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The Conflict between Technology and Scale: Evidence from China's Wooden Furniture Industry

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Abstract: The Chicago School believes that more efficient firms will earn higher profits, leading to higher market concentration. How does this apply to situations in specific industrial environments? The output value and import and export volume of China's wooden furniture industry rank among the highest in the world, but the industry's profit growth rate is decreasing. Is this phenomenon caused by a problem in the growth mode of the industry itself? It is especially important to understand the real characteristics of the industry. The purpose of this study is to discover the characteristics and trends of China's wooden furniture industry and to clarify the direction of the future development of the industry. Market concentration index, data envelopment analysis and Engel-Granger cointegration test were applied to this study respectively. Based on the theory of industrial organization, this study conducted an empirical analysis in three stages. The results show that China's wooden furniture industry is still a labor-intensive industry, the increase in market concentration mainly depends on the expansion of the labor force, and there is a conflict between industrial technological progress and scale expansion. It has also been confirmed in theory that the market structure is affected by efficiency. However, the way and degree of impact depend on the level of industrial development. This study can provide a reference for the formulation and adjustment of macro policies for industrial development, improve the understanding of industry characteristics and trends at the enterprise level to help enterprises achieve transformation, and offer international and domestic investors a reference point for investment decisions at the market level. This study combines macro-level "industry" with micro-level "enterprise" to make the study more comprehensive and systematic, and fills in the gaps in related research in the field.

Keywords: wooden furniture; market concentration; technical efficiency; scale efficiency; industry policy

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1. Introduction

As the largest manufacturer and exporter, China's furniture industry encompasses highly competitive enterprises. China's furniture industry plays an important role in the national economy. The market share of wooden furniture accounts for more than 60%, supporting the development of the furniture industry.

China's furniture industry has been fully integrated into the global value net, and participates in market competition. However, China's furniture industry is in the "manufacturing" stage with low added value; this is related to the characteristics of labor-intensive industries [1].

The export proportion of Chinese wooden furniture accounts for 98% of the whole industry. However, due to factors such as Sino–US trade friction, the wooden furniture industry is facing an unfavorable trade environment. Though the number of anti-dumping cases in global trade has been decreasing, the proportion of anti-dumping cases against China has been increasing [2]. Affected by the subprime mortgage crisis in 2008, the comparative cost advantage of China's manufacturing industry has gradually weakened. As some countries set up more and more technical barriers and green barriers, experts and

industry insiders are generally worried that China's manufacturing industry will lose its international competitive advantage [3].

In general, although China's furniture-manufacturing industry is growing, the rapid growth of sales and its export share have not brought with them a high profit growth rate for these enterprises. On the contrary, the annual growth rate of industry profits has been decreasing. In the past 10 years, the profitability of China's wooden furniture industry has declined year by year. In 2017, revenue and profit growth fell by 20% and 27%, respectively. This also shows that the market demand is insufficient. However, the scale of China's wooden furniture industry continues to expand, the number of large-scale furniture companies continues to increase, and the industry's production capacity remains strong. Is this phenomenon caused by a problem in the growth mode of the industry itself? For a long time, China's wooden furniture industry has been participating in domestic and foreign competition with its labor endowment advantage, but with changes in the domestic and foreign environments and rising labor prices, this advantage is gradually being weakened. New policy elements and technical elements such as the "natural forest protection project", "green development", and the "digital economy" are also affecting the growth mode of the wooden furniture industry. It is especially important to understand the real characteristics of the industry.

This study is intended to discover the characteristics and trends of China's wooden furniture industry, and to clarify the direction of the future development of the industry. By using China's wooden furniture industry as the study's object, we provide a reference for the formulation and adjustment of macro policies from the perspective of industrial development, improve the understanding of the status quo of the overall industrial operation at the enterprise level, identify potential adjustments in the existing business models to achieve transformation and upgrading, and offer international and domestic investors a reference point for investment decisions at the market level. We conduct an empirical study on the long-term equilibrium relationship between market structure and business efficiency, identify the characteristics of China's wooden furniture industry at its present stage, combine macro-level "industry" with micro-level "enterprise" to make the study more comprehensive and systematic, and fill in the gaps in related research in this field.

First of all, we review the relevant research in this field and develop research hypotheses and research methods on the basis of related theories. In order to ensure the scientificity and accuracy of the data, the empirical research was carried out in three stages. Finally, we discuss the empirical results, draw research conclusions, and give recommendations.

