Deciphering Housing Bubbles: Evidence from Two Housing Prices in Korea *

Sangyup Choi†
Yonsei University

Junghyuk Lee‡
Bank of Korea

January 2024

preliminary and incomplete

Abstract

The elusive nature of housing's fundamental value poses a challenge for detecting and quantifying housing bubbles. We aim to identify a speculative bubble in housing markets by leveraging the distinct institutional feature of the Korean housing system, called chonsei. Applying a sign restriction approach to housing transaction volume and two distinct housing price indices at the administrative district level, we dissect housing price movements from 2007M1 to 2023M11, attributing them to a supply factor, a residential demand factor, and a speculative demand factor driven by beliefs. Our analysis suggests that speculative demand accounts for almost a half of housing price fluctuations in our sample. Notably, the two major housing market booms—one preceding the global financial crisis and another following the COVID-19 outbreak—are predominately driven by speculative demand. Expansionary monetary policy leads to a significant increase in speculative demand without any material impact on residential demand. In contrast, the same size of monetary tightening cannot contain speculative demand, demonstrating strong asymmetry and significant policy implications.

Keywords: House Prices, Chonsei, Speculative demand, Bubble
JEL Classification Codes: E50; G10; R30; R21

*The views expressed are those of the authors and do not necessarily represent those of Bank of Korea or its policy. Chaewon Kim provided excellent research assistance. Any remaining errors are the authors' sole responsibility.

†School of Economics, Yonsei University, 50 Yonsei-ro, Seodaemun-gu, Seoul 03722, South Korea. sangyup-choi@yonsei.ac.kr

‡Office of Economic Modeling and Policy Analysis, Bank of Korea, 39, Namdaemun-ro, Jung-gu, Seoul 04531, South Korea. junghyuk.lee@bok.or.kr

1 Introduction

What drives housing prices, fundamentals or bubbles? Answering this long-lasting question remains challenging due to a unique feature of housing. Previous studies, including Ioannides and Rosenthal [1994], have highlighted the dual nature of housing as both a consumption good (akin to durable goods) and an investment good (similar to assets). This dual nature renders the pricing mechanisms of housing more intricate than those governed solely by standard supply and demand factors. In particular, many existing studies have emphasized the pivotal role of speculative demand, driven by expectations of future capital gains, in housing price cycles. For example, Case and Shiller [2003] have shown that economic fundamentals often failed to explain variations in housing prices. Exploiting survey data, they uncovered that a region characterized by an excessively optimistic outlook about future housing prices indeed experienced a surge in housing prices. However, disentangling speculative bubbles from housing price changes stemming from fundamentals (i.e., standard supply and residential demand factors) remains a challenging work.[1]

We employ a novel decomposition analysis to examine variations in Korean housing prices from 2007 to 2023, attributing them into supply, residential demand, and speculative demand factors. Our analysis leverages the distinct institutional characteristics of the Korean housing market, so-called the chonsei system.[2] Chonsei is a leasing arrangement wherein a tenant entrusts a deposit to the homeowner, foregoes rent during the contract period, and recovers the deposit at the contract's end. The unique nature of the chonsei system ensures that "unlike the sales price, the chonsei price inherently excludes the possibility of capital gains and reflects the value of housing services assessed by the spot housing market itself." (Cho [2006]). Thus, the ratio of housing sales price to Chonsei price largely reflects the degree of expectations of future housing prices.

[1]Debates persist regarding the predominant factor driving housing price fluctuations, with differing views on the significance of belief versus credit expansion. While Case and Shiller [2003] and Kaplan, Mitman, and Violante [2020] argued that consumers' expectations about future housing prices carry more weight, Mian and Sufi [2009] and Cox and Ludvigson [2021] contended that credit conditions, including bank lending standards, play a more crucial role. Greenwald and Guren [2021] added further complexity to this debate by suggesting that the relative importance of speculative demand and credit conditions is contingent upon market segmentation. However, given the nature of our data, we only focus on identifying belief-driven bubbles and do not separately identify credit-driven bubbles.

[2]Chonsei is not necessarily a unique housing system limited to Korea. The antichresis lease, which requires a lump sum tenant payment which is returned when the lease ends, has historically existed in some Civil law countries. However, Korea is the only country where the antichresis lease still remains a popular type of rental contract. See Navarro and Turnbull [2010] for further discussions on the antichresis lease.

We identify factors affecting housing price fluctuations in Korea by augmenting a distinct relationship between chonsei prices and sales prices into a simple supply-demand framework. Using a novel methodology proposed by Shapiro [2022], we first construct a Vector Autoregression (VAR) model at a disaggregated level (176 districts), incorporating variables such as housing sales transaction volume, housing sales price, and the housing-chonsei price ratio. Following the standard supply-demand model, changes in housing prices at the district-level are identified as demand-driven (supply-driven) if the signs of residuals in the sales price and transaction volume equations exhibit the same (opposite) signs, respectively. Moreover, among areas affected by demand shocks, those experiencing a change in the sales price surpassing the chonsei price are categorized as subjected to speculative demand shocks, whereas those with a change in the sales price lower than the chonsei price are assumed to be influenced by residential demand shocks. Finally, we decompose Korean housing price fluctuations by taking the weighted average of the rate of housing price changes attributable to each factor across districts using housing inventory as a weight.

Compared to the prior literature, this paper offers an advantage by relying on less stringent restrictions with an intuitive appeal. Unlike earlier studies employing short-run restrictions to identify structural shocks to the housing market, our methodology does not need to predetermine the order of variables. Additionally, in alignment with observations by Jump and Kohler [2022] and Shapiro [2022], this paper imposes even weaker assumptions than a typical sign restriction approach as in Uhlig [2005], as there is no need to introduce an additional assumption regarding the selection of impact responses from the identified set of shocks.

The main findings of this study are outlined as follows. First, over the period from January 2007 to November 2023, a speculative demand factor emerges as an important driver of housing price changes in Korea. Specifically, the cumulative housing price changes are attributed to supply (39.0%), residential demand (17.2%), and speculative demand (43.8%) factors, respectively. The share of speculative demand factor even increases to 50% when we limit our analysis to the Seoul-metropolitan area. Second, each factor exhibits an anticipated response to various shocks, such as monetary policy shocks, consistent with expectations established in prior research.

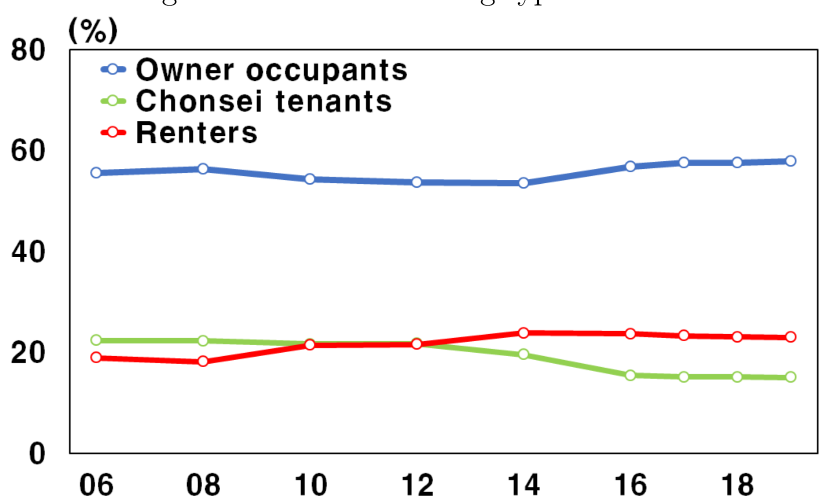
The remainder of the paper is organized as follows. In Section 2, we briefly explain the chonsei system and derive the equilibrium relationship between chonsei prices and sales prices. Section 3 outlines our methodology for decomposing house price changes into those driven by supply, residential demand, and speculative demand factors. The results of this decomposition exercise are presented in Section IV. In Section V, we examine whether the responses of these factors to various shocks are consistent with the theoretical prediction. Section VI concludes.

