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The impact of China's housing market on foreign trade under the changing international economic situation

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Abstract While regulating land resources and real estate development, the regulatory measures in China's housing market also have far-reaching impacts on foreign trade by influencing labor agglomeration, labor costs, and capital allocation. Understanding the intrinsic linkage mechanism of housing policy on trade activities is the key to formulating efficient economic policies. Based on the housing market and export trade data of 30 provinces in China from 1999 to 2024, this paper constructs a multiple regression model consisting of six variables, including housing supply regulation and volumetric rate regulation, to analyze their impact on China's foreign trade development index (FTDI). OLS and R-LS methods are used to estimate the model, while regional heterogeneity analysis and cointegration test are conducted. The results show that in the coastal region, for every 1 percentage point increase in housing supply regulation, the FTDI increases by about 0.4 percentage points, and the coefficient of volumetric regulation is 0.633, which is significant and good. Labor force size shows a negative effect with a coefficient of -0.701, indicating that restricted population density inhibits trade expansion. In addition, investment transfer and credit crowding out effects also show significant positive effects on trade. It is concluded that the housing market has a significant boost to exports, especially in coastal cities, and that policy regulation should take into account regional differences and long-term structural linkages.

Index Terms housing supply regulation, volumetric rate regulation, labor force size, labor cost, investment transfer, foreign trade index

I. Introduction

The international economic situation is affected by a variety of factors, including global economic growth, trade friction, international financial market volatility and so on. In recent years, global economic growth has faced certain downward pressure due to factors such as the global economic slowdown [1]. Trade protectionism and unilateralism have risen, the multilateral trading system has been impacted, and trade friction has intensified [2], [3]. Volatility in the international financial market, especially the sharp fluctuation of the US dollar, has had a certain impact on the financial and foreign exchange markets [4], [5]. In addition, in 2020, the global pandemic of the new crown pneumonia epidemic caused a serious setback to global economic cooperation, and the objective need for epidemic prevention and control pressed the pause button of the global economy, coupled with the politicized operation of the epidemic by individual politicians, which further exacerbated economic conflicts between countries and regions, the world's instability and uncertainty are increasing, and the international political and economic landscape has seen many new changes [6]-[9]. However, the international economy is still developing in a more balanced, inclusive and sustainable direction.

China's housing market started in the mid-to-late 1980s and has developed rapidly in just a few decades. The housing market contributes greatly to the Chinese economy and can drive the development of related industries, solve the employment problem of a large number of working people, improve the living standard of the whole nation, and at the same time, the housing market is also an important source of financial income for local governments in China [10]-[12]. Because the housing market not only has a driving effect on the national economy, but also housing, a non-traded commodity, the price of which rises for the substitution effect of traded goods, but also brings the income effect, in other conditions remain unchanged, traded goods manufacturers to export a large number of products, resulting in a substantial increase in China's foreign trade [13], [14]. On the other hand, because of the rise in the price of non-traded goods, all other things being equal, there is a real appreciation of China's exchange rate, and the price of traded goods in foreign countries relatively decreases, thus increasing the demand for foreign traded goods, but due to the decrease in real income caused by the excessive rise in the price of residential housing, the degree of increase in the demand for foreign traded goods is lower than the increase in exports, so that the net export is always positive, and trade surpluses are constantly accumulating [15]-[17].

The process of globalization has led to the rapid growth of international market demand, and China, as the world's largest country in terms of population and manufacturing center, has sufficient potential market and large-scale production capacity. The rapid development of China's foreign trade is also closely related to the world's demand for Chinese commodities, and China's active participation in the global industrial chain, providing cheap and high-quality commodities and services for the world to meet the needs of the international market, further promoting the development of foreign trade [18]-[21]. However, under the changes in the international economic situation, China's foreign trade has produced changes, in which the impact of the housing market on foreign trade is worthy of in-depth investigation.

