

## Article

# Heterogeneous Impacts of Policy Sentiment with Different Themes on Real Estate Market: Evidence from China

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**Abstract:** This paper empirically investigates the heterogeneous impacts of the media sentiment about policies with different themes on the real estate market in China. Based on the policy texts collected from both official and unofficial sources, we construct sentiment indices to capture the sentiment about policies with different themes, including real estate policies, fiscal policies, monetary policies, land policies, healthcare policies, household registration policies, and education policies, using text mining methods. Mediation models and GARCH models are then established to examine the impact of these sentiment indices on the real estate market. The E-GARCH model is established to examine the asymmetric effect of positive and negative sentiment on real estate market. The results show the following: (1) The real estate market in China is more affected by the policy sentiment on official media compared with the unofficial ones. (2) Policy sentiment affects the real estate price through the mediating variables of interest rate, real estate construction area, and real estate sales. (3) The impacts of sentiment with different themes on the volatility of the real estate market are heterogeneous. (4) The impacts of policy sentiment on official media are more pronounced in a tight government-policy environment than those in a loose one. (5) The effect of negative unofficial media policies sentiment on real estate price is bigger than the positive unofficial media policies sentiment.

**Keywords:** real estate market; heterogeneous impacts; policy evaluation; sentimental analysis; GARCH models



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## 1. Introduction

One of the particularities of the real estate market lies in that it is largely influenced by government policies [1]. The case is especially true in China [2]. Ever since the implementation of housing reform in 1998, the Chinese government has begun to regulate the real estate market with various types of policies, including land, credit, tax, and housing sale policies, etc. Therefore, how to evaluate the impacts of these policies on the real estate market has been a great concern for both the government and private sectors.

This study aims to explore how the policy sentiment would affect the real estate market and whether the impacts are varied across different policy themes. Our study is based on a fundamental perspective that participants in the real estate market are influenced by and respond to the news of releasing the policies, thus causing market volatility. Many studies have analyzed the influence of media news on the returns and volatility of financial markets [3–6], which can partly be explained by the noise trade theory, stating that the optimism of noise traders would increase price volatility and destabilize the market [7,8]. However, there is little research on the impact of policy sentiment on the real estate market. Previous studies mainly analyzed the direct impact of the policies with limited data, and few of them examined the impact of the policies from a perspective of sentimental analysis.

Hence, in this study, we use the text mining method to measure policy sentiment by processing a large number of policy texts collected from both the unofficial media and official media, and then empirically investigate the heterogeneous impacts of the policy sentiment with different themes on the real estate market. Based on the policy texts collected from both official and unofficial sources, we construct sentiment indices to capture the sentiment about policies with different themes, including real estate policies, fiscal policies, monetary policies, land policies, healthcare policies, household registration policies, and education policies. Specifically, in addition to financial and land policies that could directly affect the real estate market, we also consider policies related to people's livelihood, such as healthcare and education policies. In general, transportation, healthcare, education, and other basic service quality could affect residents' living quality, and people often choose to live in areas with rich resources and high-quality public services. As a result, first-tier and second-tier cities with more convenient facilities could generate more demand for houses and thus raise housing prices. In China, cities are evaluated according to population, economic, governance, cultural, living life, development potential and other aspects and are divided into first-, second- and third-tier cities. First-tier cities include Beijing, Shanghai, Guangzhou and Shenzhen. Second-tier cities include Xiamen, HaErbin, ShiJiazhuang and so on. Third-tier cities include Xuzhou, Shantou, Yinchuan and so on. The number of first-tier cities is smallest, and that of third-tier cities is greatest. Overall, public services, such as healthcare and education, are also important factors affecting housing price fluctuations. For that reason, we include household policies, healthcare policies, and education policies into our policy dataset, which have scarcely been considered in the existing literature.

Our main results indicate that the real estate market in China is more affected by the policy sentiment on official media compared with the unofficial ones. The sentiment of these policies, including financial policies, real estate policies, and residents living policies, mainly affect the real estate price through the mediating variables of interest rate, real estate construction area, and real estate sales. In addition, the impacts of the sentiment with different themes on the real estate market are heterogeneous. We further find that the impacts of policy sentiment on official media are more pronounced in a tight government-policy environment than those in a loose one. Tight government policy means after 2016, when Chinese governments adopted tightened real estate policies regarding real estate enterprises' financing and the credit of house buyers to curb the rapid rise of housing prices, while loose government policy means the real estate policies before 2016.

The possible contribution of our study is three-fold. First, we provide a new perspective of sentimental analysis to policy evaluation. Generally, the method of evaluating housing sentiment in the existing literature is sentiment proxy variable; for example, previous use turnover, which is the ratio of housing areas being sold to the total housing areas for sale in a given month, to evaluate housing sentiment [9]. Although some studies use the total media search volume of real estate keywords as the sentiment variable, they do not distinguish between the positive and negative sentiment. In our study, we use the variable of policy sentiment and incorporate text mining methods to divide the policy sentiment into positive and negative sentiment, which enriches the data source and methodology for policy evaluation. Second, we analyze the underlying mechanism of policy sentiment on the real estate market, which indicates how these policies affect the real estate market. Third, heterogeneous impacts of policies with different themes are verified, which can provide insights for government to improve the regulation of the real estate market.

The rest of this article is structured as follows. Related work is reviewed, and the theoretical hypotheses are proposed in Section 2. We then introduce the data and methodology in Section 3. Section 4 presents the empirical results. Section 5 tests the different effects of policy sentiment during different periods divided by policy environment. Section 6 makes robustness tests. Finally, Section 7 concludes.

## 2. Related Literature and Hypotheses

### 2.1. *The Volatility in Real Estate Market*

Housing is an important asset nowadays and makes an increasingly significant contribution for many households. The existing literature focuses on the first moment (return), though the second moment (volatility) of housing price also contains many essential information. Among a few empirical works in the literature that study the housing price volatility, positive relations between conditional variance and returns using data sets for towns near San Francisco from 1971 to 1994 [10]. There are studies identify 36 volatility events from 1975 to 1993 in four regional housing markets and find the associations between these volatility events and economic conditions [11]. The dynamics of housing price mean reversion, influenced by the factors of income, population and construction for 62 metro areas from 1979 to 1995 [12]. They also find the heterogeneity in terms of the price trend responses to these economic variables based on the time period and the specific MSA. Previous have also offered the evidence of time-varying volatility in the US and Hong Kong housing markets, respectively [13]. GARCH models and a VAR model are used to analyze possible time variation of the volatility of family home value appreciation and the interactions between the volatility and the economy; they find evidence of time-varying volatility in about 17% of the MSAs [14]. The volatility clustering effects (ARCH effects) in many Australian capital cities and asymmetry of the positive and negative shocks were also documented [15]. The asymmetric analysis of housing price volatility in European country experiences are vetified [16]. The GARCH-M model are used to estimate the housing price volatility of these two groups of transactions: leveraged investment and leveraged owner occupancy [17].

