Highlights

Monetary policy and US housing expansions: the case of time-varying supply elasticities
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- We challenge the assumption of constant housing supply elasticities across expansions.
- We use a TVP-VAR on US monthly data and high-frequency monetary policy surprises.
- House prices are more responsive than supply to monetary policy since the GFC.
- Our results suggest that US housing supply elasticities have declined.
- House prices may be more responsive to demand in the post-COVID-19 recovery.
Monetary policy and US housing expansions: the case of time-varying supply elasticities

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Abstract

We challenge the assumption in the literature of constant housing supply elasticities across housing expansions. Using a time-varying parameter (TVP)-VAR model on monthly US data since the early 1990s, we find that the response of housing supply to an expansionary monetary policy shock relative to the response of house prices has declined substantially since the Great Financial Crisis (GFC). Our findings are consistent with research suggesting that land-use regulation has tightened. Absent major reversions in regulation, our results point to a post-COVID-19 housing recovery characterised by a sluggish response of housebuilding to demand, but a relatively stronger response of house prices.

Keywords: House prices, Housing supply, Monetary policy, Housing expansions, Time-varying parameter VAR

1. Introduction

Theoretical and empirical frameworks of the housing market assume that expansions follow the standard textbook mechanism: rising demand feeds into higher house prices, stimulating supply (Glaeser et al., 2008). Housing supply elasticities, i.e. the response of housing supply to house prices, are assumed constant across housing expansions; they only vary with the business cycle – decline towards zero in a downturn as housing supply is rigid downwards (Glaeser and Gyourko, 2005) – and cross-sectionally due to

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differences in geographical and regulatory constraints (Saiz, 2010; Gyourko et al., 2008).

This paper makes a case for considering supply elasticities as varying across housing expansions. First, the US housing expansion that started in 2012 – and which may have come to an end in early-2020 – was characterised by an unprecedentedly weak response of construction activity to demand. This contrasts with previous housing expansions (Figure 1). House prices increased, however, in line with historical norms. Second, the transmission of monetary policy to economic activity and to asset prices displays substantial time variation (Galí and Gambetti, 2015; Paul, 2020; Primiceri, 2005). We argue the same applies to the housing market.

We investigate the transmission of US monetary policy shocks to the housing market since the early-1990s through the lens of a TVP-VAR model (Cogley and Sargent, 2001; Primiceri, 2005). By adding building permits to our TVP-VAR model, we inspect the housing market dynamics not only through house prices, as in Paul (2020), but also through quantities. Analysing prices and quantities allows us to draw implications about supply elasticities.

Our results document an increased responsiveness of house prices to an expansionary monetary policy shock since the GFC, nearly reaching pre-crisis levels. The response of permits remains, however, well-below historical averages. This implies that the response of permits relative to house prices has declined substantially since the GFC – by around 20% after three years following the monetary policy shock. This finding is consistent with a decline in housing supply elasticities across US metropolitan areas in the recent expansion (Aastveit et al., 2020). Tighter land-use regulation, which poses a constraint on housing supply, may help explain this structural break (Aastveit et al., 2020; Herkenhoff et al., 2018; Hsieh and Moretti, 2019).

The transmission of monetary policy to real activity appears to have remained stable over time. But the response of output relative to house prices has weakened since 2013. While our paper is silent on how the transmission of monetary policy to housing demand has evolved over time, our results suggest that structural changes in the supply side of housing may dampen the overall effect of monetary policy shocks on output. We find that a shock to housing demand that is increasingly absorbed by house prices, rather than supply, may contribute, ceteris paribus, less to overall output. Our finding adds a new perspective – based on housing supply-side considerations – to current research arguing that monetary policy may have become less effective to stimulate activity due to the low interest rate environment (Berger et al., 2020; Eichenbaum et al., 2019).
2. Housing expansions since 1975

We take a historical perspective by comparing house prices deflated by CPI, building permits, and real GDP across past US housing expansions. Applying the Harding-Pagan algorithm, we identify four turning points in real house price cycles since the mid-1970s, i.e., housing expansions: 1975M9–1979M7, 1982M11–1989M3, 1996M12–2006M4, and 2012M3–2019M12.

The pace of real house price appreciation displays a broadly similar pattern across housing expansions (Figure 1). The dynamics of the 2012-19 recovery exhibits similar characteristics to the one in the run-up to the GFC. By contrast, housebuilding activity measured by the number of building permits approved for construction, or by housing starts (see Online Appendix), stands out in the 2012-19 expansion: the flow of permits averaged 0.9% of the initial housing stock in 2012, down from a range of 1.6%-2.0% during the previous expansions. Aastveit et al. (2020) argue that the sluggish pace of housebuilding is linked to a decline in supply elasticities. While the GDP dynamics have been relatively similar across the first three housing expansions, the economic performance during the recent recovery has been subdued. In the light of these changes, we ask whether the transmission of housing demand to the housing market has changed over time.

