

China Economic Insights

Estimating Threshold in China's Real Estate Market: Lessons from Big Data¹

May 24, 2024

"Without big data analytics, companies are blind and deaf, wandering out onto the web like deer on a freeway."

- Geoffery Moore
An American Consultant and Author

I. Introduction

1. **In China, the stabilization of the real estate sector carries significant importance, given its substantial size within the economy and its intricate interconnection with various segments of economic activity.** The proportion of the Chinese real estate market within the Gross Domestic Product (GDP), considering the aggregate of construction and real estate services sectors, constitutes approximately 13 percent of the nominal GDP as of 2023. Furthermore, when industries indirectly related to the real estate sector are included, this share surpasses 25 percent². Additionally, as of 2019, the real estate sector comprises the highest percentage of household assets, amounting to 60 percent³. The proportion of housing costs reflecting changes in property prices within the total Consumer Price Index (CPI) is known to be close to 15 percent in China⁴. According to [AMRO \(2023\)](#), the impact of shocks in China's

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² According to the analysis conducted by Kenneth Rogoff, the proportion occupied by the Chinese real estate sector is reported to be 29 percent ("Can China's outsized real estate sector amplify a Delta-induced slowdown?", Voxeu Column, Sep. 2021).

³ According to the article from council on foreign relations, the value of housing composed 59 percent of households' total assets in China, quoting PBC's survey ("The PBoC Props Up China's Housing Market", council on foreign relations, Mar. 2023).

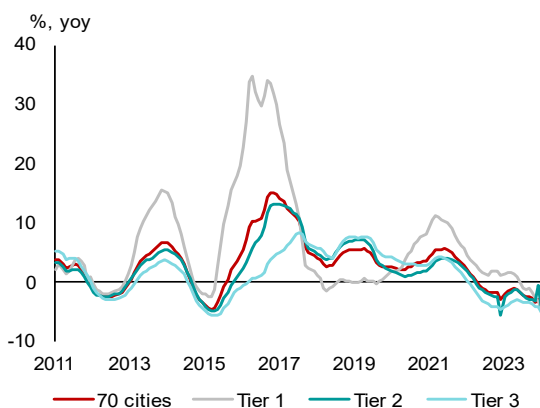
⁴ Although the National Bureau of Statistics of China does not disclose the proportions of sub-categories, according to some investment banks, the share of real estate within China's Consumer Price Index (CPI) is known to be 18 percent. However, the housing category of China's CPI includes both rental and utility costs. Excluding utility, the rental part is known to account for probably 15 percent of overall CPI.

real estate sector has considerable effects not only on China itself but also on the growth of major economies in the region.

2. **Significant fluctuations in property prices could create a ripple effect throughout the economy, exerting considerable influence on the sentiment among household and businesses⁵.** In an environment characterized by stable property prices, both households and businesses can enjoy the advantage of allocating resources towards more productive sectors without the burden of fluctuating rental costs. Conversely, in period of property price inflation, households often experience a wealth effect as the value of their homes appreciates. This can lead to a sense of increased affluence, prompting higher levels of consumer spending and investment. On the other hand, property price deflation can instill uncertainty and caution among households and corporates, dampening consumer sentiment and investment appetite. This sentiment can be further exacerbated by the significant role real estate plays in the economy, influencing various sectors such as construction, finance, and retail. Thus, the movement of property prices not only reflects economic conditions but also affects the perceptions and behaviors of key economic actors, underscoring its pivotal role in shaping overall sentiment.

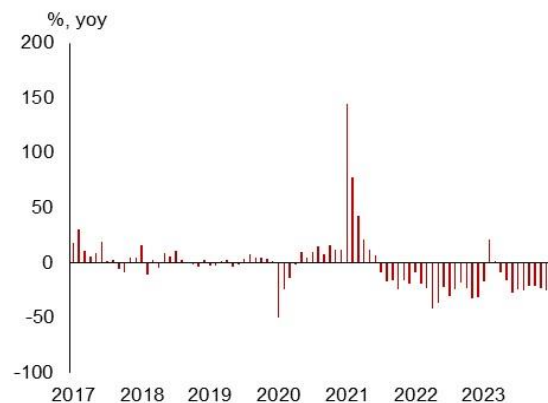
3. **Indeed, the recent downturn in China's real estate market has had a significant influence on sentiments among both households and corporates.** Following several years of rising prices, real estate prices⁶ in China began to decelerate from 2021, with the year-over-year growth rate turning negative from May 2022 (Figure 1). Residential building sales have also been declining since 2021 (Figure 2). Accompanied by sluggishness in the real estate market, investment in the real estate sector has seen a decrease compared to the same month in the previous year, starting from April 2022. The performance of newly started residential construction has also been subdued since the first half of 2022, further amplifying negative sentiment related to the real estate market.