2 Chonsei System in Korea

2.1 Institutional Background of Chonsei System

Chonsei system is a distinct feature of the Korean housing market. In a chonsei contract, a tenant provides a lump-sum deposit, typically ranging from 50% to 80% of the house's sales price, to the homeowner. During the contract period often spanning two years, the tenant is exempted from paying rent to the homeowner. At the end of the contract, the homeowner must return the deposit to the tenant. Failure to repay the deposit leads to the auction of the house, with the proceeds repaying the tenant. In other words, under chonsei contracts, the homeowner's obligation to pay the interest rate and the tenant's obligation to pay rent are mutually offset. The chonsei system is highly prevalent in the Korean housing rental market. Figure 1 illustrates the housing occupation type distribution from 2006 to 2019. Throughout this period, the share of the chonsei contract is stable around $15-20\%$, similar to that of monthly rent, representing a substantial presence in the housing market.

Figure 1: Share of housing type in Korea



Note: Share of households who are owner-occupants, Chonsei tenants, and renters by year. The share of renters includes mixed rental contracts (reduced monthly rent with lump sum deposit). The data source is the Korean Housing Survey.

Voluminous studies argue that the prevalence of the chonsei system in Korea can be attributed to the underdeveloped financial market during the economic growth era. In the 1960s, Korean financial authorities imposed low-interest rates on corporate loans, while simultaneously applying high-interest rates on consumer and housing-related loans. Moreover, in terms of housing supply policies, the authorities prioritized the construction of new buildings, which is often a time-consuming process, over the expansion of rental housing, exacerbating the housing supply issue. Faced with such circumstances, the chonsei system emerged as an appealing alternative for addressing challenges in the housing market: homeowners have an opportunity to borrow at a lower interest rate than the market rate, while tenants also incur lower costs compared to purchasing an own house (e.g., Son [1997]; Ambrose and Kim [2003]; Cho [2006]; Kim [2013]; Jing, Park, and Zhang [2022]).

2.2 Identifying Speculative Bubbles from Chonsei Prices

In this section, we illustrate how chonsei prices serve as proxy of the intrinsic value of houses by building upon the earlier conceptual explanation of a chonsei contract under the efficient market hypothesis. Following the previous literature, such as Cho [2006], we assume that the housing rental market works efficiently. When a tenant leases a house in Korea, they face two alternatives: (ii) providing a chonsei deposit, denoted as C_t, at the start of period t and receiving a refund at the end of the contract, or (ii) paying a (monthly) rent, denoted as R_{t+1}, at the end of the period t. We further assume a constant interest rate denoted as i. With no-arbitrage condition, (1) is established between the chonsei deposit and the rent:

$$C_t = \frac{R_{t+1}}{i} \tag{1}$$

Under the housing market efficiency, (2) must hold between the housing sales price and the rent:

$$P_t = \frac{R_{t+1} + E_t P_{t+1}}{1+i} \tag{2}$$

The sales price in the period t is the present value of the sum of the housing rental yield (R_{t+1}) and the expected future sales price ($E_t P_{t+1}$). Following Jing, Park, and Zhang [2022], we further assume that the housing rent grows at a constant rate π due to macroeconomic factors, such as inflation or technological changes. If people expect that future house price will grow at the same rate (therefore no speculative bubble),[3] the sales price can be expressed as the present value of the sum of future rents (3):

$$P_t = \frac{R_{t+1}}{r}, \qquad r = i - \pi \tag{3}$$

Lastly, we define the intrinsic value of the house as V_t. The following relationship between V_t and C_t holds:

$$V_t = \kappa C_t, \qquad \kappa = \frac{i}{i - \pi} \tag{4}$$

Consequently, in this model without a speculative bubble, the intrinsic value of the house and the chonsei deposits can be articulated in a proportional relationship. Therefore, in the efficient housing market, changes in chonsei prices serves as a proxy for changes in the intrinsic value of the house.

Now, we extend the model to encompass the presence of housing bubble, leading to a disparity between the intrinsic value of the house and its sales price. If there exists an expectation of significant changes in the future sales price beyond the constant growth rate of rent π, a gap B_t may arise between the sales price and the intrinsic value:

$$P_t = V_t B_t \tag{5}$$

As per (5), the growth rate in the sales price is determined by the sum of the growth rate in the intrinsic value and the growth rate in the bubble. Moreover, as in (4), the growth rate in the bubble term can be expressed as (6), using a proportional relationship between the intrinsic value of house and the chonsei price:

$$\frac{\dot{B}_t}{B_t} = \frac{\dot{P}_t}{P_t} - \frac{\dot{V}_t}{V_t} = \frac{\dot{P}_t}{P_t} - \frac{\dot{C}_t}{C_t} \tag{6}$$

Lastly, (7) can be obtained by differentiating the ratio between the sales price and the chonsei price with respect to time and employing the relationship (6):

$$\frac{d(P_t/C_t)}{dt} = \frac{P_t}{C_t}(\frac{\dot{P}_t}{P_t} - \frac{\dot{C}_t}{C_t}) = \frac{P_t}{C_t}(\frac{\dot{P}_t}{P_t} - \frac{\dot{V}_t}{V_t}) = \frac{P_t}{C_t}(\frac{\dot{B}_t}{B_t}) \tag{7}$$

(7) implies the following observations, suggesting the crucial role of the sales to chonsei price ratio in deciphering a housing bubble. If individuals expect a surge in capital gains from future housing price appreciation, the rate of increase in housing

[3] This implies $lim_{n\to\infty} \frac{E_t P_{t+n}}{(1+i)^n} = 0$.

prices surpasses the rate of increase in the intrinsic value of the house, leading to an elevation of the sales price-chonsei price ratio. Conversely, if there is an expectation of diminishing capital gains from future housing price fluctuations, the rate of decrease in housing prices exceeds the rate of decrease in the intrinsic value of the house, leading to a decline in the sales price-chonsei price ratio.