2. Literature Review

2.1. Research on Industrial Organization Theory

Among industrial organization theories, authoritative theories on market structure and market performance are divided largely into two schools, namely, the market-power (MP) hypothesis of the Harvard school and the efficiency-structure (ES) hypothesis of the Chicago school. The traditional structural-performance hypothesis was put forward by Mason [4] in 1939 and then expanded by Bain [5], who formally proposed the paradigm of market structure and market performance. He believed that higher market concentration in an industry meant that enterprises could charge higher prices based on their monopoly power and, thereby, achieve a higher-than-average profit rate in the industry. Market concentration is a concept that captures the degree of competition or monopoly in a market based on the number of market participants and their degree of participation. It is generally regarded as a key factor in determining market structure [6]. On this basis, Scherer [7] further perfected the interaction between market structure–conduct–performance by developing the SCP paradigm, popular in modern industrial organization theory. Scherer believed that market structure determined market behavior, which, in turn, determined market performance. The other view from the Harvard School is the relative market-power hypothesis [8]. These two hypotheses state that the market's concentration ratio is positively correlated with profit margins. Together, they comprise the MP hypothesis.

The ES hypothesis of the Chicago school, in contrast to the MP hypothesis, states that market performance and market structure are determined by the level of enterprise efficiency. Operational efficiency reflects the enterprise's realization of its strategic objectives and represents the enterprise's ability to transform resources into products based on its scale and technology inputs [9].

Operational efficiency is further divided into efficient structure X-efficiency (ESX) and efficient structure scale efficiency (ESS). According to the ESX hypothesis, a higher management level and greater structural efficiency can reduce an enterprise's cost basis and improve its profit level, bringing it closer to the production possibility frontier [10–13]. According to the ESS hypothesis, based on economies of scale, some large-scale enterprises should be able to reduce marginal costs and, thereby, improve their profit levels [14–17].

2.2. Research on China's Wooden Furniture Industry

Previous studies on China's wooden furniture industry mainly focus on industrial competitiveness and its export trade.

Most research on the export of furniture is based on an analysis of the target market, focusing on how to improve export market share and adjust industrial policy. However, few studies have focused on improving the competitiveness of the industry itself [18–20]. China's wooden furniture industry experienced a transformation from a comparative disadvantage to a high comparative advantage, maintaining its advantage among labor-intensive industries. However, the challenges from emerging furniture-manufacturing countries have intensified increasingly, and the entire industry urgently needs to transform to maintain a competitive advantage [21]. Additionally, China is basically embedded in the value chain of international buyers. At the same time, the advantage of labor endowment is no longer a key competitive advantage in the wooden furniture industry; rather, the key factor is technological innovation [22]. Xu believed that the subprime mortgage crisis in 2008 led to a serious imbalance between global supply and demand [23]. Song believed that China's furniture industry should transform to incorporate sustainable development, with a focus on business efficiency [24]. However, studies have shown that the domestic market share of Chinese wooden furniture will show a downward trend in the future [25]. China's furniture industry will remain export-oriented in the future. Trade competitiveness remains strong [26]. The application of the digital economy has also had a positive impact on the export of Chinese furniture [27].

From the brief literature review above, we can see that most research on China's wooden furniture industry is focused on matters at the industrial level but has ignored individual enterprises as important factors. Further, there is a lack of systematic research on the wooden furniture industry from the perspective of industrial organization theory. This study is theoretically significant as it can fill the gaps in this field of research and expand the perspective of wood furniture industry research.

3. Materials and Methods

This section presents the research methodology. The study was divided into three steps. First, Bain's market concentration index was used to measure the market concentration of the wooden furniture industry. In the second step, a data envelopment analysis was used to measure the operating efficiency of China's listed wooden furniture companies. In the last step, the Engle–Granger cointegration test was used to conduct empirical research on the industry characteristics of China's wooden furniture industry.

3.1. Methodology

3.1.1. Hypothesis Development

In view of the differences between the Harvard and Chicago hypotheses in terms of the relationships among market performance, market structure, and efficiency, many scholars have sought to test these empirically. The Harvard school deduced that there was a one-way causal relationship between the market structure, market conduct, and market performance

of enterprises by means of empirical cross-sectional analysis. The degree of concentration determines the market conduct of the enterprise, which in turn determines the quality of the market performance. Based on the Harvard school, Smirlock [25], Evanoff, and Fortier [26] and Molyneux [27], among others, have used the following model for testing:

$$\pi = \beta_0 + \beta_1 CR + \beta_2 MS + \alpha' X \quad (1)$$

where π denotes the market performance, CR denotes the concentration in the market, MS is an enterprise's market share, and α is the control variable related to the enterprise and the market, which influences the profitability of the enterprise. If β_1 is greater than 0 and β_2 is equal to 0, the market-power hypothesis is valid; if β_1 is equal to 0 and β_2 is greater than 0, then, the efficiency-structure hypothesis is valid.

Based on model (1), Berger [28] and Maudos [29] introduced enterprise efficiency and tested it with the following model:

$$\pi = \beta_0 + \beta_1 CR + \beta_2 MS + \beta_3 EF + \alpha' X \quad (2)$$

where EF denotes the enterprise efficiency. Empirical research based on the structural efficiency hypothesis shows wide agreement on the following: higher efficiency of enterprises with advanced management and production technology (the ESX hypothesis) or an optimal production scale (the ESS hypothesis) will lead to higher profit levels (market performance).