Figure 1. Real Estate Prices



Sources: National Bureau of Statistics of China.

Figure 2. Residential Building Sales



Sources: National Bureau of Statistics of China.

4. **Therefore, crucial questions arise: Is there a critical level or threshold at which the stability of the real estate market is compromised due to price inflation or deflation? If such a threshold exists, what might that level be?** Studies of these questions are

⁵ Some media outlets have reported the views of economists within China, suggesting that the decline in property prices significantly impacts consumer sentiment. ("Feeling poorer: Property slump hurting Chinese consumers, clouding recovery," April 14, 2023, Reuters)

⁶ Unless specified otherwise, the term "real estate prices" or "house price" herein refers to the prices of existing residential property prices based on the average of 70 cities in China.

essential for policy makers and market participants to understand the fragility of the real estate market, gauge its resilience, and assess its potential impact on the broader economy. Knowing the tipping point where market stability could be compromised enables proactive measures to be taken to mitigate risks and safeguard against potential destabilization.

5. **This analytical note aims to study the influence of property prices on public sentiment and to estimate the threshold of the real estate market through the analysis of internet-based search data.** The significance of this study lies in its innovative approach, utilizing big data from the internet to analyze China’s real estate market. Section II of this note examines the relationship between real estate market related data from internet and real estate prices. Section III estimates the threshold of China's real estate market using internet search data. Section IV analyzes the spiral between deflationary sentiment, measured by deflation-related internet search data and CPI, to address the burgeoning concerns over the possibility of deflation in China. Section V concludes with policy considerations.

II. Real Estate Market related Internet Search Data and Sales Prices

6. **Big data sourced from the internet is increasingly recognized as a valuable tool for understanding human psychology, with its application expanding steadily.** Surveys often yield varied responses due to factors such as social desirability bias, self-presentation concerns, or interviewer influence. However, internet search data tends to reflect individuals’ true preferences more transparently (Stephens-Davidowitz, 2017)⁷. The advantages of utilizing such data in economic research are gaining wider recognition. Notably, a recent paper⁸ analyzing the rationale behind a 2 percent inflation target for developed countries using internet search data has garnered significant attention from central banks and other institutions. Furthermore, unlike official data sources, search data is available in real-time and at high frequency, enhancing its usefulness for analysis⁹.

7. **In China, Baidu, the country’s leading search engine, offers keyword search data ideal for economic analysis given its high frequency and extensive time series.** Since 2010, Baidu has provided time-series data on internet search intensity for specific keywords across 34 regions in China. Researchers can access detailed search information for these regions. For instance, in the case of Sichuan Province, one can examine the trends in keyword search data not only for the entire province but also for 21 specific cities within Sichuan, including Chengdu, Yibin, Mianyang, and Guangyuan. Baidu tracks the frequency of searches

⁷ Stephens-Davidowitz argues that that people often don't reveal their true thoughts, beliefs, or intentions in traditional surveys in his book "Everybody Lies: Big Data, New Data, and What the Internet Can Tell Us About Who We Really Are," (2017).

⁸ Korenok, O., Munro, D. and Chen, J. (2023), "Inflation and attention thresholds"

⁹ For Japan and Korea, there exists official data based on surveys that can directly measure changes in the property market. Followings are representative examples.

Economy	Indicators	Authority
Japan	✓ Opinion Survey: Future Land Prices (Diffusion Index, Published by quarterly basis)	Bank of Japan
Korea	✓ Consumer Survey: Expectations of Housing Prices (Diffusion Index, Published by monthly basis)	Bank of Korea
	✓ Real Estate Market Consumer Sentiment Index (Diffusion Index, Published by monthly basis)	Korea Research Institute for Human Settlements

Source: National Authorities and Related Institutions

for specific keywords across both PCs and mobile phones. Leveraging Baidu's search data can offer invaluable insights for analyzing fluctuations in the real estate market and understanding shifts in people's behavior. Similarly, in Japan, while Yahoo Japan does not provide search data, Google Japan offers time-series data on specific keyword searches through Google Trends since 2004. In Korea, Naver, the leading search engine, has offered comparable search data through Naver DataLab since 2016. This research utilizes data from Baidu, Naver, and Google to analyze search trends in China, Japan, and Korea.

