Appendix for Online Publication

Appendix A: Data

Data

The empirical facts about homeownership, income and wealth are derived from the German Socio-Economic Panel (SOEP). Detailed household wealth information is not collected every year. We use the wealth modules of the SOEP collected in the years 2002, 2007 and 2012. The data is restricted to households whose head is of age 25 or older. Household labor income of household heads of age below 65 is restricted to be positive. We also exclude business owners to be consistent with our quantitative model which does not feature entrepreneurship. The resulting pooled dataset consists of 24,595 households. Homeownership is defined as owning the primary household residence. Household net wealth is defined as the value of all real and financial assets net of liabilities.

The data used in the estimations of the household labor income processes and tax functions also come from the SOEP. We use all yearly waves between 1995 and 2014. The data restrictions are on the age of the household head (25-64 years) and household labor income (positive values). The derived sample consists of 130,686 observations. The income variables utilized in the estimation of the income tax functions are gross household and net household income. The data sample excludes landlord households since mortgage interest on rental units can be deducted (see the main text). The sample size for this estimation is 112,467 observations. All monetary values are CPI-deflated and are expressed in terms of 2006 euros.

Several counterfactual exercises in the paper rely on the use of U.S. data. We derive U.S. household labor income processes and tax functions using the Panel Study of Income Dynamics (PSID) data for the years 1995-2014 with the same restrictions and variables as in the German case.

Estimating Household Labor Income Processes

The household labor income processes are estimated non-parametrically following a strategy related to De Nardi et al. (2019).[46] We construct first-order discrete Markov processes for residual labor income directly from the SOEP data as inputs for each of the working-age groups in our economic environment. We refer to "household age" when we mean the age of the household head. The procedure can be summarized as follows. Working-age stages $\tau = 1, 2, 3, 4$ in the model correspond to 10-year age groups in the data, namely 25-34, 35-44, 45-54, and 55-64 years of age. For each of these age stages of the life cycle, we pose the following specification for household labor income:

$$\log y^{\tau}_{j,t} = \alpha^{\tau}_0 + \alpha^{\tau}_{1,t} D_t + \alpha^{\tau}_2 a^{\tau}_{j,t} + \alpha^{\tau}_3 (a^{\tau}_{j,t})^2 + \varepsilon^{\tau}_{j,t} \ , \tag{16}$$

where D_t is year-t dummy variable and $a^{\tau}_{j,t}$ is the actual age of household j in year t within the age stage τ. For instance, if $\tau = 1$, then the age of the households observed in this stage would be between 25 and 34. The term $\varepsilon^{\tau}_{j,t}$ reflects the stochastic component of household labor income. Several clarifications are in order. First, we control for time and age effects and extract the residual stochastic income which is used in the construction of the Markov chains describing labor income dynamics. Second, by estimating (16) for each age group τ separately, we allow these time and age effects to be different over the life cycle.

The estimated coefficients in regressions (16) are used to construct the age-specific deterministic income levels M_{τ}. We use the estimated residuals from the four regressions (16) to construct the age-specific discrete Markov processes for income dynamics. For this purpose, we assume that $\varepsilon^{\tau}_{j,t}$ is i.i.d. distributed across households. Then, we pose that $\varepsilon^{\tau}_{j,t}$ follows a discrete Markov chain of order one with an age-dependent state space

$$E_{\tau} = \left\{ e^{\tau}_1, ..., e^{\tau}_I \right\} \ ,$$

for $\tau = 1, ..., 4$ and an age-dependent transition matrix $\Psi_{\tau}(i'|i)$ of size $I \times I$. Note that the age-dependent state space is of constant size I but the residual income realizations and the transition

[46] They argue that non-parametric estimates of the labor earnings process have significant advantages over the more traditional approaches of estimating a parametric linear Markov process for the stochastic component of earnings and discretizing it. In particular, the non-parametric method performs better when used in quantitative work in terms of matching the life-cycle patterns of consumption and savings.

matrices are age-specific. In estimating these processes we proceed as follows:

1. We fix the number of bins, $I = \{1, \ldots, 10\}$. Each discrete level of residual income can be interpreted as a decile of the age-specific residual income distribution. For each age τ, we sort the estimated $\varepsilon^{\tau}_{j,t}$ in ascending order and divide them in ten bins of equal size.

2. Each point in the state space E_τ is picked to be the mean in bin i at age τ.

3. The elements $\psi^{\tau}_{i,i'}$ of the transition matrix $\Psi_\tau(i'|i)$ are set to the observed average proportions of households in bin i in year t that are in bin i' in year $t+1$ for $t = 1995, \ldots, 2013$.

The estimated values for the annual labor income deciles vary from 3,038 euros (lowest decile) to 81,185 euros (highest decile) for age 25-34 and from 5,058 euros (lowest decile) to 120,053 euros (highest decile) for age 45-54. The transition matrices are normalized to doubly stochastic matrices with the help of the Sinkhorn-Knopp algorithm (Sinkhorn, 1964).[47] The estimated transition matrices exhibit significant persistence which increases with age.

In the additional counterfactual exercises, we use the U.S. income process estimated from the PSID data but normalized to the average labor income from the German benchmark case. According to our estimation, U.S. income risk is higher. While the standard deviation of working age income in Germany is 29,500, it is around 36,000 according to the normalized U.S. income process.

Pension Income

As mentioned in the main text, we set pension income at 42% of average earnings in the respective decile at which a household moves into retirement, and we apply caps at 32,000 euros and 6,000 euros.[48] As a result we obtain the deciles of pension incomes shown in Table 7.

Table 7: Pension income

$y(5,1)$	$y(5,2)$	$y(5,3)$	$y(5,4)$	$y(5,5)$	$y(5,6)$	$y(5,7)$	$y(5,8)$	$y(5,9)$	$y(5,10)$
6,000	6,468	9,814	12,434	14,806	17,224	20,025	23,713	29,272	32,000

[47] A doubly stochastic transition matrix delivers a uniform stationary distribution. The normalization is necessary as the income distribution is uniform across decile groups by construction.

[48] Precisely, contributions to the public retirement system are capped if income exceeds a threshold level. The upper limit is based on the assumption that a worker has paid these maximum contributions throughout the entire working life. The lower bound is based on basic old-age security (4,800 for singles and 8,800 for couples).

For the counterfactual exercise with U.S. social security, we set the replacement rate at 39% which is the gross replacement rate for men with average earnings (OECD) and apply caps based on the special minimum benefits at 30 years of coverage (lower bound) and the maximum social security benefits for worker retiring at full retirement age (upper bound) which we took from the Social Security Administration. Normalizing these by the same factor as labor income (see above) we obtain caps at 5,785 and 16,100.

Estimating Tax Functions

The income tax function $T_\tau(y)$ which describes the tax and transfer policies in place is specified as

$$T_\tau(y) = y - \lambda_\tau y^{1-\phi_\tau} \ , \tag{17}$$

where $T_\tau(y)$ are net taxes (i.e. income taxes and social security contributions net of public transfers) at taxable household income y for a household of age τ. This specification has a long tradition in economics and has been used by Benabou (2002), and more recently by Guner et al. (2014) and Heathcote et al. (2017) among others. The parameter ϕ_τ influences the progressivity of the tax and transfer system. When $\phi_\tau > 0$, marginal tax rates are always greater than average tax rates, which is the usual way to define a progressive tax system. On the other hand, if $\phi_\tau = 0$, then households in the economy face a flat tax rate $1 - \lambda_\tau$. Negative values of the parameter give rise to a regressive tax system. The parameter λ_τ, on the other hand, determines the net tax revenue and reflects the average level of taxation. Specification (17) implies that if the tax system is progressive, the average tax rate below income $\lambda_\tau^{1/\phi_\tau}$ is negative, that is, households with such income receive net transfers from the government.

