JKSCI

한국컴퓨터정보학회논문지
Journal of The Korea Society of Computer and Information
Vol. 27 No. 9, pp. 243-251, September 2022
https://doi.org/10.9708/jksci.2022.27.09.243

Market sentiment and its effect on real estate return: evidence from China Shenzhen

ZHUO LI*

*Assistant Professor, Dept. of Economics & Finance, The university of Suwon, Hwaseong, Korea

[Abstract]

In this paper, we propose a phenomenon that analyze the impact of market sentiment on China's real estate market through the perspective of behavioral economics. Previously, real estate market analyzation basically focus on some fundamental principles which include market price, monetary policies and income, etc. However, little research has explored market sentiment and its influence. By using principal components analysis (PCA), this study first creates buyer's sentiment and seller's sentiment to measure the heat of China's real estate market. Different from using traditional estimation method, the vector autoregressive model (VAR) is used to analyze how both sentiments affect real estate return. The overall results show that from unit root test and impulse response analyzation, the impact of seller's sentiment is positive to real estate market while buyer's sentiment is negative. At the same time, the higher seller's sentiment will have different influence on the housing market compared with the higher buyer's sentiment.

▸ **Key words**: Behavior economics, Market sentiment, Housing market, PCA, VAR model

[요 약]

부동산 산업은 경제와 높은 상관관계를 갖는 기초산업이다. 과거 20년 동안 중국경제성장을 가속화하면서 부동산 산업도 큰 변화를 보이고 있다. 이에 본 연구는 기존 경제성장지표인 GDP, 소득, 부동산 가격 및 금리 등 거시경제요인이 주택시장 가격상승을 종합적으로 설명하지 못한 점을 감안하여 행동경제학에서 심리지수가 주택시장에 미치는 영향을 분석한다. 방법론적으로 주성분분석법(PCA)을 활용하여 중국심천지역을 중심으로 부동산시장 수요자 심리지수 및 공급자 심리지수를 각각 도출하고 벡터자기회귀(VAR)모형을 통해 심리지수가 주택수익률에 대한 영향을 실증분석으로 진행한다. 그 결과 공급자의 심리는 주택시장에 긍정적인 영향을 미친 반면, 수요자의 심리는 부정적인 영향을 미치고 있다. 또한 공급자의 심리가 높은 경우에는 수요자의 심리가 높은 경우와 다른 영향을 미치고 있은 것을 밝혔다.

▸ **주제어**: 행동경제학, 심리지수, 주택시장, PCA, VAR모형

• First Author: ZHUO LI, Corresponding Author: ZHUO LI
*ZHUO LI (lizhuo8407@suwon.ac.kr), Dept. of Economics & Finance, The university of Suwon
• Received: 2022. 08. 26, Revised: 2022. 09. 07, Accepted: 2022. 09. 14.

http://www.ksci.re.kr pISSN:1598-849X | eISSN:2383-9945

I. Introduction

As a foundational industry highly correlated with other parts of economy, real estate industry always play a crucial role in Chinese economy. However, according to National Bureau of Statistic of China, during the past decades the growth of macro-economy slowed down from over 10% to 6.1% in 2019 and 2.3% in the pandemic year of 2020 and real-estate industry also had seen some changes. Before 2014, investment in real-estate investment was growing consistently at an average annual rate of over 20% and sales of residential houses also grew rapidly. But after 2014, as the macroeconomic growth slowed down, there was an evident slide in both real-estate investment and sales. Entering 2015, with the easing of monetary policy and more fiscal stimulus, real-estate industry started to improve again and so did market expectations. However, the situation declined again after 2020 covid-19 pandemic.

Previous research found that some basic market fundamentals such as GDP, income level and interest rate cannot explain the increasement of housing price comprehensively especially after 2015. Also, since the development of behavior economics, sentiment is applied to explain some obvious impacts on financial market. Sentiment, as one of an important factor in behavior economy, combines different elements of both psychology and economy to understand the reason and pattern of people that behave the way they do in the real world. However, little research is known about how sentiment affects housing returns previously. In order to explore these questions, the study intends to answer two questions. First; how to evaluate sentiment in real estate market? Second, how does market sentiment affect housing return in China?

