Highlights

The effect of introducing a Loan-to-Value limit on homeownership

Cindy Biesenbeek, Mauro Mastrogiacomo, Rob Alessie, Jakob de Haan

- We study the effect of the introduction of a Loan-to-Value limit in The Netherlands
- A Loan-to-Value limit improves financial stability, but might delay homeownership
- The Loan-to-Value limit only had a small effect on becoming homeowner
- The probability to become homeowner is mainly driven by housing market developments

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Abstract

We analyze the impact of the introduction of a Loan-to-Value (LTV) limit in The Netherlands on the probability for first time buyers to become homeowner using a duration model. Our research design is underpinned by a theoretical model that shows that a lower LTV limit results in suspending or never entering homeownership, but only for liquidity-constrained individuals. We use this finding to construct a treatment and control group with parents' financial wealth as a proxy for being liquidity constrained. We disentangle the effects of the LTV limit on the timing of the transition to first time homeownership from other market developments and show that the effect of the LTV limit on this transition is small.

Keywords: homeownership, down payment, liquidity constraints, inter-generational transfers, survival model
JEL: G51, R21

1. Introduction

The financial crisis has shown that supervising individual financial institutions is not enough to maintain financial stability. Macroprudential policy

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is needed as well to limit system-wide financial risks. Examples of macroprudential instruments are regulatory capital requirements for systemic risks and Loan-to-Value (LTV) limits (Galati and Moessner, 2011).

However, macroprudential policies often imply a trade off between more financial resilience in the long run and short-term macroeconomic costs such as lower credit and output growth (Bank for International Settlements, 2019). This also holds for the introduction of an LTV limit, which may enhance bank stability but may also make it more difficult to buy a house, notably for entrants at the housing market.

It is interesting to study the effect of the tightening of the LTV limit in The Netherlands. Residential mortgages with an LTV ratio above 100 percent at the time of origination used to be very common in The Netherlands, due to the tax deductability of mortgage interest payments. The combination of high LTV ratios and a decline of real estate prices after the onset of the Global Financial Crisis resulted in a strong increase in existing mortgages with an LTV ratio above 100 percent. This was a potential threat to financial stability: households with negative equity are more likely to default and generate larger bank losses in case of default (Mastrogiacomo and van der Molen, 2015; van Bekkum et al., 2019).

Therefore, several reforms were introduced that contributed to a reduction in the number of households with negative equity. Most notably, a revision of the Code of Conduct for Mortgage Loans included an LTV limit of 106% and became effective in August 2011. By the end of 2012, this LTV limit was enforced by law. Furthermore, the LTV limit was gradually tightened by 1 percentage point per year from 2013 until 2018, when it stood at 100% (see Table 1). This policy is outstanding from an international perspective (de Jong and de Veirman, 2019), which makes it interesting to study its effects. We use the variation in the LTV limit over time to identify the effect of the introduction and tightening of the LTV limit in the Netherlands on the probability for first time buyers to become homeowner.

It is difficult to identify the effect of this policy, as the probability and timing of the transition to homeownership are also affected by housing market conditions. For example, rising house prices impact the probability to become homeowner as shown by Boehm and Schlottmann (2011, 2014). Our theoretical model based on Brueckner (1986) confirms that both house price increases and a reduction of the LTV limit reduce the probability to become homeowner. However, the model also shows that the effect of the LTV

Table 1: Effective LTV-limit in The Netherlands over time

Period	LTV-limit
$\leq$ July 31, 2011	n.a.
Aug 1, 2011 - Dec 31, 2012	106%
Jan 1, 2013 - Dec 31, 2013	105%
Jan 1, 2014 - Dec 31, 2014	104%
Jan 1, 2015 - Dec 31, 2015	103%
Jan 1, 2016 - Dec 31, 2016	102%
Jan 1, 2017 - Dec 31, 2017	101%
$\geq$ Jan 1, 2018	100%

The LTV-limit is applicable at the mortgage origination date. Since our data is annual, we assume that the LTV-limit is applicable since January 1, 2012 (see Section 4).

limit is more binding for liquidity-constrained individuals.[1] We use this finding to isolate the effect of the LTV limit from housing market conditions by constructing a treatment and control group. The treatment group consists of individuals whose parents have less than a given amount of financial wealth (50,000 euro in our baseline specification). The control group consists of individuals with wealthy parents who could therefore (potentially) make the required out-of-pocket closing costs, in the remainder of this paper referred to as down payment. We exploit exogenous variation of LTV limits for liquidity-constrained and unconstrained households to identify the effect of this macroprudential instrument on the timing of home purchases using a duration model.

We use a unique and highly granular data set that contains the exact dates when individuals move to a different address. The dataset consists of more than 3.8 million individuals and their partners and parents. We also exploit loan level mortgage data, which allows us to estimate the required down payment for every individual in the data.

The average duration between an individual's 18^{th} birthday and first time homeownership has increased since the introduction of the LTV limit. How-

[1]Liquidity constraints induce consumers to save more early in life and deviate from their optimal consumption profile (Artle and Varaiya, 1978; Brueckner, 1986). Moreover, there is evidence that these constraints cause delayed home purchases and higher house prices (Haurin et al., 1997; Ortalo-Magné and Rady, 2006; Barakova et al., 2014).

ever, our results suggest that this increase is mainly caused by housing market developments. The effect of a reduction of the LTV limit on the probability for first-time home buyers to become homeowner is limited, as the difference between the treatment and the control group is approximately 6%. Our results are robust. A comparison of parametric and semi-parametric models indicates a low risk of misspecification of our baseline model. Controlling for unobserved heterogeneity by including individual random effects also hardly affects our main findings. Furthermore, our results are robust for alternative definitions of the treatment and the control group.

The remainder of the paper is structured as follows. Section 2 provides a theoretical framework that shows the effect of changes in the LTV limit and house prices on homeownership. Section 3 describes the data set and section 4 outlines the methodology. Section 5 presents the results and Section 6 concludes.

2. Theory

Brueckner (1986) presents a two period model on optimal housing tenure choice (owning or renting). He shows that a down payment constraint induces a trade off: consumers need to reduce consumption in the first period to save enough for the required down payment to buy a house, but only enjoy the benefits of homeownership in the second period. We use this model to analyze the joint effect of changes in house prices and the LTV limit on tenure choice. Furthermore, the model provides the theoretical underpinning for constructing a treatment and control group in our empirical analysis (see Section 4). We present the results below and refer to Appendix Appendix A for details.

