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# Study on the Evolutionary Mechanism of Real Estate Market Subjects' Behavior Driven by Media Sentiment

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## Abstract

**In recent years, the influence of media sentiment on the real estate market has become increasingly important, and it has become an important factor affecting market participants' decision-making and market stability. In this study, we use evolutionary game theory to construct a tripartite game model among developers, home buyers, and the government to analyze the influence mechanism of media sentiment on the behavior of real estate market participants. It is found that media sentiment affects market operation by influencing the psychological expectations and decision-making behavior of market participants. Positive sentiment can promote market activity, but excessive positivity can lead to market overheating; negative sentiment can inhibit market overheating, but excessive negativity can trigger market panic. The strength of government regulation and the speed of media sentiment dissemination are important factors affecting market equilibrium, and moderate regulation and sentiment dissemination management can help maintain market stability. Based on the results of the study, policy recommendations such as strengthening media sentiment monitoring, improving the information disclosure system, and establishing a flexible regulatory mechanism are proposed. This study provides a new theoretical perspective for understanding the role of media sentiment in the real estate market, and future research can further explore the differences in the influence of different types of media and the interaction with other factors.**

## Keywords

**Media Sentiment; Real Estate Market; Evolutionary Game Theory; Evolutionary Mechanism.**

## 1. Introduction

In recent years, with the rapid development of information technology and the popularization of social media, the impact of media sentiment on the real estate market has become increasingly important. Media sentiment not only influences the decision-making behavior of market participants, but also can trigger market fluctuations and even affect the stability of the entire real estate market[1]. Therefore, it is of great theoretical and practical significance to study the evolution mechanism of real estate market subjects' behavior driven by media sentiment.

This study aims to use the method of evolutionary game theory to construct a tripartite game model among developers, home buyers, and the government, and to analyze the influence mechanism of media sentiment on the behavior of the main players in the real estate market. Through dynamic analysis, it explores the strategic choices of market players under different types of media sentiment and their impact on market stability. At the same time, this study also examines the influence of government regulation and media sentiment propagation speed on

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market equilibrium, which provides a theoretical basis for the government to formulate relevant policies.

This study adopts a combination of literature review and model construction. First, through the literature review, the related theories of media sentiment and real estate market are sorted out to provide the theoretical basis for model construction. Second, evolutionary game theory is used to construct a three-party game model to analyze the impact of media sentiment on the behavior of market participants. Finally, through numerical simulation and case study, the validity of the model is verified and policy recommendations are made.

## 2. Basic Concepts and Characteristics

### 2.1. The Mechanism of Media Emotions

Media sentiment refers to the emotional tendencies and attitudes embedded in media reports, which can be categorized into two types: positive sentiment and negative sentiment. Positive sentiment is usually characterized by optimism, praise and support, while negative sentiment is characterized by pessimism, criticism and opposition. In the real estate market, media sentiment affects the operation of the entire market by influencing the psychological expectations and decision-making behavior of market participants[2].

Media sentiment refers to the individual or group emotional tendency transmitted through the media of text, image or audio/video, the core of which lies in the use of natural language processing (NLP), machine learning and deep learning technology to classify the sentiment of massive information and theme mining.

Media emotions are characterized by

Visibility and diffusion: the openness of the Internet makes it easier to track the spread of emotions, and emotions spread rapidly through social networks, creating the "resonance effect.

Differentiation and polarization: Similar emotions are easily aggregated and amplified, leading to the polarization of group views, such as the extreme opposition between "bullish" and "bearish" emotions in the real estate market.

Dynamic contagion: Emotions spread through indirect interactions, for example, pessimism reported by the media can trigger the wait-and-see behavior of homebuyers, further affecting market supply and demand[3].

### 2.2. Characteristics of the Real Estate Market

The real estate market is an economic system in which land, houses and related interests are traded, and its main characteristics include:

Asset characteristics and cyclicality: Real estate has both consumption and investment attributes, and prices are significantly affected by economic cycles, interest rate policies, and demographics. For example, loose monetary policy often stimulates short-term increases in house prices.

