Impact of China's real estate industry on the fixed investment growth of the furniture industry based on VEC Structural Breakpoint Model

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Abstract— The fluctuations in the real estate industry often directly affect the furniture industry. With the completion of new residential and commercial buildings, consumers and businesses need to purchase furniture for decoration, and the prosperity of the real estate market usually increases the demand for furniture; Relatively speaking, the downturn in the real estate industry will also have an impact on the furniture industry. The furniture industry, logistics transportation, wood processing, and real estate industry have formed an interdependent industrial chain, in which logistics is the link connecting all links, ensuring the efficient circulation of materials and products. As one of the important indicators of economic growth, fixed assets investment (FAI), especially in the field of real estate and infrastructure, not only promotes the demand of furniture manufacturing industry, but also drives the development of related upstream and downstream industries, forming a complete supply chain and value chain. The VECM model provides a short-term to long-term analytical perspective, and through the structural breakpoint model, it can identify the interaction between variables in different periods and economic cycles, further explore the impact of real estate industry fluctuations on furniture demand, and provide a clearer analytical framework for understanding the volatility of the industry chain.

Keywords: Real estate;Furniture industry;VECM ;Structural breakpoint;Granger causality.

I. INTRODUCTION

The rise and fall of the real estate industry is usually linked to the furniture industry. Theurillat, R é rat,&Crevoisier (2015) analyzed the main driving forces behind the development of the real estate market, including personnel, institutions, and geographical conditions. With the completion of new residential and commercial buildings, consumers and businesses need to purchase furniture for decoration and functional configuration. Therefore, the prosperity of the real estate market often leads to an increase in demand for furniture, while conversely, when the real estate market is sluggish, the furniture industry will also be impacted.

The furniture industry, logistics transportation, wood production, and real estate industry have a close industrial chain relationship, and these four industries are interdependent, forming a relatively complete supply chain and value chain. Starr, Saginor,&Worzala (2021) analyzed the impact of emerging industrial technologies on the real estate industry. Xiong et al. (2020) discussed the current situation and key considerations of green furniture manufacturing in China, as well as the challenges and prospects of green manufacturing for the furniture industry. Tong et al. (2019) studied recommendations for controlling emissions and reducing health risks in the manufacturing process of wooden furniture to promote clean production in the furniture manufacturing industry. Akbar et al. (2017) found that small and medium-sized enterprises in furniture manufacturing are crucial in the manufacturing chain. The production of furniture industry heavily relies on wood, especially solid wood furniture. The type, quality, and price of wood directly affect the design, cost, and final price of furniture products. Hartini et al. (2020) applied sustainable lean production tools to the manufacturing process of the wooden furniture industry. Thaler&Koch (2023) explored the impact of furniture quality, logistics preferences, and other factors on real estate valuation, and the subjective influence of consumer preferences.

As transportation serves as the supply chain for the furniture industry, Abu et al. (2019) provided insights into improving production efficiency in the furniture industry. Abu et al. (2021) explore the application path of lean manufacturing in the wood and furniture industry and its effectiveness in terms of efficiency and environmental protection. Azizi, M. et al. (2016) evaluated the sustainable development of production in the wooden furniture industry and proposed a comprehensive evaluation model. Humayun et al. (2020) combined VECM model and fixed assets investment to reveal the short-term and long-term impact of fixed investment on economic development. Marques, Fuinhas,&Marques (2020) proposed different impact pathways of resource utilization on growth through VECM and structural breakpoints. Veuger (2018) combines the real estate industry with blockchain technology to observe the complete chain of the industry.

Meanwhile, Saiz&Salazar Miranda (2017) analyzed the future trends of the US real estate market and predicted the direction of its development. It can provide reference for the Chinese market. Therefore, we use the vecm structure breakpoint model and introduce breakpoints to segment the data, which can analyze the mutual influence between different economic cycle variables in different time periods and better fit the changes brought about by the prosperity and depression of the real estate market. This will lead to fluctuations in furniture demand, which in turn will affect the sales and production of furniture manufacturing enterprises.