Furthermore, the study focus on VAR model to analyze how sentiment influence Shenzhen's housing return by using the data from 2005 to 2021. The content of the study is settled as follows: first, the study explains the importance of market sentiment and gives some basic literature review. Second; the study uses PCA analyzation to illustrate how to create a market sentiment index in real-estate industry. Third; model and data resource in Shenzhen's real-estate industry are explained and VAR model is used to analyze the empirical problems and finally some political suggestions and findings will be proposed.

II. Literature Review

Decades of research shows that humans do not make rational decisions and seek to maximize their own satisfaction rather than their resources. In 2016, Nobel Prize in Economics was rewarded to behavior economic, which started to explore another interesting field from traditional economy. As Shahram Heshmat wrote: "behavioral economics can provide valuable insight that individuals are not behaving in their own best interests." Different scholars such as functional psychology, cognitive psychology, and sociocultural theory have varying understandings and definitions of sentiment (Thompson, R.A. 1991).

Behavioral finance advocates that investment and consumption should be seen as a psychological process comprised of three parts: perception of market, sentiment, and willingness, among which sentiment plays a crucial part. Delong et al. (1990) Consider investor sentiment as investors' optimistic or pessimistic views of the stock market. Barberis, Shleifer, and Vishny (1998) define investor sentiment as the beliefs and value orientations that investors form during the cognitive process. Brown (2004) defines investor sentiment in his studies as the expectations of market participants. Zhang Qiang and Yang Shu'E (2009) cite Baker's study and attribute investor sentiment to the theory of noise trading, arguing that it refers to the optimistic or pessimistic feeling about the market in general, or the tendency to speculate as a result of irrational factors such as cognitive biases that are at work.

There have been relatively in-depth studies related to the impact of market sentiment or investor sentiment on the stock market, but little research is available on the real estate market. Real estate markets have lower efficiency than financial markets due to the fixity of location, incomplete market information, and lack of arbitrage mechanism. The term "sentiment" in this study refers to the subjective psychological factors such as the perceptions and judgments from both developer and consumer side. The Case-Shiller US national home price index(1988) was the first to study expectations and housing prices together and prove that expectations and housing prices are related. Lin et al. (2008) conclude that sentiment is positively related to REITs. The study of Hui and Wang (2014) reveals that short-term and long-term changes in real estate prices are relative to sentiment. Further analysis by Zhou (2011) shows that returns drop when the sentiment is optimistic, but pessimistic sentiment does not lead to higher returns. Eddie Chi-man Hui and Ziyou Wang (2016) take transaction volume in the Hong Kong real estate market as a proxy variable for market sentiment and conclude that market sentiment is significantly effective in predicting housing price movements.

III. Market sentiment indicator

1. Proxies of market sentiment

The residential real-estate market is a market system consisting of both the buyer group (the demand side) and the seller group (the supply side). Two groups are the micro entities in the housing market and each of them influence each other dynamically. On the buyers' side, the buyer group is made of many consumers who differ in how strong their housing demand is. At the same time, the seller groups which refers to real-estate developers often identify other companies in the industry as their competitors. According to the theory of Baker and Wurger(2006, 2007 , 2012) in the stock market, we use the principal component analysis (PCA) to create buyer's sentiment and seller's sentiment indicators in Shenzhen's real estate market and construct corresponding emotional proxy variables.

The study first constructs a market sentiment index to choose a set of specific proxies that may influence Shenzhen's real-estate market. Since there are some theoretical difference between stock and real estate markets, other proxies that represent the characteristics of buyer's sentiment and seller's sentiment in the real-estate markets will be chosen. In conclusion, the new proxies for buyer's sentiment consist of housing market factors and capital market factors, which reflect the importance of micro factors that include market price and value (Table 1), whereas those for seller's sentiment include land market factors, capital market factors, and housing supply factors, which reflect that seller's decisions connect closely with macro-policy influences in real estate market(Table 2).