Under the wave of globalization, the development of urbanization has had a profound impact on the economic structure of various countries, and housing policy, as an important tool for regulating urban space and resource allocation, has not only reshaped the social ecology, but also profoundly affected the flow of labor, the layout of enterprises, and the direction of capital flow. In China, housing policy not only determines the development path of the real estate industry, but also has a substantial impact on the import and export trade by influencing the intensity of urban development, the carrying capacity of the population and the business environment of enterprises. From the migratory aggregation of labor to the crowding-out effect of housing prices on productive capital, the housing market has become a key variable in the interaction between China's economic structure and external trade.

This study focuses on housing supply regulation and volumetric ratio regulation to explore their mechanisms of action on China's external trade development. The study firstly quantifies the dynamic relationship between China's housing market and external trade by constructing a multiple regression model including housing regulation, labor force, labor cost, capital allocation, etc.; secondly, the study adopts subregional regression and cointegration test to verify the stability of the model and reveal regional heterogeneity; finally, the study combines the analysis of the panel data of 30 provinces to further sort out the paths and intensity of the impact of the housing policy on external trade, aiming to provide a better understanding of China's housing market reform and the development of its external trade. Finally, with the panel data analysis of 30 provinces, we further sort out the path and intensity of housing policies affecting foreign trade, aiming to provide theoretical support and empirical evidence for the synergistic optimization of China's housing market reform and foreign trade policies.

II. Research mechanism

II. A. Regulation of housing supply and plot ratio regulation

II. A. 1) Regulation of Housing Supply (RHS)

The specific meaning of housing supply regulation refers to the implementation of a series of zoning planning and control of land development and utilization by the relevant government administrative authorities in accordance with the law and the use of administrative means, through the pre-arrangement and deployment of the utilization of land resources, in order to obtain the best comprehensive benefits of land use, to achieve the realization of public interests and promote the overall coordinated development of society. In the market economy, the pursuit of profit maximization characteristics, relying only on the market's regulatory mechanism can not achieve the optimal allocation of resources, the need for government intervention to regulate and standardize the market operation, to correct the “market failure”, the housing supply regulation is the government's public intervention in the land market is the main way. China's current more common urban housing supply regulations are mainly the following: the first is the regulation of the overall size of the city.

The first is the control of the overall size of the city, including the urban growth boundary, the central government's allocation of land use targets to localities, and so on.

The second is the control of land use zoning and intensity, such as plot ratio, green space ratio, land use nature, building height and density control.

The third is the land development planning permit system, such as real estate development needs to apply for “construction permit for building projects”, “planning permit for building projects”, “planning permit for building land” and other relevant documents [22].

II. A. 2) Regulation of Housing Floor Area Ratio (FAR)

Volume ratio regulation means the dimensionless ratio of the aboveground gross floor area of the project construction site to the net land area, which is a controlling indicator for describing the intensity of land use in the control detailed plan, and it has the most direct impact among a series of indicators affecting the control of urban development. According to some urban economics literature, plot ratio regulation is a commonly used administrative tool in the world to improve the externality of population density, and it is one of the most important housing supply regulations in China. China's plot ratio regulation usually exists in the form of a cap on the legal plot ratio, i.e., when a certain value of plot ratio is set for a piece of land, the developer's development of the land's floor area needs to be kept within the range of the legal plot ratio, which in principle cannot be exceeded, and this creates a constraint

on the developer's land use behavior. If the higher the legal floor area ratio, the greater the ratio of the developable floor area on the ground to the plot area, the higher the land use intensity. On the contrary, the intensity of land use will be lower. From the meaning of plot ratio, plot ratio and building density, building height has a close relationship, assuming that the conditions of building density remains unchanged, plot ratio and building height shows a positive relationship. Similarly, if the condition of building height is unchanged, the plot ratio is also positively proportional to the building density.