There are two types of consumers in Brueckner's model: lifelong renters (denoted R) and homeowners (H). The consumers' objective is to maximize the function $u(x_1) + \theta u(x_2)$, where x_1 and x_2 are non-housing consumption in periods 1 and 2, respectively, and $0 < \theta < 1$ is the discount factor. Let y_1 and y_2 denote income in periods 1 and 2, and τ_1 and τ_2 income tax rates. Savings in period 1 are denoted by s and the real interest rate by r. It is assumed that consumers cannot borrow against future income and pay a fixed rental or mortgage payment Q for housing. Furthermore, house prices are exogenous. The renter's budget constraints in the two periods are $x_1^R = (1-\tau_1)y_1 - s^R - Q$, $x_2^R = (1-\tau_2)y_2 + (1+(1-\tau_2)r)s^R - Q$ and $s^R \geq 0$. Homeowners need to pay a down payment at the beginning of the second period and sell their house at the end of the second period. Let α denote the down payment percentage and P house prices. Moreover, homeowners have to pay a mortgage payment in period 2, but this is tax deductible. The budget constraints for the homeowners are $x_1^H = (1-\tau_1)y_1 - s^H - Q$, and $x_2^H = (1-\tau_2)y_2 + (1+(1-\tau_2)r)s^H - (1-\tau_2)Q$ where $s^H \geq \alpha P$ denotes the down payment constraint. Brueckner (1986) derives an owner-renter utility differential $\Omega = u(x_1^H) + \theta u(x_2^H) - u(x_1^R) - \theta u(x_2^R)$ to show the effect of parameters on tenure choice.

The effect of house prices on tenure choice is the derivative of the owner-renter utility differential with respect to house prices. After substitution of the budget constraints in the owner-renter utility differential, we use the envelope theorem to assess the effect of a change in the house price:

$$\frac{\delta\Omega}{\delta P} = \underbrace{-\alpha u'(x_1^H)}_{\substack{\text{down payment} \\ -}} \underbrace{+\theta(1+(1-\tau_2)r)\alpha u'(x_2^H)}_{\substack{\text{return} \\ +}} \underbrace{+\theta\tau_2 r u'(x_2^H)}_{\substack{\text{deduction} \\ +}} \underbrace{-r(u'(x_1^H) - u'(x_1^R))}_{\text{housing costs p1}-} \underbrace{-\theta r(u'(x_2^H) - u'(x_2^R))}_{\substack{\text{housing costs p2} \\ +}} \quad (1)$$

An increase in P leads to an increase in required savings and a reduction in first-period consumption. This reduction is partly offset by returns on those savings in the second period if the down payment constraint is binding.[2] Finally, housing costs of both homeowners and renters depend on house prices,[3] but the effect of an increase in P on the utility function is not the same for renters and borrowers. Homeowners face a higher utility loss in the first period, renters in the second.[4] The total effect of price increases on tenure choice is ambiguous. It depends on multiple parameters, in particular on the time preference parameter θ. Higher house prices increase the required level of savings and hence reduce consumption in period 1, but also increase the tax deduction and consumption in period 2. The latter effect is greater if tax

[2] If the down payment constraint is binding, the loss in utility from lower period 1 consumption is greater than the increase in utility from higher returns on those savings: $-\alpha u'(x_1^H) > \theta(1+(1-\tau_2)r)\alpha u'(x_2^H)$

[3] This follows from the non-profit condition $Q = rP$

[4] Fig. 1 in Brueckner (1986) shows that if the down payment constraint is binding, $x_1^H < x_1^R$ and $x_2^H > x_2^R$. From concavity of the utility function, $r(u'(x_1^H) - u'(x_1^R)) > 0$ and $\theta r(u'(x_2^H) - u'(x_2^R)) < 0$.

rates τ_2 and/or interest rates r are high. Both increase the tax deduction of homeowners.

We adjust the Brueckner (1986) model and allow for changes in prices, so that the effect on utility will depend on the timing of the price change. Let P_1 and P_2 denote house prices in both periods. The first-order derivative with respect to P_1 is:

$$\frac{\delta\Omega}{\delta P_1} = \underbrace{-\alpha u'(x_1^H)}_{\substack{\text{down payment} \\ -}} \underbrace{+\theta(1+(1-\tau_2)r)\alpha u'(x_2^H)}_{\substack{\text{return} \\ +}} \underbrace{-\theta u'(x_2^H)}_{\substack{\text{capital loss} \\ -}}$$
$$\underbrace{\theta\tau_2 r u'(x_2^H)}_{\substack{\text{deduction} \\ +}} \underbrace{-r(u'(x_1^H) - u'(x_1^R))}_{\substack{\text{housing costs p1} \\ -}} \underbrace{-\theta r u'(x_2^H)}_{\substack{\text{housing costs p2} \\ -}} \tag{2}$$

The first effect of an increase in P_1 (without any change in P_2) is the homeowner's utility loss due to reduced consumption in period 1. This effect is negative if the down payment constraint is binding (because the savings decision is more distorted) and zero otherwise. This utility loss is partly offset by higher consumption in period 2 from a higher return on savings (the second term). If the down payment constraint is binding, the sum of the first two terms is negative. The third term refers to the capital loss or gain after the homeowner sells the house at the end in period 2. If prices in period 2 do not change, an increase of prices in period 1 leads to a higher capital loss, so the effect of an increase in P_1 on the owner-renter utility differential is negative as well. The fourth term is the effect of the tax deduction, which is positive. The fifth term refers to the loss in utility from lower non-housing consumption for both renters and homeowners in period 1. This effect is negative. Recall from Brueckner (1986) that $x_1^H < x_1^R$ if the down payment constraint is binding, and since the utility functions are concave, homeowners face a greater utility loss compared to renters if house prices in period 1 increase. Finally, the last term refers to lower housing costs in period 2. The housing costs of homeowners are determined by the house prices in period 1, when the house was purchased. An increase in house prices in period 1 does not have an effect on the housing costs of renters in period 2.

Similarly to period 1, we discuss the effect of price changes in period 2 by taking the derivative with respect to P_2 using the envelope theorem:

$$\frac{\delta\Omega}{\delta P_2} = \underbrace{\theta u'(x_2^H)}_{\substack{\text{capital gain} \\ +}} \underbrace{+\theta r u'(x_2^R)}_{\substack{\text{housing costs p2} \\ +}} \tag{3}$$

Higher prices in period 2 increases the attractiveness of homeownership compared to renting in two ways: it results in a capital gain, and homeowners do not face an increase in housing costs (unlike renters).

Next, we evaluate the effect of changes in leverage constraints on tenure choice. For simplicity, the required down payment is denoted as a fraction α of house prices as in Brueckner (1986). We will now show how the required down payment (and ultimately tenure choice) depends on the LTV limit.

