which has no other use than selling to the company. Therefore, companies often have stronger market power in the raw material purchase market. Although this empirical inference is logically established, there is currently no empirical analysis by scholars in domestic academic circles.

2.1. Model Construction. Estimating the size of each company's market power is the first step in analyzing the formation of market forces. Traditional estimation methods, including the NEIO model, Solow residual method, and non-parametric method, can only estimate the industry's average Lerner index value, which is obviously inappropriate as a dependent variable, so market forces should be reconsidered.

2.1.1. The Estimation Method. From the current research progress in this area, a more feasible solution is to estimate the Lerner index by estimating the cost function and marginal cost function of the enterprise and combining the output price of the enterprise. Specifically, the cost function is first constructed to estimate the relevant parameters, and then, the marginal cost function is obtained by derivation and the estimated parameter value of the cost function is substituted into the marginal cost function to estimate the Lerner index of each enterprise.

2.1.2. The Index Value. Such a treatment method can reflect the difference in market power of different enterprises and can be used as a dependent variable to analyze the formation factors of market forces.

The stochastic boundary cost function is currently the most widely used form of function for the cost function. Based on the random boundary production function, Schunidt and Lovell constructed the corresponding stochastic boundary cost function. Many scholars have applied the stochastic boundary cost function to study the market power-related issues. According to the special situation of China's food industry, this paper constructs a random boundary cost function as follows:

$$\begin{aligned} \ln cit = & \sum \gamma h \ln whit + \gamma q \ln qit + \frac{1}{2} \sum \sum \gamma hj \ln whit \ln wjit \\ & + \frac{1}{2} \gamma qq (\ln qit)^2 + \sum \gamma hq \ln whit \ln qjit + \rho t T \\ & + \rho q T \ln qjit + \sum \rho h T \ln whit + \ln ui + \ln vi. \end{aligned} \quad (1)$$

In which, cit is the total cost and qit is the total output of enterprise 1, $whit$ is the factor price of the enterprise (including raw materials, labour, and capital), and T is the time trend item, which represents technological progress. By calculating the yield qi , the formula for calculating the marginal cost can be obtained.

$$mcit = \left(\gamma q + \gamma q q \ln qjt + \sum \gamma h q \ln whit + \rho q T \right) \frac{cit}{qit}. \quad (2)$$

Thus, the Lerner index ($l = (p - mc)/p$) of the firm can be further estimated.

According to the “structure-behavior-performance” paradigm, the factors affecting market power can be roughly divided into two categories; one is the industry structure, including the number of buyers and sellers, product differentiation, diversification, manufacturer size, barriers to entry, and vertical integration and second is vendor behavior, including pricing, research and development, collusion, mergers, advertising, and investment. However, in addition to these two factors, government policies often affect the market power of enterprises. Especially in China, state-owned enterprises often have strong market power by virtue of government asylum. Government policies mainly include regulation, antitrust, taxation and subsidies, government procurement, investment incentives, employment incentives, and research and development support.

Among all these variables, only a few are quantifiable, which means that most of the variables affecting market forces cannot be included in the econometric model for empirical analysis, such as product differentiation and barriers to entry, which are formed by the market forces of manufacturers. But because the data is not available, important factors can only be used in qualitative analysis.

Combined with the data acquisition situation, this paper selects seven relatively important and energized indicators from the above variables as the explanatory variables of the model and one control variable and constructs the measurement model as follows:

$$\begin{aligned} \ln Lit = & a + \beta_1 \ln ADVit + \beta_2 \ln RDit + \beta_3 \ln EDUit \\ & + \beta_4 \ln LIit + \beta_5 \ln TAXit + \beta_6 \ln SUBit \\ & + \beta_7 \ln INVit + \beta_8 Dit + \epsilon it. \end{aligned} \quad (3)$$

Respectively represent the company’s market power, advertising investment, R&D investment, personnel training costs, long-term investment, taxes, subsidies, inventory, taxes, subsidies, and dummy variables. Dit presents the external environment of the enterprise; in the virtual variable representing the nature of the property rights of the enterprise, in the paid-in capital of the enterprise, when the proportion of state-owned capital exceeds the proportion of nonstate-owned capital, $D = 1$; otherwise, $D = 0$; $D = 1$ means the enterprise is state controlled, which is a control variable used to observe whether state-owned enterprises have obvious advantages in the formation of market forces.