II. B.Mechanisms of the housing market's impact on urban export trade

II. B. 1) Based on the labor force size (LS) perspective

The restriction on housing supply imposed by the volume-rate regulation reduces the capacity of cities to accommodate new labour, which is not conducive to expanding the scale of local labour agglomeration, thus affecting the degree of local industrial agglomeration and negatively affecting the growth of regional exports. Economic theory suggests that an important micro-foundation of industrial spatial agglomeration is labor market pooling. Systematically modeling the mechanism of agglomeration economic externalities, urban economists have basically reached a consensus on the motives of industrial agglomeration, and believe that agglomeration economy is an important factor causing inter-regional productivity heterogeneity, which can be attributed to three aspects: first, the sharing of the labor market, labor pooling there are two mechanisms to guide the industrial agglomeration and improve regional productivity. First, the matching mechanism. With the agglomeration of enterprises and labor, the differentiated and diversified nature of the two becomes richer and richer, which is conducive to increasing the success rate of suitable matching between enterprises and labor, achieving high-quality matching, and thus increasing the marginal productivity of local factors of production, such as labor and enterprise capital. Second, risk-sharing mechanisms. Third, knowledge and technology spillover, geographical proximity reduces the cost of formal or informal exchanges between enterprises and laborers, such as the reference of manufacturers to the production process, low-skilled workers to learn the skills of high-skilled workers, facilitating the transfer of information, promoting the spillover and diffusion of knowledge and technology, promoting the creation of new local knowledge and technology, and helping to improve regional productivity [23].

II. B. 2) Based on Labor Cost (LC) Perspective

The restriction on urban housing supply imposed by the volume rate regulation will result in a significant rise in urban wages, and wages as the main body of labor costs are an important part of the production costs of enterprises, and an increase in the regional wage level will promote the increase in the overall production costs of enterprises, which will not be conducive to the growth of the region's export trade. Higher wages increase the cost pressure of local export enterprises, will prompt enterprises to find ways to transfer costs, and then increase the price of regional exports, which will weaken the competitiveness of the region's exports. Although the normal increase in labor productivity brought about by the rise in wages will not necessarily increase the burden on enterprises, and if the increase in productivity exceeds the increase in wages will not only reduce the unit cost of labor, but will also increase the motivation of the labor force to work and work efficiency, which is conducive to improving the competitiveness of export trade.

II. B. 3) Based on the Investment Transfer (ITE) and Credit Squeeze (CS) Effect Perspectives

Restrictions on the supply of urban housing imposed by volumetric regulations can drive significant increases in house prices, with a diversionary effect on investment in the real sector. The high price of housing makes the real estate sector have a high rate of return on investment, which leads some real economy enterprises to transfer their capital to the real estate sector on a large scale in order to avoid risks or to carry out capital arbitrage. By establishing the endogenous economic growth model of two production sectors, it is pointed out that the non-technology spillover production sector with asset bubbles will suck in the limited capital and divert the investment direction of the technology spillover production sector, thus hindering the innovation investment of its main industry. The investment diversion effect is analyzed on the basis of firms' own decisions, while in reality firms obtain part of their capital from other financial institutions through exogenous financing channels. Like real enterprises, in the high prices of real estate has a high rate of return on investment in the context of financial institutions will allocate more financial resources to the low-risk, high-yield real estate industry, which in turn produces credit crowding out effect. Real estate and related industries contribute to export growth is relatively small, one is China's exports to industrial manufactured goods, the main categories for mechanical and electrical, high-tech or textile and other products, while the output of the real estate industry is based on housing, does not have the technology spillover and the correlation effect with the industry where these products are smaller, two is the real estate industry investment driven by the related industries are also to construction, steel, cement and other industries, these industries have a major impact on the real estate industry, the real estate industry, the real estate industry and the real estate industry.

Secondly, the related industries driven by investment in the real estate industry are also mainly construction, steel, cement and other industries, which have a limited role in promoting the growth of China's export trade. Thus, it can be seen that the credit crowding out effect on productive enterprises caused by the rise in housing prices brought about by the plot ratio regulation is ultimately unfavorable to the export growth of the whole city. The functioning mechanism of volume rate regulation to inhibit export growth is shown in Fig. 1.

