Will we repay our debts before retirement? Or did we already, but nobody noticed?

The legacy of Interest-Only Mortgages, Voluntary Repayments and Saving Deposits in the Netherlands

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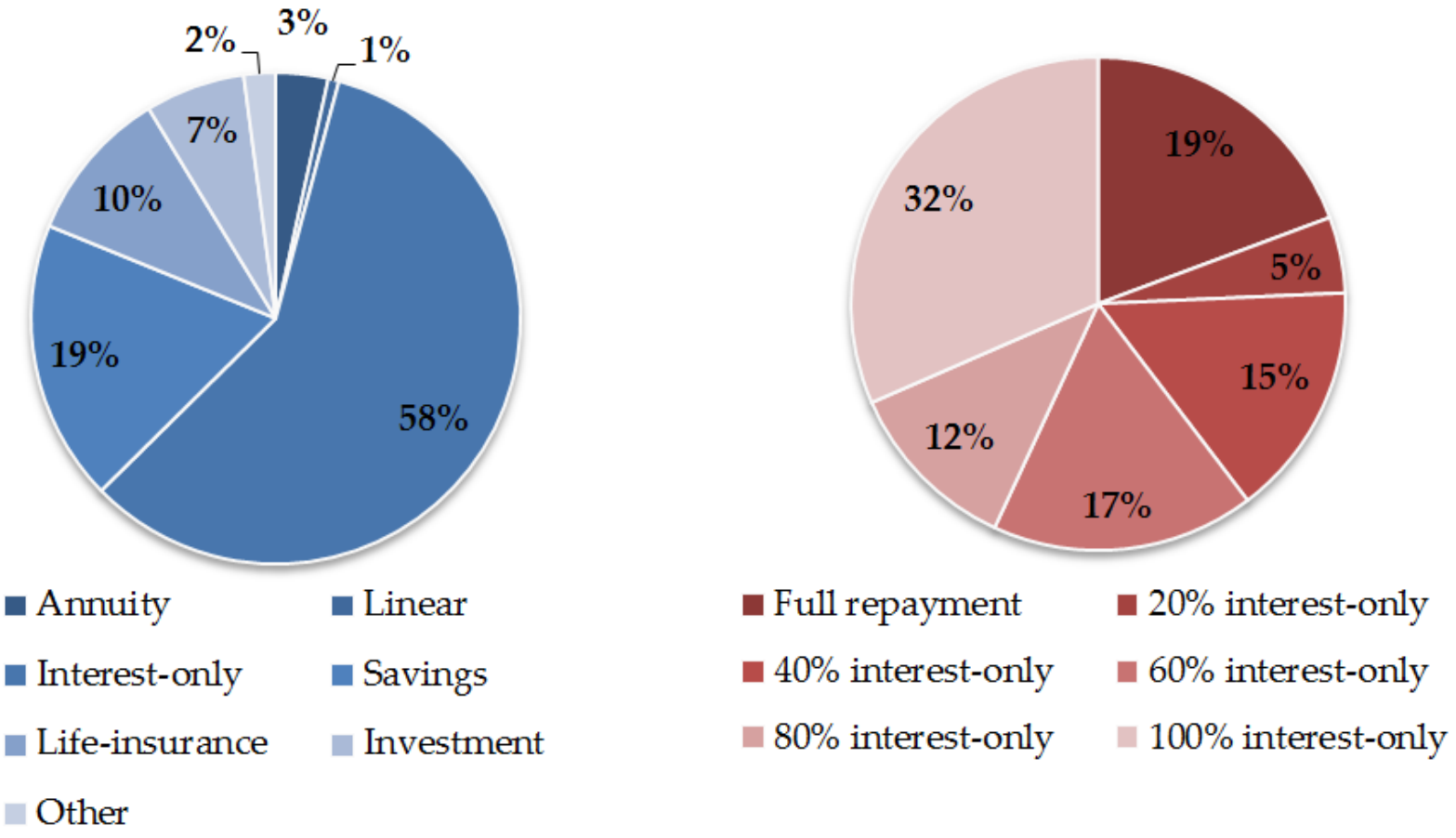
New data needed: DNB loan level data

- LLD
  - start: 2012q4
  - RMBS template also for back-books
  - 50 fields are fully filled in, 25 partly, rest mostly missing
  - 12 banks
  - 80% of mortgage portfolio: 3 mln borrowers
  - voluntary reporting … please do not circulate these graphs yet!

