Institutional investors and house prices *

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Abstract

Institutional investors are playing an increasingly important role in residential real estate markets. This raises the possibility that their actions might drive aggregate market outcomes and may change how and which macro-financial shocks transmit to house prices. We show that a demand shock from institutional investors has a positive and persistent effect on aggregate euro area house price growth and mortgage lending volumes. Institutional investors also increase their purchase activity following a loosening of monetary policy. Exploiting regional heterogeneity across eight euro area countries, we show that institutional investors weaken the link between house price growth and local economic fundamentals, but strengthen the sensitivity to monetary policy and financial market developments.

JEL classification: R31; E52; G23
Key words: Real estate; financial stability; non-bank financial intermediation; institutional investors; monetary policy

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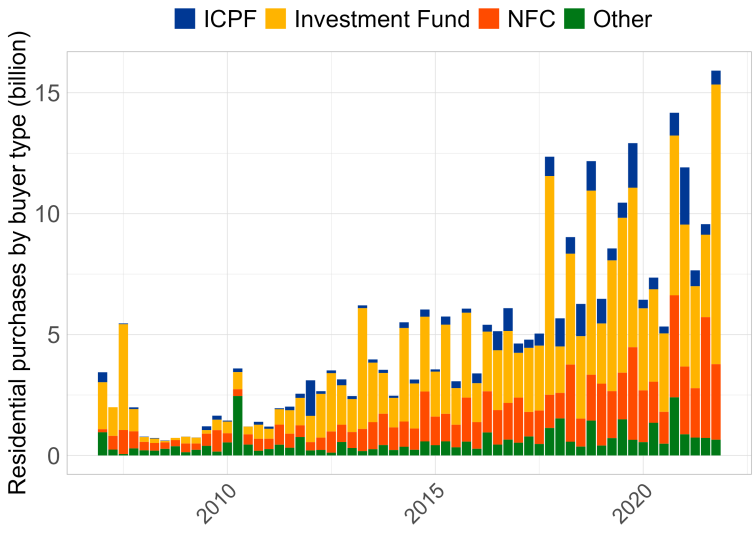
1 Introduction

Housing is one of the most important asset classes in developed economies, playing a central role in driving the credit cycle, the transmission of monetary policy, and overall economic activity (Jordà et al., 2015; Mishkin, 2007; Mian et al., 2013; Kaplan et al., 2020). Our understanding of house price dynamics, particularly in the euro area, typically focuses on households and the banks which lend to them. However, the presence of institutional investors in this market has steadily increased over the past decade (Figure 1) and our understanding of whether and how they influence market dynamics remains limited. Our definition of institutional investors includes investment funds, insurance corporations, pension funds, non-financial corporations and smaller investment firms, endowments and foundations. Where the presence of these investors becomes significant enough to influence aggregate market dynamics, it raises a range of important questions regarding the capacity of these players to amplify house price cycles or to create links between vulnerabilities in the non-bank financial system and housing markets.

Figure 1: *Purchases of residential real estate assets by buyers such as investment funds and firms have grown steadily over the past decade.*



Notes: The figure shows the total euro amount of residential real estate purchases by institutional investors from 2007 to 2021 in the euro area, broken down by type of buyer. ICPF stands for insurance companies and pension funds. NFC stands for non-financial corporation. The 'Other' category includes smaller non-household investors, such as investment firms, endowments and foundations.

This paper uses a data set covering large real estate transactions to examine the role of institutional investors in euro area housing markets. First, we document the evolution of investor purchases of euro area housing over time, finding a steady increase in activity since 2013. We then use a Bayesian vector autoregressive (BVAR) model to show that a demand shock from institutional investors has a positive and persistent effect on residential house prices and mortgage lending volumes at the euro area aggregate level. Investor demand

also increases in response to a loosening of monetary policy. Finally, we examine how the participation of investors in a market changes the response of house prices to macrofinancial shocks. We find that investors' presence tends to weaken the link between house price growth and local economic fundamentals. Institutional investors also appear to increase the sensitivity of the housing market to both monetary policy and financial market shocks.

The channel through which institutional investor demand can affect prices is mainly through the direct impact on demand-supply equilibrium, given that often investors purchase properties on a large scale. When institutional investors acquire multiple properties, either for rental or for re-selling purposes, it can lead to increased demand in the housing market. This increased demand can drive up the general level of house prices due to competition between potential buyers or investors looking to purchase properties in that area. Moreover, institutional investors frequently buy residential units with the intention of renting them to generate long-term yields on their investments (Mühlhofer, 2019; Cvijanović et al., 2022). Hence, large-scale purchases can reduce the available housing supply for individual home buyers, potentially driving up prices due to the scarcity of units to be purchased.

The behaviour of institutional investors may differ from that of households because they face different trade-offs to households and because they have different funding structures. Regarding trade-offs, institutional investors may be particularly sensitive to the relative returns on real estate vs. other assets when deciding to invest in real estate or not. Notably, prolonged periods of accommodative monetary policy, which compress returns on traditional fixed-income assets, may prompt institutional investors to reallocate capital toward alternative asset classes such as real estate (see, for example, Campbell and Sigalov, 2022). While households primarily fund house purchase with wages and domestic bank lending, institutional investors are funded via a range of sources including capital markets financing and investment fund flows. Thus the presence of institutional investors in a market may cause house prices to respond differently to variations in monetary policy (trade-offs) and shocks to local wages or financial markets (funding) compared to markets without them.

A major barrier to our understanding of these dynamics to date has been the availability of data. Our use of a transaction-level data set allows us to examine for the first time the participation of institutional investors in euro area housing markets. Our data set shows a steady increase in total purchases of residential assets by institutional investors from approximately 2013 onwards, with this increase largely driven by the investment fund sector. However, not all euro area housing markets appear to be equally exposed, with institutional investor presence particularly pronounced in Germany, the Netherlands, Finland and in a number of capital cities such as Paris, Dublin, Madrid, and Helsinki.

From a macroeconomic perspective, the relevance of institutional investors in the housing

market will rest on their ability to affect aggregate market dynamics. We use a BVAR model to show that increased demand for residential properties by institutional investors is indeed associated with a persistent rise in euro area house prices. It is the first time that this has been shown for the euro area and the first time that it has been shown for any jurisdiction using a BVAR framework. Crucially, our BVAR framework allows us to capture feedback loops between key variables (such as house prices and investor demand) which have significant implications for market dynamics.

The BVAR model also allows us to study for the first time the interaction between these non-bank players and the banking system through housing markets: we show that rising purchases of real estate by institutional investors are associated with a rise in mortgage lending. Finally, we provide the first empirical evidence that institutional investor purchases are responsive to monetary policy, with an expansionary monetary policy shock associated with an increase in purchases. This confirms the views expressed by prominent policy figures during the low-for-long monetary policy period regarding the role of institutional investors in driving house price growth (Schnabel, 2021). Taken together, these findings indicate that institutional investors have become systemically relevant players in euro area housing markets and that they may play an amplifying role in euro area house price cycles.

Next we take advantage of the heterogeneity in investor participation across the euro area to examine - to our knowledge also for the first time - how the participation of institutional investors in real estate markets changes the response of house prices to macro-financial shocks. To do this, we use a panel data model based on regional data for eight euro area countries and take a comprehensive approach to our question, examining transmission of real economy, monetary policy, and financial market developments.

First, we investigate whether the presence of institutional investors in housing markets weakens the link between house prices and local economic fundamentals. We find that the relationship between house price growth and local household income is significantly weaker in markets with a pronounced institutional investor presence. From a financial stability perspective, this may insulate housing markets from the effect of local economic developments. However, where prices are detached from local economic fundamentals this may also give rise to overvaluation and increase the vulnerability of housing markets to sharp corrections, particularly in response to any turnaround in investor demand.

Next, we examine whether the presence of institutional investors affects the link between monetary policy and house prices. We provide evidence that a high presence of institutional investors in a given market increases the sensitivity of house price growth to variations in euro area monetary policy. This is a particularly important finding given that the euro area as a whole is subject to a single monetary policy but we have shown that the composition of buyers varies quite substantially across regions, thus creating heterogeneity

in the transmission of monetary policy via the housing market.

Lastly, we examine whether institutional investors create a link between financial markets and local housing markets. For example, households may be less exposed to financial markets than institutional investors, such as investment funds. Our results suggest that institutional investors do appear to increase the short-term sensitivity of housing markets to financial market volatility.

These findings overall suggest that institutional investors play a systemically relevant role in euro area housing market dynamics and that understanding this role is an important component of assessing how different housing markets may respond to real economy, monetary policy and financial market developments. Moreover, the predominance of investment funds among these investors highlights that real estate fund vulnerabilities could have wider implications for euro area real estate markets. In this regard, Daly et al. (2023) emphasise the structural liquidity risks within the real estate funds of the euro area. Taken together, our findings imply that widespread real estate fund firesales might have implications for euro area house prices and further emphasise the importance of widening the macroprudential toolkit to the non-bank sector.

In the next Section, we discuss our work in the context of the wider literature. In Section 3 we provide an overview of our data and a descriptive analysis of institutional investor activity in euro area housing markets. In Section 4, we present our euro area-level BVAR analysis. In Section 5, we construct our regional data set and use this to first confirm key BVAR findings and then to examine how investors affect house price response to financial and economic factors. Finally, Section 6 considers implications for policy and concludes.

2 Related Literature

Our paper adds to a number of strands of existing literature. Regarding the existing empirical literature on the effects of institutional investor activity on house price dynamics, we are the first to study the euro area, to use a structural VAR framework and to examine how the participation of institutional investors in real estate markets changes how house prices respond to macro-financial shocks.

The existing literature on this topic focuses entirely on US markets and, in many cases, on specific US counties and metropolitan areas (Gay, 2015; Allen et al., 2017; Mills et al., 2019; Smith and Liu, 2020; D'Lima and Schultz, 2022). Our findings largely confirm those of the US-focused literature. In particular, our key finding that fluctuations in investor demand do appear to play a role in driving market prices is also found throughout the U.S. literature. The US housing markets with a higher share of short-term investors, including institutional investors, have also grown substantially in the last decades (Ganduri et al.,

2023; Mills et al., 2019). The growth of institutional real estate investments in the US has been identified as an enhancing factor in the boom-bust cycle preceding the global financial crisis (Alter and Dernaoui, 2020; Gao et al., 2020). This has also been identified as a contributing factor to the increase in house prices and the decrease in affordability and homeownership rates after the Great Recession (Gay, 2015; Allen et al., 2017; Mills et al., 2019; Lambie-Hanson et al., 2019; Halket et al., 2020; Garriga et al., 2021, 2022).[1] By confirming that these investors can also drive aggregate market dynamics in the euro area - and indeed across a range of euro area countries with very different institutional setups - we show that the findings of the existing literature are relevant beyond the US and provide an important new perspective on how European real estate markets operate. One notable exception to this US focus is McCarthy (2024), which examines implications of investment fund ownership of housing for rents in Ireland, finding that investment fund ownership is associated with higher rents.

Our use of a BVAR framework as opposed to a purely microeconometric approach is also an important addition to this literature. A structural VAR framework allows us to model the relationships between a number of endogenous variables and their responses to structural shocks. In particular, this allows us to model feedback loops between endogenous variables which are highly relevant to the market dynamics being studied. For example, the BVAR allows us to account for feedback loops between price growth and investor demand. Reverse causality in this relationship, in which future price growth drives investor demand as opposed to vice versa, has been identified in the existing literature: D'Lima and Schultz (2022) use repeat sales of homes to show that institutional investors were skilled in identifying undervalued homes in areas with high house price growth potential.[2] The structural VAR framework is also well suited to examine how investor demand affects other endogenous variables, such as bank lending, and to understand the response of investor demand to monetary policy shocks.

The granularity of our data and the heterogeneity of investor participation in real estate markets across the euro area allow us to study for the first time how the participation in real estate markets by these investors affects the transmission of macro-financial developments to local house prices. We take a comprehensive approach to this exercise, studying how institutional investors may change the vulnerability of real estate markets to real economy, monetary policy, and financial market. This is an important exercise given the growing role of institutional investors in international real estate markets and the implications of house price fluctuations for financial stability (Jordà et al., 2015; Iacoviello and Neri, 2010;

[1] A possible reason is that institutional investors have a stronger bargaining power and tend to purchase at a large discount compared to single-purchase buyers (Allen et al., 2017; Smith and Liu, 2020). Institutional investor purchases can also have a spillover effect on nearby home values by reducing the supply of available properties for sale (Ganduri et al., 2023).

[2] We also address this potential for reverse causality in our panel data set-up and provide further evidence that the link between current investor demand and future house price growth is not simply a case of reverse causality.

Reinhart and Rogoff, 2008) and key macroeconomic variables such as household consumption (Mian et al., 2013; Aladangady, 2017; Berger et al., 2018). Our findings also have clear implications for the literature on drivers of overvaluation in housing markets (Muellbauer, 2012; Álvarez-Román and Garcia-Posada, 2021) and drivers of synchronisation in global housing markets, for example via the response of investors to financial market variables (Hirata et al., 2013; Hoesli, 2020; Duca, 2020).

By studying the response of institutional real estate investors to monetary policy, we contribute to both the literature on the transmission of monetary policy via housing markets and the literature on the transmission of monetary policy via non-banks. Although the response of house prices to changes in monetary policy has been extensively studied, this literature overwhelmingly focuses on transmission via households and bank lending (Jarocinski and Smets, 2008; Battistini et al., 2022; Aastveit et al., 2023; Garriga et al., 2017; Cloyne et al., 2020).[3] The budding literature on monetary policy transmission via nonbanks, in contrast, focuses largely on transmission via financial markets (Hau and Lai, 2016; Banegas et al., 2016; Holm-Hadulla and Thürwächter, 2020; Giuzio et al., 2021). By showing that institutional investor purchases of real estate increase following an accommodative shock, our BVAR analysis shows that non-banks also play a role in transmitting monetary policy via housing markets. Our panel analysis indicates that investors may, in fact, amplify the impact of monetary policy via their stronger response relative to households.

