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Monetary Policy and House Prices at Risk: Evidence from China

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This paper studies the effects of the M2 money supply shock on the downside risks to house prices in China, using local projections and smooth local projections. We rely on measures of house prices at risk and downside entropy to capture the downside risks to house prices. Our results show that M2 monetary stimulus positively impacts house prices and can help mitigate downside risks to house prices. We investigate the monetary transmission mechanism through investment and find that the monetary stimulus shock boosts investment and benefits house prices. Our results suggest that monetary policy is an effective tool for managing downside risks to house prices in China.

Key Words: China; Monetary policy; House prices at risk; Downside risks; Local projections.
JEL Classification Numbers: R30, E52.

1. INTRODUCTION

The housing market plays a significant role in China's economy and is a key driver of China's business cycles (Ge et al., 2022). The rapid growth of China's GDP over the past two decades has been strongly linked to China's property boom. The recent slowdown in China's housing sector, therefore, poses a major threat to China's overall economy. How should policymakers manage the downside risks to house prices? Monetary policy is one of the most widely used tools to achieve this goal. For example, the Federal Reserve implemented a set of monetary policies to combat the 2007-2010 subprime mortgage crisis in the U.S.

In this paper, we study the transmission of monetary policy to the downside risks to house prices in China. We use the concept of house prices at risk and downside entropy to capture the downside risks to house prices in China. Deghi et al. (2020) develop the house-prices-at-risk (HaR) measure to capture the downside risks to house prices in 32 advanced and emerging

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market economies. Similar to the widely used growth-at-risk framework (Adrian et al., 2019), a 5% HaR describes the 5% probability of a large house price decline over a given time horizon. Downside entropy measures the divergence between the unconditional and the conditional densities, with a high value indicating that the conditional density assigns positive probability to more extreme left tail growth outcomes than the unconditional density, which implies a higher downside risk.

The usual procedure for analysing the impact of monetary policy on house prices has been the structural vector autoregressions (SVARs) (Del Negro and Otrok, 2007; Jarocinski et al. 2008; Bjørnland and Jacobsen, 2010; Robstad, 2018; Nocera and Roma, 2018). In this paper, we instead estimate the impulse responses of house prices to monetary policy shocks using local projections (Jordà, 2005). Compared to VARs, local projections are more robust to model misspecification (Ramey, 2016), however, Plagborg-Møller and Wolf (2021) also show that local projections and VARs in fact estimate the same impulse responses in population. In particular, we rely on the recently developed method of smooth local projections (Barnichon and Brownlees, 2019), which is more efficient than the standard local projections.

One of the difficulties in studying monetary effects is the identification of exogenous monetary policy shocks. This is particularly challenging for studies of China's monetary policy because the Chinese central bank does not have a single instrument to implement its monetary policy. China's monetary policy is still quantity-based, focusing on the growth of the M2 money supply. Therefore, this paper relies on the identified M2 monetary stimulus shocks from Chen et al. (2023), which are shown to be exogenous to other non-monetary shocks, such as fiscal policy shocks.

We find that the M2 monetary stimulus has a positive effect on house prices and helps to reduce downside risks to house prices. Following an M2 monetary stimulus shock, house prices increase, the lower 5th percentile of house prices increases, and downside entropy decreases, all of which suggest a reduction in downside risks. We further examine the underlying transmission mechanism through monetary effects on investment and find that monetary stimulus shocks boost investment in real estate development, non-real estate industries, and total fixed assets, thereby boosting house prices and reducing house prices at risk. Our findings provide policy implications, that is, monetary policy is an effective tool to manage downside risks to house prices in China.

The literature on the effects of monetary policy on house prices is rich. Koeniger et al. (2022) examine the heterogeneous transmission of monetary policy to the housing market for three European countries: Germany, Italy and Switzerland. Fischer et al. (2021) study the impact of monetary policy on regional housing prices in the United States. Aastveit and Anundsen

(2022) study the asymmetric effects of monetary policy in the US regional housing markets. Bjørnland and Jacobsen (2010) investigate the role of house prices in the monetary policy transmission mechanism in Norway, Sweden and the UK using structural VARs. Wadud et al. (2012) examines the monetary policy transmission effects in the Australian housing market.

