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Macroprudential Policy and Household Wealth Inequality

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Abstract

Macroprudential policies, such as caps on loan-to-value (LTV) ratios, have become part of the policy paradigm in emerging markets and advanced countries alike. Given that housing is the most important asset in household portfolios, relaxing or tightening access to mortgages may affect the distribution of household wealth in the country. In a stylised model we show that the final level of wealth inequality depends on the size of the LTV ratio, housing prices, credit cost and the strength of a bequest motive; ultimately with no unequivocal effect of LTV ratios on wealth inequality. These trade-offs are illustrated with estimations of "Gini Recentered Influence Function" regressions on household survey data from 12 eurozone countries that participated in the first wave of the Household Finance and Consumption Survey (HFCS). The results show that, among the households with active mortgages, high LTV ratios at the time of acquisition are related to high contributions to wealth inequality today, while house price increases are negatively related to inequality contributions. A proxy for the strength of bequest motives tends to be negatively related with wealth inequality, but credit cost does not show a significant link to the distribution of wealth.

Keywords: Household Finance, Macroprudential policy, Inequality, LTV ratio, Wealth distribution
JEL classification:, D31, E5, E21, G21

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1. Introduction

Macroprudential policies, such as caps on loan-to-value (LTV), loan-to-income (LTI), debt-service-to-income (DSTI) ratios, limits on credit growth and other balance sheets restrictions, have become part of the policy paradigm in emerging markets and advanced countries alike. National authorities with explicit macroprudential mandate have been established in most EU countries under the auspices of the European Systemic Risk Board (ESRB) in the last 3 years and the Capital Requirements Directive 2013/36/EU now gives to the macroprudential authorities a new set of policy instruments to address financial stability risks more effectively.

According to the Annual Report 2015 of the ESRB, published in July 2016, more than 130 new macroprudential measures were taken in the EU in the course of 2015. As Claudio Borio presciently suggested in 2009, paraphrasing Milton Friedman, "we are all macroprudentialists now".

The empirical literature on the effectiveness of the newly activated macroprudential tools is growing and mainly assesses whether, and how much, bank credit and house prices respond to the activation of the macroprudential policies. See among others Cerutti et al. (2016) for a comprehensive panel analysis of 119 countries over 2000-2013, Tressel and Zhang (2016) for a Euro area perspective, Claessens et al. (2013) for a 48 countries panel analysis based on bank-level data or Gross and Poblacion Garcia (2016) for an analysis based on EU household survey data.

Despite these efforts, much remains to be studied. As pointed out by Tressel and Zhang (2016) and Claessens (2014) little is known empirically about their effectiveness in mitigating systemic risks, about their channel of transmission and about the tools' costs. Most empirical studies to date have focused on the potential benefits of macroprudential policies, while their potential costs have received less attention (exceptions include Behn et al. (2016) and Arregui et al. (2013), which examine output losses resulting from banks' responses to higher capital requirements).

The objective of this paper is to bridge the literature on macroprudential policy and the literature on wealth inequality. Stiglitz (2015) has already noted that increases in the wealth-to-income ratio and in inequality are related to the increase in rents and in the value of land, and to the financial system. He specifically shows that "a lowering of collateral requirements or of banks' capital adequacy requirements does not result in an increase in the overall efficiency of the economy, but leads to more inequality." In the same vein, Galbraith (2012) argues that the rise in U.S. inequality is mainly driven by financial and macroeconomic policy choices. More specifically, our

paper examines the connection between macroprudential policy and wealth inequality, both theoretically and empirically. It also brings specific inequality tools in the wider toolkit of the empirical literature on macroprudential policy effectiveness.

Looking at the impact of macroprudential policies on inequality matters, and is not disconnected of policy makers' concerns. Macroprudential policies are widely known to have redistributive effects. Policy makers illustrate this concern when they modulate LTVs caps, as is the case in Ireland where the central bank has imposed a 90% cap for first-time-buyers of properties up to EUR220,000 and of 80% otherwise. By documenting the impact of macroprudential policies on inequality, our paper is also designed to provide some indirect guidance on inequality-mitigating devices such as the one implemented in Ireland.

We first present a model able to highlight the main trade-offs and links between credit market, housing market and household wealth inequality in the society. We specifically show the links between LTV ratios, house prices, cost of financing and bequest motives. We then explore the effects of LTV ratios on 'within generations' inequality by means of simulations. We show that LTV ratios have a non-monotonic effect on wealth inequality, that the intensity of inter-generational transfers is key in determining the relationship between LTV policies and wealth inequality and that a higher cost of credit associated to loose LTV policies can reduce wealth inequality.

We then implement the so-called "Gini recentered influence function" (Gini-RIF) regressions (see Firpo et al. (2009) and Choe and Van Kerm (2014)) to assess the relationship of LTV ratios and other covariates on net wealth inequality. The empirical work relies on the Eurosystem Household Finance and Consumption Survey (HFCS) dataset, which is a harmonized household survey initiated and coordinated by the European Central Bank. The survey includes a large set of core questions inquiring about assets, debt, income, bequests and demographics of the household.

The main contributions of this paper are the following. First, we provide a unique assessment of the impact of macroprudential policies (limited in this paper to the specific LTV tool) on inequality. Second, this paper is one of the few exploiting household-level dataset to assess macroprudential policies (the only other one we know is Ampudia et al. (2014) who specifically assess the impact of macroprudential policies on the loss given default (LGD) of households). Third, we bring some analytical tools utilized in the empirical literature of income distribution to study some macroprudential policy variables and their (unintended) effects on wealth inequality.