3. Econometric framework

3.1. High-frequency identification

Monetary policy plays an important role in stimulating housing demand via lower borrowing costs – the credit channel – or through the collateral or refinancing channel. We use high-frequency data to identify exogenous changes in monetary policy (Gertler and Karadi, 2015). This identification assumes that price movements within a narrow window around FOMC meetings reflect a reaction to the unanticipated component of the policy announcement. Following Paul (2020), we proxy monetary policy shocks by surprise movements in the 30-day Federal funds futures within a 30-minute window. Using (current month) short-term interest rates has the advantage

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1In a non-technical summary of this paper, we discuss in more detail the prominent role of housing for economic activity. Available on VoxEU.org at https://voxeu.org/article/monetary-policy-and-post-covid-19-housing-recovery, and also on Bank Underground blog at https://bankunderground.co.uk/2020/06/23/monetary-policy-and-us-housing-expansions-what-can-we-expect-for-the-post-covid-19-housing-recovery/.
Figure 1: Housing expansions

Notes: Real GDP and real house prices are scaled to 100 at the beginning of each housing expansion. Building permits are in % of the housing stock at the beginning of each expansion. The vertical line at zero is the starting point of each expansion; x-axis is in quarters.
of minimising the central bank ‘information effect’ (Paul, 2020). In what follows, these monetary surprises are treated as a proxy of the structural shocks.

3.2. Time-varying parameter VAR

We use a TVP-VAR model to identify the transmission of monetary policy (Cogley and Sargent, 2001; Primiceri, 2005). We follow Paul (2020) and include the pre-identified surprises as an exogenous variable in the VAR. Paul (2020) shows that this ‘exogenous variable approach’ consistently estimates the contemporaneous relative responses and, assuming that $z_t$ is uncorrelated with the remaining regressors, the subsequent relative responses.

The (reduced-form) TVP-VAR(X) can be written as

$$y_t = B_{0,t} + B_{1,t}y_{t-1} + \ldots + B_{p,t}y_{t-p} + A_t z_t + u_t, \quad u_t \sim \mathcal{N}(0, \Sigma), \quad (1)$$

for $t = 1, ..., T$, and where $y_t$ is a $N \times 1$ vector of endogenous variables, $z_t$ is the monetary policy surprise, $B_{0,t}$ is a vector of intercepts, and $B_{k,t}$ for $k \in \{1, ..., p\}$ and $A_t$ are coefficient matrices on the lagged endogenous variables and the monetary policy surprises. The $(2N + pN^2) \times 1$ vector $C_t$ containing all (stacked) time-varying coefficients of Equation (1) is assumed to evolve according to a (driftless) random walk:

$$C_t = C_{t-1} + v_t, \quad v_t \sim \mathcal{N}(0, Q). \quad (2)$$

We estimate the model over 1991M1–2019M6 using Markov Chain Monte Carlo (MCMC) methods with 15,000 iterations and discard the first 5,000 draws as burn-in (Primiceri, 2005). The priors are based on OLS estimates of a constant VAR over the training sample 1975M5–1990M12 (Primiceri, 2005; Paul, 2020).

We include seven variables: monthly real GDP from Macroeconomic Advisers, CPI, the policy rate measured by the Wu and Xia (2016) shadow rate, building permits, real house prices, the GZ spread (Gilchrist and Zakrajšek, 2012), and real bank credit. All variables are measured in first log-differences, only the policy rate and the GZ spread are in levels. Each variable enters the VAR specification with $p = 3$ lags. We normalise the monetary policy shock such that it decreases the policy rate by 25 bp in the first month of our sample (1991M1). The Online Appendix contains details on the exogenous variable approach, the prior configurations, and the data.
4. Results

4.1. Main results

An expansionary monetary policy shock stimulates housing demand, output, building permits, and house prices (Figure 2). The responses of the remaining variables are also in line with standard macroeconomic models (Figure A.4 in Appendix A). While the GDP response seems to be overall constant, the responses of house prices and permits exhibit substantial time variation. House prices have become more responsive since the GFC, reaching levels similar to those during the pre-GFC period. In contrast, although the response of permits has recovered after the GFC, it remains well-below historical averages.