Tax function (17) implies the following relation between taxable income y and net income $\tilde{y}$,

$$\tilde{y} = \lambda_\tau y^{1-\phi_\tau}. \tag{18}$$

We log this equation and estimate it via OLS for the pooled data sample, separately for each age group τ. The latter reflects the idea that household size, in particular the number of children, varies with age and hence implies different tax deductions which are not taken into account.

Table 8: Tax functions

Age (τ)	25-34	35-44	45-54	55-64	25-64
λ_τ	50.634***	58.405***	46.842***	20.329***	37.560***
	(1.142)	(1.028)	(0.827)	(0.512)	(0.380)
ϕ_τ	0.377***	0.385***	0.364***	0.293***	0.346***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.001)
R^2	0.801	0.797	0.834	0.836	0.821
N	23,023	37,420	32,342	19,682	112,467

NOTES: Standard errors in parentheses. The delta method is used to compute the standard errors from the OLS estimation of the logged version of equation (18). Significance levels: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

The results from the estimation are presented in Table 8. The fit of the regression model is reasonably good. The estimates for ϕ_τ indicate that the German tax and transfer system has a strong redistributive component.

In the additional counterfactual exercises, we use U.S. tax functions estimated from PSID data. The estimated U.S. tax schedules show a lower degree of redistribution as the age-specific progressivity parameters ϕ_τ for working age vary between 0.16 and 0.21. This is in line with the results of Heathcote et al. (2017). Their estimation exercise for the United States uses the same tax functional form and delivers a value of 0.181 for the progressivity parameter ϕ (all ages pooled).

Estimating House Value Risk

Housing in the model is subject to idiosyncratic house value shocks, $\chi' \sim \mathcal{N}(-\sigma_\chi^2/2, \sigma_\chi^2)$. As in the model, we specify the empirical process for idiosyncratic house values as a random walk with drift. We estimate it using the wealth modules of the SOEP for the years 2002, 2007 and 2012. The empirical specification is

$$\Delta \log(p_{i,t+5}) = \theta + \chi_{i,t}, \tag{19}$$

where $\Delta \log(p_{i,t+5}) = \log(p_{i,t+5}) - \log(p_{i,t})$ is the log difference of the house price per square meter $p_{i,t}$ reported by a homeowner i who stays homeowner of the same property from year t to year $t+5$, where $t = \{2002, 2007\}$. The estimated parameter of interest is the variance of the residuals,

$\text{Var}(\chi_{i,t})$. The estimated variance is based on five-year periods between observations. Therefore, in order to derive the implied annual standard deviation we divide this variance by five and take the squared root, $\hat{\sigma}_\chi = \sqrt{\text{Var}(\chi_{i,t})/5}$.[49]

Table 9: House value risk

	(1)	(2)	(3)	(4)	(5)
σ_χ	0.1083	0.1083	0.1073	0.1042	0.1040
Time trends:					
Year		Yes			
Year × State			Yes		
Year × State × House size				Yes	Yes
Income changes					Yes
Adjusted R^2	-	0.0002	0.018	0.074	0.078
N	1,918	1,918	1,918	1,918	1,918

NOTE: Standard errors are omitted because parameter estimates are highly significant in all cases.

We estimate the parameter σ_χ restricting the data sample to working-age households, i.e. household heads are of age 25-54. We further restrict the sample by removing the highest and the lowest 5% of house price changes.

Table 9 presents the estimation results. Specification (1) estimates the raw standard deviation σ_χ from equation (19). Furthermore, in specification (2) we control for differential time trends across the two periods (2002-2005 and 2007-2012). Specification (3) imposes differential time trends across the 16 German states. Specification (4) makes these trends also dependent on the size of the housing units. We group housing units in eight categories based on the size in squared meters, $\{0-50, 50-100, ..., 300+\}$. Finally, in specification (5), we control for the log changes in equivalent household labor income.[50] The estimated standard deviation σ_χ is around 0.10-0.11. Based on these results, we set $\sigma_\chi = 0.104$ in the benchmark model.

We repeat this exercise using the same sample restrictions and truncations for the bi-annual PSID data samples for the years 1999-2013. The variable we utilize is the self-reported house value by the household head. The estimation results using year and state controls point to $\sigma_\chi = 0.09$.

[49] In the presence of serial correlation in the annual disturbances, this estimate is an upper bound of the annual standard deviation.

[50] Changes in household income can influence the self-reporting bias of house prices.

Therefore, the idiosyncratic house value risk in Germany and in the U.S. is of a similar magnitude.

Estimating Rental Rate Risk

Rental rates ρ in the model evolve according to the autoregressive process

$$\log \rho' = (1-\omega)\log \bar{\rho} + \omega \log \rho + \nu',$$

where $\nu \sim N(-\frac{\sigma_\nu^2}{2(1+\omega)}, \sigma_\nu^2)$. We estimate the two parameters ω and σ_ν, using the yearly files of the SOEP (1995-2014). The basic estimation specification is an AR(1) process,

$$\log(\rho_{i,t+1}) = \omega \log(\rho_{i,t}) + u_{i,t}, \tag{20}$$

where $\log(\rho_{i,t})$ is the log rental price per square meter for all market renters. If we specify $u_{i,t} = u_i + \nu_{i,t}$, the OLS estimator is biased and inconsistent even if $\nu_{i,t}$ are not serially correlated. This is because $\log(\rho_{i,t+1})$ is a function of u_i, and so is $\log(\rho_{i,t})$. The fixed-effects (FE) estimator is biased but consistent for $T \to \infty$ (see Nickell, 1981). To quickly explain the rationale behind the bias and its most popular solution (Arellano and Bond, 1991), look at a first-difference version of equation (20),

$$\log(\rho_{i,t+1}) - \log(\rho_{i,t}) = \omega(\log(\rho_{i,t}) - \log(\rho_{i,t-1})) + (\nu_{i,t} - \nu_{i,t-1}),$$

and observe that the OLS estimator which corresponds to the FE estimator of equation (20) is biased because $\log(\rho_{i,t})$ and $\nu_{i,t-1}$ are correlated. The Arellano-Bond GMM (A-B) estimator instruments the right-hand side variable with past values such as $\rho_{i,t-1}$ and further lags, which are correlated with $\log(\rho_{i,t}) - \log(\rho_{i,t-1})$, but not with $\nu_{i,t} - \nu_{i,t-1}$.

We restrict the data sample to market renters who stay in the same property between years t and $t+1$ and are of working age. We again conduct the analysis for the top/bottom trimmed sample at 5%. The results of the three estimation techniques (OLS, FE and A-B) are reported in Table 10. In line with the results, we set the benchmark model parameters to $\omega = 0.404$ and $\sigma_\nu = 0.094$.

Table 10: Rental rate risk

	OLS	FE	A-B
ω	0.9244	0.6421	0.4044
σ_ν	0.1143	0.1091	0.0944
Year effects	Yes	Yes	Yes
State effects	Yes	Yes	Yes
House size effects	Yes	Yes	Yes
Adjusted R^2	0.8758	0.8868	-
N	29,027	29,027	29,027

NOTE: Standard errors are omitted because parameter estimates are highly significant in all cases. The Arellano-Bond system GMM estimator uses 3 lagged variables as instruments.

Empirical Facts on Homeownership and Wealth

Based on the wealth modules of the SOEP for the years 2002, 2007 and 2012, homeowners comprise around 44% of all households in Germany with household heads older than 24 years.[51] Table 11 shows the age profiles of the homeownership rate, net wealth, gross housing wealth and financial wealth positions of households. The difference between the sum of gross housing wealth and financial wealth, and the net wealth position equals the average mortgage liability.