In many empirical studies, the application significance of the MS variable in the model has been considered controversial. Shepherd [15] believed that the market share variable did not directly influence the efficiency of an enterprise, as it comprised factors that had no impact on efficiency, such as product differentiation and/or power. In fact, Schmalensee [30] believed that the influence of market share on efficiency was so limited that it could be completely ignored.

Based on the hypothetical models of the other scholars discussed, we tested following hypothesis concerning China's wooden furniture industry:

$$\pi = \beta_0 + \beta_1 CR + \beta_2 EF + \alpha' X \quad (3)$$

The return on assets (ROA) and operating margin (OM) of China's wooden furniture industry are selected as indicators of market performance, variable CR is market concentration index, and EF is the comprehensive efficiency value of China's listed wooden furniture companies obtained using a data envelopment analysis.

3.1.2. Market Structure

Market concentration index, also known as "market concentration rate", refers to the total market shares of the top N largest companies in the relevant market of the industry. Market concentration is the most basic and important factor determining the market structure, reflecting the degree of competition and monopoly in the market. Within the market's structure, the level of market concentration captures how much certain enterprises influence the output, sales volume, and assets of the industry. Generally, market concentration is measured as the proportion of the prime operating revenue of the major companies in the industry to the total sales volume in the industry. This study uses the concentration ratio CR_n to investigate market structure. CR_4 represents the four largest companies in the industry and CR_8 represents the eight largest companies in the industry. According to Bain's classification of industry concentration, industry concentration is divided into two categories: oligopoly ($CR_4 \geq 30$) and competition ($CR_4 < 30\%$), where a market share exceeding 70% for the top four companies is classified as an extreme oligopoly, and a market share between 40% and 70% for the top four companies is a low concentration

oligopoly. Competitive industries are subdivided into low concentration competition ($20\% \leq CR_4 < 30\%$) and decentralized competition ($CR_4 < 20\%$) [8].

$$CR_n = \sum(X_i)n / \sum(X_i)N \tag{4}$$

where $\sum (X_i)n$ represents the annual prime operating revenue of the listed companies in the wooden furniture industry and $\sum (X_i)N$ represents the annual total sales of the wooden furniture industry.

3.1.3. Operational Efficiency of the Enterprise

DEA is a model for evaluating the relative effectiveness of decision-making units (DMU) with multiple inputs and outputs. Based on known business data, the DEA model can be used to obtain the corresponding production frontier. It is widely used for its simple aggregation of different inputs and outputs [31]. DEA was originally proposed by Charnes et al. [32] and named the CCR model. Banker et al. [33] changed the assumption that the return to scale was constant in the CCR model and developed the BCC model. In DEA, the relative efficiency of firms is distributed within the interval (0,1), and the efficiency of enterprises at the frontier of efficiency is 1. Comprehensive efficiency can be decomposed into scale efficiency and pure technical inefficiency. Each DEA model has input-oriented and output-oriented forms. The output-oriented DEA model is built to assume a certain number of input factors and to obtain the maximum output value. Conversely, the input-oriented DEA model minimizes input costs at a hypothetical output level. Compared with traditional econometric methods, the DEA model focuses on production efficiency only and does not require a pre-known function with parameters [34]; thus, it does not need to specify the form of the underlying production relationship [35]. Therefore, DEA, as an objective decision-making method with multiple indices, has been widely used to evaluate the relative efficiency of enterprises [36]. The input-oriented CCR and BCC models are used to assess the operational efficiency of China's listed wooden furniture companies.

1. The CCR model

Suppose there are N departments that are comparable. There are M types of inputs and S types of outputs for the DMU. To simplify the calculation, the concept of the non-Archimedean infinitesimal is introduced. The CCR model with the non-Archimedean infinitesimal is:

$$\theta^0 = \min\left[\theta - \varepsilon\left(\widehat{\ell}^t S^- + \ell^t S^+\right)\right]$$
$$\begin{cases} \sum_j^n X_j\lambda_j + S^- = \theta X_0 \\ \sum_j^n Y_j\lambda_j - S^+ = Y_0 \\ \lambda_j \geq 0, j = 1, 2, \cdots, n \\ S^- \geq 0, S^+ \geq 0 \end{cases} \tag{5}$$

where ε is the non-Archimedean infinitesimal and $\hat{e} = (1, 1, \ldots, 1)^T \in E^m$, $e = (1, 1, \ldots, 1)^T \in E^s$ and θ is comprehensive efficiency. Let $\left(\lambda^0, S^{-0}, S^{+0}, \theta^0\right)$ be the optimal solution of the model and it can be judged accordingly whether the *DMU* is valid.

- If $\theta^0 = 1, S^{-0} \neq 0, S^{+0} \neq 0$, due to the inefficiency of scale efficiency or pure technical efficiency, the comprehensive efficiency is invalid.
- If $\theta^0 = 1, S^{-0} = 0, S^{+0} = 0$, the comprehensive efficiency is valid.
- If $\theta^0 < 1$, the comprehensive efficiency is invalid.

