Dynamics and Determinants of Housing Tenure Choice in Europe

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1. Introduction

This project studies the dynamics and determinants of homeownership in Europe. We analyze data from several sources to scientifically understand what is happening. We use multiple sources of aggregate and micro data. We study different European countries and across demographic groups. Then, we think on implications for the housing and mortgage industries and for policymakers.

Figure 1 shows the dynamics of homeownership, that is, the share of households that own their house, around the globe. Through the 1990s and beginning of the 2000s, most developed countries experienced a boom in homeownership. However, the later years, after the mid-2000s, saw a remarkable drop in homeownership rates. This drop coincided with the Global Financial Crisis.

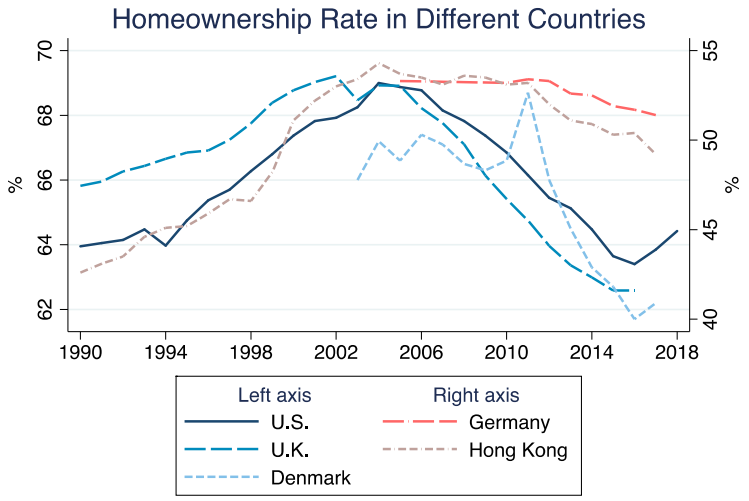

Figure 1. Homeownership rate around the globe. The figure plots the time series of the homeownership rate for different countries. Homeownership rate is defined as the number of households that own their home. Source: U.S. Census Bureau, U.K. Ministry of Housing, Communities & Local Government, Eurostat, and Hong Kong Census and Statistics Department.

In fact, as we show in detail in Section 2 using data from Central Banks and National Statistical Agencies, still today, there are no strong signs that the homeownership rates are picking up. Consistently across the globe, fewer households own their home. House prices have recovered, but homeownership rates no. There has been a decoupling between housing prices and homeownership rates.

Then Section 3, using micro data from EU-SILC, shows the evolution of homeownership across age groups in different countries. We show that there has been a remarkable shift in the distribution of housing ownership in most countries. Homeownership rates substantially dropped for young households. For example, in Spain the share of households below 30 years old who own a house was cut in half. Households above 50 years old dramatically increased the number of properties they own.

Sections 4 and 5, using both graphical and regression analysis on the Spanish Survey of Household Finances, show three key results: first, mortgage demand for credit from young households is falling as they move from homeownership into rental markets. This fall is not replaced by the elder who now buy multiple properties and become landlords. Second, the elder households reduce their demand for financial products as they reallocate their savings to buy real estate. Third, those households who borrow, now borrow more. That is, the extensive margin of mortgage credit (number of borrowers per age group) collapsed for young households. However, the intensive margin (loan amount) increased.

With the previous portfolio reallocation, elder households become real estate investors. Since they increase demand for houses in the market, the prices of houses keep going up. This makes the price-to-income ratio for young households extremely high. Young households entering an economy with very low starting salaries, find their income prohibiting to buy a house

in a market where prices are high. The young are forced then to become renters. The young increase the demand for rentals, which matches the increased supply from investors in equilibrium.

Overall, mortgage credit was reduced because elder households did not increase mortgage credit much. That is, they financed new purchases of properties with savings. Hence, real estate investment is crowding-out other financial savings options.

Section 6, doing a cross-country regression analysis on the EU-SILC database, shows that the previous facts are due to 3 forces: 1) income dynamics hurting the young. That is, the endemic low growth of the economy might be driving the results. In particular, the recovery after the crisis is not effective for the young households. Housing prices recover, however unemployment for the young is still very high, and the labor income for those who work is not increasing at the same rate as housing prices. As a result, the price-to-income ratio for the young households is very high, forcing them to postpone purchasing their home. 2) Lower mortgage credit due to tighter standards towards the riskiest borrowers. 3) The emergence of housing investors due to chase for yield that crowds-out the traditional young buyers. As rents are mostly stable, housing becomes an investment asset and a close substitute to safe yield-earning investments (Jordà et al. 2019).

Section 7, using the ING loan level dataset for the Netherlands, confirms that Covid has reinforced the dynamic of credit and the housing stock going towards the elder and wealthy.

2. First new fact: The decoupling of homeownership and housing prices

Historically, housing prices and homeownership (percentage of households who own the house they live in) have been strongly correlated. The explanation was that demand for ownership was the main driver of housing prices. When demand was high, prices surged. New households usually financed part of the purchase with a mortgage to become new homeowners. Nearly all macroeconomics and finance publications focus on the homeowner as the driver of housing dynamics.

In this section we documented an important new fact: following the latest global financial crisis, known as the Great Recession, there has been a structural break in the correlation of housing prices and homeownership rate. That is, homeownership and housing prices are no longer in sync. Figure 2 contains this result.

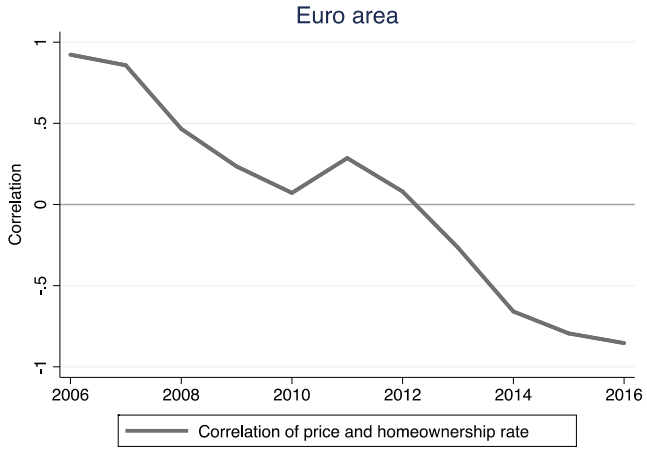

Figure 2. Correlation of housing prices and homeownership rate in the Euro area (smoothed 5-year moving average). Source: Eurostat.

Figure 2 plots the correlation of housing prices and homeownership rate in the Euro area. Historically, this correlation has been positive. However, since 2012 this correlation is no longer positive. In fact, the correlation is in a downward trend reaching values close to minus one in 2016.

The explanation for the new fact shown in Figure 2 is that home prices started to recover, but the number of households who owned their property did not increase. Thus, prices and ownership decoupled.

Figure 3 confirms the new fact. It shows the time series of the housing prices and homeownership rate in the Euro area. The two series have been increasing together, they both dropped after 2009. However, the housing prices recovered after 2014, whereas the homeownership rate keeps decreasing. The prices decoupled from homeownership.

Figure 4 confirms the decoupling in the U.S. and in a set of European countries. We see the homeownership rate and the housing prices correlated pre-crisis and uncorrelated or having negative correlation post the Great Recession. Like with any empirical fact, there are some exceptions, for example the Netherlands.

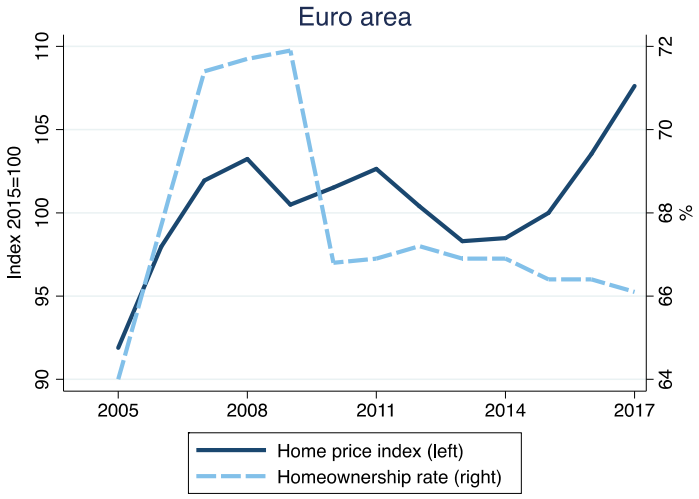

Figure 3. Housing prices and homeownership rate in the Euro area. Source: Eurostat.

