

A Housing Portfolio Channel of QE Transmission

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ABFER Household Finance Meeting

23 May 2023

Motivation

- *“Unlike in cities such as New York or London, local agents say rapid price growth [in Cologne, Germany] has not been driven by international buyers . . . Instead, agents blame the recent price rises on an influx of domestic buy-to-let purchasers.”*
 - ▶ Financial Times, October 19, 2017, square bracket added.
- *“Due to a growing demand for rental properties in Germany, renting out properties has become a great source of income, September 2022.”*
 - ▶ <https://howtogermany.com>, an online information resources for expatriates in Germany.
- A large body of research examines the effects of central banks' quantitative easing (QE) policies on household, firm, and bank behavior, and the macroeconomy as a whole, through credit and asset markets
 - ▶ See, for example, Tristani's (2021) survey.

This paper

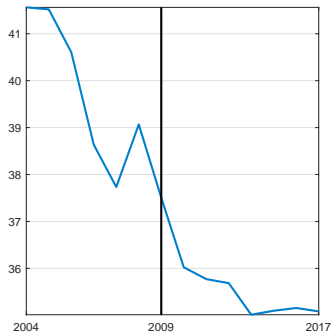
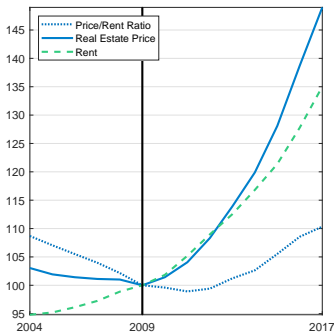
- Documents a household portfolio rebalancing channel of ECB QE transmission working alongside other channels and evaluates its impact on housing outcomes in Germany.
- Identifies this channel in German household-level and regional data
 - ▶ Estimates portfolio rebalancing towards second homes by exploiting idiosyncratic ex-ante heterogeneous exposure to QE in the Bundesbank's PHF Survey (PHF) in a diff-in-diff setting
 - ▶ Estimates price and quantity impact on regional housing markets exploiting variation in the share of refugees in independent accommodation in a Bartik setting

A housing portfolio rebalancing channel of QE transmission that differs from the credit and collateral channels

- QE lowers the net supply of bonds, increasing bond prices and depressing their returns
- Ex-ante heterogeneous households rebalance their portfolios toward housing, equities, and other risky assets without necessarily borrowing (i.e., cash purchases)
 - ▶ The more so, the larger their initial bond share
- Rebalancing bids up house prices and lowers expected future housing returns
 - ▶ The more so, the lower the house supply
- Whether rebalancing increases or decreases risky assets' portfolio shares depends on the return covariance matrix
- The cash share can increase or decrease
- Leverage and credit can amplify this transmission but are not critical in the mechanism

Germany: a housing boom without credit boom

Panel A: Residential house price and rent indexes (2009=100) B: Domestic housing credit to households (% GDP)



- Housing booms without credit booms are not uncommon (Cerutti, Dell'Ariccia, and Dagher, 2017)

German households

Have a high share of housing wealth in total assets or net worth as in other countries, but

- Increasing ratio of real estate to bonds
- Low and declining leverage
- Low and falling home ownership (increasing buying-to-let?)
- Low stock market participation

	2010	2014	2018
Real Estate/Total Assets	0.55	0.55	0.57
Bonds/Total Assets	0.065	0.064	0.059
Equity/Total Assets	0.083	0.085	0.085
Real Estate/Bonds	8.51	8.63	10.12
Loans/Total Assets	0.15	0.13	0.12
Homeownership (in %)	53.2	52.5	51.5
Homeownership (with loans, in %)	27.8	26.6	25.6

Preview of results

- ① Households with larger ex-ante bond shares rebalance more towards housing, especially toward second homes
 - ▶ Effect stronger for higher-income households that benefit more from the tax deductions, church-affiliated, and more financially literate households
 - ▶ Effect is not driven by rising mortgage credit
- ② Rebalancing toward housing boosted by households with high deposit shares
- ③ Equity share declines
- ④ QE has a stronger impact on rental yield and rent listings in regions with a higher share of refugees in independent accommodation
 - ▶ The estimated effect is sizable: QE is associated with a 0.1-0.5 pp larger cumulative housing return decline in more exposed regions (or about a third of the total change over the sample period)