2. The BCC Model

Based on the CCR model, the BCC model is decomposed further into pure technical efficiency and scale efficiency. Specifically, pure technical efficiency refers to the production efficiency of an enterprise due to factors such as management and technology, and scale

efficiency refers to the production efficiency due to the influence of enterprise scale factors. It is expressed as follows:

$$\theta^0 = \min\left[\theta - \varepsilon\left(\widehat{\ell}^t S^- + \ell^t S^+\right)\right]$$
$$\begin{cases} \sum_j^n X_j\lambda_j + S^- = \theta X_0 \\ \sum_j^n Y_j\lambda_j - S^+ = Y_0 \\ \sum_j^n \lambda_j = 1 \\ \lambda_j \geq 0, j = 1, 2, \cdots, n \\ S^- \geq 0, S^+ \geq 0 \end{cases} \quad (6)$$

where ε is the non-Archimedean infinitesimal and $\hat{e} = (1, 1, \ldots, 1)^T \in E^m$, $e = (1, 1, \ldots, 1)^T \in E^s$, and θ is the value of comprehensive efficiency. If $\left(\lambda^0, S^{-0}, S^{+0}, \theta^0\right)$ is the optimal solution of the model, then

- If $\theta_0 = 1$, the pure technical efficiency is valid.
- If $\theta_0 < 1$, the pure technical efficiency is invalid.

3.1.4. The Engle–Granger Cointegration Test and Error Correction Model

The Engle–Granger cointegration test [37], also known as the E–G two-step method, is used to test the long-term equilibrium relationship of time-series variables [38]. In the case of two variables, if X_t and Y_t are subject to $I(1)$ and the regression model is estimated by the orthogonal least squares (OLS), then

$$Y_t = \alpha_0 + \alpha_1 X_t + \mu_t \quad (7)$$

The unbalanced error is calculated to obtain:

$$\hat{Y}_t = \hat{\alpha}_0 + \hat{\alpha}_1 X_t \quad (8)$$

The residual differential order is listed as:

$$\hat{e}_t = Y_t - \hat{\alpha}_0 - \hat{\alpha}_1 X_t \quad (9)$$

When testing the stationary of the sequence, if the residual sequence is stationary, then there is a cointegration relationship between X_t and Y_t. The test model is:

$$\Delta e_t = \delta e_{t-1} + \sum_{i=1}^{p} \theta_i \Delta e_{t-i} + \varepsilon_t \quad (10)$$

A cointegration test of multiple variables is more complicated than that of two variables because there may be several cointegration relations among the multiple variables [39]. By determining the different explained variables, the test is performed separately until the cointegration relationship is found.

According to the Engle–Granger theorem, if there is a cointegration relationship between X_t and Y_t, an error correction model (ECM) can be established [40] as follows:

$$\Delta Y_t = \beta_0 \Delta X_t + (\beta_2 - 1)(Y_{t-1} - \alpha_0 - \alpha_1 X_{t-1}) + \varepsilon_t \quad (11)$$

where $\gamma = \beta_2 - 1$, and if $\gamma < 0$, the error correction process is a reverse adjustment process. When regression e_{t-1} is used instead of μ_{t-1}, the perturbation term μ_t may have sequence-dependent problems that need to be eliminated by the addition of lag terms ΔY_t and ΔX_t. The autoregressive distributed lag model (ARDL) can be considered to determine

the *ECM*. If $Y_t, X_{1t}, X_{2t}, \ldots X_{kt}$ is subject to $I(1)$, the ARDL $(p,q_1,q_2,\ldots,q_k)$ with k variables is as follows:

$$\Delta Y_t = \alpha + \omega t + \gamma e_{t-1} + \sum_{i=1}^{p} \varnothing_i \Delta Y_{t-i} + \sum_{j=1}^{k} \sum_{l_j=0}^{q_j} \beta_{jl_j} \Delta X_{j,t-lj} + \varepsilon_t \quad (12)$$

3.2. Data

Listed enterprises, as the most representative of all enterprises in the industry, can reflect the development of the whole industry [41]. By analyzing the operating efficiency of these listed companies, we can identify potential problems in their operations and management over time as well as provide targeted countermeasures for improvement. Listed Chinese wooden furniture manufacturing companies have good brand awareness. Judging from the published annual reports, operating income mainly comes from the domestic market. The relevant data on the listed companies are from the Shanghai Stock Exchange and the Shenzhen Stock Exchange. The annual data of the wooden furniture industry, such as sales volume, ROA (return on assets) and OM (operating margin) come from the Prospective Economics Database and the China Furniture Yearbook. By searching for the keywords "wood & furniture", we found that by the end of 2017 there were 35 listed companies in China's wooden furniture industry. The main business of these enterprises includes wooden furniture manufacturing, wooden door and floor manufacturing, forest cultivation, and home decoration. The research in this study is confined to "wooden furniture manufacturing" enterprises, and 35 companies were therefore identified on the basis of this being their primary business. Finally, 18 "wooden furniture manufacturing" companies were selected as the study objects. We then collected and sorted through their operational data from 2000 to 2017. The data include prime operating revenues, operational profits, total non-current assets, administrative costs, and operating expenses. The reason for selecting data up to 2017 is that the study requires accurate and authoritative data. Though we always try to update the data, we never obtain comprehensive and accurate statistics. The reason may be due to the impact of the COVID-19 epidemic on the statistical work of the relevant institutions in the past two years. However, we believe that the long-term equilibrium state of the industry will not be affected by short-term data. This study will also continue in the future.