However, these studies have focused on housing markets in developed countries. In terms of the monetary effects on Chinese house prices, Xu and Chen (2012) show that expansionary monetary policy tends to accelerate subsequent house price growth, while contractionary monetary policy tends to slow subsequent house price growth. Su et al. (2019) documents that the money supply has a positive effect on house prices. Huang et al. (2021) finds that monetary policy and hot money shocks significantly affect national house price growth. Yin et al. (2020) show that the M2 money supply has a positive effect on house prices and that the money supply is more effective than the interest rate channel in controlling house prices in China. Zhang (2013) illustrates the important role of monetary policy in containing the housing bubble and macroeconomic tail risks in China.

While the above literature only examines the impact of monetary policy on average house prices, this paper focuses on the monetary transmission of downside risks to house prices in China. In this respect, this paper contributes to the limited literature on house prices at risk. Deghi et al. (2020) show that house prices at risk can predict future downside risks to economic growth and financial crises. Alter and Mahoney (2021) find an important spatial dependence in housing risks, with overvaluation in nearby cities increasing the downside risks to house prices in a given city. Mian and Sufi (2016) show that shocks to household wealth from the collapse of house prices were an important determinant of consumption growth during the Great Recession, thus greatly impacting business cycles.

This paper is also related to the literature studying the monetary policy transmission in China. Chen et al. (2017) propose a Qual VAR framework to study the impact of monetary policy in China. Das and Song (2023) study the monetary policy transmission in China while considering coordination between monetary and fiscal policies. Han et al. (2023) study the impact of quantity-based monetary policy on corporate investment and financing. This paper relies on the identified exogenous M2 monetary stimulus shocks of Chen et al. (2023) to study the monetary transmission to house prices using local projections.

The paper is organized as follows. Section 2 describes measures of downside risks. Section 3 investigates the effects of monetary policy on house prices, downside risks to house prices, and investment. Section 4 concludes this paper.

2. MEASURES OF DOWNSIDE RISKS TO HOUSE PRICES

We adopt two measures to capture downside risks to house prices. First, it's the house prices at risk, defined as the fifth percentile of the estimated future house price distribution. The more negative the value is, the greater the downside risk is. We use quantile regressions (Koenker and Bassett Jr, 1978) to estimate the conditional housing price distributions over one-quarter ahead. The estimated lower 5th percentile of house prices is then labeled as house prices at risk (Har).

Let y_{t+h} be the average growth rate of house prices between $t+1$ and $t+h$, and x_t be a set of conditioning variables, then the estimation of quantile regression of y_{t+h} on x_t is given by

$$\hat{\beta}_\tau = \underset{\beta_\tau \in R^k}{argmin} \sum_{t=1}^{T-h} (\tau.\mathbf{1}_{(y_{t+h} \geq x_t\beta)}|y_{t+h} - x_t\beta_\tau| + (1-\tau).\mathbf{1}_{(y_{t+h} < x_t\beta)}|y_{t+h} - x_t\beta_\tau|), \tag{1}$$

where $\mathbf{1}_{(.)}$ denotes the indicator function and $\tau \in (0,1)$ represents the τth quantile. The predicted value from the quantile regression is the quantile of y_{t+h} on x_t,

$$\hat{Q}_{y_{t+h}|x_t}(\tau|x_t) = x_t\hat{\beta}_\tau. \tag{2}$$

The conditional variables in our case include the current quarter of house prices, GDP growth, and the financial stress index (FSI). House prices are the growth rate of real residential property prices collected by the Bank for International Settlements. GDP growth data are collected from the China Stock Market and Accounting Research (CSMAR) database. The financial stress index is collected from the Asian Development Bank. All samples are quarterly data from the second quarter of 2005 to the second quarter of 2022.