Taken together, from all these pieces of evidence it emerges a clear new fact: the homeownership rate and housing prices correlated pre-crisis but no longer did so after the Great Recession in most countries.

The previous fact is important for three reasons: 1) For the banking industry, mortgages are one of the key financial products. Given that homeowners traditionally borrow to buy a house, permanent falls in homeownership rates even when prices are rising, may show structural changes in demand for this key banking product. 2) Changes in consumption induced by changes in housing prices are a key element of the monetary policy toolbox. If homeownership is decoupled from prices, then that transmission channel breaks. 3) To understand the dynamics of housing prices it is important to know who the buyer of the housing stock is.

There may be at least three potential causes of the decoupling between housing prices and homeownership. The most obvious one that we will explore below in this study is difficulty of access to credit by some households: Banks may have tightened lending standards due to their own willingness or to satisfy the Basel III regulation requirements. More difficult access to credit

together with housing prices stickiness increases demand for rentals (Gete and Reher 2018) and makes homeownership rate to fall permanently.

Another factor that may explain the decoupling is changes in tastes. For example, it may be that bad experiences with homeownership during the last recession discourage some households from ownership. Moreover, new technology encourages the mobility associated with rentals. That is, the sharing economy (e.g. Uber, Airbnb) is generating less demand for ownership of assets and more demand for rentals especially among young generations.

Finally, the decoupling between housing prices and homeownership may be due to the exponential growth of a new type of homebuyer: investors. Investors view housing and real estate in general as a new global asset class: Since 2016 Real Estate is a new Sector in S&P 500. Following the last financial crisis, Quantitative Easing has made real estate an interesting investment in the environment of low yields (Martìnez-Miera and Repullo 2017; Rodnyansky and Darmouni 2017; Campbell and Sigalov 2021). Daniel, Garlappi and Xiao (2021) document this portfolio channel, showing that investors search for income in stock investments. Consistent with this theory, De Stefani (2020) documents that the investment attitude towards housing increased significantly among the wealthy U.S. population following the financial crisis. Garriga, Gete and Tsouderou (2021) study the surge of local investors in the U.S. after the Global Financial Crisis. Chinco and Mayer (2016), Cvijanovic and Spaenjers (2021), Davids and Georg (2020) and Favilukis and Van Nieuwerburgh (2021) analyze foreign and out-of-town investors. Moreover, new technology and REITs open up new investment opportunities. As a result, the traditional borrowers are crowded out.

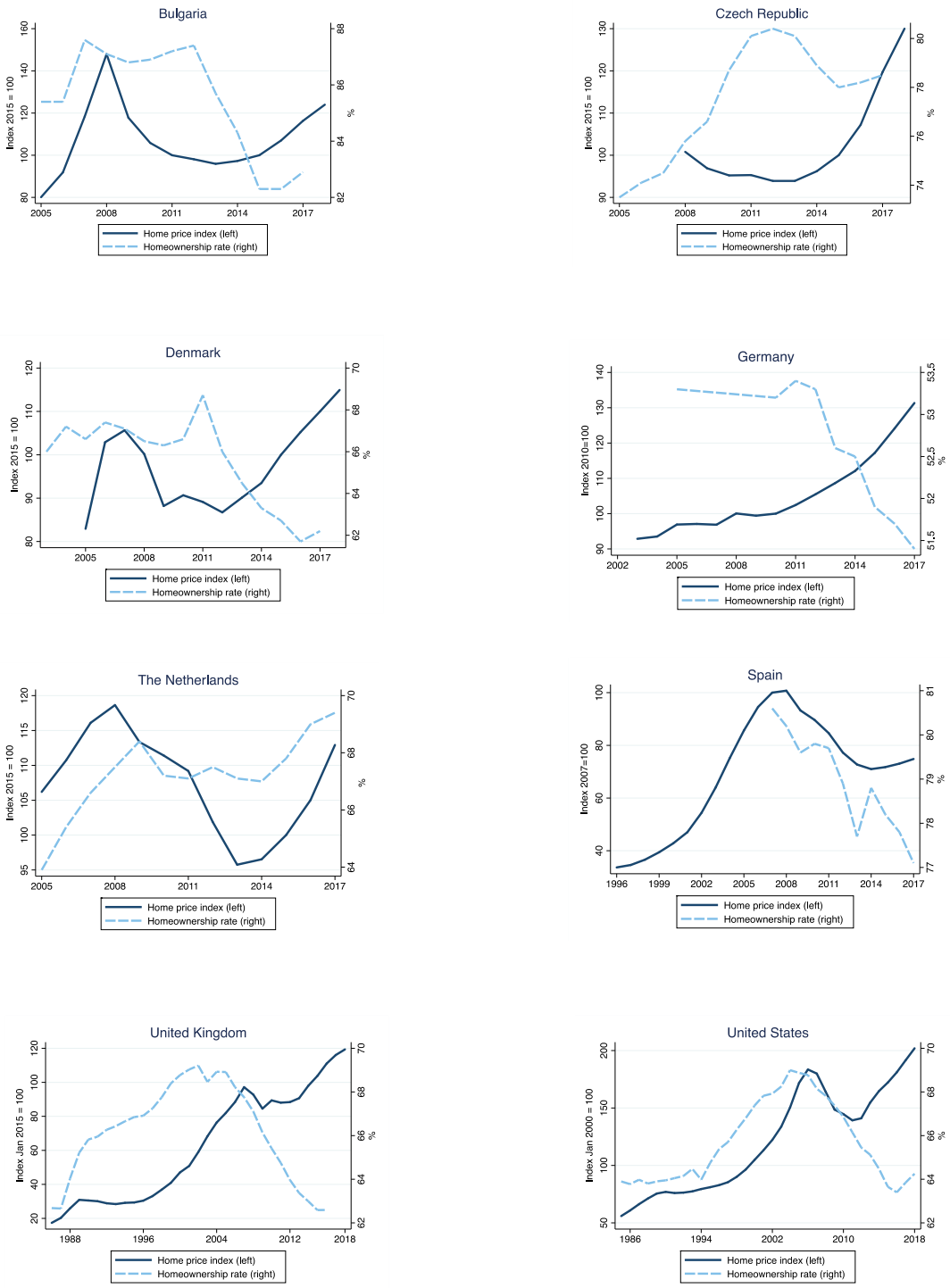

Figure 4. Housing prices and homeownership rate in selected countries. Sources: Bank of International Settlements, European Central Bank, HM Land Registry and Ministry of Housing, Communities & Local Government, Robert J. Shiller website and U.S. Census Bureau and Eurostat.

3. Second new fact: Changes in homeownership & housing costs by age group

The previous section shows that average homeownership rates did not recover from the crisis even if housing prices did. To better understand this fact, in this section we study the time series of homeownership (HOR) for several European countries. We focus on France, Germany, Italy, Portugal, Spain, Netherlands and United Kingdom. We look at HOR dynamics for multiple age groups. This is the first time in the literature that these statistics are reported. Moreover, we computed the series for each wave of the EU-SILC database. EU-SILC is a cross-sectional and longitudinal sample survey, coordinated by Eurostat, based on data from the European Union member states.

Figure 5 shows how the homeownership rates by age group evolved in several EU countries. For easier presentation we show the survey waves 2005, 2009, 2013 and 2017. In most countries in our sample, homeownership fell over time for the 30-50 age group, especially for the younger households. Only France seems to be an exception to this fact. In all countries in our sample homeownership increased over time for the 70-80 age group. Thus, Figure 5 documents a significant redistribution of homeownership across age groups.

To gauge the welfare consequences of the new fact reported in Figure 5, we repeated the previous analysis for housing costs. Figure 6 shows the results. To measure housing costs the survey asks for the monthly costs connected with households' right to live in the accommodation. Figure 6 shows that age groups that saw a drop in HOR had largest increases in rents. That is, households who moved from owning to renting have seen an increase in the share of their spending going towards housing costs. These are mostly young households.