Related literature

- **Unconventional monetary policy, bank and firm behavior, and macroeconomic outcomes**

- ▶ Kurtzman, Luck and Zimmermann (2017); Rodnyansky and Darmouni (2017); Chakaraborty, Goldstein, MacKinlay (2019); Acharya, Eisert, Eufinger and Hirsch (2019); Todorov (2020); Berg, Haselmann, Kick and Schreiber (2022); Bittner, Rodnyansky, Saidi and Timmer (2022)
- ▶ Eberly, Stock and Wright (2019); Luck and Zimmermann (2020); Fabo Jancoková, Kempf and Pástor (2021)

- **Portfolio rebalancing**

- ▶ Peydro, Polo and Sette (forthcoming)
- ▶ Kojien, Koulischer, Nguyen and Yogo (2021)
- ▶ Korevaar (2022); Gargano and Giacoletti (2022)

- **Literature that views housing as a risky asset in household portfolios**

- ▶ Flavin and Yamashita (2002); Yao and Zhang (2005); Cocco (2005)

- **Post-2009 German housing boom**

- ▶ Le Blanc, Kindermann, Piazzesi, Schneider (2022), Bednarek, te Kaat, Ma and Rebucci (2021);

Outline

- A simple model and its implications
- Data
- Household-level analysis
- Regional analysis
- Conclusions

Model

A simple housing portfolio model

- Two risky assets (houses and long-term bonds) and cash (x):
 - ▶ Houses with price P and pays off $\mu_1 + \epsilon_1$
 - ▶ Bonds with price Q and pays off $\mu_2 + \epsilon_2$
 - ▶ Assumption: $E[\epsilon_1] = E[\epsilon_2] = 0$, $Var(\epsilon_1) = \sigma_1^2$, $Var(\epsilon_2) = \sigma_2^2$ and $Cov(\epsilon_1, \epsilon_2) = \sigma_{12}$
- Three agents: two preferred-habitat investors and one regional household that can arbitrage across all markets (e.g., Vayanos and Vila, 2021)
 - ▶ *Local* preferred-habitat investor in city housing market with demand:

$$\tilde{h} = -\alpha_1(P - \beta_1)$$

- ▶ *National* preferred habitat investors in the bond market with demand:

$$\tilde{b} = -\alpha_2(Q - \beta_2)$$

Arbitrager (local household)

The *local* household trades the two risky assets, houses (h) and bonds (b), and has access to a storage technology (x), solving the following mean-variance portfolio problem:

$$\max_{h,b,x} \quad h\mu_1 + b\mu_2 + x - \frac{\gamma}{2}(h^2\sigma_1^2 + b^2\sigma_2^2 + 2hb\sigma_{12}) \quad (1)$$

$$\text{s.t.} \quad W = hP + bQ + x, \quad \text{with multiplier } \lambda \quad (2)$$

Optimality requires

$$\lambda P = \mu_1 - \gamma h\sigma_1^2 - \gamma b\sigma_{12} \quad (3)$$

$$\lambda Q = \mu_2 - \gamma b\sigma_2^2 - \gamma h\sigma_{12} \quad (4)$$

$$\lambda = 1 \quad (5)$$

And market clearing is

$$b + \tilde{b} = \bar{b} \quad (6)$$

$$h + \tilde{h} = \bar{h} \quad (7)$$

Housing market and portfolio return impact of QE

- If bonds and houses are substitutes, and housing holdings are large enough, housing portfolio share increase and housing portfolio return decline with QE.
- **Result 1:** A reduction in the net supply of bonds, \bar{b} (a QE intervention), increases demand for houses and house prices (i.e., $\frac{dh}{db} \leq 0$ and $\frac{dP}{db} \leq 0$) if and only if housing and bond returns are positively correlated ($\sigma_{12} \geq 0$)
 - ▶ **Intuition:** in equilibrium, a decline in the covariance risk component of the risk premium allows for an increase in exposure to house price risk and vice-versa:

$$\lambda P = \mu_1 - \gamma h \sigma_1^2 - \gamma b \sigma_{12}$$

$$\lambda Q = \mu_2 - \gamma b \sigma_2^2 - \gamma h \sigma_{12}$$

Housing market and portfolio return impact of QE (Cont.)