The second measure is the downside entropy, which compares the probability assigned to left tail outcomes by the unconditional density with the probability assigned to the same outcomes by the conditional density. A high value of downside entropy means that the conditional density assigns a positive probability to left tail outcomes than the unconditional density. Following Adrian et al. (2019), the downside entropy L_t^D of unconditional density $\hat{g}_{y_{t+h}}(y)$ relative to conditional density $\hat{f}_{y_{t+h}|x_t}(y|x_t)$ can be expressed as

$$\begin{aligned} L_t^D(\hat{f}_{y_{t+h}|x_t}; \hat{g}_{y_{t+h}}) \ = \ & -\int_{-\infty}^{\hat{F}^{-1}_{y_{t+h}|x_t}(0.5|x_t)} \Big(\log \hat{g}_{y_{t+h}}(y) - \log \hat{f}_{y_{t+h}|x_t}(y|x_t)\Big) \\ & \times \hat{f}_{y_{t+h}|x_t}(y|x_t)dy, \end{aligned} \tag{3}$$

where $\hat{f}_{y_{t+h}|x_t}(y|x_t) = f(y; \hat{\mu}_{t+h}, \hat{\sigma}_{t+h}, \hat{\alpha}_{t+h}, \hat{v}_{t+h})$ is the fitted skewed t-distribution of these quantile regression estimates according to Azzalini and Capitanio (2003). $\hat{F}_{y_{t+h}|x_t}(y|x_t)$ is the cumulative distribution associated with $\hat{f}_{y_{t+h}|x_t}(y|x_t)$ and $\hat{F}^{-1}_{y_{t+h}|x_t}(0.5|x_t)$ is the conditional median. The unconditional density $\hat{g}_{y_{t+h}}(y)$ is computed by matching the unconditional empirical distribution of house prices where only the constant term is included in the quantile regression.

FIG. 1. Measures of downside risks to house prices: house prices at risk and downside entropy

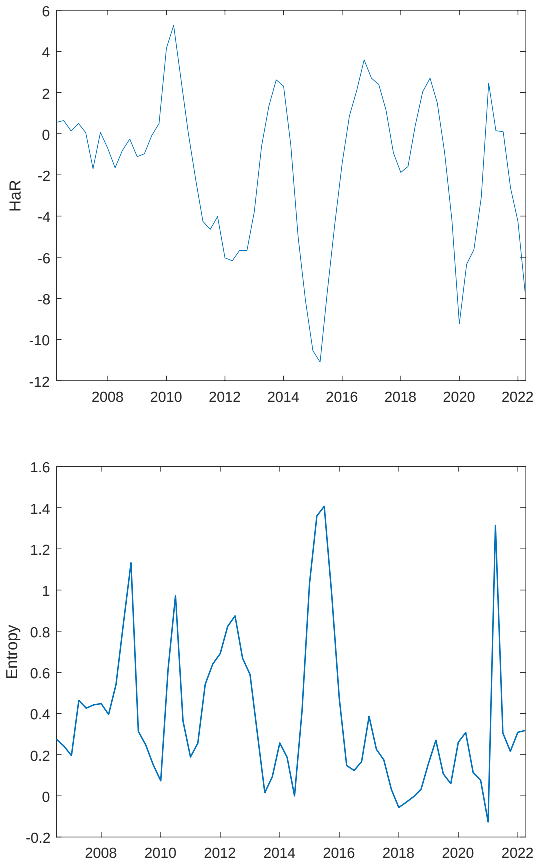


Figure 1 presents the time series of these two measures from 2006Q2 to 2022Q1. The top panel shows the estimated house prices at risk (HaR), and there are two major periods with large downside risks to house prices in China. The first is during 2015, and the estimated HaR is −11%. The second is the COVID outbreak period in 2020, where the estimated HaR reaches −9%. The bottom panel shows the estimates of downside entropy; in addition to the two downside periods identified by HaR, downside entropy also suggests high downside risks in late 2008, 2010 and 2012.

3. MANAGING DOWNSIDE RISK WITH MONETARY POLICY

One of the most widely used tools to manage downside risk during economic downturns is monetary stimulus. For example, during the 2007-2010 subprime mortgage crisis in the US, the Federal Reserve implemented a number of conventional and unconventional monetary policies to combat the crisis, including lowering the federal funds rate to near zero. However, unlike monetary policy in the United States, the People's Bank of China (PBC) does not target an interest rate; instead, China's monetary policy has been quantity-based, focusing on the growth of M2 money supply.