By showing that rising institutional investor activity is associated with rising mortgage lending, we also complement the existing literature on the interactions between banks and non-banks in financing real economic activity. Interestingly, while much of the existing literature examines how the expansion of non-bank activity can lead to a contraction of bank activity, we show that the actions of these two groups can also amplify one another. For example, Gete and Reher (2018) show that the growth of institutional investors in US housing markets has been amplified by the tightening in lending standards in the aftermath of the Global Financial Crisis. Recent theoretical work has also found a link between banking and macroprudential regulations and the presence of institutional investors in the housing markets (Muñoz and Smets, 2022). Indeed, the wider literature on bank and non-bank financing of economic activity typically frames non-bank activity as a "spare tyre" which increases following a reduction in bank lending (De Fiore and Uhlig, 2011; Adrian et al., 2012; Becker and Ivashina, 2014; Altavilla et al., 2019; Holm-Hadulla and Thürwächter, 2020). In contrast, we show that rising purchases of residential real estate by institutional investors is also associated with an expansion in banks' mortgage lending, suggesting that amplifying feedback loops may also exist between these two parts of the financial system.

[3] Garriga et al. (2021) use the Fed Quantitative Easing as an instrument to proxy the geographical presence of institutional housing investors after the GFC, but the main focus of their analysis is the impact of investors on US housing affordability.

Finally, we add to the existing literature on the growing role of non-banks in the global financial system. This literature, particularly for the euro area, has focused largely on non-banks' financing of firms (Altavilla et al., 2019; Holm-Hadulla and Thürwächter, 2020). In terms of economic growth, non-bank financial intermediation has positive effects but can also introduce new sources of volatility throughout economic cycles (European Central Bank, 2021). This literature has also highlighted that structural vulnerabilities, in particular in the investment fund sector, can amplify financial distress and negatively affect financial stability (Chen et al., 2010; Feroli et al., 2014; Goldstein et al., 2017; Morris et al., 2017; Giuzio et al., 2021; Ma et al., 2022; Ryan, 2022). Given the importance of housing as an asset class, understanding the role of non-bank players in real estate markets is another crucial element in understanding the implications of this structural change for the real economy and for financial stability.

3 Novel data on investor transactions in euro area residential real estate markets

3.1 Real estate transactions data

Our main explanatory variables are computed using Real Capital Analytics (RCA) data, provided by Morgan Stanley Capital International (MSCI). RCA publishes several data sets on real estate transactions, collected from different public sources, data partners and brokers. RCA specifically targets commercial real estate transactions, which also include large housing deals for investment purposes. RCA provides transaction-level data for deals closed from 2007 onwards. More specifically, the data set includes detailed information on purchases of residential assets by non-households such as non-financial companies, financial entities or government bodies. The available variables include information regarding the location of the building, the transaction date and price, as well as the names and locations of both buyers and sellers.

Although the data set is very granular in nature, it can only offer a partial picture of all relevant transactions in European housing markets, as it solely focuses on institutional investors and, therefore, does not cover purchases by households. This also implies that the observed transactions of institutional investors cannot be expressed as a share of total housing market transactions. The data set is also biased towards large transactions, covering mostly deals valued at 10 million euros or more, and - as it is compiled from different original sources across countries - data quality may vary across euro area countries. Finally, the RCA data set may not provide a complete picture, even of large transactions occurring in the euro area, and so total figures should be interpreted with caution. However, fluctuations in total figures over time likely reflect fluctuations in total market activity

and variation in purchase intensity across regions should also reflect variation in market participation by investors.

Despite its shortcomings, RCA data allow us to analyse for the first time the impact of institutional investors on housing markets in the euro area. As such, it provides valuable insights into the role these investors play in house price growth, affordability, and procyclical market dynamics. The following section offers selected descriptive statistics based on this data set to illustrate the dynamics of institutional investment over time and across the euro area.

3.2 Summary statistics: Institutional investors in euro area residential real estate markets

The role of institutional investors in euro area housing markets has remained broadly unstudied until now, so we begin our work by examining our transactions data set to see what type of institutional buyers are present in euro area markets, changes in activity over time and geographic heterogeneity.

First, we identify purchases flagged in the data as purchases of residential assets (e.g., as opposed to offices) and also identify those which are flagged in the data as being bought for investment purposes.[4] Figure 1 shows the total value of these transactions by quarter between 2007 and 2021. Here, we see a clear growth in purchases over time, with the total value of purchases in a typical quarter approximately tripling between 2012 and 2020. The median purchase size is 25 million euros, reflecting the nature of our data set which covers large real estate deals as opposed to deals for individual homes. Such developments provide clear motivation for the rest of our analysis as the rapid expansion in market activity increases the capacity for institutional investors to play a systemically relevant role in euro area housing markets, for example, by driving aggregate market prices. We will examine this in the next sections.

For each quarter, we first break down activity by type of buyer (Figure 1) and find that most of these purchases of residential assets are made by investment funds. Indeed, the rapid increase in buying activity by investment funds reflects the expansion in the broader euro area investment fund sector over this time period and its increasing importance in financing euro area economic activity. Non-financial corporations (NFCs) such as large institutional landlords make up the second biggest sector and, while insurance companies and pension funds (ICPFs) are also present in the market, they typically account for a small share of transactions. Institutional buyers are also quite geographically diverse. A large share come from three of the euro area's biggest economies - France, Germany, and

[4]The vast majority of purchases are recorded as being for investment purposes. The remainder includes transactions for renovation purposes. As we are interested in investment activity, we remove non-investment purchases from our sample for the remainder of the analysis.

the Netherlands - and non-euro area buyers are also active in the market, with the US and the UK well represented within this group (Figure 2a).

We can also take a look at the sample broken down by the location of the building bought. Figure 2b shows that activity is concentrated in Germany and the Netherlands, with Finland, Austria, and France making up most of the remaining transactions. However, if we want to understand the impact this activity may be having on housing markets we need to account for the varying size of euro area countries. To get a rough initial idea of the importance of institutional investors across the euro area we take the total number of purchases occurring between 2007 and 2021 and divide by the country's end 2021 population, as shown in Figure 3a. We repeat the exercises dividing the total value of purchases by GDP in Figure 3b. This simple analysis indicates clear cross-country heterogeneity in the importance of institutional investors across housing markets in the euro area. In particular, the Netherlands appears to be the country where institutional investors may play the most pronounced role, with significant market participation also shown for Austria, Germany, Finland, and Ireland.

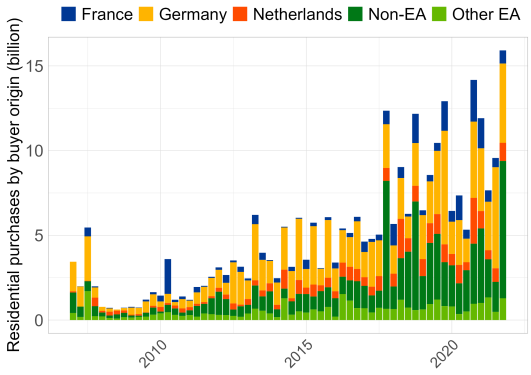
The granularity of our data allows us to extend our analysis to the region-level, where we also see investor activity also varying substantially within countries. Figure 4 shows the average transactions between 2007 and 2021 by NUTS2 region, normalised by GDP, with darker-shaded regions representing a higher concentration of institutional investor activity. The map shows that country-level aggregates mask significant regional heterogeneity. For example, while the role of institutional investors in French markets appears limited, we can see a significant presence in Paris and very little in most other parts of the country. Similarly, Finnish investor activity is highly concentrated in the region close to Helsinki and Irish activity in the area around Dublin. In contrast, institutional investors appear to play an active, although varying, role in Germany and the Netherlands.

This geographic heterogeneity motivates the second part of our analysis. If institutional investors do play a systemically relevant role in euro area housing markets but are particularly concentrated in certain countries and regions - then we may expect housing markets to behave differently in these markets. In particular, a significant presence of institutional investors may increase the exposure of housing markets to shocks affecting institutional investors - such as financial market shocks or global shocks - and may also weaken their link with the local economy. Moreover, given that the euro area is subject to a single monetary policy, the sensitivity of institutional investors to monetary policy changes is also important - with geographic variation in their market participation potentially creating heterogeneity in monetary policy transmission. We examine these issues in Section 5.

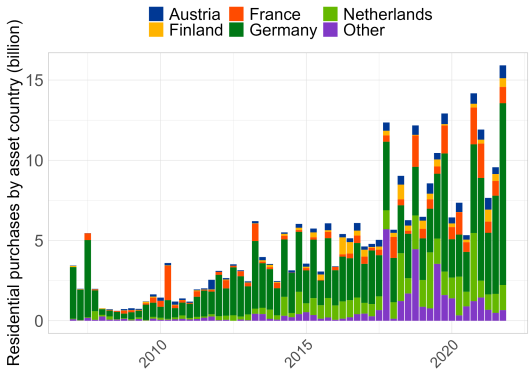
Before moving on, we compare these findings to estimates put together by public and private sector bodies for individual euro area countries. Overall, this comparison indicates that our RCA data does provide an accurate picture of market participation by institutional

Figure 2: *Buyers typically come from a number of large euro area economies but a substantial share come from outside of the euro area, while purchases appear concentrated in a small number of countries.*

(a) *Residential purchases by origin of buyer*



(b) *Residential purchases by country of asset*



Notes: The figures show the total euro amount of residential real estate purchases by institutional investors from 2007 to 2021 in the euro area, broken down by buyer country and asset country respectively.

investors. Savills examines the role of private companies in ownership of German housing and finds patterns strikingly similar to our data, with ownership particularly pronounced in major cities such as Berlin and Munich and typically more pronounced in the North than the South.[5] McCarthy (2024) examines the role of investment funds in the Irish rental market, showing a pronounced participation in the Dublin market, with limited activity in other parts of the country, and highlighting that investor participation began in the years following the sovereign debt crisis, a dynamic also captured in the RCA data.

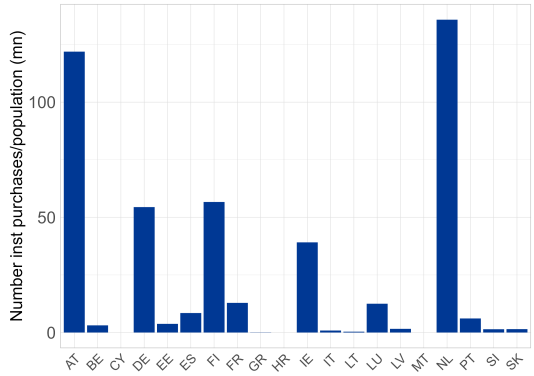
These sources can also be used to gauge the share of total housing owned by institutional investors and therefore understand the potential economic significance of their role in the market. Ritterwald estimates that approximately 13% of the housing stock in the Netherlands is owned by institutional and professional investors.[6] Savills estimate that approximately 7% of the stock of German apartments are owned by private companies, although this figure is significantly higher in the regions flagged above. Overall, this supports the literature's typical focus on households in understanding housing market dynamics. However, institutional investors may play the role of marginal buyers and therefore still play a significant role in driving price dynamics. Of course, in markets where participation is particularly high, we may expect their behaviour to have quite a significant effect on prices.

[5] See "Ownership structure of the residential market." German Residential Market Report. Savills, March 2019.

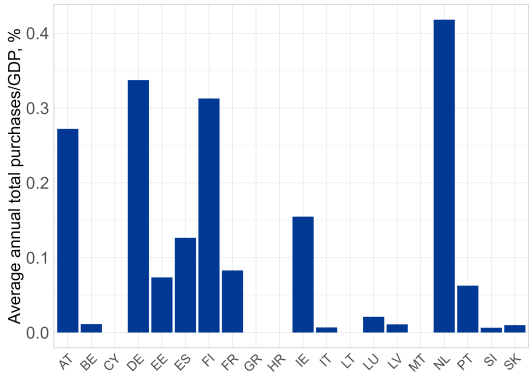
[6] See "Institutional investments in social and affordable housing in Europe". Ritterwald, May 2020.

Figure 3: *Normalising by country size reveals a number of further countries where investors play a prominent role.*

(a) *Total number of purchases (2007-2021) normalised by population*

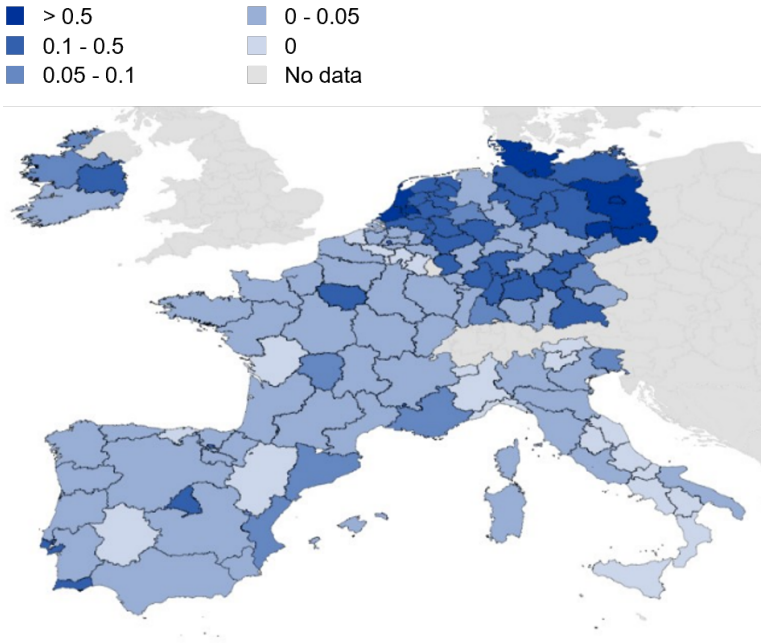


(b) *Average annual total value of purchases (2007-2021) normalised by GDP*



Notes: Subfigure (a) shows the country-level average annual total number of residential real estate purchases by institutional investors from 2007 to 2021 in the euro area, normalised by annual population. Subfigure (b) shows the country-level average annual total euro value of residential real estate purchases by institutional investors from 2007 to 2021 in the euro area, normalised by annual GDP.