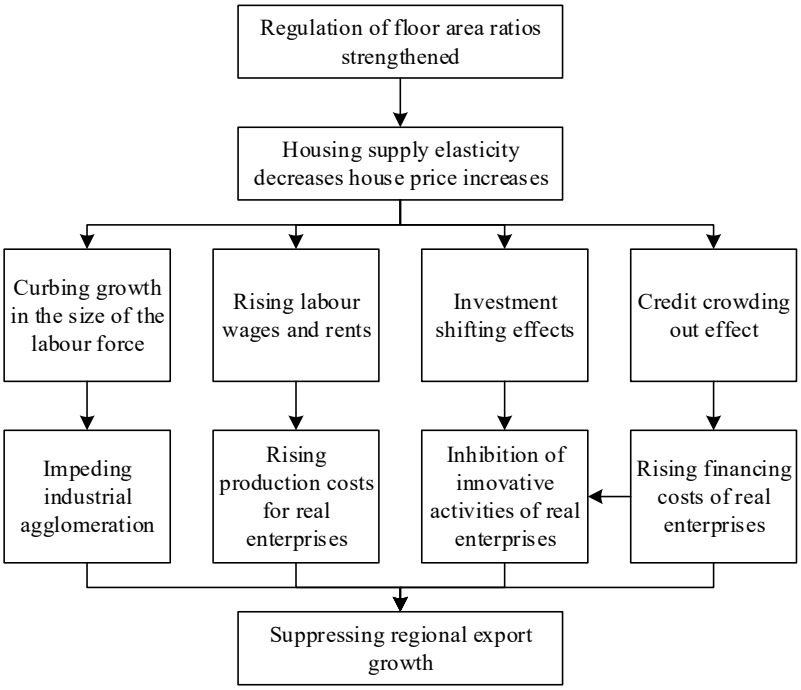

Figure 1: Action mechanism

III. Modeling

III. A. Model Construction and Variable Selection

Based on the existing research, combined with the current development status and trend of China's housing market and foreign trade, this paper argues that the development of China's housing market will promote the continuous development of China's foreign trade activities. Based on this, in order to study the impact of China's housing market on China's foreign trade and collect relevant data, the following benchmark model is first set.

$$\ln(FTDI) = \alpha + \beta_1 \ln(RHS) + \beta_2 \ln(FAR) + \beta_3 \ln(LS) + \beta_4 \ln(LC) + \beta_5 \ln(ITE) + \beta_6 \ln(CS) + \varepsilon \quad (1)$$

In this case, the Foreign Trade Development Index (FTDI) serves as the explanatory variable, and the explanatory variables in the model are the regulation of housing supply (RHS) and the regulation of floor area ratio (FAR), labor force size (LS), and the cost of labor (LC), respectively. Investment transfer (ITE) and credit crowding out effect (CS) are control variables. Denoted by β_1, β_2, β_3, β_4, β_5, β_6 respectively α and ε denote the constant and residual terms respectively [24].

III. B. Data collection and organization

In this paper, the time series data of China from 1999 to 2024 are selected for the study, and all the original data come from the Chinese housing market data of 30 provinces in China with their foreign trade volume. The descriptive statistics and correlation analysis of variables are shown in Table 1.

Table 1: Data descriptive statistics

Variable	RHS	FAR	LS	LC	ITE	CS	FTDI
Mean	11.645	9.451	4.098	5.216	4.022	9.236	8.579
Max	11.978	9.046	4.012	4.897	3.879	10.136	10.474
Min	12.685	11.824	8.143	10.147	5.786	11.638	10.956
N	30	30	30	30	30	30	30

The correlations are shown in Fig. 2, and through the analysis of covariance,we get the correlation coefficients of housing supply regulation and volumetric rate regulation, labor force size, labor cost, investment transfer and credit crowding out effect are 0.912, 0.923, 0.922, 0.954, 0.967, 0.933 respectively, all of them above 0.90, which indicates that there is a significant positive correlation between the FTDI and the six Chinese housing market explanatory variables have a significant positive correlation.