Recently, the level of housing price volatility has become increasingly important, as the proportion of renters has increased. Higher housing price volatility levels may also discourage some newly formed households from committing to homeownership, as they may not perceive that housing is viewed as a stable long-term investment and a reliable hedge against inflation. Therefore, reducing housing price volatility through stabilizing housing markets has emerged as a critical challenge for housing policy makers. Higher price volatility could exacerbate the risks faced by households, distort housing choices, lead to a higher likelihood of mortgage foreclosure and also affect house building and intergenerational equity [14]. The first-time buyer policy where an innovative approach using the E-GARCH model is employed to assess the effect of the scheme on the housing market. Their findings indicate that the FHOG scheme offered a stabilization effect on the housing market [18]. Homeowners could be better protected from the consequences of volatility, through a mixture of prudential lending, responsible borrowing and an improved safety net [19].

All of the studies provide important insights. However, several fundamental questions regarding the volatility of housing market prices remain to be studied. The questions include the factors that could influence the real estate market, especially the irrationality factors, such as sentiment, as well as the potential mechanism of these factors influencing the real estate market.

### 2.2. *The Role of Media Sentiment in the Real Estate Market*

It is proved in the literature that the media sentiment would affect the behaviors of market participants and then the market performance. Various media are found to have effects on the real estate market [20–23] Four factors account for the influence, corporate and government links, neoliberal ideology, advertising pressures, and sourcing. Media are part and parcel of the political and corporate establishment; as such, the news they convey tends to reflect those sectors' interests and views, which plunged the Irish housing bubble in 2007 [24]. For example, the news sentimental indicator were constructed from The Wall Street Journal and predict returns of commercial real estate up four quarters in advance [22]. Housing prices are impacted by human psychological attitudes, and news articles are one of the factors that influence such human psychological attitudes. They use

the internet search frequency of keywords in news articles to constitute the forecast model of house prices [21]. Forecast model for real estate investment trusts (REITs) are constituted that use the daily measures of uncertainty due to infectious diseases and uncertainty due to infectious diseases constructed, whose media index is widely used by top studies [22,25].

Furthermore, different sources of media may play different roles in the market [26]. For instance, The roles of social media, including blogs, forums, Twitter, and conventional media, including major newspapers, television broadcasting companies, and business magazines are compared, and different types of social media influence stock market in various directions and degrees. Social media sentiment has a stronger impact on firm stock performance than conventional media, while social and conventional media have a strong interaction effect on stock performance [27]. The real estate confidence index (RECI) are constructed which is used to evaluate real estate industry development, which becomes an effective and powerful measure in China's real estate market (REM). They classify the data source into official and unofficial news and discover that official news contains more ambiguous terms, unofficial news contributes to higher accuracy. We also divide the two kinds of media data sources into official news and unofficial news and try to identify the different impacts on the real estate market [20]. Overall, it is reasonable to conclude that different sources of media sentiment have different impacts on the real estate market as Hypothesis 2.

Thus, we propose the following two hypotheses.

**H1.** *Media sentiment could influence the real estate market.*

**H2.** *Different sources of media sentiment have different impacts on the real estate market.*

### 2.3. *Heterogeneous Impacts of Policies with Different Themes*

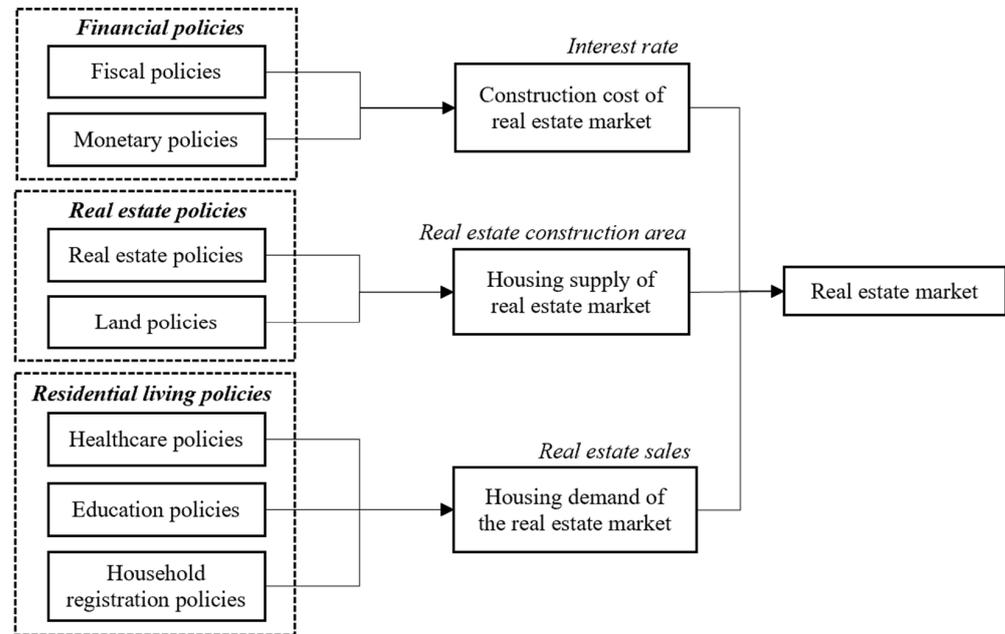
Different themes of policies have different influences on the real estate market. For instance, in China, the development of the real estate market is accompanied by a series of monetary policies. Lots of studies have proved that monetary policies play an important role in the stability of real estate prices. Monetary policies affect the stock prices in real estate-related industries through their impact on the future expected stock returns and a rate cut of 25 basis points (bps) is associated with an increase of about 170 bps in the value-weighted returns of real estate-related industries [28]. The effectiveness of the monetary policies are verified based on the real estate market and the asymmetrical effects of monetary policies on the real estate market and monetary policies have bigger positive effects on the real estate market in a low-speed growth regime [29]. The effects of expansionary monetary policies on the Italian economy are investigated and the policies have a positive impact on the real estate market are confirmed. Overall, these studies have proved that these monetary policies have a positive impact on the real estate market [30]. The general significant and positive correlation between land supply and real estate investment, and land supply control can function as a critical tool in governing real estate investment in China [1]. The effect that property taxation has on investment in the real estate market are investigated, and taxation on real estate, possession taxation, transfer taxation, and income taxation has minor importance in terms of influencing investors' choices, even less important in possession taxation [31]. Private money creation and real estate price inflation could prop up consumption, and the contemporary economy is driven by finance and real estate industry [32]. The reward and punishment mechanism is the key to promoting the implementation of real estate policies [33]. Furthermore, the mainland Chinese government has determined to tighten bank lending to the real estate market by resorting to administrative tools through specific real estate control policies to curb overheated investment in the real estate market. This study leads to a better understanding of the institutional backdrop behind the less-than-expected results of the real estate macro-control measures [2].