It is true that the model misses some important explanatory variables, but the purpose of this paper is not to use the

model for prediction but mainly to analyze the impact of each variable on market forces. Therefore, under the condition that the data is not available, this is a suboptimal choice.

2.2. Data Description. The variables selected when estimating the random boundary cost function and the marginal cost are basically the same. Some variables were added in estimating the formation of market forces, including advertising inputs, R&D investment, staff training costs, long-term investments, taxes, subsidies, inventory, and virtual variables of the nature of corporate property rights. The dummy variables of the nature of enterprise property rights are derived from the composition of the paid-in capital of enterprises published in the “China Industrial Enterprise Database”. The paid-in capital in the original data is divided into six categories, namely state-owned capital, collective capital and corporate capital, gold, personal capital, capital from Hong Kong, Macao and Taiwan, and foreign capital. First, calculate the proportion of various types of capital in the paid-in capital, and then, compare the sum of the proportion of the national capital and the proportion of the other five types of capital; the former is greater than the latter and vice versa. The average values of the main variables that affect the formation of market power are shown in Table 1.

The remaining data on variables such as advertising investment and R&D investment are obtained directly from the China Industrial Enterprise Database. Since many companies invest very little or even zero investment in these areas, the explanatory power of individual variables on market forces is relatively weak. See the results of the analysis below.

Table 1 shows the average investment value of enterprises in different industries in advertising, research and development, etc. It can be seen that the tobacco processing enterprises’ investment in various indicators is far greater than other industries. In other industries except tobacco, processing enterprises are significantly more expensive than other companies in terms of advertising investment, and the processing investment of processing enterprises is also the largest among all enterprises. These reflect the behavior characteristics of companies in different industries.

3. Results Analysis

By using the stochastic boundary cost function analysis method in the Stata 12.1 software to regress the model, the cost function of the enterprise can be estimated, as shown in Table 2. It is not difficult to find from the table that except for the automobile processing industry, the parameter estimation of the cost function of other industries is mostly significant, indicating that the fitting effect of the model is better. The best model fitting results are in the tobacco, food, and garment processing industries. As can be seen from the table, the cost function coefficients of these three industries are mostly significant. In industries other than tobacco, multicollinearity problems may exist between the intersection of time-trend items and other variables and certain variables in the model and are therefore eliminated when estimating the model.

TABLE 1: Mean of the main variables affecting the formation of market forces.

Industry	ADV	RD	EDU	LI	TAX	SUB	INV
Tobacco	3030000	10400000	1578855	16500000	91900000	7361961	545000000
Automobile industry	202452	23997	16338	1578228	5327519	237776	59900000
Foodstuffs	15857	19085	93515	5761954	1080000	211211	20400000
Clothing	13479	73224	6309	26413	912358	37938	2721520
Electronic product	31886	3349	6229	404361	808828	128833	9175943

TABLE 2: Parameter estimation of random boundary cost function.

Ln c	Tobacco		Automobile industry		Foodstuffs		Clothing		Electronic product	
	Coefficient	Standard deviation	Coefficient	Standard deviation	Coefficient	Standard deviation	Coefficient	Standard deviation	Coefficient	Standard deviation
γh	219.64	88.164	-41.99	42.14	9.283	4.609	-5.766	4.142	17.868	7.445
$\gamma h j$	-30.55	14.27	6.604	7.010	0.499	0.999	-1.432	0.520	2.508	0.918
γq	121.79	42.04	1.134	14.095	-98.03	16.00	169.7	15.4	-78.884	16.416
$\gamma q q$	0.053	0.010	-7.064	15.711	17.53	2.868	-27.33	2.643	3.579	3.414
$\gamma h q$	-0.228	0.041	3.101	10.010	3.712	1.240	0.018	1.069	8.938	2.046
ρt	0.102	0.032	-0.009	0.158	0.023	0.027	-0.065	0.001	0.096	0.002
ρq	-0.111	0.045	-0.097	0.074	0.151	0.012	-0.115	0.018	0.055	0.043
ρh	0.016	0.007	0.007	0.108	0.055	0.010	0.032	0.011	-0.035	0.013
CONS	64.35	317.34	87.979	199.128	-274	46	544	42.14	126.3	57.0
σ^2	0.118	0.037	0.148	0.1008	0.054	0.043	0.145	0.050	11.627	0.131
γ	0.424	0.007	0.784		0.971	0.002	0.947	0.015	0.933	0.001