The rest of the paper is structured as follows. Section 2 reviews the lit-

erature on macroprudential policy effectiveness and its side effects. Section 3 presents the model and the simulations designed to illustrate the links between LTV ratios and inequality. Section 4 presents the Household Finance and Consumption Survey data, outlines the econometric approach and interprets the results. Section 5 concludes and discusses potential extensions.

2. Review of literature

The literature on the effectiveness of macroprudential tools is growing fast. The most comprehensive analysis so far is by Cerutti et al. (2016) for a panel analysis of 119 countries over 2000-2013. Their main finding is that the activation of macroprudential policies is generally associated with lower growth in credit and that this relationship is weaker in financially more developed and open economies. They also find that the effectiveness of macroprudential policies depends on the financial cycle, and that they work less well in busts (also see McDonald (2015)).

Other key empirical references include Kuttner and Shim (2013) who perform panel regressions over 57 countries and three decades and find that housing credit growth is significantly affected by changes in the maximum debt-service-to-income ratio, the maximum LTV ratio and limits on exposure to the housing sector. Vandenbussche et al. (2012) study Central, Eastern and South-Eastern Europe, known to have used a rich set of prudential instruments over the last decades. Their evidence suggests that the most effective measures were changes in the minimum capital adequacy ratio and non-standard liquidity measures (marginal reserve requirements on foreign funding, marginal reserve requirements linked to credit growth). Using data from 49 countries, Lim et al. (2011) evaluate the effectiveness of macroprudential instruments in reducing systemic risk over time and across institutions and markets. Their analysis suggests that tightened LTV and debt-to-income ratios, reserve requirements, dynamic provisioning and ceilings on credit growth (also in foreign currency) all seem to reduce the pro-cyclicality of credit growth. Claessens et al. (2013) take an alternative approach and analyze how changes in balance sheets of some 2,800 banks in 48 countries from 2000 to 2010 respond to specific macroprudential policies. They find that measures aimed at borrowers (caps on debt-to-income and LTV ratios) and at financial institutions (limits on credit growth and foreign currency lending) are effective in reducing asset growth.

Beside the panel analyses, country-specific analyses are now growing abundant for the U.S. (Berger and Bouwman, 2013, Carlson et al., 2013), Hong-Kong (Craig and Hua, 2011), Spain (Jimenez et al., 2013), the U.K.

(Aiyar et al., 2012), Korea (Igan and Kang, 2011), Ireland (Kelly et al., 2015) the Netherlands (Verbruggen et al., 2015) and France (Dietsch and Welter-Nicol, 2014, Avouyi-Dovi et al., 2014). Two preliminary conclusions emerge from these empirical studies. First, macroprudential policies are generally found to have an impact on credit growth, but less effectively on price dynamics. Second, most papers are mainly concerned by the benefits (lower probability and impact of financial crises) of macroprudential policies, and less by their costs.

Some references take the costs into consideration. Behn et al. (2016) investigate the effects of policy-induced shocks to banking sector capitalization on the probability of future banking crises while accounting for potential endogenous responses that higher banking sector capitalization may imply for macro-financial variables. Their model integrates the costs, understood in terms of output losses that might result from banks responses to higher capital requirements. Similarly, Arregui et al. (2013)) propose a "cookbook" to evaluate the net benefits of macroprudential policy, with the costs defined as arising from an increase in the cost of intermediation and its effect on long-run output.

Still, inequality, a very specific cost not directly captured by output losses, is widely overlooked as a potential collateral damage of macroprudential policies. Along with Stiglitz (2015)—cited above—who demonstrated that lower collateral requirement "does not result in an increase in the overall efficiency of the economy, but leads to more inequality", some recent papers challenge the view that the distribution of income and wealth is irrelevant to macroeconomic stability. According to the study of Perugini et al. (2016) on inequality, credit and the financial crisis, policy makers should cast the net wider than monetary policy and regulatory reforms and consider the effects of changes to distributive patterns. Social impacts are examined by Ampudia et al. (2014) who study how caps on the LTV ratio affect the loss given default of the households, and more generally the household distress in case of crisis. To our knowledge, this paper and ours are, so far, the first ones to exploit the household-level data from the HFCS for macroprudential policy effectiveness analyses. Igan and Kang (2011) propose an extension where they utilize information on individual households using a national survey on mortgages and housing demand conducted annually by the central bank of South Korea. We finally note that the national studies often rely on loan-level national databases such as Dietsch and Welter-Nicol (2014) and Kelly et al. (2015).

3. Wealth inequality and Loan-To-Value ratios in an overlapping generations model

We first build a simple overlapping generations (OLG) model to show how LTV ratios can affect wealth inequality (see Deaton and Laroque (2001) and Gary-Bobo and Nur (2015) for similar modelling approaches). The model is designed to highlight the links between LTV ratios, house prices, cost of financing and willingness of inter-generational transfers (so-called bequest motives). We then utilize a inequality index able to take into account for 'within generations' inequality (Shorrocks (1980)). The use of a OLG is motivated by its clear mechanisms of accumulation and transmission of wealth between generations and because it offers the possibility to account for life-cycle effects on the accumulation of wealth. This is particularly important in the estimation of wealth inequality as the distribution of wealth in the society is significantly affected by where the individuals stand along the life-span. We finally derive comparative statics in view to see how LTV ratios affect inequality, and how this relationship is affected by the cost of credit and bequest motives.