Therefore, in this section, we first use the quarterly growth of M2 money supply related measures to identify China's exogenous monetary policy shocks. We then investigate the effects of China's monetary policy on the average house prices and the downside risks to house prices. Finally, we explore the underlying mechanism of these monetary policy effects on house prices.

3.1. Impulse responses to money supply shocks

To determine the effect of monetary policy, we rely on local projections (LP) and smooth local projections (SLP) to estimate the impulse response functions. Compared to the standard local projections (LP) of Jordà (2005), the estimators of the smooth local projections are more efficient.

Consider y_t as the endogenous response variable of interest, x_t be the exogenous shock variable, and z_{it} be a set of control variables. A standard local projection method to estimate the h-step-ahead impulse response function of y_{t+h} with respect to a change in x_t can be set as:

$$y_{t+h} = \alpha_{(h)} + \beta_{(h)} x_t + \sum_{i=1}^{p} \gamma_{i(h)} z_{it} + \epsilon_{(h)t+h}, \tag{4}$$

where $\epsilon_{(h)t+h}$ is a prediction error term with $Var(\epsilon_{(h)t+h}) = \sigma_h^2$.

Smooth local projection approach further approximate each coefficient $\alpha_{(h)}, \beta_{(h)}, \gamma_{i(h)}$, with linear B-splines basis functions B_k for $k = 1, ..., K$ in the forecast horizon h, that is,

$$y_{t+h} \approx \sum_{k=1}^{K} a_k B_k(h) + \sum_{k=1}^{K} b_k B_k(h) x_t + \sum_{i=1}^{p}\sum_{k=1}^{K} c_{ik} B_k(h) z_{it} + \epsilon_{(h)t+h}. \quad (5)$$

We can define the impulse response of y_t to a structural shock η_t as,

$$IR(h,\delta) = E(y_{t+h}|\eta_t = \delta) - E(y_{t+h}|\eta_t = 0). \quad (6)$$

The key to estimating the impulse response is the identification of structural shocks. Here, we rely on the identified M2 monetary stimulus shocks in China by Chen et al. (2023), constructed based on a regime-switching period of the monetary policy rule (chen et al., 2018). The monetary policy equation is specified as

$$g_{m,t} = \gamma_0 + \gamma_m g_{m,t-1} + \gamma_\pi(\pi_{t-1} - \pi^*) + \gamma_{y,t}(g_{y,t-1} - g^*_{y,t-1}) + \sigma_{m,t}\xi_{m,t}, \quad (7)$$

where $\xi_{m,t}$ is a serially independent random shock with the standard normal distribution, $g_{m,t} = \Delta logM_t$ is quarterly growth of M2 denoted by M_t, $\pi_t = \Delta logP_t$ is quarterly inflation measured by the consumer price index (CPI) P_t, π^* is the average inflation rate targeted by the government, $g_{y,t} = \Delta logy_t$ is quarterly growth of real GDP denoted by y_t, and $g^*_{y,t} = \Delta logy^*_t$ is targeted GDP quarterly growth. The time-varying coefficients take the form

$$\gamma_{y,t} = \begin{cases} \gamma_{y,a} & if \quad g_{y,t-1} - g^*_{y,t-1} \geq 0 \\ \gamma_{y,b} & if \quad g_{y,t-1} - g^*_{y,t-1} < 0 \end{cases}, \sigma_{m,t} = \begin{cases} \sigma_{m,a} & if \quad g_{y,t-1} - g^*_{y,t-1} \geq 0 \\ \sigma_{m,b} & if \quad g_{y,t-1} - g^*_{y,t-1} < 0 \end{cases}. \quad (8)$$

The subscript "a" stands for "above the target" and "b" for "below the target." As reported in Chen et al. (2018), the estimated coefficients $\gamma_m = 0.391$, $\gamma_\pi = -0.397$,$\gamma_{y,a} = 0.183$,$\gamma_{y,b} = -1.299$, $\sigma_{m,a} = 0.005$, and $\sigma_{m,b} = 0.010$, are all statistically significant at the 0.01 level. The targeted inflation $\pi^* = 0.875\%$.