Policy sensitivity: Policies such as land supply, purchase and lending restrictions directly regulate market supply and demand. In 2023, transaction volume increased by 12% year-on-year after some Chinese cities eased purchase restrictions.

Information asymmetry: Differences between buyers' and sellers' perceptions of market trends and cost structures lead to transaction inefficiencies, e.g., developers may hide the real inventory pressure through marketing strategies[4].

The path of media sentiment in the real estate market includes:

Expectations: Optimistic reports increase homebuyers' confidence and boost demand; conversely, negative public opinion exacerbates the market's wait-and-see sentiment.

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Risk amplification: New media's focused coverage of localized risk events (e.g., real estate company defaults) can trigger global panic, leading to irrational price declines.

### 2.3. Analysis of the Necessity of Introducing Game Theory to the Real Estate Market

Traditional supply and demand models are difficult to explain market anomalies driven by emotions, and game theory provides a structured framework for analyzing multi-subject strategy interactions, the necessity of which is reflected in:

Strategic interdependence: The behaviors of buyers and sellers, developers and regulators constrain each other. For example, the buyers' strategy of "chasing up and down" and the developers' pricing strategy form a Nash equilibrium.

Incomplete information game: Media sentiment exacerbates information asymmetry, and participants rely on limited information to make decisions. The Bayesian game model can be used to simulate strategy adjustment under different emotional scenarios, such as a panic mood in which home buyers lock in low price contracts in advance.

Dynamic coordination mechanism: The game of policy regulation and market sentiment needs to consider the timing. For example, if the government releases control signals (such as raising lending rates) during the period of overheated housing prices, developers can delay the push to observe the market reaction and form a sequential equilibrium[5].

## 3. Evolutionary Model Construction of Real Estate Market Subjects' Behavior Driven by Media Sentiment

### 3.1. Construction of the Game Model

In game theory, most cases require the players to be completely rational and make no mistakes, but in actual M&A negotiation, the players are often in the state of limited rationality and information asymmetry, so this paper introduces the evolutionary game model. Evolutionary game theory originated from biological evolution theory, which was used by Lewontin in the 1960s for ecological research, and plays an important role in understanding socio-economic issues.

In the evolutionary game of real estate market financing, the game parties adjust their own strategies by learning each other's investment strategies, which ultimately determines the success or failure of mergers and acquisitions[6]. The model is constructed under the assumption of an asymmetric game relationship between government agencies and private investors in the real estate market, as shown in Table 1.

**Table 1.** An asymmetric game model of government and real estate market investor groups

| Subject of investment and construction | Attitudes adopted by private investors | |
|---|---|---|
| | x | 1-x |
| x | $a_0$-$a_1$+$a_2$ | $a_0$-$a_1$-$a_2$ |
| | $b_0$-$b_1$+$b_2$ | $b_0$-$b_1$ |
| y | $a_0$+$a_3$ | $a_0$ |
| | $b_0$+$b_2$-$b_3$ | $b_0$ |

In Table 1, x is the proportion of private investors actively investing in the real estate market, and (1-x) is the proportion of their negative investment; y is the proportion of the government

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actively participating in real estate construction investment and financing, and (1-y) is the proportion of their negative participation. $a_0$ is the government's gain when private investors do not invest and the government negatively participates; $a_1$ is the negative gain when the government (e.g., tax incentives, etc.); $a_2$ is the long-term social gains (e.g., housing quality improvement) from the government's active participation; $a_3$ is the unexpected social gains of the government when the government is negatively involved but private investors still invest. $b_0$ is the private gains when the government is negatively involved and the private investors don't invest; $b_1$ is the gains from the government's incentives when private investors invest; $b_2$ is the reputational gains from the private investors' investment; and (1-y) is the proportion of their negative involvement. $b_1$ is the gain from government incentives when private investors invest; $b_2$ is the reputational gain from private investor investment; and $b_3$ is the negative gain when private investors invest but are not adequately compensated by the market.