3.1. An OLG model

We consider a stylised economy where individuals live for two periods. The first period of life comprises the full length of the active life (early and mid adulthood) in which the individual chooses consumption and the quantity of housing to be acquired. Consumption and housing are financed out of a bank loan and an anticipated bequest given at the beginning of the first period. There are not unintentional bequests. For brevity, we abstract from any other form of saving different of housing and other source of income. The loan is taken at the beginning of the first period and paid back in full at the beginning of the second period. The bank lends a share θ of the house market value and charges an interest rate equal to r.

The second period of life corresponds to old age where the individual chooses consumption and the bequest given to the children. Consumption in the second period is financed out of the updated value of the house—which is the only way to finance inter-temporal consumption—and after repaying the loan and leaving a bequest to the child.

There is no specific amenity associated with a house. The house appears in the utility function due to the resources it provides in the future. The house is described by housing units and by a price per unit. Without loss of generality, the housing units can also be interpreted as quality measures. It is assumed that each old agent will have only one child.

The loan-to-value ratio (θ in the model) is a parameter that indicates the ratio of the loan over the value of the house. As this ratio is generally lower than one, then $1-\theta$ is the down-payment required by the bank. In this setting, all adults borrow as much as they can to buy the biggest possible house, and therefore the saving can be seen as the down-payment, and the loan as the maximum amount that a bank accepts to lend. Such situation occurs in countries where house price expectations are high, or where the demand is highly elastic compared to the supply. These are precisely the cases that we want to capture since these are the cases where housing prices are affected by credit supply and where specific wealth inequality issues arise. Similarly, Bover (2016) argue that an increase in the regulatory LTV ratio can be modelled as an increase in the demand of credit.

Although house prices are typically endogenous and affected by the credit supply, our model treats prices as exogenous. This might be criticized as a situation where the LTV is fixed (in other words where agents all borrow as much as the banks allow), but at least this choice allows to simplify the identification of the channels by which LTV affect wealth inequality.

The consumption restrictions of adult and old individuals are the following:

$$b_t + H_t p_t \theta = c_{1,t} + H_t p_t \tag{1}$$

$$H_t p_{t+1} = c_{2,t+1} + H_t p_t \theta (1 + r) + b_{t+1} \tag{2}$$

where $c_{1,t}$ and $c_{2,t+1}$ are first period consumption in adulthood and second period consumption when old, b_t is the bequest received in t, H_t is the housing units, p_t is the price per housing unit in t, θ is the LTV, r is the interest rate on the bank loan. Furthermore, in this setting $b_t \geq 0$ for all t (no Ponzi game). Individuals derive utility from consumption in both periods and from the 'joy of giving' motive (Abel and Warshawsky (1988)) of leaving a bequest b_{t+1} to their children. The utility function of an individual born at time t is:

$$U_t = \ln(c_{1,t}) + \beta \ln(c_{2,t+1}) + \gamma \ln(b_{t+1}) \tag{3}$$

The optimal values for H_t and b_{t+1} are obtained from the maximization of the utility function subject to both consumption restrictions, and the growth of prices is assumed constant ($\frac{p_{t+1}}{p_t} = 1 + \pi$). The optimal values are:

$$H_t = \frac{\beta + \gamma}{(1 + \beta + \gamma)p_t(1 - \theta)}(b_t) \tag{4}$$

$$b_{t+1} = \frac{\gamma(1 + \pi - \theta(1 + r))}{(1 + \beta + \gamma)(1 - \theta)}(b_t) \tag{5}$$

It is easy to observe that $dH_t p_t/d\theta > 0$ and $dH_t p_{t+1}/d\pi > 0$, but for the bequest: $db_{t+1}/d\theta > 0$ if $\pi - r > 0$.

3.2. Wealth inequality

Although we are aware of the challenges in the conceptualization and measurement of wealth inequality (a recent survey is Cowell and Van Kerm (2015)) we need an operational definition to be able to track changes in the wealth stock of the two types of agents overlapping in one period in our model. We will look at any period $t + 1$ where the adult and the old individuals overlap and focus on inequality between and within generations:

wealth in adulthood: $W_{1,t+1} = W_1$

wealth in old age: $W_{2,t+1} = W_2$

Measuring inequality at the very beginning of $t + 1$ means that we are only considering the initial wealth of the adult (the bequest received) and the house of the old. In contrast, if we consider the very end of period $t+1$, the adult would have a house, but the old will have zero wealth (there are not accidental bequests). So, in order to circumvent this limitation, we define net wealth for each agent as the market value of the house minus credit debt in $t + 1$.

$$W_1 = H_{t+1}p_{t+1} - H_{t+1}p_{t+1}\theta(1 + r) \tag{6}$$

$$W_1 = \frac{(\beta + \gamma)\gamma(1 + \pi - \theta(1 + r))(1 - \theta(1 + r))}{(1 - \theta)^2(1 + \beta + \gamma)^2}(b_t) \tag{7}$$

$$W_2 = H_{t+1}p_{t+1} - H_t p_t \theta(1 + r) \tag{8}$$

$$W_2 = \frac{(\beta + \gamma)(1 + \pi - \theta(1 + r))}{(1 - \theta)(1 + \beta + \gamma)}(b_t) \tag{9}$$