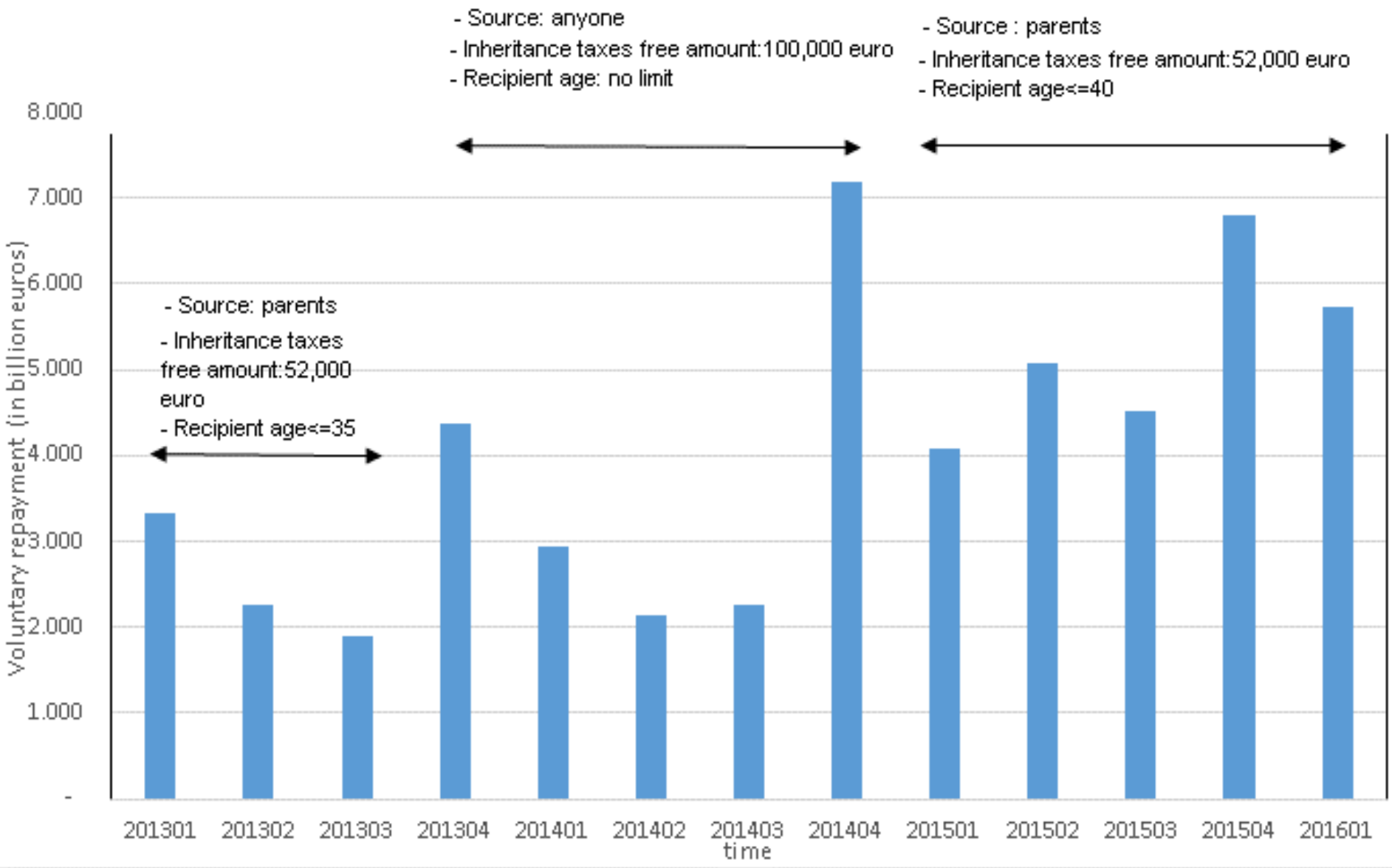
Residual mortgage debt: research questions

- Will we repay our interest only debt?
  - quantify voluntary and contractual repayments
- Will we repay our investment loans?
  - quantify current and future savings in pledged accounts (BEW)
- Who will not?
  - How much will they save?