II.METHODOLOGY

Vector Error Correction Model (VECM) is a variant of the traditional VAR model, which expands the assumption that the original model requires all variables to be stationary in terms of model setting. The VECM model is proposed under the Johansen cointegration framework to handle non-stationary problems. It is constructed based on cointegration relationships and incorporates error correction mechanisms to describe possible short-term deviations and long-term equilibria between variables. Shakeel (2021): Explored the multiple relationships between economy and resource utilization by studying economic output through VECM and structural breakpoint models. The VEC model is suitable for analyzing non-stationary variables in VAR models. After passing the skewness test, it means that there are short-term or long-term interactions between these variables, making it suitable for VECM model analysis. Cetin&Ecevit (2017) combined economics and carbon emissions, using a structural breakpoint model to analyze the relationship between development and environmental protection. And Pala (2013) provides feedback on the long-term equilibrium relationship and volatility between two different markets in the VEC model.

The classical VECM does not consider the influence of structural breakpoints and assumes that the long-term equilibrium relationship remains unchanged throughout the entire time period. Š kare et al. (2019) used the VECM model to study the impact of credit structure on economic growth. Perron (1989) found that if structural changes in time series are ignored and only unit root tests are used, the overall fit of the model will have errors. And at the same time, it promoted the combination analysis of model parameters and time. Therefore, based on the VECM model, we introduced structural breakpoints, which analyze the impact of VECM model analysis on specific variables in different periods. Bai and Perron's (1998) method further developed the testing method for multiple structural breakpoints, providing mathematical formulas for structural breakpoint models and methods for breakpoint detection, and gradually began to combine breakpoint analysis with VECM models. Suharsono et al. (2017) compared the application effects of VAR and VECM in analyzing indices, and pointed out the prediction accuracy and applicable scenarios. Hansen, P. R. (2003) proposed a parameter stability testing method for vector error correction models, which can be used for detecting abrupt structural points and determining whether the cointegration relationship changes over time. The breakpoint VEC model can achieve automated breakpoint detection and parameter estimation. The computational formula of this model can be written as:

$$\Delta Y_{it} = \alpha_{i1}(\beta_{i1} wp_{1_{t-1}} + \beta_{i2} fn_{2_{t-1}} + \beta_{i3} tp_{3_{t-1}} + \beta_{i4} re_{4_{t-1}} - \mu_t) + \delta_{i1} wp_{1_{t-1}} + \delta_{i2} fn_{2_{t-1}}$$
$$+\delta_{i3} tp_{3_{t-1}} + \delta_{i4} re_{4_{t-1}} + \gamma_{i1} wp_{1_{t-2}} + \gamma_{i2} fn_{2_{t-2}} + \gamma_{i3} tp_{3_{t-2}} + \gamma_{i4} re + \epsilon_t \quad (1)$$

Where: ΔY_{it} represents the change of variable Y_{it} during period i. (where Y represents variables wp, fn, tp, re); $\alpha_{i1}(\beta_{i1} wp_{1_{t-1}} + \beta_{i2} fn_{2_{t-1}} + \beta_{i3} tp_{3_{t-1}} + \beta_{i4} re_{4_{t-1}} - \mu_t)$ represents the cointegration equation (with period α_i as the adjustment coefficient), which reflects the long-term equilibrium relationship between the four variables; $\delta_{ij} X_{j_{t-1}}$ is the lagged first-order difference item, reflecting the impact of the change in variable X_j during the t-1 period on X_i during the t period. (where X represents variables wp, fn, tp, re); $\gamma_{ij} X_{j_{t-2}}$ is the lagged second-order difference item, reflecting the impact of the change in variable X_j during the t-2 period on X_i during the t period. (where X represents variables wp, fn, tp, re); ϵ_t , μ_t are the error term.