The population n in $t+1$ is composed of n_1 adults and n_2 old individuals, with $n = n_1 + n_2$. Wealth of each agent i is:

$$W_{1i} = \alpha_1 b_{it} \text{ , with } \alpha_1 = \frac{(\beta+\gamma)\gamma(1+\pi-\theta(1+r))(1-\theta(1+r))}{(1-\theta)^2(1+\beta+\gamma)^2} \tag{10}$$

$$W_{2i} = \alpha_2 b_{it} \text{ , with } \alpha_2 = \frac{(\beta+\gamma)(1+\pi-\theta(1+r))}{(1-\theta)(1+\beta+\gamma)} \tag{11}$$

Equations (10) and (11) indicate that wealth observed in $t+1$ for the adult and old generation is a function of the bequests received in period t. This setting allows to find closed form solutions for some inequality measures. Wealth inequality is measured for the total population n, and given that this can be subdivided in two groups, we use an inequality index that can be additively decomposed by groups with desirable properties. This is the case of the generalized entropy family of indices (Bourguignon (1979), Cowell (1980), Shorrocks (1980)).

$$I_e(W) = \frac{1}{n}\frac{1}{e(e-1)}\sum_1^n[(\frac{W_i}{\mu})^e - 1] \text{ with e} \neq 0, 1 \tag{12}$$

The popular Theil index of entropy is obtained with $e = 1$ and the mean log deviation is the limiting case with $e = 0$. For being able to find closed solutions, we will use I_2, that is equivalent to half the squared coefficient of variation:

$$I_2(W) = \frac{1}{2n}\sum_1^n[(\frac{W_i}{\mu})^2 - 1] \tag{13}$$

For a partition of the population into two distinct subgroups—here the two generations alive at any time t—generalized entropy measures can be decomposed into a component measuring within-group inequality (I_w) and another component measuring between-group inequality (I_b): $I_2(W) = I_b + I_w$. The between group component captures differences in average wealth between the two groups. The within group component is a population and wealth weighted average of inequality within the groups. We focus on the within component. The reason is that this metric is not affected by inequality arising from comparing the group of adult individuals with that

of old individuals. Inter-generational inequality is significantly affected by life-cycle effects, i.e. by the position of the individual in the life-cycle. Our main purpose is to highlight the effects of macroprudential policy on the distribution of wealth within the same generation of individuals. Given the younger individuals need to finance out down-payments due to binding LTV caps, the OLG framework allows to include parental bequest transfers that will be used to pay these down-payments and consumption. Thus, though we need to make explicit this transmission mechanism from the old to the young, measuring wealth differences between both generations is not our primary focus.

We insert equations (10) and (11) into equation (13). The population of adults (n_1) is always equal to that of old individuals (n_2), i.e. each individual has one child, which is a consequence of no including fertility decisions in the model. We obtain the following expression for the within inequality index:

$$I_w = \frac{\alpha_1^2 + \alpha_2^2}{(\alpha_1 + \alpha_2)^2} A_1 \text{ ,with } A_1 = \frac{1}{n} \sum_1^m [\frac{b_i^2 - \bar{b}^2}{(\sum_1^m b_i)^2}] > 0 \tag{14}$$

Where $n_1 = n_2 = m = n/2$. The expression A_1 must be positive because parents cannot transmit debts to children. In addition, A_1 was determined in period t and hence this is taken as a constant in period $t+1$, which is our period of evaluation for wealth inequality. Therefore, A_1 will be treated as a constant in the comparative statics performed in $t+1$. In short, the source of heterogeneity in this model is the distribution of bequest amounts received by the adult individuals, which will allow them to accumulate different values of wealth through the acquisition of housing. Interestingly, the term A_1 somewhat captures this distribution of bequests for the adults.

3.3. Comparative statics

We study the effects of changes in LTV and other parameters on wealth inequality. It is easy to see that

$$\frac{dI_w}{d\theta} = \frac{(1+\beta)(1-\theta) + r\theta\gamma}{((1+\beta+2\gamma)(1-\theta) - r\theta\gamma)^3} 2r\gamma(1+\beta+\gamma)A_1 \tag{15}$$

And therefore,

$$Sign[\frac{dI_w}{d\theta}] = Sign[(1+\beta+2\gamma)(1-\theta) - r\theta\gamma] \tag{16}$$

$\frac{dI_w}{d\theta}$ will tend to be positive for large values of θ or γ. However, this derivative can become negative if both interest rate r and the joy of giving γ are large enough. The following expression shows the relationship between the parameter values that will assure $\frac{dI_w}{d\theta} > 0$, meaning that wealth inequality will increase with 'easy' credit:

$$r < \frac{(1+\beta+2\gamma)(1-\theta)}{\theta\gamma} \tag{17}$$

Wealth inequality will decrease with 'easy' credit $\frac{dI_w}{d\theta} < 0$ if:

$$r > \frac{(1+\beta+2\gamma)(1-\theta)}{\theta\gamma} \tag{18}$$

Figure 1 shows, by means of simulations, in which cases the effect of a change in θ on wealth inequality is positive or negative. The first panel (Figure 1(a)) reports the effects on inequality by LTV ratio and mortgage cost. All the combinations of these values falling on the dark shaded area indicate a negative effect of LTV ratio on inequality, while the combinations falling on the light shaded area indicate a positive effect of LTV ratio on inequality. For example, for a given value $r = 0.33$ (which is the total financial cost of a mortgage of 30 years with a yearly interest rate of 2%) we observe that a rise in the LTV ratio increases wealth inequality up to the LTV is about 0.92, but then the effect becomes negative for larger values of LTV. So, easy credit can have positive effects in the reduction of wealth inequality only if the LTV is sufficiently large. Furthermore, larger values of r increase the number of cases where a rise of LTV ratio can reduce wealth inequality. So, when the cost of credit is high enough, easy credit can reduce wealth inequality. Richer individuals (in our case, the individuals with larger bequests) can benefit more from loose credit to acquire more housing, and in this way, increase wealth inequality. But, a high financial cost will neutralize or reverse this impact.

INSERT FIGURE 1 HERE

Figure 1(b) shows that the intensity of the bequest motive is important in determining the relationship between easy credit and wealth inequality. Similar to before, Figure 1(b) shows the direction of the effect of a change in θ on wealth inequality by LTV ratio and the strength of the bequest motive. The combinations of LTV ratios and values of bequest motive falling

on the dark (light) shaded area indicate a negative (positive) effect of LTV ratio on inequality. In general, it is more likely to observe a reduction in wealth inequality due to an increase in the LTV ratio when the intensity of the bequest motive is higher. Therefore, it is important to investigate the strength of the bequest motive in order to better assess the relationship between credit and wealth inequality. In a similar vein, some studies in wealth taxation have pointed out that much more must be done to understand what is the incidence of bequest motives because the responses to estate taxation crucially depend on these motives (Kopczuk (2013), Pestieau and Thibault (2012), Cremer and Pestieau (2011) and Cigno et al. (2011)).

4. Wealth inequality and Loan-to-Value in the Household Finance and Consumption Survey

Our theoretical model suggests that the relationship between wealth inequality and LTV regulations is ambiguous, even in a very simple model. In this Section, we exploit the Eurosystem Household Finance and Consumption Survey (HFCS) to provide empirical evidence about how LTV ratios are related to wealth inequality.

We first present the HFCS data and describe the variables used in the empirical exercise. We then present 'Gini recentered influence function regressions' to illustrate the empirical relationship between levels of LTV ratios and households contributions to wealth inequality in twelve eurozone countries.

Our analysis here is avowedly descriptive. The results shed light on how much LTV ratios and other covariates highlighted in our model are related to observed wealth inequality in our data. Identification of a causal relationship between LTV ratios (or regulations affecting LTV ratios) and wealth inequality is beyond the scope of the analysis. For example, we cannot capture the impact of LTV ratio caps on affordability of housing; that is, we cannot see the impact on inequality of mortgages *not* taken because of LTV restrictions.[1] Causal analysis would require exogenous variations that are not available in the sort of cross-section sample that we are able to examine to date. However, at the very least, the analysis illustrates how income distribution methods can be applied to macroprudential policy issues at the household level and reveals a robust and relatively strong empirical association between LTV ratios and wealth inequality.

[1] In other words, we examine variation of LTV ratios at the 'intensive' margin rather than at the 'extensive' margin.

4.1. The data

The Eurosystem Household Finance and Consumption Survey (HFCS) is a harmonized household survey initiated and coordinated by the European Central Bank. The survey has been implemented in all eurozone countries. It is nationally representative of the resident household population in each participating country. It includes a large set of core questions inquiring about assets, debt, income and demographics of the household and some country-specific questions. The HFCS resembles the US Survey of Consumer Finances, which is considered the gold standard for household surveys on wealth. See European Central Bank (2014) for details. Two waves of HFCS data have been collected around 2010 and 2014 (but only the first wave was available at the time of preparing this paper).

Although the first wave of HFCS is available in 15 countries, we only use 12 countries. Finland and France are excluded from our analysis because they do not have information on key variables (such as the means of acquisition of the house of main residence), and Slovenia is left out because of its small sample size.

The population of households is divided into two distinct 'generations': adult households aged 25–59 and old households aged 60–84. Regression analysis of the relationship of LTV ratios and other variables with wealth inequality is performed on the sample of adult households. The age and other demographic characteristics are drawn from the 'reference' person in the household, which is identified in the HFCS as the person who is at the centre of the household's finances. The initial sample size consists of 20,477 households from 12 countries: Austria, Belgium, Cyprus, Germany, Spain, Greece, Italy, Luxembourg, Malta, the Netherlands, Portugal and Slovakia.

Our main variable of interest for the distributional analysis is household net worth which is the value of total assets (excluding public and private occupational pension entitlements) minus household's total liabilities. Household net worth is the concept most commonly used for wealth inequality analysis. As an alternative, we also compute a variable of 'net housing wealth', which is the current self-reported value of the household main residence (HMR) minus the outstanding balance of the corresponding mortgage. This variable only measures the wealth that is related to housing, a significant part of wealth for the majority of households (see, e.g., Bover et al., 2016, Cowell and Van Kerm, 2015).[2]

[2]Missing data in the HFCS data have been multiply imputed by the data providers. In all our analyses we repeat estimations on each of the five completed data replicates and

Table 1 shows various summary measures about the distribution of net worth in each of our national samples for households aged 25–59. Table 2 provides corresponding statistics for households aged 60–84. These summary statistics reveal large cross-country differences in the level of net worth inequality. The Gini coefficient for example ranges between 0.46 (in Slovakia) and 0.78 (in Germany) among 'young' households and between 0.40 (in Slovakia) and 0.70 (in Austria) among 'old' households. In all countries, inequality is lower in 'old' households than in 'young' households, but the levels are not systematically lower among young households. Note that, in line with much of the literature on wealth inequality, we examine the distribution across households, not across individuals, and do not apply any equivalence scale adjustment to account for household size and composition (Cowell and Van Kerm, 2015).