After estimating the cost function, the relevant coefficient is substituted into the marginal cost function to estimate the marginal cost of the enterprise, thereby further estimating the market power of the enterprise. Finally, by regression model, the main results affecting market forces can be obtained, as shown in Table 3. Due to the lack of data in some variables (such as advertising and R&D) and the possible omission of important explanatory variables, the model's goodness of fit (R^2) is not high, especially in soybean oil, rapeseed oil, and rice. In the pork and beef processing industries, the expansion is less than 0.1, which is the biggest flaw in this study. The parameter estimates of the random boundary cost function are shown in Table 2.

3.1. Corporate Behavior and Market Power. According to the "structure-behavior-performance" paradigm, corporate behavior is the decisive factor in shaping market forces. In a market economy environment, companies generally use a variety of means to achieve their business objectives of minimizing costs and maximizing profits.

3.1.1. Advertising and R&D. Advertising and R&D are the most important means for enterprises, and they are also the most common business strategy. The former has a significant effect on maintaining product prices and promoting product sales, while the latter is a key means to maintain product quality and diversity and enhance the core competitiveness of enterprises. In the food industry, product brand aware-

ness, reputation, quality and safety, diversification, packaging, quality, taste, and other aspects of improvement, to promote and enhance product prices, have a great role in promoting. Therefore, there is reason to believe that advertising and R&D investments are likely to be important factors in promoting the formation of corporate market forces.

Due to the data published in the "China Industrial Enterprise Database", the lack of data on corporate advertising and R&D is more serious. In addition, many food companies in China have invested little or even zero investment in this area. Therefore, in the estimation results of the model, the coefficients of these two variables are not significant. Despite that, in some industries with large sample sizes, some better estimates are still available. Among them, the advertising investment of tobacco and garment processing enterprises has a significant positive impact on their respective market forces, but the impact is very small. The former has an elasticity value of 0.1 and the latter has only 0.02. The advertising investment of automobile processing enterprises has a significant negative impact on its market power, and the impact is also very small, at 0.02, which is inconsistent with empirical judgment. Although the coefficient of advertising investment in other industries is not significant, the coefficient values are mostly positive, which confirms the promotion of advertising to market power to a certain extent. Among the estimated coefficients of R&D investment, the coefficient value is 0.1 to 0.06, which indicates that in these two processing industries, the market power will increase by 0.1% and 0.06% for

TABLE 3: ADF test results.

Variable	Level	First order difference	Number of unit roots
RPt	-1.93	-7.55	RPt $\sim I(1)$
RBt	-1.69	-5.47	RBt $\sim I(1)$
RLt	-1.41	-7.20	RLt $\sim I(1)$
RCt	-2.65	-9.87	RCt $\sim I(1)$
PPt	0.30	-7.36	PPt $\sim I(1)$
Lt	4.10	-0.39	Lt $\sim I(1)$
NWt	-2.62	-13.20	NWt $\sim I(1)$
EX1	-2.87	-8.28	EX1 $\sim I(1)$
EX2	-3.34	-9.81	EX2 $\sim I(1)$
EX3	-2.62	-9.81	EX3 $\sim I(1)$
EX4	-2.41	-16.41	EX4 $\sim I(1)$

every 1% increase in R&D investment. As with the ad input variable, although the coefficient of R&D investment in most industries is not significant, the estimates are mostly positive.

3.1.2. Government Policies and Market Forces. Government policy is an important factor influencing market forces and has become a consensus in the academic community. However, in China, the influence of government policies on the market power of enterprises varies greatly depending on the nature of the industry and it has a decisive influence on the formation of market forces in certain special industries (such as state-owned monopoly industries and cutting-edge technology industries). The impact on market forces in the general industry may be relatively small.

The impact of government policies on market forces is very complex. Because the data used in this paper is enterprise-level panel data, it may affect the market power of each company, and there are not many government policy variables that can be quantified. This paper selects two indicators, tax and subsidy, both of which can be obtained directly from the database.