In most countries, including The Netherlands, consumers need to pay transaction costs including taxes, bank commission, and brokerage fees, to buy a house. We assume that these transaction costs are proportional and denote them as ρ. So the total costs C to purchase an house are $K = (1+\rho)P$.

Until 2011, it was common for first-time home buyers in The Netherlands to obtain a mortgage M that exceeded purchasing costs $K : M > K$. An LTV limit of 106 percent was introduced in August 2011, and gradually declined to 100 percent in 2018. We therefore have an exogenous variation in LTV limits that will help us identify its effect in the empirical analysis.

Denote the LTV limit as γ. The maximum value of the mortgage M is a percentage γ of the value of the house V: $M^* \leq \gamma V$. Assume for simplicity that the value of the house is equal to the purchasing price (there is no over- or underbidding), so $V = P$[5] and recall that house prices are independent of the LTV limit in this model (see Section 4 for a discussion of the exogeneity of house prices). Households need to make an out-of-pocket down payment D if the LTV constraint is binding, i.e. $K > M^*$ which implies that $(1+\rho)P > \gamma P$. The required down payment is $D = (1+\rho)P - \gamma P$. Now divide D by house prices and plug the required down payment into the budget constraints:

$$\alpha = (1 + \rho - \gamma) \tag{4}$$

We can substitute equation (4) to the savings constraint: $s^H \geq (1+\rho-\gamma)P$.[6] Take the first-order derivative of the owner-renter utility differential with the

[5] In case of overbidding, $V > P$ and the required down payment increases.

[6] If the down payment constraint is binding, it is sub-optimal for homeowners to save more than the required down payment, so that $s^H = (1 + \rho - \gamma)P$.

new savings constraints to the LTV limit γ using the envelope theorem:

$$\frac{\delta\Omega}{\delta\gamma} = \underbrace{Pu'(x_1^H)}_{\substack{\text{down payment}\\ +}} \underbrace{-\theta P(1+(1-\tau_2)r)(u'(x_2^H))}_{\substack{\text{return}\\ -}} \tag{5}$$

This derivative consists of two parts. The first one is the effect on consumption in period 1. If the down payment constraint is binding, an increase in the LTV limit increases non-housing consumption in period 1, because of lower required savings. This implies that the first effect is positive. The second part is the return on savings. A smaller down payment leads to smaller required savings and a smaller return on these savings. If the down payment constraint is binding, equation 5 is positive: constrained individuals need to save more than optimal to make the required down-payment: $\theta P(1+(1-\tau_2)r)(u'(x_2^H)) < P(u'(x_1^H))$. This implies that a reduction in the LTV-limit reduces the probability to become homeowner for liquidity-constrained individuals. The required down payment does not affect saving behavior of unconstrained individuals. This finding is used to construct a treatment and a control group in our empirical analysis.

3. Data

Our unit of analysis is the individual housing spell from CBS. By this we mean the period between two subsequent moves to a different address. Every spell includes an anonymized person ID, an address ID, and the start and end date of the period that the individual lives at this address. Our dataset contains every inhabitant in The Netherlands since 1995 (23.0 million people). On average, each individual lives at 3.0 different addresses; so, there are 69.5 million spells in total (see Table 2).

Our sample is a subset of this large dataset. First, we are interested in first-time home buyers only, and therefore restrict the sample to individuals between 18-40 years (15.6 million individuals). We treat homeownership as an absorbing state: individuals are removed from the sample after their first transition to homeownership. We leave all individuals that are homeowners at the first observation out of the sample as well, because we cannot observe their transition to homeownership. Finally, we drop all individuals with one or more spells with unknown housing type, missing information on parents' financial wealth, and missing data for control variables. The control variables

Table 2: Sample size after selections (millions)

	Individuals	Spells
Total sample	23.0	69.5
Within age group 18-40 year	15.6	41.7
Dropped after transition	12.7	26.7
Without homeowners after first observation	9.3	23.3
Without unknown residence type	8.1	19.1
Parents' wealth available	5.4	10.3
Control variables available	3.8	7.2

are available as of 2006. There are 3.8 million individuals left in our sample (see Table 2). [7]

We obtain information about additional individual characteristics by merging several other data sources from Statistics Netherlands (CBS). These including gender, age, migration background, parents' ID, field of education, highest level of education achieved, annual income, wealth, gifts and inheritances received, main social economic category, and having a partner or not. We observe most of these characteristics annually, so most of our controls are time-varying (except for gender, day of birth, and ethnicity).

The dataset contains a time-varying dummy variable for the LTV limit. This LTV limit became effective for new mortgages originated after August 2011. Because our dataset contains observations by calendar year, this dummy equals 0 up and until 2011 and 1 thereafter [8]. In our baseline model, we assume that the introduction of an LTV limit has a larger effect on the probability to become homeowner than the small annual reduction of the LTV limit.

As the LTV limit was introduced to all potential buyers simultaneously,

[7] Appendix Appendix D presents the sample's characteristics before and after the two final selections in Table 2. Our sample remains representative in terms of gender and level of education. People with a migration background are underrepresented in our sample: parents' financial wealth is unavailable if they live abroad. Moreover, because level of education is our sample is on average a few years younger after selecting on control variables available, because the level of education is less available for older workers, the median age in our sample is slightly lower.

[8] The measurement error of this simplification is limited, because here is a delay between the mortgage origination date and the date of becoming homeowner.

selecting a control and a treatment group that would allow estimating the effect of the LTV limit is not obvious. Our theoretical model suggests that notably liquidity-constrained individuals are affected by an LTV limit. We thus need an indicator of liquidity constraints. Although data on personal wealth is available, it does not qualify to identify liquidity constraints, as it is evidently endogenous to the home purchase decision. Instead, we use parents' financial wealth. Financial support from parents can help to overcome liquidity constraints which distorts inter-temporal consumption (Cox, 1972; Engelhardt and Mayer, 1998; Guiso and Jappelli, 2002). Housing-related financial transfers from parents to children (which were exempted from taxes for an amount up to 100,000 euro) are not available in our dataset. Therefore, we use parents' financial wealth as a proxy for being liquidity constrained.

Parents' financial wealth is calculated in two steps. First, we merge the (anonymized) parents' ID by a parent-child table. The mother's ID is available for 82.1% of our population and the father's ID for 77.8%. Second, we find the annual wealth levels of these mothers and fathers. Wealth is registered at the household level. In case the parents are not in the same household, parents' total wealth is calculated as the sum of the mother's and father's household wealth. Parents' wealth is available for 56.4% of the sample. We assume individuals are unconstrained if their parents' wealth is at least 50,000 euro. Financial wealth is defined as the total value of financial assets, including bank balances, savings and securities. Since the threshold of 50,000 euro is arbitrary, we use different threshold levels in our robustness analysis. Moreover, we adjust parents' financial wealth for the number of children within a household in another robustness test. Financial wealth is not adjusted for number of children in the baseline specification, because siblings usually do not buy a house in the same year.