INSERT TABLES 1 AND 2 HERE

On the other side of the equation, we examine the role of the LTV ratio of the mortgage obtained by households, a measure similar to θ in the theoretical model. We focus on loans obtained to finance acquisition of the household main residence (which has been collateralised for obtaining a mortgage). The LTV ratio—LTV for short—is obtained as the ratio between the amount of the loan and the value of the house at the time of acquisition of the property. This information is only reported by households with an outstanding balance on a mortgage. No LTV is defined for households not owning their main residence, households who have repaid their loans and households owning their homes through inheritance, gifts, or ex-ante savings.

On average, the LTV is 0.77 for all countries, and about 13% of households have a LTV larger than 1.[3] Tables 1 and 2 indicate that there are however large country differences. For example, in the Netherlands, 14% of households aged 25–59 have a LTV equal to 1, 37% have and LTV larger than 1 and the average LTV is 0.88, while in Austria the LTV mean is 0.58 and only 7% of households have an LTV larger than 1. In almost all countries, young households have larger average LTV than old households.

Table 3 shows how net worth varies according to the presence and age of the mortgage and their LTV (among young households). Unsurprisingly, the current wealth of households with older mortgages is generally higher

report average estimates, as prescribed, e.g., in Reiter (2003).

[3]The LTV values that are unlikely to be realistic (larger than 2) were recoded as missing (in few cases, they were larger than 2)

than that of households with younger mortgages. This reflects both an age effect (young mortgages are generally held by younger households among our group of 'young' households) and the fact that a larger share of the mortgage has been repaid for older mortgages so household liabilities are generally lower and net worth correspondingly higher. Households with low LTV (conditionally on the age of the mortgage) generally have higher net worth. This holds for houses acquired up to 5 years ago (that is, after approximately 2005), but also for houses acquired more than 10 years ago (before, approximately, 2000). For mortgages contracted between 2000 and 2005 approximately, the relationship is much less clear.

INSERT TABLE 3 HERE

The association between the LTV on a mortgage contracted in the past and current net worth can arise from various causes. A low LTV ratio on a mortgage may be explained by credit constraints to the households—itself either imposed by regulatory policies, or by discretionary risk assessments of the banks. This is the context considered in our theoretical model and is likely to be more realistic for relatively 'poor' households (at the time the loan is taken) who are not able to offer enough collateral guarantees, and in countries with stronger macroprudential regulations. But a low LTV ratio may also reflect household preferences, in which case the decision to borrow less than the value of the asset is not constrained and the LTV ratio does not reflect credit constraints. This is more likely to happen for relatively 'rich' households that are able to bring in large downpayments and prefer to reduce interest rate payments on mortgages. This is also likely to happen when interest rates are high at the time the loan is taken. We therefore expect the income and wealth position of households *at the time of taking the loan* to be an important determinant of the observed LTV, and this association also contributes to the association that we observe between *current* wealth and LTV.

Unfortunately the HFCS data do not contain information about past wealth and incomes that we can use as a control in our regressions. One should therefore not interpret the relationship between LTV and current wealth that we illustrate as a causal effect of past credit constraints too naively. To mitigate this problem, our regression analysis includes variables that attempt to absorb some of the variations in past wealth positions, such as human capital, in addition to other variables such as age, sex, household gross income, and its square, and dummies of year periods of the acquisition of the household main residence.

Other variables entering the theoretical model are the interest rate, the bequest motive and house price variations. These can also be assessed empirically in the HFCS. We measure the financial cost of the loan (similar to r in the theoretical model) by the percentage of the principal that must be paid at the end of the mortgage. Construction of this variable combines information on annual interest rates, principal and duration of the mortgage.[4] However, some households in Belgium, Cyprus, Italy, the Netherlands, Portugal and Slovakia present missing information on interest rates. This is mostly problematic in Italy and Portugal, where 47% and 34% of households with LTV information do not have information on interest rates. Econometric results employing the financial cost of the loan in those countries must be taken with caution.

The strength of the bequest motive is more difficult to capture. As an indicator of the motives of the old generations, we create for young households a dummy variable indicating whether the household has received a substantial gift or inheritance or expects to receive it in the future. Note that Spanish households do not have information on bequest expectations, while Italian households lack information on both received and expected bequests. Therefore, the role of bequest is not analysed in Italy, while the econometric results for Spain are not perfectly comparable with other countries.

Finally, house price variations are computed as the average yearly variation between the value of acquisition of the HMR and the current value reported by the household.

4.2. LTV and inequality: Gini recentered influence function regressions

Descriptive statistics suggest that low LTV are associated with high net worth, even conditionally on the age of the mortgage. To examine the implications of this observation for wealth inequality, we explore "Gini recentered influence function" (Gini-RIF) regressions (Firpo et al., 2009, Choe and Van Kerm, 2014).