3.1.3. The Nature of Corporate Property Rights and Market Forces. For a long time, state-owned enterprises have suffered from various diseases in the monopoly and management efficiency. In the eyes of many people, state-owned enterprises have even become synonymous with monopoly and inefficiency. Regardless of whether this view is too extreme, it is well known that state-owned enterprises, with their own superior position, have more favorable treatment than private enterprises in many aspects and fields such as industry access, bank loans, and administrative examination and approval. Does state-owned capital holdings have a significant impact on the market power of enterprises? From the current research progress, the answer to this question is only at the level of empirical judgment or simple data analysis. There is no strong evidence to support both the positive and the negative. .

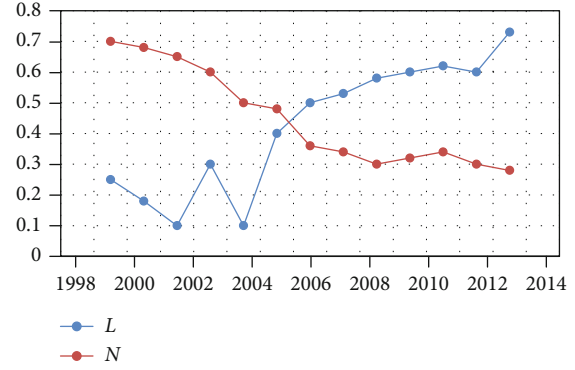


FIGURE 3: Trends in the number and market power of tobacco processing enterprises in China.

3.1.4. The Market Structure. First, there is often a relationship between the number of firms in an industry and the average market power of firms. In general, The smaller the number of enterprises, the higher the concentration, the larger the average size of the enterprise, and the stronger the average market power of the enterprise. In China's food industry, the structure of certain industries has undergone earth-shaking changes since the reform and opening up. Through mergers and acquisitions between enterprises, the production capacity is quickly concentrated to enterprises with high production efficiency and good management efficiency. Compared with the previously dispersed small enterprises, the large-scale enterprises after the merger and reorganization have more prominent economies of scale and the integration of horizontal and vertical chains is also higher, which is why it is easy to produce the so-called scope economy and economies of scale. These are all beneficial to the company to save production costs, control product prices, and thus increase the market volume of enterprises.

Taking the tobacco processing industry as an example, since 1999, China's tobacco processing industry has implemented a merger and reorganization policy with "Guanxiao-Fuda" as its main strategy, and the number of tobacco processing enterprises and cigarette brands has declined rapidly. The number of cigarette industrial enterprises with legal person qualification decreased from 143 in 2001 to 30 in 2011, and the average production scale of cigarettes per enterprise increased from 240000 to 1.61 million; the number of cigarette brands decreased from 1049 in 2001 to 2004 nearly 210 brands were reduced each year. At the same time, the market power of tobacco companies as a whole is rising, especially after 2003; the value of the Lerner index rose rapidly from 0.1 to 0.7 in 2011, as shown in Figure 2. It shows that there is a clear reverse trend between the number of tobacco processing enterprises in China and the market forces. This result is basically consistent with the previous judgment. Under the influence of these policies, the number of cigarette companies and the number of brands have been greatly reduced. Figure 3 shows the trend of the number of Chinese tobacco processing companies and market strength.

However, in the strict sense, the exact causal relationship between the two is far more than that simple. In the absence of scientific theoretical methods, it can only be inferred from

the existing data, as well as experience and logic that the reduction in the number of firms may lead to an increase in market power, and it cannot be assumed that such a relationship exists between the two. At least, changes in market power are also affected by many other factors.

4. Adjustment of Market Power

4.1. The Impact of Market Forces on Price Transmission. The price transfer between vertically related markets often shows a certain asymmetry, mainly including two situations: first, the speed and amplitude of the transmission between the upstream and downstream prices in the industrial chain are asymmetrical, that is, the price of the upper (lower) tour changes. The grid does not change at the same time or at the same extent, and the second is that the price of the lower (upper) tour does not respond to the price increase and decline of the upper (lower) tour. Symmetrically, when the price of the upper (lower) tour is more fully or quickly transferred to the lower (upper) tour price than the fall, it is “positive” asymmetric price transfer and vice versa is a “negative” asymmetric price transfer.