The above VEC model will be divided into different parts before and after the breakpoint, thereby increasing the numbering of the equations. Parot et al. (2019) completed the residual analysis of VAR-VECM and proposed a linear combination method for prediction that can improve prediction accuracy.It can be used for time series analysis of multivariate systems, especially when analyzing data with long-term stable cointegration relationships and short-term fluctuations and structural changes caused by external shocks. Marques et al. (2020) used the VECM model globally to discuss the impact of historical structural transition shocks. Provided empirical analysis from a global perspective for policy-making. Parajuli&Chang (2015) analyzed the dynamics of the cork lumber market in Louisiana, USA, and applied structural mutation and vector error correction models to study the price fluctuations in the lumber market. When comparing the differences between different countries and whether there are external shocks, if the cointegration relationship undergoes significant changes before and after two breakpoints, it means that the long-term equilibrium mechanism of the system has changed. The short-term dynamics reflect how the system adjusts back to equilibrium from the deviation from long-term equilibrium. And the pattern or speed of short-term dynamic adjustment has changed.

The model proposed in the article can be used to test for structural mutations in time series. The impact of multiple breakpoints can also overlap with each other. Perron (1989) studied the unit root hypothesis, particularly the stability of time series models in the context of major economic events. In addition, Hansen's (2003) new asymptotic testing method is used for compound hypothesis testing problems. The article discusses in detail the applicability and statistical properties of these tests in hypothesis combinations, providing a foundation for the theoretical development of composite hypothesis testing. By studying the factors influencing the growth rate of fixed assets investment in the furniture manufacturing industry, we introduced four variables to illustrate the upstream and downstream processes of the furniture manufacturing industry, namely, wood production and processing manufacturing, furniture industry, transportation industry, and real estate business.

III.DATA SOURCES

The growth rate of fixed assets investment in the furniture industry, the growth rate of fixed assets investment in the wood processing industry, the growth rate of fixed assets investment in the transportation industry, and the growth rate of fixed assets investment in the real estate industry are all monthly time data from the National Bureau of Statistics of China. The growth rate of fixed assets investment refers to the cumulative data of each month. All data are expressed as percentages, representing the cumulative increase or decrease in the current month of the year compared to the cumulative value at the end of last year.

Variables; available at www.chana

IV. EMPIRICAL ANALYSIS

The analysis of VECM structure breakpoint model mainly consists of several steps. Firstly, verify the stationarity of the variables. The stationarity of VECM variables is tested using ADF stationarity test when selecting the lag order of the model. In the following variables, wp is the growth rate of fixed assets investment in wood processing and products industry, fn is the growth rate of fixed assets investment in furniture manufacturing industry, tp is the growth rate of fixed assets investment in transportation industry, and re is the growth rate of fixed assets investment in real estate industry. After the data was subjected to first-order differencing, the results showed that the ADF statistic of the wood processing industry was much smaller than the critical value of -3.45695 at the 1% significance level, and the p-value was less than 0.01. The ADF statistic of the furniture industry is far below the critical value of 1% significance level -3.458225, with a p-value of less than 0.01. The ADF statistic of the transportation industry is below the critical value of 1% significance level, with a p-value of less than 0.01. The ADF statistic of the real estate industry is also less than the 1% significance level, and the p-value is also less than 0.01. This indicates that all variables can reject the null hypothesis at the 1% significance level, suggesting that the data, after first-order differencing, has no unit roots and is stationary.

Table1:Lag Optimal Selection to select best VAR (p) model

Criteria	AIC(n)	HQ(n)	SC(n)	FPE(n)
1	11.46803	11.58599	11.76069*	95612.02927
2	11.25991	11.47224*	11.78671	77657.10482
3	11.23164*	11.53834	11.99256	75514.42426*
4	11.27007	11.67114	12.26512	78515.92709
5	11.29882	11.79426	12.528	80876.70072

Source: authors' own calculation

From the results in the table above, it can be seen that the lag order of the VECM model is affected by the lag order of the VAR model, which can affect the fitting effect and predictive ability of the model. The lag order is selected as the minimum order of AIC, HQ, SC, and FPE. Although from the perspectives of HQ and SC, lag orders 2 and 1 also provide smaller values, overall, AIC and FPE emphasize more on the model's fitting and predictive ability, and 3rd order has two minimum parameters at the same time. Therefore, using VAR model for the above parameters takes a lag order of p=3. In the VECM model, the lag order is usually represented as p - 1, as the VECM model is constructed through differencing based on the VAR model. Therefore, when we select the lag order of 3 through the VAR model, we choose that the lag order corresponding to the VECM breakpoint model should be p-1=2.