Gini-RIF regressions consist of two stages. First, we calculate the "influence" on the net wealth Gini coefficient of each household in our samples as a function of their net wealth and of the distribution of net wealth in their country—this is the influence function calculation (Hampel, 1974). Intuitively, households in the tails of the distribution of net wealth have positive

[4]The interest rate of the mortgage corresponds to the current interest rate on the loan reported by the individual, which is either the current fixed interest rate or the current adjustable interest rate resulting from the most recent rate fixation

influence on inequality—all else equal, more of them will tend to increase the Gini coefficient—whereas households in the middle of the distribution will have negative influence—more of them will tend to reduce the Gini coefficient. Second, we regress households' "influence" on the Gini on various household characteristics in order to see what are the important drivers of households contributions to inequality. Formally, the regression coefficients tell us how the Gini coefficient would respond to an infinitesimal shift in the distribution of a regressor, holding the distribution of other covariates constant (Firpo et al., 2009).

By including LTV as a regressor (along with other covariates), we can assess whether the LTV of household's mortgages is associated to their present contribution to inequality. A positive coefficient for LTV would indicate that higher LTV tends to increase (future) net wealth inequality: that is, households that can finance the acquisition of their main residence through larger borrowing—notably, because of easier access to credit—tend to have (future) net wealth levels in the segments of the net wealth distribution that have positive influence on the Gini coefficient.

The key limitation discussed above remain however: one should interpret this association carefully as it does not necessarily represent a causal effect of credit constraints on future net worth, but also captures heterogeneity in household preferences and initial wealth positions. Also, remember this approach only examines the role of LTV at the 'intensive margin'. Tight access to credit can also lead to mortgages not being granted altogether and this is not captured by the regressions.

More formally, let $\nu(F)$ be the inequality functional of interest calculated over the distribution F of a random variable y (here the net worth distribution among 'young households'). Our functional of interest is the Gini index. The influence function of ν is a function of y and F and is defined as:

$$\mathrm{IF}(y;\nu,F) = \lim_{\epsilon \to 0} \frac{\nu((1-\epsilon)F + \epsilon\Delta_y) - \nu(F)}{\epsilon} \tag{19}$$

The IF captures the effect on $\nu(F)$ of an infinitesimal 'contamination' of F at point mass y. Expressions for $\mathrm{IF}(y;\nu,F)$ can be derived using differential calculus and have been published for a wide range of statistics; see, for example, Essama-Nssah and Lambert (2012) for a catalogue of IFs relevant to income distribution analysis. The IF for the Gini coefficient is given, for example, in Cowell and Flachaire (2007). To fix ideas, Figure 2 shows the influence function for the Gini coefficient of Germany estimated

in our HFCS data. The figure is a plot of $\hat{\text{IF}}(y_i; \nu, \hat{F})$ against net worth y_i for each household in the sample.

Households with net worth below 41,300 euros or above 1'132,750 euros tend to influence inequality positively: if the number of households with such net worth were to increase infinitesimally, the Gini coefficient would increase. Conversely households with net worth between those values tend to decrease the Gini with the maximum reduction achieved for households with the average net worth. The illustration is for Germany but the shape of the function is similar across countries—although thresholds and curvature varies with the underlying distribution of net worth.

Figure 2, apart from showing the IF estimated for all households, shows the IF of three distinctive groups of households: home owners with active mortgages, home owners without active mortgages (the house is fully owned) and non home owners. In general, households owning a house without active mortgages are the richest, followed by owners with active mortgages and then households that are non-owners. This translates in non-owners having the largest influence on overall wealth inequality. For example, in Germany, the IF mean is 0.88 for non-owners, 0.70 for home owners without active mortgages and 0.57 for the owners with active mortgages. This shows that contributions to inequality are not simply picking which households are richest.

INSERT FIGURE 2 HERE

RIF regression consists in regressing $\hat{\text{RIF}}(y_i; \nu, \hat{F}) = \hat{\text{IF}}(y_i; \nu, \hat{F}) - \nu(\hat{F})$ on LTV and a set of additional controls. Note that regression analysis is focused on investigating the effects of LTV on wealth inequality only among households for whom the LTV exists, i.e. the group of households with active mortgages.

The relationship between the regression coefficients and Gini coefficient relies on a linear approximation and the magnitude of the coefficient is to be interpreted for marginal changes in the LTV from the observed situation. To help interpretation, we also report regression coefficients divided by 100 and expressed as a fraction of the Gini coefficient so that the magnitude obtained is an approximation of the percentage change in the Gini for a one percentage point increase in LTV (holding other regressors constant).

4.3. Results

Tables 4 to 7 show our Gini RIF regression results. The model specifications always include as regressors LTV ratio and a set of control variables

(sex, age, education, gross income and its square and period of HMR acquisition). Alternative specifications add, one by one, other covariates drawn from the theoretical discussion. Control variables are included because the access to a mortgage and its conditions can be determined by the age and socio-economic status of households. We only report the coefficients on LTV ratios and other covariates related to credit and housing conditions. The complete econometric results of the control variables are available upon request.