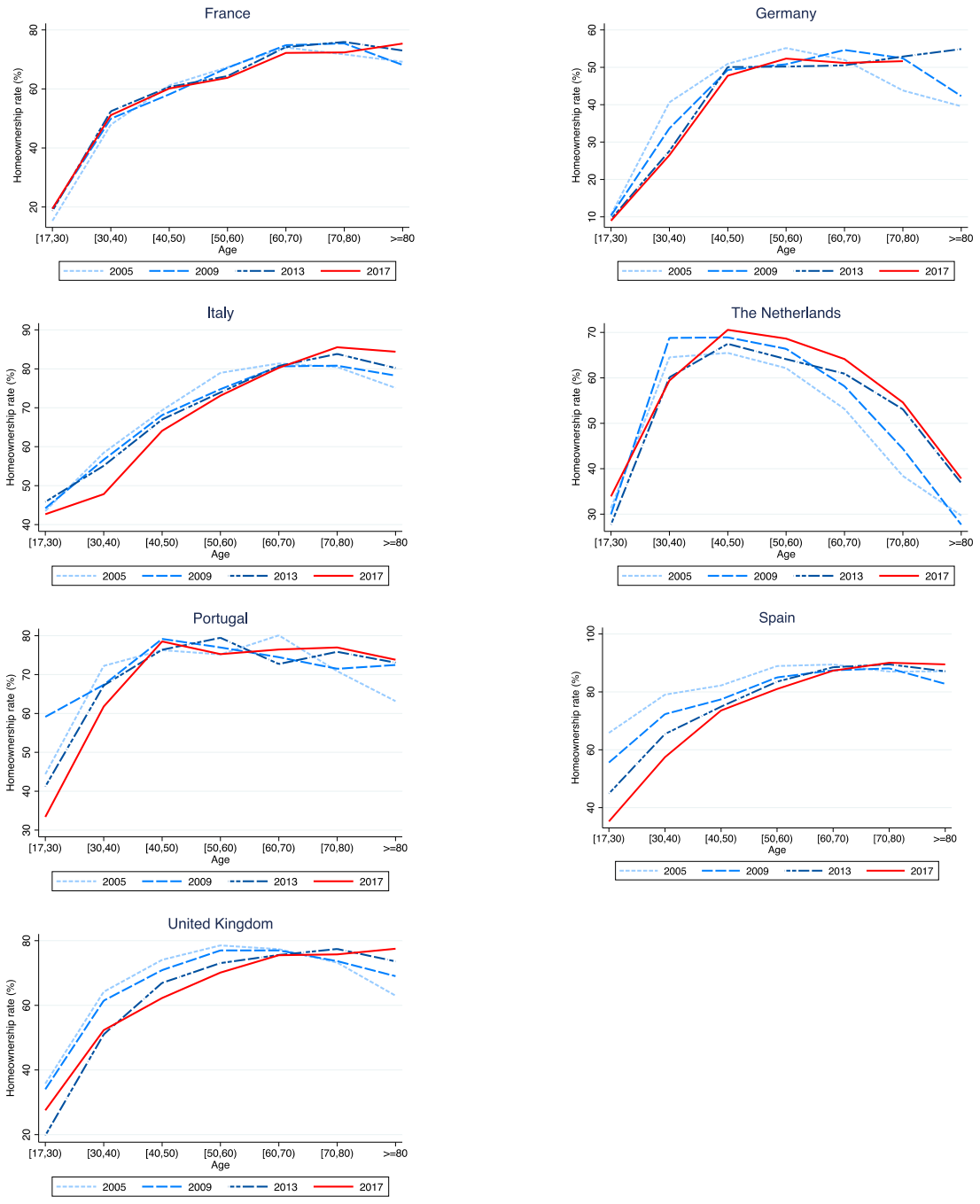

Figure 5. Homeownership rate by age group in selected European countries. Source: EU-SILC and authors' calculations using the survey waves 2005, 2009, 2013 and 2017.

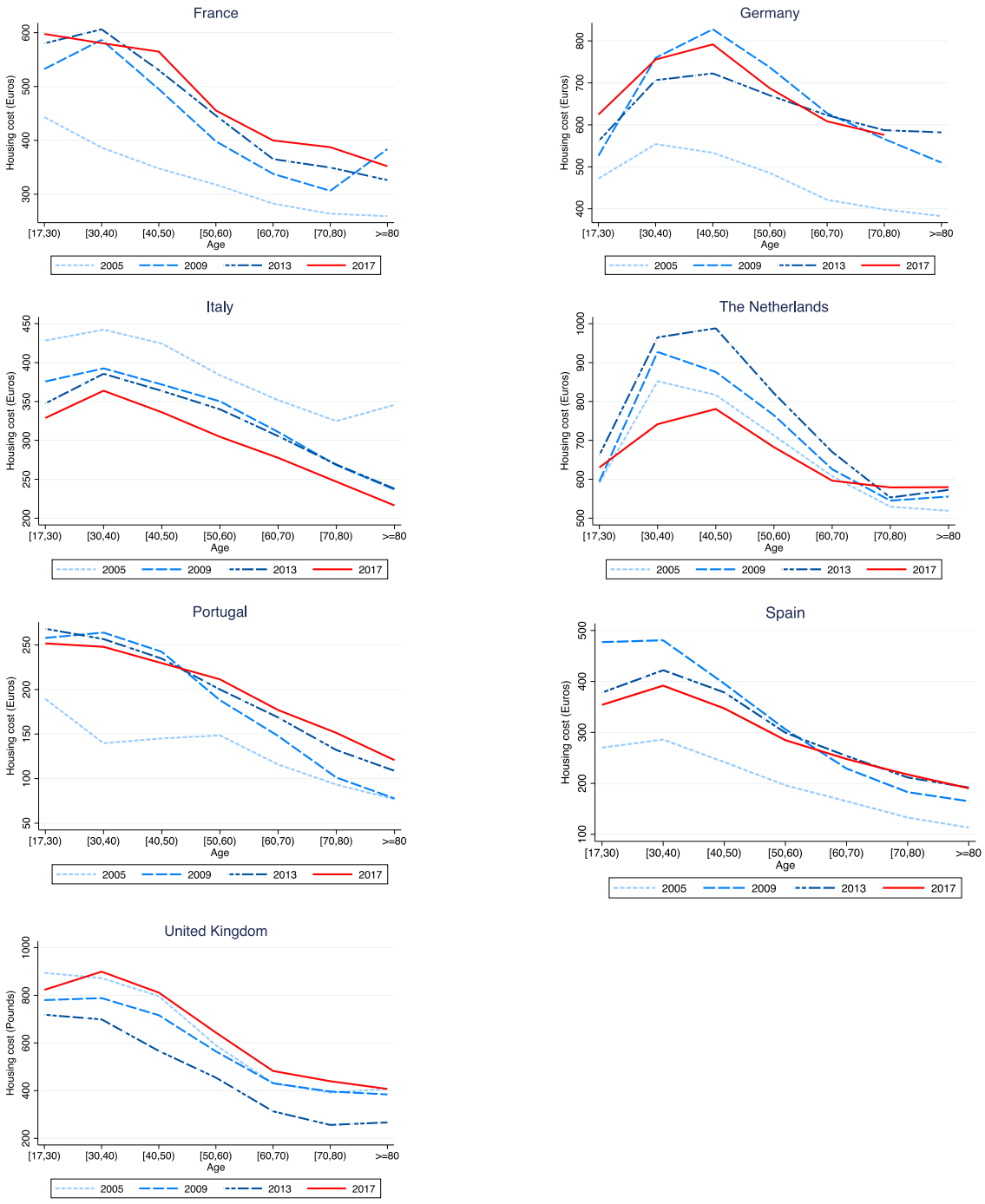

Figure 6. Monthly housing costs by age group in selected European countries. Source: EU-SILC and authors' calculations using the survey waves 2005, 2009, 2013 and 2017.

4. Explaining the new facts: Empirical evidence on the role of age post-Financial Crisis

To understand the drivers of the homeownership dynamics shown before, now we delve into the analysis of the Spanish Survey of Household Finances, or Encuesta Financiera de las Familias (EFF). In this section we look at the empirical evidence, in the next one we use regression analysis to confirm the visual facts.

The EFF is an official survey undertaken by the Bank of Spain, in collaboration with the National Statistics Institute. This survey is conducted every three years, with the first wave being in 2002, and the last wave that is publicly available in 2014.

The original microdata are collected through a comprehensive and detailed questionnaire, by means of personal interviews, about the households' financial conditions. The questions concern housing, debt, labor and non-labor income, and other financial and non-financial assets. The purpose of the survey is to empower studies on the financing and investment decisions of Spanish households, and their financial position at each point in time.

The sample is selected from all adult ages and socioeconomic classes. Importantly, the surveys oversample the highly wealthy households. Such oversampling ensures that there is a sufficient number of households to study, with enough precision, the financial behavior of households at the top of the wealth distribution and to measure more accurately the aggregate wealth of the economy.[1] Since our analysis compares different survey waves within age groups, we do not make use of any weights to aggregate the data to the whole population.

[1] This aspect is crucial in surveys of this kind, since the distribution of wealth is very asymmetrical and only a small fraction of the population invests in certain kinds of assets, mainly high-wealth households.