As we are interested in transitions to the first owner-occupied house, we need to identify whether individuals are tenants, owner-occupants, or living at their parents' house. We do so using the registered property type of the address. This is available for almost all properties as of 2006. If not, we use the first available property type of the address. In case an individual is registered on the same address as one or both parents, we set property type as *living at parents* rather than rental or owner occupied.[9]

[9]There is one exception: if the parent and the child live on the same address but the child is the owner of the house, the residential type is defined as *owner occupied* rather

We enrich the empirical analysis using a set of background variables. Age, gender and migration background are available for all individuals in the sample through the Municipal Records Database (Gemeentelijke Basisadministratie, GBA). The highest level of education attained and corresponding field of education are derived at a reference date from registers and from the Labour Force Survey and grouped to ISCED and ISCO classifications. Attained education is available for 85.5% of the sample.

Income is registered at the individual level and derived at a reference date from multiple sources, including the Dutch Tax Authority. The income variable in our database refers to gross income from labour, business and social benefits, and it is normalized. The socioeconomic category refers to the most important source of income.

Besides CBS data, we use DNB loan level data. This database contains information on mortgages for individuals that purchased an house before or in 2016, including purchase price. Table 3 contains a summary of the key variables for the treatment and control group.

4. Methodology

The theoretical model in section 2 shows that a lower LTV limit reduces the probability to become homeowner in period 1 if the down payment constraint is binding. Our hypothesis is therefore that the reduction of the LTV limit reduces the hazard ratio of transitioning to first-time homeownership for constrained households only.

Previous research shows that the effect of an LTV limit on house price growth depends on the rate of house price growth at the time when the policy is implemented; it is smaller and lasts shorter during periods of high house price growth rates (Armstrong et al., 2019). Thus, the increase in the required down payment due to the higher LTV limit γ is offset by a slow down in house price increases. However, using a Dynamic Stochastic Equilibrium model, (Elbourne et al., 2020) conclude that for liquidity-constrained households the slow down in house price increases does not fully compensate the increase in the required down payment.

In our paper, we identify the effect of introducing an LTV limit on homeownership by comparing a treatment group against a control group for whom the down payment constraint is not binding ("the unconstrained").

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than *living at parents*.

Table 3: Key variables for the treatment and control group

	Treatment	Control
Residential type		
Rental	32.9	32.3
With parents	67.1	67.7
Gender		
Male	51.8	53.5
Female	48.2	46.5
Level of education		
Low	37.0	20.1
Medium	52.0	58.4
Bachelor	8.5	15.0
Master	2.6	6.5
Migration background		
Dutch	72.9	90.3
Western	7.4	5.5
Non-western	19.8	4.2
Socioeconomic category		
Employee	75.0	73.8
Self-employed	20.1	18.0
Other	2.8	6.4
Median values		
Age	23.3	23.0
Income	13.5	14.8
Household income	17.7	18.9
Household wealth	12.7	141.1
Parents' household wealth	15.0	212.8
Received gifts	0.1	0.8
Received inheritances	0.1	0.4

Categorical variables are reported in percentages. Age is denoted in years and other median values in 1,000 euro. Individuals are in the treatment group (liquidity constrained) if their parents' wealth is less than 50,000 euro and in the control group (unconstrained) if their parents have more financial wealth. The value of variables can change over time. In this table, the last available value for every individual is reported. We use current values in our empirical model.

We use a duration model to estimate the probability for a first-time home buyer to purchase a house, conditional on covariates, among which a dummy for the presence of an LTV limit and a dummy for being liquidity constrained. Duration models are dynamic models with a hazard rate as key parameter. In economics, duration models are mostly known from their applications in unemployment studies. There are also some applications in housing economics, where the hazard rate is defined as the transition from one type of housing to another.[10]

The most common methods to estimate the effect of borrowing constraints on the probability of homeownership are binary choice models like logit and probit models (Linneman and Wachter, 1989; Bourassa, 1995; Quercia et al., 2003; Acolin et al., 2016).[11] However, using duration models for our purpose has several advantages. First, duration models control for right-censoring. Some individuals do not buy a house within the observation period, and those individuals are not random. Leaving them out would bias the estimated effect of the LTV limit on the probability of transition to homeownership. Furthermore, a duration model estimates the probability of homeownership over the full length of the spell before purchasing and thus employs more information than a model that estimates the probability of transition to homeownership at a specific point in time. Finally, duration models allow for time-varying covariates, and take life events, such as a new job with a higher wage or getting married, into account.

Figure 1 shows the Kaplan-Meier survival function. This is a non-parametric estimate of the probability that an individual has not yet made the transition to homeownership after a certain time, without any controls. Time is denoted as years since the 18^{th} birthday and individuals leave the sample after the first purchase of an house, censoring at the 40^{th} birthday or leaving The Netherlands. The figure shows that the survivor function first

[10]For instance, Boehm and Schlottmann (2008) and Andrew et al. (2016) estimate the hazard rate from renting to ownership, Bahchieva and Hosier (2001) analyze the hazard rate of leaving a public house; Guiso and Jappelli (2002) estimate the effect of private transfers on the hazard rate of becoming a homeowner; Deutsch et al. (2006) evaluate the spells starting at adulthood age to first time homeownership; while di Salvo and Ermisch (1997) use a competing risk proportional hazards model to estimate the hazard to either homeownership or social housing.

[11]van Bekkum et al. (2019) use a difference-in-differences framework to estimate the effect of an LTV limit on the transition to homeownership.