In real life, many economic variables do not function in one direction but often influence each other and jointly promote the operation of the entire economic system. At the same time, time series variables generally have their own and cross-span effects, that is, the current observations of endogenous variables are affected by the value of the variable itself and other endogenous variables [16]. The effects of these aspects are traditional single-equation models, and even the simultaneous equation model is difficult to reveal effectively. Until 1980, Sims proposed a vector autoregressive (VAR) model to make this problem reasonable. Therefore, a large number of scholars try to use the VAR model to study the price transfer problem. Although there are some differences in the selection of variables or specific functional forms, the main ideas are developed under the framework of the VAR model.

Based on the VAR model, Engle and Granger combine the counteraction theory with the error correction model and propose a vector error correction (VEC) model. The VEC model can basically eliminate the possible trend of the variables by using the first-order difference and avoid the “pseudoregression” problem to some extent. At the same time, the error correction term retains the important information of the variable level value, so it is used by some scholars to analyze the price. Pass the question, most of the relevant empirical researches in China fall into this category, that is, using VAR or VEC models, focusing on the analysis of price transfer between vertically related markets from the perspective of the statistical relationship of time series data. In general, such models biased toward econometric theory and techniques have strong advantages in empirical analysis and can overcome the drawbacks of pure theoretical models that are difficult to regress with data. At the same time, this kind of measurement model is gradually improved in the continuous development and the reliability of the model is increasingly enhanced. The biggest shortcoming lies in the lack of theoretical foundations, especially when the causal

relationship between variables is not clear and the conclusions drawn are easily questioned.

4.2. The Measurement Model. A large number of studies have shown that the VAR model has certain advantages in analyzing time series data, which can not only avoid the “pseudoregression” problem caused by the traditional method due to data instability but also better fit the dynamic relationship between variables. The VAR(p) constructed in this paper is

$$X_t = \Phi_1 X_{t-1} + \Phi_2 X_{t-2} + \dots + \Phi_p X_{t-p} + \Psi w_t + \varepsilon_t, \quad t = 1, 2, \dots, T. \quad (4)$$

Among them, X_t is the $k \times 1$ dimension endogenous variable, w_t is the price of pork and its substitutes in this article, p is a $d \times 1$ dimension exogenous variable, that is, the supply and demand shock of pork, P is the lag order, and T is the sample size. The estimated coefficients are $k \times k$ dimensional matrices. And Φ_p is the $k \times d$ dimensional matrix Ψ , and ε_t is a $k \times 1$ dimensional perturbation vector, which can be correlated with each other but cannot be related to its own hysteresis value. The ε_t covariance matrix is Σ which a $k \times k$ dimensional positive definite matrix.

When the time series data is nonstationary, the VEC model can obtain effective estimation and test results. Thus, the model can be converted to

$$\Delta X_t = \alpha \beta' X_t - p + \sum_{i=1}^{p-1} \gamma_i \Delta X_{t-i} + \Psi w_t + \varepsilon_t, \quad t = 1, 2, \dots, T. \quad (5)$$

In which, β is the $r \times k$ dimension vector representing the counteraction relationship between endogenous variables, that is, the long-term equilibrium relationship between retail and production prices and the retail price of substitutes, which determines the number and form of counteraction relations; k_{xr} represents the dimension vector a . The error correction coefficient represents the speed at which the equilibrium relationship between prices is adjusted to the equilibrium state when it deviates from the long-term equilibrium state. After analyzing the counteraction relationship between the variables, this paper uses the generalized impulse response function to further estimate how the impact of the supply and demand affects the price and its transmission when a food safety incident occurs. At the same time, this method can also test whether market forces will affect the asymmetric transmission of food prices in the production and retail sectors.