Figure 4: *Substantial regional heterogeneity in institutional investor residential real estate transactions can also be seen at the regional level (share of regional GDP).*



Notes: For each NUTS2 region in our regional sample, the figure shows the average purchase volume of residential assets by institutional investors between 2007 and 2021, normalised by regional GDP. More details on the regional analysis are available in Section 5.

4 Institutional investors and aggregate market dynamics

We start our analysis by studying whether and to what extent the increased presence of institutional investors might play a role in influencing aggregate euro area housing market dynamics. Moreover, we examine whether aggregate demand by these investors responds to monetary policy.

4.1 The model

We consider the following reduced-form VAR(p) model:

$$y_t = \alpha + \sum_{i=1}^{p} B_i y_{t-i} + u_t \tag{1}$$

where y_t is a (N $\times$ 1) vector containing N endogenous variables, α is a (N $\times$ 1) vector of constants, B_i for $i = 1, ..., p$ are (N $\times$ N) slope coefficients matrices, p represents the number of lags, and u_t is the (N $\times$ 1) reduced-form residual with $u_t \sim \mathcal{N}(0, \Sigma)$, where Σ is the (N $\times$ N) variance–covariance matrix of the error terms, which is not assumed to be diagonal.

The vector of endogenous variables includes real house prices, lending volumes for house purchase, interest rates on the outstanding stock of mortgages, real residential investments (proxied by fixed capital formation in the construction sector) and real disposable income. To capture the effect of both conventional and non-conventional monetary policy measures that go beyond steering the policy rates, we opt for using the shadow rate (Krippner, 2013). Moreover, we include a measure of institutional investor demand for residential properties, given by the gross residential real estate purchases of institutional investors, using RCA aggregated at the euro area level. We use quarterly series for the euro area aggregate covering the period 2007 Q1 to 2021 Q4. Measures of house prices, lending for house purchase, residential investments, and institutional investor gross purchases enter the model in log-levels, while the shadow rate and lending rate on housing loans enter in levels. The series on residential investments, house prices, mortgage volumes and real disposable income are sourced from ECB Statistical Data Warehouse, the shadow rate is sourced from Krippner,[7] while the series on institutional investor demand is computed using RCA data (see Section 3.1). The lag length in the baseline model p is set to 2. We adopt a Bayesian approach to estimation and use a Gibbs sampling algorithm to approximate the posterior distribution of the model parameters. As discussed by Uhlig (2005), this approach offers a convenient method to estimate error bands for impulse responses. We use a flat prior and, therefore, the results reported below are data driven.

[7] https://www.ljkmfa.com/

4.1.1 Identification of structural shocks

The structural shocks are identified relying on a combination of zero and sign restrictions following the algorithm proposed by Arias et al. (2018). We identify five structural shocks in the real estate markets, namely housing supply, housing demand, mortgage supply, monetary policy, and institutional investor demand shocks.

Households, banks and monetary policy. Housing supply shocks are identified by assuming an inverse relationship between housing output (proxied by fixed capital formation in the construction sector) and prices. Intuitively, a positive shock to housing supply (for example, a surge in new construction or an easing of building costs) increases the quantity of housing (e.g. residential investment) and puts downward pressure on house prices (Gambetti and Musso (2017) and Furlanetto et al. (2017)). Housing demand shocks are instead characterised by a positive co-movement of housing quantities and prices. We impose that an exogenous increase in housing demand – driven, for instance, by shifts in household preferences, changes in households beliefs on house prices, higher income expectations, or demographic changes – raises both real house prices and residential investment (Furlanetto et al. (2017); Iacoviello and Neri (2010); Lambertini et al. (2013); Pancrazi and Pietrunti (2019)). Economically, this scenario corresponds to households becoming more eager or able to purchase housing, which brings up prices and stimulates new construction. We also assume no contemporaneous change in the policy interest rate in response to a pure housing demand shock, recognising that monetary policy does not react within the same quarter to sector-specific developments (consistent with a standard Taylor-rule response). Mortgage supply shocks (i.e. credit supply shocks in the housing sector) are identified in the spirit of Gambetti and Musso (2017) by their distinct impacts on credit volumes and interest rates. A positive mortgage supply shock is conceived as an exogenous improvement in credit availability – for example, due to looser bank lending standards, regulatory changes, or shifts in lenders' risk appetite – that increases the volume of mortgage lending and lowers the mortgage interest rate. The economic intuition is that banks respond to such a shock by offering more loans at cheaper rates, independently of borrowers' demand. This simultaneous expansion of credit quantity and reduction in borrowing cost distinguishes a credit supply shock from a pure demand-driven credit surge (in the latter, stronger loan demand would tend to push up interest rates). We differentiate mortgage supply shocks from monetary policy shocks by the behavior of the policy rate: an increase in credit supply originates in the banking sector and need not entail an immediate change in the central bank's policy stance. By imposing the above sign restrictions – higher mortgage volumes and lower mortgage lending rates – and leaving the policy rate unrestricted, we aim to capture the notion of a credit-driven housing boom stemming from lenders' willingness to extend credit on easier terms. Monetary policy shocks are identified by conventional sign restrictions consistent with an unanticipated loosening or tightening of monetary conditions. We assume that both interest rates and house prices react simultaneously to such

shocks, as in Nocera and Roma (2017). To consider house prices as forward looking variables which respond within the same quarter to monetary policy news is consistent with Iacoviello (2005) and Iacoviello and Neri (2010). Assuming a decrease in loans after a contractionary monetary policy shock is in line with Gerali et al. (2010) and Gertler and Karadi (2011).

Institutional investors. We extend our set of identifying restrictions to study the impact of the increased presence of institutional investors in the residential real estate (RRE) market. Our "Institutional investors shock" aims to isolate exogenous shifts in the investment behaviour of the institutional investors captured in our data. An intuitive interpretation of this shock is a change in the relative attractiveness of residential real estate assets compared to other asset classes, prompting a reallocation of capital into real estate holdings. This may result from changes in regulation, global financial market volatility, or evolving risk-return trade-offs. As such, we identify an institutional investor demand shock as one that contemporaneously increases investor purchases, house prices, and residential investments. To distinguish this from a household demand shock, we impose that both mortgage lending volumes and mortgage lending rates do not react contemporaneously, reflecting the fact that the series used to capture mortgage lending throughout the model includes loans to households only and so will not include any credit provided to institutional investors. By isolating a pure shift in investor demand unaccompanied by changes in household credit conditions, we aim to capture the independent role of institutional investors in driving housing market dynamics.

This identification strategy is further supported by the financial stability literature, which highlights the structural differences in balance sheet composition, investment horizons, and risk sensitivity between institutional and household buyers (Daly et al., 2023; Cvijanovic et al., 2021).

Table 1: *Restrictions used for each variable (in rows) to identify shocks (in columns) in our VAR. Asterisks indicate that the response of the variable is left unrestricted.*

	Housing Supply	Housing Demand	Mortgage Supply	Monetary Policy	Institutional Investors
Residential Investments	-	+	0	0	+
RRE Prices	+	+	+	+	+
HHs Mortgage loans	+	*	+	+	0
Lending rate	*	+	-	-	0
Shadow rate	0	0	0	-	0
Disposable income	0	0	0	0	0
Inst. investor purchases	*	*	*	*	+

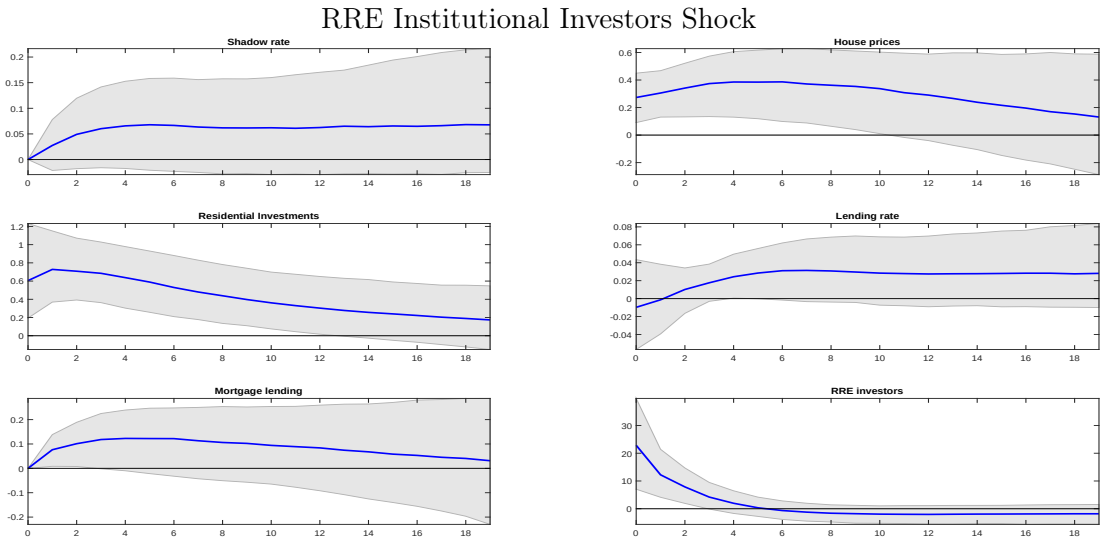
4.2 Impulse responses for the euro area aggregates

This section examines the transmission channels through which institutional investor activity affects the housing market in the euro area as a whole, and to what extent these investors can amplify markets' cyclical swings. We do so by studying the estimated impulse response functions from the model described above. The impulse response functions refer to one standard deviation shock and are computed over a 20-quarter horizon. Results are based on 11,000 iterations of the Gibbs sampler after discarding the first 10,000 iterations.

Institutional investors shock. Starting with our RRE institutional investor shock (Figure 11), we find that a positive demand shock from institutional investors has a positive and statistically significant impact on residential property prices which persists over about 8 to 10 quarters after the shock occurs. Specifically, a one standard deviation increase in investors' demand is associated with an increase in house prices of about 0.3 percent. The channel through which institutional investor demand can affect prices is mainly through the direct impact on demand-supply equilibrium, given that often investors purchase properties on a large scale. When institutional investors acquire multiple properties, either for rental or for re-selling purposes, it can lead to increased demand in the housing market. This increased demand can drive up the general level of house prices due to competition between potential buyers or investors looking to purchase properties in that area.

Moreover, institutional investors frequently buy residential units with the intention of renting them to generate long-term yields on their investments (Mühlhofer, 2019; Cvijanović et al., 2022). Hence, large-scale purchases can reduce the available housing supply for individual home buyers, potentially driving up prices due to the scarcity of units to be purchased. The impact of this channel will be particularly pronounced in those markets where household preferences are strongly skewed towards home ownership as opposed to renting. In fact, where the two options are not seen as substitutes, higher scarcity in units for sale will drive up prices, ceteris paribus. In those markets where households do not strongly prefer home ownership over renting and the two options are seen as substitutes, an increase in investor demand and subsequent upward pressure on house prices might still come from people choosing to buy homes instead of renting when rental rates rise. In fact, in areas with a substantial institutional investor presence, their rental pricing strategies, aimed at maximising their investments returns, can influence the overall rental market rates, indirectly affecting property values. In this regard, some institutional investors might invest in upgrading or renovating properties to attract higher-paying tenants. These improvements can contribute to an increase in property values within the surrounding area, affecting overall market prices and rents. These findings are corroborated by the historical decomposition of house prices, which shows that, starting from 2010, namely since investors' presence in the EA RRE market has started to increase at a greater pace, the relative contribution of institutional investors to house prices is positive and larger in magnitude

Figure 5: *Median responses and 68 per cent credibility intervals to a 1 standard deviation increase in institutional investors' gross purchases of residential assets. Estimation sample: 2007Q1-2021Q4.*



(see Appendix A).

To the best of our knowledge, this represents the first empirical evidence on the significance of institutional investors role in the aggregate dynamics of the euro area housing market. It shows that the presence of institutional investors, despite being highly concentrated in certain regions, plays a large enough role to influence the overall price levels and, as such, institutional investors should be regarded as systemically relevant players. In our view, this represents a key result and warrants careful consideration of institutional investors when studying aggregate RRE market dynamics, especially from a financial stability perspective. One reason is that institutional investors, especially investment funds, tend to be subject to a number of pro-cyclical behaviours and structural vulnerabilities that can amplify market cycles and have adverse effects on those markets. For example, positive flow-performance relation dynamics can lead to higher investment volumes and hence higher housing purchases in times of strong performance and increasing prices while a poor performance might prompt investors to redeem their investments, resulting in abrupt outflows. Given the illiquidity of real estate as an asset class, there is a particularly high risk that such outflows may lead to funds engaging in firesales, further depressing market prices, and potentially giving rise to negative feedback loops. As mentioned above, Daly et al. (2023) highlights that approximately 80 per cent of euro area real estate fund assets are held in open-ended structures, creating substantial exposure to this type of run risk.