The five survey waves create a dataset of mainly repeated cross-sectional survey data. That is, a different set of households is asked the same questions each wave, so the data are comparable over time. Each cross-section of households is representative of the overall sample.[2] Our main analysis uses the full sample of the five waves and treats the survey as repeated cross-section.[3] Table 1 presents the summary statistics of the key variables in this study.

Table1. Summary statistics

	Mean	SD	P1	P99
Age	59.25	15.36	26	86
Share of households who own their main residence	0.86	0.35	0	1
Share of households who own additional properties	0.51	0.50	0	1
Number of additional properties	1.28	2.91	0	11
Share of households with outstanding debt for main residence	0.18	0.38	0	1
Share of households with outstanding debt for other properties	0.09	0.29	0	1
Outstanding debt for main residence ('000 Euros)	14.98	56.33	0	220.00
Outstanding debt for other properties ('000 Euros)	16.55	242.18	0	260.38
Total annual income ('000 Euros)	56.35	148.10	2.46	420.35

Note: Number of observations: 29,528. The sample consists of all households in all triennial survey waves, from 2002 to 2014. All Euro values are inflation adjusted, to the equivalent of 2014 Euros. P1 means the first percentile, and P99 the 99th percentile of each distribution.

[2] About half of the households in each wave had participated in the survey of the previous wave. Hence, part of the data consists of household panel data. However, households might have changed their composition substantially between different waves.

[3] Missing data in the surveys are imputed five times using a multiple imputation procedure, as is common for these type of surveys. To make inferences from the five multiply imputed datasets, we perform the full analysis with each of the five datasets separately. The final results are given by averaging the results of the five analyses. For simplicity, in this study we present the results from one of the datasets. Using a dataset with a different imputation, or combining all datasets, does not change any of the results. Specifically, the only variable in our analysis that is imputed when there are missing data is the total household income.

A typical household balance sheet has mortgage credit as the largest liability, and perhaps consumer credit as smaller liability. On the asset side, households hold real estate, deposits, stocks and other financial products (see Table 2). Elder households increased their holdings of real estate assets, while at the same time decreased their holdings of deposits, stocks and other financial products. Many young households, however, do not buy any houses or other real estate, and do not take on any mortgage credit.

Table 2. A typical household balance sheet

Assets	**Liabilities**
Primary residence	Mortgage debt
Other real estate	Consumer debt
Deposits	
Stocks	
Other financial assets	

Figure 7 shows that the homeownership rate in Spain decreased significantly, from the year 2002 to 2014. Importantly, the homeownership rate collapsed for young households. While in 2002, 60% of households below 30 years old owned their main residence, this percentage was cut to 36% in 2014. As we explained in the data section, the homeownership rates come from a sample that overrepresents wealthy households, hence it is safe to say that the homeownership rates for this young age group are even lower, and the decrease over time could be even more dramatic.

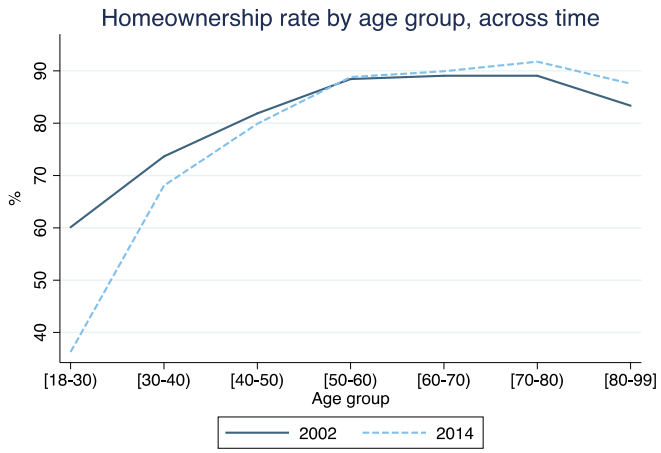

Figure 7. Homeownership rate in Spain by age. The figure plots homeownership rate by age group for the survey waves 2002 and 2014. Source: Spanish Survey of Household Finances.

Figure 7 shows that elder households, above 50 years old, have been historically owning their houses in vast majority. Both in 2002 and in 2014 around 90% of households in the elder age groups are homeowners.

Since homeownership rate is dropping in Spain for young households, then the question is: who buys the excess stock of houses? Figure 8 shows that post-financial crisis, the elder households not only own their main residence, but the recently have substantially increased their holdings of real estate. For example, 50% of households between 60 and 70 years old owned more than one properties in 2000, whereas this percentage exploded to 70% in 2014.

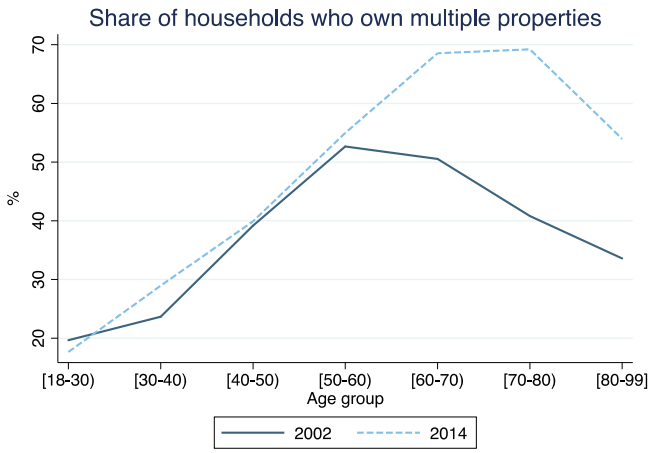

Figure 8. Share of households in Spain who own multiple properties by age. The figure plots the share of households by age group who own additional properties, apart from their main residence, for the survey waves 2002 and 2014. Source: Spanish Survey of Household Finances

Figures 9 and 10 show how much the average number of properties each household owns increased over time for the elder households, and that it remained unchanged or even decreased for the younger households.

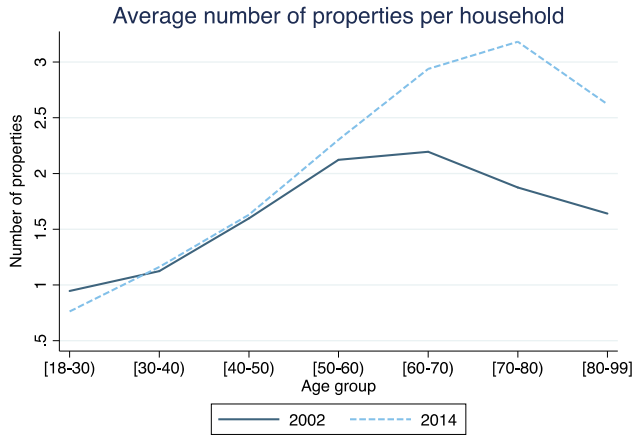

Figure 9. Average number of properties each household in Spain owns by age. The figure plots the average number of properties each household owns, in each age group, for the survey waves 2002 and 2014. Source: Spanish Survey of Household Finances

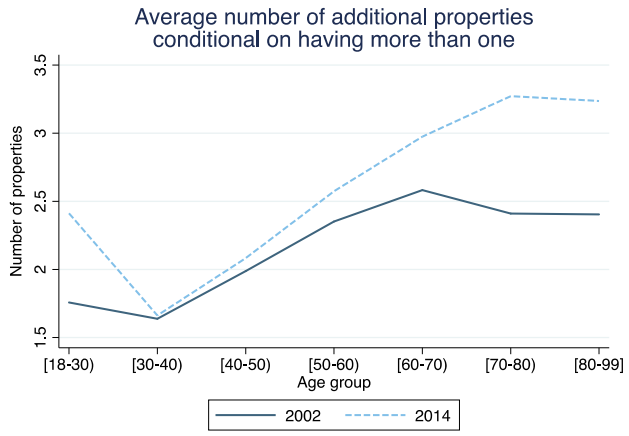

Figure 10. Average number of additional properties each household in Spain owns by age. The figure plots the average number of additional properties each household owns, conditional on owning additional properties apart from their main residence, in each age group, for the survey waves 2002 and 2014. Source: Spanish Survey of Household Finances

The data in the previous figures corroborate that the elder (and wealthy) households buy the stock of houses that the young do not buy. These additional houses might be vacation homes, but they might also be used as investment assets. That is, the elder households now rent houses to the young and become landlords.