Table 11: Homeownership and wealth by age

Age group (τ)	25-34	35-44	45-54	55-64	65+
Homeownership rate (in %)	17.07	40.86	48.23	54.03	46.56
Net wealth (in thousand euros)	35.79	94.32	139.26	188.97	156.91
Gross housing wealth (in thousand euros)	38.98	108.87	133.19	156.97	124.63
Financial wealth (in thousand euros)	15.81	27.95	41.07	55.41	37.90

Table 12 shows the homeownership rates by deciles of the household income and wealth distributions for working-age households.

[51] In the model calibration procedure we target a homeownership rate of 42.2% which is the result of the age-specific homeownership rates aggregated according to the population shares of each age group in the model.

Table 12: Homeownership rates by income and wealth

Homeownership rate (in %) for working-age households										
Decile	1	2	3	4	5	6	7	8	9	10
Income	18.73	22.27	28.11	30.52	34.74	42.94	48.99	55.38	65.41	70.11
Wealth	9.82	0.61	2.68	6.46	13.04	41.19	69.20	87.27	92.97	94.48

Appendix B: Further Results

Counterfactuals: General Equilibrium with Fixed Taxes

Table 13 presents results of the four policy experiments under the assumption that the government does not adjust taxes to restore budget balance. House prices and rents are fully flexible. If the RETT is cut or mortgage interest payments become tax deductible, the increase of the homeownership rate is weaker when taxes are fixed compared to the case where taxes are increased to balance the budget. This is because of a stronger effect on housing demand which increases the house price even further, hence mitigating the positive impact of the policy. When social housing is abolished, the homeownership rate increases slightly more compared to the case of revenue neutrality where the government cuts taxes. In the combined scenario we find that the increase of the homeownership rate is 1.5 percentage points smaller with fixed taxes than under revenue neutrality.

Table 13: Counterfactuals: General equilibrium with fixed taxes

	Benchmark	RETT C1	Mort Ded C2	No Social H C3	Combination C4
Homeownership (%)	42.5	49.5	44.4	46.8	56.5
– 25-34 yrs	13.2	18.8	15.8	15.6	24.9
– 35-44 yrs	33.0	42.0	36.8	37.3	51.7
– 45-54 yrs	52.7	65.6	58.0	58.8	76.1
– 55-64 yrs	61.2	73.9	63.9	67.1	82.7
– 65+ yrs	47.4	48.3	46.1	51.1	51.9
Total wealth	128.7	139.2	131.3	132.9	143.6
– Housing	85.7	106.4	92.5	93.5	120.7
– Financial	47.4	38.6	44.2	43.6	32.4
– Mortgage	-3.6	-5.9	-5.4	-4.2	-9.5
House price	1.000	1.027	1.010	0.994	1.024
Price-to-rent ratio	18.38	18.54	18.44	18.34	18.52
Rationing prob π (%)	1.28	1.57	1.33	0	0
ΔGov't BC (per HH)	–	-0.345	-0.077	+0.087	-0.423
–ΔRETT Rev	–	-0.266	0.018	0.026	-0.262
–ΔIncTax Rev	–	-0.072	-0.094	-0.024	-0.246
–ΔSocHous Subs	–	0.006	-0.001	-0.085	-0.085
ΔDemand (in %)	–	1.12	0.45	-0.26	0.99
–Income Q1	–	2.14	0.46	-0.60	1.11
–Income Q2	–	2.07	1.16	-0.74	1.78
–Income Q3	–	1.46	0.81	-0.50	0.83
–Income Q4	–	0.22	0.18	-0.17	0.17
–Income Q5	–	0.48	-0.07	0.31	1.23

NOTE: All monetary values in thousand euros.

Homeownership Rates by Age, Income and Wealth

Figure 8 presents the model fit to the data in terms of age-specific homeownership rates by income deciles for each working-age group separately. The model captures well the level of homeownership for each age group. It also delivers increasing patterns of homeownership with income which are less pronounced for the younger age groups.

Figure 9 shows the model fit in terms of homeownership rates by wealth deciles for each working-age group separately. These patterns are captured well with the exception of the youngest age group where the model underestimates the homeownership for the lower wealth deciles. As discussed in the main text, an explanation could be that there are no direct housing bequests or inter-vivo transfers to young households in the model.