Overall, the themes of fiscal policies, land policies, real estate policies, monetary policies, and other government factors could influence the real estate market in various ways, and to various degrees. Hence, we propose another hypothesis.

**H3.** *Different themes of policies have different influences on the real estate market.*

#### 2.4. Impact Mechanism of Policies on Real Estate Price

This section discusses the potential mechanism that could explain the influence of media sentiment on the real estate market. We use mediation models to provide confirmatory evidence for the mechanism, which is shown in Figure 1.



**Figure 1.** Impact mechanism of policies on real estate price.

According to the themes, policies are subsumed under three broad categories. First, fiscal policies and monetary policies are classified as financial policies. As discussed above, financial policies could influence the real estate market through expected stock returns and interest rates, and then influence the construction cost of the real estate market [28,30]. In general, slack financial policies have a positive impact on the real estate market [29,30,34,35], where slack financial policies may include increasing the money supply in the market, such as issuing money directly, buying bonds in the open market, lowering reserve requirements and interest rates. Second, real estate policies and land policies are classified as real estate policies. In China, among many forces affecting real estate investment, land supply is a crucial factor because the land is a prerequisite for real estate development and investment. Central land policies and the varying land leasing strategies adopted by different tiers of cities contribute to the varying land supply trajectories, and there is a significant and positive correlation between land supply and real estate investment, suggesting that land supply control can function as a critical tool in governing real estate investment in China [1,36]. Third, healthcare policies, education policies, and household registration policies are classified as residential living policies. In addition to financial policies and real estate policies that are directly related to the real estate market, we also consider other policies that may indirectly affect housing prices. For instance, transportation, medical level, education, and other basic public services determine residents' living standards, and people are often willing to live in areas with rich resources, which generates more demand for houses and raises local housing prices [37]. We conclude that healthcare, education, and household registration policies could affect housing price fluctuations through the housing demand of the real estate market.

Overall, the impact mechanism of policies on real estate price is shown in Figure 1. Accordingly, we propose H4a, H4b, and H4c.

**H4a.** Financial policies influence real estate prices through the construction cost of the real estate market.

**H4b.** Real estate policies influence real estate prices through the housing supply in real estate market.

**H4c.** Residential living policies influence real estate prices through the housing demand in the real estate market.

### 3. Data and Methodology

#### 3.1. Data and Sentiment Index Construction

In this paper, we focus on the real estate price and sales area for empirical analysis. For this purpose, we select the national real estate price and sales data of China from National Bureau of Statistics over the period between January 2010 and December 2020. Our choice of the estimation period is determined by the availability of official and unofficial media data.

We select two kinds of media data sources, one is official media from the Chinese Government Website, and the other one is unofficial media from China Core Newspapers Full-text Database. On the Chinese Government Website, we select eight themes of official policies: real estate policies, fiscal policies, monetary policies, land policies, health-care policies, household registration policies, and education policies. In total, we collect 99,272 policy news by searching from the website using theme keywords.

We construct a daily sentiment index for each the policy themes, which indicates that the real estate market is positively or negatively influenced by the policies. We establish a lexicon dedicated to policy text sentiment analysis. It covers the Chinese Academy of Sciences NLPPIR Sentiment lexicon, Tsinghua University Lijun Chinese lexicon, Taiwan University NTUSD sentiment lexicon, and Hownet lexicon. Positive words include “achieve, top, increase, reward, boom, constructive, etc.”. Negative words include “worse, decrease, accident, accuse, adverse, bribe, bubble, collapse, etc.”. We manually list 700 policy-context words and add them to the lexicon above, and then establish a policy sentiment lexicon. The sentiment index of one piece of news is calculated followed by the noise index [38]:

$$Sentiment = \ln \left[ \frac{1 + M_{buy,i,t}}{1 + M_{sell,i,t}} \right] \quad (1)$$

where  $i$  represents one piece of news and  $t$  represents the date.  $M_{pos,i,t}$  denotes the number of positive words in one piece of news.  $M_{neg,i,t}$  denotes the number of negative words in one piece of news.  $S_{jt} > 0$  indicates that the policies may positively influence the real estate market, and  $S_{jt} < 0$  vice versa. The monthly sentiment index is the average of all the news sentiment indexes in one month.

#### 3.2. Heterogeneous Impacts of Policy Themes on Real Estate Price

To evaluate the mechanism of the impact of various themes of policies on real estate price, we use the following regression model. From Figure 1, we know that various themes of policies influence the real estate market through mediators, so we use mediation models. The dependent variable,  $P_t$ , is the monthly national real estate price of China.  $I_{i,t}$  is the mediator, including benchmark interest rate for RMB loans (3 to 5 years), national real estate construction area of China, and national real estate sales of China. The independent variable,  $Policy_{i,t}$ , is the sentiment index of three categories of policies: financial policies, real estate policies, and residential living policies. The sentiment index of each category is the sum of the subsumed themes of policy sentiment.

In terms of mediators, we use the benchmark interest rate for RMB loans (3 to 5 years) as the proxy variable of the construction cost of the real estate market; the national real estate construction area of China as the proxy variable of the housing supply of the real

estate market; and national real estate sales of China as the proxy variable of the housing demand of real estate market. The specification of the mediation model is as follows:

$$P_t = d + cPolicy_{i,t} + \varepsilon_{i,t} \quad (2)$$

$$I_{i,t} = d + aPolicy_{i,t} + \varepsilon_{i,t} \quad (3)$$

$$P_t = d + c'Policy_{i,t} + bI_{i,t} + \varepsilon_{i,t} \quad (4)$$

In Equation (2), coefficient  $c$  measures the total impact of various policies on real estate prices. In Equation (3),  $I_{i,t}$  is the mediator, coefficient  $a$  measures the impact of policies on the mediating variable  $I_{i,t}$ . Equation (4) includes the independent variable of  $Policy_{i,t}$  and the mediating variable of  $I_{i,t}$ . If coefficient  $c$  is significant, hypothesis **H1** could be confirmed and is the premise of mediating mechanism. If the coefficients  $a$  and  $b$  are significant, mediating effects are examined, and hypotheses **H4a**, **H4b**, and **H4c** could be confirmed. The coefficient  $c'$  measures the direct impact of policies on real estate price, and  $ab$  measures the mediating effect of policies on real estate price.