Table 1. Internet Search Data among ASEAN-3 Countries

Economy	Search Engine	Data provision period	Availability by region	Frequency
China	✓ Baidu	From 2011	Available	Daily Basis
Japan	✓ Google	From 2004	Available	Daily Basis
Korea	✓ Naver	From 2016	Available	Daily Basis

Source: Each Internet Search Engine

8. **The relationship between search data pertaining to real estate market¹⁰ and sales prices suggests the existence of thresholds that may influence changes in people's behavior.** When plotting Chinese real estate market sentiment, as measured by internet search data from Baidu, against property prices on an XY plane, a U-shaped convex quadratic function emerges (Figure 3). This indicates that households and businesses pay heightened interest to real estate sales prices when they fluctuate beyond, or below certain price thresholds compared to when they remain stable. Consequently, the consumption and investment decisions of households and businesses can undergo significant changes around these price thresholds. For example, a significant decline in prices may increase concerns about a downturn in the real estate market, leading to reduced spending, while businesses may become more cautious about real estate investments. This convex quadratic function relationship between real estate market-related search data and sales prices is not only observed in China but also in Korea and Japan. Particularly noteworthy is the rapid strengthening of this relationship in China since 2021, coinciding with the deceleration of property prices.

¹⁰ For constructing the real estate market-related internet search data, the keywords used are "房地产" in Chinese, "부동산" in Korean, and "住宅価格" in Japanese. Using another set of keywords, "房价" in Chinese and "집값" in Korean, also reveals a downwardly convex shape, although with some degree of variation. The frequency of use of these local language terms, which denote property, is confirmed through AMRO staff from China and Japan. It is gathered that analyzing these terms would not pose significant issues.

Figure 3. ASEAN-3 Real Estate related Internet Search Data and Sales Prices (China) (Japan) (Korea)



Sources: Each country's internet search engine, National authorities.
 Note: Each dot line describes trend. Volume of search data is calculated as monthly averages.

9. **The U-shaped convex quadratic function, representing the relationship between real estate market-related search data and sales prices, suggests the presence of price thresholds where market sentiment could turn around in response to changes in prices in either direction.** If the regression coefficients explaining the relationship between search data and prices are statistically significant, then there are important implications. Should the sales price move higher or lower than a specific threshold, market sentiment may react strongly, amplifying price movement through a self-fulfilling process and generating volatility in real estate-related sector.

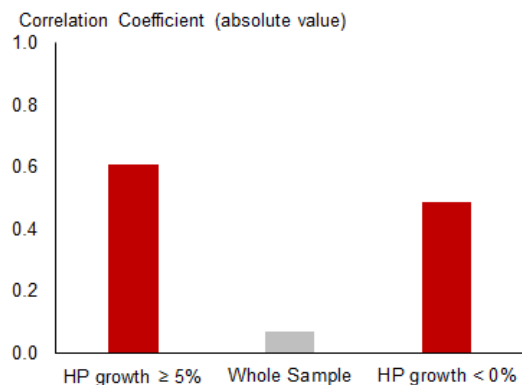
III. Estimating Thresholds in Real Estate Market in China

10. **A statistically significant relationship has been observed between the real estate-related search data collected from Baidu¹¹ and the real estate sales prices in China.** Calculating the correlation between real estate prices and search volumes from 2011 to 2024 for the entire sample reveals a correlation nearly close to zero. However, during periods of rising real estate prices or periods of declining real estate prices, a strong correlation emerges (Figure 4). This suggests that interest in real estate among households and businesses increases significantly during periods of substantial price rises or declines. Moreover, Granger causality tests indicate that although no significant causal relationships between the two datasets are observed across the entire period (2011-2023), significant causal relationships emerge during periods characterized by rising or falling prices (Table 2). Specifically, when real estate prices increase by more than 5 percent (indicating a positive average change in real estate prices in the sample period), it becomes apparent that real estate prices Granger cause shifts in search data volume. Similarly, during periods negative growth in real estate prices, real estate prices are also found to significantly Granger cause shifts in search data volume. This suggests that when real estate prices rise above or fall

¹¹ The real estate market-related search data is constructed using local languages that denote real estate as keywords. In the case of Korenok et al. (2023), the local language terms for inflation were verified using a Google translation, and based on this, data necessary for analyzing appropriate inflation levels was constructed.

below a certain threshold, then real estate prices are likely to change more significantly as people's interest in real estate increases¹².

Figure 4. Correlation Coefficient of Real Estate Sales Price and Search Volume



Sources: National Bureau of Statistics of China, Baidu, and AMRO staff calculations.
 Note: HP represents Residential Real Estate Sales Prices based on the average of 70 cities in China.