The latter is confirmed by another insight that is worth highlighting in Figure 5. An increase in demand from institutional investors for residential units tends to push up house prices, but, as one would expect, this does not affect households' income. The latter is

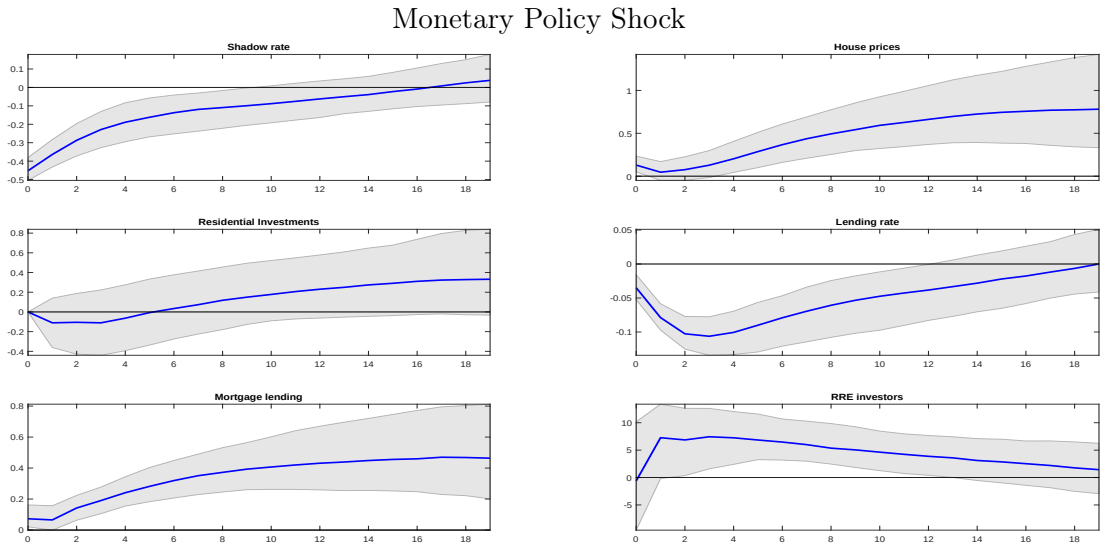
true on impact by assumption, but it holds true also in subsequent periods where responses are left unrestricted. An increase in prices not accompanied by an increase in households income would result in a decrease in housing affordability for the households sector. This corroborates the concern that the presence of institutional investors might lead to a increase in prices faster than what in line with economic fundamentals (proxied by households' disposable income) and, most importantly, it suggests that the impact is empirically significant also at aggregate level, confirming a systemic role of institutional investors in affecting not only house prices dynamics but also housing affordability. Given the uneven distribution of investors across region, we will explore this aspect also at regional level of granularity, as presented in the next Section.

A common empirical challenge faced in the literature when studying the impact of institutional investors on price dynamics is the "reverse causality" problem. Institutional investors enter the housing market in search for yields, hence it is likely that their presence will be larger in those markets where they foreseen higher price growth and hence better earnings. Pinpointing whether the increased demand from institutional investors is the primary driver of price increases or if rising prices attract more investor interest becomes challenging. In this context, adopting a structural approach is particularly convenient. In fact, structural VAR models are well-suited to deal with reverse causality issues by imposing identifying restrictions that can isolate structural shocks and disentangle the causality among endogenous variables included in the model. We will also further examine this issue in the next Section.

We now look at the response of mortgage volumes to institutional investors' demand shock. The positive and statically significant reaction, slightly delayed with respect to prices, suggests that the price increase induced by the demand-push shock feeds through higher credit volumes. This can occur, for example, via an increase in financing needs by individual buyers due to increasing prices, or also via increased collateral values, thus strengthening the balance sheets of both households and banks. By influencing the amount of cash available to lenders to originate new loans, institutional investors' participation in these markets may have an indirect impact on the volume of mortgages issued. Abstracting from the prevailing channel, this evidence points to a clear link between bank and non-bank activity via the real estate market.

Monetary policy shock. Turning to the monetary policy shock (Figure 6), we find that an easing monetary policy shock transmits to the housing market mainly through a lower bank lending rate and leads to a positive yet delayed response in house prices, in line with standard findings in the economic literature. However, we do also find that an accommodative monetary policy shock has a positive and statistically significant impact on institutional investors' residential purchases. Taken together, these results give empirical grounds to Schnabel (2021), suggesting that increased participation in housing markets by investors from 2013 onwards may have been driven by low-for-long monetary

Figure 6: *Median responses and 68 per cent credibility intervals to a 1 standard deviation decrease in the euro area shadow rate. Estimation sample: 2007Q1-2021Q4.*



policy.[8] This makes intuitive sense, as easing monetary policy can increase institutional investors' demand for real estate due to several factors. Lower financing costs make it easier for investors to finance property acquisitions or development projects, increasing their appetite for capital-intensive investments. Real estate assets are more attractive in a lower interest rate environment than traditional fixed-income investments, offering high returns in terms of capital growth or rental income. Furthermore, easing monetary policy can protect against potential future inflationary pressures by increasing property values and rental income within certain inflation ranges. Lower bank lending rates and economic activity following a monetary stimulus can also encourage demand for housing, leading to higher property values and capital appreciation. In general, easing monetary policy fosters an environment favourable to real estate investment, making residential real estate an attractive investment option for institutional investors. This raises the possibility that the uneven distribution of institutional investors across the euro area may give rise to a heterogeneous response of housing markets to the euro area's common monetary policy. We will also examine this in the next Section.

5 Institutional investors and regional market dynamics

Having examined aggregate dynamics, we take advantage of the granularity of our data set and examine the role of institutional investors at the regional level. First, we re-assess the link between institutional investor demand and prices to confirm our previous results,

[8] Looking at the cumulated series of identified monetary policy shocks (see Appendix A), it can be observed that the accommodative monetary policy stance in place during the "low for long" period, was accompanied by a series of unexpected loosening shocks.

this time using a dynamic panel data model. We then examine whether the presence of institutional investors has implications for the way real estate markets behave. If institutional investors are able to affect aggregate market outcomes - as we have shown above - then markets where they are particularly prevalent may be exposed to a very different range of shocks compared to markets where buyers are almost entirely households. The heterogeneity in institutional investor presence across the euro area allows us to study this empirically and we take a comprehensive approach to our question, examining transmission of real economy, monetary policy and financial market developments.

5.1 Regional house price growth

Our transaction-level data can be easily aggregated to the regional level, but access to other variables is more challenging. In particular, traditional house price indices are not widely available at the regional level for the euro area. To produce our dependent variable, house price growth, we rely on residential real estate collateral valuation data from the European Data Warehouse (EDW) and apply an approach first laid out in Battistini et al. (2022). EDW is a loan-level data set compiled using data provided to the ECB when residential mortgage-backed securities (RMBS) are used as collateral for the ECB lending facility.[9] As part of this data set, property valuation figures associated with individual mortgages are provided and we use this to produce regional indices of residential property values at the regional level (NUTS2). As a low number of housing transactions by region and quarter might introduce excessive noise, we smooth our house price data by computing a 12-month moving average.

Due to cross-country differences in the use of securitised mortgages as collateral in ECB operations - sufficient data is only available to produce indices for a subsample of euro area countries: Belgium, Germany, Spain, France, Ireland, Italy, the Netherlands, and Portugal. It should be noted that, even for these countries, the data set will only include those mortgages which were securitised and then used as collateral with the ECB and so will only reflect a subsample of mortgage lending within a given country or region. However, Battistini et al. (2022) aggregate the data at the country level and find a satisfactory level of correlation between our indices and traditional house price indices.

Summary statistics for each variable using the final matched data set are shown in Appendix B. Due to data availability constraints, the final merged data set for the regional analysis ranges in a time window between 2008 and 2020 and covers 133 NUTS2 regions. Occasionally, some additional data availability constraints might further restrict the time

[9] EDW has been introduced by the European Central Bank in 2011 as part of its Asset-Backed Securities (ABS) loan-level data (LLD) initiative and it started collecting data in 2014. The LLD initiative establishes specific information requirements for ABSs and for non-marketable debt instruments backed by eligible credit claims accepted as collateral in Eurosystem credit operations. In particular, we use loan-level data for loans belonging to a RMBS.

window, the frequency of observations or the number of available regions.

5.2 Investor demand and price dynamics

We first use our regional panel data to confirm the link between investor demand and house prices shown in our BVAR model in Section 4. In the euro area aggregate analysis explained in Section 4, we used the total gross residential purchases by institutional investors to measure institutional investor demand for residential property, and then identified a shock using sign restrictions. As we move to a panel regression setting in the current Section, we replicate this institutional investors demand variable at the regional level, computing the local NUTS2 ratio of investor purchases over GDP as a deviation from historical averages. Although the regional panel does not allow for a straightforward exogenous shock identification, we select a range of observable control variables and fixed effects to reduce endogeneity concerns.

We use a panel local projection model (Jordà, 2005; Jordà, 2023) and our baseline regression equation presents as follows:

$$y_{i,t+h} = \alpha + \beta \cdot D_{i,t} + \lambda' \cdot X_{i,t} + \delta_i + \kappa_t + \epsilon_{i,t} \tag{2}$$

Where y is house price growth in region i and quarter $t+h$. Institutional investor demand D is calculated at regional (i) level by summing up total purchases by institutional investors in the quarter t, normalising by regional quarterly GDP and finally calculating its deviation from the historical mean.[10]

Of course any study of the relationship between these two variables is subject to a range of missing variable concerns, including bias where both house price growth and investor demand are jointly driven by other factors. We address these concerns in a variety of ways. First, we include as many relevant control variables as are available in regional data. $X_{i,t}$ time-region controls include current house price growth, quarterly GDP per capita (thousand population), GDP growth, and population growth (all calculated on 12 month moving averages to smooth out seasonality) and the shadow rate. Controlling for local GDP per capita and current GDP growth, in particular, should account for investors choosing richer or more economically successful parts of the euro area, which may also have higher house price growth. We account for the shadow rate as it is likely that low interest rates are driving both house prices and investor demand.

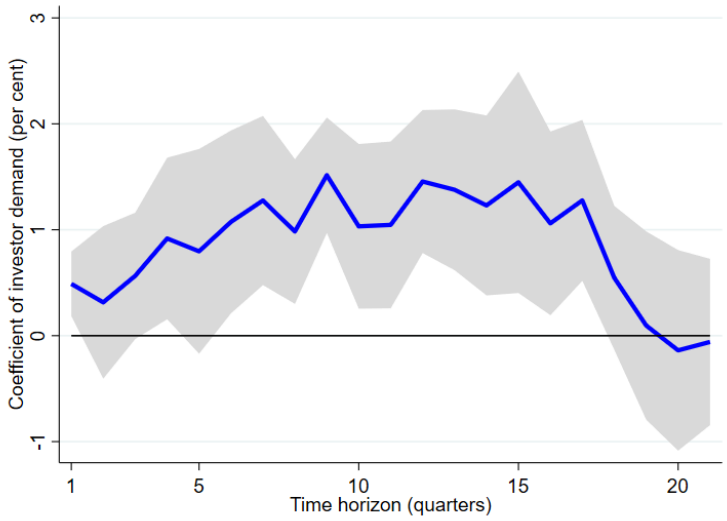
[10] Extreme values at the right-hand side of each regional distribution are truncated at 5 per cent in order to avoid upward bias given by unusually large transactions.

We also accept that our range of available control variables is limited and many institutional, policy, and regulatory factors may be difficult to empirically control for using specific variables. We address this by using region (δ) and year (κ) fixed effects to control for broad euro area macroeconomic conditions and regional time-invariant characteristics.

Given that our panel data has a sufficiently long time dimension, we estimate the model using ordinary least squares (Wooldridge, 2010). We cluster standard errors at the region level throughout.

The results shown in Figure 7 reflect the previous BVAR results: the impact of institutional investor demand on house price growth remains positive and significant over the medium term. Table 6 in Appendix B shows this result in table form at the four quarter ahead horizon, as this is the horizon we will focus on for rest of the paper (findings are robust to variation in this horizon). Results in this table show that findings also hold when we normalise investor activity by population instead of GDP (Column 2). Table 7 shows that our results are robust to removing the current house price growth control, which could be a possible source of Nickell bias.

Figure 7: *Impulse response from local projection of future house prices on investor demand qualitatively confirms BVAR results within a region and holding broad euro area conditions constant*



Notes: The figure plots the regression coefficients on investor demand in a regression of house prices at different future time horizons on investor demand and a set of controls, following Jordà (2005). The estimated model refers to Equation 2, including region- and year- fixed effects. 90 per cent confidence intervals shown. Estimation sample: 2007Q1-2021Q4.

Reverse causality remains a key endogeneity concern as institutional investors may be better able than households to identify markets where prices are going to increase in the future and may invest in a market on this basis. Controlling for current house price growth should, in theory, account for any currently available information about the housing market, including expectations of future growth. Furthermore, additional control variables should

account for the most important local fundamentals that institutional investors would use to identify markets where they expect future house price growth, namely population growth, economic growth, economic prosperity per capita, and monetary policy.

As an additional check, we run several regressions in which investor demand is the dependent variable and future house price growth is instead an explanatory variable (Appendix B Table 8). First, we run a simple regression with future house price growth as our only explanatory variable (Column 1). As expected, one year before a rise in house prices we typically see a rise in investor demand. However, once we include all of our control variables, including the shadow rate, we no longer find a statistically significant reverse causality relationship when including relevant control variables and fixed effects (Column 4).