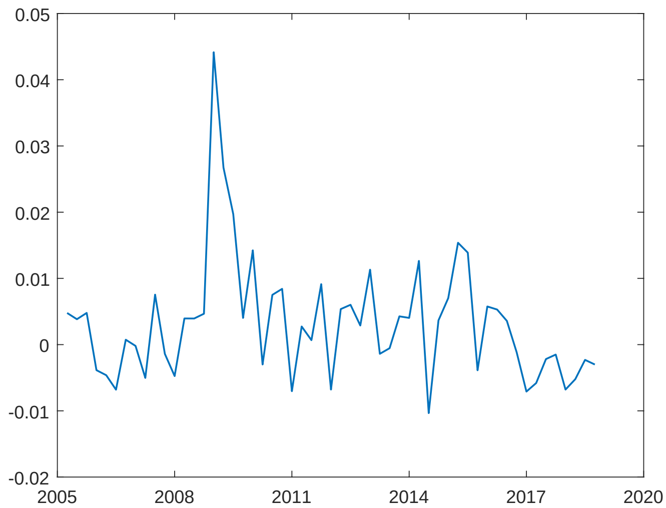
One can then construct a measure of total exogenous monetary policy changes, which consists of three components,

$$\epsilon_{m,t} = \epsilon^{Norm}_{m,t} + \epsilon^{Extra}_{m,t} + \epsilon^{PolCh}_{m,t}, \quad (9)$$

where $\epsilon^{Norm}_{m,t} = \sigma_{m,a}\xi_{m,t}$, $\epsilon^{Extra}_{m,t} = (\sigma_{m,t} - \sigma_{m,a})\xi_{m,t}$, and $\epsilon^{PolCh}_{m,t} = (\gamma_{y,t} - \gamma_{y,a})(g_{y,t-1} - g^*_{y,t-1})$. Chen et al. (2023) show these constructed monetary policy shocks are exogenous to non-monetary shocks that drive infrastructure investment.

Figure 2 presents the time series of these identified exogenous monetary policy shocks from 2005Q2 to 2018Q4. The monetary policy shocks were extremely large in 2009, which corresponds to the period of the four trillion RMB stimulus package implemented by the Chinese government, and the growth rate of the M2 money supply increased by more than 25%.

FIG. 2. Time series of China's exogenous M2 monetary policy shocks

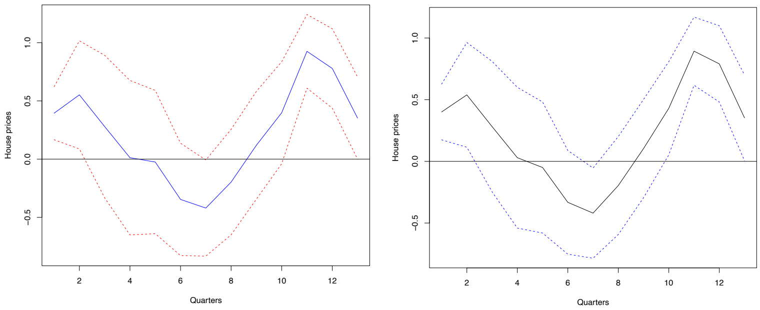


3.2. Results

Figure 3 shows the response of house prices to monetary stimulus shocks. The estimation is set up with 3 lags and shocks hit in period 1 with 12 impulse horizons. Control variables include the growth rate of GDP growth, the growth rate of CPI inflation, and lags of house prices, GDP growth, CPI inflation, and M2 money supply. The data on CPI inflation and M2 money supply are both obtained from CSMAR. All impulse response plots in this paper display the median as well as the 90% confidence interval, with confidence intervals constructed by using the Newey-West estimator to address the issue of serial correlation. The left column shows the result of local projections, and the right column shows the result of smooth local projections. These two results are similar, with the confidence band of LP being wider than that of SLP.

Following a one standard deviation shock to M2 money supply, average house prices increase by around 0.4 % on impact, i.e. we find that the M2 monetary stimulus has a positive impact on house prices. A plausible explanation is that, in response to the monetary stimulus shock, abundant

FIG. 3. Impulse responses of house prices to monetary stimulus shocks: LP (Left column) and SLP (Right column).



liquidity enters the real estate sector, induces increased speculation in the housing market, and drives up house prices.