4. Results

4.1. Market Concentration of China's Wooden Furniture Industry

According to the market structure classification of Bain, $CR_4 < 30\%$ and $CR_8 < 40\%$ is a competitive market. In 2017, the value of the listed wooden furniture companies' CR_4 was 5.01%; even when all the listed companies are added together, the CR_{18} value was only 10.8%, which indicates that China's wooden furniture market is still a strongly competitive market. Furthermore, this trend has continued over a long period of time (Figure 1).

4.2. Operating Efficiency of Listed Companies in China's Wooden Furniture Industry

Referring to relevant research results [42,43], non-current assets, administrative costs, and operating expenses were selected as input indicators. Non-current assets cannot be liquidated or consumed within one business cycle, i.e., within at least one year [44]. Administrative expenses refer to all kinds of expenses incurred by enterprise administrative departments for organizing and managing production and operation activities. Operating expenses refer to the actual costs incurred by the enterprises in selling goods and providing labor services along with other primary business activities, sales materials, and miscellaneous activities. Prime operating revenue and operating profit were selected as output indicators [45]. The prime operating revenue is considered the most important economic indicator of the enterprise. In general, it is the best reflection of the operating status of the enterprise and represents the operating income earned by the enterprise engaging in production and operation activities in the industry. Operating profit refers to the profit made by a company in its production and operation. It is the main source of profit and the

result of its most basic operational activities. However, operating profit can also reflect the profit efficiency and management of an enterprise and determine whether the enterprise can expand production. The performance of the listed wood furniture manufacturing enterprises from 2000 to 2017 was measured and analyzed using MaxDEA 6.4. The results are shown in Table 1.

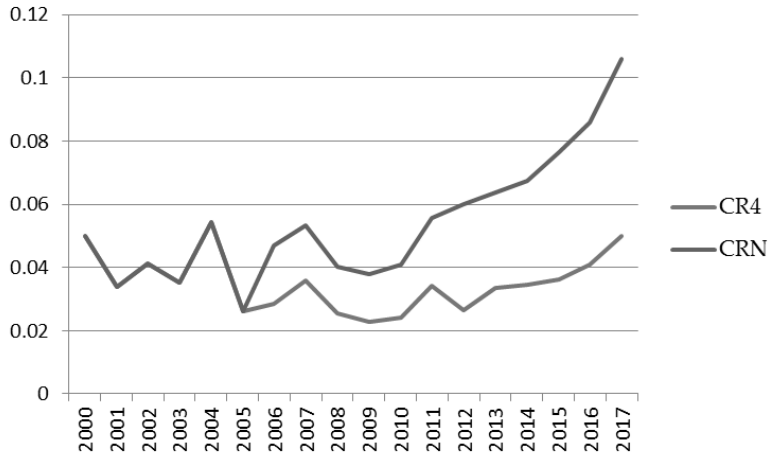

Figure 1. Market concentration of China's wooden furniture industry.

Table 1. The operating efficiency of China's listed wooden furniture enterprises.

Year	N	Effective	Min	Average Value (AVG)			>AVG	<AVG	Scale Return		
				CE	PTE	SE			=	+	–
2000	4	2	0.840	0.937	0.978	0.957	2	2	2	0	2
2001	4	2	0.963	0.987	1	0.987	2	2	2	1	1
2002	4	3	0.950	0.988	0.988	0.999	3	1	3	0	1
2003	4	4	1	1	1	1	4	0	4	0	0
2004	4	4	1	1	1	1	4	0	4	0	0
2005	4	3	0.943	0.986	1	0.986	3	1	3	1	0
2006	4	3	0.986	0.996	1	0.996	3	1	3	0	1
2007	4	3	0.901	0.975	1	0.975	3	1	3	1	0
2008	6	3	0.929	0.985	1	0.985	4	2	3	1	2
2009	7	2	0.887	0.944	1	0.944	3	4	2	1	4
2010	7	5	0.893	0.973	1	0.973	5	2	5	0	2
2011	12	2	0.782	0.902	0.958	0.943	6	6	2	3	7
2012	16	3	0.745	0.893	0.974	0.917	7	9	3	6	7
2013	18	4	0.711	0.870	0.951	0.916	7	11	4	9	5
2014	18	6	0.687	0.879	0.940	0.936	7	11	6	7	5
2015	18	7	0.682	0.898	0.947	0.948	9	9	7	8	3
2016	18	6	0.689	0.896	0.936	0.958	9	9	6	9	3
2017	18	6	0.721	0.903	0.949	0.952	8	10	6	9	3

Note: CE = comprehensive efficiency; PTE = pure technical efficiency; SE = scale efficiency.