### 3.3. Heterogeneous Impacts of Policy Themes on Real Estate Market Volatility

The existing literature uses different versions of GARCH models augmented by investor sentiment to explore the impact of irrational traders' activity on the formation of expected returns and volatility [8,39]. In this study, we attempt to test the response of the real estate market to the policy information from official media and unofficial media. Based on the literature [40,41], we use the following GARCH (1,1) model, incorporating official and unofficial news sentiment into the mean and conditional variance equations of real estate price and sales area:

$$P_t = \alpha_0 + \sum \delta_j Policy_{jt} + \varepsilon_t \quad (5)$$

$$\sigma_{pt}^2 = \beta_0 + \beta_1 \sigma_{t-1}^2 + \beta_2 \varepsilon_{t-1}^2 + \sum \gamma_j Policy_{jt} \quad (6)$$

$$A_t = \alpha_0 + \sum \delta_j Policy_{jt} + \varepsilon_t \quad (7)$$

$$\sigma_{At}^2 = \beta_0 + \beta_1 \sigma_{t-1}^2 + \beta_2 \varepsilon_{t-1}^2 + \sum \gamma_j Policy_{jt} \quad (8)$$

In Equation (5), the mean equation  $P_t$  is the monthly national real estate price of China. In Equation (6), the variance equation  $\sigma_{pt}^2$  depends on the lagged conditional variance  $\sigma_{t-1}^2$ , and the lagged squared disturbance term, which is assumed to be normally distributed with the zero mean. To capture the effect of policy tendency on real estate price, we add  $\sum \gamma_j Policy_{jt}$  to the mean and variance equations, where  $j$  denotes the policy theme. Similarly, in Equation (7), the mean equation  $A_t$  is the monthly national real estate sales of China. In Equation (8), the variance equation  $\sigma_{pt}^2$  depends on the lagged conditional variance  $\sigma_{t-1}^2$ ,  $\sum \gamma_j Policy_{jt}$  is the effect of policy tendency.

The coefficient  $\delta_j$  measures the impact on real estate price and real estate sales. The coefficient  $\gamma_j$  measures the impact on the volatility of real estate prices and real estate sales. If the coefficients  $\delta_j$  and  $\gamma_j$  are significant, hypotheses **H1**, **H2**, and **H3** could be confirmed. Media sentiment could influence the real estate market. Different sources and themes of media sentiment have different impacts on the real estate market. Although the coefficient  $c$  in Equation (2) could also prove hypothesis **H1**, the coefficients  $\delta_j$  and  $\gamma_j$  measure the impacts on real estate price and real estate sales, which reflects two aspects of the real estate market.

## 4. Empirical Results

### 4.1. Measuring Policy Sentiment

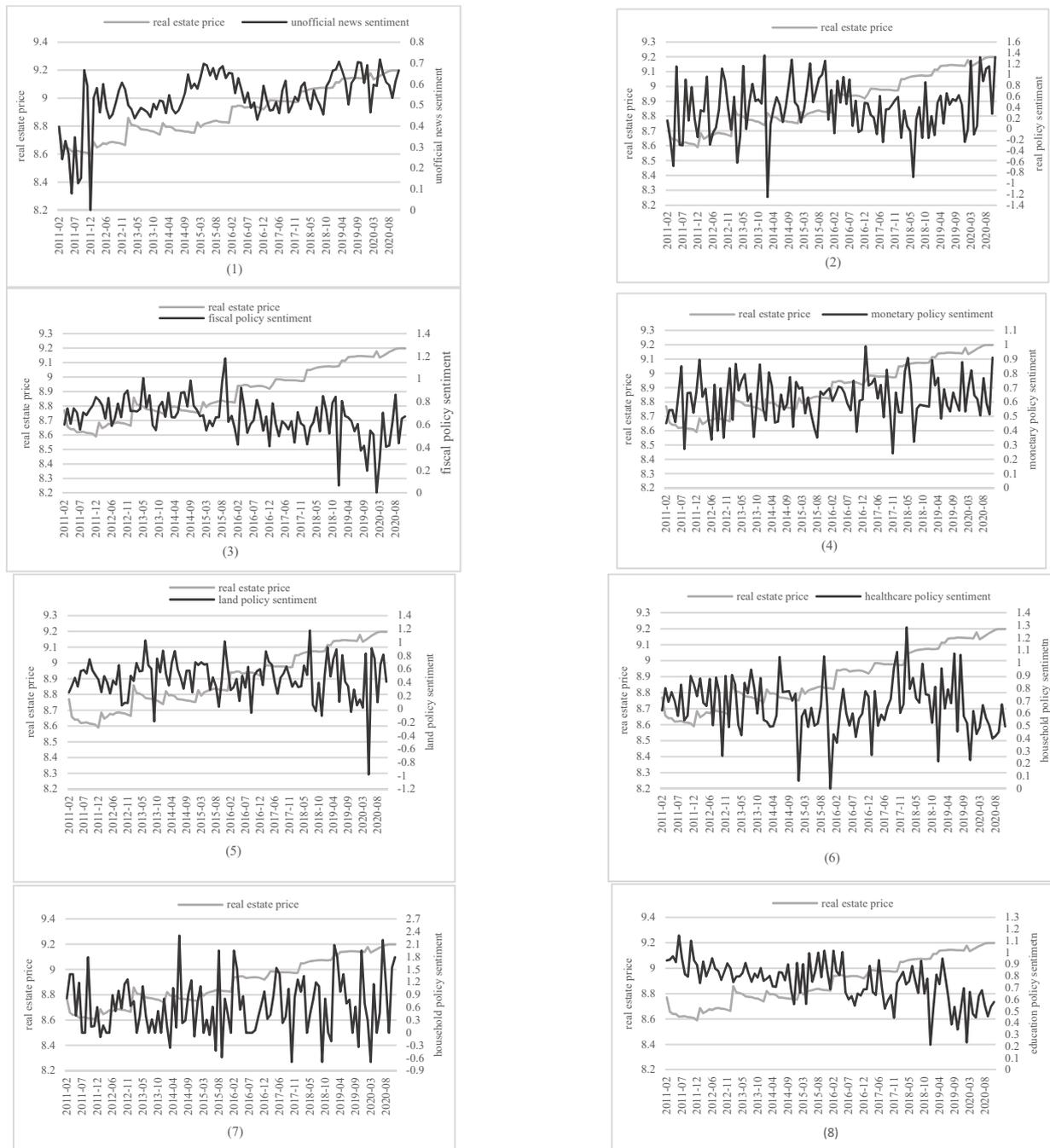
We examined the daily responses of real estate prices and sales to official media policy sentiment and unofficial ones between January 2010 and December 2020. Table 1 illustrates descriptive statistics of the sentiment index of each policy theme and unofficial media.