Table 2. Result for Granger-Causality Test between Real Estate Sales Price and Search Volume

Testing Period	Null Hypothesis	F-statistics
2011-2023	Price \neq S.V.	0.795
	S.V. \neq Price	0.535
When Sales Price \geq 5%	Price \neq S.V.	2.554*
	S.V. \neq Price	0.208
When Sales Price < 0%	Price \neq S.V.	2.736**
	S.V. \neq Price	0.637

Sources: AMRO staff estimations.
 Note: ***, ** and * denote that null hypothesis is rejected at 1 percent, 5 percent, and 10 percent significant level respectively. 2) S.V. represents search volume.

11. **This analytical note estimates two price thresholds: an 'upper threshold' and a 'lower threshold', taking into account the U-shaped convex quadratic function that represents the relationship between real estate-related search data and the change in real estate sales prices.** When the relationship between the two variables exhibits an L-shape, there is a high likelihood of a single threshold existing. However, if a U-shaped pattern is observed, there may be periods where the relationship between the variables intensifies at both ends, while diminishing in the middle period. To estimate the thresholds of the Chinese real estate market, this analytical note utilizes the Threshold equation proposed by Korenok *et al.* (2023), applying it across 70 cities, including Tier 1, Tier 2, and Tier 3 cities in China, respectively. The period of analysis extends from January 2011 to January 2024. To estimate the thresholds, the entire dataset is first used to estimate the 'upper threshold', located on the upper part of the distribution, and then the distribution below the upper threshold is used to estimate the 'lower threshold'.

- Threshold equation: $y_t = \alpha + x_{t-1}(x_{t-1} < \gamma)\beta_1 + x_{t-1}(x_{t-1} \geq \gamma)\beta_2 + u_t$

Where y_t is the measure of people's search volume for the real estate market in China during period t (search data from Baidu) and x_{t-1} is the official measure of real estate sales price growth. γ is the threshold parameter that separates two regimes: the first regime occurs when $x_t < \gamma$ and has a coefficient of β_1 and the second regime occurs when $x_t \geq \gamma$ and has a coefficient of β_2 . The threshold (γ) is estimated by allowing the linear relationship between real estate-related search words and the rate of change in real estate prices to vary based on a specific threshold and finding the value that minimizes the residual sum of squares (RSS) for the entire sample. Specifically, to find the threshold, we started with 0 as the initial point

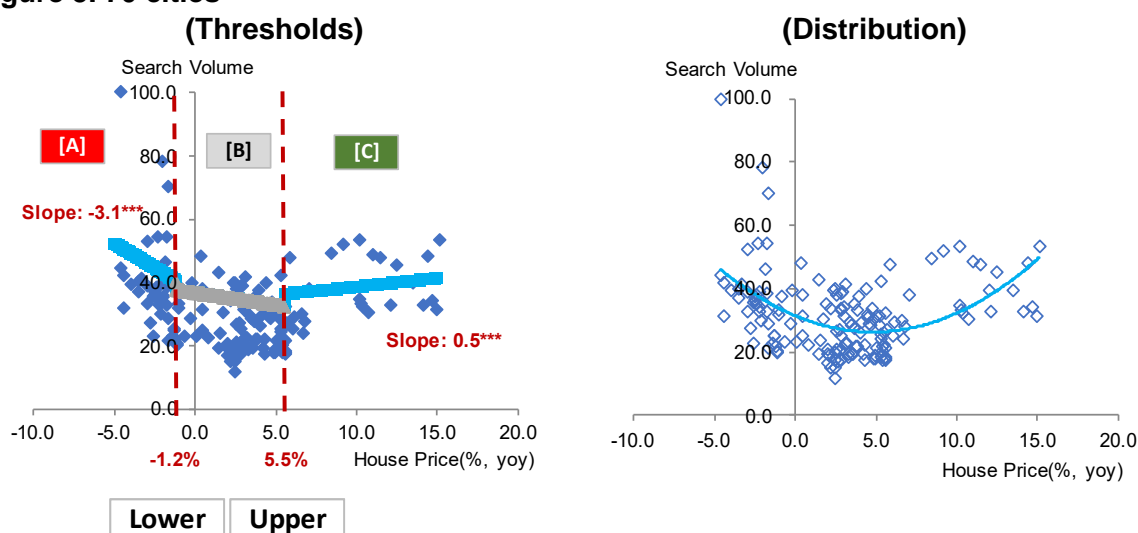
¹² In another study using Weibo (Zhu *et al.*, 2022), it was analyzed that not only do real estate prices affect people's sentiments, but people's current sentiments about future real estate prices also have a significant impact on future price changes.

and moved in increments of 0.1 in the (+) and (-) directions to find the value that minimizes the RSS.