2. Application of PCA and data source

Principal component analysis(PCA) is the process of computing the principal components and using them to perform a change of basis on the data, which is used in economics widely recently. It can transform p original indicators into a few unrelated comprehensive indicators through linear combination. As a result, this study first apply PCA method to explain two sentiments in real estate market separatedly and the data is collected from 2005 to 2021 in Shenzhen, China. For a few indicators, the missing monthly data are filled in by linear interpolation and all data are gathered from Wind Database. Wind Economic database collect over 1.3 million macroeconomic and industry time series with powerful data and tools to give financial professionals the most comprehensive analyzation into China's economy. Also some official information, such as the national bureau of

statistics, the people's bank of China and some non-government sources related to stock market and real-estate market can be explored together.

Table 1. Proxies for buyer sentiment

Category	Proxies for buyer sentiment	variable
Stock market	Shanghai composite index	SSEC
	Market value of real estate industy/total market value	MARKETVALUE
	HSI(Hang Seng Index)	HSI
Housing market	Primary transaction volumes	PRISALEAMOUNT
	Secondary transaction volumes	SESALEAMOUNT
Capital market	New bank loan	LOAN
	Fulfilled amount of investment of developer	INVEST

Table 2. Proxies for seller sentiment

Category	Proxies for seller sentiment	variable
Stock market	Market value of real estate industy/total market value	MARKETVALUE
	HSI(Hang Seng Index)	HSI
Land market	Land cost	LANDCOST
Development situation	Area of construction	NEWFLATS
	Area of sales	LANDAREA
Capital market	New bank loan	LOAN
	Fulfilled amount of investment of developer	INVEST
	New bank loan approved to developer	FUNDS

3. The construction of buyer sentiment index(SENTIB) and seller sentiment index(SENTID)

Buyer's sentiment index in housing market is performed on 7 different variables, which include SSEC, MARKTEVALUE, HSI, PRISALEAMOUNT, SESALEAMOUNT, LOAN and INVEST. The KMO test result is 0.7891, which means that principal component analysis is a suitable method. According to the principle, the cumulative variance contribution rate is not less than 85% and we compute principal components scores by using the selected proxies and the final equations for SENTIBS is as follows:

$$SENTIB = 0.3095*LNSSEC + 0.2921*LNMARKETVALUE + 0.3357*LNHSI + 0.1630*LNPRISALEAMOUNT + 0.2462*LNSESALEAMOUNT + 0.2673*LNLOAN + 0.2128*LNINVES \quad (1)$$

The result shows that the above seven indicators are positively correlated with buyer's sentiment, which means a greater proportion of the willingness to buy a house will be demonstrated with the variables in both stock market and housing market. The statistical results are also consistent with the actual economic findings, which indicates that the construction of the buyer's composite sentiment index (SENTIB), has a sound economic theoretical basis.

Seller's sentiment index in housing market is performed on 9 different variables, which include MARKETVALUE; HSI; LANDCOST; NEWFLATS; LANDPRICE; LANDAREA; LOAN; INVEST and FUNDS. The KMO test result is 0.87, indicating that principal component analysis is a suitable method. According to the principle that the cumulative variance contribution rate is not less than 85% and the final equations for SENTID are as follows:

$$SENTID = 0.2192*LNMARKETVALUE + 0.0827*LNLANDAREA + 0.1638*LNHSI + 0.2184*LNLANDCOST + 0.2673*LNNEWFLATS + 0.1565*LNLANDPRICE + 0.2706*LNINVEST - 0.0896*LNFUNDS + 0.2311*LNLOAN \quad (2)$$

It is reflected that when a real estate developer is optimistic, it will increase land investment and acquire land at a high premium, also the supply of products and new constructions will be increased as well. On the contrary, if sentiment is pessimistic, real estate developers will lower their investment and slow down the pace of new launches. This feature is consistent with the actual economic significance, which indicate that seller's composite sentiment index (SENTID) has a sound economic theoretical basis.