- **Result 2:** Consider the total portfolio return, defined as

$$\begin{aligned} E[R] &= \frac{E[W']}{W} = \frac{h\mu_1 + b\mu_2 + x}{W} \\ &= 1 + \frac{h(\mu_1 - P) + b(\mu_2 - Q)}{W}. \end{aligned}$$

As long as σ_{12} is positive, $\frac{dE[R]}{db} > 0$.

- Moreover, if the equilibrium holding of houses is large enough, the QE impact on the house price (P) dominates the effect on the quantity (h), and the expected housing return $E[R^h]$ also declines, i.e., $\frac{dE[R^h]}{db} > 0$.

Model predictions about a QE intervention (\bar{b} declines)

- With QE, bond supply to the private sector (\bar{b}) declines
 - ▶ Bond holdings go down, bond prices increase, bond returns fall
 - ▶ Households rebalance towards real estate, housing price and quantity, and housing portfolio share increase
 - ▶ Overall household portfolio return and housing component decline
 - ▶ Cash share's response depends on what the bond share does, which is ambiguous given that price increases and quantity declines
 - ▶ Equity and credit are not in the model, and we investigate their response empirically
- At the core of the mechanism, housing is cash purchases for financial investment purposes.

Data

Household data

- Based on Bundesbank's Panel of Household Finance survey; 3 waves (2011, 14, 17) covering 4,000-5,000 households each
- Detailed wealth data, including breakdown of housing into main residence and second homes
- We can also track households' borrowing behavior
- Detailed information on household characteristics, such as income, gender, financial literacy, etc.

Regional data and QE Indicator

- Annual data from 2010 to 2017 covering all 401 urban and rural regions, matched based on a common region identifier (Kreiskennziffer)
- Residential price and rent indexes, and rental yields from Bulwiengesa: average of new and existing apartments, based on transaction and valuation data
 - ▶ We use rental yields as predictor of housing returns and their components
- Listing data aggregated at the regional level from the online platform Immoscout24.de
- In the regional analysis, the QE indicator is total debt securities held by the ECB over nominal euro area GDP

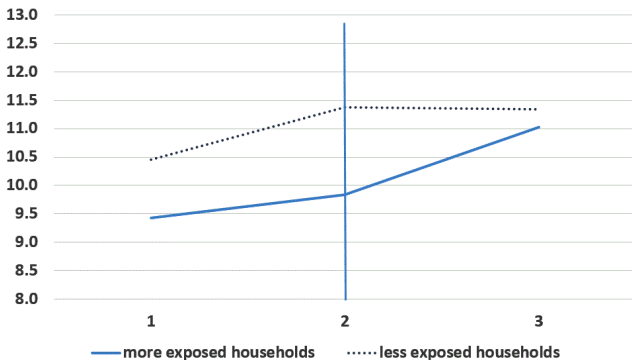
Household Analysis

Diff-in-diff specification

$$\Delta Y_{h,t} = \alpha_t + \alpha_h + \sigma \cdot (\text{Post}_t \times \text{Bonds}_{h,2014}) + \epsilon_{h,t}$$

- $\Delta Y_{h,t}$ is the change in housing portfolio share in wave 2 (2014) and 3 (2017), adjusted for valuation effects;
- “ Post_t ” is 1 in wave 3
- $\text{Bonds}_{h,2014}$ is the wave 2, pre-QE share of wealth invested in bonds (directly and indirectly)
- The regressions include time and household fixed effects, or time-income quartile fixed effects
- SEs are heteroskedasticity-robust (clustering at the regional level gives very similar results)

Identification



- Parallel trends assumptions likely satisfied
- Treatment is not random: we control for this with fixed effects and likely determinants
- We assume that the assignment is not affected by QE