## 3.2. Evolutionary Game Analysis

### 3.2.1. Evolutionary Game Analysis of the Government:

The fitness of the government to choose an active participation strategy is:

$$E_{11} = x(b_0 + b_1 + b_2) + (1-x)(b_0 + b_2 - b_3) \quad (1)$$

The fitness of the government to choose a negative involvement strategy is:

$$E_{12} = x(b_0 - b_1) + (1-x)b_0 \quad (2)$$

The average fitness of the government's strategy is:

$$E = yE_{11} + (1-y)E_{12} \quad (3)$$

The replicated dynamic equation for the government in the game is:

$$F(y) = y(E_{11} - E) = y(1-y)[(2b_1 + b_3)x + (b_2 - b_3)] \quad (4)$$

Let $F(y) = 0$, which gives $y_1^* = 0$, $y_2^* = 1$, and $x^* = (b_3 - b_2) / (2b_1 + b_3)$. When $x = x^*$, $F'(y) = 0$, indicating that private investors' investment and financing strategies in real estate projects are in a steady state when the proportion of government participation with a positive attitude is $x^*$.

When $x < x^*$, $F'(0) < 0$, $F'(1) > 0$, and $y_1^* = 0$ is an evolutionary stable strategy, i.e., the government participates in a negative manner, and private investors do not invest in financing;

When $x > x^*$, $F'(0) > 0$, $F'(1) < 0$, $y_2^* = 1$ is an evolutionary stable strategy, i.e., the government actively participates and both parties maximize their benefits to achieve Pareto optimality.

### 3.2.2. 3.2.2 Evolutionary Game Analysis for Individual Investors

The fitness of the investor's choice of investment strategy is:

$$F_{11} = y(a_0 - a_1 + a_2) + (1-y)(a_0 - a_1 - a_2) \quad (5)$$

The fitness of the investor's choice of non-investment strategy is:

$$F_{12} = y(a_0 + a_3) + (1-y)a_0 \quad (6)$$

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The average fitness of the individual investor is:

$$F = xF_{11} + (1-x)F_{12} \tag{7}$$

The replication dynamic equation for the private investor in the game is:

$$F(x) = x(F_{11} - F) = x(1-x)[(2a_2 - a_3)y - (a_1 + a_2)] \tag{8}$$

Let F(x) = 0, which gives

$y^* = (a_1 + a_2) / (2a_2 - a_3)$, which means that F(x) = 0 regardless of the value of x, i.e. the steady state in all cases; $x_1^* = 1$; $x_2^* = 0$.

According to the theory of "evolutionary stabilization strategy", F(x) = 0 and F'(x) = 0[7], i.e:

$$F'(x) = (1-2x)[(2a_2 - a_3)y - (a_1 + a_2)] \tag{9}$$

When $y = y^* = (a_1 + a_2) / (2a_2 - a_3)$, the implementation of the government's positive economic incentives reaches a steady state.

When $y < y^*$, $F'(0) > 0$, $F'(1) < 0$, and $x_1^* = 1$ is an evolutionary stabilization strategy, i.e., the private investor does not participate and the government does not implement active policies;

When $y > y^*$, $F'(0) > 0$, $F'(1) > 0$, $x_2^* = 0$ is an evolutionary stable strategy, i.e., the government actively cooperates with private investors to achieve Pareto optimality.

### 3.2.3. Evolutionary Game Analysis

Through the game analysis conducted by the government and private investors, the evolutionary game evolution trend of both parties is drawn on the coordinate axis (see Fig. 1).