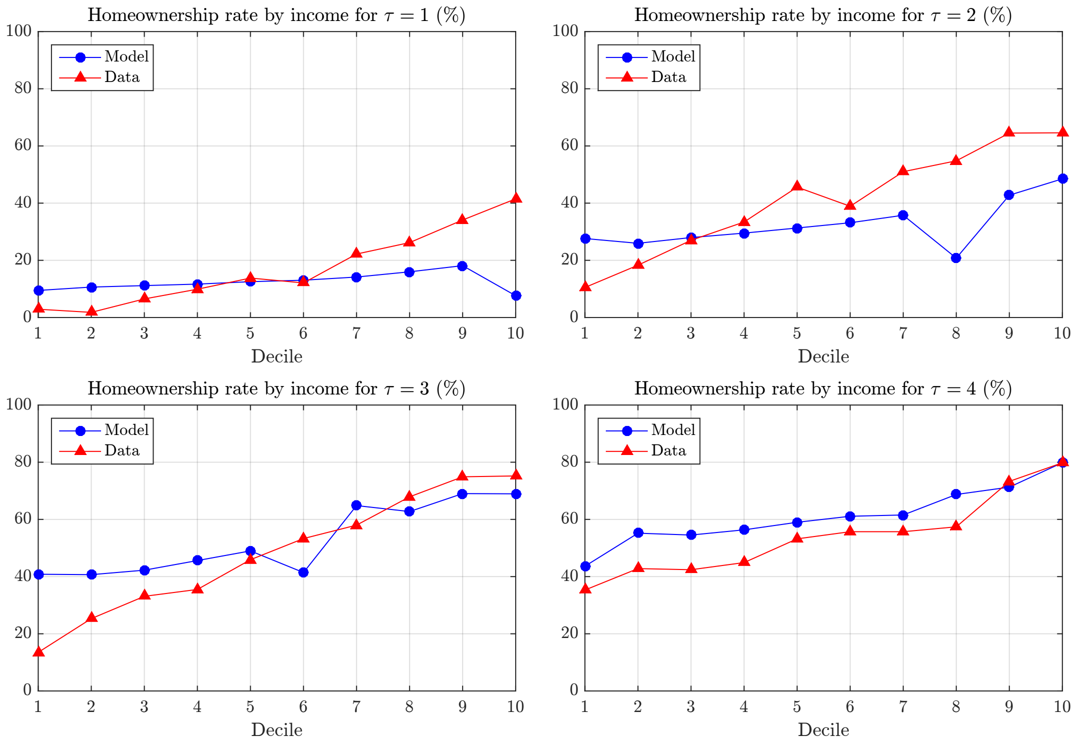

Figure 8: Homeownership rate by income and age group

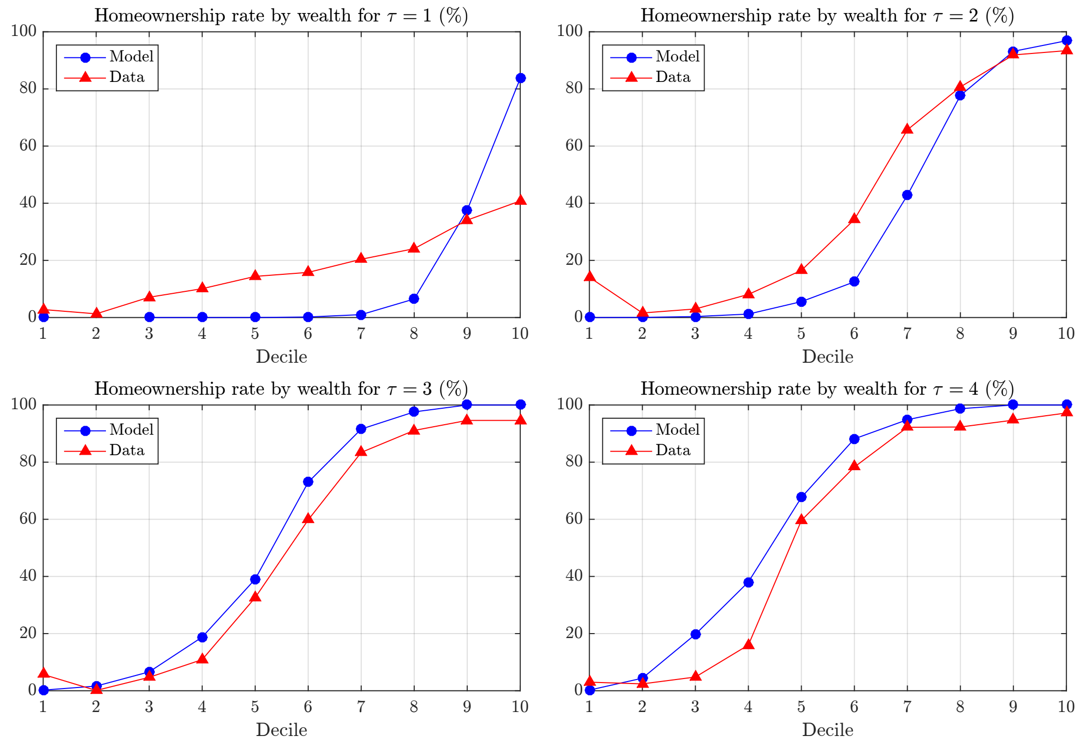

Figure 9: Homeownership rate by wealth and age group

Additional Statistics of the Wealth Distribution

Here we present the comparison between the model and the data in terms of selected age-specific percentiles of household net wealth and its components, gross housing wealth and net financial wealth. Figure 10 shows that the model generates adequate life-cycle wealth dispersion patterns relative to the data. The only caveat is that the model delivers too much financial wealth accumulation especially among young-age households.

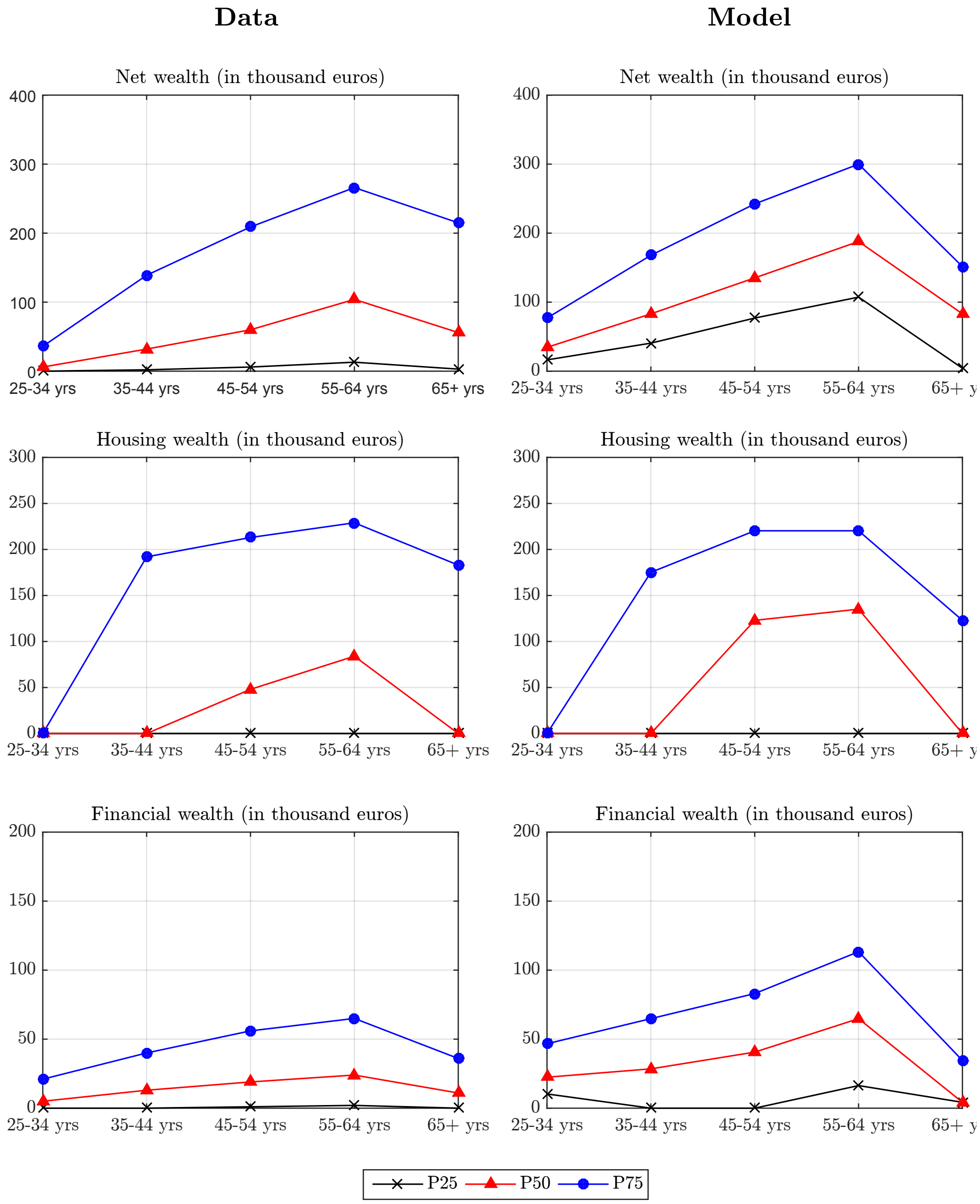

Figure 10: Percentiles of net, housing and financial wealth by age group

Landlord Households

Our model has testable implications for household landlords. Table 14 compares the benchmark model's share of landlords to the data. The model's share is somewhat lower than in the data. Looking at the life cycle, the discrepancy between model and data diminishes with age. Regarding differences across the wealth distribution, we underestimate the fraction of poor household landlords as well as the share of rich household landlords, while we match the fraction for households in the middle of the wealth distribution fairly well.

Table 14: Share of landlords

Share of landlords (%)	Model	Data
Overall	7.9	11.5
By age		
– 25-34 yrs	2.9	4.6
– 35-44 yrs	5.0	10.7
– 45-54 yrs	8.1	14.6
– 55-64 yrs	12.5	16.7
– 65+ yrs	11.3	11.3
By wealth quintile		
– Wealth Q1	0.0	1.3
– Wealth Q2	0.1	1.4
– Wealth Q3	7.7	6.6
– Wealth Q4	11.1	13.4
– Wealth Q5	20.7	36.5

Dynamics of Tenure States

The left panel of Table 15 reports the annual transition rates between owning and renting. A homeowner becomes a renter with annual probability 0.54%. This number is slightly higher in the model (0.93%). Vice versa, a renter becomes a homeowner with annual probability 1.7% (2.1%) in the data (model).

The right panel of Table 15 shows the annual probability of homeowners changing their property while keeping their homeowner status. In the data, this probability is fairly low with 0.72%. The model implies that homeowners update the size/quality of their property more frequently than in the data. An explanation for the discrepancy might be that owners have no option to adjust the size or quality of their property in our model.

Table 15: Annual transition between tenure states (in %)

	Transition probabilities	
	Data	Model
O $\rightarrow$ R'	0.54	0.93
R $\rightarrow$ O'	1.74	2.10
O $\rightarrow$ O'	0.72	2.04

NOTE: O: owner, R: renter

Tails of the Age Distribution

The stochastic life-cycle modeling implies that there is a distribution over individuals' lifetimes in the model. We assess the role of the tails of this distribution by computing some aggregate statistics based on a smaller population sample that excludes individuals living either very short or very long. Specifically, we simulate a cohort of newborn agents and track their individual histories until death. Then we remove those agents that have experienced the 10% shortest lifetimes (30 years or less) and those that have experienced the 10% longest lifetimes (97 years or more). Table 16 compares a selection of aggregate statistics based on this restricted population sample without age tails to their respective benchmark values. While there are some small differences, these numbers suggest that aggregate results are not much affected by extreme ageing realizations.