Portfolio rebalancing: main results

	Benchmark Estimates		Different dependent variables			Control for deposits	Different bond shares	
	(1) ΔSEC. HOUSING	(2) ΔSEC. HOUSING	(3) ΔSEC. HOUSING (2)	(4) ΔHOUSING	(5) ΔUNITS	(6) ΔSEC. HOUSING	(7) ΔSEC. HOUSING	(8) ΔSEC. HOUSING
Bonds × Post	0.196*** (0.047)	0.178*** (0.048)	0.341*** (0.055)	0.186*** (0.045)	0.002** (0.001)	0.121** (0.047)	0.412*** (0.102)	0.462*** (0.170)
Deposits × Post	-	-	-	-	-	0.128*** (0.027)	-	-
Household FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes
Income-Time FE	No	Yes	No	No	No	No	No	No
Obs	2954	2954	2954	2968	3072	2952	2954	2954
R ²	0.345	0.347	0.390	0.344	0.430	0.354	0.344	0.340

- A household with an initially 10 pp larger (interquartile range) bond share increases its second home share post-QE by an additional 1.8-2.0 pps.
- Result robust to alternative dependent variables (second homes scaled by total portfolio instead of model-consistent, total housing shares, change in the number of second homes) and bond shares (without indirect holdings, missing bond values not imputed)
- Households with higher deposits rebalance more

Who is buying and who is selling?

Variable	$+\Delta FirstHous.$	$+\Delta Sec.Hous.$	$-\Delta FirstHous.$	$-\Delta Sec.Hous.$	<i>Bonds</i>	<i>NoBonds</i>
Observations	51	197	18	135	928	549
Net wealth	57000	364000	413500	541000	290110	163000
Income per.cap.	24365.5	27700	22825	33325	27791.7	21550
Housing wealth	0	260000	365000	409000	230000	140000
Age	50	58	71	63	56	68
Δ Mortgage credit	162.9	0	0	0	0	0

Controlling for non-random assignment and rebalancing toward equities

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	ΔY	ΔY	ΔY	ΔY	ΔY	ΔY	$\Delta \text{EQUITIES}$
Bonds \times Post	0.249*** (0.064)	0.274*** (0.070)	0.198*** (0.048)	0.120*** (0.048)	0.203*** (0.048)	0.198*** (0.048)	-0.412** (0.021)
Net Worth _{t-1}	-5.928*** (1.314)						
Members _{t-1}	4.691*** (1.714)						
Age _{t-1}	-0.386 (0.346)						
Fin. Lit. _{t-1}	-1.481 (1.164)						
Risk Aversion _{t-1}	0.977 (1.421)						
Household FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Obs	2788	2850	2954	2954	2954	2952	3072
R ²	0.372	0.351	0.345	0.345	0.346	0.345	0.381

Characteristics of households that rebalance

	(1)	(2)	(3)	(4)	(5)	(6)
	ΔY	ΔY	ΔY	ΔY	ΔY	ΔY
Bonds \times Post \times Financial Advice	0.324** (0.138)					
Bonds \times Post \times Financial Literacy		0.122*** (0.039)				
Bonds \times Post \times Renter			-0.252 (0.166)			
Bonds \times Post \times Middle Age				0.281** (0.140)		
Bonds \times Post \times Older Age				0.117 (0.077)		
Bonds \times Post \times Mortgage to Housing					0.001 (0.002)	
Bonds \times Post \times Δ Mortgage						0.001 (0.000)
Household FE	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes
Obs	890	2954	2954	2954	2954	2954
R^2	0.344	0.348	0.346	0.349	0.346	0.356

- Financially more literate households, middle-aged, and those that were financially advised by their banks rebalance more strongly (points to strong cross-selling activities of banks)
- Renters rebalance towards second homes as well as homeowners
- No evidence of effects being driven by mortgage credit expansions

Controlling for the credit channel

	Households with Non-Positive Credit Growth		All Households	
	(1)	(2)	(3)	
	ΔY	ΔY	ΔY	ΔY
Bonds \times Post	0.183*** (0.047)	0.184*** (0.047)	0.183*** (0.047)	
Mortgage to Housing \times Post		-0.047 (0.034)		
Δ Mortgage Credit \times Post				0.009*** (0.003)
Household FE	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes
Obs	2580	2954	2954	
R^2	0.367	0.346	0.354	