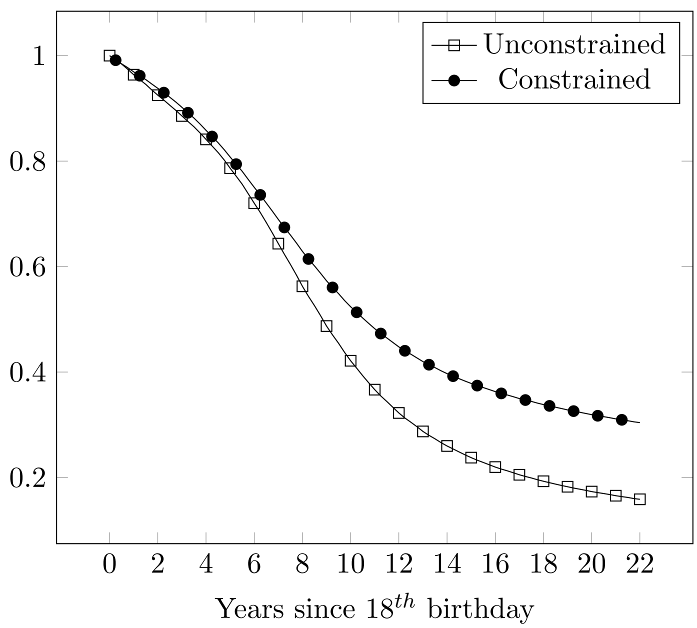

Figure 1: Kaplan-Meier Survival function first-time home buyers

decreases at an increasing rate and later at a decreasing rate. The median time before purchasing a house is approximately 9 years for unconstrained individuals and 10.5 years for constrained individuals. This implies that after 9 (10.5) years, approximately half of the unconstrained (constrained) sample has made the transition to homeownership, while the other half of the sample still rents or lives at their parents' house. Approximately 30% of the constrained sample versus 16% of the unconstrained sample has not made the transition to homeownership at the age of 40.

We use a proportional hazard model, a class of duration models, to estimate hazard rates after controlling for censoring. This approach is similar to methods used by Guiso and Jappelli (2002) and Deutsch et al. (2006). In contrast to these studies, our unit of observation is an individual rather than a household. We assume individuals would start considering homeownership from adulthood at age 18. The proportional hazard model can be written as a combination of a baseline hazard and an individual hazard:

$$h(t) = h_0(t)exp(\beta_x X'_{i,t}) \tag{6}$$

where $h_0(t)$ is the baseline hazard, t time of house purchase, x_i a vector of individual (time-varying) characteristics and β_x the effect of these characteristics on the hazard rate. Let the spell until home purchase be T while $f(t)$ is its probability distribution. The cumulative probability or the probability to become homeowner before t is the product of the probabilities up to t, or

$$F(t) = \int_0^t f(s)ds \tag{7}$$

The survivor function is the inverse of the cumulative probability function, or

$$S(t) = 1 - F(t) \tag{8}$$

The hazard rate $h(t)$ is the probability to become homeowner at t, given that one has not been homeowner before:

$$h(t) = \frac{f(t)}{S(t)} \tag{9}$$

This hazard rate can be estimated by several models, including parametric models or the semi-parametric Cox proportional hazard models. Parametric models assume a distribution of the baseline hazard, like Weibull, exponential or loglogistic. Cox proportional hazard models do not impose any restrictions on the baseline hazard and are less prone to misspecification. If the assumption about the baseline hazard rates are correct, parametric models are more efficient. Parametric models are feasible in the sense that the expected duration can be derived from the estimate of the survivor function.[12]

Since we do not have priors about the relationship between time elapsed since the 18^{th} birthday and the probability to buy a first house, we impose a Weibull distribution to the baseline hazard rate.[13] We check for misspecification of the baseline hazard rate with a Cox proportional hazards model, which does not require assumptions about the baseline hazard rate.

[12] The expected value of the survival time (predicted mean duration) is:

$$\mu_{T_j} = E(T_j|\mathbf{x}_j) = \int_0^\infty tf(t|\mathbf{x}_j)dt = \int_0^\infty S(t|\mathbf{x}_j)dt$$

where the probability function $f()$ and the survivor function (S) depend on the choice of the parametric model (Cleves et al., 2010).

[13] The baseline hazard function for a Weibull distribution is $p\lambda^p t^{p-1}$, where p is the shape parameter. A Weibull distribution is flexible, since the hazard rate can be increasing ($p > 1$), constant ($p = 1$) or decreasing ($p < 1$) over time.

We estimate the following hazard function:

$$h(t) = h_0(t) \cdot exp(\alpha C'_{i,t} \cdot \delta L'_t \cdot \gamma I'_{i,t} \cdot \beta_x X'_{i,t}) \tag{10}$$

where L is the LTV dummy, with value 0 before 2012 and 1 thereafter; C a dummy for being financially constrained, I is the interaction term of both dummies, and $X'_{i,t}$ is a vector of control variables. The interaction term I is the key variable of interest. We expect that the LTV limit reduces the hazard rate for constrained individuals, i.e. $exp(\gamma) < 1$.

We add control variables in Models 1-3 and add more variables (one by one to avoid collinearity) in subsequent models. Table 4 provides an overview of the specifications of the estimated hazard function.

Table 4: Overview of hazard model specifications

Model	Key parameter	Controls	Additional variables
Model 1	Constrained×LTV limit	-	-
Model 2	Constrained×LTV limit	Some	-
Model 3	Constrained×LTV limit	All	-
Model 4	Constrained×LTV limit	All	Year dummies
Model 5	Constrained×LTV limit	All	Predicted value house
Model 6	Constrained×LTV limit	All	Required down payment

Control variables in Model 2 are gender, migration background, and a dummy for having a partner. In Models 3-7, we include the same variables and socioeconomic status, the level of education, tenure status (renting or living at parents), and household income.

Beyond house prices, other year-specific effects might be important as well. This leads us to estimate a fourth model including year dummies. We expect the hazard ratio to be lower in 2012 when the LTV limit was introduced. Afterwards, the LTV limit was reduced further, but only in small steps.

In a fifth model, we include the predicted value of the house in case an individual would become first time homeowner. This variable is constructed as follows. We take the conditional mean of recently purchased houses by similar individuals in the DNB loan level data to proxy for their desired home and calculate the required down payment based on exogenous variation in the LTV limit. For those individuals, we regress the logarithm of observed purchase price on individual characteristics including municipality, age, income, year of birth, residential type before homeownership (rental or at parents), and level of education, and use it to predict the purchase price for other households (see Appendix Appendix B). The predicted house value is available for 93.8% of the sample. The mean predicted house value for first-time home buyers was approximately 159,000 euro in 2012 and 191,000 euro in 2018 (see Table 5).

In a sixth model, we include the predicted value of the required down payment. Recall from the theory section that the required down payment to buy an house is $(1+\rho-\gamma)P$. We use the predicted value of the house and assume proportional transaction costs of 6% of the initial value of the house and calculate the predicted required down payment. The required down payment was 0 euro until 2012 and increased after the introduction of the LTV limit. We expect the hazard ratio of the required down payment to be smaller than 1.