IV. VAR model analyzation

After the construction of market sentiment variables (SENTIBS, SENTID), this study want to analyze how the market sentiment affect the commodity housing market, and does the commodity housing market in turn affect market sentiment? Traditionally, the operation of housing market involves variables including price, supply, demand, trading volume, transaction volume, investment, rent and vacancy rate etc. In this study, we use VAR model to analyze the dynamic relationship between each traditional variables and market sentiments.

1. VAR model and variables

Following the work from Baker and Wurgler (2007) and Lam(2013), we build a new property lag model to explore the effect of sentiment on housing market return.

$$LNHOUSERETURN = C_i + \alpha LNHOUSE \quad (3)$$
$$RETURN_{i,t-n} + \beta_1 SENTIB_{t-n} + \beta_2 SENTID_{t-n} + \gamma X_{t-n} + \epsilon_{i.t-n}$$

where i denotes housing market and t denotes time period (month). SENTIB and SENTID are the proxies for buyer's sentiment and seller's sentiment respectively. Here we add the 1-period lag of house return to the independent variable, as a result, the past information can be reflected in the current housing return. X is a vector of fundamental economic factors that affect real estate market return which include economic growth. The vector autoregressive model (VAR) will then be explained to measure two types of housing market sentiment on the influence of housing market return. VAR model is a time series model which reflect current observations of a variable with past observations of itself and the others in the system. Also it is useful when one is interested in predicting multiple time series variables by using a single model. In this study, the variables of model include housing market returns, housing market sentiment (SENTIB and SENTID) and control variables which is industrial added value growth rate (industry) to illustrate real macro-economic development level. The definitions and descriptive statistics for all variables including market sentiment index are shown in table 3.

Also the optimal amount of lagged terms to be chosen in the VAR model is based on the lowest result of AIC criteria. After that, both impulse response analysis and variance decomposition analysis will be explained separately in order to explain the impact of market sentiment on real-estate industry.

Table 3. Definitions of variables

Variables	Obs	Mean	Std. Dev.	Min	Max
LNHOUSERETURN	198	5.368	.774	3.415	6.978
SENTIB	198	6.407	.76	4.635	7.866
SENTID	198	7.176	1.035	5.35	9.167
LNINDUSTRY	198	1.581	1.291	-2.303	3.721

2. Empirical results

2.1 unit root test

Prior to the construction of VAR model, we adopted the Dickey Fuller (ADF)test for a unit root test on all variables and Granger causality tests are also conducted. Table 4 shows that all the variables are stationary at 5% critical value, which means VAR model is suitable in this study and the optimal number of lagging items in VAR model is based upon the lowest result of AIC Criterion. With the optimal VAR order identified, both variance decomposition analysis and impulse response analysis will then be analyzed to gauge the impact of market sentiment (SENTIB and SENTID) and economic factors on house market returns (HOUSEREUTRN).

2.2 Impulse response analysis result

Impulse response analysis is used to study the dynamic influence of one variable to another in VAR model. It is often used to capture current response and future value of each variable to one unit or one-unit Standard deviation in the present values of VAR structure error. As a result, this

study focuses on the impulse response function based on the VAR model, and analyzes the impact of shocks to amongst variables in order to explore the impact of market sentiment on commodity housing market transactions and their interactions.