How did the previous dramatic changes in the ownership of real estate translate to the dynamics mortgage credit? As Figure 11 shows, out of the households that become homeowners, the share that gets mortgage credit has increased over the years for some age groups but remained unchanged for most households. For example, about half of homeowners below 30 years old have debt outstanding for their main residence, both in 2002 and 2014. Since 60% of households in this age group are homeowners, 30% (half of 60%) of all households (homeowners and renters) in this age group have debt outstanding in 2002. With the same calculation, 18% (half of 36%) of all households below 30 years old have debt outstanding in 2014. This means that the extensive margin of mortgage credit has collapsed for young households. Households in the next age groups, especially 40 to 50 years old, seem to have

increased their extensive margin of mortgage credit. The elder households naturally have very low outstanding debt from the purchase of their main residence, and this remained unchanged.

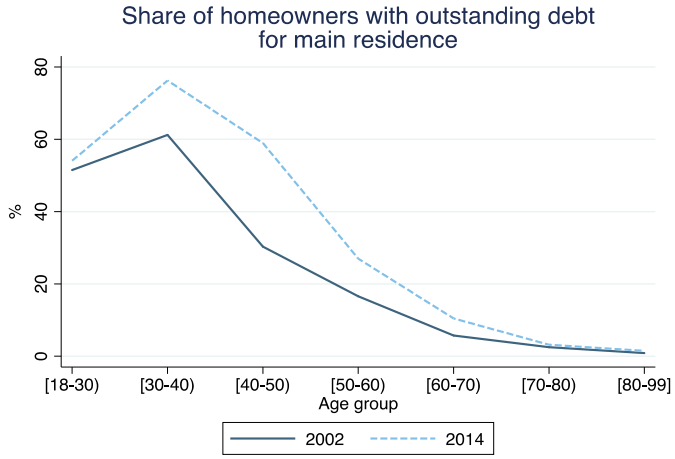

Figure 11. Share of households in Spain that have debt outstanding for their main residence by age: Extensive margin. The figure plots the share of homeowners who have debt outstanding for the purchase of their main residence, by age group, for the survey waves 2002 and 2014. Source: Spanish Survey of Household Finances

We can extract similar observations from Figure 12 regarding real estate debt that is not for the main residence. The share of households of any age group with outstanding debt has slightly increased over time.

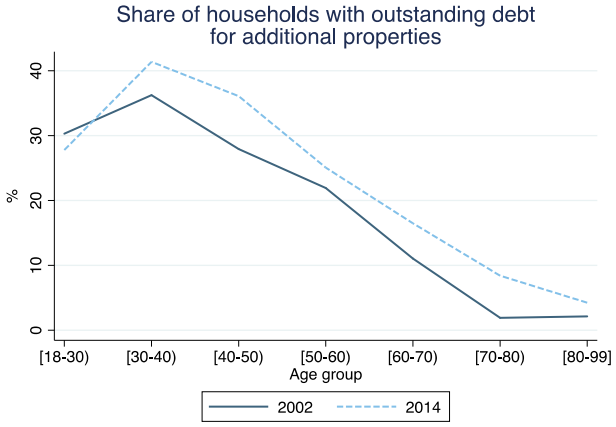

Figure 12. Share of households in Spain that have debt outstanding for additional properties by age: Extensive margin. The figure plots the share of households who own additional properties, apart from their main residence, who have debt outstanding for the purchase of the additional properties, by age group, for the survey waves 2002 and 2014.

The previous evidence does not mean however that overall there was an increase in the extensive margin of real estate debt, since only elder households purchase additional properties and these households are precisely the ones with the lowest propensity for using debt.

The previous figures show that fewer and fewer young households in Spain take on mortgage debt over the last ten years. Those who do borrow, how much do they borrow compared to the previous decade? It seems that the young households take on much larger mortgages than before. Figure 13 shows a huge jump to the average outstanding mortgage amount for households between 18 and 50 years old.

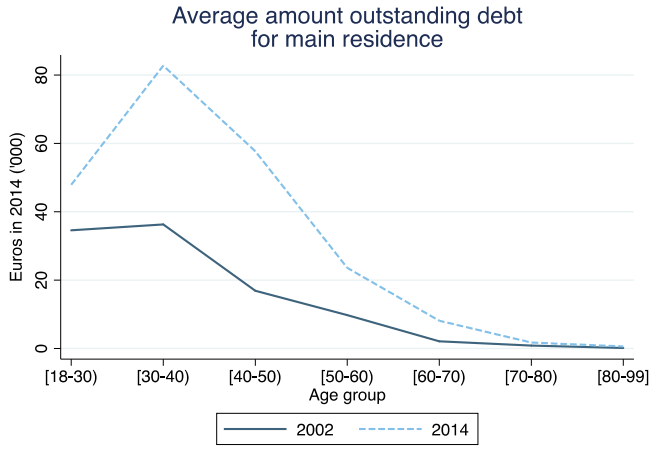

Figure 13. Outstanding debt for main residence by age: Intensive margin. The figure plots the average value of debt that households have outstanding for the purchase of their main residence, by age group, for the survey waves 2002 and 2014. All Euro values are inflation adjusted to reflect 2014 Euros. Source: Spanish Survey of Household Finances

Figure 14 shows a jump to the average outstanding debt amount related to additional properties for all households above 30 years old. These increases in households' leverage might be related to increased risk of default and might raise concerns for the financial stability of the lenders.

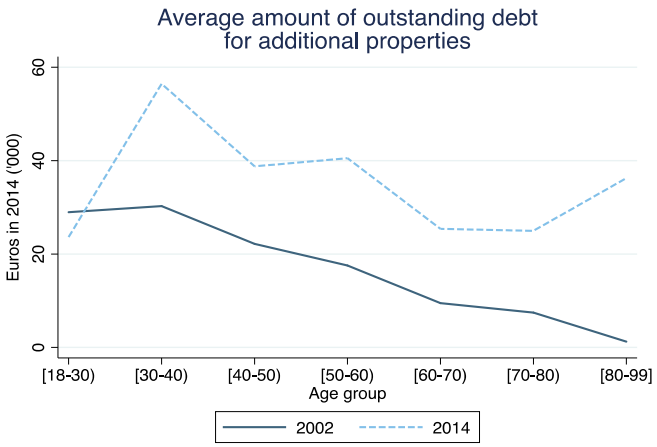

Figure 14. Outstanding debt for additional properties by age: Intensive margin. The figure plots the average value of debt that households have outstanding for the purchase of additional properties apart from their main residence, by age group, for the survey waves 2002 and 2014. All Euro values are inflation adjusted to reflect 2014 Euros. Source: Spanish Survey of Household Finances

Figure 15 shows the aggregate effects of the previous facts: bank lending to households dropped dramatically. These numbers come from the Bank Lending Survey of Banco de España.

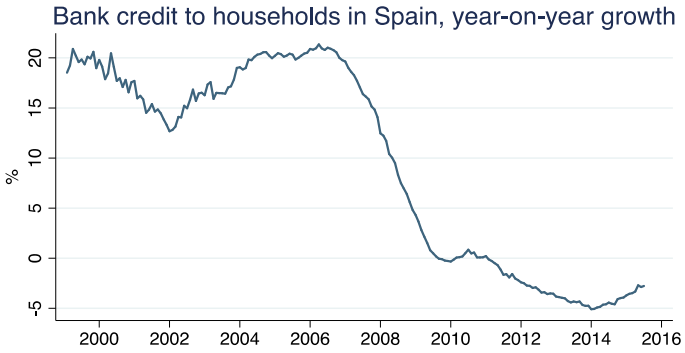

Figure 15. Bank lending to households in Spain over time. The figure plots the year-on-year growth of lending to households in Spain, since the year 2000. The growth is adjusted for securitization and sales. Source: Banco de España.

5. Explaining the facts: Regression analysis on the role of age post-Financial Crisis

The previous facts show striking changes in the households' property ownership and debt holdings. To understand the factors driving the households to own more properties, or take on more debt, we estimate the following logistic regression using the Spanish Survey of Household Finances:

$$L_{i,t} = \beta_0 + \beta_1 P_t A_{i,t} I_{i,t} + \beta_2 P_t A_{i,t} + \beta_3 P_t I_{i,t} + \beta_4 A_{i,t} I_{i,t} + \beta^5 P_t + \beta^6 A_{i,t} + \beta^7 I_{i,t} + C_t + u_{i,t}$$

where i indexes the household and t the year of the survey wave. $L_{i,t} = \frac{\log \pi_{i,t}}{1 - \pi_{i,t}}$, denotes the log-odds of the probabilities of interest $\pi_{i,t}$. These are (a) the probability of household i owning multiple properties at time t, and (b) the probability of household i having outstanding debt from their main residence at time t. P_t is a binary variable that takes the value of one post-crisis, that is, for the survey waves 2011 and 2014, and the value of zero pre-crisis, that is, for the waves 2002, 2005 and 2008. $A_{i,t}$ is the age of the reference person of the household. The reference person is the one who chiefly deals with the household's finances. $I_{i,t}$ is the household's annual income. This is calculated as the sum of labor and non-labor income for all household members. we adjust the total income for inflation, so all values are in 2014 Euros. The final values of income are in thousands of Euros. C_t denotes the controls, which are dummies for each survey wave.