12. **The empirical results show the existence of price thresholds in the Chinese real estate market that prompt shifts in public sentiment.** The upper threshold is estimated to be around 5 percent, same as the economic growth target set by Chinese authorities. Conversely, the lower threshold is around -1 percent for the 70 cities (as depicted in the left side in Figure 5). The existence of lower thresholds has been confirmed in Tier 1-3 cities, while the presence of upper thresholds is also verified in Tier 1 and Tier 2 cities. Tier 3 cities are excluded, with larger cities showing higher levels of price thresholds (as depicted in the left sides in Figure 6-8). The relatively higher thresholds in Tier 1 cities are deduced from the significantly higher rates of real estate sales price increases historically observed in these areas, indicating that public sentiment reacts sensitively to notable decelerations in the rate of price increases.

Estimation Results for Thresholds

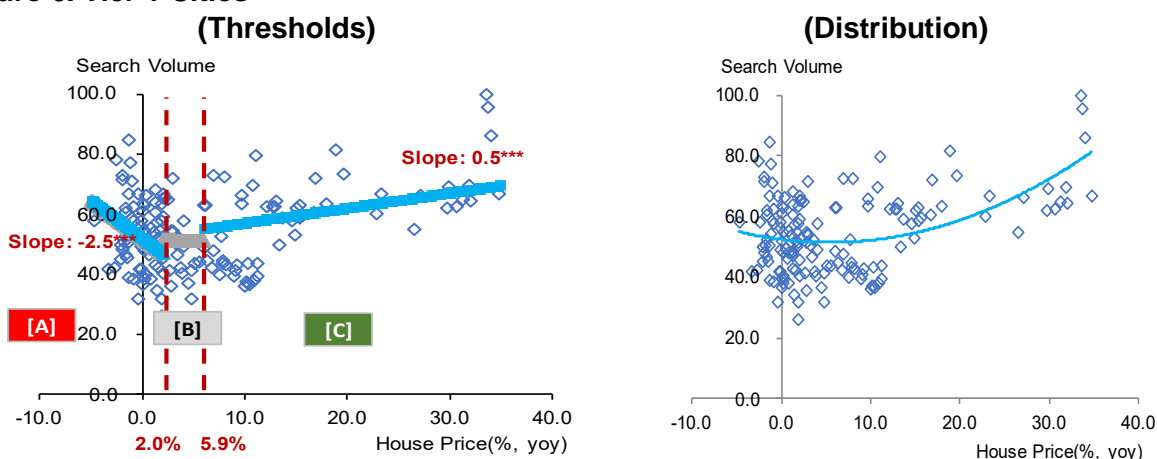
Figure 5. 70 cities



Sources: AMRO staff estimations.
 Note: The slope for grey line is not statically significant. ***, ** and * denote that null hypothesis is rejected at 1 percent, 5 percent, and 10 percent significant level respectively.

Sources: National Bureau of Statistics of China, Baidu, and AMRO staff calculations.
 Note: Blue line describes polynomial trend from Excel.

Figure 6. Tier 1 Cities

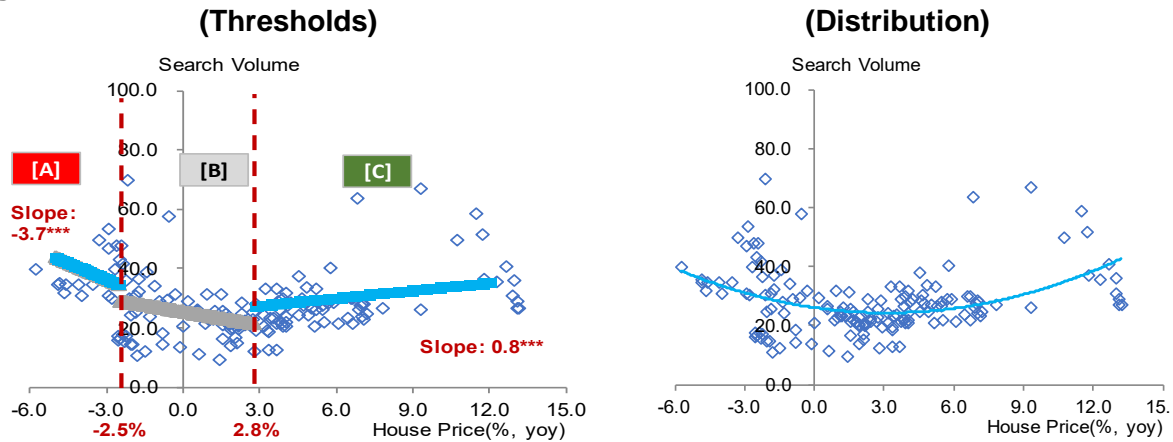


Sources: AMRO staff estimations.