Rebalancing motives

	Full Sample		Urban	Rural	Church Aff.	No-Church Aff.
	(1)	(2)	(3)	(4)	(5)	(6)
	ΔY	ΔY	ΔY	ΔY	ΔY	ΔY
Bonds \times Post	0.140** (0.062)	0.020 (0.060)	0.129 (0.090)	0.139 (0.092)	0.105 (0.076)	0.180** (0.090)
Deposits \times Post		0.059** (0.029)				
Income \times Post	-0.026 (0.036)	-0.138*** (0.036)	-0.016 (0.032)	-0.103* (0.059)	-0.072* (0.038)	0.001 (0.034)
Bonds \times Post \times Income	0.003* (0.001)	0.005*** (0.001)	0.003** (0.002)	0.001 (0.003)	0.004*** (0.002)	0.000 (0.003)
Deposits \times Post \times Income		0.003*** (0.001)				
Household FE	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes
Obs	2954	2952	1056	1898	1766	1188
R^2	0.346	0.365	0.402	0.322	0.364	0.321

- Second homes in Germany are subject to significant tax advantages
- We find stronger rebalancing for higher-income households
- Effects stronger for church members and urban regions where house price appreciations (tax-free after 10 years) are more important than rental income (taxed as income), see Schularick et al. (2022).

Interpreting the results

- Second homes benefit from a massive tax advantage relative to first homes
- Assume an apartment price tag of 200,000 EUR, with transaction costs (real estate agent, property taxes and notary) of 10% (20,000 EUR) and renovation costs of 15% (30,000 EUR)
- Further assume a marginal tax rate for high-income households of 42% and no mortgage borrowing
- If this is a first-home purchase, you can deduct only up to 1,200 EUR per year (of the renovation costs) - a **504 EUR per year tax advantage**
- If this is a second-home purchase to let, in the first year, you can deduct 2% of the tag price (4,000 EUR), the full renovation costs (30,000 EUR), and 2% of the additional charges (400 EUR) - a **14,448 EUR tax advantage**
- In subsequent years, it is 2% of the apartment price (4,000 EUR) and 2% of the additional charges (400 EUR) per year - a **yearly 1,848 EUR tax advantage** - plus the annual property tax (rather small, so abstracted from here)

Which households engage in this trade?

	Pre-own	Not Pre-own	Pre-own & Inc.	Pre-own & No Inc.
	(1)	(2)	(3)	(4)
Bonds \times Post	0.717*** (0.215)	0.034 (0.046)	0.883*** (0.241)	0.537* (0.290)
Household FE	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes
Obs	986	1968	698	288
R^2	0.398	0.425	0.417	0.377

QE Impact on Local Housing Markets

Specification

- Unfortunately, limited information on housing returns and prices in the PHF
- We exploit regional variation in housing price and quantity indicators for which we have high-quality data
- Identification via geographic variation:

$$\Delta X_{r,t} = \alpha_r + \alpha_t + \beta \cdot (\text{QE}_{t-1} \times \text{Exposure}_r) + \varepsilon_{r,t}$$

where $X_{r,t}$ is either rental yield, real house price or rent growth, or the number of sale and rental listings

- Identification hinges on finding suitable exposure measure (Bartik instrument)