4.3. Data Description. The data used in this paper are monthly time series data, and the sample period is from January 1 to December 2010 for a total of 120 months. RP_t , RB_t , RL_t , and RC_t represent the retail prices of food 1, food 2, food 3, and food 4, respectively, and the latter three are the substitute prices of food 1; PP_t is the purchase price. L_t is the average monthly salary of employees in manufacturing urban units. Since the relevant departments in China only announces quarterly wage levels, L_t is based on quarterly

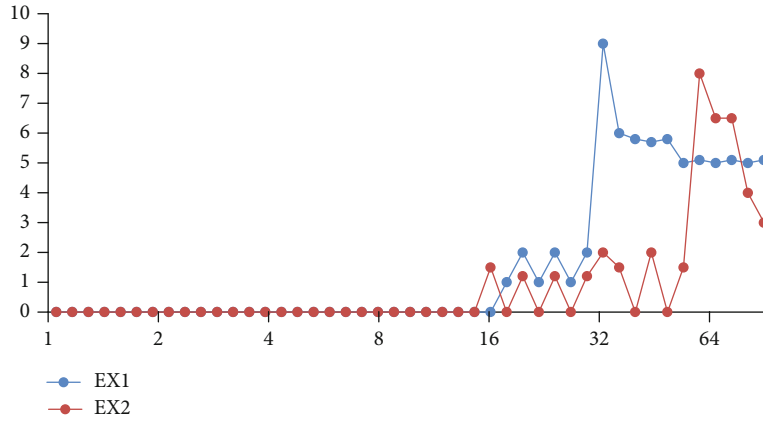


FIGURE 4: About the number of negative news reports.

TABLE 4: The results of counteraction analysis.

Explained variable	Explanatory variables
RP_t	$32.78 + 2.44RB_t - 5.38RL_t + 3.2RC_t + 4.1EX1 - 0.15NW_t$ (3.21) (-5.69) (3.97) (6.67) (-5.72)
	$5.78 + 1.33RB_t - 1.72RL_t + 1.54RC_t + 0.48EX1 - 0.04NW_t$ (5.10) (-5.32) (5.91) (3.79) (-5.25)
	$6.65 + 1.35RB_t - 0.33RL_t + 0.44RC_t + 1.36EX1 - 0.06NW_t$ (2.06) (-0.47) (0.7) (-3.10) (-3.42)
	$5.37 - 0.16RB_t - 0.52RL_t + 0.76RC_t + 0.02EX1 + 0.44NW_t$ (-0.29) (1.26) (1.61) (0.08) (2.95)
	$15.78 + 0.98RB_t - 2.30RL_t + 1.11RC_t + 1.98EX1 - 0.07NW_t$ (2.49) (-5.00) (2.88) (6.58) (-5.34)
$RP_t - PP_t$	$3.78 + 0.23RB_t - 0.25RL_t + 0.19RC_t + 0.14EX1 - 0.01NW_t$ (2.06) (-1.74) (1.68) (2.49) (-1.73)
	$1.58 + 0.36RB_t + 0.28RL_t - 0.33RC_t + 1.36EX1 - 0.06NW_t$ (1.00) (0.73) (-0.95) (-3.18) (4.39)
	$2.37 - 0.16RB_t - 3.45RL_t + 3.76RC_t + 0.89EX1 + 0.02NW_t$ (-2.03) (3.13) (-0.12) (0.74) (3.84)

salary conversion and the accuracy is poor. NW_t is the net export (export-import) quantity, which represents the supply shock of food.

When a food safety incident occurs, the net export volume tends to change accordingly. The change in the volume of imports and exports will inevitably have a full impact on the supply of domestic food. Therefore, it is a better choice to use the net export of pork as a substitute for supply shock. $EX1$, $EX2$, $EX3$, and $EX4$ represent the media exposure index of the event impact variable. After the natural logarithmic transformation, the measurement model is introduced. This paper is called the media exposure index.

In empirical research, these impact variables are difficult to quantify. Because the time span of the impact cannot be accurately evaluated, the method of dummy variables is not necessarily the most effective. This article selects the number of news stories for each type of event as a surrogate variable for these shocks. From the perspective of knives and demand, news reports are the most important source of consumer confidence and access. The negative reports of food safety incidents will hurt the con-

sumer confidence of the people and affect their consumption of food 1; from the perspective of supply, when the epidemic broke out, the relevant news reports were overwhelming, and as the epidemic gradually eased, the number of reports also corresponded accordingly. Therefore, it is a relatively good choice to replace these variables with the number of news reports. Figure 4 shows the number of negative news reports.