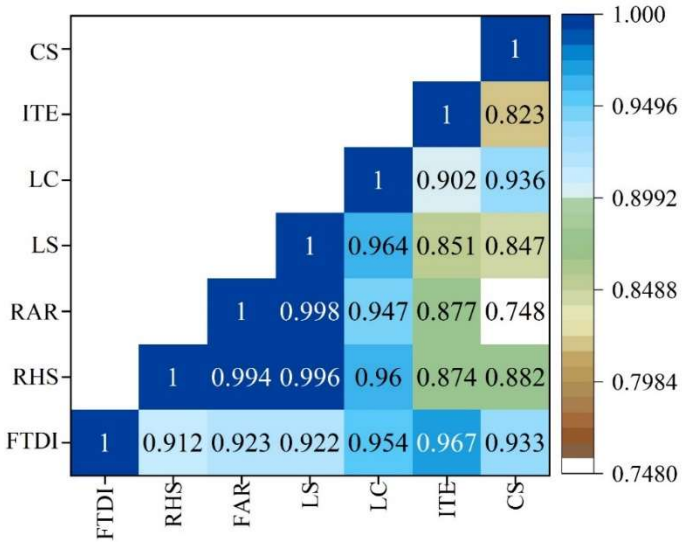

Figure 2: Variable correlation

IV. Empirical analysis

IV. A. Benchmark regression of China's housing market on export trade

The cross-sectional data may generate the problem of conditional heteroskedasticity, and the existence of heteroskedasticity makes the best linear unbiased estimation (BLUE) difficult to realize. Currently, there are three mainstream methods: least squares + robust standard error (R-LS), weighted least squares (WLS), and generalized weighted least squares (FWLS), and the premise of WLS is that the variance of each individual must be known accurately, which is difficult to be realized in practice. The exact form of conditional variance is often unknown. Based on the above considerations, R-LS is used to estimate the model in this study. In addition, for comparison purposes, the estimation results of OLS are shown in Table 2. Further, the 30 provinces in the sample are categorized into three camps: coastal, border and inland, based on their natural geographic locations, levels of economic development, and in conjunction with the provincial administrative regions to which they belong. The regressions of the three camps are conducted separately to examine the heterogeneity of economic laws in different regions on the one hand. On the other hand, the model robustness test is taken into account, and the adaptability of the model to the sample is examined through the regression of different regional economic data. Through comparison, it is found that the signs of all explanatory variables remain unchanged regardless of OLS regression or R-LS regression, with minor fluctuations in the coefficient values, and the overall significance is highly consistent, which indicates that the model robustness is good. As far as the core explanatory variables are concerned, the development of housing supply regulation in coastal cities effectively promotes foreign trade. Controlling for other variables, every 1 percentage point increase in housing supply regulation increases the level of foreign trade by nearly 0.4 percentage points, which is in line with expectations. For coastal and inland cities, the development of China's housing market positively affects their international trade, but not significantly, and the coefficient of effect is significantly lower than that of coastal areas. The main reason is that the development of China's housing market industry is also unbalanced and insufficient, and the evolution of the industry in coastal cities is generally ahead of

that of inland and border cities. Some famous domestic companies are headquartered in coastal areas. In contrast, China's housing market in the inland and border areas is lagging behind, with weak Internet infrastructure, and the integration with international trade business needs to be improved, lagging behind cities in coastal provinces represented by Shenzhen, Guangzhou, Beijing and Shanghai. Under the general trend of Internet development, inland and border areas should spare no effort to promote infrastructure construction, deepen the application of China's housing market in the field of foreign trade, and reduce the cost of information collection and communication cost of foreign trade business with the help of Internet technology. At the same time, they should break down the barriers to factor flows, open up the telecommunication market in an orderly manner, and create a favorable policy and institutional environment for the growth of the new business mode of “China's housing market + international trade”, so as to add a new engine for the development of foreign trade.