Table 4. unit root test result

Variables	ADF test statistic	5% critical value
LNHOUSERETURN	-3.582	-2.884
SENTIB	-2.893	-2.884
SENTID	-3.448	-2.884
LNINDUSTRY	-4.825	-2.884

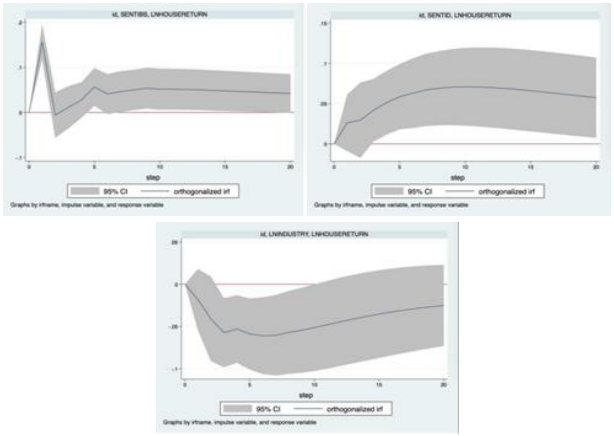

Fig. 1. Impulse response of LNHOUSERETURNs

2.2.1 Impact of sentiment on housing market (Figure 1)

Figure 1 displays the impulse responses of the housing market return (LNHOUSERETURN) to other variables, which reflect market sentiment shocks have a clear impact on the sales of residential housing. The study finds that when the buyer sentiment composite index (SENTIB) is given a standard deviation positive shock, the commodity residential sales in the first month is the largest positive response of about 0.16. Then this number begins to decline to about -0.01 in the third month, a small negative response which indicate that the demand-side market sentiment has a rapid and obvious impact on the market.

The study also illustrates that if commodity housing sales are subjected to a positive shock of one standard deviation from the seller's sentiment composite index, a gradual rise and slow decline toward zero is generated, which showthat when market supply-side sentiment turns optimistic, there is a sustained positive stimulus to the commodity housing market transactions.

In addition, the result of value added of industry above scale (LNINDUSTRY), a control variable added to the model, produces significant response results for the sales of residential housing. Also, it is found that industrial added value growth rate has a persistent negative effect on housing return, and this negative effect reaches the maximum value of -0.06 in the fifth month.

2.2.2 Impulse response of buyer's sentiment(SENTIB)(Figure 2)

Figure 2 shows the impulse responses of buyer's sentiment (SENTIB) to the other variables. It concludes that the commodity housing transaction shock has a clear impact on market sentiment. According to the impulse response, the positive shock of one standard variance of commodity residential sales causes the largest positive response of buyer sentiment in period 0, weakening to 0.06 in period 2, and gradually declining after rising to 0.08 in month 3, slowly converging to 0. The positive impact is maintained throughout the process, indicating that the performance of the commodity housing market has an interactive effect on market sentiment.

The study also finds the buyer's sentiment composite index receives a positive shock of one standard deviation from the seller's sentiment composite index, which indicate when the market supply-side sentiment turns optimistic, there is a continuous positive stimulus for the market buyer sentiment. In terms of the current situation of China's real estate market, every short-cycle hot and cold market transition is accompanied by a change in the government's demand-side regulatory policies. When the government adopts policies such as relaxing restrictions on purchases and loans and giving tax incentives, the buyer's sentiment will be significantly optimistic and the short-cycle market will fluctuate upward. If the government tightens the

policy grip and the demand is suppressed, the short cycle of the market will go down rapidly, while the supply of real estate has a relative lag. Also figure 2 reflect that the impact of control variable LNINDUSTRY has a significant negative response on buyer's sentiment, which reaches the maximum value of -0.07 in the sixth month.