Measuring regional exposure to our channel

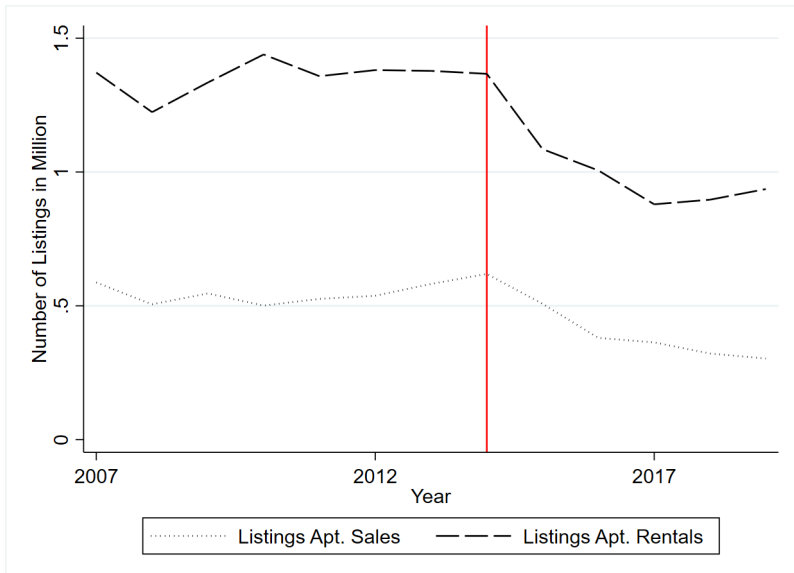
- We cannot use regionally aggregated bond shares, as we have 4-5,000 households only scattered across 400 regions
- The model predicts that the impact of QE on housing returns should be stronger the lower the housing supply, i.e., in regions in which real estate markets are tighter
- We use the ex-ante (pre-sample value in 2008) share of refugees housed in independent accommodations as a measure of market tightness (Bednarek, te Kaat, Ma and Rebucci, 2021)
- Results robust when we use the pre-sample share of renters as a measure of market depth

Reduced form results: rental yields and their components

	(1)	(2)	(3)	(4)	(5)	(6)
	Rental Yield	House Prices	Rent Prices	Rental Yield	House Prices	Rent Prices
Share of Refugees _{<i>r</i>,2008} × QE _{<i>t-1</i>}	-0.0003** (0.0001)	0.0100** (0.0042)	0.0023 (0.0016)			
Share of Renters _{<i>r</i>,2011} × QE _{<i>t-1</i>}				-0.0014*** (0.0002)	0.0141** (0.0063)	0.0088*** (0.0026)
Time FE	Yes	Yes	Yes	Yes	Yes	Yes
Region FE	Yes	Yes	Yes	Yes	Yes	Yes
Obs	3080	3080	3080	3208	3208	3208
R ²	0.937	0.781	0.813	0.939	0.781	0.812

- We find that QE reduces rental yields (rent-to-price ratios) in regions with more refugees or a larger rental market
- QE is associated with a rental yield decline in more (75th percentile) relative to less exposed regions (25th percentile) of about 0.1-0.5 pp cumulatively
- This decrease is driven by house prices increasing more than rents

Sale and rental listings after QE



Reduced form results: sale and rental listings

	(1)	(2)	(3)	(4)	(5)	(6)
	Sale Listings	Rental Listings	Sale/Rental Listings	Sale Listings	Rental Listings	Sale/Rental Listings
Share of Refugees $_{r,2008} \times QE_{t-1}$	-1.795*** (0.287)	-7.234*** (0.847)	-0.00007** (0.00003)			
Share of Renters $_{r,2011} \times QE_{t-1}$				-1.170*** (0.312)	-3.818*** (1.190)	-0.00051*** (0.00008)
Time FE	Yes	Yes	Yes	Yes	Yes	Yes
Region FE	Yes	Yes	Yes	Yes	Yes	Yes
Obs	3080	3080	3080	3208	3208	3208
R ²	0.944	0.967	0.770	0.936	0.954	0.770

- Both sale and rental listings decline (not very surprising in a house price boom)
- But QE reduces sale listings more than rental listings in more exposed regions, which is consistent with a buy-to-let motive rather than a consumption motive driving housing purchases

Conclusions

- We spell out in a simple model and study a housing portfolio channel of QE transmission that does not work through leverage and credit
- It works through portfolio rebalancing and cash purchases of housing for investment purposes
- We provide supporting empirical evidence exploiting German household-level and regional data
 - ▶ Our household data show that households with larger ex-ante bond exposure rebalance more towards second homes
 - ▶ This effect becomes stronger for high-income, financially literate households being high-income, and households that got advised by their bank
 - ▶ At the region level, we show that more exposed regions see stronger declines in rental yields and sale listings

THANK YOU!