As far as the control variables are concerned, the development of investment transfer and credit crowding-out effect effectively promotes the country's foreign trade. The progress of financial development can diversify the risk for foreign trade enterprises, reduce the cost of financing, and help enterprises to expand the import and export business. Combined with the estimation results of the model in the table, it can be seen that China's foreign trade development is indeed characterized by spatial heterogeneity. The digitization process of economy, government, life, culture and other fields in coastal cities is ahead of other regions, the degree of industrial integration between China's housing market and foreign trade is higher, and the location advantage is obvious, with a large number of high-quality ports, which provides good external natural conditions for the development of international trade promoted by “China's housing market +”.

Table 2: The estimates of ols and the called ls

Variable	Sample range							
	Whole country		Coast		Inland		Edge	
	OLS	R-LS	OLS	R-LS	OLS	R-LS	OLS	R-LS
RHS	0.384*** (0.125)	0.362*** (0.112)	0.274* (0.165)	0.314** (0.145)	0.284 (0.168)	0.334* (0.170)	0.305 (0.412)	0.218 (0.360)
FAR	0.662*** (0.145)	0.633*** (0.634)	0.784*** (0.222)	0.635*** (0.184)	0.742*** (0.212)	0.594*** (0.213)	0.169 (0.394)	0.225 (0.345)
LS	-0.845* (0.180)	-0.701*** (0.160)	-0712*** (0278)	-0.489** (0.222)	-1.145*** (0.253)	-1.047*** (0.268)	-0.479 (0.542)	0.175 (0.483)
LC	0.611*** (0.130)	0.498*** (0.115)	0.568*** (0.189)	0.514*** (0.416)	0.714*** (0.195)	0794*** (0.201)	0.853** (0.358)	0.172 (0.320)
ITE	0.384*** (0.080)	0.445*** (0.070)	0.296** (0.112)	0.326*** (0.09)	0.578*** (0.111)	0.794*** (0.195)	0.857** (0.362)	0.170 (0.315)
CS	-0.040 (0.041)	-0.022 (0.036)	-0.162** (0.068)	-0.038 (0.057)	-0.033 (0.050)	-0.025 (0.05)	0.078 (0.112)	0.024 (0.099)
FTDI	0.998*** (0.162)	1.095*** (0.140)						
R^2	0.778	0.641	0.814	0.758	0.689	0.584	0.522	0.456

IV. B. Stability tests

Foreign trade development index, housing supply regulation and volumetric rate regulation, labor force size, and labor costs in the empirical evidence. Investment transfer and credit crowding out effects must be tested for the smoothness of the variables before the cointegration analysis. In this paper, the ADF unit root test is chosen to test the smoothness of the series, and the results are shown in Table 3 (four decimals are retained here): RHS, LS, ITE in this paper are all first-order smooth series after the first-order differencing, i.e., RHS, FAR, LS, LC, ITE, and CS are the same-order monotonous series each other to satisfy the conditions of the standard cointegration test.

Table 3: ADF test results

Variable	ADF	1%level	5%level	10%level	Prob	Conclusion
RHS	2.331	-2.7584	-2.0147	-1.6125	0.9910	No smoothness
FAR	-2.6854	-2.7820	-2.0136	-1.6130	0.0120	Smoothness
LS	2.0365	-2.7623	-2.0147	-1.6125	0.9845	No smoothness
LC	-2.8879	-2.2785	-2.0136	-1.6130	0.0084	Smoothness
ITE	2.4880	-2.7632	-2.0147	-1.6125	0.9945	No smoothness

CS	-2.5056	-2.7841	-2.0136	-1.6130	0.0185	Smoothness
FTDI	-2.0194	-5.0214	-3.4125	-3.4147	0.5362	No smoothness