Table 5: Mean predicted house values and required down payments

Year	Predicted house value	Required down payment
2006	193	0
2006	193	0
2007	191	0
2008	195	0
2009	185	0
2010	179	0
2011	172	0
2012	158	0
2013	146	1.5
2014	147	2.9
2015	151	4.5
2016	162	6.5
2017	178	8.9
2018	198	11.9
2019	225	13.5

Values are expressed in 1,000 euro. The predicted house value is the conditional mean of recently purchased houses by similar individuals. It is based on a regression of observed purchase prices on individual characteristics. The required down payment is the amount of the purchasing costs that cannot be financed by a mortgage. It is based on the current LTV limit, the predicted value of the house, and the assumption that transaction costs are 6% of the predicted value of the house.

5. Results

The main results for the duration models are shown in Table 6 in the form of hazard ratios.[14] A hazard ratio is the ratio of the probability to become homeowner corresponding to two different values of an explanatory variable. The hazard ratio is the exponent of its coefficient. A hazard ratio of 1 implies that the explanatory variable does not have an effect on the hazard rates; a hazard below 1 implies a negative effect. For continuous variables, the hazard ratio should be interpreted as the percentage change in the dependent variable associated by a unit change of the regressor.

The key parameter of interest is the effect of the LTV limit for the treatment group. The hazard ratio of the interaction term between being liquidity constrained and the LTV dummy is significant and is slightly below 1 in almost every model. Under the LTV limit, the hazard rate of a liquidity-constrained individual is approximately 0.935 times the hazard rate of an unconstrained individual (see model (3) in Table **??**). This is in line with the empirical literature (Brueckner, 1986; Linneman and Wachter, 1989; Bourassa, 1995; Quercia et al., 2003; Acolin et al., 2016). For example, Acolin et al. (2016) show that the probability to become homeowner dropped by 2.3% in the United States as a result of more stringent down payment constraints.

Next, we estimate a model with year-specific dummies for the treatment group. The hazard ratio for the constrained in 2012 is estimated at 1.245 (see model (4) in Table 6). A higher value of the house reduces the probability to become homeowner. The coefficient of the predicted value of the house is 0.956, which is smaller than 1, as expected (see Model 5 in Table 6). A higher expected value of the house implies a higher required down payment in case an LTV limit prevents financing (part of) the transaction costs by a mortgage.

Finally, we exploit exogenous variation in the LTV limit by including the required down payment in the hazard model. The empirical results in Table 6 show that an increase in the down payment reduces the probability to become homeowner slightly, but only for the treatment group. The hazard ratio of the required down payment for the full sample is close to 1 while for the treatment group it is 0.992 (see model (6) in Table 6). This implies that an increase in the down payment, due to a more stringent LTV limit,

[14] Results for the full model are available on request.

an increase in house prices, or a higher house value, has a small effect on the probability to become first time homeowner. An increase in the required down payment by 1000 euro reduces this probability by approximately 1%.

Our baseline result is that the introduction of the LTV limit has reduced the probability to become homeowner only to a small extent for the treatment group. Next, we change some of the main assumptions in our approach to examine whether the baseline result is robust.

First, we define the treatment group differently. We assumed in the baseline model that individuals are not financially constrained if their parents' wealth is at least 50,000 euro. Since this threshold is arbitrary, we use a threshold value of 100,000 euro of financial wealth as well. The key results do not change: the hazard ratio for the interaction term for the presence of an LTV limit and being liquidity constrained in the model with a larger threshold is 0.938, compared to 0.935 in the baseline model (see Model B in Table 7). We control for the number of children as well, with little effect on the hazard ratio (Model C). When we use parents' housing wealth minus the mortgage in stead of financial wealth, the hazard ratio gets close to one (Model D). However, in our view, housing wealth is an inferior proxy compared to financial wealth as a house is a very illiquid asset .

In the baseline model, we assume that individuals start considering homeownership at age 18, which is arbitrary. However, the main results do not change when we assume that individuals start considering homeownership at age 21 (Model E). Alternatively, spells may start when individuals get their first job, as in the baseline model of Guiso and Jappelli (2002). In that case, the effect of the introduction of the LTV limit becomes slightly larger (0.909, see Model F). A problem with this approach is that part time student jobs are common in The Netherlands.

Finally, we consider different estimation methodologies. We include individual random effects in Model G and assume that these effects are gamma distributed, as is common in the literature. The effect of the presence of an LTV limit on the treatment group hardly changes. This suggests that unobserved heterogeneity plays a limited role in our models. In Model H, we use a Cox proportional hazard model to estimate the baseline specification. Parametric hazard models assume a certain distribution of the baseline hazard function (see Section 4). Cox Proportional Hazard Models do not impose any restrictions on the baseline hazard function. We compare the outcomes of our fully parametric baseline model with those of a Cox proportional hazard model with the same specification (see Model H in Table 7).

Table 6: Parametric duration model with Weibull distribution, hazard ratios

	(1)	(2)	(3)	(4)	(5)	(6)
Constrained × LTV limit	0.936***	0.938***	0.935***	0.715***	0.940***	0.984***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.004)	(0.003)
Constrained×2012				1.245***		
				(0.007)		
Predicted house value					0.956***	
					(0.001)	
Req. savings						0.998***
						(0.000)
Req. savings ×Constrained						0.992***
						(0.000)
Control variables included[a]	No	Some	Yes	Yes	Yes	Yes
Constrained × year dummies	No	No	No	No	No	No
Observations (millions)	3.8	3.8	3.8	3.8	3.8	3.8

Dependent variable: time in years, starting at 18^{th} birthday, ending at censoring or transition to homeownership. Robust standard errors in parentheses, clustered by the individual *** = 1%, ** = 5%, * = 10% significance level. Control variables that are always included are gender, migration background, and a dummy for having a partner. Other controls sequentially included are socioeconomic status, level of education, tenure status(renting or living at parents), and household income. Model 5 includes year effects for liquidity-constrained individuals for all years.

The hazard ratio under the presence of an LTV limit for the treatment group is 0.945, which is fairly close to the ratio in the fully parametric model. This indicates that the risk of misspecification of the Weibull baseline hazard function is low.

Table 7: Alternative duration models, hazard ratios

Model	Changed assumption	HR interaction	N
A	Baseline	0.935***	3.8
B	Unconstrained: Parents' wealth >100k	0.938***	3.8
C	Unconstrained: Parents' wealth/children >35k	0.930***	3.8
D	Unconstrained: Parents' housing wealth >100k	0.987***	3.8
E	Start spell: age 21	0.933***	2.9
F	Start spell: first job	0.909***	2.7
G	Baseline, with random effects	0.932***	3.8
H	Baseline, Cox model	0.945***	3.8

HR interaction is the estimated hazard ratio of the interaction term of the presence of an LTV limit and an individual being liquidity constrained. Dependent variable: time in years, starting at 18^{th} birthday (except Models E and F), until first time homeownership. Robust standard errors in parentheses, clustered by the individual. *** = 1%, ** = 5%, * = 10% significance level. Control variables are gender, migration background, a dummy for having a partner, socioeconomic status, level of education, tenure status (renting or living at parents) and household income.