We investigate this time variation by looking at the relative responses between permits and house prices at selected horizons (upper panel of Figure 3). These relative responses allow us to gain insights into their dynamic relationship; the percentage change in permits given a one percent change in house prices. The relationship between permits and house prices seems rather stable since the early-90s and until the GFC. After the GFC, we find evidence of a substantial decline in the response of permits relative to a one percent change in house prices: a drop of around 15% after one year, and of around 20% after three years. This finding is consistent with the notion that construction has been reacting less to changes in demand (Aastveit et al., 2020). Although we see clear trends in the mean responses of this ratio, the posterior density intervals around the difference between selected points in time typically only exclude the zero at lower levels than conventional. This is a typical outcome of TVP-VAR models due to their complexity, even in cases where the model dimension is lower than in our case (see Primiceri, 2005; Paul, 2020).

The transmission of monetary policy to real activity relative to house prices has weakened since around 2013 (bottom panel of Figure 3). An expansionary monetary policy shock in 2019M6 raised house prices relatively more than output, especially at medium-term horizons, compared to the period in the aftermath of the GFC. This was a period when the measures adopted by the Federal Reserve to fight the crisis seemed to have stimulated economic activity more relative to house prices.

We acknowledge that our model has limitations to assess the overall effect of monetary policy on output; the TVP-VAR framework is not suited to study general equilibrium effects resulting from reallocations between the construction sector and other parts of the economy. In particular, our model is silent on how the transmission of monetary policy to housing demand
Notes: Cumulative mean time-varying responses to an expansionary monetary policy shock that decreases the policy rate by 25 bp in 1991M1.
has evolved over time, either through the credit-supply or balance-sheet channels. While these considerations are outside of the scope of the paper, our results suggest that the weaker response of housing supply to a given change in housing demand may dampen the overall effect of monetary policy shocks on output.

Figure 3: Relative impulse response functions

Notes: Cumulative mean time-varying responses of building permits and real GDP relative to real house prices to an expansionary monetary policy shock. Responses for 12 and 36 months after the shock. The grey bars represent US recessions as defined by the NBER.

4.2. Robustness checks

Our main results remain robust to using: (i) housing starts as the housing supply measure; (ii) industrial production, non-farm payroll employment, or the unemployment rate as the main variable of economic activity; (iii) the Federal funds rate or the two-year Treasury rate as the policy indicator; (iv) two lags of the endogenous variables; (v) monetary policy surprises that accounts for information shocks; and (vi) monetary policy surprises that load more heavily on the longer end of the yield curve. Appendix B shows the
results using industrial production, and when using policy surprises based on three-months Fed funds futures – potentially capturing the overall monetary policy stance more broadly – and that strips out possible information effects. We use Jarociński and Karadi (2020) poor man’s sign restrictions surprises, available until 2016M12. The robustness of our findings suggests that the differential response of house prices relative to permits over time does not seem to be influenced by either information effects or by surprises measured at slightly longer horizons. We corroborate this finding with the surprise series of Bu et al. (2019), which takes the whole yield curve into account (Figure 17 in the Online Appendix).\(^2\) The remaining robustness checks can be found in the Online Appendix.

But the results are less clear-cut when comparing the post-crisis era to the 1990s: the specifications with industrial production (Figure B.6 in the Online Appendix), or with the unemployment rate (Figure 9) yield relatively similar relative responses for the two periods.

5. Conclusion

We have challenged the assumption that housing supply elasticities are constant across housing expansions. The response of US housing supply to an expansionary monetary policy shock relative to the response of house prices has declined substantially in the wake of the GFC. This aligns well with research showing that land-use regulation has been tightening across the country.

The COVID-19 pandemic and the resulting economic contraction are likely creating challenges for housing markets. The next economic recovery may be very different from previous ones – a recovery from a recession marked by simultaneous supply, demand and uncertainty shocks. Our results suggest, however, that the next housing recovery, absent major reversions in land-use regulation, may exhibit similar features to the 2012-19 housing expansion: a sluggish response of housebuilding to rising demand but a relatively stronger price reaction.

\(^2\)The decline of the relative response starts somewhat earlier, but the overall conclusion remains unchanged: the post-GFC response of permits relative to house prices is lower than the pre-GFC one.
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Disclaimer

The views expressed in this paper should not be reported as representing the views of the Bank of England.

Appendix A. Additional results

Figure A.4: Time-varying impulse response functions of the benchmark model

Notes: (Cumulative) Mean time-varying responses of the remaining variables in the TVP-VAR to an expansionary monetary policy shock that decreases the policy rate by 25 bp in 1991M1.

Electronic copy available at: https://ssrn.com/abstract=3827954
Appendix B. Robustness checks

1. Alternative measure of real activity: industrial production

Figure B.5: Time-varying impulse response functions

Figure B.6: Relative impulse response functions

Electronic copy available at: https://ssrn.com/abstract=3827954
2. Alternative surprise series: Jarociński and Karadi (2020) poor man’s sign restrictions

Figure B.7: Time-varying impulse response functions

Figure B.8: Relative impulse response functions
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