Further regressions in Appendix B (Tables 9 and 10) investigate if institutional investors are simply able to identify undervalued markets and buy assets in these locations. Although in this case they may still be driving price growth, they would not be driving overvaluation.[11] As a simple test, we run two sets of regressions. First, we regress our investor demand variable on dummy variables reflecting simple measures of overvaluation and undervaluation in national housing markets. We classify a market as being over (under) valued when the house price to income ratio is 5% over (below) its national long run average. The results show that investor demand is typically higher in overvalued markets, so investors do not appear to be focusing on undervalued markets. Second, we add this measure of undervaluation as an interaction to our investor demand variable in the original regression set up. We find no evidence that the link between investor demand and house price growth is driven just by undervalued markets. These results are robust to replacing the house price to income variable with an econometric measure of house price overvaluation produced by the ECB.[12]

5.3 Investor presence and market response to macrofinancial shocks

To gauge the importance of institutional investors in a given market, we introduce a new *investor participation* variable, which we calculate as a 3-year rolling average of total institutional investor purchases normalised by GDP in region i and period t. While the *investor demand* variable used in the previous section captures short term fluctuations in investor demand, *investor participation* takes a longer term perspective and aims to capture the extent of institutional investor presence in a given market. In particular,

[11] A detailed analysis of the role of institutional investors in driving prices towards or away from equilibrium values is beyond the scope of this paper. We are also unable to study hedonic prices because of the lack of crucial building-level characteristics in our transaction-level dataset.

[12] This measure is the residual from a Bayesian static equation method and is available on ECB SDW as part of its Residential Property Valuation (RESV) data set. For further information on this model, see Box 3 in Financial Stability Review, ECB, June 2011. Unfortunately, neither measure is available at the regional level.

accounting for the longer time horizon aims to avoid conflating temporary purchases with structural investor presence. We present results for an alternative specification of *investor participation* using a 5 year horizon in Appendix B and our findings are broadly unchanged.

5.3.1 Sensitivity to local real economy

Regarding local economic fundamentals, we focus on the link between household earnings - i.e. the amount of money households might have to buy a home - and local house prices. We measure this using annual growth in the compensation of employees, which is available at the regional level via Eurostat ($M_{i,t}$). However, this is only provided on an annual basis, so for this part of our analysis, we run regressions at the year-region level. We include the same $X_{i,t}$ time-region controls as in the previous set of regressions, and our baseline specification is as follows:

$$y_{i,t+4} = \alpha + \beta_1 \cdot P_{i,t} + \beta_2 \cdot P_{i,t} \cdot M_{i,t} + \beta_3 \cdot M_{i,t} + \lambda' \cdot X_{i,t} + \epsilon_{i,t} \tag{3}$$

The first two columns of Table 2 show our results. As expected, higher local household income growth is indeed associated with higher future house price growth. However, the negative coefficient on the interaction term between household income measure and investor presence suggests that this relationship is weaker in markets where institutional investors play a greater role. The size of these effects is also economically significant. Results in Column 1 suggest that the sensitivity of house prices to wages is 22% weaker in the average region with institutional investor presence compared to a region with no institutional investors. For the 80th percentile value of investor participation (among regions where the value is not zero) the sensitivity is 31% weaker. These findings are robust to the inclusion of both country (Column 1) and region-fixed effects (Column 2) which will account for potential time-invariant confounding factors - both observable and unobservable factors - which result in certain countries or regions tending to have higher/lower house price and household income growth.

From a financial stability perspective, this intuitive result could have a number of implications. First, this dynamic may insulate housing markets from the effect of local economic shocks, for example supporting house prices during periods of low wage growth. However, most definitions of overvaluation rest on the price of an asset deviating from what can be explained by economic fundamentals. Following this approach, the presence of institutional investors in markets may lead to overvaluation of house prices, particularly during periods where investor demand for this type of asset is high. Moreover, (as highlighted in Section 4) this may also result in housing affordability issues, including higher LTIs on mortgages within the banking system, and may increase the vulnerability of housing markets to sharp corrections, particularly in response to any turnaround in institutional investor demand.

Table 2: *Markets with more institutional investors appear less sensitive to local economic dynamics and more sensitive to monetary policy*

VARIABLES	(1) Compensation of employees Country FE	(2) Compensation of employees Region FE	(3) EA shadow rate Country FE	(4) EA shadow rate Region FE
GDP per capita (th.)	0.0226	0.165*	0.0164	0.256
	(0.0163)	(0.0859)	(0.0517)	(0.235)
House price growth	-0.183***	-0.225***	-0.105***	-0.139***
	(0.0478)	(0.0481)	(0.0360)	(0.0363)
GDP growth	-0.190	-0.213	-0.00618	-0.0141
	(0.144)	(0.163)	(0.0659)	(0.0766)
Population growth	0.689**	0.692**	1.030***	1.035***
	(0.275)	(0.327)	(0.263)	(0.347)
Investors participation	6.311*	10.75***	-0.459	0.443
	(3.264)	(4.090)	(0.494)	(1.112)
Comp. employees growth	0.458***	0.441***		
	(0.135)	(0.137)		
Inv. partic. # Comp. empl. growth.	-0.892*	-1.091**		
	(0.535)	(0.546)		
Shadow rate			-0.408***	-0.371***
			(0.0723)	(0.0845)
Inv. partic. # Shadow rate			-0.882***	-0.904***
			(0.278)	(0.294)
Constant	-0.437	-4.747*	-0.140	-1.389
	(0.497)	(2.492)	(0.380)	(1.667)
Observations	1,556	1,556	6,452	6,452
R-squared	0.165	0.073	0.152	0.044
Fixed effects	Country	Region	Country	Region
Number of NUTS2		133		133

Dependent variable: 4-quarter-ahead house price growth.
Robust standard errors clustered at region level in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Note: For every region, investor participation is calculated as a 3 year moving average of total investor purchases on quarterly GDP. As in Section 4 the shadow rate is sourced from Krippner (2013). Regressions (1) and (2) are calculated on the dataset collapsed to annual frequency. Regressions (3) and (4): house price growth, GDP growth, population growth, and quarterly GDP per thousand population are smoothed by a 12 month moving average. Estimation sample: 2007Q1-2021Q4.

5.3.2 Sensitivity to monetary policy

Next, we examine whether the presence of institutional investors affects the link between monetary policy and house prices. Although we have shown in Section 4 that institutional investors respond to monetary policy, we now want to know if their presence also makes house prices more responsive to monetary policy changes. This is a particularly important question given that the euro area as a whole is subject to a single monetary policy, but the presence of institutional investors varies quite substantially across regions.

Monetary policy affects the willingness and capacity of households and institutional investors to buy real estate through different channels. Household demand may be primarily affected by variations in mortgage interest rates and the willingness of the banking system to extend credit. To a lesser extent, households may react to changes in the relative return on housing versus other investment assets. As discussed in Section 4, institutional investors may be more affected by this trade-off between real estate and other asset classes in terms of returns, with low interest rates driving a search for yield among investors. This may operate via intentional portfolio allocation decisions by the institutional investor themselves or - for example, among investment funds - inflows of funds from other investors making these types of decision. Institutional investors may also be affected by the price of borrowing from financial markets, with this determining their capacity and willingness to increase leverage to purchase (more) real estate.

We repeat our specification shown in Equation 3, replacing the household income variable with the shadow rate variable used in our BVAR analysis. The results are shown in Columns 3 and 4 of Table 2. As we would expect, we find a negative and statistically significant relationship between the shadow rate and future house price growth. We also find a negative and statistically significant result for the interaction with investor presence. This finding holds for specifications with both country- and region-fixed effects. Again, findings are also economically significant. The average region with positive investor presence has a 16% stronger sensitivity of house prices to the shadow rate. For the 80th percentile region this rises to 23%.

This suggests that institutional investors can amplify monetary policy transmission via housing markets. This makes sense given the period in question, when unprecedentedly low returns on traditional safe assets pushed institutional investors into riskier asset classes (see, for example, Giuzio et al., 2021). Among real estate funds, this drove persistent fund inflows, resulting in the sector more than tripled in size in the decade following 2012 (Daly et al., 2023). While households also faced low interest rates on mortgage borrowing, they may not have had the same pressure to increase real estate investments. This finding also provides further evidence for the argument in Schnabel (2021) that institutional investors may have played a role in the persistent house price growth seen over this period.[13]

[13] As a robustness test we also run this analysis with the alternative measure of the shadow rate from

Table 3: *Markets with a high institutional investor presence appear to be more sensitive to financial market developments.*

VARIABLES	(1) Country FE 4q horizon	(2) Country FE 12q horizon	(3) Region FE 4q horizon	(4) Region FE 12q horizon
GDP per capita	0.0986*	0.116**	0.898***	0.488**
	(0.0579)	(0.0514)	(0.341)	(0.233)
House price growth	-0.100***	-0.111***	-0.144***	-0.132***
	(0.0358)	(0.0279)	(0.0354)	(0.0304)
GDP growth	0.0195	0.119**	-0.0103	0.0661
	(0.0598)	(0.0487)	(0.0788)	(0.0482)
Population growth	0.856***	-0.270	0.740**	-0.679**
	(0.282)	(0.240)	(0.370)	(0.278)
Investors participation	4.783***	4.417**	5.642***	6.092**
	(1.499)	(1.793)	(2.031)	(2.355)
VSTOXX (Mean)	0.0372***	-0.159***	0.0562***	-0.150***
	(0.0121)	(0.0171)	(0.0141)	(0.0175)
Inv. partic. # VSTOXX (Mean)	-0.154***	-0.134*	-0.135**	-0.149
	(0.0531)	(0.0741)	(0.0673)	(0.0947)
Constant	-1.310***	3.413***	-7.298***	1.014
	(0.483)	(0.517)	(2.643)	(1.816)
Observations	6,452	5,381	6,452	5,381
R-squared	0.138	0.182	0.037	0.075
Fixed effects	Country	Country	Region	Region
Number of NUTS2			133	133

Dependent variable: 4-quarter-ahead house price growth.
Robust standard errors clustered at region level in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Note: For every region, investor participation is calculated as a 3 year moving average of total investor purchases on quarterly GDP. House price growth, GDP growth, population growth, and quarterly GDP per thousand population are smoothed by a 12 month moving average. "Mean" VSTOXX refer to quarterly aggregate statistics. Estimation sample: 2007Q1-2021Q4.

5.3.3 Sensitivity to financial markets

Finally, we examine whether institutional investors create a link between local housing markets and financial market developments.

Table 3 shows a final set of specifications that interact our investor participation variable

Wu and Xia (2016). Although results remain broadly the same in terms of coefficient sign and significance, the size of the interaction terms' coefficients decrease substantially. The shadow rate measures deviate from each other during the period when monetary policy was mostly accommodative, suggesting that the strength of the result with our chosen shadow rate variable comes from investor behaviour during this period.

with VSTOXX, a measure of volatility in euro area equity markets. We source its values from Bloomberg. We enter VSTOXX into our regressions as its average value over a quarter. Here, we might expect housing markets with a high level of institutional investor presence to experience a bigger decline in house price growth following an increase in financial market volatility measured by VSTOXX. This could be, for example, because institutional investors fund themselves directly from financial markets or because financial market volatility reduces inflows to real estate investment funds.

When we run our regression with 4 quarter ahead house price growth as our dependent variable, as we have done throughout the rest of the paper, we do find a negative and statistically significant coefficient on the interaction term between VSTOXX and investor participation (Column 1), as expected. The positive and significant coefficient for VSTOXX entered alone is less intuitive. However, it is possible that households respond more slowly to financial market factors than institutional investors. For example, their exposure to financial market volatility may operate via banks' credit supply, and it may take time for banks' decreased appetite for mortgage lending following market volatility to feed through to house prices. At the same time, if VSTOXX acts as an early warning signal for crises, it may typically spike during periods when house price growth is still high, thus explaining the positive and statistically significant coefficient over a relativly short time horizon.

We test this hypothesis by expanding the time horizon of our dependent variable to 12 quarter ahead house price growth. Here, we find that all markets typically experience lower house price growth following a VSTOXX increase, while the impact of institutional investor presence appears to weaken. We interpret this combination of results as follows: financial market volatility is ultimately associated with lower house price growth across all markets, but the participation of institutional investors speeds up this transmission and creates downward pressure on house prices in the quarters immediately following the increase in volatility.

All results shown in Table 3 are robust to including region-fixed effects in Columns 3 and 4. Additional specifications in Appendix B further confirm the robustness of the results to spikes in volatility proxied by maximum quarterly VSTOXX and average investor participation over a 5 year horizon.

6 Conclusions and way forward

Institutional investors, such as investment funds, play an increasingly important role in euro area housing markets. However, evidence on how their behaviour can affect market dynamics remains scarce, in large part due to a lack of available data. We exploit informa-

tion from a novel transaction-level data set to link the presence of institutional investors to house price dynamics in the euro area. In a BVAR setting, we find that a demand shock from institutional investors has a positive and persistent effect on residential house price growth and mortgage lending volumes. Investors also tend to increase their demand following a loosening in monetary policy. Complementing our findings in a regional panel regression framework, we also show that house prices in regions with a high presence of institutional investors tend to grow faster and become detached from regional economic fundamentals, such as household income or wage growth. Institutional investors may, as such, contribute to overvaluation and become drivers of affordability concerns. Finally, they may increase the sensitivity of housing markets to financial market shocks and may amplify the effects of monetary policy.

Taken together, these findings suggest that institutional investors play a macroeconomically relevant role in euro area housing market dynamics and that understanding this role is an important component of assessing the vulnerability of different housing markets to real economy, monetary policy, and global shocks.