The listed companies, which represent the comprehensive strength of China's wooden furniture manufacturing industry, have relatively high operational efficiency. The overall efficiency of the DEA average is higher than 0.8697, the pure technical efficiency is higher than 0.9357, and the scale efficiency is higher than 0.9157. The enterprises with constant returns to scale were those with DEA efficiency.

4.3. Relevance Test of the Market Structure and Enterprise Efficiency of the Wooden Furniture Industry in China

After validating Equation (3), it was found that when ROA and OM are selected as dependent variables to represent market performance, there is no long-term equilibrium

relationship between market performance (ROA or OM) and market structure or enterprise efficiency (Table 2). This shows that market performance may not be determined by market structure or enterprise efficiency, either together or individually; that is, There is no market power hypothesis and structural efficiency hypothesis in China's wooden furniture industry at the present stage. In order to further verify the characteristics and trends of the wooden furniture industry, this study will not consider market performance variables for the time being, but will verify the relationship between market structure and enterprise efficiency and propose a new hypothesis:

$$CR = \beta_0 + \beta_1 TEF + \beta_2 SEF + \varepsilon \quad (13)$$

Table 2. Cointegration test of related variables.

Dependent	Tau-Statistic	Prob. *
ROA	−3.528559	0.1635
OM	−3.649677	0.1305

* Independent is CR_4 and EF; * MacKinnon (1996) *p*-values.

The enterprise efficiency index is further decomposed into pure technical efficiency and scale efficiency, which is consistent with the Chicago school's X efficiency hypothesis and scale efficiency hypothesis.

We analyzed the relationship between market structure and enterprise efficiency according to the results of Sections 3.1 and 3.2. CR_4 was selected as the market structure variable, the average value of pure technical efficiency was selected as the technical efficiency variable, and the average value of scale efficiency was chosen as the scale efficiency variable. The values of the data are all unified between 0–1. Because the data are time-series data from 2000 to 2017, there may be some problems with instability. If the time series is not stable, it cannot be tested by the traditional regression method or the phenomenon of pseudo-regression will occur. Therefore, a unit root test was first performed on the test data to determine stationarity. The results are shown in Table 3.

Table 3. Augmented Dickey–Fuller test for time series from 2000 to 2017.

Series	Augmented Dickey–Fuller Test Statistic		Test Critical Values		
	t-Statistic	Prob.	1% level	5% Level	10% Level
CR_4 (0)	−2.846624	0.2016	−4.616209	−3.710482	−3.297799
CR_4 (1)	−7.269366	0.0000	−2.717511	−1.964418	−1.605603
PTE (0)	−0.924341	0.7545	−3.886751	−3.052169	−2.666593
PTE (1)	−6.363542	0.0000	−2.717511	−1.964418	−1.605603
SE (0)	−2.893456	0.1881	−4.616209	−3.710482	−3.297799
SE (1)	−5.340604	0.0000	−2.717511	−1.964418	−1.605603

As can be seen from test results of the unit root test, all three original time series are unstable. After the first difference, the t-statistics are lower than the critical value at the 1% confidence level. It can be seen that all three time series are first-order single integral sequences without trend terms and intercept terms. An Engle–Granger cointegration test can be used to verify the cointegration relationship of the variables. The cointegration test results of the three variables are as shown in Table 4.

Table 4. Cointegration test for market concentration, pure technical efficiency, and scale efficiency.

Dependent	Tau-Statistic	Prob. *	Z-Statistic	Prob. *
SE	−3.765275	0.1102	−15.03083	0.1267
CR_4	−5.317012	0.0089	−19.99544	0.0170
PTE	−3.348621	0.1986	−13.10318	0.2240

Note: * MacKinnon (1996) *p*-values.

According to the results of the cointegration test, when CR_4 is used as the dependent variable, the t-statistic value is −5.317012 and is significant at the 5% level, and there is a cointegration relationship among the three variables. This conforms to the model hypothesis of this study. Engle and Granger have proved that when the sample size is large enough, the OLS estimators of the cointegration variables have strong consistency. Therefore, when the sample size is large enough, the OLS estimation of the cointegration parameters is the main method utilized. However, in actual economic analysis, especially in the macro-economy, the sample size is often small. The fully modified OLS method improves the OLS method by adjusting the sequence correlation effect to solving the endogenous problems caused by the cointegration relationship. Therefore, it can deal with the problem of a small sample size in the cointegration parameter estimation [46]. Andrews [47] has suggested using the quadratic spectral kernel with automatic bandwidth selection. Cappuccio and Lubian [48] have demonstrated by simulation that adding a prewhitening process to the time series can be very helpful in estimating the results. With reference to the above suggestions, the following cointegration equation was established using the fully modified OLS method (Table 5).