3 Empirical Methodology

3.1 Definition of Shocks

In the conventional supply-demand framework, the housing market within a region i can be represented by a upward sloping housing supply curve (8) and a downward sloping housing demand curve (9. The identification of (standard) supply and demand shocks closely follows the approach developed by Shapiro [2022].[4]

$$q_i = \sigma^i p_i + \alpha^i \tag{8}$$

$$p_i = -\delta^i q_i + \beta^i, \tag{9}$$

where q_i represents quantity (or transaction volume of house), p_i represents sales price of house in region i, $\sigma^i(> 0)$ is the slope of the housing supply curve, $\delta^i(> 0)$ is the slope of the housing demand curve, and α^i and β^i are the intercepts. Commonly, supply shock ($\epsilon^s_{i,t}$) is delineated as a shift of supply curve, denoted by the shift of α^i in (10). Similarly, a demand shock ($\epsilon^d_{i,t}$) is illustrated as a shift of the demand curve, expressed as the shift of β^i in (11).

$$\epsilon^S_{i,t} = \Delta\alpha^i = (q_{i,t} - \sigma^i p_{i,t}) - (q_{i,t-1} - \sigma^i p_{i,t-1}) \tag{10}$$

$$\epsilon^d_i, t = \Delta\beta^i = (p_{i,t} + \sigma^i q_{i,t}) - (p_{i,t-1} + \sigma^i q_{i,t-1}) \tag{11}$$

As explained in the previous section, however, this simple supply-demand framework is not adequate in analyzing the housing market due to a bubble. We further exploit the chonsei price to identify structural shocks in the housing market. We define c_i as the chonsei price in region i and r_i as the ratio between the sales and chonsei prices for the region. Following the discussion in Section 2, (12) is introduced

[4] The housing market we consider is not limited to new housing. Homeowners are willing to sell their houses if they believe that current house price exceeds its intrinsic value. In this case, it is optimal to sell the house and move to rental housing, especially in the form of chonsei contract with the proceeds of house sales. Thus, the supply of housing is not fully inelastic even in the short run.

to articulate the connection between the chonsei price—acting as a proxy for the intrinsic value of the house——and the sales price.

$$r_i = \gamma^i, \quad r_i = \frac{p_i}{c_i} \tag{12}$$

Lastly, we further identify demand shocks into "residential demand" and "speculative demand" shocks by defining these shocks as follows:

$$\text{Residential demand shock: } \text{sign}(\epsilon^d_{i,t}) \neq \text{sign}(\epsilon^r_{i,t}), \quad \epsilon^r_{i,t} = \Delta\gamma^i = \gamma_{i,t} - \gamma_{i,t-1} \tag{13}$$

$$\text{Speculative demand shock: } \text{sign}(\epsilon^d_{i,t}) = \text{sign}(\epsilon^r_{i,t}), \quad \epsilon^r_{i,t} = \Delta\gamma^i = \gamma_{i,t} - \gamma_{i,t-1} \tag{14}$$

(13) and (14) indicate that demand shocks are identified as speculative demand shocks if the fluctuation following the demand shock in the sales price exceeds that of the intrinsic value of the house. In contrast, if the fluctuation in the sales price is smaller than the fluctuations in intrinsic value, the demand shocks are interpreted as a residential demand shocks. Though simple, this identifying assumption has an intuitive appeal and captures the distinctive feature of the Korean housing market well. For example, we do not differentiate the supply curve for housing sales and chonsei markets, which substantially simplifies our identifying restrictions. The choice of our modelling assumption is justified by the fact that markets for housing sales and chonsei contracts are not segmented.

Under this identifying assumption, suppose a positive speculative demand shock leads to an increase in both housing price and the ratio of sales to chonsei price. As discussed in Section 2, this circumstance indicates that the rate of increase in the sales price surpasses the rate of increase in the intrinsic value of the house due to the expectation of future price appreciation beyond the fundamental. This feature is compatible with the notion of speculative bubble in many theoretical models.[5]

[5] Before delving further, it is important to rationalize our identifying assumption. First, an alternative approach to distinguish between residential and speculative demand shocks involves comparing the sizes of their shocks using a structural model. However, this requires additional assumptions regarding model parameters. Second, another alternative method considers classifying residential demand shock when the difference between sales price and chonsei price fluctuations is sufficiently small, and speculative demand shock when the difference exceeds some threshold. However, choosing such a threshold is highly arbitrary and therefore can affect the quantitative importance of each shock.

3.2 Identification of Shocks

In sum, (8) through (14) can be translated and estimated through the following structural VAR model:

$$A^i z_{i,t} = \Sigma_{j=1}^{N} A_j^i z_{i,t-j} + \epsilon_{i,t}, \tag{15}$$

where $z_{i,t} = \begin{bmatrix} q_{i,t} & p_{i,t} & r_{i,t} \end{bmatrix}'$ represents a vector comprising the following three variables, house transaction volume, houing sales price, and sales-chonsei price ratio, in region i period t and $A^i = \begin{bmatrix} 1 & -\sigma^i & 0 \\ \delta^i & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}'$ represents a coefficient matrix based in (8), (9), and (12), and $\epsilon_{i,t} = \begin{bmatrix} \epsilon_{i,t}^s & \epsilon_{i,t}^d & \epsilon_{i,t}^r \end{bmatrix}'$ represents a set of housing supply shocks, housing demand shocks, and shocks causing changes in the sales-chonsei price ratio. Lastly, a structural VAR in (15) can be rewritten as the following reduced-form VAR (16):

$$Z_{i,t} = (A^i)^{-1} \Sigma_{j=1}^{N} A_j^i Z_{i,t-j} + \epsilon_{i,t} \tag{16}$$

In (16), the reduced-form error term $v_{i,t} = \begin{bmatrix} v_{i,t}^s & v_{i,t}^d & v_{i,t}^r \end{bmatrix}'$ can be expressed as $\epsilon_{i,t} = A^i v_{i,t}$. By examining the sign of $v_{i,t}$, it is possible to determine whether the shock is a supply shock, a residential demand shock, or a speculative demand shock. First, as shown in and Jump and Kohler [2022] and Shapiro [2022], the sign of $\epsilon_{i,t}^s$ and $\epsilon_{i,t}^d$ can be inferred using the sign of $v_{i,t}$ as illustrated in (17) through (20):

$$\text{Positive (+) supply shock: } v_{i,t}^p < 0,\ v_{i,t}^q > 0 \ \rightarrow\ \epsilon_{i,t}^s > 0 \tag{17}$$

$$\text{Negative (-) supply shock: } v_{i,t}^p > 0,\ v_{i,t}^q < 0 \ \rightarrow\ \epsilon_{i,t}^s < 0 \tag{18}$$

$$\text{Positive (+) demand shock: } v_{i,t}^p > 0,\ v_{i,t}^q > 0 \ \rightarrow\ \epsilon_{i,t}^d > 0 \tag{19}$$

$$\text{Negative (-) demand shock: } v_{i,t}^p < 0,\ v_{i,t}^q < 0 \ \rightarrow\ \epsilon_{i,t}^d < 0 \tag{20}$$

Moreover, by exploiting the correspondence between the sign of $v_{i,t}^r$ and $\epsilon_{i,t}^r$, it is possible to distinguish between residential demand shocks and speculative demand shocks as defined in Section 3. Specifically, this identification is achieved by (21) through (24):

$$\text{Positive (+) residential demand shock: } v^p_{i,t} > 0,\ v^q_{i,t} > 0,\ v^r_{i,t} < 0 \tag{21}$$

$$\text{Negative (-) residential demand shock: } v^p_{i,t} < 0,\ v^q_{i,t} < 0,\ v^r_{i,t} > 0 \tag{22}$$

$$\text{Positive (+) speculative demand shock: } v^p_{i,t} > 0,\ v^q_{i,t} > 0,\ v^r_{i,t} > 0 \tag{23}$$

$$\text{Negative (-) speculative demand shock: } v^p_{i,t} < 0,\ v^q_{i,t} < 0,\ v^r_{i,t} < 0 \tag{24}$$

Our methodology presents notable advantages over the methodologies to identify housing market shocks in the existing literature. First, compared to commonly-used short-run restrictions, which assume unidirectional effects between variables in the system within a given period, sign restrictions impose weaker and rather intuitive assumptions based on a simple supply-demand framework (see, for example, Uhlig [2005]). Second, as highlighted in Shapiro [2022], our methodology imposes even weaker assumptions than a standard sign restriction approach used in the existing literature. Since a standard approach typically focuses on deducing the impact response from the identified model, it only achieves set identification. In other words, any identified set can be compatible with multiple models. Thus, determining which impulse response functions to use within the identified set requires additional information, which compromises the flexibility and simplicity of sign restrictions (Fry and Pagan [2011]). In contrast, our methodology does not require any additional assumption, as it focuses solely on the sign of residuals derived from constraints above rather than any specific impact responses.