Moreover, the predominance of investment funds among these investors gives rise to the possibility that vulnerabilities among real estate funds could have implications for wider euro area real estate markets. A central concern of policy makers regarding real estate funds is liquidity mismatch. Real estate funds hold highly illiquid assets, but in the euro area 80 per cent of their assets are in open-ended structures, raising the possibility that sharp redemptions could drive firesale activity by funds (Daly et al., 2023). Given we have shown that these investors are able to influence market prices, this firesale activity could create negative feedback loops between market prices and fund redemptions. Where institutional investor activity has driven overvaluation in the market, prices may be more vulnerable to a disorderly market correction.

This further emphasises the importance of widening the macroprudential toolkit to allow financial stability authorities to mitigate financial stability risks from this sector. As discussed by Daly et al. (2023), suitable policies could include managing liquidity demands, internalising the costs of redemptions during market stress and ensuring fund managers have the capacity to enact adequate the use of liquidity management tools such as redemption fees or gates. Policy measures that address structural liquidity mismatch could also be considered, such as increasing the share of liquid assets held, lower redemption frequencies, longer notice and settlement periods, and longer minimum holding periods. More frequent valuations would improve transparency and asset value, reducing the risk of first-mover advantage.

The use of leverage by real estate funds may also amplify market procyclicality. Muñoz and Smets (2022) provides a theoretical examination of the impact of leverage limits on real estate funds. They find that such an instrument could be effective in smoothing house

price, business cycle and credit dynamics. Notably, such an instrument has also been introduced by the Central Bank of Ireland in the form of a 60 per cent leverage limit on the ratio of property funds' total debt to their total assets. In line with our findings, this measure was motivated by the pronounced presence of funds in Irish property markets and by concerns that a shock to the fund sector could have negative implications for wider Irish real estate market outcomes as a result.[14]

Of course, our findings also have implications for wider policies related to housing, such as housing supply and housing access. For now we will consider these issues beyond the scope of our work, but also to be important areas for future research.

[14]For further detail see the Central Bank of Ireland's macroprudential policy framework for Irish property funds.

References

Aastveit, Knut Are, Bruno Albuquerque, and Andre K. Anundsen, "Changing Supply Elasticities and Regional Housing Booms," *Journal of Money, Credit and Banking*, 2023.

Adrian, Tobias, Paolo Colla, and Hyun Song Shin, "Which financial frictions? Parsing the evidence from the financial crisis of 2007 to 2009," *NBER Macroeconomics Annual*, 2012, *27* (1), 159 – 214.

Aladangady, Aditya, "Housing wealth and consumption: evidence from geographically linked microdata," *American Economic Review*, 2017, *107* (11), 3415–3446.

Allen, Marcus T., Jessica Rutherford, Ronald Rutherford, and Abdullah Yavas, "Impact of investors in distressed housing markets," *The Journal of Real Estate Finance and Economics*, 2017, *56* (4), 622 – 652.

Altavilla, Carlo, Matthieu D. Pariès, and Giulio Nicoletti, "Loan supply, credit markets and the euro area financial crisis," *Journal of Banking and Finance*, 2019, p. 105658.

Alter, Adrian and Zaki Dernaoui, "Non-Primary Home Buyers, Shadow Banking, and the US Housing Market," 2020, (174).

Álvarez-Román, Laura and Miguel Garcia-Posada, "Are house prices overvalued in Spain? A regional approach," *Economic Modelling*, 2021, *99*, 105499.

Arias, Jonas E., Juan F. Rubio-Ramírez, and Daniel F. Waggoner, "Inference Based on Structural Vector Autoregressions Identified With Sign and Zero Restrictions: Theory and Applications," *Econometrica*, 2018, *86* (2), 685 – 720.

Banegas, Ayelen, Gabriel Montes-Rojas, and Lucas Siga, "Mutual Fund Flows, Monetary Policy and Financial Stability," Technical Report, Board of Governors of the Federal Reserve System (US) 2016.

Battistini, Niccolò, Matteo Falagiarda, Angelina Hackmann, and Moreno Roma, "Navigating the housing channel of monetary policy across euro area regions," *ECB Working Paper Series*, 2022, *2752.*

Becker, Bo and Victoria Ivashina, "Cyclicality of credit supply: Firm level evidence," *Journal of Monetary Economics*, 2014, *62*, 76 – 93.

Berger, David, Veronica Guerrieri, Guido Lorenzoni, and Joseph Vavra, "House prices and consumer spending," *The Review of Economic Studies*, 2018, *85* (3), 1502–1542.

Campbell, John Y. and Roman Sigalov, "Portfolio choice with sustainable spending: A model of reaching for yield," *Journal of Financial Economics*, 2022, *143* (1), 188–206.

Chen, Q., I. Goldstein, and W. Jiang, "Payoff complementarities and financial fragility: Evidence from mutual fund outflows," *Journal of Financial Economics*, 2010, *97* (2), 239 – 262.

Cloyne, James, Clodomiro Ferreira, and Paolo Surico, "Monetary policy when households have debt: new evidence on the transmission mechanism," *The Review of Economic Studies*, 2020, *87* (1), 102–129.

Cvijanovic, Dragana, Stanimira Milcheva, and Alex Van de Minne, "Impact of Institutional Investors on Real Estate Risk," *Available at SSRN 3942539*, 2021.

Cvijanović, Dragana, Stanimira Milcheva, and Alex Van de Minne, "Preferences of Institutional Investors in Commercial Real Estate," *Journal of Real Estate Finance Economics*, 2022, *65*, 321–359.

Daly, Pierce, Lennart Dekker, Sean O'Sullivan, Ellen Ryan, and Michael Wedow, "The growing role of investment funds in euro area real estate markets: risks and policy considerations," *Macroprudential Bulletin*, 2023, *144* (3).

De Fiore, Fiorella and Harald Uhlig, "Bank finance versus bond finance," *Journal of Money, Credit and Banking*, 2011, *43* (7), 1399 – 1421.

Duca, John V., "Making sense of increased synchronization in global house prices," *Journal of European Real Estate Research*, 2020, *13* (1), 5–16.

D'Lima, Walter and Paul Schultz, "Buy-to-Rent Investors and the Market for Single Family Homes," *Journal of Real Estate Finance and Economics*, 2022, *64*, 116 – 152.

European Central Bank, "Non-bank financial intermediation in the euro area: implications for monetary policy transmission and key vulnerabilities," *European Central Bank Occasional Paper Series No. 270*, 2021.

Feroli, Michael, Anil Kashyap, Kermit Schoenholtz, and Hyun Song Shin, "Market Tantrums and Monetary Policy," Working Paper 101, Chicago Booth 2014.

Furlanetto, Francesco, Francesco Ravazzolo, and Samad Sarferaz, "Identification of Financial Factors in Economic Fluctuations," *The Economic Journal*, 2017.

Gambetti, Luca and Alberto Musso, "Loan Supply Shocks and the Business Cycle," *Journal of Applied Econometrics*, 2017, *32* (4), 764–782.

Ganduri, Rohan, Steven Chong Xiao, and Serena Wenjing Xiao, "Tracing the source of liquidity for distressed housing markets," *Real Estate Economics*, 2023, *51* (2), 408 – 440.

Gao, Zhenyu, Michael Sockin, and Wei Xiong, "Economic consequences of housing speculation," *Review of Financial Studies*, 2020, *33* (11), 1 – 40.

Garriga, Carlos, Finn E. Kydland, and Roman Šustek, "Mortgages and monetary policy," *The Review of Financial Studies*, 2017, *30* (10), 3337–3375.

_ , Pedro Gete, and Athena Tsouderou, "Investors and Housing Affordability," *Federal Reserve Bank of St. Louis Working Paper*, 2021, (47).

_ , _ , and _ , "The Economic Effects of Real Estate Investors," *SSRN Electronic Journal*, 11 2022.

Gay, Sebastien, "Investors effect on household real estate affordability," 2015.

Gerali, Andrea, Stefano Neri, Luca Sessa, and Federico M. Signoretti, "Credit and Banking in a DSGE Model of the Euro Area," *Journal of Money, Credit and Banking*, 2010, *42*, 107–141.

Gertler, Mark and Peter Karadi, "A model of unconventional monetary policy," *Journal of Monetary Economics*, 2011, *58* (1), 17–34.

Gete, Pedro and Michael Reher, "Mortgage supply and housing rents," *The Review of Financial Studies*, 2018, *31* (12), 4884–4911.

Giuzio, Margherita, Christoph Kaufmann, Ellen Ryan, and Lorenzo Cappiello, "Investment funds, risk-taking, and monetary policy in the euro area," Working Paper 2605, European Central Bank 2021.

Goldstein, Itay, Hao Jiang, and David Ng, "Investor Flows and Fragility in Corporate Bond Funds," *Journal of Financial Economics*, 2017, *126* (3), 592 – 613.

Halket, Jonathan, Lars Nesheim, and Florian Oswald, "The housing stock, housing prices, and user costs: The roles of location, structure, and unobserved quality," *International Economic Review*, 2020, *61* (4), 1777 – 1814.

Hau, Harald and Sandy Lai, "Asset Allocation and Monetary Policy: Evidence from the Eurozone," *Journal of Financial Economics*, 2016, *120* (2), 309 – 329.

Hirata, Hideaki, M. Ayhan Kose, Christopher Otrok, and Marco E. Terrones, "Global house price fluctuations: Synchronization and determinants," in "NBER International Seminar on Macroeconomics," Vol. 9 University of Chicago Press Chicago, IL 2013, pp. 119–166.

Hoesli, Martin, "An investigation of the synchronization in global house prices," *Journal of European Real Estate Research*, 2020, *13* (1), 17–27.

Holm-Hadulla, Fédéric and Claire Thürwächter, "Heterogeneity in Corporate Debt Structures and the Transmission of Monetary Policy," Working Paper 2402, European Central Bank 2020.

Iacoviello, Matteo, "House Prices, Borrowing Constraints, and Monetary Policy in the Business Cycle," *American Economic Review*, June 2005, *95* (3), 739–764.

_ **and Stefano Neri**, "Housing market spillovers: evidence from an estimated DSGE model," *American Economic Journal: Macroeconomics*, 2010, *2* (2), 125–164.

Jarocinski, Marek and Frank Smets, "House prices and the stance of monetary policy," 2008.

Jordà, Òscar, "Local projections for applied economics," *Annual Review of Economics*, 2023, *15* (1), 607–631.

Jordà, Òscar, "Estimation and inference of impulse responses by local projections," *American economic review*, 2005, *95* (1), 161–182.

Jordà, Òscar., Moritz Schularick, and Alan M. Taylor, "Betting the house," *Journal of International Economics*, 2015, *96* (1), S2 – S18.

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

Krippner, Leo, "Measuring the stance of monetary policy in zero lower bound environments," *Economics Letters*, 2013, *118* (1), 135–138.

Lambertini, Luisa, Caterina Mendicino, and Maria Teresa Punzi, "Leaning against boom–bust cycles in credit and housing prices," *Journal of Economic Dynamics and Control*, 2013, *37* (8), 1500–1522.

Lambie-Hanson, Lauren, Wenli Li, and Michael Slonkosky, "Leaving Households Behind: Institutional Investors and the U.S. Housing Recovery," *Federal Reserve Bank of Philadelphia Working Paper*, 2019, (19).

Ma, Yiming, Kairong Xiao, and Yao Zeng, "Mutual Fund Liquidity Transformation and Reverse Flight to Liquidity," *The Review of Financial Studies*, 2022, *35* (10), 4674 – 4711.

McCarthy, Barra, "Institutional Investment and Residential Rental Market Dynamics," Technical Report, Central Bank of Ireland 2024.

Mian, Atif, Kamalesh Rao, and Amir Sufi, "Household balance sheets, consumption, and the economic slump," *The Quarterly Journal of Economics*, 2013, *128* (4), 1687–1726.

Mills, James, Raven Molloy, and Rebecca Zarutskie, "Large-Scale Buy-to-Rent Investors in the Single-Family Housing Market: The Emergence of a New Asset Class," *Real Estate Economics*, 2019, *47* (2), 399 – 430.

Mishkin, Frederic S, "Housing and the monetary transmission mechanism," 2007.

Morris, S., I. Shim, and H.S. Shin, "Redemption risk and cash hoarding by asset managers," *Journal of Monetary Economics*, 2017, *89*, 71 – 87.

Muellbauer, John, "When is a housing market overheated enough to threaten stability?," 2012.

Muñoz, Manuel A. and Frank Smets, "Macroprudential Policy and the Role of Institutional Investors in Housing Markets," *ESRB Working Paper Series*, 2022, *137*.

Mühlhofer, Tobias, "They Would If They Could: Assessing the Bindingness of the Property Holding Constraints for REITs," *Real Estate Economics*, 2019, *47* (2), 431–477.

Nocera, Andrea and Moreno Roma, "House prices and monetary policy in the euro area: evidence from structural VARs," Working Paper Series 2073, European Central Bank June 2017.

Pancrazi, Roberto and Mario Pietrunti, "Natural expectations and home equity extraction," *Journal of Housing Economics*, 2019, *46*, 101633.

Reinhart, Carmen M and Kenneth S Rogoff, "Is the 2007 US sub-prime financial crisis so different? An international historical comparison," *American Economic Review*, 2008, *98* (2), 339–344.

Ryan, Ellen, "Are fund managers rewarded for taking cyclical risks?," Working Paper 24652, European Central Bank 2022.

Schnabel, Isabel, "Monetary policy and inequality," *European Central Bank Speech*, 2021.

Smith, Patrick S and Crocker H. Liu, "Institutional Investment, Asset Illiquidity and Post-Crash Housing Market Dynamics," *Real Estate Economics*, 2020, *48* (3), 673 – 709.