4.3.1. Estimated Results. Since time series data often exhibits nonstationary characteristics, it is necessary to perform a smooth test on the data before performing the metering regression; otherwise, a “pseudoregression” problem will occur. This paper uses the ADF (augmented Dickey-Fuller) method; the test results are shown in Table 3.

It can be seen from the test results in Table 3 that except L , which is a two-order difference stationary (that is, there are two unit roots), the other variable is the first-order difference. Therefore, in addition to L , the remaining variables can be constructed into VAR and VEC models for further quantitative analysis.

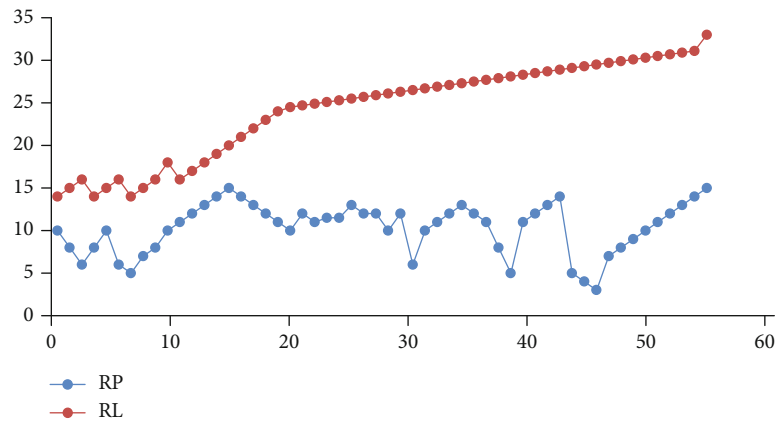


FIGURE 5: Changes in retail prices of food 1 and substitute.

4.3.2. Counteraction Analysis. This paper introduces four types of negative event shocks into different models, on the one hand, to distinguish the four types of impacts. The impact of food prices on supply and demand and the direction of the impact are different; on the other hand, considering the placement of four shock variables in the model, there may be an obvious collinearity problem [13]. That is, some events may occur at the same time. If they are placed in the same model, it is impossible to distinguish which impact variable from which the effect is derived. The results of the countermeasure analysis are shown in Table 4.

In the absence of food safety incidents, the increase in net exports (NW_t) will reduce the supply of food in the domestic market, causing food prices to rise, which creates a “positive effect”, as shown in Figure 5; at the time of food supply, since the decrease in net exports (increased net imports) is negligible compared to the reduction in supply due to news, its “positive effect” on prices is relatively weak; at the same time, consumers will compete to purchase relatively reliable imported foods. This raises the price of imported food and produces a more significant “negative effect.” At this time, the supply of domestic food was originally in short supply and the price of food increased. Therefore, in many cases, the reduction in net out days will lead to a huge increase in food prices in the event of a negative news outbreak.

The price of substitutes has a positive impact on the price transfer of the pork industry in most cases, that is, the price increase of substitutes will lead to an increase in pork prices and the price of live pigs does not increase rapidly or equally, thus expanding pork retail and production. The changes in retail prices of food and substitutes are shown in Figure 5.

5. Conclusion

This paper uses monthly time series data to study the impact of food safety incidents of e-commerce food companies on prices and their transmission in vertical associated markets and analyses the role of market forces in them. Research indicates that first, there is a clear asymmetry in the price transfer of China’s food industry. The impact of food safety incidents on the retail price of food is greater than its impact on the purchase price. Second, China’s food retailers have a certain

market power, which is an important reason for the asymmetric transmission of food industry prices. Although we cannot deny that the gap between food retail and production prices is related to other marketing or regulatory costs, the test results show that market forces do have an impact on the difference between the two prices. Third, the impact of different types of security incidents on pork prices and their transmission is not consistent. Some have a significant positive impact on food prices, while also increasing the gap between food retail prices and production prices, while others have the opposite effect, not only causing food retail prices to fall but also shrinking retail and the gap in production prices. And fourth, in different food safety incidents, the net export of food and food (supply shock) has different effects on pork prices and their transmission. At the same time, in the price transfer model, net exports will offset the impact of some negative news to narrow the gap between food retail and production prices; conversely, net exports will increase the impact of negative news events on price transmission.

Data Availability

All author information is available from the author.

Conflicts of Interest

We declare that there is no conflict of interest regarding the publication of this article.

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