Granger (1987) proposed that cointegration analysis can be used to analyze the long-term relationships of non-stationary time series of individual variables.The null hypothesis of Trace Hypothesis Test is that the number of cointegration vectors r present is less than or equal to the test input value ri. The alternative hypothesis is that the number of cointegration vectors present is greater than ri.

Table2: Johansen Cointegration Test Results

Hypothesis	Test Statistic	10% Critical Value	5% Critical Value	1% Critical Value
$r \leq 3$	3.9	7.52	9.24	12.97

r ≤ 2	11.65	17.85	19.96	24.6
r ≤ 1	21.26	32	34.91	41.07
r = 0	189.35	49.65	53.12	60.16

Source: authors' own caculation

In the Trace statistics model, the cointegration test showed that among the four selected variables, the trace statistic with r=0 was 189.35, which was much higher than the critical value of 53.12 at the 5% significance level. The F-statistic passed the 95% significance level test, indicating that the model rejected the null hypothesis of 'the model has no cointegration relationship'. The cointegration models of these four variables have at least one long-term cointegration relationship. When r ≤ 1, the trace statistic is 21.26, which is below the critical value of 34.91 at the 5% significance level, indicating that the null hypothesis of 'at most one cointegration relationship' cannot be rejected. The same test statistic with r>1 also did not pass the significance test. Based on the above, it can be concluded that there is at most one cointegration relationship among the wood processing industry, furniture industry, transportation industry, and real estate industry in the model. It means that there is a long-term equilibrium relationship between the four industries. Indicating that the selected variables are suitable for VECM model analysis.

Table3:VECM Structure Breakpoint Fit and Observation Number

No. Breakpoints	RSS	BIC	Breakpoints
0	57508	2064	-
1	34216	1952	49
2	26680	1907	49, 204
3	18084	1828*	49, 145, 204
4	17733*	1839	49, 108, 145, 204
5	18731	1869	49, 86, 136, 173, 210

Source: authors' own calculation

Taking all factors into consideration, RSS measures the goodness of fit of a model, while BIC is used as a punitive information criterion for model selection. The optimal BIC value should be chosen, with the breakpoint of 49145204 being the best among the three breakpoints. Therefore, we can divide the overall model data into four parts according to breakpoints, namely 2004. Jan-2008. Jian, 2008. Feb-2016. Jan, 2016. Feb-2020. Dec, 2021. Jan-2024. Jul. These breakpoints divide the overall model into different segments, reflecting the potential structural change nodes in the data. The segmentation can reflect the impact of fixed assets investment in the real estate industry on the furniture industry chain in different time periods.

We also did long-run estimations among variables. In each model, re(real estate industry) is set as the baseline variable with a coefficient of 1. The coefficients of other variables represent their long-term relationship with the real estate industry. The cointegration vectors of these VECM structural breakpoint models represent the long-term impact of the real estate industry on the wood processing industry (wp), furniture industry (fn), and transportation industry (tp). After three breakpoints, differences in the long-term impact intensity and direction of each industry were observed in the VECM1 to VECM4 models.

Table4:Cointegrating Vector(Long-run Relationship)

	wp	fn	tp	re	End Sample Size
VECM-1	1.0000	-0.7389	0.0381	0.4079	46
VECM-2	1.0000	-1.6895	0.4718	0.3415	93
VECM-3	1.0000	-7.4609	4.9505	2.2568	56
VECM-4	1.0000	43.5647	-36.3512	-17.0923	40

Source: authors' own calculation

From the results, Long term relationships will show significant differences at different structural breakpoints and samples. The long-term impact of the real estate industry on the wood processing industry shows significant changes in different models, from strong negative to strong positive relationships. This may be related to the impact of market structure or fluctuations in raw material costs. The real estate industry has a moderate impact on the furniture industry in most models, but shows a strong positive effect in VECM4, indicating its potential support for real estate demand. The long-term role of the transportation industry exhibits negative positive alternation in different models, which may reflect the dynamic impact of changes in infrastructure investment or transportation costs in the real estate industry. Therefore, optimizing resource allocation and promoting positive interaction between industries are very important.