**Table 1.** Descriptive statistics of the sentiment index of each policy theme and unofficial media.

Name	Obs.	Mean	S.E.	Min	Max
Unofficial media sentiment	139	0.588	0.262	0	1.792
Real estate policy sentiment	113	0.386	0.491	−1.253	1.353
Fiscal policy sentiment	109	0.660	0.175	0.005	1.182
Monetary policy sentiment	148	0.654	0.247	0	2.079
Land policy sentiment	125	0.478	0.297	−0.980	1.334
Healthcare policy sentiment	120	0.667	0.216	0.001	1.283
Household registration sentiment	123	0.730	0.645	−0.693	2.303
Education policy sentiment	120	0.757	0.166	0.214	1.145

Figure 2 shows the comparison charts of each policy sentiment index and real estate price. Part (1) is the unofficial media sentiment. It fluctuates dramatically in 2011 and after that unofficial media sentiment started to stabilize at 0.6 scores. Part (2) is the real estate policy sentiment and it fluctuated greatly. It was most pessimistic in late 2011, early 2014 and 2018 and then started to escalate. It also shows that after 2016, the sentiment toward real estate policies is more negative compared with the sentiment before 2016. The possible reason is that the government started to tighten real estate policy after 2016. Real estate government departments introduced corresponding policies, such as real estate enterprise financing and the credit of house buyers. Part (3) shows that fiscal policy sentiment keeps more than zero and starts to decline in 2019. Part (4) shows the monetary policy sentiment, and it fluctuates around the score of 0.6. This is because the government periodically tightens and relaxes monetary policy to regulate the financial market. Part (5) is the land policy sentiment, which also keeps fluctuating, and the most negative level is in early 2020 with a score of −0.2. Part (6) shows that healthcare policy sentiment was positive in early 2011 then declined; the lowest positive level is in December 2015, and the score of the sentiment is more than zero. In particular, after 2016, the healthcare policy remains of low sentiment. This reflects that the government adopted a series of healthcare policies to control potential risks affected by COVID-19. Part (7) is the household registration policy sentiment. It keeps fluctuating between 0 and 1.65 in score, and the highest levels are in 2008, 2019, and 2020. Part (8) shows that the education policy sentiment slightly fluctuates, and the score of the sentiment before December 2015 is higher than the sentiment after that.

In all, the real estate policy sentiment, land policy sentiment, and household registration policy sentiment fluctuate greatly, whereas fiscal policy sentiment, healthcare policy sentiment, and education sentiment are less volatile and scores above 0.3.



**Figure 2.** Policy sentiment and real estate price. Notes: Part (1) is unofficial media sentiment and real estate prices. Part (2) is real estate policy sentiment and real estate price. Part (3) is fiscal policy sentiment and real estate price. Part (4) is monetary policy sentiment and real estate price. Part (5) is land policy sentiment and real estate policy sentiment and real estate price. Part (6) is healthcare policy sentiment and real estate price. Part (7) is household registration policy sentiment and real estate price. Part (8) is education policy sentiment and real estate price. The darker line is policy sentiment.

#### 4.2. Real Estate Market Price Models

Table 2 shows the results of the mediation models. Columns (1), (2) and (3) illustrate the impact of financial policies on real estate price through the construction cost of the real estate market explained by the variable of the interest rate. The result shows that financial policies have a negative impact on real estate price at the 1% significant level, and the interest rate has a positive mediating effect on it at the 5% significant level, which

is consistent with the result in the following Table 3. This illustrates that financial policies affect the real estate market through the interest rate. Financial policies increase the interest rate and may imply higher mortgage rates and higher construction costs in the real estate market. It causes the decreased investment inclination of real estate developers and the decreased purchase intention of residents and then has a negative impact on real estate prices. This is also consistent with previous studies that showed that an increased interest rate may decrease real estate prices [29]. This confirms the mechanism in Figure 1 that financial policies have a negative impact on real estate price, and the construction cost has a positive mediating effect on it.

Columns (4), (5) and (6) illustrate the impact of real estate policies on real estate price through the housing supply of the real estate market explained by the variable of real estate construction area. The coefficient of real estate policies on real estate price is positive at 5%, and the real estate construction area is positive at the 5% level. This illustrates the mechanism that real estate policies have a negative impact on real estate price and real estate construction area has a positive mediating effect on it. But the result is not significant in Column (4), which implies that the government may not be able to obtain the effect of the real estate regulative policies.

Columns (7), (8) and (9) illustrate the impact of residential living policies on real estate prices through housing demand of the real estate market explained by the variable of real estate sales. The result shows that residential living policies have a negative impact on real estate price, and real estate sales have a negative mediating effect on it at the 1% significant level. This verifies hypotheses 1 and 3 that media could influence the real estate market and different themes of media information have different influences on the real estate market. This result is one of the major contributions of our study and verifies the impact of the “nearby entrance education system” on the real estate market in China. In 1997, the Chinese government gradually abolished the entrance examination for compulsory education and replaced it with a system of “nearby entrance education system”. This reinforces the behavior of residents to buy houses near high-quality schools and increase access to good educational resources for high-income families. According to the result in Table 2, positive residential living policies usually imply the improvement of education resources, this will alleviate the behavior of buying nearby houses and then decrease the real estate price.

Our investigation uses a stepwise regression test to analyze the mediating effect on the real estate market, which is the most common method to test the mediation effect [35,42–44]. The mediating effect is the coefficient of the independent variable to mediating variable multiply the coefficient of mediating variable by the dependent variable. The mediating effect of fiscal policies on real estate price through interest rate is  $-0.413$ , which indicates that interest rate has a negative effect on real estate price. The mediating effect of real estate policies on real estate price through real estate construction area is  $0.069$ , which indicates that real estate construction area has a positive effect on real estate price. The mediating effect of education policies on real estate price through real estate sales is  $-0.077$ . This indicates that the variable of real estate sales has a negative effect on real estate prices.

**Table 2.** The impact mechanism of policies on real estate price.

Variables	Financial Policies			Variables	Real Estate Policies			Variables	Residential Living Policies		
	(1)	(2)	(3)		(4)	(5)	(6)		(7)	(8)	(9)
Dependent variable	Real estate price	Interest rate	Real estate price	Dependent variable	Real estate price	Real estate construction	Real estate price	Dependent variable	Real estate price	Real estate sales	Real estate price
Financial policies	−0.457 *** (−5.121)	1.178 ** (2.613)	−0.315 *** (−4.294)	Real estate policies	0.021 (0.607)	0.107 ** (2.462)	−0.048 ** (−2.233)	Residential living policies	−0.642 *** (−7.983)	−1.633 *** (−3.634)	−0.564 *** (−6.838)
Interest rate			−0.121 *** (−7.909)	Real estate construction			0.649 *** (13.910)	Real estate sales			0.047 *** (2.819)
<i>N</i>	109	109	109	<i>N</i>	109	109	109	<i>N</i>	109	109	109
_cons	9.198 *** (150.888)	2.270 *** (7.369)	9.471 *** (158.831)	_Cons	8.887 *** (401.749)	13.309 *** (485.577)	0.253 (0.408)	_cons	9.377 *** (151.552)	11.834 *** (34.208)	8.818 *** (42.569)
mediating effect		−0.143		mediating effect		0.069		mediating effect		−0.077	
mediating effect/total effect		0.313		mediating effect/total effect		3.307		mediating effect/total effect		0.120	

Notes: Column (1), Column (2), and Column (3) are mediating effect of fiscal policies on real estate price through interest rate, Column (4), Column (5), and Column (6) are mediating effects of real estate policies on real estate price through real estate construction, Column (7), Column (8), and Column (9) are mediating effects of education policies on real estate price through real estate sales. \*\*\*, \*\* indicate the significant levels of 1% and 5%.