Table 16: Effects of removing the tails of the age distribution

	Benchmark	No tails
Homeownership (%)	42.5	42.5
– 25-34 yrs	13.2	11.9
– 35-44 yrs	33.0	31.3
– 45-54 yrs	52.7	50.8
– 55-64 yrs	61.2	60.5
– 65+ yrs	47.4	51.5
Total wealth	128.7	131.1
– Housing	85.7	87.2
– Financial	46.7	47.7
– Mortgage	-3.6	-3.8

NOTES: In the "No tails" case the 10% lowest ($\leq$ 30 years) and 10% highest ($\geq$ 97 years) lifetimes of a simulated cohort of new entrants have been removed.

Welfare Effects of the RETT Reduction: Partial Equilibrium

Figure 11 complements the top-left graph in Figure 5. Next to the welfare effect of the RETT reduction with fixed taxes and prices (top line) and the one with both tax and price adjustments (bottom line), it also shows the welfare changes in partial equilibrium when the house price and rent remain fixed, while income taxes adjust to balance the budget (middle line, pink). The main insight of this line is that a replacement of RETT by higher income taxes benefits all newborn households except those in the lowest initial income decile. See Section 6 for further discussion.

Figure 11: Welfare effects of the removal of the RETT by income decile

Appendix C: Housing Policies Across Countries

The quantitative policy analysis of our paper focuses on the features of the German housing market. In this appendix we provide an overview and qualitative assessment of housing policies for other developed countries with a long history of housing policies: France, Italy, Spain, the United Kingdom and the United States. We assess the likely impact of these policies on homeownership choices. As in our study of Germany, we focus on mortgage interest deductions (MID), transaction taxes (RETT) and costs, and social housing (SH). In addition, we also report direct subsidies to homeownership. We limit our summary of policies to the last two decades and put a lower emphasis on policies that were active only for a part of that time period. Many housing policies are likely to have long-lasting effects which we cannot adequately capture here.

Table 17 compares these housing policies across countries in a qualitative way based on our policy summaries which are detailed further below. We gauge how supportive a country's policy is regarding homeownership, where "+" indicates the least supportive level and "+++" the most supportive level.

Intuitively, tax deductions and subsidies related to owning should have a clear direct effect on the propensity to become a homeowner. In the third and fourth columns we rank the support of MID and owner subsidies roughly based on the expenditures relative to GDP. The table indicates that higher homeownership rates are positively associated with more subsidies or more possibilities of deducting mortgage interest payments from taxes.

Columns five and six rank RETT rates and total transaction costs which also include notary fees and average costs of real-estate agents. Homeownership rates tend to be higher if transaction costs are lower, with the exception of Spain.

The relation between homeownership and social housing is shown in the last column. Social housing is harder to evaluate as not only the share of households in social housing is important, but also how strict income eligibility criteria are and how they are enforced after moving in when income changes. Moreover, for three countries in our sample (Italy, Spain, and the U.K.) social housing provides a direct route to homeownership as the government provides large discounts when social housing tenants buy their current social housing unit. Our ranking takes all these factors in a qualitative way into account and shows a positive relation between the incentives for ownership associated with social housing and the homeownership rates.

Table 17: Cross-country comparison of policies

Country	**HOR**	**MID**	**MID+Sub.**	**RETT**	**Trans.**	**SH**
Germany	44	+	+	+	+	+
France	55	+	++	+	+	+
United Kingdom	64	++	+++	+++	+++	+
United States	67	+++	+++	+++	++	+++
Italy	68	++	++	++	++	++
Spain	82	+++	+++	+	+	+++

NOTES: HOR: Homeownership rate; MID: Mortgage interest deduction; Subs.: Subsidies to owner-occupiers: RETT: Real-estate transfer tax; Trans.: Transaction costs including RETT; SH: Social housing. A higher number of + signs indicate policies more favorable for homeownership. Homeownership rates for Euro area countries are from the Household Finances and Consumption Survey for the year 2010, for the U.K. are for England and Wales from the 2010 census, and for the U.S. from the 2010 census.

In the following policy summary we start the description of each policy with Germany and the U.S. for easier reference in the main text.[52]

Mortgage Interest Deduction for Owner Occupiers (MID)

Germany: No MID, except for the years 1982-1986 (see Bach and Bartholmai, 1995). There exists an MID for landlords.

United States: The MID (for both owner occupiers and landlords) has existed since the turn of the 19th century (see Lowenstein, 2006), causing an estimated tax loss of 80 billion USD or 0.6% of GDP in 2009 (see Congressional Budget Office, 2009).

France: No MID.

Italy: Limited MID. Before 1993, each co-signer of a mortgage could deduct up to 3,500 euros from the interest payments; in 1993, this was reduced to 3,500 euros per year for each mortgage contract. Moreover, the reform eliminated the regressive feature of the MID (see Jappelli and Pistaferri, 2007). See also the paragraph on subsidies below.

Spain: Both MID and a tax credit on payments for the principal of a mortgage exist. The MID was enacted in 1979 with the introduction of the income tax (see Raya, 2012). During 1992-98

[52]Policies for the U.K. mainly refer to England and Wales which make up 89% of the population.

the upper threshold for MID was 6,000 euros plus 15% credit on the principal. After 1998, the total deduction, including the the tax credit was capped at 9,000 euros (see García-Vaquero and Martínez, 2005). There have been various policy changes after the financial crisis. Spending on on these policies was 2.3% of GDP in 1990 and 7.7 billion euros or 1.4% in 1999 (see European Central Bank (2003) and Martínez (2005)). The spending numbers include subsidies for house purchases for lower-income households, see the paragraph on subsidies below.

United Kingdom: Currently no MID, but there was a MID in place from 1969-2000. Over time, the treatment of mortgage interest was subject to considerable changes. "Before 1983, the interest on the first 730,000 GBP of a mortgage was deductible from taxable income. In April 1983, the MIRAS, (Mortgage Interest Relief at Source) scheme was introduced [where] a borrower paid the lender the interest less the tax relief, initially equal to the marginal tax rate. Moreover, until 1988 the 730,000 GBP limit applied on single mortgagers rather than the property, so married people could each receive relief on loans up to 730,000 GBP, including more than one on the same property" (Jappelli and Pistaferri, 2007). The average spending on MIRAS in the 1980s was about 1% of GDP and about .5% in the 1990s.[53] The total direct spending on housing policies was 0.6% of GDP in 2000 (European Central Bank, 2003).

Subsidies to Home Buyers

We list here subsidies to home buyers/owners other than mortgage interest deductions.

Germany: No subsidies after 2005. There have been various subsidies from the 1950s onwards. From 1987 until 1995 there was a capped and income dependent depreciation allowance for the duration of 8 years after purchase with additional deductions for children. From 1996-2005 this was replaced by a direct subsidy to home buyers for the duration of 8 years from the point of purchase. In 2000 -close to the peak of accumulated expenditures - the subsidy for that policy had a total volume of 6.7 billion euros or 0.3% of GDP (see Müller et al., 2002).