Sources: National Bureau of Statistics of China, Baidu, and AMRO staff calculations.
 Note: Blue line describes polynomial trend from Excel.

Note: The slope for grey line is not statically significant. ***, ** and * denote that null hypothesis is rejected at 1 percent, 5 percent, and 10 percent significant level respectively.

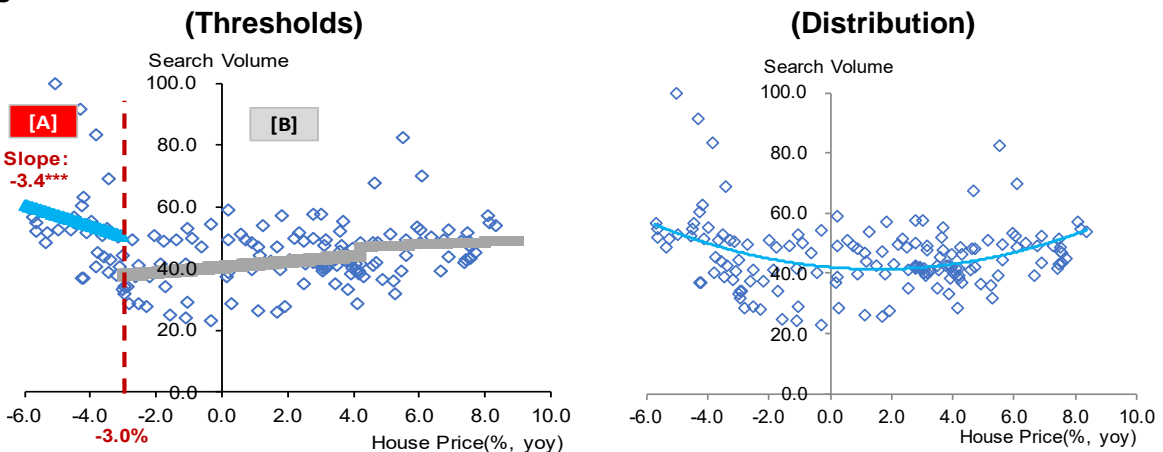
Figure 7. Tier 2 Cities



Sources: AMRO staff estimations.
 Note: The slope for grey line is not statically significant. ***, ** and * denote that null hypothesis is rejected at 1 percent, 5 percent, and 10 percent significant level respectively.

Sources: National Bureau of Statistics of China, Baidu, and AMRO staff calculations.
 Note: Blue line describes polynomial trend from Excel.

Figure 8. Tier 3 Cities



Sources: AMRO staff estimations.
 Note: The slope for grey line is not statically significant. ***, ** and * denote that null hypothesis is rejected at 1 percent, 5 percent, and 10 percent significant level respectively.

Sources: National Bureau of Statistics of China, Baidu, and AMRO staff calculations.
 Note: Blue line describes polynomial trend from Excel.

13. **There exists a period across all regions where the sentiment in the real estate market does not significantly respond to changes in sales prices.** This corresponds to Section B in Figures 5-8. The regression coefficients (slope, β) explaining the relationship between search data and real estate sales prices in this B section are statistically insignificant. This implies that households and businesses can engage in economic activities without significant worry about fluctuations in real estate prices, as long as price movements remain within the B section.

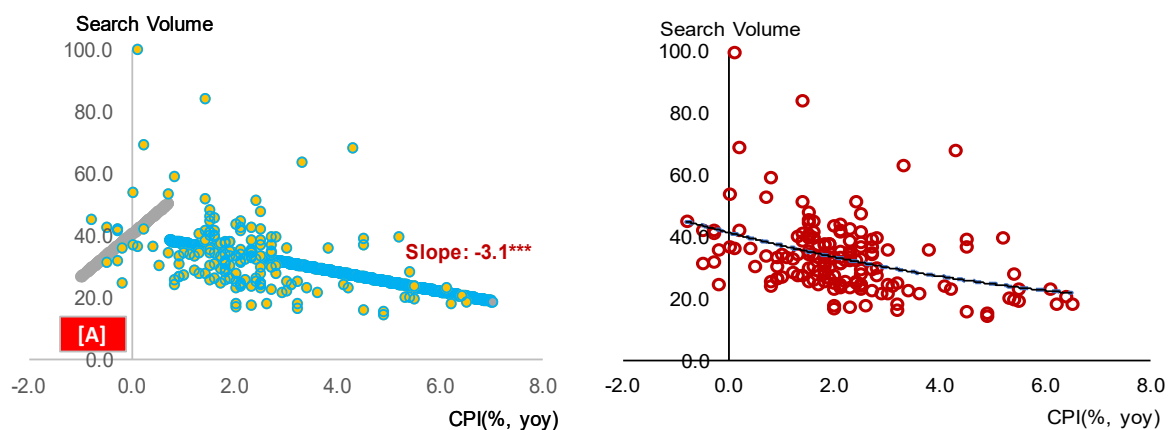
14. **A broader range of analyses could be conducted once data diversity be enhanced and the results of the estimation may vary depending on the selection of keywords.** Since Baidu search volume does not provide the breakdown between homeowners and non-owners, there is a limitation in that it is unclear whose search volume the search data belongs to. In the future, if the data can be divided separately into non-homeowners and homeowners or property firms and non-property firms, more useful analysis