4 Decomposing Housing Price Dynamics

4.1 Data and Estimation

We use data on housing sales prices, transaction volumes, and the sales-chonsei price ratio from 176 districts, spanning from January 2006 to November 2023.[6] The

[6] The analysis primarily covers the period from January 2006 for most regions, considering that housing transaction volume data typically commences from that date. However, due to administrative district reorganization, certain regions joined the analysis at later stages. Among total 226 districts in Korea, 176 districts provide consistently-available data for the three main variables. Appendix A provides details on the districts included in

housing sales price index is taken from the "National Housing Price Trend Survey" by the Korea Real Estate Board, while regional transaction volume data is downloaded from the "Real Estate Transaction Situation" report by the same agency. For the housing sales-chonsei price ratio, it is computed by dividing the housing sales price index by the housing chonsei price index for each district, which is the smallest administrative unit within the areas presented in the "National Housing Price Trend Survey." We make seasonal adjustments to these data using X-13 ARIMA-SEATS.

The following trivariate VAR model is estimated for each district (25):

$$y_{i,t} = \alpha + \Sigma_{j=1}^{N} \Phi_j^i y_{i,t-j} + v_{i,t}, \quad y_{i,t} = [q_{i,t} \ p_{i,t} \ r_{i,t}]', \tag{25}$$

where $q_{i,t}$ is the log transactions volumes, $p_{i,t}$ is the log housing sales index, and $r_{i,t}$ denotes the sales-chonsei price ratio in region i, period t. Following the approach outlined by Shapiro [2022], we adopt a benchmark specification including 12 lags to account for persistent movements in the data driven by low-frequency factors, such as demographic and technological changes.

After the estimation of the VAR model at the district level, three housing market structural shocks are identified by examining the signs of the estimated residuals, as discussed in Section 3. Specifically, using the signs of estimated $v_{i,t}$ in (25), housing price fluctuations in the district i during period t are labeled as (26) to (31):

$$I_{i \in sup(+),t} = \begin{cases} 1 & if \quad \hat{v}_{i,t}^p < 0, \ \hat{v}_{i,t}^q > 0 \\ 0 & otherwise \end{cases} \tag{26}$$

$$I_{i \in sup(-),t} = \begin{cases} 1 & if \quad \hat{v}_{i,t}^p > 0, \ \hat{v}_{i,t}^q < 0 \\ 0 & otherwise \end{cases} \tag{27}$$

$$I_{i \in dem_{Res}(+),t} = \begin{cases} 1 & if \quad \hat{v}_{i,t}^p > 0, \ \hat{v}_{i,t}^q > 0, \ \hat{v}_{i,t}^r < 0 \\ 0 & otherwise \end{cases} \tag{28}$$

$$I_{i \in dem_{Res}(-),t} = \begin{cases} 1 & if \quad \hat{v}_{i,t}^p < 0, \ \hat{v}_{i,t}^q < 0, \ \hat{v}_{i,t}^r > 0 \\ 0 & otherwise \end{cases} \tag{29}$$

this study, specifying the start and end points of data for each region, along with their average weights computed over the sample period.

$$I_{i \in dem_{Spc}(+),t} = \begin{cases} 1 & if \quad \hat{v}^p_{i,t} > 0,\ \hat{v}^q_{i,t} > 0,\ \hat{v}^r_{i,t} > 0 \\ 0 & \quad otherwise \end{cases} \tag{30}$$

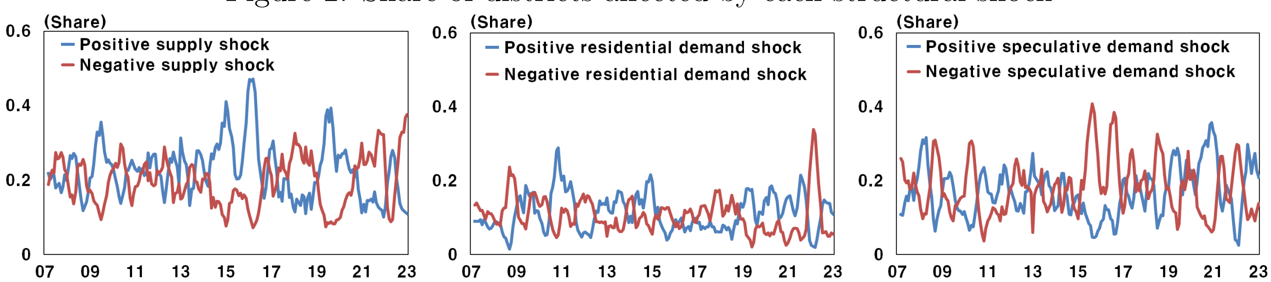
$$I_{i \in dem_{Spc}(-),t} = \begin{cases} 1 & if \quad \hat{v}^p_{i,t} < 0,\ \hat{v}^q_{i,t} < 0,\ \hat{v}^r_{i,t} < 0 \\ 0 & \quad otherwise \end{cases} \tag{31}$$

Once identifying which types of structural shocks drive housing price fluctuations in district i during period t, we calculate the share of total districts experiencing each type of shocks in period t as in Shapiro [2022]:

$$\theta_{s,t} = \Sigma_i I_{i \in s,t} w_{i,t}, \tag{32}$$

where $s \in \{sup(+), sup(-), dem_{Res}(+), dem_{Res}(-), dem_{Spc}(+), dem_{Spc}(-)\}$ and $w_{i,t}$ is the weight of district i in calculating house sales price index.[7] For example, $\theta_{sup(+),t} = 1$ indicates that all districts were affected a by positive supply shock in period t, while and $\theta_{dem_{Spc}(+),t} = 0.5$ denotes that 50% of the districts were affected by a positive speculative demand shock. Figure 2 plots the fluctuations in these shares over the sample period. As expected, positive shocks and negative shocks are negatively correlated for each of structural shocks.

Figure 2: Share of districts affected by each structural shock



Note: The share of housing sales price changes at the district level driven by supply, residential demand, and speculative demand shocks, respectively. The centered five-month moving average is used to smooth out the series. All series above sum to one for any given month.

[7] Because the national housing price trend survey does not contain information on such weights at the district level, we use the ratio of housing inventory in each district to the total housing inventory as a weight. Since the housing inventory data are provided only annually, monthly weights were derived by linearly interpolating the annual housing inventory data to a monthly scale.