United States: Capital gains from primary residences are tax exempt and local/state property taxes for homes for personal use can be deducted from federal income taxes leading to an esti-

[53]Her Majesty's Government in the United Kingdom, HM Revenue & Customs, "T5.1 Mortgage interest relief. Cost of relief and of the mortgage option scheme", Available at: `https://webarchive.nationalarchives.gov.uk/20040722123219/http://www.inlandrevenue.gov.uk/stats/mir/mir_t01_1.htm` (Accessed on July 1, 2018)

mated revenue loss of 16 billion USD for each exemption or a combined loss of 0.2% of GDP (see Congressional Budget Office, 2009). As government sponsored entities provide a large share of mortgages that benefit from an implicit bailout guarantee and direct subsidies, home buyers gain from a lower interest rate (of an estimated 0.25 of a percentage point), see Jeske et al. (2013) and Congressional Budget Office (2001). A smaller subsidy is the "Assets for Independence" program which provides a down-payment subsidy for low-income households, with relatively low volume of government spending with 10.9 million USD in 2008, see Ergungor (2011) and also Grinstein-Weiss et al. (2013). In addition, there were temporary subsidies in the aftermath of the financial crisis, such as the "First-Time Homebuyer Credit" with a total volume of 14 billion in 2009 and the "Making Home Affordable" program (see Congressional Budget Office, 2009).

France: Since 1995 there have been zero interest rate loans for lower-income households which act as a down payment subsidy. In 2003 the expenditures totalled 780 million euros or .05% of GDP (see Gobillon and Le Blanc, 2008).

Italy: Direct spending on homeownership subsidies was 3.5 billion or 0.2% of GDP in 2008 (Dol and Haffner, 2010), 0.1% of GDP in 1998 and 0.3% of GDP in 1980 (see European Central Bank, 2003). Moreover, there have been indirect transfers due to buying SH units at a much reduced rate. Since 1993 about 200,000 dwellings or 4% of all houses of owner-occupiers have been acquired from the public housing sector. The average price discount is estimated to range between 64% to 86% of the market price (see Bianchi, 2014). Thus, the effect of these implicit subsidies is potentially large, especially as they offer a direct route from social housing to homeownership.

Spain: Large direct and implicit subsidies for building for low-income households "Vivienda de Proteccion Oficial", with prices at much reduced rates. Social housing units for sale to lower-income households were sold as low as 50% of the market price in 2007. From 1978-1986 almost half of all housing starts were subsidized through this program (see Alberdi, 2014). For the total direct subsidy spending, see the paragraph on the MID above.

United Kingdom: Since 1980 there is the "Right to Buy" (RTB) program: Social housing tenants with at least three years tenure in their house gained a statutory right to buy their home at discounts ranging from 33% to 50% of the market price depending on their length of tenure. In addition, local authorities were required to make mortgages available to would-be purchasers. Total sales of SH dwellings were about 2 million units until 2017 or 55,000 units per year.[54] Therefore, this policy opens up a direct transition from SH to homeownership. RTB was extended to tenants of housing associations with the "Right to acquire" program starting in 1997. For an overview of the development of housing policies in the U.K. see also Millins et al. (2006). Starting in 2013, the "Help to buy" program provides an interest-free loan up to 20% of the property value for 5 years if the property is newly built. The total volume of this subsidy is relatively low (less than 0.01% of GDP in 2017).[55]

Transaction Taxes and Costs

The numbers given here are real-estate transfer taxes (RETT) plus an estimate of average total brokerage fees plus an estimate of (legal) fees. For overviews see also Andrews et al. (2011), Kälin (2005) and Brown and Hepworth (2002).

Germany: 5.2%+7%+1.5%=13.7%. The RETT used to be 3.5% until 2006 for all of Germany and increased after 2006 when legislation was delegated to the states within Germany (see Fritzsche and Vandrei, 2019). The number given here is the average across German states. Notary fees are legally fixed in Germany. Real-estate agent fees usually follow a commonly applied rule and split evenly between buyers and sellers.[56]

United States: 0.3%+6%+1%=8%. RETT is an average over US states. The current RETT numbers by state are compiled by the National Conference of State Legislatures.[57] Each state is weighted by the Census state population from 2010. For states in which there are tax schedules for different transaction prices only the lowest tax category is used. See also Kopczuk and Munroe (2015). For real-estate commissions see Hendel et al. (2009). There are various fees which are

[54]DCLG UK, 2018, English housing survey. Table 678: Social housing sales: Annual sales by table scheme for England: 1980-81 to 2016-17. Available online at https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/406317/LT_678.xlsx. Accessed on November 15, 2018.

[55]HM Treasury UK, 2018, Help to buy: ISA scheme quarterly statistics. Available at https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/734007/Official_Statistics_Publication_Help_to_Buy_ISA_-_March_2018.pdf. Accessed on November 15, 2018.

[56]See e.g. Immobilienscout24, 2018, Available at: https://www.immobilienscout24.de/eigentuemer/lexikon/maklerprovision.html#hoehe-bundeslaender, Accessed on June 12, 2018.

[57]Online available at: http://www.ncsl.org/research/fiscal-policy/real-estate-transfer-taxes.aspx, Accessed on May 10, 2017.

usually not proportional to the house price and which can vary. We found example calculations ranging between 0.5%-1.5% and we took the intermediate value of 1%.

France: 5%+7%+1%=13%. RETT is 5% for used houses or for any land transactions between private individuals. New houses are subject to a registration tax of 0.7% (see Bérard and Trannoy, 2017 and Brown and Hepworth, 2002). In 2014 the tax system was changed, see Bérard and Trannoy (2017). For brokerage fees we use the number reported by a large French broker firm of 7% for a house worth 250,000 euros.[58] Delcoure et al. (2002) report an average number of 5% and remark that about half of the sales are directly done by the owner. Notary fees depend on value and are about 1% on average.[59]

Italy: 3%+6%+2%=11%. A buyer who is registered in the commune where they acquire a used property pays a reduced RETT of 3% if it is not a "luxury" property. Otherwise the RETT is 10%. It used to be common practice to underreport the sales price to lower the RETT payment (see Kälin, 2005 and Brown and Hepworth, 2002). Delcoure et al. (2002) report a real-estate fee of 2-3% for each the buyer and the seller. The notary fee for a 200,000 euro property is 2% with a lower rate for more expensive houses (see Kälin, 2005).

Spain: 7%+5%+1.5%=13.5%. RETT for private residences is the reduced rate of 7% (see Kälin, 2005), regional variations apply.[60] For the real-estate agent commission, see Delcoure et al. (2002). Notary fees vary, we used a medium value of 1.5%.[61]

United Kingdom: 1%+2%+0%=3%. The RETT is progressive, the reported value is based on a property value of 250,000 GBP. Below 125,000 GBP the tax is zero.[62] Private purchases of new residential homes are VAT exempt (see Brown and Hepworth, 2002) Delcoure et al. (2002) state a brokerage fee between 1-2% on average. Notary fees are fixed at GBP 750 (see Kälin, 2005).

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[58] See Century 21, 2017, Honoraires, available at `https://www.century21.fr/imagesBien/202/3117/v5/bareme_honoraires.pdf`, accessed on November 15, 2018.

[59] See Notaires de France, 2014, Cost of buying a house: Conveyancing fees, available at `https://www.notaires.fr/en/housing-tax-system/financing/cost-buying-house-conveyancing-fees`, accessed on January 7, 2018.

[60] The older study by Brown and Hepworth (2002) reports a smaller RETT of 4%.

[61] The firm DLA Piper reports notary fees between 0.5% up to 2.5%, see DLA Piper, 2018, Real-Estate Investment in Spain available at: `https://www.dlapiperrealworld.com/export/sites/real-world/guides/downloads/Spain-Investor-Guide.pdf`, accessed on July 1, 2018. Kälin (2005) quotes numbers up to 3%.

[62] See HM Government in the United Kingdom, 2018, Stamp Duty Land Tax. Available at: `https://www.gov.uk/stamp-duty-land-tax`, accessed on December 1, 2018. See Kälin (2005) for more details and changes in the legislation. See also Besley et al. (2014) and Best and Kleven (2017) for economic analyses of the RETT in the U.K.