Next, we examine the effect of monetary policy on the downside risks to house prices. Since we find that monetary stimulus elevates average house prices, will it also help to ease the downside risks to house prices? Figure 4 shows the impulse responses of house prices at risk to monetary stimulus shocks estimated with smooth local projections. The responses broadly follow the response pattern of average house prices, specifically, the lower 5th percentile of future house prices increase in response to the monetary stimulus shock, implying that house prices at risk are declining. Figure 5 shows the impulse responses of downside entropy to monetary stimulus shocks, the response pattern is opposite to the response of house prices at risk, an increase in HaR corresponds to a decrease in downside entropy. In response to a one standard deviation M2 monetary stimulus shock, the value of downside entropy decreases by 0.02 on impact, suggesting a reduction in downside risks to house prices. Overall, both results suggest that M2 monetary stimulus can help to reduce downside risks to house prices.

3.3. Transmission mechanism

What's the mechanism behind the positive effects of monetary stimulus on house prices and their downside risks? One possible channel is through its effect on investment. In this section, we explore the transmission mechanism by examining the effects of the M2 monetary stimulus on total fixed investment, real estate development investment and non-real estate investment. Total fixed asset investment is the sum of real estate development investment and non-real estate industry investment. All three variables are collected from China Stock Market and Accounting Research (CSMAR).

Figure 6 shows the impulse responses of real estate development investment, non-real estate development investment, and fixed assets investment to China's M2 money supply stimulus shocks estimated with local projec-