4.2 Decomposition Results

In this section, based on the categorization of housing sales price changes established in Section 4.1, we decompose housing price dynamics at the national level into supply, residential demand, and speculative demand factors. Given the labels from (26) to (31), variations in housing prices in district i during period t are now categorized into three indicator functions as in (33) through (35):

$$I_{i \in sup,t} = \begin{cases} 1 \quad if \quad I_{i \in sup(+),t} = 1 \ or \ I_{i \in sup(-),t} = 1 \\ 0 \quad \quad \quad \quad otherwise \end{cases} \tag{33}$$

$$I_{i \in dem_{Res},t} = \begin{cases} 1 \quad if \quad I_{i \in dem_{Res}(+),t} = 1 \ or \ I_{i \in dem_{Res}(-),t} = 1 \\ 0 \quad \quad \quad \quad otherwise \end{cases} \tag{34}$$

$$I_{i \in dem_{Spc},t} = \begin{cases} 1 \quad if \quad I_{i \in dem_{Spc}(+),t} = 1 \ or \ I_{i \in dem_{Spc}(-),t} = 1 \\ 0 \quad \quad \quad \quad otherwise \end{cases} \tag{35}$$

Lastly, (36) shows how national housing sales price dynamics are divided into three distinct components, the supply-driven, residential demand-driven, and speculative demand-driven contribution:

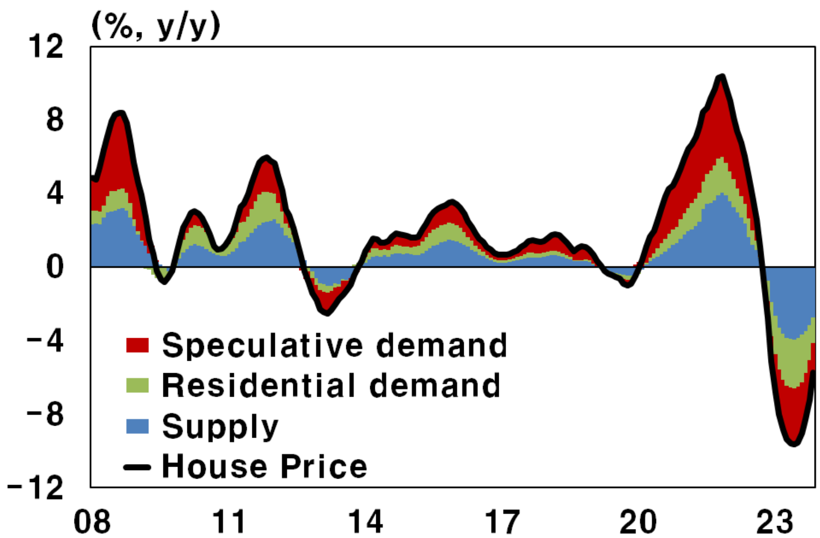
$$\pi_t = \Sigma_{i=1}^{N} I_{i \in sup,t} w_{i,t} \pi_{i,t} + \Sigma_{i=1}^{N} I_{i \in dem_{Res},t} w_{i,t} \pi_{i,t} + \Sigma_{i=1}^{N} I_{i \in dem_{Spc},t} w_{i,t} \pi_{i,t}, \tag{36}$$

where π_t is growth rate of national housing sales price, $\pi_{i,t}$ is growth rate of housing sales growth in district i, and $w_{i,t}$ is the corresponding weight of district i in period t. For subsequent discussions, factors driving variations in national housing prices are denoted as a "supply factor," a "residential demand factor," and a "speculative demand factor," respectively.

It is possible that the sum of the three factors may deviate from the genuine housing price dynamics. This discrepancy can be attributed to variations in district-level weight, reorganization of administrative districts, and seasonal adjustments applied per district. Figure A.1 in the appendix illustrates the actual growth rate of the housing sales price index, seasonally adjusted using X-13-ARIMA-SEATS, alongside the sum of three structural factors. Given the remarkably high correlation of 0.999 between the two series, any discrepancy appears negligible.

Figure 3 presents the key finding of the paper, the decomposition of year-over-year housing price changes from January 2007 to November 2023 into three structural factors.[8] The black line signifies the national housing price changes, while the blue area represents the supply factor, and the green and red areas represent the residential demand and speculative demand factor, respectively. National year-over-year housing price changes and contributions to year-over-year house price changes are calculated as the running sum of the current and past 11 monthly data: $\pi_{t,t-12} = \Sigma_{k=0}^{11} \pi_{t-k,t-k-1}$, $\pi_{t,t-12}^{i} = \Sigma_{k=0}^{11} \pi_{t-k,t-k-1}^{i}$ $(i = sup,\, dem_{Res},\, dem_{Spc})$

Figure 3: Supply, residential demand, and speculative demand-driven housing price growth (year-over-year)



Note: Black solid line is the year-over-year growth rate of housing prices in Korea. The series are divided into supply (blue), residential demand (green), and speculative demand (red) factors.

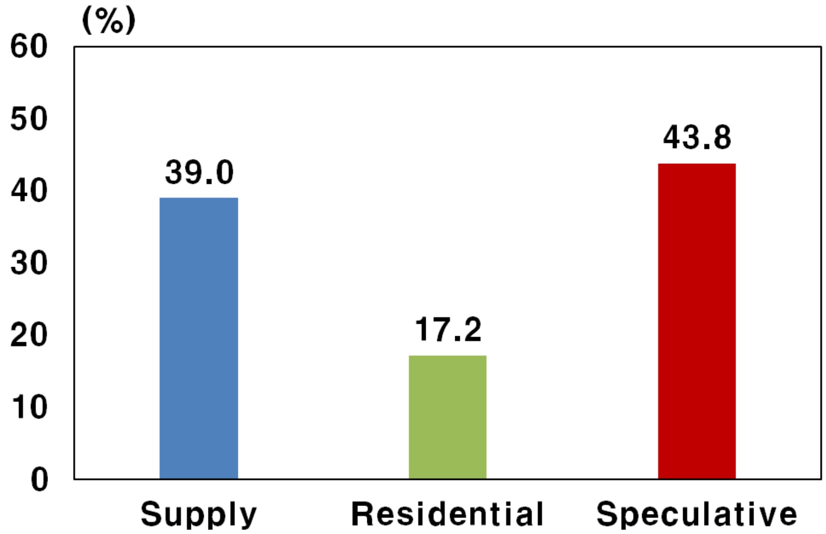
The identified factors exhibit the following characteristics. First, during the period under study, speculative demand factors have played an important role in housing price fluctuations, constituting 43.8% of the changes from 2007 to 2023. In contrast, a supply factor and a residential demand factor accounted for 39.0% and 17.2%, respectively (see Figure 4).[9] These findings align with the literature highlighting the crucial role of speculative demand in Korean housing price dynamics (e.g., Lee, Ann, and Park [2022]).

Second, three housing market factors display strong co-movements, with the highest correlation observed between supply and residential demand factors (0.79). Other pairs, such as supply and speculative demand (0.76) and residential demand and

[8]Figure A.2 in the appendix includes the results of decomposing the month-over-month rate of change into three structural factors.

[9]The contribution of each factor to house price fluctuations is computed by dividing the cumulative growth rate of each factor by the cumulative growth rate of national housing prices.

Figure 4: Average contribution of each factor to Korean housing price dynamics



Note: The contribution of each factor to house price fluctuations is computed by dividing the cumulative growth of each factor by the cumulative growth of actual housing prices.

speculative demand (0.71), also exhibit strong correlations. This suggests a strong bidirectional influence between housing transaction volume and prices, and therefore highlights a potential bias caused by the identification via standard short-run restrictions.

Third, through cross-correlation analysis, we find that residential demand and speculative demand factors lead the supply factor by one month, while indicating a contemporaneous co-movement between the two demand factors. Lastly, Figures A.3 and A.4 in the appendix show the contribution of each factors in explaining housing price dynamics for the Seoul metropolitan area. The evolution of housing price dynamics in this area driven by three structural factors is similar to the national trend. If anything, the role of a speculative demand factor is even more important than the national level.