Social Housing

Germany: Total spending on SH (mostly in form of subsidized loans for new SH construction) in 2001 was 3.2 billion euros or 0.1% of GDP (Pfeiffer et al. (2003)). The target population of SH is relatively broad and reaches up to median-income households. Eligibility is not strictly monitored after moving in. See also Section 2 of the paper for further details.

United States: Currently 1.8% of households in SH.[63] Funding for SH in the U.S. comes in form of tax reductions for developers, "Low-income housing tax credit", and an "accelerated depreciation" - each with an estimated volume of about 5 billion USD, support for public SH development (the "public housing program" with a volume of 11 billion USD) and a "project based voucher" program for SH units with a volume of 9 billion USD in 2009. The total estimated spending on SH is about 30 billion USD or 0.2% of GDP in 2009. SH is available to poor households (below 80% of the local median income) and income limits are strictly enforced.

France: 17.4% are currently in SH. The SH rent is cost based and is about 60% below the market rent. Access is income based and targeted to poor households. Yearly reassessment with rent increase if income has increased above a threshold. SH has steeply increased from the 1960 to the 2000s, see Le Blanc and Laferrère (2001) and Schaefer (2008).

Italy: Around 4-5% of households during 1995-2014 were in SH. The system is not very targeted, with a share of SH tenants that is relatively similar across income deciles. Discount of rent about 10% relative to hypothetical market rent (see Poggio and Boreiko (2017); Bianchi (2014), in contrast, reports a sizable rent discount for SH). Moreover, as reported above, SH units were sold to private individuals from 1993 onwards at a highly subsidized rate, implying a direct transition from SH to ownership.

Spain: Only 2% of households are in SH. There have been financial incentives of SH tenants to buy their SH unit in the past (see Alberdi, 2014).

United Kingdom: About 17% of households are currently in SH, down from 30% in the 1970s. SH rent is about 30% below market rent with large variations. Access is usually strongly targeted at

[63]For this and the following numbers on social housing in the U.S., see the U.S. Department of Housing and Urban Development, 2018. Available at: `https://www.huduser.gov/portal/datasets/picture/about.html`, accessed on December 1, 2018.

needy households using a point-based system (see Pawson and Kintrea, 2002). There are strong incentives to become an owner for SH tenants since the “Right to buy” policy was introduced in 1980. That policy gives a discount up to 35% of the purchase price (see also Adam et al., 2015). Using social rents for comparable apartments we calculate the total implicit rent subsidy to be around 0.1% of GDP in 2017.[64]

Other Housing Policies

Clearly, there are other policies that might be relevant for the homeownership decision. The most important ones are housing related taxation of capital gains and bequests of residences, taxes on imputed rents, property taxes, housing benefits, rent regulations and (regulatory) constraints for the provision of mortgages.

None of the countries mentioned here taxes imputed rents and all have similarly generous tax exemptions for capital gains from selling the primary residence (see European Central Bank (2003) and the U.S. Internal Revenue Code of 1986). Property taxes are unlikely to have a strong effect on the choice between owning versus renting if taxation is uniform across tenure states. Italy and the U.S. allow for a reduced property tax for (primary) residences for personal use (see Baldini and Poggio (2014) and Congressional Budget Office (2009)), which might affect the buy or rent margin. Turning to housing benefits, these can favor renting if benefits are high or if they set disincentives to save.

Rent controls have generally ambiguous effects since they affect both the supply and the demand of rental units. In particular, if rental price regulation is strict and housing supply is inelastic, the long run effects of rent regulation can lead to an advantage of owning.

Finally, stricter down payment requirements enforced through limits on the loan-to-value ratio (LTV) can lower the propensity to buy a home. Cross-country studies of mortgage constraints are severely limited by availability of micro data, however.

[64] HM Government in the United Kingdom, “Live tables on rents, lettings and tenancies”, Table 706, Available at: `https://www.gov.uk/government/statistical-data-sets/live-tables-on-rents-lettings-and-tenancies`, and “Private rental market summary statistics” available at `https://www.gov.uk/government/statistics/private-rental-market-summary-statistics-october-2016-to-september-2017`, accessed on November 12, 2018.

Appendix D: Computation of Transition Dynamics

While the computation of a transition path from one stationary equilibrium to another one follows standard practices in the literature, we find it useful to provide some details on the algorithm for our model. In particular, we describe the set of variables whose evolution along the transition path have to be guessed upon, and the set of equilibrium conditions that must be satisfied along the way in order to verify the guess. Importantly, the set of variables and equilibrium conditions differ across the various counterfactuals. For instance, social housing access and exit probabilities must be adjusted differently depending on whether the policy reform abolishes social housing or not.

Throughout all experiments, we assume that the economy is at its benchmark stationary equilibrium in period 0. Then, at time $t = 1$, the policy change occurs unexpectedly. We are interested in computing the transition path to the new stationary equilibrium. We employ the following algorithm:

1. Fix the number of transition periods T. We set $T = 251$ years and verify later that this value is large enough (see below).

2. Guess time paths for the following objects:

   (i) House price $\{p_t\}_{t=1}^{T-1}$

   (ii) Tax shifter $\{\lambda_t\}_{t=1}^{T-1}$

   (iii) The distribution of bequests $\{B_t(.)\}_{t=1}^{T-1}$

   (iv) Social housing access probability $\{\pi_t\}_{t=1}^{T-1}$

   (v) Social housing investment $\{I_t^s\}_{t=1}^{T-1}$ (only counterf. C1 and C2)

   (vi) Social housing exogenous exit probability $\{\eta_t\}_{t=1}^{T-1}$ (only counterf. C3 and C4)

   Given these guesses, the transition path for the following variables can be backed out:

   - The path of rental rates, $\{\bar{\rho}_t\}_{t=1}^{T-1}$, is determined through the recursion $V_t = \frac{1}{1+r}\left[\bar{\rho}_t - c^m + (1-\delta)V_{t+1}\right]$, the discounted value per housing unit, and $V_t = p_t$.

   - The path for investment, $\{I_t + I_t^s\}_{t=1}^{T-1}$, is implied by the first-order condition of construction firms, $p_{t+1} = K'(I_t + I_t^s)$.

- The path for the total housing stock, $\{H_t + H_t^s\}_{t=1}^{T-1}$, is determined by the following law of motion: $H_{t+1} + H_{t+1}^s = (1-\delta)(H_t + H_t^s) + I_t + I_t^s$.

3. Setting all variables at time T to their respective values in the new stationary equilibrium, solve the sequence of household problems backwards from $t = T-1$ to $t = 1$.

4. Starting from the benchmark stationary equilibrium distribution at $t = 1$, simulate the distribution forward from $t = 1$ to $t = T-1$ using the optimal policy functions and the exogenous stochastic processes.

5. At each t, check whether the following conditions are fulfilled:

   (i) All housing units are occupied (cf. condition 4 in our definition of a stationary equilibrium). If not, adjust the price p_t.

   (ii) The government budget is balanced. If not, adjust the tax shifter λ_t.

   (iii) The distribution of bequests must be identical to the distribution of estates left behind by dying households in the previous time period (cf. condition 7 in our definition of a stationary equilibrium). If not, adjust $B_t(.)$.

   (iv) [Only counterfactuals C1 and C2:] The fraction of households living in social housing units must remain equal to the benchmark value of 7.1% (see calibration). If not, adjust the social housing access probability at $t-1$, π_{t-1}.

   (v) [Only counterfactuals C1 and C2:] Supply and demand for social housing units must coincide. If not, adjust social housing investment at $t-1$, I_{t-1}^s.

   (vi) [Only counterfactuals C3 and C4:] Supply and demand for social housing units must coincide, provided that after $t \geq 1$ the government does not invest in new social housing units anymore, $I_t^s = 0$ for all $t \geq 1$. If not, adjust the social housing access and exogenous exit probabilities. Specifically, if the supply exceeds the demand, raise π_{t-1} (or lower η_{t-1}, but not below its benchmark value). If the demand exceeds the supply, raise η_{t-1} (or lower π_{t-1}, but not below zero).