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

Wooldridge, Jeffrey M, *Econometric analysis of cross section and panel data*, MIT press, 2010.

Wu, Jing Cynthia and Fan Dora Xia, "Measuring the Macroeconomic Impact of Monetary Policy at the Zero Lower Bound," *Journal of Money, Credit and Banking*, 2016, *48* (2-3), 253 – 291.

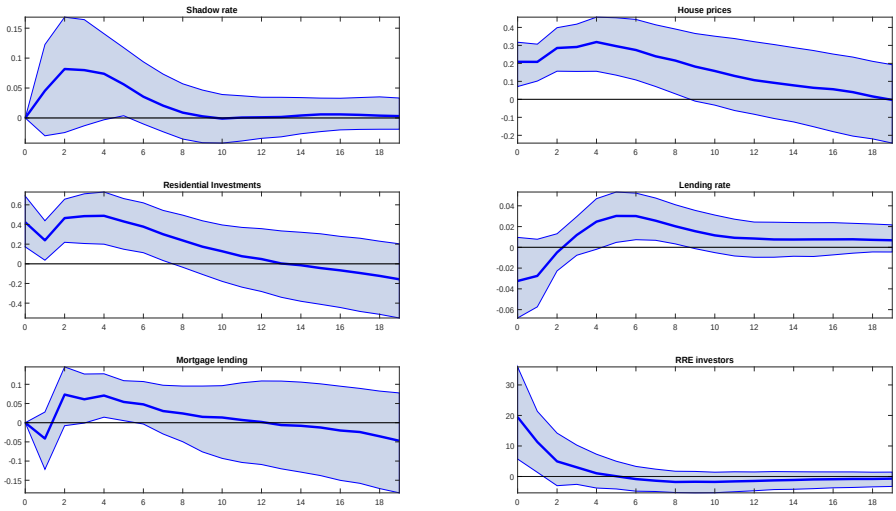
Appendices

A BVAR robustness checks

We run a number of robustness checks to ensure that the results of our main shock of interest, namely the institutional investors shocks, are stable across different specifications and identification schemes.

Specification with time trend

Figure 8: *RRE Institutional Investors Shock - Specification with time trend*



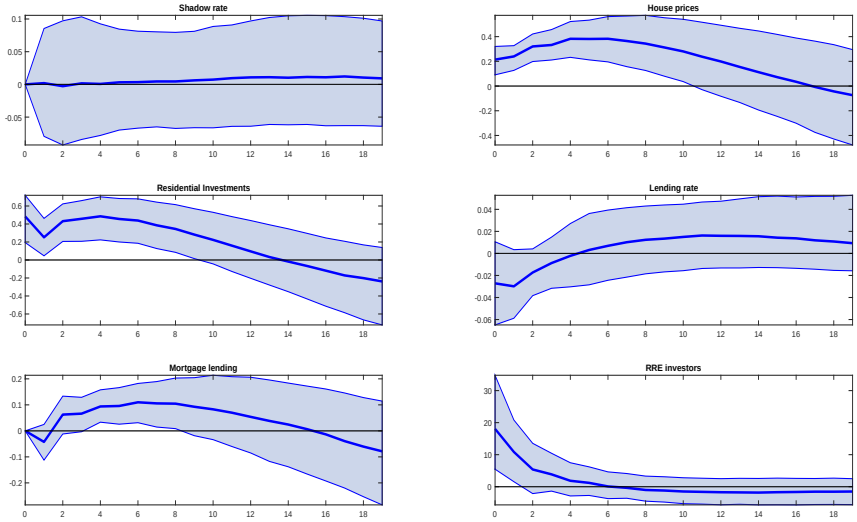
Notes: Median responses and 68 percent credibility intervals to a 1 standard deviation increase in institutional investors' gross purchases of residential assets.Estimation sample: 2007Q1-2021Q4.

Alternative signs and zero restrictions

Table 4: *Alternative restrictions used for each variable (in rows) to identify shocks (in columns) in our VAR. Asterisks indicate that the response of the variable is left unrestricted.*

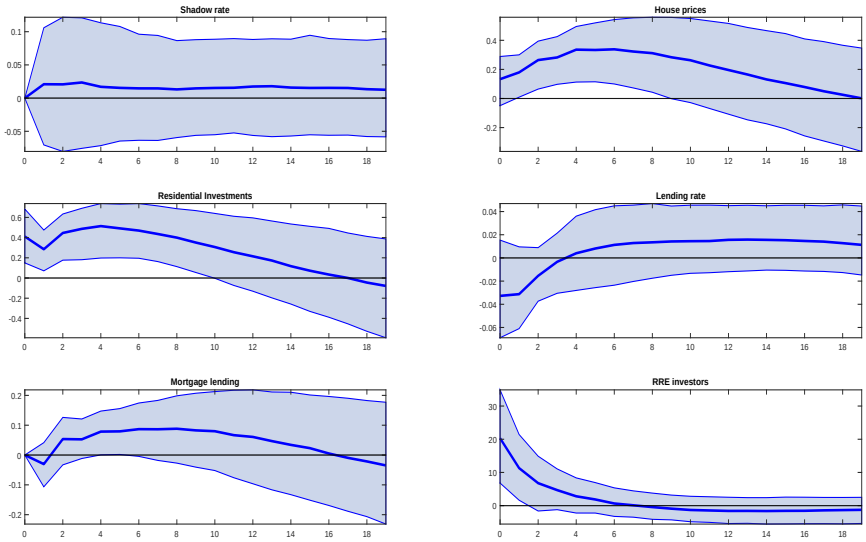
	Housing Supply	Housing Preference	Income	Mortgage Supply	Monetary Policy	Institutional Investors
Residential Investments	-	+	*	0	0	+
RRE Prices	+	+	*	+	+	+
Mortgage loans	*	+	+	+	+	0
Lending rate	0	+	+	-	-	0
Shadow rate	0	0	0	0	-	0
Disposable income	0	0	+	0	0	0
Inst. investor purchases	0	0	0	0	*	+

Figure 9: *RRE Institutional Investors Shock - Identification with alternative restrictions*



Notes: Median responses and 68 percent credibility intervals to a 1 standard deviation increase in institutional investors' gross purchases of residential assets.Estimation sample: 2007Q1-2021Q4.

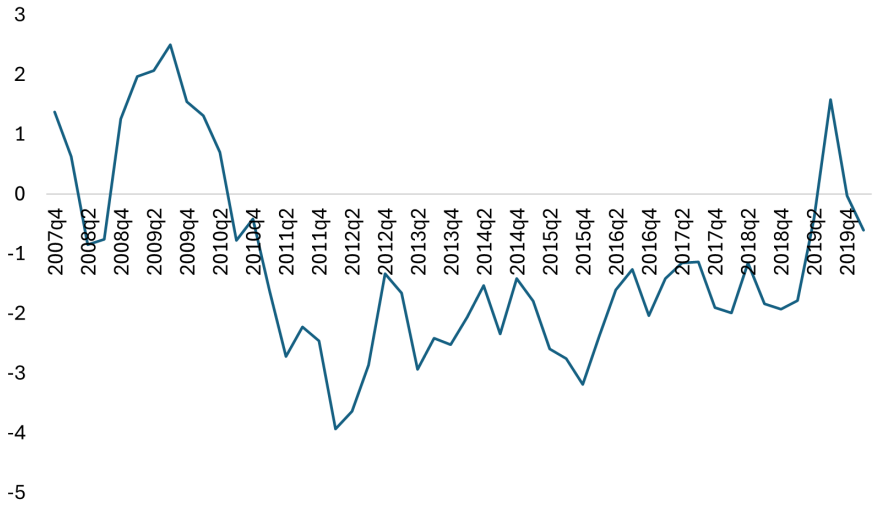
Figure 10: *RRE Institutional Investors Shock - Responses with house prices left unrestricted*



Notes: Median responses and 68 percent credibility intervals to a 1 standard deviation increase in institutional investors' gross purchases of residential assets.Estimation sample: 2007Q1-2021Q4.

Cumulated monetary policy shock

Figure 11: *Cumulated series of identified monetary policy shocks. Estimation sample: 2007Q1-2021Q4.*



B Panel regression descriptive statistics and further robustness checks

Table 5: *Descriptive statistics for variables used in panel regressions*

	n	Mean	S.D.	p25	Median	p75
House price growth	6,452	0.99	5.77	-2.44	0.86	4.12
Investor demand	6,452	0.00	0.16	-0.02	0.00	0.00
Investor demand (alt.)	6,452	25.73	1,682.60	-175.27	0.00	0.00
Investor purchases	6,452	0.06	0.19	0.00	0.01	0.05
EA investor purchases	6,452	0.09	0.28	0.00	0.00	0.06
Foreign investor purchases	6,452	0.01	0.05	0.00	0.00	0.01
GDP growth	6,452	1.71	3.10	0.25	1.99	3.37
Population growth	6,452	0.25	0.66	-0.10	0.24	0.63
GDP per capita	6,452	7,672.02	2,545.51	6,099.47	7,238.85	8,784.05
Shadow rate	6,452	-0.89	1.77	-2.21	-1.35	0.29
VSTOXX (Quarter max)	6,452	26.55	9.63	19.12	24.67	31.33
VSTOXX (Quarter mean)	6,452	23.72	7.85	18.05	21.74	27.85

Note: Figures based on the regression sample shown in Table 4 at quarterly frequency. For each region in the sample, investor demand is calculated as the deviation from the historical average of the ratio between total investor purchases and quarterly GDP. The right tail of investor purchases is winsorised at 5%. The alternative version is calculated on population. For every region, investor participation is calculated as a 3 year moving average of total investor purchases on quarterly GDP. House price growth, GDP growth, population growth, and quarterly GDP per thousand population are smoothed by a 12 month moving average. As in Section 4 the shadow rate is sourced from Krippner (2013). Estimation sample: 2007Q1-2021Q4.

Table 6: *Panel regressions show a positive and statistically significant relationship between current investor demand and 4-quarter-ahead house price growth.*

VARIABLES	(1) Baseline	(2) Alternative	(3) Country FE	(4) Region FE	(5) Shadow rate
GDP per capita (th.)	0.336***	0.335***	0.0886	0.796***	-0.334
	(0.0893)	(0.0896)	(0.0575)	(0.285)	(0.278)
House price growth	0.0328	0.0327	-0.0997***	-0.140***	-0.219***
	(0.0352)	(0.0352)	(0.0361)	(0.0361)	(0.0329)
GDP growth	0.0900*	0.0907*	0.0130	-0.0195	0.174***
	(0.0513)	(0.0513)	(0.0615)	(0.0817)	(0.0465)
Population growth	-0.0341	-0.0307	0.974***	0.949***	0.942***
	(0.240)	(0.239)	(0.273)	(0.352)	(0.307)
Investor demand	1.384**		1.604**	1.041*	0.897*
	(0.541)		(0.631)	(0.547)	(0.455)
Investor demand (alt.)		0.000122**			
		(5.71e-05)			
Shadow rate					-0.718***
					(0.165)
Constant	-1.637***	-1.631***	-0.396	-5.058**	4.823**
	(0.609)	(0.612)	(0.404)	(2.057)	(2.206)
Observations	6,452	6,452	6,452	6,452	6,452
R-squared	0.027	0.027	0.136	0.031	0.151
Fixed effects	No	No	Country	Region	Region and Year
Number of NUTS2				133	133

Dependent variable: 4-quarter-ahead house price growth.
Robust standard errors clustered at region level in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

Note: For each region in the sample, investor demand is calculated as the deviation from the historical average of the ratio between total investor purchases and quarterly GDP. The right tail of investor purchases is winsorised at 5%. The alternative investor demand variable is investor purchases normalised by regional population. House price growth, GDP growth, population growth, and quarterly GDP per thousand population are smoothed by a 12 month moving average. As in Section 4 the shadow rate is sourced from Krippner (2013). Estimation sample: 2007Q1-2021Q4.

Table 7: *Panel regressions show a positive and statistically significant relationship between current investor demand and 4-quarter-ahead house price growth - Robustness check with no current house price growth control.*

	(1)	(2)	(3)	(4)	(5)
VARIABLES	Baseline	Alternative	Country FE	Region FE	Shadow rate
GDP per capita	0.333***	0.331***	0.0805	0.670**	-0.420*
	(0.0909)	(0.0913)	(0.0539)	(0.271)	(0.232)
GDP 1y growth	0.102**	0.103**	-0.00432	-0.0389	0.119***
	(0.0515)	(0.0515)	(0.0578)	(0.0740)	(0.0447)
Population 1y growth	-0.0544	-0.0510	0.874***	0.824**	0.741***
	(0.244)	(0.242)	(0.247)	(0.319)	(0.274)
Investor demand	1.444**		1.474**	0.966*	0.766*
	(0.567)		(0.577)	(0.497)	(0.445)
Investor demand (alternative)		0.000129**			
		(5.92e-05)			
EA shadow rate					-0.741***
					(0.184)
Constant	-1.574**	-1.567**	-0.229	-4.140**	5.425***
	(0.621)	(0.624)	(0.371)	(1.956)	(1.960)
Observations	6,470	6,470	6,470	6,470	6,470
R-squared	0.025	0.025	0.127	0.016	0.120
Fixed effects	No	No	Country	Region	Region and Year
Number of NUTS2				133	133

Dependent variable: 4-quarter-ahead house price growth.
Robust standard errors clustered at region level in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

Note: For each region in the sample, investor demand is calculated as the deviation from the historical average of the ratio between total investor purchases and quarterly GDP. The right tail of investor purchases is winsorised at 5%. The alternative investor demand variable is investor purchases normalised by regional population. House price growth, GDP growth, population growth, and quarterly GDP per thousand population are smoothed by a 12 month moving average. As in Section 4 the shadow rate is sourced from Krippner (2013). Estimation sample: 2007Q1-2021Q4.