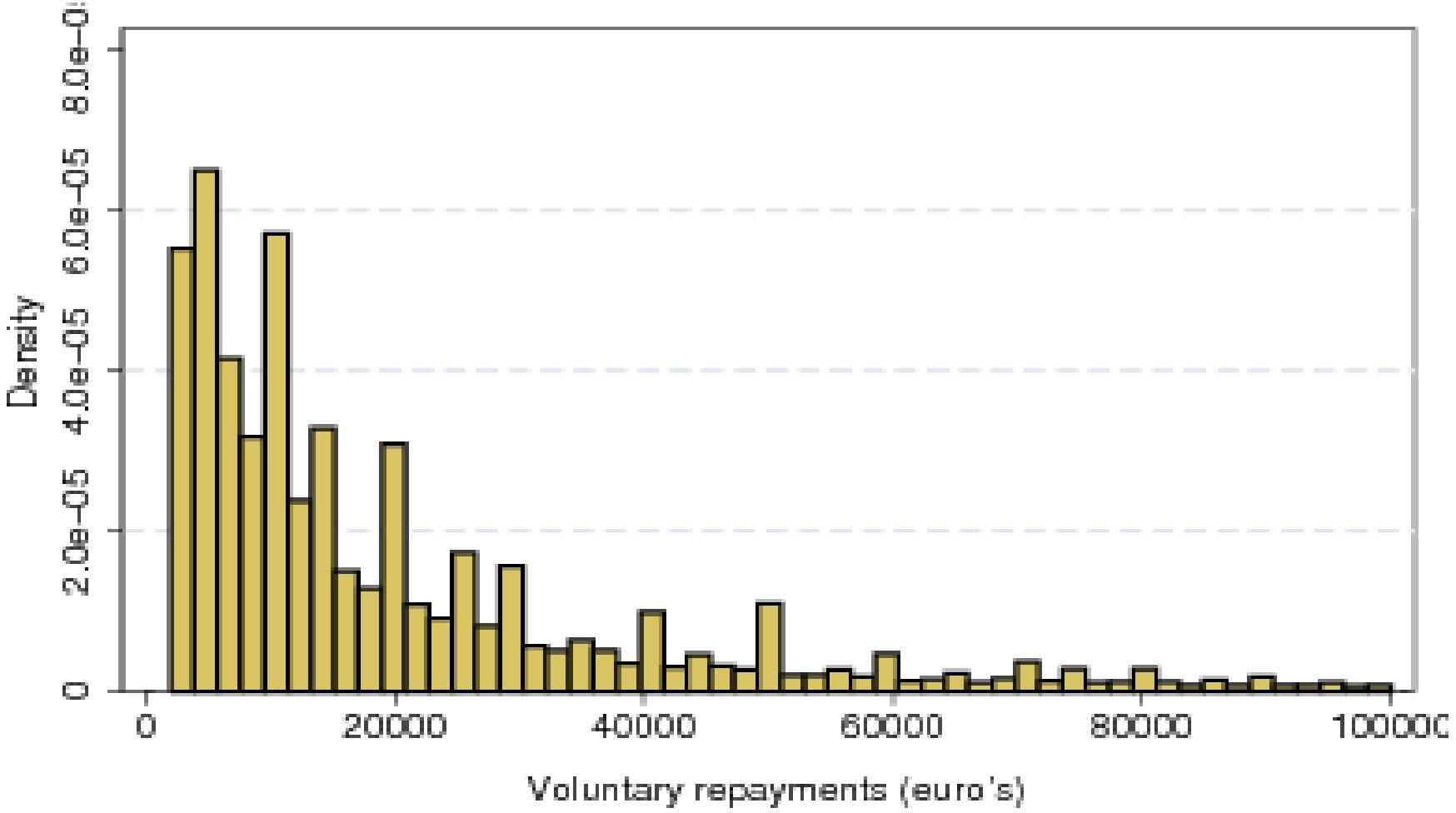
Facts and figures



Voluntarely



Truncated Distribution



Micro-simulation model

- Aim : projection of future household mortgage debt and FW
- Three elements
  - deterministic
    - contractual repayment
    - accumulation of SD
  - stochastic
    - Voluntary

Methodology

- y_i = voluntary repayments for borrower $i = 1,2, \dots, N$.
- y_i = zero with positive probability, but is a continuous random variable over strictly positive values (corner solution response models).
- compare different model specifications using the log-likelihood and pseudo R^2

Model

- Tobit:

$$y_i^* = \mathbf{x}_{i\prime}\boldsymbol{\beta} + \varepsilon_i, i = 1,2, \dots, N,$$

explanatory variables: age, age squared, current LTV, debt-weighted share of interest-only loans, mortgage interest rate, NHG dummy, underwater dummy, interaction term age*underwater.

- Instead of observing the latent variable y_i^*, we observe

$$y_i = \begin{cases} y_i^* & \text{if } y_i^* \geq L \\ 0 & \text{if } y_i^* < L, \end{cases}$$

However, here we are dealing with a non-zero threshold. We estimate $\boldsymbol{\beta}$ by running a standard Tobit on $y_i^{\bullet} = \max(0, y_i^* - L)$, which has zero censoring point, and then adjust the estimated intercept by L.

We define the participation equation

$$w_i = \begin{cases} 1 & \text{if } y_i > 0 \\ 0 & \text{if } y_i = 0, \end{cases}$$

such that the conditional probability of a voluntary repayment is given by

$$\begin{aligned} \Pr(w_i = 1|\mathbf{x}_i) &= \Pr(y_i^* \geq L|\mathbf{x}_i) \\ &= \Pr(\mathbf{x}_{i\prime}\boldsymbol{\beta} + \varepsilon_i \geq L) \\ &= \Pr\left(\frac{\varepsilon_i}{\sigma} \geq \frac{L - \mathbf{x}_{i\prime}\boldsymbol{\beta}}{\sigma}\right) \\ &= \Phi\left(\frac{\mathbf{x}_{i\prime}\boldsymbol{\beta} - L}{\sigma}\right), \end{aligned}$$

the last step follows since the distribution of ε_i is symmetric around zero. Hence, w_i follows a probit model.