**Table 3.** The policy sentiment on real estate price volatility.

Variables	Unofficial	Real Estate Policies	Fiscal Policies	Monetary Policies
$\delta$	2.924 *** (−112.119)	0.401 *** (−8.931)	−1.743 *** (−92.131)	1.013 *** (−105.512)
$\gamma$	−0.002 (−1.490)	−0.023 *** (−7.258)	−0.001 (−0.238)	−0.001 (−1.542)
	Land policies	Healthcare policies	Household registration policies	Education policies
$\delta$	−3.173 *** (−480.968)	−3.174 *** (−41.028)	−2.025 *** (−21.034)	−1.875 *** (−73.245)
$\gamma$	−0.002 (−1.272)	−11.719 (−0.895)	−0.016 * (−1.842)	0.001 (−0.208)

\*\*\*, \* indicate the significant levels of 1% and 10%.

#### 4.3. Real Estate Market Volatility Models

First, we use the ARCH model to verify the volatility clustering effect of real estate price in China. The results indicate that the coefficients of ARCH(1), ARCH(2) and ARCH(3) of real estate price are significant at the level of 1%, which confirms the volatility clustering effect of real estate price in China. After that, the result of the influence of policy sentiment on real estate prices is shown in Table 3. It illustrates that real estate prices are significantly correlated with unofficial media news, real estate policies, fiscal policies, monetary policies, land policies, healthcare policies, household registration policies, and education policies. The volatility of real estate prices is significantly correlated with real estate policies and household registration policies.

Unofficial news has a positive effect on real estate prices at the 1% significant level, which is consistent with the previous relevant literature that macroeconomic news could influence the price market [3–6]. Positive unofficial news increases real estate prices, while negative unofficial news decreases them. This phenomenon could be explained by investor behavior. Existing research argues that there are two categories of traders: rational traders with the belief in economic fundamentals, and noise traders with random beliefs. Noise traders would be affected by positive macroeconomic news and then have a positive impact on price volatility. They also affect the reaction of rational traders and further increase price volatility. As a result, there is a positive relationship between news sentiment and the financial market, which is consistent with our result in Table 3. Real estate policies have a positive effect on real estate prices at the 1% significant level and a negative effect on volatility. It means that positive real estate policy sentiment could increase real estate prices and decrease volatility. The government controls the real estate bubble through real estate tax policies and house purchase quota policies [33].

Monetary policies are positively correlated with real estate policies at the 1% significant level. The reason for this phenomenon may be that positive monetary policies indicate liberal loan policies and lower mortgage rates in the financial market. This will stimulate the investment inclination of real estate developers and increase the purchase intention of residential, which will then have a positive impact on real estate prices. This is also consistent with the result in Table 2, which further increases the robustness of our result. Table 3 also shows that household registration policies are negatively correlated with real estate prices at the 1% level. This is mainly because in China, household registration is related to the house purchasing right. With the development of urbanization in China, the urban–rural gap is gradually narrowing. The growth of population in urban areas and the shortage of housing supply stimulates the huge potential demand in the real estate market, and then housing prices rise sharply. On the other hand, the reform of the household registration system makes it linked to housing qualifications. For example, according to the house purchase policies in Beijing, only those with Beijing registered permanent residence have house purchasing rights. This limits the behavior of the buying intention of residents and then decreases real estate price volatility. As a result, there is a negative relationship between registration household policies and real estate price volatility.

Table 3 also shows that real estate price is significantly negatively correlated with education policies sentiment at the 1% level, which implies that optimistic education policies sentiment could decrease real estate price volatility. The reason for this phenomenon could be also illustrated by the “nearby entrance education system”, which is illustrated in Section 4.2 that Chinese compulsory education school enrollment adheres to the “nearby” policies. Due to the lack of high-quality schools and the uneven distribution, parents are competing for the school district houses and then increase the price volatility. The optimistic sentiment of education policies reflects the improvement of education resources to some extent, and then has a negative impact on the price volatility.

In addition, the result shows that real estate price is significant and negatively correlated with healthcare policies at the 1% level. This may be related to the current environment of COVID-19. To some extent, the COVID-19 environment has had an impact on residents’ income and has reduced their demand for housing, thus negatively affecting real estate price volatility. These findings further verify hypotheses 1 and 3 that policy sentiment could influence the real estate market and different themes of policy information have different influences on the real estate market. Overall, these results also verify hypothesis 2 that different sources of media have different impacts on the real estate market.

Second, the result of the influence of policy sentiment on real estate sales is shown in Table 4. The results show that the real estate sales volatility is related to unofficial media news, real estate policies, fiscal policies, monetary policies, land policies, healthcare policies, and education policies. Unofficial news sentiment positively correlates with real estate sales at the 1% level, and positive correlates with the volatility of it at the 10% level. This indicates that positive unofficial news could increase real estate sales volatility. The result is also consistent with the result in Table 3 that unofficial news has a positive impact on real estate price volatility. Fiscal policies sentiment is negatively correlated with real estate sales at 1% significant level and negatively correlated with the volatility of it at 1% level, which indicates that fiscal policies affect real estate sales and could decrease the volatility. This result confirms the evidence reported that special real estate policies in China, especially land policies, affect the supply of houses and then the economic fundamentals [33]. Our results also show the effect of healthcare policies and education policies have effects on real estate sales, and household registration policies have positive effects on it. In all, the results of unofficial news, real estate policies, fiscal policies, monetary policies, land policies, healthcare policies, and education policies in Table 4 are consistent with the result in Table 3. Overall, these results further verify hypothesis 2 that different sources of media have different impacts on the real estate market.

**Table 4.** The policy sentiment on real estate sales volatility.

Variables	Unofficial	Real Estate Policies	Fiscal Policies	Monetary Policies
$\delta$	2.817 *** 3.366	0.342 (0.857)	−1.749 *** (−3.132)	1.281 *** (158.657)
$\gamma$	0.041 * (1.851)	0.081 *** (5.937)	−0.094 *** (−8.259)	0.028 ** (2.389)
	Land policies	Healthcare policies	Household registration policies	Education policies
$\delta$	−2.388 *** (−38.533)	−1.379 (−1.263)	0.992 *** (4.787)	−2.059 *** (−17.666)
$\gamma$	−0.184 *** (−10.490)	−0.228 *** (−969.363)	0.081 * (1.673)	−0.066 *** (−3.114)

\*\*\*, \*\*, \* indicate the significant levels of 1%, 5% and 10%.