FIG. 4. Impulse responses of house prices at risk to monetary stimulus shocks

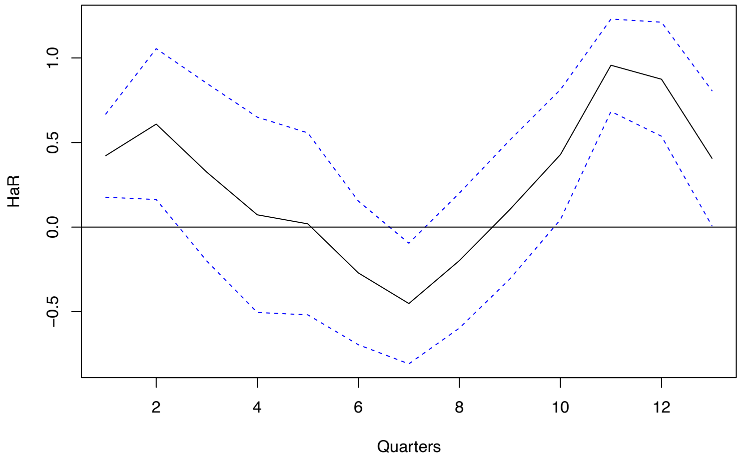
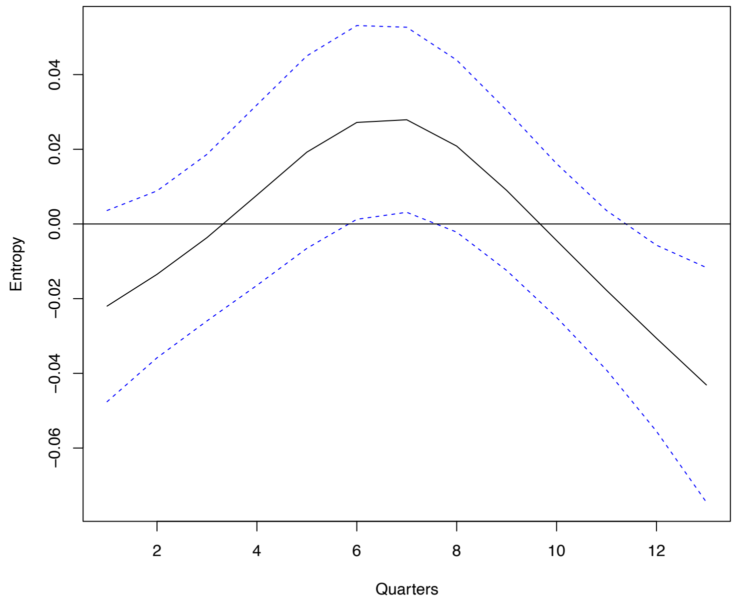
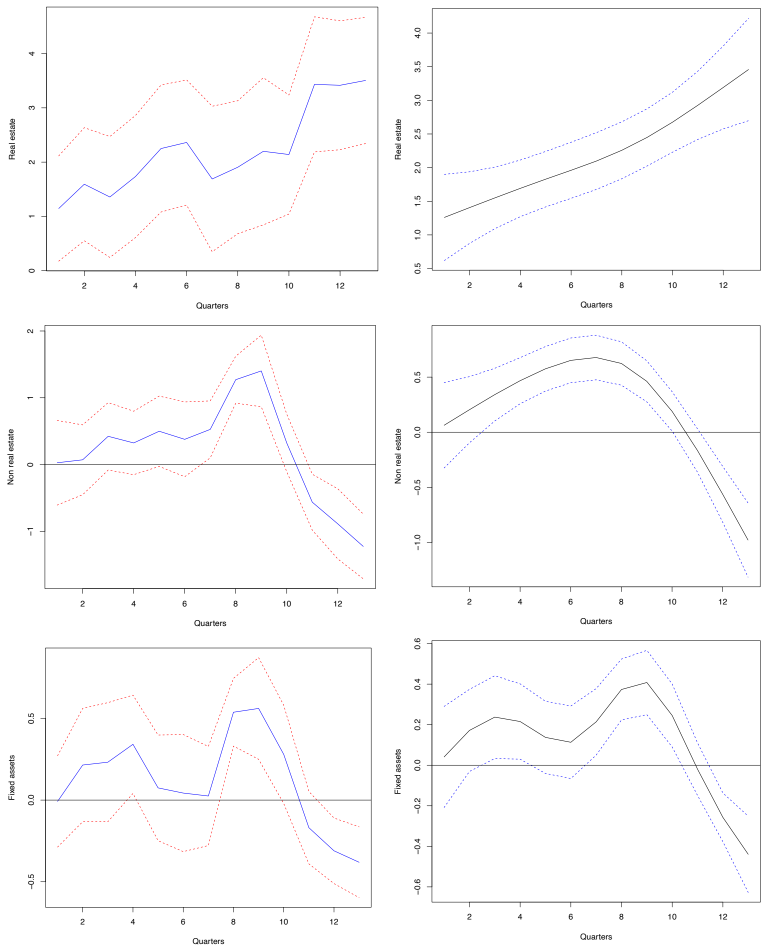


FIG. 5. Impulse responses of downside entropy to monetary stimulus shocks.



tions (LP) and smooth local projections (SLP), respectively. In response to a one standard deviation M2 money supply stimulus shock, real estate development investment jumps, and continues to increase over the next 12 quarters. Non-real estate industry investment also increases gradually.

FIG. 6. Impulse responses of real estate development investment, non real estate investment, fixed assets investment to monetary stimulus shocks: LP (Left column) and SLP (Right column).



Finally, the monetary stimulus shocks also boost total fixed assets investment.

In summary, we find that M2 monetary supply stimulus shocks have positive effects on investment, following the shock, investment in real estate development, non-real estate industries, and total fixed assets all increase, with the increase in real estate development investment being particularly large. These increases in investment are likely to push house prices up and reduce the downside risks to house prices. This explains why we observe an increase in house prices and a decrease in downside risks to house prices following the monetary stimulus shock.

4. CONCLUSION

This paper uses local projections and smooth local projections to study the effects of monetary policy on average house prices and the downside risks to house prices in China. We find that the M2 money supply stimulus positively impacts housing prices, and can help mitigate the downside risks to house prices. We also examine the underlying transmission mechanism through monetary effects on investment, and we document that monetary stimulus shocks boost investment in real estate development, non-real estate industries, and total fixed assets, thereby boosting house prices and mitigating risks to house prices.

Our results have policy implications for China's monetary policy and real estate. When house prices fall sharply and face substantial downside risks, monetary policy is an effective tool to manage the risks. For example, policymakers can use the M2 money supply to provide monetary stimulus to boost investment and house prices.

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