- Probit and Tobit should yield similar parameter estimates,
- σ and $\boldsymbol{\beta}$ are not uniquely identified in a probit model (it is assumed that $\sigma = 1$).
- We get an estimate of the $(k+1) \times 1$ vector

$$\boldsymbol{\gamma} = (\gamma_1, \dots, \gamma_{k+1})' = ((\beta_1 - L)/\sigma, \beta_2/\sigma, \beta_3/\sigma, \dots, \beta_{k+1}/\sigma).$$

- As $\sigma > 0$, we would at least expect that Tobit and probit estimates have the same sign. One could also compare the marginal effects (ME) of a change in regressor on $\Pr(y_i > 0|\mathbf{x}_i)$ with the ME from the probit model.
- The Tobit model has some restrictive implication, e.g. the ME of x_{ij} on $\Pr(y_i > 0|\mathbf{x}_i)$ and $\mathrm{E}(y_i|\mathbf{x}_i, y_i > 0)$ always have the same sign. By relaxing these assumptions we might obtain a better fit.
- We consider the Cragg log-normal hurdle (Cragg, 1971), or Two-Part model, which allows separate mechanisms to determine the two decision:

$$y_i = w_i \cdot y_i^* = I(\mathbf{x}_{i'}\boldsymbol{\lambda} + v_i > L)\exp(\mathbf{x}_{i'}\boldsymbol{\delta} + u_i),$$

- where $I(.)$ is the indicator function, $v_i|\mathbf{x}_i \sim NID(0,1)$ and $u_i|\mathbf{x}_i \sim NID(0, \sigma^2)$ and where we assume v_i and u_i are independent.

3 sets of results

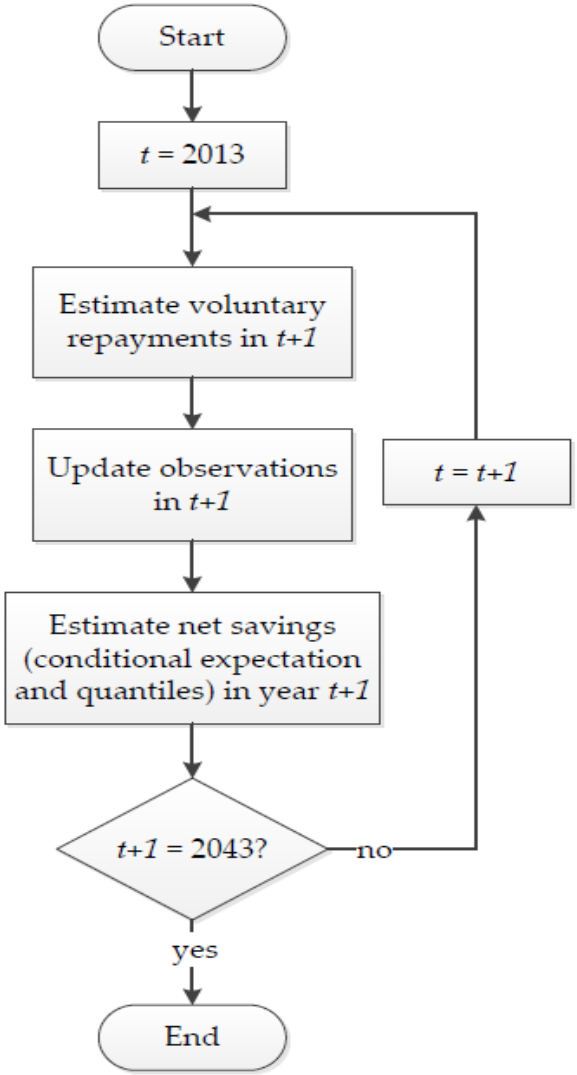
- probability models (linear, logit and probit) for the participation decision to voluntarily repay
- for voluntary repayments (Tobit in levels, Tobit in logs and the Cragg log-normal hurdle)
- robust regression on net savings and three quantile regressions on the inverse hyperbolic sine transformation of net savings

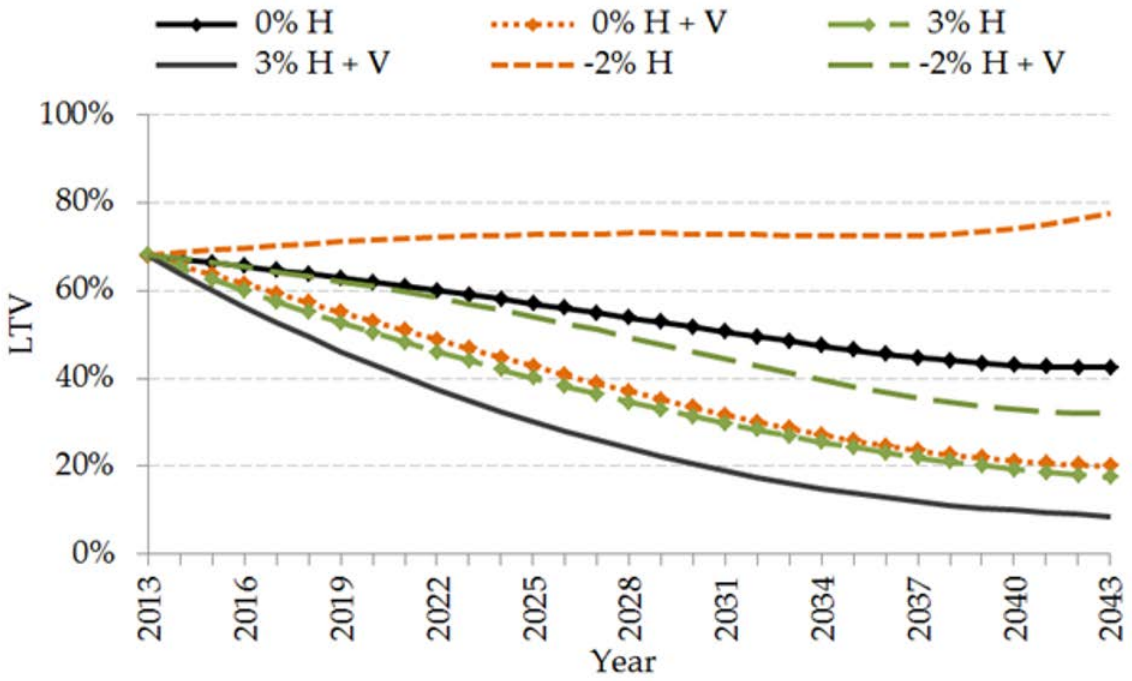
Table 6: Three probability models (linear, logit and probit) for the participation decision to voluntarily repay (1 = voluntary repayment, 0 = no voluntary repayment).