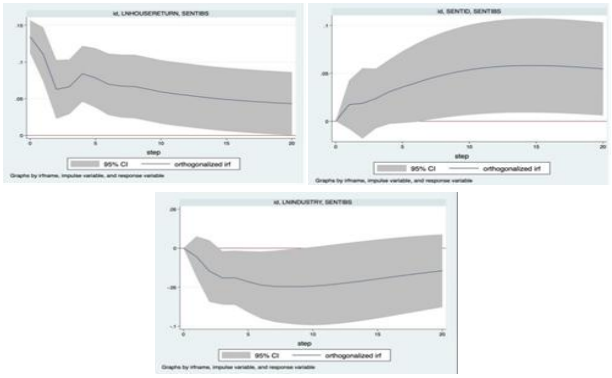

Fig. 2. Impulse response of SENTIB

2.2.3 Impulse response of seller's sentiment(SENTID)(Figure 3)

Figure 3 shows that seller's sentiment (SENTID) in the market is subjected to a one standard deviation positive shock imposed from the other variables in the model. Theoretically, it is obvious that the performance and prospects of the housing market have a significant impact on the sellers (real estate developer) in the market and the change of market demand in turn produces a sizable impact on the decisions of real estate developers.

From figure 3, the study finds that sales of commercial residential units (LNHOUSERETURN)

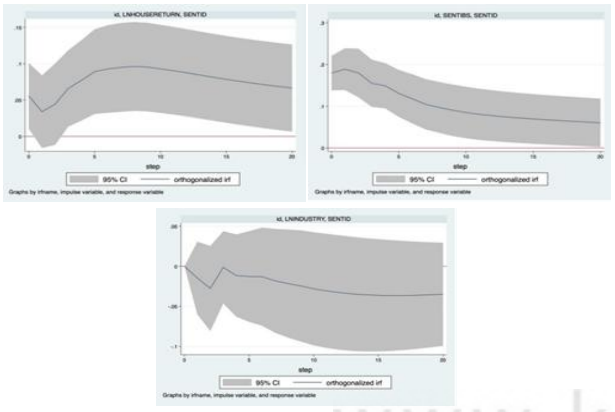

Fig. 3. Impulse response of SENTID

deliver a positive shock of one standard variance to the seller's composite sentiment index (SENTID). The response level decays and gradually converges to 0, indicating that the improvement in market transaction boosts developers' confidence in the future for several periods, especially for the following 6 to 8 months. The shock of the control variable LNINDUSTRY also produces a significant negative response on seller sentiment, which reaches the maximum value of -0.03 in the third month.

2.3 Variance Decomposition analysis result

VAR impulse response chart qualitatively visualizes the interaction between housing market sentiment and transactions, however, in order to quantify how market sentiment influences and interacts with the market, variance decomposition is needed to explore further.

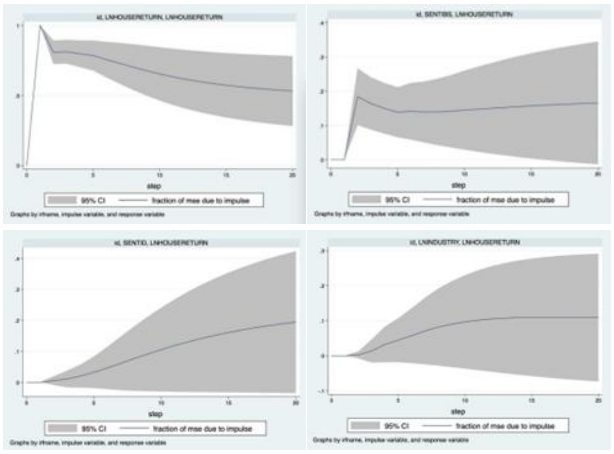

Fig. 4. Variance Decomposition of LNHOUSERETURN

As shown in figure 4, the composite buyer's sentiment index(SENTIB) contributes 18.40% to the sales variance and the composite seller's sentiment index (SENTID) contributes 0.52%. As a result, only 0.25% variance can be explained by the value added of industries, which suggest that comparing with LNHOUSERETURN itself, the other variables in the model are less explanatory when it comes to the variation in commodity market.