In our study, we mainly discuss the influence factors of social media sentiment on real estate market volatility. Other influences should also be considered, such as those of the volatility linkages of real estate assets. The inception of listed real estate futures contracts does have a stabilization effect by improving the market efficiency and reducing market noise in international real estate stocks [45–47]. The relationships between local and global securitized real estate markets are analyzed, but also between securitized real estate and common stock markets [48].

## 5. Heterogeneous Effects during Different Periods

At the end of 2016, the central government of China addressed the policy tendency that the most basic feature of houses is for living, not for speculation. From then on, the real estate market in China stepped into a new stage when the Chinese government started to tighten real estate policies. Real estate government departments successively introduced corresponding policies, regarding real estate enterprises' financing and the credit of house buyers. This means that the government will play a more positive role in curbing the rapid rise of housing prices. The adjustment of interest rate policies will help guide rational housing consumption and curb speculative house purchases, with multiple goals of reducing real estate inventories to ensure growth and controlling housing prices. Therefore, we divide the sample period into February 2011–December 2015 and February 2016–December 2020 and investigate the different effects of policy sentiment on the real estate market during different policy environments.

The results are shown in Tables 5 and 6. We can see that residential living policies have a negative impact on real estate price and real estate sales have a negative mediating effect on it at the 1% significant level. The result also shows that the coefficients of real estate policies on real estate price and real estate construction area are both positive. These results are consistent with the result in Table 2.

We can find that the coefficients of financial policies and real estate policies on real estate prices in February 2016–November 2020 are bigger than those of February 2011–December 2015. This illustrates government policy theme sentiment has a bigger effect during the tight policy environment. As mentioned above, from the end of 2016, real estate government departments successively introduced corresponding policies, regarding real estate enterprises' financing and the credit of house buyers. As a result, investors responded more intensely to policies, whereas the government played a more dominant role in the real estate market.

**Table 5.** The impact mechanism of policies on real estate prices during 2011.02–2015.12.

Variables	Financial Policies			Variables	Real Estate Policies			Variables	Residential Living Policies		
	(1)	(2)	(3)		(4)	(5)	(6)		(7)	(8)	(9)
Dependent variable	Real estate price	Interest rate	Real estate price	Dependent variable	Real estate price	Real estate construction	Real estate price	Dependent variable	Real estate price	Real estate sales	Real estate price
Financial policies	0.072 (0.842)	−1.243 (−1.278)	0.048 (0.556)	Real estate policies	0.023 (1.136)	0.470 ** (2.651)	0.045 ** (2.338)	Residential living policies	−0.301 *** (−3.385)	0.576 (0.588)	−0.300 *** (−3.334)
Interest rate			−0.020 (−1.602)	Real estate construction			−0.049 *** (−3.337)	Real estate sales			−0.001 (−0.074)
N	52	52	52	N	52	52	52	N	52	52	52
_cons	8.680 *** (134.019)	4.541 *** (6.197)	8.770 *** (103.413)	_Cons	8.725 *** (665.178)	11.142 *** (95.797)	9.266 *** (57.029)	_cons	8.987 *** (119.228)	9.764 *** (11.727)	8.996 *** (61.012)
mediating effect		0.025		mediating effect		−0.023		mediating effect		−0.001	
mediating effect/total effect		0.345		mediating effect/total effect		−1.001		mediating effect/total effect		0.002	

\*\*\*, \*\* indicate the significant levels of 1% and 5%.

**Table 6.** The impact mechanism of policies on real estate price during 2016.02–2020.11.

Variables	Financial Policies			Variables	Real Estate Policies			Variables	Residential Living Policies		
	(1)	(2)	(3)		(4)	(5)	(6)		(7)	(8)	(9)
Dependent variable	Real estate price	Interest rate	Real estate price	Dependent variable	Real estate price	Real estate construction	Real estate price	Dependent variable	Real estate price	Real estate sales	Real estate price
Financial policies	−0.086 (−1.231)	0.151 (0.661)	−0.065 (−1.030)	Real estate policies	0.058 ** (2.102)	0.330 (1.352)	0.055 * (1.943)	Residential living policies	−0.193 *** (−2.855)	−1.050 (−1.667)	−0.186 ** (−2.643)
Interest rate			−0.137 *** (−3.407)	Real estate construction			0.009 (0.535)	Real estate sales			0.007 (0.454)
N	49	49	49	N	49	49	49	N	49	49	49
_cons	9.115 *** (217.875)	2.449 *** (17.834)	9.450 *** (89.731)	_Cons	9.046 *** (577.080)	11.261 *** (80.469)	8.947 *** (48.081)	_cons	9.193 *** (199.458)	11.684 *** (27.263)	9.109 *** (47.789)
mediating effect		−0.02		mediating effect		0.003		mediating effect		−0.007	
mediating effect/total effect		0.240		mediating effect/total effect		0.051		mediating effect/total effect		0.038	

\*\*\*, \*\*, \* indicate the significant levels of 1%, 5% and 10%.

## 6. Asymmetric Effect Analysis

In this section, we attempt to test the asymmetric effect of positive and negative sentiment on the real estate market. We consider using the EGARCH model to measure the impacts of asymmetric effect on real estate price. According to previous literature [35,49], we use the following EGARCH (1,1) model, incorporating news sentiment into conditional variance equations of real estate prices:

$$\ln \sigma_{pt}^2 = \alpha_0 + \alpha_1 |\varepsilon_{t-1}/\sigma_{t-1}| + \lambda_1 (\varepsilon_{t-1}/\sigma_{t-1}) + \lambda_2 \ln \sigma_{pt-1}^2 \quad (9)$$

In Equation (9), the variance equation  $[\sigma_{pt}]^2$  depends on the lagged conditional variance  $\sigma_{t-1}^2$ , and the lagged squared disturbance term, which is assumed to be normally distributed with the zero mean. The significance of  $\lambda_1$  indicates the asymmetric effect of policy tendency on real estate price.

Table 7 shows the results of asymmetric effect analysis of real estate price. The result shows that the coefficient of unofficial media policies sentiment on real estate price is negative ( $\lambda_1 = -1.105$ ) at the 5% significant level. It means that the effect of negative unofficial media policies sentiment on real estate price is bigger than the positive unofficial media policies sentiment. The coefficient of education policies sentiment on real estate price is also negative ( $\lambda_1 = -1.238$ ) at the 1% significant level. It also means that the effect of negative education policies sentiment on real estate price is bigger than the positive education policies sentiment. Further, we find that all the EARCH coefficients of sentiment are negative even though not all of them are significant. These illustrate that the negative policies sentiment has a bigger effect on real estate prices than the positive sentiment.