6. After updating the guessed time paths, return to step 2 if necessary (given some stopping rule). After convergence, check whether the time horizon T is long enough.

In practice, we use relaxation parameters to update guesses in order to improve convergence. Even though this shooting algorithm involves quite a few variables (including a distribution), we find that it converges relatively smoothly.

References for the Online Appendix

Adam, Stuart, Daniel Chandler, Andrew Hood, and Robert Joyce (2015), "Social rent policy: choices and trade-offs." Technical report, IFS Reports, Institute for Fiscal Studies.

Alberdi, Baralides (2014), "Social housing in Spain." In *Social housing in Europe* (Kathleen Scanlon, Christine Whitehead, and Melissa Fernández Arrigoitia, eds.), 223–237, John Wiley & Sons.

Andrews, Dan, Aida Caldera, and Asa Johansson (2011), "Housing markets and structural policies in OECD countries." OECD Economics Department Working Paper No. 836.

Arellano, Manuel and Stephen Bond (1991), "Some tests of specification for panel data: Monte Carlo evidence and an application to employment equations." *Review of Economic Studies*, 58, 277–297.

Bach, Stefan and Bernd Bartholmai (1995), "Neuregelung der Wohneigentumsförderung." *DIW Wochenbericht 39/95.*

Baldini, Massimo and Teresio Poggio (2014), "The Italian housing system and the global financial crisis." *Journal of Housing and the Built Environment*, 29, 317–334.

Benabou, Roland (2002), "Tax and education policy in a heterogeneous-agent economy: What levels of redistribution maximize growth and efficiency?" *Econometrica*, 70, 481–517.

Bérard, Guillaume and Alain Trannoy (2017), "The impact of a rise in the real estate transfer taxes on the french housing market." Working paper.

Besley, Timothy, Neil Meads, and Paolo Surico (2014), "The incidence of transaction taxes: Evidence from a stamp duty holiday." *Journal of Public Economics*, 119, 61–70.

Best, Michael Carlos and Henrik Jacobsen Kleven (2017), "Housing market responses to transaction taxes: Evidence from notches and stimulus in the UK." *Review of Economic Studies*, 85, 157–193.

Bianchi, Ranieri (2014), "Tenlaw: Tenancy law and housing policy in multi-level Europe. National report for Italy." Technical report.

Brown, Peter K. and Moira A. Hepworth (2002), "A study of European land tax systems." Lincoln Institute of Land Policy Working Paper.

Congressional Budget Office (2001), "Federal subsidies and the housing GSEs."

Congressional Budget Office (2009), "An overview of federal support for housing." *Economic and Budget Issue Brief*.

De Nardi, Mariacristina, Giulio Fella, and Gonzalo Paz Pardo (2019), "Nonlinear household earnings dynamics, self-insurance, and welfare." Forthcoming in the *Journal of the European Economic Association*.

Delcoure, Natalya, Norm G Miller, et al. (2002), "International residential real estate brokerage fees and implications for the U.S. brokerage industry." *International Real Estate Review*, 5, 12–39.

Dol, Kees and Marietta Haffner (2010), "Housing statistics in the European Union 2010." Delft University of Technology.

Ergungor, O. Emre (2011), "Homeowner subsidies." *Economic Commentary, Federal Reserve Bank of Cleveland*.

European Central Bank (2003), "Structural factors in the EU housing markets." European Central Bank.

Fritzsche, Carolin and Lars Vandrei (2019), "The German real estate transfer tax: evidence for single-family home transactions." *Regional Science and Urban Economics*, 74, 131–143.

García-Vaquero, Víctor and Jorge Martínez (2005), "Fiscalidad de la vivienda en españa." Technical report, Banco de España Occasional Papers.

Gobillon, Laurent and David Le Blanc (2008), "Economic effects of upfront subsidies to ownership: The case of the prêt à taux zéro in France." *Journal of Housing Economics*, 17, 1–33.

Grinstein-Weiss, Michal, Michael Sherraden, William G. Gale, William M. Rohe, Mark Schreiner, and Clinton Key (2013), "Long-term impacts of individual development accounts on homeownership among baseline renters: Follow-up evidence from a randomized experiment." *American Economic Journal: Economic Policy*, 5, 122–45.

Guner, Nezih, Remzi Kaygusuz, and Gustavo Ventura (2014), "Income taxation of U.S. households: Facts and parametric estimates." *Review of Economic Dynamics*, 17, 559–581.

Heathcote, Jonathan, Kjetil Storesletten, and Giovanni Violante (2017), "Optimal tax progressivity: An analytical framework." *Quarterly Journal of Economics*, 132, 1693–1754.

Hendel, Igal, Aviv Nevo, and François Ortalo-Magné (2009), "The relative performance of real estate marketing platforms: MLS versus FSBOMadison.com." *American Economic Review*, 99, 1878–98.

Jappelli, Tullio and Luigi Pistaferri (2007), "Do people respond to tax incentives? An analysis of the Italian reform of the deductibility of home mortgage interests." *European Economic Review*, 51, 247–271.

Jeske, Karsten, Dirk Krueger, and Kurt Mitman (2013), "Housing, mortgage bailout guarantees and the macro economy." *Journal of Monetary Economics*, 60, 917–935.

Kälin, Christian H (2005), *International Real Estate Handbook*. Wiley.

Kopczuk, Wojciech and David Munroe (2015), "Mansion tax: The effect of transfer taxes on the residential real estate market." *American Economic Journal: Economic Policy*, 7, 214–57.

Le Blanc, David and Anne Laferrère (2001), "The effect of public social housing on households' consumption in France." *Journal of Housing Economics*, 10, 429–455.

Lowenstein, Roger (2006), "Who needs the mortgage interest deduction?" *New York Times Magazine*.

Martínez, Maria Teresa Sánchez (2005), "Distributive aspects of public expenditure on housing in Spain." *European Journal of Housing Policy*, 5, 237 – 253.

Millins, David, Alan Murie, and Philip Leather (2006), *Housing Policy in the UK*. Palgrave.

Müller, R., I. Rohrbach, and M. Sigismund (2002), "Arbeitsgruppe Wirkungsanalyse Eigenheimzulage des Ausschusses für Wohnungswesen der ARGEBAU–Bericht zur Inanspruchnahme der Eigenheimzulage in den Jahren 1996–2000." Bundesamt für Bauwesen und Raumordnung, Bonn.

Nickell, Stephen (1981), "Biases in dynamic models with fixed effects." *Econometrica*, 49, 1417–1426.

Pawson, Hal and Keith Kintrea (2002), "Part of the problem or part of the solution? Social housing allocation policies and social exclusion in Britain." *Journal of Social Policy*, 31, 643–667.

Pfeiffer, U., H. Föhr, N. Gerlach, and K. Wedemeier (2003), "Nachhaltige Finanzpolitik: Subventionen auf dem Prüfstand." *Manuscript*.

Poggio, Teresio and Dmitri Boreiko (2017), "Social housing in Italy: Old problems, older vices, and some new virtues?" *Critical Housing Analysis*, 4, 112–123.

Raya, José Maria (2012), "Una aproximación al impacto económico de la recuperación de la deducción por la compra de la vivienda habitual en el IRPF." *Working Papers Observatorio de Divulgación Financiera*.

Schaefer, Jean-Pierre (2008), "Social rental housing and housing markets in France." In *Social Housing in Europe II; A review of policies and outcomes* (K. Scanion and C. Whitehead, eds.), London School of Economics, London.

Sinkhorn, Richard (1964), "A relationship between arbitrary positive matrices and doubly stochastic matrices." *The Annals of Mathematical Statistics*, 35, 876–879.