Table5:VECM Short-run Relationships

Eq.1[a]	wp	fn	tp	re	Eq.2[b]	wp	fn	tp	re
ECT[c]	-0.2761(0.1116)*	-0.0778(0.1331)	0.0299(0.0544)	0.0209(0.0191)		-0.1607(0.0728)*	0.1551(0.1021)	0.0892(0.1049)	-0.0170(0.0404)
Intercept	0.2390(1.1537)	0.1829(1.3754)	-0.5863(0.5627)	0.0200(0.1971)		-0.0323(0.3829)	-0.1692(0.5372)	-0.1821(0.5519)	-0.1967(0.2124)
wp-1	-0.0399(0.1700)	-0.1487(0.2027)	-0.0808(0.0829)	-0.0136(0.0290)		-0.0760(0.1108)	-0.1744(0.1554)	-0.1233(0.1597)	0.0564(0.0615)
fn-1	0.0719(0.0774)	0.4612(0.0923)***	-0.0007(0.0377)	0.0301(0.0132)*		-0.1541(0.0734)*	-0.0230(0.1029)	0.0702(0.1057)	-0.0055(0.0407)
tp-1	-0.7218(0.2704)*	0.0551(0.3223)	-0.3071(0.1319)*	0.0164(0.0462)		0.1152(0.0872)	-0.0963(0.1224)	0.2211(0.1258).	-0.0038(0.0484)
re-1	-0.9369(0.8718)	-0.5357(1.0394)	-0.5664(0.4252)	0.2032(0.1490)		0.1711(0.2280)	1.3604(0.3198)***	-0.4575(0.3286)	0.4872(0.1265)***
wp-2	0.1340(0.1591)	-0.0715(0.1896)	-0.0195(0.0776)	-0.0094(0.0272)		0.0202(0.1068)	-0.1706(0.1498)	-0.1269(0.1539)	-0.0365(0.0592)
fn-2	0.1161(0.0653).	-0.0952(0.0779)	0.0894(0.0319)**	-0.0127(0.0112)		0.0771(0.0682)	-0.2087(0.0956)*	0.0210(0.0983)	-0.0099(0.0378)
tp-2	-0.4304(0.2789)	-0.6686(0.3325).	-0.3985(0.1360)**	-0.0278(0.0476)		-0.2030(0.0873)*	-0.0638(0.1224)	-0.1276(0.1258)	-0.0421(0.0484)
re-2	-0.9792(0.8868)	0.1483(1.0573)	-0.8956(0.4325)*	0.1696(0.1515)		-0.0289(0.2440)	0.1167(0.3423)	0.0655(0.3517)	-0.1723(0.1354)

Notes: [a] denote represents equation 1; [b] denote represents equation 2; and [c] denote is error correction term.

Table5:VECM Coefficients Short-run Relationship(Continued)

Eq.3[a]	wp	fn	tp	re	Eq.4[b]	wp	fn	tp	re
ECT[c]	-0.1981(0.1125).	-0.1068(0.1372)	0.0026(0.0863)	0.0160(0.0832)		-0.0354(0.0814)	0.0417(0.0740)	0.0044(0.0666)	-0.0052(0.0197)
Intercept	-0.3878(0.5546)	-0.2537(0.6761)	-0.2794(0.4255)	-0.0576(0.4099)		-0.1023(1.1040)	-0.1899(1.0038)	0.3575(0.9043)	-0.2290(0.2667)
wp-1	0.2518(0.2098)	0.1290(0.2558)	-0.1151(0.1610)	0.0395(0.1551)		0.5745(0.2112)*	0.4480(0.1920)*	0.2160(0.1730)	-0.0155(0.0510)
fn-1	-0.0204(0.1784)	0.0293(0.2175)	-0.0890(0.1369)	-0.0053(0.1319)		-0.0553(0.1799)	0.5201(0.1636)**	0.1346(0.1473)	-0.0405(0.0435)
tp-1	0.2071(0.2942)	0.3514(0.3587)	0.2821(0.2258)	0.1974(0.2175)		-0.3032(0.2749)	-0.2119(0.2499)	-0.1250(0.2252)	0.0241(0.0664)
re-1	0.1839(0.2985)	0.1285(0.3639)	0.5333(0.2290)*	0.2314(0.2206)		-0.1899(0.3633)	-0.6011(0.3303).	0.3316(0.2975)	0.4907(0.0877)***
wp-2	-0.0287(0.2046)	0.1945(0.2495)	-0.0041(0.1570)	-0.0185(0.1512)		-0.1665(0.2389)	-0.1747(0.2172)	-0.1163(0.1957)	-0.1084(0.0577).
fn-2	0.0110(0.1760)	-0.2041(0.2145)	0.1032(0.1350)	0.0430(0.1301)		0.4047(0.1688)*	0.0402(0.1535)	0.3002(0.1382)*	0.0476(0.0408)
tp-2	-0.0389(0.2484)	0.0733(0.3028)	-0.0512(0.1906)	-0.2645(0.1836)		-0.2137(0.2449)	-0.1758(0.2226)	-0.1030(0.2006)	0.0807(0.0592)
re-2	-0.2320(0.2948)	-0.5460(0.3594)	-0.2228(0.2262)	-0.2787(0.2179)		-0.1533(0.3146)	0.5530(0.2860).	0.0949(0.2577)	0.0880(0.0760)