Part of the data are panel (the same household is interviewed over time), but the most part is repeated cross-section. That is, in every survey wave the majority of households are different from the previous waves. Surveying different households reduces the serial correlation of the variables between survey waves.

The coefficients of interest, β^1 and β^2 quantify how much more one additional year of age and one thousand Euros additional annual income post crisis, contribute to increase the log-odds of owning multiple properties and having real estate debt.

Table 3 shows the results of the estimation of the logit model. The likelihood of owning multiple properties increases with age, and increases even more post-crisis, as the interaction term of age with the post-crisis dummy is positive and significant. This likelihood increases additionally with the income of households, as the triple interaction of age, post-crisis dummy and income is positive and significant.

Table 3. Probability of owning multiple properties

	Own properties in addition to main residence			
Age × Post-crisis	0.005***	0.005***	0.001	0.001
	(0.002)	(0.002)	(0.003)	(0.003)
Age × Income × Post-crisis			0.0003***	0.0003***
			(0.0001)	(0.0001)
Age	0.025***	0.025***	0.012***	0.012***
	(0.001)	(0.001)	(0.002)	(0.002)
Income	0.021***	0.021***	-0.001	-0.001
	(0.0004)	(0.0004)	(0.002)	(0.002)
Post-crisis	0.070	0.315***	0.027	0.280*
	(0.105)	(0.110)	(0.162)	(0.165)
Dummies for waves	No	Yes	No	Yes
Observations	29,528	29,528	29,528	29,528

Note: Standard errors are in parentheses. Post crisis years include the survey waves 2011 and 2014, while pre-crisis the waves 2002, 2005 and 2008. Each observation is a household. ***sig. at 1%; **sig. at 5%. Source: Spanish Survey of Household Finances.

Tables 4 and 5 show the results of the estimation of the logit model for having mortgage credit. Table 4 uses the full sample that includes homeowners and renters, whereas Table 5 uses only the sample of homeowners. The result from both tables is that the coefficient of the interaction of age with the post-crisis dummy is negative and significant. That is, post-crisis the likelihood of having mortgage debt decreases even more with age.

Table 4. Probability of outstanding debt from main residence: Extensive margin (unconditional)

	Have outstanding debt from main residence			
Age × Post-crisis	-0.011***	-0.010***	-0.011***	-0.011***
	(0.003)	(0.003)	(0.003)	(0.003)
Age × Income × Post-crisis			0.00001	0.00001
			(0.00004)	(0.00004)
Age	-0.073***	-0.074***	-0.069***	-0.070***
	(0.002)	(0.002)	(0.002)	(0.002)
Income	0.0003***	0.0003***	0.006***	0.007***
	(0.0001)	(0.0001)	(0.001)	(0.001)
Post-crisis	0.886***	1.150***	0.937***	1.213***
	(0.135)	(0.141)	(0.166)	(0.171)
Dummies for waves	No	Yes	No	Yes
Observations	29,528	29,528	29,528	29,528

Note: Standard errors are in parentheses. Post crisis years include the survey waves 2011 and 2014, while pre-crisis the waves 2002, 2005 and 2008. Each observation is a household. ***sig. at 1%. Source: Spanish Survey of Household Finances.

Table 5. Probability of outstanding debt from main residence: Extensive margin (conditional)

	Have outstanding debt from main residence			
Age × Post-crisis	-0.017***	-0.015***	-0.015***	-0.015***
	(0.003)	(0.003)	(0.004)	(0.004)
Age × Income × Post-crisis			-0.00002	0.00002
			(0.00003)	(0.00003)
Age	-0.099***	-0.100***	-0.100***	-0.101***
	(0.002)	(0.002)	(0.002)	(0.002)
Income	-0.0002	-0.0001	-0.002	-0.001
	(0.0002)	(0.0001)	(0.001)	(0.001)
Post-crisis	1.232***	1.604***	1.165***	1.556***
	(0.172)	(0.178)	(0.191)	(0.196)
Dummies for waves	No	Yes	No	Yes
Observations	25,318	25,318	25,318	25,318

Note: Standard errors are in parentheses. The sample includes only the households who are homeowners. Post crisis years include the survey waves 2011 and 2014, while pre-crisis the waves 2002, 2005 and 2008. Each observation is a household. ***sig. at 1%. Source: Spanish Survey of Household Finances.

To quantify the influence of age and income post-crisis on the value of the households' debt, we employ the following specification:

$$D_{i,t} = \beta_0 + \beta_1 P_t A_{i,t} I_{i,t} + \beta_2 P_t A_{i,t} + \beta_3 P_t I_{i,t} + \beta_4 A_{i,t} I_{i,t} + \beta^5 P_t + \beta^6 A_{i,t} + \beta^7 I_{i,t} + C_t + u_{i,t}$$

where $D_{i,t}$ is household's i value of outstanding debt in thousands of 2014 Euros, in the year t. The rest of the variables and controls are as before. We estimate the previous equation using ordinary least squares regression (OLS).

Table 6 shows the results of the estimation of the debt equation using the sample of homeowners. The negative and significant coefficient of the age main effect shows that, the lower the age, the higher the intensive margin of mortgage debt. The interaction term of age with

the post-crisis dummy, and the triple interaction of age, post-crisis dummy and income are negative and significant. Post-crisis the intensive margin of mortgage debt decreases even more with age, and even more with income.

Table 6. Value of outstanding debt from main residence: Intensive margin (conditional)

	Outstanding debt of homeowners from main residence			
Age × Post-crisis	-0.548***	-0.540***	-0.449***	-0.443***
	(0.050)	(0.050)	(0.054)	(0.054)
Age × Income × Post-crisis			-0.002***	-0.002***
			(0.0004)	(0.0004)
Age	-1.068***	-1.075***	-0.998***	-1.003***
	(0.031)	(0.031)	(0.035)	(0.035)
Income	0.009***	0.009***	0.099***	0.103***
	(0.002)	(0.002)	(0.021)	(0.021)
Post-crisis	40.237***	44.651***	34.289***	39.024***
	(3.096)	(3.211)	(3.402)	(3.508)
Dummies for waves	No	Yes	No	Yes
Observations	25,318	25,318	25,318	25,318

Note: Standard errors are in parentheses. The sample includes only the households who are homeowners. Post crisis years include the survey waves 2011 and 2014, while pre-crisis the waves 2002, 2005 and 2008. Each observation is a household. ***sig. at 1%. Source: Spanish Survey of Household Finances.

To understand the different factors that affect the changes post crisis, we study whether the changes come from the ECB's large asset purchase program. Specifically, this unconventional enhanced credit support approach had a strong effect on risk-free rates, making these drop a lot, and eventually reaching the zero-lower bound. Accordingly, in the previous specification, we replace the post-crisis dummy with the average deposits interest rate in Spain. The specification becomes:

$$D_{i,t} = \beta_0 + \beta_1 R_t A_{i,t} I_{i,t} + \beta_2 R_t A_{i,t} + \beta_3 R_t I_{i,t} + \beta_4 A_{i,t} I_{i,t} + \beta^5 R_t + \beta^6 A_{i,t} + \beta^7 I_{i,t} + C_t + u_{i,t}$$

where R_t is the average interest rate in Spain paid by commercial banks on savings deposits. If some of the effects from the time post financial crisis come from the ECB's monetary policy, we expect the coefficients of interest β^1 and β^2 to be the opposite sign from the coefficients estimated in the previous equation, since the time post-crisis is related to drop in deposit rates.

Table 7 shows the results of the estimation of the last equation using the sample of homeowners. The interaction term of age with the CD rate, and the triple interaction of age, CD rate and income are positive and significant. As CD rates drop, so does the intensive margin of mortgage debt by age, and by age and income. The previous results are robust to alternative specifications and controls.