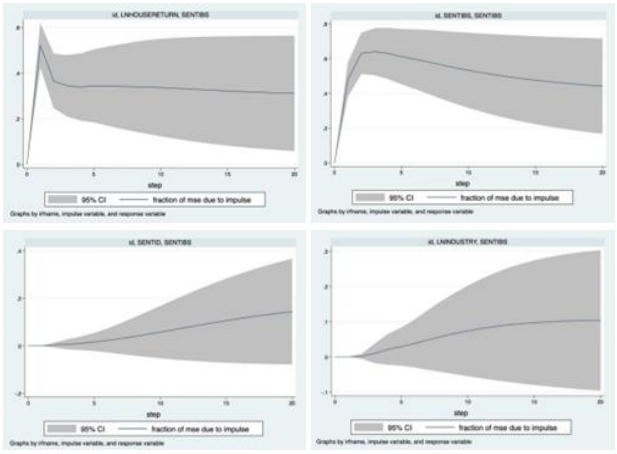

Fig. 5. Variance Decomposition of SENTIB

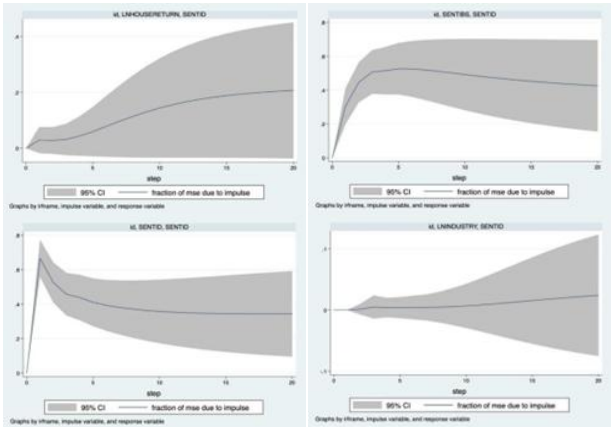

Fig. 6. Variance Decomposition of SENTID

Also figure 5 and 6 display the variance decomposition of buyer's sentiment (SENTIB) and seller's sentiment (SENTID) separately. The result shows that buyer's sentiment in the housing market is initially influenced by the transactions volume and seller's sentiment in the housing market is mainly influenced by the demand side and its own sentiment, which demonstrate the "demand-oriented" behavior and different decisions of real estate companies.

V. Conclusions

Based on the traditional housing market mechanism, the study illustrates a new indicator to explain the influence in real-estate market, which is the market sentiment. By using PCA and quantitative model from SHENZHEN's housing market data, the China's real estate market sentiment index was developed and explain how does market sentiment affect housing return. After that, the study use VAR model to get the market sentiment indicator and analyze the relationship with housing market return, the major findings are as follows:

First, the comprehensive sentiment index developed by PCA can effectively reflect the market sentiment and it is divided into buyer's sentiment and seller's sentiment. By using VAR model, we get conclusion that buyer's sentiment has the negative relationship with housing return while the seller's sentiment is combined with a higher relationship with housing return. Also, the variance decomposition results explore that the contribution of seller's sentiment is higher than buyer's sentiment and both sentiments have a larger influence than individual market fundamentals.

Second, the study illustrates that as an important indicator in behavior economics, market sentiment has a clear impact on the transactions in the commercial real estate market. Therefore, the government should pay close attention to how market sentiment influencing housing market and provide stronger expectation management. For example, when real estate inventories are being digested, the government should facilitate the release of effective demand by nurturing optimistic market sentiment through infrastructure improvement in high-inventory areas. On the other hand, if housing market is overheating or there has a real-estate bubble risk, the government should stabilize the market sentiment by releasing future land supply plans, disclosing information about the real volume-price trend or more tight policies.

Third, an effective sentiment index can reflect market players' expectations and attitudes towards the real estate market. As a result, building market sentiment is also important for all stakeholder to optimize their decision-makings. For example, government can apply market sentiment with policies and maintain an appropriate level of

financial support in the market. Also, business can use market sentiment monitoring mechanism to optimize their investment and supply-chain decisions while buyers can re-examine their judgement and decisions to avoid some impulsive consumption.