	Linear Probability		Logit		Probit	
	Coef	ME	Coef	ME	Coef	ME
Age/10	0.0480***	-0.00964***	0.494***	-0.00994***	0.261***	-0.00968***
	-0.00143	-0.000257	-0.0131	-0.000241	-0.00687	-0.000241
$(Age/10)^2$	-0.00610***		-0.0600***		-0.0317***	
	-0.000127		-0.00118		-0.000619	
Share I-O	0.0462***	0.0462***	0.387***	0.0454***	0.209***	0.0452***
	-0.00073	-0.00073	-0.00626	-0.000734	-0.00337	-0.00073
Interest rate	0.234***	0.234***	2.143***	0.251***	1.125***	0.244***
	-0.029	-0.029	-0.246	-0.0289	-0.135	-0.0292
Underwater	-0.119***	-0.00654***	-1.309***	-0.00603***	-0.673***	-0.00660***
	-0.00292	-0.00114	-0.0275	-0.00116	-0.0142	-0.00116
Age * underwater	0.00222***		0.0246***		0.0126***	
	-0.0000694		-0.000632		-0.000332	
NHG	-0.0196***	-0.0196***	-0.182***	-0.0214***	-0.0985***	-0.0214***
	-0.000688	-0.000688	-0.00622	-0.00073	-0.00327	-0.000709
Current LTV / 100	-0.0300***	-0.0300***	-0.237***	-0.0278***	-0.123***	-0.0267***
	-0.00109	-0.00109	-0.00913	-0.00107	-0.00495	-0.00107
Constant	0.0534***		-2.796***		-1.597***	
	-0.00433		-0.0385		-0.0205	
N	1901566		1901566		1901566	
Pseudo R2	0.01		0.01		0.01	
Log-likelihood	-760934		-750842		-750856	

Standard errors below coefficients *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Simulation method