**Table 7.** The asymmetric effect analysis of real estate price volatility.

Variables	Unofficial	Real Estate Policies	Fiscal Policies	Monetary Policies
$\lambda_1$	-1.105 ** (-2.554)	-0.640 (-1.089)	-0.675 (-1.377)	-0.125 (-0.410)
$\lambda_2$	0.888 *** (4.207)	0.924 *** (4.196)	0.773 *** (3.720)	0.929 *** (6.383)
	Land policies	Healthcare policies	Household registration policies	Education policies
$\lambda_1$	-0.251 (-1.018)	-0.411 (-1.249)	-0.324 (-0.666)	-1.238 *** (-3.014)
$\lambda_2$	0.824 (0.652)	0.912 *** (4.661)	0.796 *** (8.368)	0.764 *** (4.235)

\*\*\*, \*\* indicate the significant levels of 1% and 5%.

## 7. Robustness Tests

### 7.1. Replacing the Dependable Variable

In this section, we discuss other specifications that provide some robust evidence supporting our conclusions. First, we replace the dependent variable of real estate price with an alternative variable which could also reflect the fundamental fluctuation of real estate market. Since we consider the livelihood policies, such as household policies and education policies, that have more impact on residential housing prices, we replace the dependent variable of real estate prices with a subtype of real estate, residential real estate prices. We further test whether it is in accordance with the mechanism in our research. The result is shown in Table 8, and it shows that the impact mechanism of financial policies, real estate policies, and residential living policies are significantly correlated with residential real estate prices. The signs of these coefficients are consistent with the result in Table 2. Overall, these results verify the robustness of our study.

Table 8. Robustness test (replacing the dependent variable).

Variables	Financial Policies			Variables	Real Estate Policies			Variables	Residential Living Policies		
	(1)	(2)	(3)		(4)	(5)	(6)		(7)	(8)	(9)
Dependent variable	Residential real estate price	Interest rate	Residential real estate price	Dependent variable	Residential real estate price	Real estate construction	Residential real estate price	Dependent variable	Residential real estate price	Real estate sales	Residential real estate price
Financial policies	−0.536 *** (−5.102)	1.221 *** (2.636)	−0.360 *** (−4.269)	Real estate policies	0.032 (0.760)	0.411 *** (2.832)	0.034 (0.780)	Residential living policies	−0.757 *** (−8.000)	−1.562 *** (−3.299)	−0.666 *** (−6.948)
Interest rate			−0.144 *** (−8.145)	Real estate construction			−0.006 (−0.192)	Real estate sales			0.059 *** (3.032)
N	101	101	101	N	101	101	101	N	101	101	101
_cons	9.209 *** (128.275)	2.287 *** (7.222)	9.538 *** (138.539)	_Cons	8.843 *** (339.480)	11.198 *** (125.161)	8.906 *** (26.962)	_cons	9.424 *** (129.066)	11.785 *** (32.253)	8.734 *** (36.693)
mediating effect		−0.175		mediating effect		−0.002		mediating effect		−0.092	
mediating effect/total effect		0.328		mediating effect/total effect		0.077		mediating effect/total effect		0.122	

\*\*\* indicate the significant levels of 1%.

## 7.2. Addressing the Endogeneity of Policy Sentiment

To address the endogeneity of policy sentiment, we replace independent variables of three categories of policies (financial policies, real estate policies, and residential living policies) in the mediation model with the one-month lagged variables, which exclude the influence of omitted variables in the current period. Besides, current policies usually maintain a certain degree of continuity with the previous ones, so the policy sentiment index can be considered to be serially correlated. Table 9 presents the result that the coefficients of lagged variables on real estate price are significant, and the signs are almost consistent. These results also verify the robustness of our study.

**Table 9.** Robustness test (addressing the endogeneity of policy sentiment).

Variables	Financial Policies			Variables	Real Estate Policies			Variables	Residential Living Policies		
	(1)	(2)	(3)		(4)	(5)	(6)		(7)	(8)	(9)
Dependent variable	Real estate price	Interest rate	Real estate price	Dependent variable	Real estate price	Real estate construction	Real estate price	Dependent variable	Real estate price	Real estate sales	Real estate price
Financial policies <sub>1</sub>	−0.467 *** (−5.256)	1.670 *** (−5.256)	−0.273 *** (−3.490)	Real estate policies <sub>1</sub>	0.014 (0.381)	0.271 * (1.901)	0.016 (0.439)	Residential living policies <sub>1</sub>	−0.631 *** (−7.713)	−1.356 *** (−3.024)	−0.558 *** (−6.817)
Interest rate			−0.116 *** (−7.150)	Real estate construction			−0.009 (−0.362)	Real estate sales			0.054 *** (3.169)
N	108	108	108	N	108	108	108	N	108	108	108
_cons	9.205 *** (151.559)	1.939 *** (6.499)	9.431 *** (159.355)	_Cons	8.892 *** (400.269)	11.241 *** (127.575)	8.992 *** (32.427)	_cons	9.372 *** (148.461)	11.647 *** (33.658)	8.744 *** (42.211)
mediating effect		−0.194		mediating effect		−0.002		mediating effect		−0.073	
mediating effect/total effect		0.415		mediating effect/total effect		−0.174		mediating effect/total effect		0.116	

\*\*\*, \* indicate the significant levels of 1% and 10%.

## 8. Conclusions and Implications

In China, the real estate market is a special market, which is greatly influenced by the government. In this paper, we select eight themes of policies, including real estate policies, fiscal policies, monetary policies, land policies, healthcare policies, household registration policies, and education policies. To evaluate the mechanism of the impact of various themes of policies on real estate prices, we use the mediating model through the mediating variables of the interest rate, real estate construction area, and real estate sales. To test the response of the real estate market with the macroeconomic information from official media and unofficial media, we use the GARCH model to analyze the effect on the real estate market. We also classify the sample period into February 2011–December 2015 and February 2016–December 2020 to further analyze the impact during different policy environments.

Based on our empirical results, we find that, first, the real estate market in China is more affected by the policy sentiment on official media compared with the unofficial ones. Second, policy sentiment affects the real estate price through the mediating variables of interest rate, real estate construction area, and real estate sales. Third, the impacts of sentiment with different themes on the volatility of the real estate market are heterogeneous. Moreover, the impacts of policy sentiment on official media are more pronounced in a tight government-policy environment than those in a loose one.

Based on the above conclusions, we try to provide some policy implications for real estate regulation. First, besides real estate policies, livelihood policies and fiscal policies will all have impacts on the real estate market. Therefore, these government departments should incorporate with each other in regulating the real estate market while considering the impact of other kinds of policies to realize the expectations of these policies. In addition,

these policies should also take into account the reaction of market participants and avoid the adverse impact of investor sentiment on the real estate market.

As part of future research, it would be interesting to analyze the way that social media sentiment influences the real estate market [50]. Unlike the above-mentioned studies, one could look at other online media, such as Wechat, Sina microblog, and Tik Tok, to investigate whether these media could also have impacts on the real estate market.

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