5 Eternal Validity of Identified Shocks

In this section, we provide an external validity test of our identified shocks by checking whether the responses of three identified factors obtained in Section 4 to various structural shocks is consistent with the theoretical prediction or previous empirical findings. The first candidate is a monetary policy shock with its well-known effects on housing prices (Iacoviello [2005]; Fischer, Huber, Pfarrhofer, and Staufer-

Steinnocher [2021]; Ehrenbergerova, Bajzik, and Havranek [2023]). To this end, we employ the local projection method by Jordà [2005]. Additionally, we explore the potential asymmetry in the impact response by examining the reactions to positive and negative shocks using flexibility embedded in this method.

5.1 Local Projections

We briefly explain the local projection method and provide rationale for its utilization in our study. The local projection method is a technique for estimating the impulse response function like the VAR model with a few notable differences. While the VAR model computes the impact response up to the h period by iteratively multiplying the estimated model, the local projection method computes the impulse response by estimating h regression equations directly.

Compared to the VAR model, the local projection method offers several advantages. First, it demonstrates greater robustness against model setting errors. Jordà [2005] illustrated that when estimating the impact response using the VAR model, if the data generation process deviating from the VAR model, the model setting error amplifies through repeated multiplication, leading to an inaccurate estimation of the impact response. In contrast, the local projection method calculates the impact response by separately estimating the regression equation up to the previous period, minimizing concerns about amplifying model setting errors. Given the uncertainty about the data generation process for housing demand and supply in this paper, a robust local projection method is employed to mitigate potential errors.

Second, unlike typical VAR models, the local projection method conveniently allows for estimating asymmetry in impulse response functions. Given the potential asymmetry in the impact of monetary policy shocks on housing prices, the local projection method appears more suitable for our analysis compared to the VAR model.[10]

5.2 Monetary Policy Shocks and Housing Price Factors

Now we analyze the responses of each identified factor to exogenous monetary policy shocks. Initially, the impulse response (β_j^h) is computed by regressing each of the housing price supply factor (π_{t+h}^{sup}), residential demand factor ($\pi_{t+h}^{dem_{Res}}$), and

[10] Although VAR models equipped to handle asymmetry, such as Markov-switching VAR and Threshold VAR also exist, local projections maintain the advantage of being simpler to calculate and more intuitively interpretable (Albrizio, Choi, Furceri, and Yoon [2020]).

speculative demand factor ($\pi_{t+h}^{dem_{Spc}}$) preceding h period, on the structural monetary policy shock (ϵ_t) identified from a VAR model and control variables, as illustrated in (37) and (38):

$$\pi_{t+h}^{j} = \alpha_j^h + \beta_j^h \epsilon_t + \theta_j^h(L) Z_{t-1} + e_t \tag{37}$$

$$IRF_{t+h} = \frac{\partial \pi_{t+h}^{j}}{\partial \epsilon_t}, \tag{38}$$

where π_{t+h}^{j} represents cumulative growth in the factors of $j \in \{sup, dem_{Res}, dem_{Spc}\}$ between $t-1$ to $t-h$, ϵ_t represents the structural monetary policy shock in period t, and Z_{t-1} represents control variables. The monetary policy shock is identified from structural residuals in the four-variable VAR, including WTI crude oil prices, CPI, GDP, and the call rate.[11] All variables, except for call rate, are converted to month-over-month growth rate to ensure stationarity.

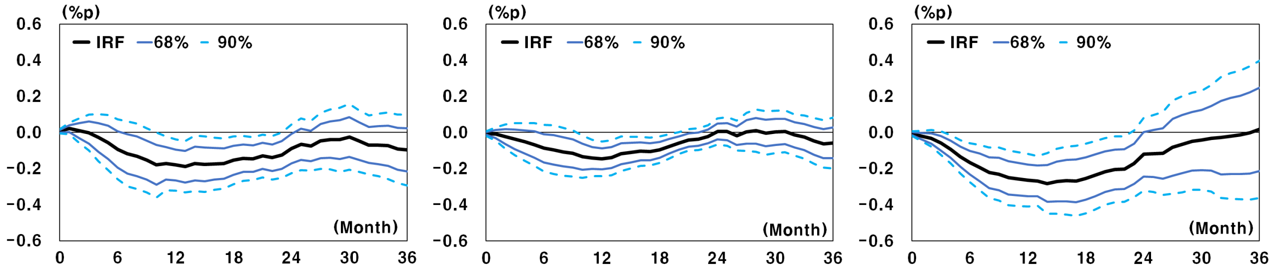
As shown in Figure 5, three identified factors respond to the monetary policy shock in a qualitatively similar manner, which is not surprising given the high correlation among the factors. As expected, monetary policy tightening reduces the supply of housing as well as both residential and speculative demand. Interestingly, however, the response of speculative demand is larger in magnitude and more statistically significant. For example, a 100bp increase in the policy rate reduces housing price growth driven by the speculative demand factor immediately. After a year, such a decline reaches about 0.3% and continues to be statistically significant up to a two-year horizon.

In contrast, the same shock does not induce any significant decline in housing price growth driven by the residential demand factor in the short run and the peak effect is only a half of the effect on speculative demand. In sum, the finding that speculative demand responds most swiftly and strongly to monetary policy shocks demonstrates successful identification of a component in housing price changes that is attributable to a speculative bubble.

Considering potential asymmetry in the effect of monetary policy, we examine the asymmetric responses of the identified factors using (39) and (40):

[11] Monthly GDP is obtained by interpolating quarterly GDP to a monthly frequency using industrial production. Structural shocks are obtained using the above Cholesky ordering, which is standard for identifying monetary policy shocks in a small open economy context as in Korea. The number of lags for the VAR model is set to three following the Akaike information criterion.

Figure 5: Effects of monetary policy shocks on three housing market factors



Note: This figure shows the cumulative impulse responses of the supply, residential demand, and speculative demand factor to the externally identified monetary policy shock. The solid blue line indicates the 68% confidence interval, while the light blue dotted line represents the 90% confidence interval. The estimation sample is from January 2007 to November 2023.

$$\pi^j_{t+h} = \alpha^h_j + \beta^{h,+}_j max[0, \epsilon_t] + \beta^{h,-}_j min[0, \epsilon_t] + \theta^h_j(L)Z_{t-1} + e_t \tag{39}$$

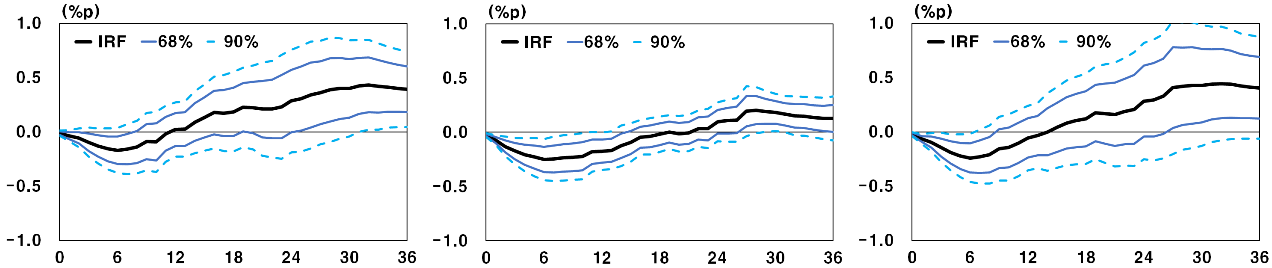
$$IRF_{t+h} = \frac{\partial \pi^j_{t+h}}{\partial \epsilon_t} = \begin{cases} \beta^{h,+}_j & if \quad \epsilon_t > 0 \\ \beta^{h,-}_j & if \quad \epsilon_t < 0 \end{cases} \tag{40}$$

Figure 6 presents the responses of each factor to a contractionary shock (top panel) and an expansionary shock (bottom panel). An interesting asymmetry emerges, as the same size of monetary easing is followed by a larger response of the identified factors than monetary tightening. This finding is consistent with the observations in the previous literature (e.g., Drechsler, Savov, and Schnabl [2022], Koeniger, Lennartz, and Ramelet [2022]) possibly due to some downward rigidity in housing prices. Such an asymmetry is most pronounced for the speculative demand factor.