6. Conclusion and discussion

The introduction of a lower LTV limit is a macroprudential tool often used to improve financial stability. While lowering LTV limits may enhance financial stability, such a policy may also imply that potential borrowers need to save longer before being able to purchase their first home.

In the present study, we find that the introduction of the LTV limit in the Netherlands has reduced the probability to become first time homeowner at any point in time by approximately 6 percent. Our results are robust for using alternative ways to define liquidity-constrained individuals, alternative assumptions about when individuals start considering homeownership, unobserved heterogeneity, and potential misspecification of the baseline hazard function. Our result can be interpreted as an upper limit of the effect of introducing an LTV limit on homeownership as this effect is partly offset by a slow down in house price increases.

Our results are in line with existing research. For example, van Bekkum et al. (2019) find a somewhat larger effect of the LTV limit on homeownership in the short term and during a period of declining house prices in The Netherlands (van Bekkum et al., 2019). This is consistent with the results of Armstrong et al. (2019), who find that the effect of the LTV limit on housing demand depends on house price growth rates. Our study shows that over a longer time period, liquidity-constrained individuals are able to purchase a house, but it takes longer.

The average duration between an individual's 18^{th} birthday and first time homeownership has increased since the introduction of the LTV limit. However, we find little difference between the treatment and control group. This finding suggests that the increase in duration until homeownership is mainly caused by housing market developments, notably rapidly increasing house prices. Previous research indicates that house price growth would have been even stronger in the absence of macroprudential policy.

A potential explanation for the limited effect of the LTV limit on the transition to homeownership could be that Debt-Service-to-Income limits bind first and that LTV limits simply impose a choice of what to buy and when, given the maximum amount of potential debt. Alternatively, the effect could be local, as the reduction from 106% to 100% in 7 years was small and slow; we cannot exclude that further reductions could entail larger side effects. The effect of other macroprudential policy tools on the transition to homeownership, is a topic for further research.

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Appendix A. Derivation of Formulas in the Theory Section

From Brueckner (1986):

$$x_1^R = (1-\tau_1)y_1 - s^R - Q \tag{A.1}$$

$$x_2^R = (1-\tau_2)y_2 + (1+(1-\tau_2)r)s^R - Q \tag{A.2}$$

$$x_1^H = (1-\tau_1)y_1 - s^H - Q \tag{A.3}$$

$$x_2^H = (1-\tau_2)y_2 + (1+(1-\tau_2)r)s^H - (1-\tau_2)Q \tag{A.4}$$

We plug in equations A.1 - A.4 in the owner-renter utility differential and get:

$$\begin{aligned}\Omega = {} & u((1-\tau_1)y_1 - s^H - Q) \\ & + \theta u((1-\tau_2)y_2 + (1+(1-\tau_2)r)s^H - (1-\tau_2)Q) \\ & - u((1-\tau_1)y_1 - s^R - Q) \\ & - \theta u((1-\tau_2)y_2 + (1+(1-\tau_2)r)s^R) - Q)\end{aligned} \tag{A.5}$$

First-time home buyers in general have low current income and higher future income: $y_1 < y_2$. Moreover, we assume that they cannot borrow against future income to make the down payment (like Brueckner (1986). This implies that the down payment constraint is binding. First-time home buyers save just enough to be able to make a down payment, because additional savings reduces utility if the down payment constraint is binding. This implies that $s^H = \alpha P$. Note that from the non-profit condition, housing costs are $Q = rP$ for both renters and homeowners (Brueckner, 1986). Substitution of $s^H = \alpha P$ and $Q = rP$ in equation A.5 yields:

$$\begin{aligned}\Omega = {} & u((1-\tau_1)y_1 - \alpha P - rP) \\ & + \theta u((1-\tau_2)y_2 + (1+(1-\tau_2)r)\alpha P - (1-\tau_2)rP) \\ & - u((1-\tau_1)y_1 - s^R - rP) \\ & - \theta u((1-\tau_2)y_2 + (1+(1-\tau_2)r)s^R) - rP)\end{aligned} \tag{A.6}$$

Take the partial derivative with respect to house prices P:

$$\begin{aligned}\frac{\delta\Omega}{\delta P} = {} & -(\alpha + r)u'(x_1^H) \\ & + \theta((1+(1-\tau_2)r)\alpha - (1-\tau_2)r)u'(x_2^H) \\ & + ru'(x_1^R) \\ & + \theta ru'(x_2^R)\end{aligned} \tag{A.7}$$

Rewriting A.7 results in equation (1).

Brueckner (1986) assumes that house prices are constant, so the price of the down payment is equal to the price after the house is sold. The down payment is made at the beginning of period 1 and the house is sold at the end of period 2. Denote those prices as P_1 and P_2 respectively. Substitute $s_H = \alpha P_1$, $Q = rP_1$ in period 1 and $Q = rP_2$ in period 2. In the original model, αP cancels in out of the constraint for homeowners in period 2, because they get the down payment back after selling the house. In the model with varying house prices, the down payment does not cancel out, because house prices can change. Moreover, homeowners can make a loss or profit on the part of the house financed by a mortgage, $(1-\alpha)$, as well. The constraints become:

$$x_1^R = (1-\tau_1)y_1 - s_R - rP_1 \tag{A.8}$$
$$x_2^R = (1-\tau_2)y_2 + (1+(1-\tau_2)r)s^R - rP_2 \tag{A.9}$$
$$x_1^H = (1-\tau_1)y_1 - \alpha P_1 - rP_1 \tag{A.10}$$
$$x_2^H = (1-\tau_2)y_2 + (1+(1-\tau_2)r)\alpha P_1 - (1-\tau_2)rP_1 + P_2 - P_1 \tag{A.11}$$

after substituting in equations A.8-A.11, the owner-renter utility differential is now:

$$\begin{aligned}\Omega = {} & u((1-\tau_1)y_1 - \alpha P_1 - rP_1)\\ & + \theta u((1-\tau_2)y_2 + (1+(1-\tau_2)r)\alpha P_1 - (1-\tau_2)rP_1 + P_2 - P_1)\\ & - u((1-\tau_1)y_1 - s^R - rP_1)\\ & - \theta u((1-\tau_2)y_2 + (1+(1-\tau_2)r)s^R - rP_2)\end{aligned} \tag{A.12}$$

Take the first-order derivative with respect to to P_1 using the envelope theorem (note that P_1 is not in x_2^R):

$$\begin{aligned}\frac{\delta\Omega}{\delta P_1} &= -(\alpha + r)u'(x_1^H)\\ +\theta((1+(1-\tau_2)r)\alpha - ((1-\tau_2)r - 1)u'(x_2^H) &+ ru'(x_1^R)\end{aligned} \tag{A.13}$$

rewriting (A.13) results in (2). Now take the derivative of (A.12) with respect to P_2:

$$\frac{\delta\Omega}{\delta P_2} = \theta u'(x_2^H) + \theta r u'(x_2^R) \tag{A.14}$$

which coincides with equation (3).