IV. C. Cointegration tests

In this paper, we choose the EG two-step method to test the cointegration of the relationship between China's housing market and China's foreign trade, which is based on the cointegration test of the regression residuals, and is often used to test whether there is a cointegration relationship between the two variables, and is mainly for the single-equation, the specific steps are as follows: the first step, firstly, estimate the regression model by OLS, so as to get to the residuals of the residuals of the series. In the second step, the residuals obtained in the first step are tested for smoothness, if the residuals are smooth, it means that there is a cointegration relationship. The OLS models are constructed for RHS, FAR, LS, LC, ITE, CS and FTDI respectively, and the results are shown in Table 4, from which it can be seen that the R-squared and adjusted R-squared of the three OLS models are more than 0.87, which indicates that the models are more significant, and at the same time, the values of AIC and SC are smaller, which indicates that the equations are better fitted, and the three models' coefficients of the explanatory variables are all significant at 1% level.

Table 4: The result of the -eg association

		Explained variable		
		RHS	LS	LC
Interpretation variable	C	12.2451***	11.468***	11.6578***
		(0.0451)	(0.0432)	(0.0452)
		[312.6254]	[268.6678]	[289.5634]
	FTDI	0.3289***	0.3112***	0.3426***
		(0.0322)	(0.0346)	(0.0325)
		[10.3254]	[9.1278]	[10.7145]
Model significance test	R-squared	0.9014	0.8745	0.9163
	Adjusted R-squared	0.8895	0.8745	0.9084
	F-statistic	107.0895	84.1084	115.5462
	AIC	-1.0178	-0.8947	-1.0036
	SC	-0.9256	-8046	-0.9147

The residual series are tested for smoothness, and the test results are shown in Table 5 (four decimals are retained here): As can be seen from Table 5, the RHS and LC reject the original hypothesis at 5% significant level, and the FTDI rejects the original hypothesis at 1% significant level, and the RHS residual series, the LC residual series, and the FTDI residual series are smooth, which indicates that there is a long term stable relationship between the foreign trade development index and the housing supply and the size of the labor force of all (1, 1) order cointegration, there is a long-term stable relationship. From the long-term trend model, it can be seen that there is a long-term stable and positive relationship between China's housing market and the OFDI. It can be seen that the application of China's housing market in China's foreign trade can promote the development of China's foreign trade, which mainly promotes the development of China's export trade.

Table 5: The stability test of the residual differential sequence

Variable	ADF	1%level	5%level	10%level	Prob	Conclusion
FTDI	-2.5697	-2.7481	-2.0147	-1.6128	0.0145	Smoothness
RHS	-2.3641	-2.7845	-2.0747	-1.6128	0.0302	Smoothness
LC	-2.7769	-2.7658	-2.0747	-1.6128	0.0098	Smoothness

V. Conclusion

Volumetric regulation in the housing market has a significant effect on trade growth. In the regression results, the coefficient of the volumetric regulation variable FAR reaches 0.633, which is a good significance, indicating that increasing land use intensity can promote export output. Controlling for other variables, labor cost (LC) also shows a positive drive on foreign trade, with a coefficient of 0.498, indicating the important role of rational remuneration mechanism in promoting export capacity. Meanwhile, the investment transfer effect (ITE) should not be ignored, with a regression coefficient of 0.445, implying that real estate attracts capital spillovers that can indirectly drive the

development of related export industries in the short term. However, the coefficient of labor force size (LS) is -0.701, which is negative and significant, reflecting the insufficient capacity of urban population under the restriction of housing supply, which hinders industrial agglomeration and productivity enhancement, and restricts the potential of trade expansion. Thus, the housing market regulation strategy should take into account the efficient use of land and the improvement of population carrying capacity, avoiding the spillover of labor and capital due to the restriction of floor area ratio or high housing prices, and further enhancing China's competitiveness and coordination in the global trading system.

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