Reverse causality and undervaluation robustness checks

Table 8: *We re-run analysis with future house price growth as an explanatory variable and current investor purchases as a dependent variable to check for reverse causality problems.*

VARIABLES	(1) No controls	(2) Baseline	(3) Region FE	(4) Shadow rate
GDP per capita		0.00370***	0.0459***	0.0306
		(0.00129)	(0.0145)	(0.0199)
House price growth, 1y ahead	0.00124***	0.000885**	0.000648*	0.000568
	(0.000390)	(0.000361)	(0.000372)	(0.000474)
GDP growth		0.00191*	0.000103	-0.000767
		(0.000994)	(0.000712)	(0.00112)
Population growth		0.0187***	0.0185***	0.0263***
		(0.00475)	(0.00626)	(0.00871)
Shadow rate				-0.00348
				(0.00412)
Constant	-0.00158***	-0.0343***	-0.354***	-0.262*
	(0.000516)	(0.0104)	(0.110)	(0.144)
Observations	7,093	6,470	6,470	6,470
R-squared	0.002	0.017	0.058	0.069
Fixed effects	No	No	Region	Region and Year
Number of NUTS2			133	133

Dependent variable: Current investor demand.
Robust standard errors clustered at region level in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Note: For each region in the sample, investor demand is calculated as the deviation from the historical average of the ratio between total investor purchases and quarterly GDP. The right tail of investor purchases is winsorised at 5%. House price growth, GDP growth, population growth, and quarterly GDP per thousand population are smoothed by a 12 month moving average. As in Section 4 the shadow rate is sourced from Krippner (2013). Estimation sample: 2007Q1-2021Q4.

Table 9: *Regressing indicators of market overvaluation on investor demand shows that demand is typically higher in overvalued markets*

	(1)	(2)
	Overvaluation	Undervaluation
VARIABLES	Year FE	Year/Country FE
Overvalued market	0.0269***	
	(0.00701)	
Undervalued market		-0.0321***
		(0.0113)
Constant	-0.0383***	-0.0244***
	(0.00909)	(0.00794)
Observations	7,448	7,448
R-squared	0.048	0.048
Fixed effects	Year	Country and Year

Dependent variable: investor demand
Robust standard errors clustered at region level in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Note: Left hand side variable is investor demand. For each region in the sample, investor demand is calculated as the deviation from the historical average of the ratio between total investor purchases and quarterly GDP. The right tail of investor purchases is winsorised at 5%. Real estate under and overvaluation is captured at the country-time level using deviations from long-term averages of the house price-to-income ratio. A market is defined over(under)valued if the ratio is more than 5 per cent above (below) its long-term average. Estimation sample: 2007Q1-2021Q4.

Table 10: *Interacting measure of undervaluation measures with the demand variable shows that the link between house price growth and investor demand is not driven by undervalued markets*

VARIABLES	(1) Baseline	(2) Alternative	(3) Baseline Year FE	(4) Alternative Year FE
GDP per capita (th.)	0.314***	0.308***	0.208**	0.203**
	(0.0855)	(0.0850)	(0.0848)	(0.0839)
House price growth	0.0342	0.0340	-0.0327	-0.0330
	(0.0352)	(0.0353)	(0.0323)	(0.0323)
GDP growth	0.0747	0.0753	0.219***	0.219***
	(0.0507)	(0.0506)	(0.0670)	(0.0664)
Population growth	0.302	0.304	0.241	0.246
	(0.274)	(0.274)	(0.259)	(0.258)
Investor demand	3.223***		2.100***	
	(0.937)		(0.734)	
Undervalued market	1.090***	1.082***	1.745***	1.730***
	(0.257)	(0.258)	(0.283)	(0.284)
Undervalued market # Investor demand	-3.233***		-2.299*	
	(1.220)		(1.280)	
Investor demand (alt.)		0.000294***		0.000188***
		(7.39e-05)		(6.48e-05)
Undervalued market # Investor demand (alt.)		-0.000342***		-0.000285**
		(0.000105)		(0.000128)
Constant	-1.923***	-1.878***	-2.161***	-2.146***
	(0.571)	(0.569)	(0.664)	(0.659)
Observations	6,452	6,452	6,452	6,452
R-squared	0.034	0.034	0.136	0.136
Fixed effects	NO	NO	Year	Year

Dependent variable: 4-quarter-ahead house price growth
Robust standard errors clustered at region level in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Note: Left hand side variable is 4 quarter ahead house price growth. For each region in the sample, investor demand is calculated as the deviation from the historical average of the ratio between total investor purchases and quarterly GDP. The right tail of investor purchases is winsorised at 5%. The alternative investor demand variable is investor purchases normalised by regional population. As in Section 4 the shadow rate is sourced from Krippner (2013). House price growth, GDP growth, population growth, and quarterly GDP per thousand population are smoothed by a 12 month moving average. Real estate under and overvaluation is captured at the country-time level using deviations from long-term averages of the house price-to-income ratio. A market is defined over(under)valued if the ratio is more than 5 per cent above (below) its long-term average. Estimation sample: 2007Q1-2021Q4.

Alternative investor participation variable

We re-estimate results presented in Table 2 and Table 3 using alternative definitions of institutional investor participation based on moving averages of 5 years rather than 3 years.

Table 11: *Markets with more institutional investors appear less sensitive to local economic dynamics and more sensitive to monetary policy - alternative investor participation specification.*

VARIABLES	(1) Compensation of employees Country FE	(2) Compensation of employees Region FE	(3) EA shadow rate Country FE	(4) EA shadow rate Region FE
GDP per capita (th.)	0.0222	0.153*	0.0159	0.246
	(0.0164)	(0.0879)	(0.0514)	(0.236)
House price growth	-0.184***	-0.227***	-0.105***	-0.139***
	(0.0479)	(0.0481)	(0.0360)	(0.0363)
GDP growth	-0.189	-0.209	-0.00593	-0.0129
	(0.144)	(0.163)	(0.0658)	(0.0764)
Population growth	0.707**	0.731**	1.033***	1.049***
	(0.274)	(0.327)	(0.262)	(0.343)
Investor participation	6.854**	13.38***	-0.167	1.050
	(3.444)	(4.520)	(0.502)	(1.177)
Comp. employees growth	0.456***	0.443***		
	(0.135)	(0.137)		
Inv. partic. # Comp. empl. growth	-0.955*	-1.267**		
	(0.552)	(0.509)		
Shadow rate			-0.413***	-0.378***
			(0.0728)	(0.0851)
Inv. partic # Comp. empl. growth			-0.806***	-0.809***
			(0.252)	(0.278)
Constant	-0.432	-4.474*	-0.143	-1.339
	(0.499)	(2.537)	(0.377)	(1.667)
Observations	1,556	1,556	6,452	6,452
R-squared	0.165	0.074	0.152	0.044
Fixed effects	Country	Region	Country	Region
Number of NUTS2		133		133

Dependent variable: 4-quarter-ahead house price growth.
Robust standard errors clustered at region level in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Note: For every region, investor participation is calculated as a 5 year moving average of total investor purchases on quarterly GDP. As in Section 4 the shadow rate is sourced from Krippner (2013). Regressions (1) and (2) are calculated on the dataset collapsed to annual frequency. Regressions (3) and (4): house price growth, GDP growth, population growth, and quarterly GDP per thousand population are smoothed by a 12 month moving average. Estimation sample: 2007Q1-2021Q4.

Table 12: *Markets with a high institutional investor presence appear to be more sensitive to financial market developments - alternative investor participation specification.*

VARIABLES	(1) Country FE 4q horizon	(2) Country FE 12q horizon	(3) Region FE 4q horizon	(4) Region FE 12q horizon
GDP per capita (th.)	0.0993*	0.116**	0.896**	0.509**
	(0.0578)	(0.0511)	(0.344)	(0.235)
House price growth	-0.101***	-0.112***	-0.145***	-0.132***
	(0.0358)	(0.0279)	(0.0355)	(0.0304)
GDP growth	0.0194	0.120**	-0.00991	0.0661
	(0.0598)	(0.0488)	(0.0789)	(0.0480)
Population growth	0.858***	-0.256	0.755**	-0.647**
	(0.280)	(0.239)	(0.367)	(0.278)
Investor participation	5.443***	4.494**	6.406***	6.168**
	(1.714)	(1.964)	(2.284)	(2.703)
VSTOXX (Mean)	0.0375***	-0.160***	0.0560***	-0.151***
	(0.0121)	(0.0171)	(0.0142)	(0.0176)
Inv. partic. # VSTOXX (Mean)	-0.179***	-0.133*	-0.158**	-0.156
	(0.0568)	(0.0757)	(0.0744)	(0.0984)
Constant	-1.323***	3.422***	-7.275***	0.896
	(0.482)	(0.515)	(2.662)	(1.838)
Observations	6,452	5,381	6,452	5,381
R-squared	0.139	0.181	0.037	0.074
Fixed effects	Country	Country	Region	Region
Number of NUTS2			133	133

Dependent variable: 4-quarter-ahead house price growth.
Robust standard errors clustered at region level in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Note: For every region, investor participation is calculated as a 5 year moving average of total investor purchases on quarterly GDP. House price growth, GDP growth, population growth, and quarterly GDP per thousand population are smoothed by a 12 month moving average. "Mean" VSTOXX refers to quarterly aggregate statistics. Estimation sample: 2007Q1-2021Q4.

Alternative VSTOXX variable

We re-estimate results presented in Table 3 using maximum quarterly values of VSTOXX rather than averages.

Table 13: *Markets with a high institutional investor presence appear to be more sensitive to financial market developments - alternative VSTOXX specification.*

	(1)	(2)	(3)	(4)
	Country FE	Country FE	Region FE	Region FE
VARIABLES	4q horizon	12q horizon	4q horizon	12q horizon
GDP per capita	0.0945	0.125**	0.825**	0.683***
	(0.0585)	(0.0526)	(0.319)	(0.253)
House price growth	-0.104***	-0.106***	-0.147***	-0.128***
	(0.0353)	(0.0280)	(0.0351)	(0.0306)
GDP growth	0.0221	0.149***	-0.0106	0.0808
	(0.0593)	(0.0565)	(0.0791)	(0.0500)
Population growth	0.881***	-0.291	0.795**	-0.750**
	(0.283)	(0.249)	(0.367)	(0.294)
Investors participation	3.355***	3.713***	4.791***	5.485***
	(0.944)	(1.394)	(1.496)	(1.841)
VSTOXX (Max)	0.0310***	-0.0984***	0.0362***	-0.0898***
	(0.00915)	(0.00918)	(0.00981)	(0.00932)
Inv. partic. # VSTOXX (Max)	-0.0616**	-0.0681*	-0.0653**	-0.0693
	(0.0250)	(0.0376)	(0.0282)	(0.0477)
Constant	-1.442***	2.634***	-6.618***	-1.181
	(0.532)	(0.461)	(2.451)	(1.933)
Observations	6,452	5,381	6,452	5,381
R-squared	0.140	0.174	0.038	0.067
Fixed effects	Country	Country	Region	Region
Number of NUTS2			133	133

Dependent variable: 4-quarter-ahead house price growth.
Robust standard errors clustered at region level in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Note: For every region, investor participation is calculated as a 3 year moving average of total investor purchases on quarterly GDP. House price growth, GDP growth, population growth, and quarterly GDP per thousand population are smoothed by a 12 month moving average. "Max" VSTOXX refers to quarterly aggregate statistics. Estimation sample: 2007Q1-2021Q4.

Table 14: *Markets with a high institutional investor presence appear to be more sensitive to financial market developments - alternative VSTOXX and investor participation specifications.*

VARIABLES	(1) Country FE 4q horizon	(2) Country FE 12q horizon	(3) Region FE 4q horizon	(4) Region FE 12q horizon
GDP per capita (th.)	0.0952	0.126**	0.824**	0.705***
	(0.0584)	(0.0523)	(0.322)	(0.257)
House price growth	-0.104***	-0.106***	-0.148***	-0.129***
	(0.0354)	(0.0280)	(0.0352)	(0.0306)
GDP growth	0.0221	0.150***	-0.0102	0.0808
	(0.0592)	(0.0567)	(0.0792)	(0.0497)
Population growth	0.886***	-0.274	0.812**	-0.713**
	(0.282)	(0.248)	(0.364)	(0.295)
Investor participation	3.836***	3.798**	5.507***	5.628**
	(1.049)	(1.539)	(1.635)	(2.171)
VSTOXX (Max)	0.0312***	-0.0990***	0.0362***	-0.0905***
	(0.00910)	(0.00919)	(0.00978)	(0.00940)
Inv. partic. # VSTOXX (Max)	-0.0734***	-0.0684*	-0.0770***	-0.0741
	(0.0245)	(0.0386)	(0.0287)	(0.0496)
Constant	-1.459***	2.638***	-6.613***	-1.315
	(0.530)	(0.458)	(2.468)	(1.965)
Observations	6,452	5,381	6,452	5,381
R-squared	0.140	0.174	0.038	0.067
Fixed effects	Country	Country	Region	Region
Number of NUTS2			133	133

Dependent variable: 4-quarter-ahead house price growth.
Robust standard errors clustered at region level in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Note: For every region, investor participation is calculated as a 5 year moving average of total investor purchases on quarterly GDP. House price growth, GDP growth, population growth, and quarterly GDP per thousand population are smoothed by a 12 month moving average. "Max" VSTOXX refers to quarterly aggregate statistics. Estimation sample: 2007Q1-2021Q4.