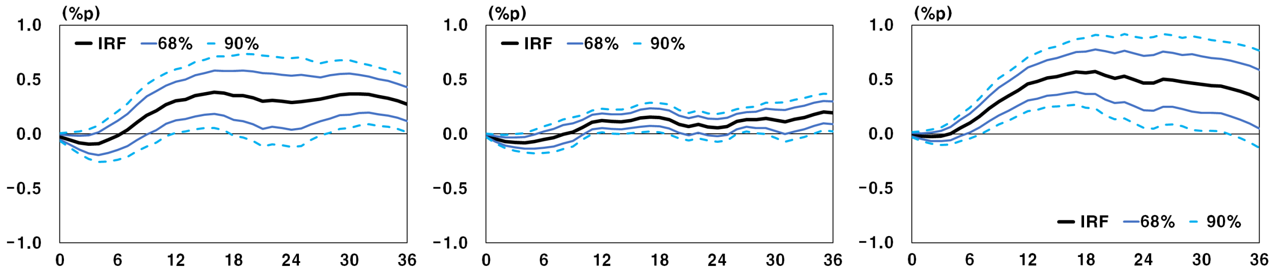
As shown in the bottom panel, monetary easing stimulates speculative demand significantly. An exogenous 100bp decrease in the policy rate drives up the housing price growth driven by the speculative demand factor by about 0.5% and this effect is very persistent (remains statistically significant over 30 months). In contrast, the same size of monetary tightening is not followed by any meaningful decline in speculative demand. Our findings bear important policy implications. While monetary easing can significantly stimulate speculative demand, it is much more difficult to contain it by tightening the monetary policy. This poses a great challenge in managing financial instability stemming from a housing bubble by solely relying on monetary policy.

Figure 6: Asymmetric effects of monetary policy shocks on three housing market factors

A) Monetary policy tightening



B) Monetary policy easing



Note: This figure shows the cumulative impulse responses of the supply, residential demand, and speculative demand factor to the externally identified monetary policy shock. The solid blue line indicates the 68% confidence interval, while the light blue dotted line represents the 90% confidence interval. The estimation sample is from January 2007 to November 2023.

6 Conclusion

This paper examines the decomposition of housing prices in Korea into supply, residential demand, and speculative demand factors based on sign restrictions, utilizing data of district-level housing sales prices, transaction volumes, and sales-chonsei price ratios. The analysis, spanning from January 2007 to November 2023, reveals that speculative demand factors play a predominant role in housing price fluctuations. Furthermore, the shock response of each factor to monetary policy aligns with findings from previous studies.

Monitoring the housing market and understanding the factors influencing current housing price fluctuations are crucial for policymakers and researchers. This study addresses these important issues, providing insights that can assist in finding answers. Additionally, distinguishing the impact of policy measures, such as monetary policy, on residential and speculative demand is challenging but essential. The findings presented in this paper contribute valuable information to research on these topics.

References

Albrizio, S., S. Choi, D. Furceri, and C. Yoon (2020): "International bank lending channel of monetary policy," *Journal of International Money and Finance*, 102, 102124.

Ambrose, B. W., and S. Kim (2003): "Modeling the Korean Chonsei lease contract," *Real Estate Economics*, 31(1), 53–74.

Case, K. E., and R. J. Shiller (2003): "Is there a bubble in the housing market?," *Brookings Papers on Economic Activity*, 2003(2), 299–362.

Cho, D. (2006): "Interest rate, inflation, and housing price: With an emphasis on Chonsei price in Korea," in *Monetary Policy with Very Low Inflation in the Pacific Rim*, pp. 341–370. University of Chicago Press.

Cox, J., and S. C. Ludvigson (2021): "Drivers of the great housing boom-bust: Credit conditions, beliefs, or both?," *Real Estate Economics*, 49(3), 843–875.

Drechsler, I., A. Savov, and P. Schnabl (2022): "How monetary policy shaped the housing boom," *Journal of Financial Economics*, 144(3), 992–1021.

Ehrenbergerova, D., J. Bajzik, and T. Havranek (2023): "When does monetary policy sway house prices? A meta-analysis," *IMF Economic Review*, 71(2), 538–573.

Fischer, M. M., F. Huber, M. Pfarrhofer, and P. Staufer-Steinnocher (2021): "The dynamic impact of monetary policy on regional housing prices in the United States," *Real Estate Economics*, 49(4), 1039–1068.

Fry, R., and A. Pagan (2011): "Sign restrictions in structural vector autoregressions: A critical review," *Journal of Economic Literature*, 49(4), 938–960.

Greenwald, D. L., and A. Guren (2021): "Do credit conditions move house prices?," Discussion paper, National Bureau of Economic Research.

Iacoviello, M. (2005): "House prices, borrowing constraints, and monetary policy in the business cycle," *American economic review*, 95(3), 739–764.

Ioannides, Y. M., and S. S. Rosenthal (1994): "Estimating the consumption and investment demands for housing and their effect on housing tenure status," *Review of Economics and Statistics*, pp. 127–141.

Jing, B., S. Park, and A. L. Zhang (2022): "The Credit Channel of Monetary Policy Transmission: Evidence From the Chonsei System," *Available at SSRN 4019774*.

Jordà, Ò. (2005): "Estimation and inference of impulse responses by local projections," *American Economic Review*, 95(1), 161–182.

Jump, R. C., and K. Kohler (2022): "A history of aggregate demand and supply shocks for the United Kingdom, 1900 to 2016," *Explorations in Economic History*, 85, 101448.

Kaplan, G., K. Mitman, and G. L. Violante (2020): "The housing boom and bust: Model meets evidence," *Journal of Political Economy*, 128(9), 3285–3345.

Kim, J. (2013): "Financial repression and housing investment: An analysis of the Korean chonsei," *Journal of Housing Economics*, 22(4), 338–358.

Koeniger, W., B. Lennartz, and M.-A. Ramelet (2022): "On the transmission of monetary policy to the housing market," *European Economic Review*, 145, 104107.

Lee, J., J. Ann, and C. Park (2022): "What causes house prices to fluctuate? Evidence from South Korea," *Asian Economic Journal*, 36(4), 365–384.

Mian, A., and A. Sufi (2009): "The consequences of mortgage credit expansion: Evidence from the US mortgage default crisis," *Quarterly Journal of Economics*, 124(4), 1449–1496.

Navarro, I., and G. K. Turnbull (2010): "Antichresis leases: Theory and empirical evidence from the Bolivian experience," *Regional Science and Urban Economics*, 40(1), 33–44.