Notes: [a] denote represents equation 1; [b] denote represents equation 2; and [c] denote is error correction term.
Source: authors' own calculaiton

Regarding short-term realtionships, from the perspective of the wood processing industry, the coefficient of the negative ECT term of wp: independent variable -0.2761 * is significant in some models, indicating a significant regression adjustment when deviating from equilibrium; The negative impact of the real estate industry on it is relatively consistent with -0.7218 *, reflecting the short-term inhibitory effect of the real estate industry on the wood processing industry. The ECT term of the fn project in the furniture industry has no significant impact, indicating that its short-term adjustment power is weak. However, the furniture industry is significantly positively affected by the real estate industry (1.3604 **), reflecting that the growth of the real estate industry drives furniture demand. Transportation industry tp: The adjustment to long-term equilibrium is relatively weak, while the positive support from the furniture industry is relatively stable, such as 0.4612 **, indicating that the increase in demand for the furniture industry has driven the transportation industry.Real estate industry re: The lagged term of the independent variable has a significant positive impact on itself (0.4907 **), indicating that its short-term growth trend is self-supporting, indicating that the real estate industry has strong growth inertia in the short term. The analysis of VEC structural breakpoint model shows that the relationship between different industries is influenced by market and resource supply and demand in the short term. In the long run, the wood processing industry and real estate industry have a significant guiding role. We further analyze the breakpoint impact of the real estate industry on the furniture industry.

By conducting Granger causality tests before and after breakpoints in the VEC model, the short-term impact effects of breakpoints can be captured.The structural breakpoint has a positive impact on Granger causality, and the error correction coefficient of the VEC model indicates that the structural changes after the breakpoint may affect the short-term relationships between variables.

Table 6: Granger Causality Test Results

Test1	Model Comparison	Res.Df	Df	F	p-value (Pr(>F))
4 to 1	M1:wp~L(wp,1:2)+L(re,1:2)	42			
	M2:wp~L(wp,1:2)	44	-2	0.1676	0.8463
4 to 2	M1:fn~L(fn,1:2)+L(re,1:2)	42			
	M2:fn~L(fn,1:2)	44	-2	15.341	9.963e-06 ***
4 to 3	M1:tp~L(tp,1:2)+L(re,1:2)	42			
	M2:tp~L(tp,1:2)	44	-2	0.4457	0.6434
Test 2					
4 to 1	M1:wp~L(wp,1:2)+L(re,1:2)	89			
	M2:wp~L(wp,1:2)	91	-2	5.3121	0.006616 **
4 to 2	M1:fn~L(fn,1:2)+L(re,1:2)	89			
	M2:fn~L(fn,1:2)	91	-2	23.338	7.101e-09 ***
4 to 3	M1:tp~L(tp,1:2)+L(re,1:2)	89			
	M2:tp~L(tp,1:2)	91	-2	0.4582	0.6339
Test 3					
4 to 1	M1:wp~L(wp,1:2)+L(re,1:2)	52			
	M2:wp~L(wp,1:2)	54	-2	1.6709	0.198
4 to 2	M1:fn~L(fn,1:2)+L(re,1:2)	52			
	M2:fn~L(fn,1:2)	54	-2	1.9518	0.1523
4 to 3	M1:tp~L(tp,1:2)+L(re,1:2)	52			
	M2:tp~L(tp,1:2)	54	-2	3.9331	0.02567 *
Test 4					
4 to 1	M1:wp~L(wp,1:2)+L(re,1:2)	36			
	M2:wp~L(wp,1:2)	38	-2	5.9149	0.00601 **
4 to 2	M1:fn~L(fn,1:2)+L(re,1:2)	36			
	M2:fn~L(fn,1:2)	38	-2	19.008	2.32e-06 ***
4 to 3	M1:tp~L(tp,1:2)+L(re,1:2)	36			
	M2:tp~L(tp,1:2)	38	-2	1.7855	0.1823