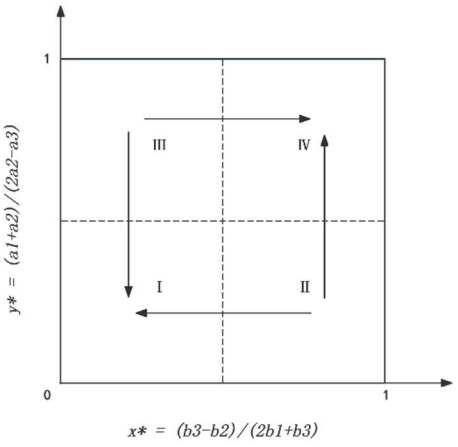


**Fig. 1** Trends in the dynamic development of evolutionary games

As shown in Fig. 1, the system reaches the evolutionary stabilization strategy at two initial state points (0,0) and (1,1), which correspond to the stabilization strategies ($X_1$,$X_2$) and ($Y_1$,$Y_2$) of the government and private investors, respectively.

When the initial proportion of active government participation in real estate investment and construction x < x* and the proportion of private investor investment and financing attitude y < y, the initial state of the system is located in the region Ⅰ and gradually converges to the Pareto equilibrium point (0,0), i.e. ($X_1$,$X_2$).

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If the proportion of active government construction x > x and the proportion of private investor's attitude y > y, the initial state of the system is in region Ⅳ and converges to (1,1), reaching the Pareto optimum, i.e. ($Y_1$,$Y_2$).

If x > x and y < y*, or x < x and y > y, the system is in regions II and III, respectively.

where $x^* = (b_3-b_2)/(2b_1+b_3)$ and $y^* = (a_1+a_2)/(2a_2-a_3)$ are thresholds in the asymmetric game model. Small changes in the initial state lead to different game outcomes, reflecting the significant impact of initial conditions on the final outcome.

## 4. Analysis of the Evolution Mechanism of Real Estate Market Participants' Behavior Driven by Media Sentiment

Through model solving and stability analysis, we find that media sentiment has a significant impact on the strategy choice of real estate market participants. Under the influence of positive media sentiment, developers are more inclined to adopt the high-price strategy, home buyers are more inclined to adopt the purchase strategy, and the government may be inclined to relax regulation. On the contrary, under the influence of negative media sentiment, developers may be forced to adopt a low-price strategy, home buyers may be more inclined to adopt a wait-and-see strategy, and the government may be inclined to tighten regulation[8].

There are also differences in the effects of different types of media sentiment on market stability. Moderately positive sentiment helps maintain market activity, but excessive positive sentiment can lead to market overheating and bubble risks. While negative sentiment can prevent market overheating, excessive negative sentiment can lead to market overcooling or even trigger market panic. Therefore, maintaining a moderate balance of media sentiment is crucial to maintaining the stability of the real estate market.

The strength of government regulation and the speed of media sentiment dissemination are two important factors that affect market equilibrium. Moderate government regulation can effectively prevent excessive market volatility, but excessive regulation can hinder market vitality[9]. The acceleration of media sentiment dissemination may increase market volatility and increase market instability. Therefore, the government must strike a balance between the intensity of regulation and the freedom of the media, while strengthening the guidance and management of the spread of media sentiment.

## 5. Conclusion

Based on evolutionary game theory, this study explores the evolutionary mechanism of real estate market participants' behavior driven by media sentiment. It is found that media sentiment significantly affects the strategic choices of market participants, and there are differences in the effects of different types of sentiment on market stability. The intensity of government regulation and the speed of media sentiment dissemination are important factors affecting market equilibrium.

Based on the results of the study, we suggest the following policy recommendations: 1) the government should strengthen the monitoring and guidance of media sentiment to prevent excessive emotional reports from adversely affecting the market; 2) improve the real estate market information disclosure system to enhance market transparency and reduce information asymmetry; 3) establish a flexible government regulatory mechanism to adjust regulatory efforts in a timely manner according to market conditions; 4) strengthen education and guidance to improve their risk awareness and rational decision-making ability.

This study provides a new theoretical perspective for understanding the role of media sentiment in the real estate market, but there are still some limitations. Future research could further consider the differences in the influence of different types of media and the interaction

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between media sentiment and other factors (e.g., macroeconomic policies). In addition, the development of empirical studies will help to validate and improve the conclusions of the theoretical model.

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