From equation (4), $s^H \geq (1+\rho-\gamma)P$. Assuming that this constraint is just binding, substitution of $s^H = (1+\rho-\gamma)P$ in x_1^H and x_2^H yields:

$$
\begin{aligned}
x_1^H &= (1-\tau_1)y_1 - (1+\rho-\gamma)P - Q && \text{(A.15)}\\
x_2^H &= (1-\tau_2)y_2 + (1+(1-\tau_2)r)((1+\rho-\gamma)P) - (1-\tau_2)Q \\
&\quad - (1+\rho-\gamma)P + (1-\gamma)P \\
&= (1-\tau_2)y_2 + (1+(1-\tau_2)r)((1+\rho-\gamma)P) - (1-\tau_2)Q - \rho P && \text{(A.16)}
\end{aligned}
$$

The renter's constraints x_1^R and x_2^R do not change. The owner-renter utility differential becomes (after some simplification):

$$
\begin{aligned}
\Omega &= u((-1-\rho+\gamma)P) \\
&\quad + \theta u((1+(1-\tau_2)r)(1+\rho-\gamma)P + \tau_2 Q - \rho P) \\
&\quad - u(-s^R) \\
&\quad - \theta u(y_2 + (1+(1-\tau_2)r)s^R)) && \text{(A.17)}
\end{aligned}
$$

Take the first-order derivative of the owner-renter utility differential with respect to γ:

$$
\frac{\delta\Omega}{\delta\gamma} = Pu'(x_1^H) - \theta P(1+(1-\tau_2)r)u'(x_2^H) \qquad \text{(A.18)}
$$

which coincides with equation (5).

Appendix B. Coefficients in Predicted House Value Model

The coefficients of the OLS-model on house purchase prices are listed in Table B.8. The sample consists of all first-time home buyers in our sample who actually purchased an house in or before 2016 and are in the LLD. The dependent variable is the original purchase price of the house from the LLD denoted in 2016 prices, using a CBS national price index. The explanatory variables age, (household) income, residential status (living at parents or renting), partner, gender, year of birth, highest level of education achieved, and region are from CBS registration files (see Section 3) and are step wise added to the model. Region is the municipality of the individual's first owner-occupied house in the first model. In the second model, it is the municipality of the latest house before the transition to homeownership is made. The latter leads to a decrease in the predictive power of the model and hence we use the municipality of the first owner-occupied house in models 3-5. The R^2 improves from 0.186 (model 1) to 0.247 (model 3) after replacing income and income^2 by household income and household income^2. Finally, adding the level of education and house tenure status increases the predictive power of the model further to 0.285. We use the coefficients of model (5) to predict house values for first-time home buyers.

Table B.8: OLS-model of house purchase price at origination

	(1)	(2)	(3)	(4)	(5)
Age	0,004***	0,001***	0,001***	0,001***	0,000*
Female	0,075***	0,015***	0,014***	0,016***	-0.001
Income	0,100***				
Income^2	-0,001***				
Household income		0,178***	0,184***	0,179***	0,148***
Household income^2		-0,002***	-0,002***	-0,002***	-0,001***
Lives at parents				0,010***	0,027***
Without partner					-0,096***
Level of education					
Medium					0,032***
Bachelor					0,077***
Master					0,133***
Constant	11,855***	11,878***	11,898***	11,866***	11,945***
Year of birth	Included	Included	Included	Included	Included
Region	Current	Previous	Current	Current	Current
R^2	0.186	0.260	0.246	0.260	0.285
N (1000 obs)	286	286	286	283	223

Dependent variable: Log value of the house at origination of observed transitions, denoted in 2016 prices. Source: DNB loan level data (dependent variable) and CBS Microdata (other variables). * = 10%, ** = 5%, * = 1% significance level.

Appendix C. Used data sources

GBAPERSOONTAB: Demographic information on individuals registered in the Netherlands Key Register of Persons (Basisregistratie Personen) from October 1^{st} 1994.

GBAADRESOBJECTBUS: Addresses in The Netherlands of everyone registred in the Key Register of Persons since 1995, including beginning- and end date.

EIGENDOM(WOZ)TAB: Information about addresses, including ownership status.

KINDOUDERTAB: Parents' ID of every individual in the Key Register of Persons since 1995.

GBASAMENWONERSBUS: Information about living together in a couple for every individual in the Key Register of Persons, including beginning- and end date of living together. Beyond marriage, having a child together, moving together from one address to another or being fiscal partners count as being a couple.

VRKTAB: Received inheritances, applicable to inheritance tax.

SCHTAB: Inter vivos gifts, applicable to gift tax.

(S)POLISBUS: Information about jobs and wages of employees in The Netherlands.

HOOGSTEOPLTAB: Highest level and field of education achieved.

INPATAB and INTEGRAAL PERSOONLIJK INKOMEN (previous version): Annual income information for Dutch inhabitants.

VEHTAB: Annual wealth level of Dutch households.

Appendix D. Key variables of the sample before and after selection

Table D.9: Key variables for the treatment and control group

	Without unknown residence type	Parents' wealth available	Control variables available
Gender			
Male	51.6	52.8	52.4
Female	48.4	47.2	47.6
Level of education			
Low	22.8	21.4	21.1
Medium	53.4	55.0	55.2
Bachelor	16.9	17.0	17.1
Master	6.9	6.5	6.5
Migration background			
Dutch	67.5	78.5	78.0
Western	14.6	7.0	6.8
Non-western	18.0	14.5	15.3
Socioeconomic category			
Employee	71.6	75.9	79.9
Self-employed	18.9	15.0	14.1
Other	9.5	7.6	6.0
Median values			
Age	28	27	25
Observations (million)	8.1	4.6	3.8

Categorical variables are reported in percentages, age is denoted in years. The value of variables can change over time. In this table, the last available value for every individual is reported. We use current values in our empirical model.