Table 7. Value of outstanding debt from main residence: Intensive margin (conditional) using CD rate to quantify crisis

	Outstanding debt of homeowners from main residence			
Age × CD rate	0.171***	0.168***	0.028	0.022
	(0.028)	(0.028)	(0.032)	(0.032)
Age × Income × CD rate			0.003***	0.003***
			(0.0003)	(0.0003)
Age	-1.657***	-1.663***	-1.193***	-1.189***
	(0.066)	(0.066)	(0.078)	(0.078)
Income	0.008***	0.009***	0.698***	0.716***
	(0.002)	(0.002)	(0.060)	(0.060)
Post-crisis	-13.186***	-11.857***	-3.090	-1.229
	(1.732)	(1.868)	(2.041)	(2.169)
Dummies for waves	No	Yes	No	Yes
Observations	25,318	25,318	25,318	25,318

Standard errors are in parentheses. The sample includes only the households who are homeowners. Each observation is a household. The certificate of deposits (CD) rate from Spain comes from the World Bank. ***sig. at 1%; **sig. at 5%. Source: Spanish Survey of Household Finances.

The results are relevant for the growing literature analyzing optimal macroprudential regulation. Gete and Reher (2016) characterize two extensive margins of credit, one demand- and the other supply-driven. The authors highlight the beneficial role of mortgage debt in providing access to homeownership, and the importance of loan-to-value and loan-to-income policies in the optimal allocation of credit. Iacoviello (2005) develops a monetary business cycle model that focuses on the intensive margin of credit. Lambertini, Mendicino and Punzi (2013), and Rubio and Carrasco-Gallego (2014) study monetary and macroprudential policies, and optimal loan-to-value regulation.

Furthermore, the results relate to the recent quantitative literature studying mortgage markets. For example, Campbell and Cocco (2015) solve a dynamic model of households' mortgage decisions and quantify the effects of loan-to-value ratios and mortgage affordability measures on default. Corbae and Quintin (2015) study a model of heterogenous agents, and show that exogenous changes in approval standards increased the number of high-leverage loans prior to the financial crisis in the U.S. This increase in high-leverage loans can explain over 60% of the rise in foreclosure rates. Chatterjee and Eyigungor (2015), using a model of heterogenous agents and long-term debt, study three shocks that can account for the dynamics of house prices and foreclosures. Gete and Zecchetto (2018) study quantitatively how loan guarantees affect credit supply and demand. Our analysis provides evidence for the recent changes in the extensive and intensive margins of mortgage debt and offers new insights on how these are linked to new risks for the financial system.

6. Explaining the new facts: Regression analysis on potential causes

In this section, we run cross-country panel regressions to study what explains the changes in HOR documented above. We focus on three theories:

1) Income variables. The theory is that drops in income may explain the drop in HOR. The endemic low growth of the economy might be driving the results. In particular, the recovery after the crisis is not effective for the young households. Figure 16 plots the income data from EU-SILC for the countries in our sample.

2) Credit variables that we proxy with loans to households. The theory is that tighter credit access may explain the drop in HOR. Figure 17 reports the credit data from EU-SILC. The data from EU-SILC report homeowners with mortgage from 2010 onwards. The drop in mortgage credit for younger households is dramatic in countries as Spain.

3) Portfolio variables. Specifically, we capture the "search for yield" motive of housing investors. These investors, once safe asset returns (that we proxy with the yield of government bonds) fall, then see housing as an interesting asset. Investors buying housing causes a crowding out effect and leads to lower HOR.

Table 8 then contains the results from a cross-sectional regression for the sample of EU countries. It shows that the three theories outlined above are operating in Europe. Including country and year fixed effects or controlling for demographics do not alter the results.

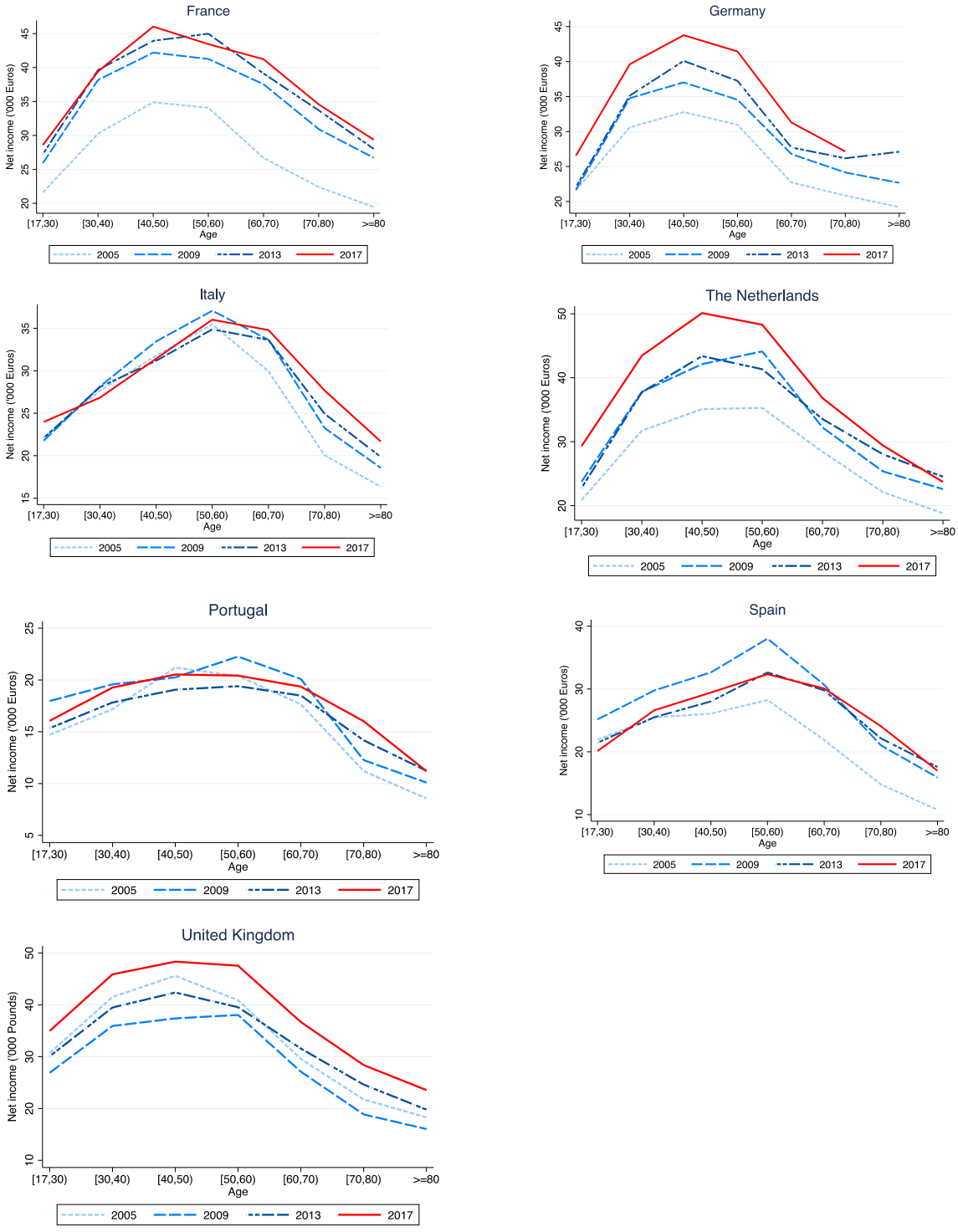

Figure 16. Net Income by age group in selected European countries. Source: EU-SILC and authors' calculations using the survey waves 2005, 2009, 2013 and 2017.