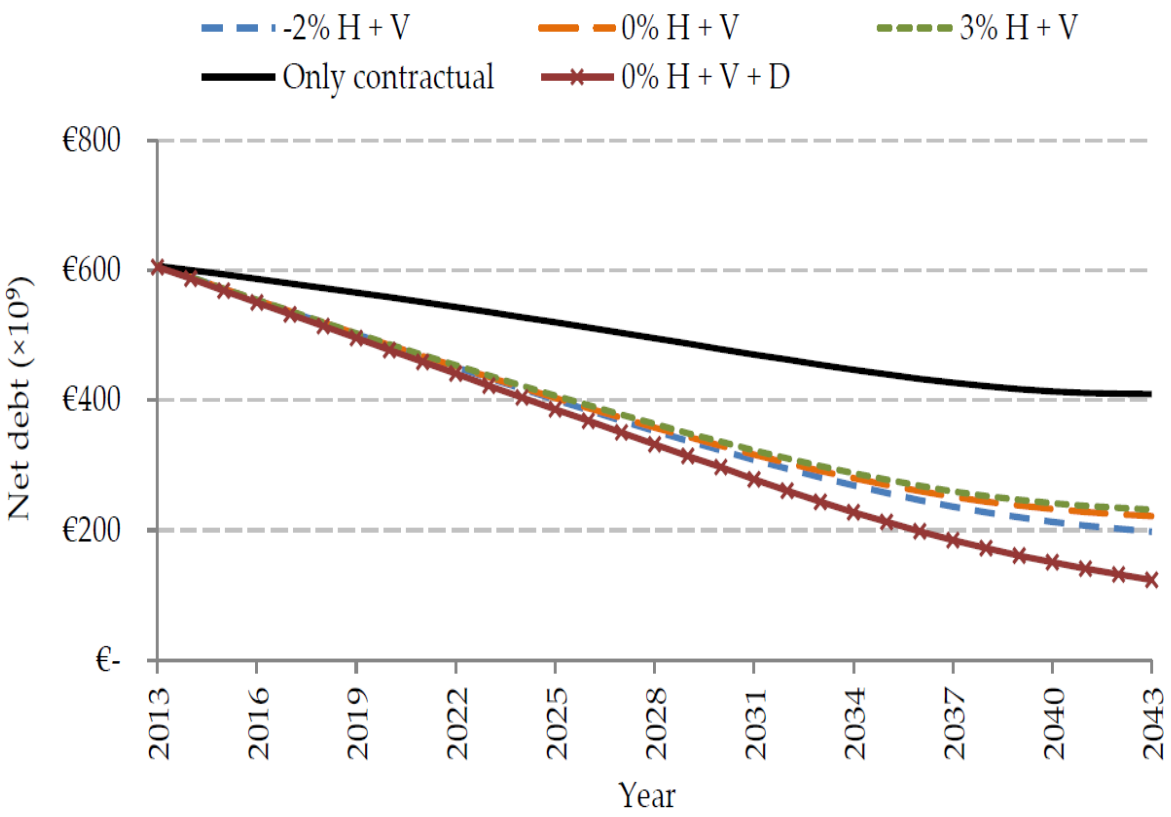




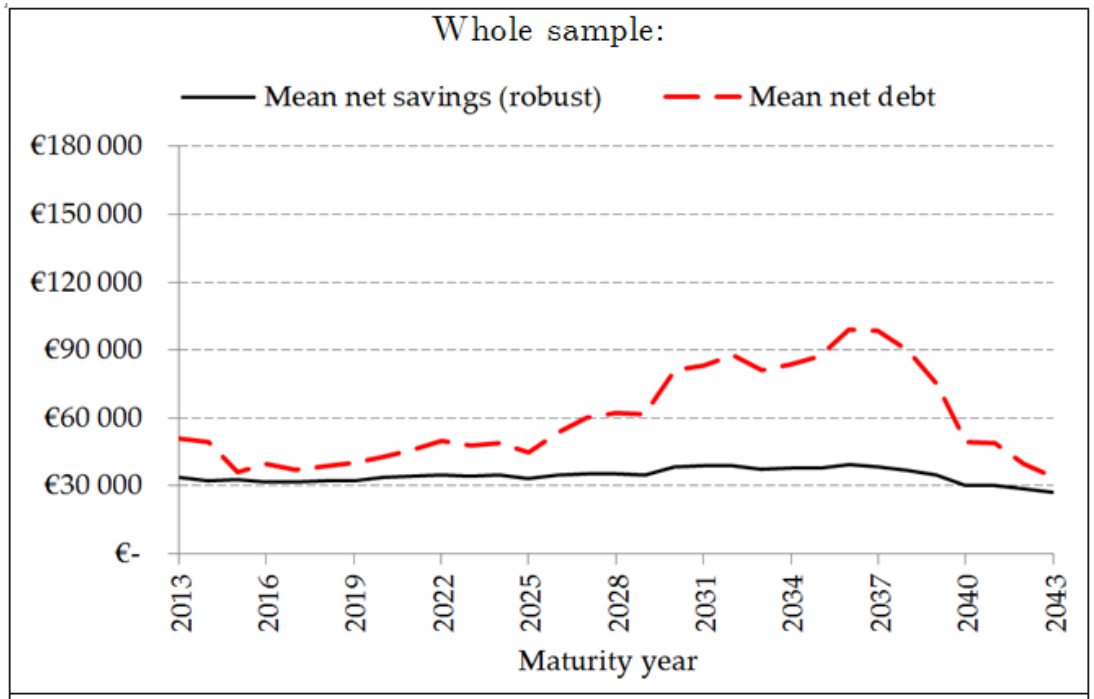
Simulation results: Micro

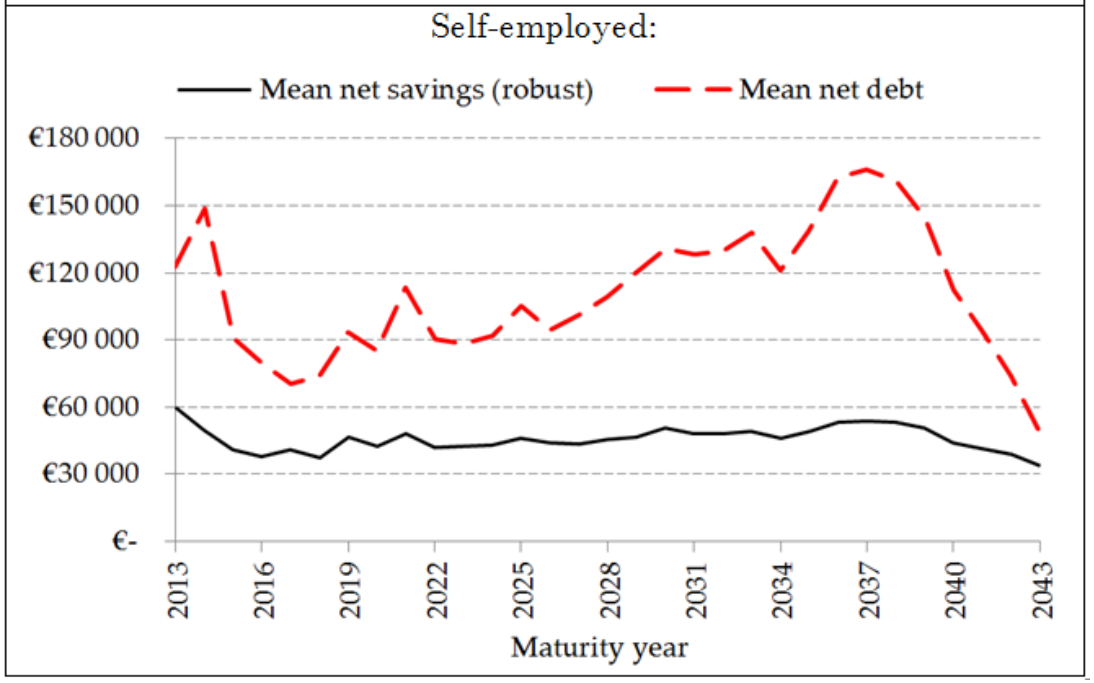
Simulation of the average LTV of the mortgages existing in the Netherlands in 2013Q4, where different scenarios are considered (H = house price change; V = voluntary repayments).