of the real estate market will be possible. For example, when real estate prices fall, the increase in search volume is likely to be driven by those who do not own a home, which could be a sign that the real estate market has bottomed. Due to data limitations, it is currently not possible to make this interpretation, but what is important is that there exist price thresholds. Additionally, it is noted that using different keywords to measure real estate-related sentiment, other than the term 'real estate,' for keyword could result in different thresholds or estimates that are not statistically significant¹³.

IV. Testing the Spiral between Deflationary Sentiment and CPI

15. **Employing big data to estimate the threshold of price levels that amplify deflationary sentiment**¹⁴ in China, it was found that **no segment exacerbates deflationary sentiment as a result of price declines**. The relationship between price and deflationary sentiment appears to strengthen as prices fall, a natural outcome given that deflation signifies a persistent downward trend in prices (as depicted in the right side of Figure 9). Clearly, an inverse relationship between price and deflationary sentiment is observed above a certain threshold level. However, the important finding is that no statistically significant relationship is established below the threshold¹⁵ (as shown in the left side of Figure 9). This seems primarily due to the authorities' proactive responses to falling prices. Since last year, Chinese authorities have been more aggressively addressing the risk of economic slowdown through measures such as interest rate cuts and easing loan regulations. The recent lack of significant response or reduction in private deflationary sentiment to falling prices suggests (as seen in section A in left side of Figure 9) that deflation may not yet pose a major concern in China¹⁶.

Figure 9. Estimation Results for CPI Thresholds spike Deflationary Sentiment (Threshold) (Distribution)



Sources: AMRO staff estimations.

Note: The slope for grey line is not statically significant. ***, ** and * denote that null hypothesis is rejected at 1 percent, 5 percent, and 10 percent significant level respectively.

Sources: National Bureau of Statistics of China, Baidu, and AMRO staff calculations.

Note: Blue line describes polynomial trend from Excel.

¹³ Also, Szczygielski et al. (2024) pointed out that search trends in stock markets tend to reflect uncertainty rather than sentiment. In this respect, it may be necessary to be more careful about the meaning of search trends. Nevertheless, if search trends are interpreted as having a tendency to reflect uncertainty, the significance of this study still holds in terms of finding that uncertainty increases around a certain threshold.

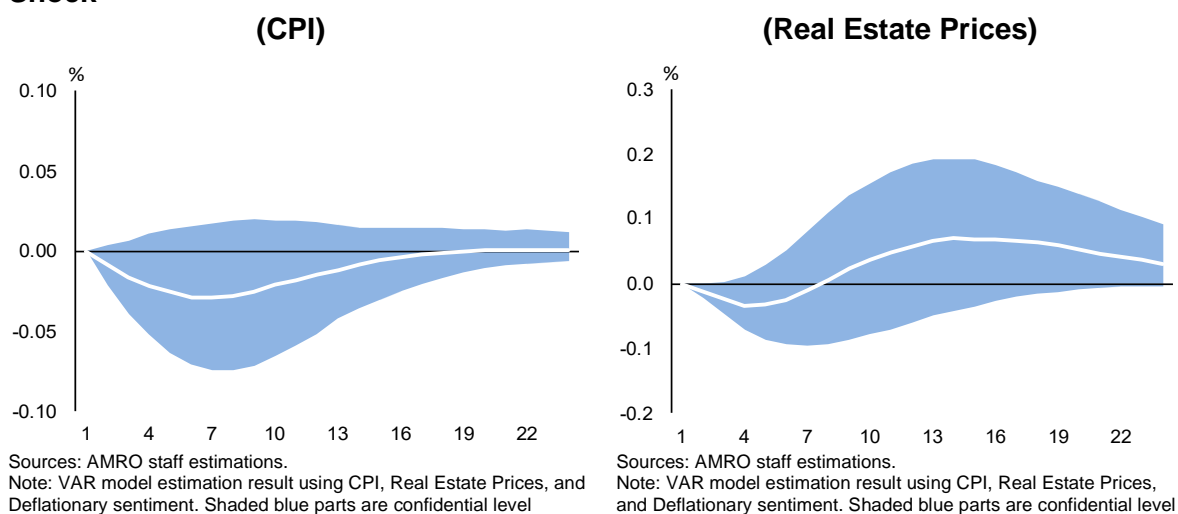
¹⁴ For constructing deflation-related internet search data, the keyword used is "通货紧缩" in Chinese. Utilizing different Chinese keywords that signify deflation as search terms could alter the estimation results.