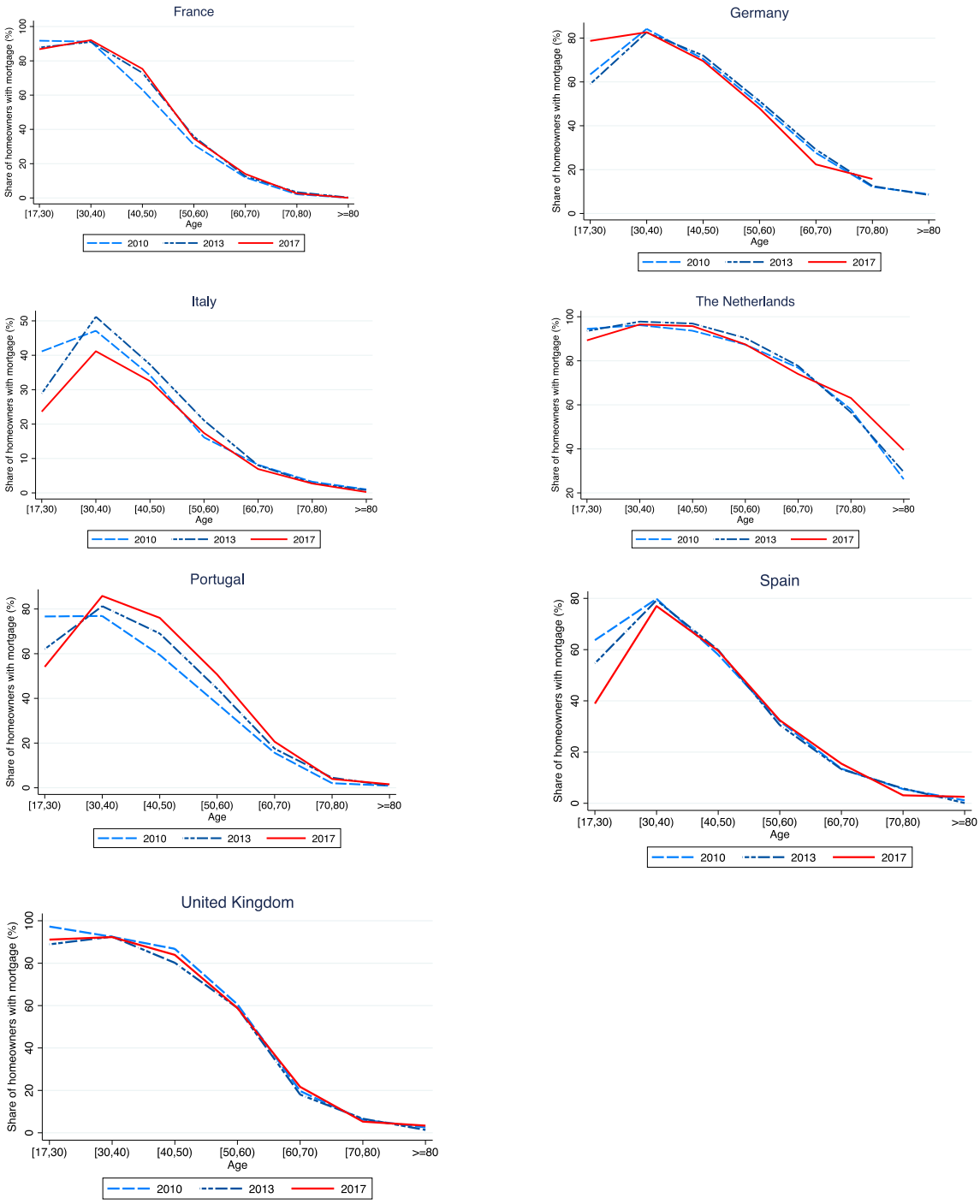

Figure 17. Mortgage credit (share of homeowners with mortgages) by age group in selected European countries. Source: EU-SILC and authors' calculations using the survey waves 2010, 2013 and 2017.

Table 8. Cross-country analysis of drivers of homeownership

	(1)	(2)	(3)	(4)	(5)
	Homeownership rate change				
Household loans	0.249***	0.303***			
	(0.085)	(0.114)			
Income growth			0.026***	0.030***	
			(0.008)	(0.009)	
Government bond rate change					0.089**
					(0.044)
Economic controls	Yes	Yes	Yes	Yes	Yes
Country fixed effects	Yes	Yes	Yes	Yes	Yes
Year fixed effects		Yes		Yes	
Observations	229	229	364	364	317
Number of countries	25	25	30	30	26

Standard errors in parentheses
*** p<0.01, ** p<0.05

Note: This table shows factors that are related to the change in homeownership rates in European countries. The household loans are the log value of the total household loans in a country-year. Income is the net household income. Government bonds are 10-year bonds. Economic controls are the unemployment rate change and population growth. All independent variables and controls are lagged for one year. The sample consist of European countries for the years 2008 to 2020. Source: EU-SILC.

7. Robustness test using ING loan level dataset for the Netherlands.

In this section we revisit the previous results using the ING loan level dataset for the Netherlands. We focus on mortgage originations and the recent financial crisis that was caused by the global health crisis of the Covid-19 pandemic. We had 10 months of data available.

First, Figure 18 plots the share of mortgage originations by income quartiles. Post-2020 there is a trend in which the high-income households increase their mortgage origination share, while the low-income households decrease their share. Specifically, the top income quartile increases their share from 24% to 32%, from March 2020 to December 2020. At the same time, the mortgage origination share of the lowest income quartile drops from 25% to 17%. This finding shows an interesting redistribution of mortgage credit from low income to high income households.

We analyze mortgage originations by age. We split the customers into age groups and calculated their share of mortgage originations every month, for the last five years. Figure 19 shows that, overall, there is little variation over time in the age at the time of origination. A slight change in the trend after 2020, shows that the mortgage originations by the youngest group, age 35 or below, have been dropping. The share of originations of the youngest group decreased from 50% to 40%, from March 2020 to December 2020. At the same time the age group of 45-to 55-year-olds has increased its share from 16% to 22%. This finding shows that the younger households have been impacted more by the crisis.

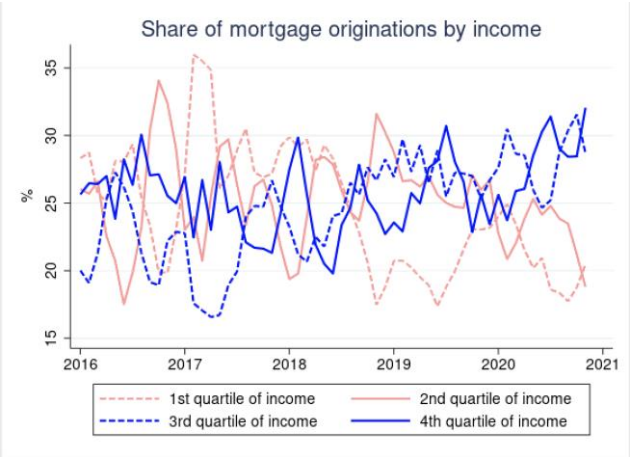

Figure 18. Share of mortgage originations by income quartiles. The share of originations is at monthly frequency and is calculated as the 3-month moving average. Source: ING loan level database and authors' calculations

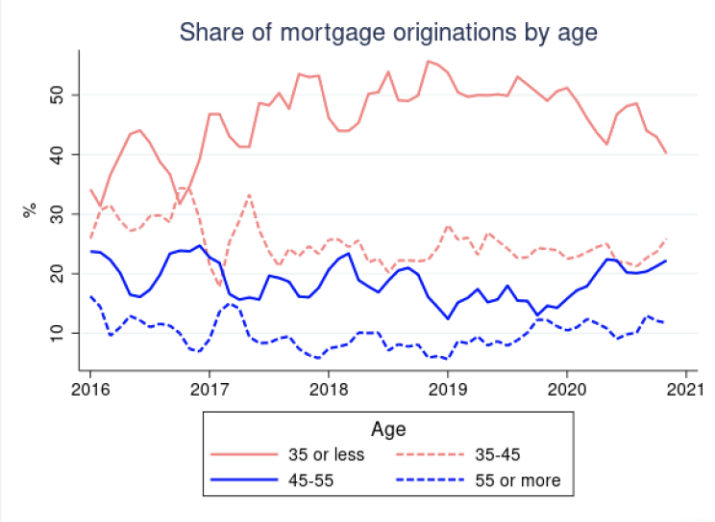

Figure 19. Share of mortgage originations by age groups. The share of originations is at monthly frequency and is calculated as the 3-month moving average. Source: ING loan level database and authors' calculations.

8. Conclusions and implications

The novel results of this paper have important implications for the economy, policymakers, Central Banks, and for the banking industry. Here we highlight four implications:

First, banks may face more difficulty to generate lending revenue. Traditionally the main borrowers from banks have been the young households buying their homes. Decreased demand from young households means that banks face a decrease in their income from lending.

Second, banks may face problems to raise deposits or sell financial products to elder households. Elder households buy increasingly more real estate and have much greater scope to invest in real estate. Rental yields from their additional properties replace the income from more traditional investments. Demand for financial products drops as well as deposits.

Third, leverage is increasing among those households borrowing. As the loan-to-value and loan-to-income indicators increase, so is the default risk of the loans. To the extent that banks are taking on higher default risk, this puts at risk the financial stability of the banking industry.

Finally, from a macroprudential point of view, the transmission channel of monetary policy may change. Garriga, Kydland and Šustek (2017) describe two channels through which monetary policy can affect housing investment and the economy. The transmission mechanisms work through the cost of new mortgage borrowing and real payments on outstanding debt. The authors find that persistent monetary policy shocks affecting the level of the nominal yield curve have large real effects. In this new economic reality, the young households are renters. Renters are not sensitive to interest rates as young homeowners are. For example, changes to interest

rates do not affect the consumption of young households who do not have a mortgage. This makes the transmission channels of monetary policy less effective.

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