Simulation results: **macro**



Simulation of the aggregate net mortgage debt for currently existing mortgages in the Netherlands. Different scenarios are considered (H = house price change; V = voluntary repayments; D = mortgage is repaid at death (85 year)).

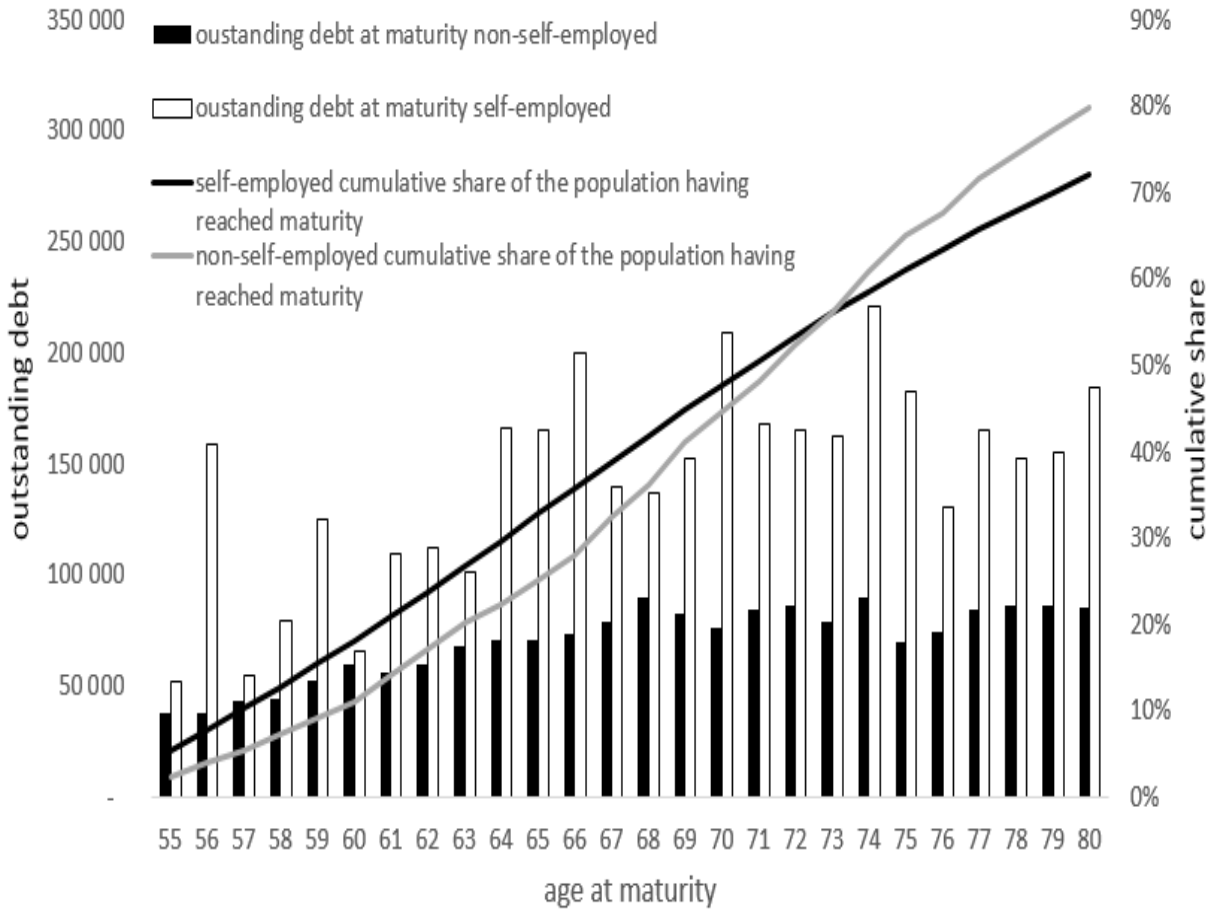




Average net debt and average net savings per maturity year. Here, average net savings are calculated by taking the average of the conditional expectations of all borrowers having a specific maturity year. House prices are considered to remain constant and both GDP and CPI increase with 2% annually.

Back of the envelope: no savings, 3% interest, no MID

- Monthly costs = 375-500 euro, if self-employed keep IO perpetuity
- With 10 years annuity, self-employed monthly costs increase to about 1500-2000 euro.
- For the non-self-employed the two options range between 190-740 euro a month.