REFERENCES

[1] Baker, M., & Wurgler, J. “Investor sentiment and the cross-section of stock returns”, Journal of Finance, Vol. 61, No.4, pp. 1645-1680, August 2006, DOI: 10.1111/j.1540 -6261.2006.00885.x

[2] Baker, M., & Wurgler, J. “Investor sentiment in the stock market”, Journal of Economic Perspectives, Vol. 21, No.2, pp.129-151, March 2007, DOI: 10.1257/jep.21.2.129

[3] Baker, M., Wurgler, J., & Yuan, Y. “Global, local, and contagious investor sentiment”, Journal of Financial Economics, Vol. 104, No. 2, pp. 272-287, May 2012, DOI: 10.1016/j.jfineco.2011.11.002

[4] Barberis ,N. A.Sheifer,R , Vishny. “A Model of Investor Sentiment”. Journal of Financial Economics Vol,49, No.3, pp : 307-343, September 1998, DOI:10.1016/S0304-405X(98) 00027-0

[5] Brown , G.W, Cliff , M .T. “Investor Sentiment and the Near-term Stock Market”. Journal of Empirical Finance, Vol. 11, No. 1, pp : 1-27, January 2004, DOI:10.1016 /j.jempfin. 2002.12.001

[6] De Long,J. Bradford, Andrei Shleifer, Summers .L .H, Waldmann, R.J. “Noise Trader Risk in Financial Markets” Journal of Political Economy, Vol.98, No.4, pp.703-738, August 1990, DOI: jstor.org/stable/2937765

[7] Eddie Chi-man Hui & Ziyou Wang. “Market sentiment in private housing market”. Housing, theory and society, Vol.34, No.1, pp : 57-78, June 2016, DOI: 10.1080/1403 6096.2016.1196240

[8] Hui, E. C. M., Wang, Z., & Wong, H. “Risk and credit change in Asian securitized real estate market”. Habitat International, Vol. 43, No. 1, pp: 221-230, July 2014, DOI: 10.1016/j.habitatint.2014. 03.008

[9] Karl E. Case & Robert J. Shiller. “The efficiency of the market for single-family homes”. The American Economic Review, Vol. 79, No. 1, pp. 125-137, February 1988, DOI: 10.3386/w2506

[10] Lin, C. Y., Rahman, H., & Yung, K.. “Investor sentiment and REIT returns”. The Journal of Real Estate Finance and Economics, Vol. 39, No. 4, pp: 450-471. June 2008, DOI: 10.100 7/s11146-008-9115-5

[11] Thompson, R.A. "Emotional regulation and emotional development", Educ Psychol Rev, Vol.3, No. 4, pp:269-307, Dec. 1991. DOI:/10.1007/BF01319934

[12] Shahram Heshmat.. "Eating Behavior and Obesity: Behavioral Economics Strategies for Health Professionals", Journal of Nutrition Education and Behavior, Vol. 45, Nol.4, P383.E1, July 2013, DOI: 10.4324/9781410605061

[13] Zhang Qing, Yang Shu.. “Noise Trading, Investor Sentiment Volatility, and Stock Returns”, Systems Engineering-Theory & Practice, Vol.29, No,3, pp.40-47, March 2009, DOI: 10.1016/ S1874-8651(10)60010-5

[14] Zhou, J., & Anderson, R. I. “An empirical investigation of herding behavior in the U.S. REIT market”, Journal of Real Estate Finance and Economics, Vol. 47, No. 1, pp: 83-108, November 2011, DOI: 10.1007/s11146-011-9352-x

Authors

ZHUO LI received the B.S., M.S. and Ph.D. degrees in Economics, Industrial Economics and International Trade from Liaoning University, Shandong University, China and Chungnam National University, Korea, in 2005, 2008 and 2013, respectively. She is currently an assistant Professor in the Department of Economics and Finance at the University of Suwon, Hwaseong, Korea. Her research interested in urban economics, real estate economics and carbon neutral economy.