Shapiro, A. H. (2022): "Decomposing supply and demand driven inflation," *Federal Reserve Bank of San Francisco Working Paper*.

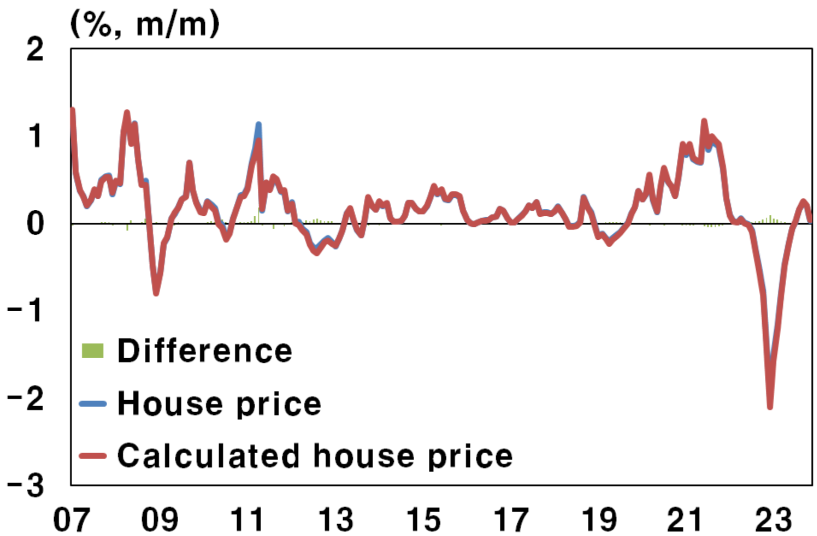
Son, J.-y. (1997): "A review of the Korean housing market and related policies," *Review of Urban & Regional Development Studies*, 9(1), 80–99.

Uhlig, H. (2005): "What are the effects of monetary policy on output? Results from an agnostic identification procedure," *Journal of Monetary Economics*, 52(2), 381–419.

Appendix

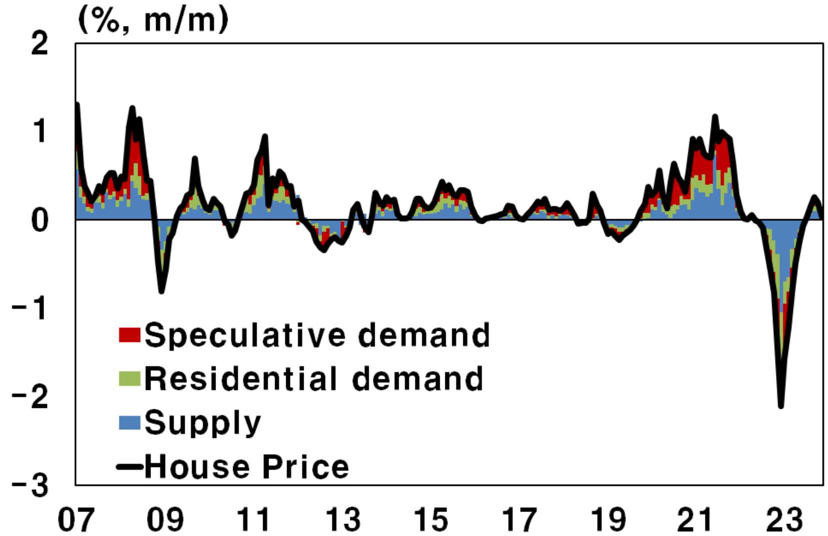
A Additional figures and tables

Figure A.1: Actual vs. computed housing price growth



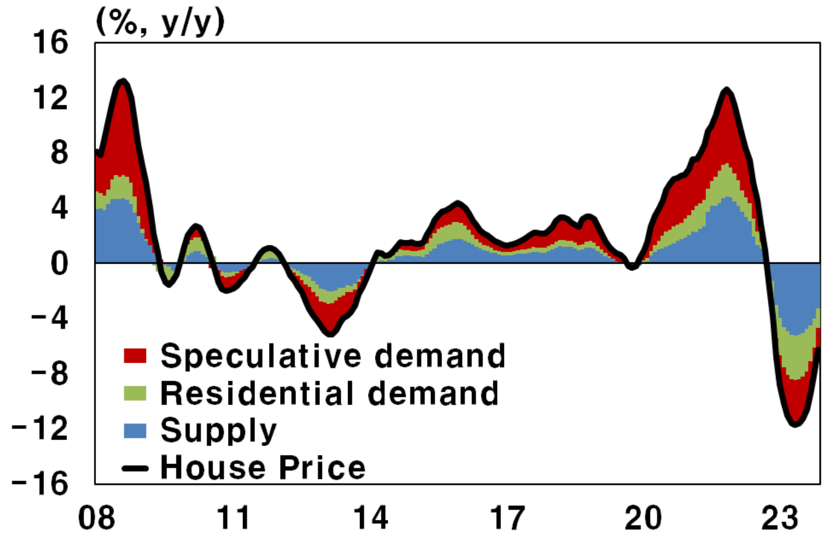
Note: House price refers to the month-over-month growth rate of the seasonally-adjusted national housing sales price obtained from the National Housing Price Trend Survey. Calculated house price is the sum of the supply, residential demand, and speculative demand factors.

Figure A.2: Supply, residential demand, and speculative demand-driven housing price growth (month-over-month)



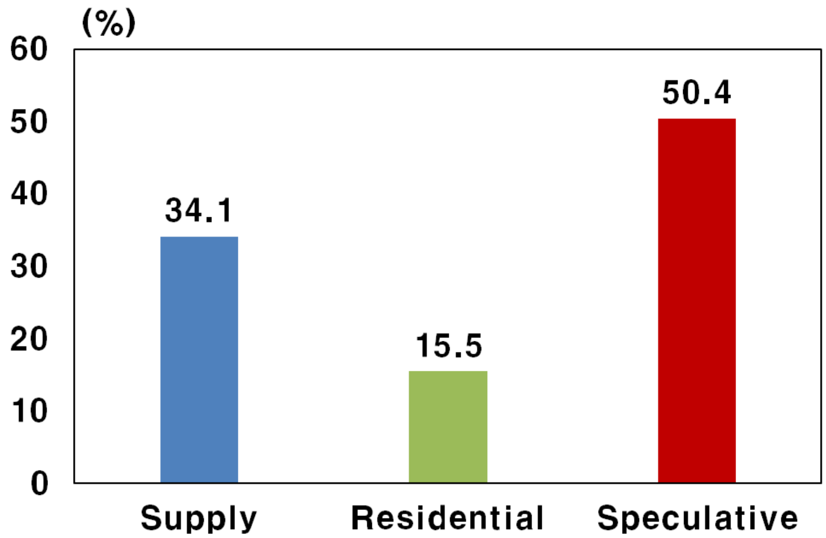
Note: Black solid line is the month-over-month growth rate of housing prices in Korea. The series are divided into supply (blue), residential demand (green), and speculative demand (red) factors.

Figure A.3: Supply, residential demand, and speculative demand-driven housing price growth (Seoul metropolitan area)



Note: Black solid line is the month-over-month growth rate of housing prices in Korea. The series are divided into supply (blue), residential demand (green), and speculative demand (red) factors.

Figure A.4: Average contribution of each factor to Korean housing price dynamics (Seoul metropolitan area)



Note: The contribution of each factor to house price fluctuations is computed by dividing the cumulative growth of each factor by the cumulative growth of actual housing prices.