Source: authors' own calculation

Stage 1 (2004. John 2008. John): The real estate industry has a significant short-term Granger causality relationship with the furniture industry (re → fn), with a very low p-value (9.963e-06), indicating that its strong growth has driven furniture demand. But it has no significant impact on the wood processing industry and transportation industry (re→wp, re→fn), which may be due to industry independence or different market driving factors. Stage 2 (2008. Feb-2016. Jan): The real estate industry has a significant short-term impact on both the wood processing industry and the furniture industry, with a particularly significant impact on the furniture industry (p-value 7.101e-09). The impact on the wood processing industry (p-value 0.006616) may be related to the correlation between the demand for wood as a building material. However, the short-term impact on the transportation industry is still not significant. Stage 3 (2016-Feb-2020. Dec): The real estate industry showed a significant short-term causal relationship with the transportation industry for the first time (p-value 0.02567), reflecting the correlation between this stage and logistics demand. However, the short-term impact on the wood processing and furniture industries is not significant, indicating that changes in these industries require longer cycles or other factors to drive. Stage 4 (2021-Jan-2024. Jul): The real estate industry has a significant short-term impact on the wood processing industry and furniture industry, especially the furniture industry (p-value 2.32e-06). This demand may come from the new housing construction and decoration market. However, the short-term impact on the transportation industry is still limited. In summary, the short-term impact of the real estate industry on related industries varies in different periods, reflecting the dynamic correlation between industries. The short-term impact of the real estate industry on furniture, wood processing, and transportation industries has dynamic changes in different periods. In the first two stages, the furniture industry was significantly driven by real estate; The third stage focuses on the transportation industry; The impact of the fourth stage wood processing industry has once again strengthened, indicating that the interdependence between industries is driven by market and cyclical changes.

V. CONCLUSIONS

This study examined the impact of Chinese real estate industry on fixed investment growth of the furniture industry based on Vector Error Correction (VEC) structural breakpoint models by using monthly timeseries data from January 2004 to July 2024. Based on VECM structural breakpoints, this paper discusses the impact of China's real estate industry on the growth rate of fixed assets investment in the furniture industry. Research has shown that the relationship between the real estate industry and the furniture industry is not only driven by short-term fluctuations in market demand, but also includes long-term impacts on the industry chain. After introducing structural breakpoints, we divided the model data into four stages through verification.

Empirical analysis showed that in the long-term equilibrium relationship, the VEC model identifies that the real estate industry has a significant long-term impact on the furniture industry, especially showing changes in the direction and intensity of the relationship at specific breakpoints. The cointegration vectors in VECM-1 to VECM-4 show that the furniture industry, wood processing industry, and transportation industry exhibit different cointegration relationships with the real estate industry in different economic cycles, indicating that each industry has different response mechanisms driven by resource allocation, cost fluctuations, and market demand. Overall, the VEC structural breakpoint model successfully reveals the complex impact of the real estate industry on various links in the furniture industry chain. This indicates that the role of the real estate industry in the Chinese furniture industry chain is constantly changing, and future policies should pay more attention to cross industry collaborative development and response to external shocks. We also acknolwedged that this study has a few limitations including econometric model used in this study that future research can address for more comprehensive analysis in this field.

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