Table 5. Cointegration equation of market structure and enterprise efficiency.

	Model 1	Model 2	Model 3	Model 4
Variable	**Coefficient**	**Coefficient**	**Coefficient**	**Coefficient**
PTE	−0.330799 ***	−0.327702 ***	−0.309896 ***	−0.290405 ***
SE	0.246161 ***	0.230667 ***	0.242068 ***	0.224489 ***
C	0.120855 *	0.132907 **	0.104459 **	0.102021 ***
R^2	0.410416	0.403971	0.416202	0.419615
Adjusted R^2	0.326189	0.318824	0.332802	0.336703
Prewhitening lags	0	1	2	3
Andrews bandwidth	1.4932	1.4041	1.2383	1.4991

A. Dependent Variable: CR_4; B. * Significantly correlated at the 0.1 level; ** Significantly correlated at the 0.05 level; *** Significantly correlated at the 0.01 level.

According to the results of the cointegration regression, the cointegration coefficient terms under different prewhitening lags reached a significant level while the change was not significant and the direction was the same. The goodness of fit and the significance of the coefficient increased with the increase in the number of lag periods. This shows that under the condition of constant scale efficiency, a change in pure technical efficiency will cause a change in market concentration in the opposite direction. While the pure technical efficiency level remains unchanged, the scale efficiency will lead to a positive change in market concentration. Moreover, the impact of pure technical efficiency on market structure is greater than that of scale efficiency. This result shows that the market structure change in China's wooden furniture industry is not driven by technological progress and improvements in operations and management. The whole industry is still a labor-intensive industry with low added-value products, and the improvement in market concentration mainly depends on the expansion of production scale. Specifically, it depends on the massive increase in the size of the labor scale.

Some uncertain factors in the industry will cause short-term fluctuations in the market structure. Thus, an error correction model was established to test the influence of the long-term equilibrium relationship on the short-term disturbances. Based on the ARDL model, the following error correction model (Table 6) was established according to the modeling method of "from general to special" [49].

$$\Delta CR_4 = -0.072468\Delta CR_{4t-1} - 0.222608\Delta PTE + 0.131049\Delta SE - 1.164210e_{t-1}$$

Table 6. Error correction model.

	Model 1		Model 2	
Variable	**Coefficient**	**Std. Error**	**Coefficient**	**Std. Error**
D(CR_4 (−1))	−0.072468	0.207003	-	-
D(PTE)	−0.222608 ***	0.039323	−0.234342 ***	0.058602
D(SE)	0.131049 **	0.052575	0.142688 **	0.053799
ECM(−1)	−1.164210 ***	0.225832	−1.232929 ***	0.151324
R^2	0.664945		0.661257	
Adjusted R^2	0.581181		0.609143	
Durbin–Watson stat	2.124485		2.137483	

A. Dependent Variable: D(CR_4); B. ** Significantly correlated at the 0.05 level; *** Significantly correlated at the 0.01 level.

However, we found that the first order lag statistic of ΔCR_4 did not significantly impact the short-term effects. Therefore, ΔCR_{4t-1} was deleted and the model was regressed to obtain the following error correction model after adjustment:

$$\Delta CR_4 = -0.234342\Delta PTE + 0.142688\Delta SE - 1.232929e_{t-1}$$

A sequence correlation test was conducted on the residuals of the above two models. Under the condition of third-order lag, the F statistics were 0.432545 and 0.285671, respectively. It was concluded that there was no sequence correlation in the residual series.

The error correction model shows that the short-term fluctuations in the wooden furniture industry conform to the negative feedback mechanism. In the short-term fluctuations, the influence direction of pure technical efficiency and scale efficiency on market structure is consistent with that in the long-term equilibrium state, and the influence is significant. If the short-term fluctuations in the market structure cause a deviation in the long-term equilibrium state, then the internal constraint effect of the system will be adjusted to the long-term equilibrium state in the next period, and the adjustment effect is extremely significant.

5. Discussion

Overall, the number of listed wooden furniture enterprises is relatively small, which indicates that although the market is large, the industry concentration is low. Thus, the number of large-scale enterprises is small, and small- and medium-sized enterprises occupy the dominant position. Moreover, the change in CR_4 is unstable and fluctuates; only in recent years has it slowly increased. It reached its lowest level between 2008 and 2010, indicating that the global economic crisis in 2008 had a somewhat large influence on China's wooden furniture industry. After 2013, the number of listed enterprises remained unchanged, and the market concentration represented by CR_4 was about 50% among all 18 enterprises. Moreover, during this period, the market concentration began to rise slowly.