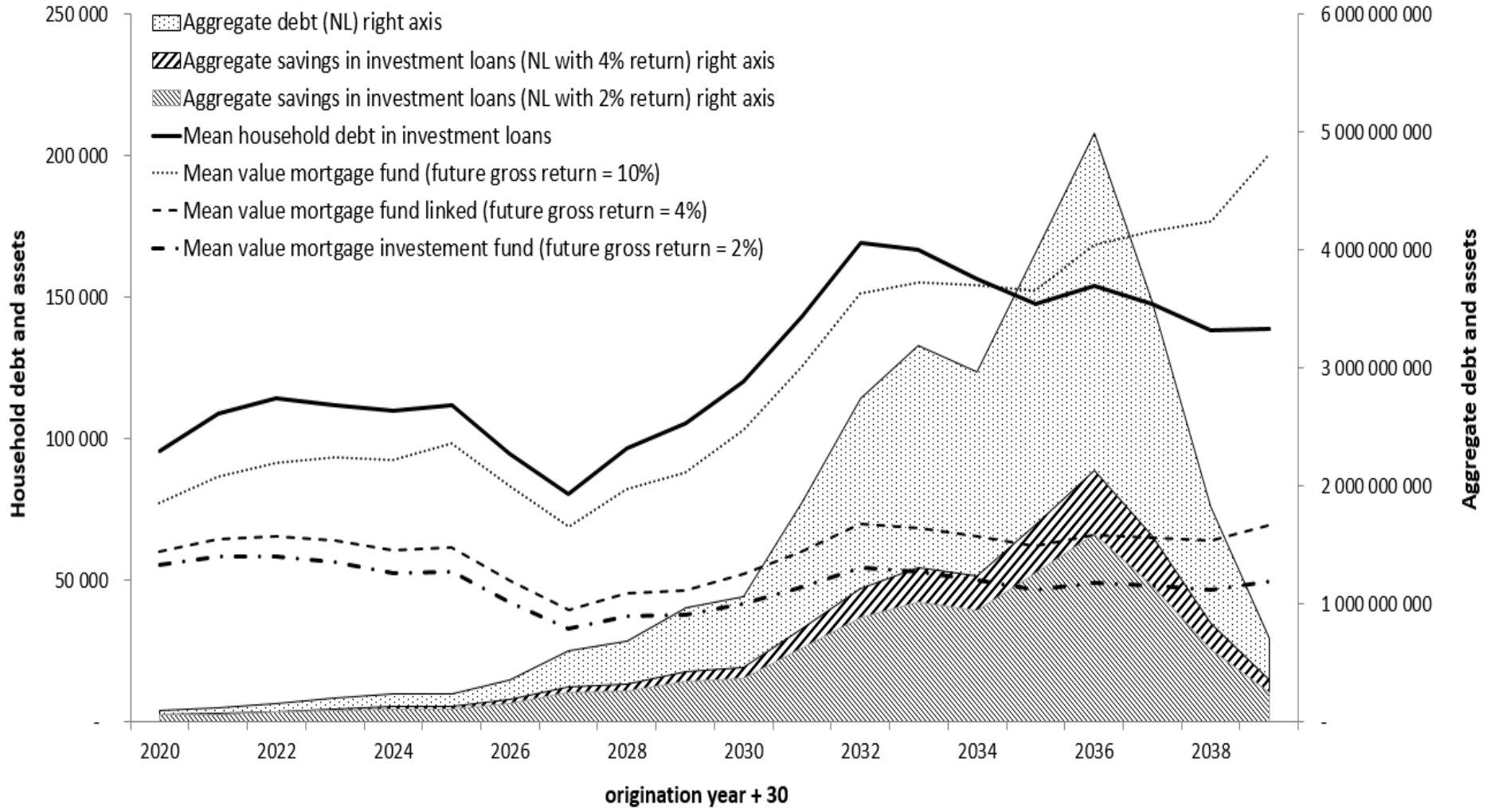
Do investment loans repay?

Table 8: Combination of investment loans with interest-only loans

	20% investment	40% investment	60% investment	80% investment	100% investment
no interest-only component	3%	4%	7%	11%	100%
20% interest-only	3%	4%	3%	89%	
40% interest-only	9%	7%	90%		
60% interest-only	12%	85%			
80% interest-only	73%				

Explanatory note: The diagonal cells indicate no amortization. The residual category is non-investment and non interest-only loan.

Cumulated value in investment loans



NB : past returns between origination and 2015 equal the AEX index. Mean values reported at household level. Gross returns are lowered with costs = 1%.

Summary:
risk of incomplete amortization

- part of the current debt has already been repaid (but nobody understands that due to lacking data).
- part of the debt is likely to be repaid in the future, even if this debt is partly in interest-only mortgages
- debt and asset ownership co-exist. In the future financial assets will only cover a small part of outstanding debt
  - but mortgages will no longer be underwater
- self-employed and owners of investment loans have higher risk of remaining with higher debt, but no losses for banks!
- These groups might face a large increase in future DSTI
- 1/3 of outstanding debt at the end of 2013 will not be repaid in the coming 30 years … deposit-funding gap?