¹⁵ The slope obtained using the "threshold equation" presented previously. Specifically, the search volume for "deflation" is used as a dependent variable, and CPI is used as an explanatory variable.

¹⁶ Section A primarily consists of the period around late 2020, and from 2023 through January 2024.

16. **The estimation of the impact of deflationary sentiment on price and real estate prices in China reveals that deflationary sentiment has not yet significantly influenced these variables.** This conclusion is supported by the estimated impulse response function of a VAR model composed of CPI, real estate prices, and deflationary sentiment (Figure 10). Despite recent declines in prices, CPI does not have a significant impact on deflationary sentiment as illustrated in previous section A. When combining this finding with the estimation results of the VAR model, it can be deduced that the interaction between price levels and deflationary sentiment has not yet triggered a deflationary spiral, resulting in actual deflation in China¹⁷.

Figure 10. Responses of CPI and Real Estate Prices from Deflationary Sentiment Shock



V. Conclusion

17. **The existence of price thresholds in the real estate market underscores the importance of minimizing price volatility within the real estate market to mitigate potential adverse macroeconomic repercussions.** This analytical note sheds light on the existence of upper and lower thresholds of real estate price changes that influence public sentiments. Within these thresholds, real estate sentiment remains relatively stable regardless of movements in real estate prices. Several implications arise from this observation.

- The relationship between real estate prices and search data volume exhibits a steeper slope below the lower threshold compared to above the upper threshold. This pattern holds consistently across China's 70 cities, Tier 1, Tier 2, and Tier 3 cities. It suggests that households and businesses may react more to declines in real estate prices than to increases. Consequently, in China, negative wealth effects during price declines could outweigh the positive wealth effects during price increases.
- Greenspan, former chairman of the U.S. Federal Reserve, defined price stability as the level at which people engage in economic activities without paying attention to

¹⁷ We expect to extend the study further by directly analysing the relationship between real estate sentiment and consumption in the future, and we leave this as a future research topic.

price changes¹⁸. This definition can be similarly applied to real estate prices, and section B in the case of 70 cities (Figure 5) is the corresponding area for the definition. The stable section between the upper and lower thresholds suggests **the importance of managing real estate price movements at a slightly positive (+) level, lower than the overall economic growth rate**. This is because if the rate of change in real estate prices is significantly higher than the economic growth rate, interest in real estate will increase significantly, and there could be problems of overinvestment and oversupply. Additionally, even in the case of a rapid adjustment in real estate prices, as noted in this note, negative perceptions of real estate can spread, hindering stable economic growth. The section can serve as a reference for policymakers aiming to stabilize the real estate market.

- The estimation result that thresholds vary by city size supports the need for customized real estate policies that match the real estate market conditions of each region or city. Therefore, **authorities should consider formulating policies to fit the circumstances of the region or city when introducing real estate policies, including macroprudential policies**.

18. **Against this backdrop, the array of measures implemented by Chinese authorities to stabilize the real estate market are commendably timely and strategic.** The continuation of a downward trend in real estate prices poses the risk of skewing market sentiment, potentially triggering a broader contraction in economic activities. It is crucial to emphasize that occasional breaches of a threshold, whether exceeding or falling below, do not drive shifts in sentiment. This underscores the fact that short-term fluctuations or transient events typically do not have a permanent impact on overall market sentiment or sectoral trends. What is of paramount importance is the sustained breach of this threshold over a substantial period of time, serving as a signal of structural shift in sentiment. Excessive fluctuations in asset prices can exacerbate macroeconomic uncertainties, driven by the irrational impulses of economic agents, and impede the efficient allocation of resources. In light of these factors, it is imperative for Chinese authorities to persevere in their efforts to stabilize the real estate market.

¹⁸ From his speech at Economic Policy Conference, October 2001.

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