The "smile curve" theory [50] holds that the industrial chain consists of three links: research and development, manufacturing, and marketing. Most of China's manufacturing is in the middle of "production" with low added value, especially in labor-intensive industries such as the wooden furniture industry. Ratnasingam and Ioras have pointed out that China had a low per capita GDP and a huge production capacity as a furniture export-dependent country [51]. The growth in China's wooden furniture-manufacturing

enterprises has been extensive, and the added value mainly comes from its labor force. The industry needs to improve in terms of production technology, product design, and branding. The trend showing the average of pure technical efficiency decreasing year over year while scale efficiency increases gradually confirms this point. Further, the increasing returns to scale of a growing number of listed enterprises also proves this. In addition, with the development of China's social economy, wages are also rising, resulting in higher labor costs. According to the China Statistical Yearbook, labor costs in China's manufacturing industries are rising at an annual rate of about 14%, putting enormous pressure on the labor-intensive wooden furniture industry, which has a low profit margin and mainly focuses on processing trade [52]. If enterprise operating efficiency does not improve with technological innovation and still mainly depends on the input of labor, even if the income level and degree of market concentration increase, the profit of these enterprises will drop sharply. Paul Krugman's geo-economic work put forward a reason for spatial location: spatial agglomeration (i.e., the cost savings of industrial or economic activities due to agglomeration can drive the creation of geographical clusters) [53]. China has gradually formed five clusters of wooden furniture enterprises in its eastern region. The effect of industrial clusters leads to cost savings, which can influence the scale of enterprise operations and the gradual improvement in market concentration. However, China's wooden furniture industry clusters mainly rely on cheap labor, low production costs, and relatively low product prices to increase their market share. In an open environment, these comparative advantages will gradually weaken and disappear [54].

6. Conclusions and Recommendations

China's wooden furniture market is still a strongly competitive market at present. The proportion of large-scale companies is very small; thus, the industry concentration degree is low and its rate of increase is slow. Both the CR_4 value of the industry leaders and the CR_{18} value of the listed companies representing the industry are very low. The furniture industry does not show an integration trend yet; accordingly, the market should continue to maintain a competitive state.

China's wooden furniture industry is still a labor-intensive industry, and this will be the case for a long time. The influence of pure technical efficiency and scale efficiency on market structure in China's wooden furniture industry shows a trend of differentiation at present. Pure technical efficiency showed a significant negative influence on market structure, while scale efficiency showed a significant positive influence. In addition, the impact of pure technical efficiency on market structure is greater than that of scale efficiency. The application of advanced technology and advanced management methods will inevitably improve the profitability of large enterprises in general, thereby increasing market concentration. However, in China's wooden furniture industry, it is just the opposite. The use of new technologies and high-quality management personnel will make the industry more and more competitive. The fundamental reason lies in the labor-intensive industrial characteristics of China's wooden furniture industry. The improvement of market concentration depends entirely on the massive output brought about by the expansion of the labor force alone, and the input of new technologies and high-quality talent cannot achieve marginal benefits. Therefore, in order to achieve the sustainable development of China's wooden furniture industry in the new economic situation, we must first reverse the reality of the negative impact of pure technical efficiency and then gradually realize a normal state in which technological progress is relied upon to promote industrial development.

In view of the actual situation of China's wooden furniture industry, we recommend the following industry developments.

Technological progress and innovation should be promoted throughout the industry. This would include the research and application of advanced production equipment and technology as well as an improvement in the quality of employees to realize the transformation of China's wooden furniture industry from one that is labor-intensive to one that is technology-capital-intensive. Increased specialization in production leads to economies

of scale, which, in turn, make sustained growth possible [55]. The growth of enterprises requires the rational arrangement of the input resources of the R&D department and production department for intermediate products and final products, including capital, the general labor force, and specialized human capital (skilled labor) [56]. However, the current problems faced by China's wooden furniture enterprises mainly lie in their excessive investment in labor and their unscientific and irrational investment in technology and management, resulting in an unreasonable business model. In the future, the development of the furniture industry needs to be based on sustained competitive advantages combined with continuous innovations in design, the supply chain, manufacturing processes, distribution, and in service and customer relations. Although it will lead to intensified competition for a period of time, technological progress will definitely become the driving force for industrial development in the future.

Government macro-control and policy support should be initiated. Enterprises in China's furniture industry evaluate favorably the government's macro-control, which is believed to have helped improve the industry's external business environment. The government should continue to strengthen regulation and guidance, thereby optimizing the structure of the furniture industry and nurturing larger listed enterprises with development potential for brand and channel building. More support should also be given to furniture manufacturing enterprises in terms of market information sharing, fiscal and financial policies, and import and export tax policies to help them to upgrade technologies, reduce the cost of raw materials, and update existing business models that are not suitable for the market environment. At the same time, the government should also control the coordinated development of the furniture industry to further improve market access requirements for listed enterprises, improve the quality of listed companies. Regulatory departments should give priority to companies with high technology and high management level as listed companies.

7. Limitations

Considering the availability and validity of data, this study collected and used time series data related to China's wooden furniture industry from 2000 to 2017. However, the rapid development of China's wooden furniture industry began at the start of this century, and these data already represent the process of industry development. With time, the length of the available time series will increase gradually, and this could verify and extend the conclusions of this study.

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