Table 4 shows that LTV has a positive contribution to wealth inequality in all 12 countries. The sign of the effect is consistent across countries, although it is not statistically significant in the Netherlands, Portugal and Austria. The greater the LTV on a household's mortgage, the greater is the household's contribution to inequality of current net wealth. Regressions allowing the effect of LTV to vary by net worth position—distinguishing households with net worth above the median and below the median—reveal that much of this positive effect is driven by the relationship at the bottom of the distribution (results are not reported but available on request). The sign of the relationship at the top of the distribution differs across countries and is only large and significant in Germany (a positive relationship) and in Portugal (a negative relationship). So, we find a positive relationship between LTV and wealth inequality in all countries which mostly reflect the fact that households with higher LTV end up in the lower segments of the wealth distribution where they tend to push inequality upwards. There is therefore no obvious indication from these descriptive regressions that promoting larger LTV would help reducing wealth inequality. This situation is similar to observing increases in LTV within the light shaded areas in the plots of Figure 1.

We also observe that the magnitude of estimated coefficients on LTV tends to be larger in countries with a lower number of households with HMR mortgages (e.g., in Greece, Italy and Slovakia). The correlation between the LTV coefficients and the share of households with mortgages across the twelve countries is –0.47. It is interesting to note that the LTV has a larger influence on wealth inequality in countries where mortgages are more scarce. This suggests that a policy seeking to restrict the housing credit, i.e., through lower LTV caps, may also reduce wealth inequality more significantly in countries with a more limited mortgages market.

INSERT TABLE 4 HERE

The model specification of Table 5 adds the financial cost of the mortgage. Eight countries keep a positive and significant effect of LTV on wealth

inequality. There is no clear result for the effect of financial cost as this is only statistically significant in four countries. The effect is positive in Germany, Portugal and Italy and negative in the Netherlands.[5] For the cases where LTV and mortgage cost are statistically significant (Germany and Italy), their coefficients are both positive, i.e. these countries are located in the light shaded area of Figure 1(a).

The bequest motive is added in the specification of Table 6. LTV is still significant and positive in eight countries over eleven (Italy does not have information on bequest motives). The bequest motive has a negative effect on wealth inequality in Germany, Luxembourg, Malta and Portugal, but a positive effect in Spain. A negative effect of bequests on wealth inequality can indicate that the households located in lower and middle sections of the wealth distribution benefit relatively more from these transfers than richer households.

INSERT TABLES 5 AND 6 HERE

The price variation of the HMR is added in the model specification in Table 7. As before, the coefficient of LTV is always positive and this time it is statistically significant in ten of twelve countries. So, LTV is never significant in any of the specifications for the Netherlands and Portugal, the two countries with the largest LTVs in our samples (see Table 1). The effect of price variation, when significant, is always negative. This occurs in seven countries. This suggests that house price increases mostly benefited households in the middle of the distribution.

INSERT TABLE 7 HERE

We reiterated estimation using net housing wealth (HMR value minus mortgage debt) instead of net worth and have not observed changes in the directions of the effects. The effects of LTV and housing price variation are only more precisely estimated. We also estimated models using dummies for LTVs set at $[0.6-0.8]$, $[0.8-0.98]$, $[0.98-1.02]$ and > 1.02 in order to allow for potential non-linearities. Results are in Tables 8 to 11. Coefficients of the dummies for LTV ranges increase with the value of LTV, although not all the dummy coefficients are significant. The largest impacts are obtained for the largest LTV ranges (above 1). Households with loans larger than the value of the asset appear to contribute most to wealth inequality.

[5] We also used annual interest rate instead of the financial cost, but the results are even less precisely estimated.

INSERT TABLES 8 TO 11 HERE

5. Concluding remarks

This paper present a simple model that highlights the main trade-offs and links between the credit market, housing market and household wealth inequality. In particular, we focus on the effects of LTV caps on wealth inequality as this is one of the relevant tools at disposal for macroprudential policy. It is generally acknowledged that LTV caps are able to reduce the supply of mortgages and prompt a better selection of household risk profiles by the banks. In the end, it is an important aim to keep prudent levels of household indebtedness and reduce the risk of crisis. However, policy makers should be aware that these credit regulations also have effects on the accumulation of wealth by households and on its distribution. Some policy makers in Ireland, Finland or Cyprus have recently imposed LTV regimes with caps depending on the household status (first-time buyer or not; value of the house).

There is no unequivocal effect of LTV ratios on household wealth inequality in the model, but we illustrate possible trade-offs between LTV ratios, loan financial costs, housing prices and bequests. We illustrate this first by simulations of our theoretical model, and then with household survey data drawn from HFCS. We employ Gini-RIF regressions to explore the effects of those variables on wealth inequality.

Results show that, in the sample of households with active mortgages, households with higher LTV ratios (at the time of acquisition of the property) tend to contribute positively to wealth inequality (at present time), that is, they are in the tails of the wealth distribution—especially the lower tail. This suggests that easier credit and higher LTV is unlikely to reduce wealth inequality. On the contrary, house price increases and gifts and inheritances tend to contribute negatively to inequality—they appear to benefit mostly households in the middle of the distribution. Credit costs do not show a significant role on the distribution of wealth.

Our analysis exposes promising directions for research that incorporates insights from the income distribution literature into the analysis of macroprudential policy, but we cannot emphasize too much that our results are exploratory by nature. With cross-section data and no means to capture exogenous variation in LTV ratios in the countries and time period covered by our data, any causal interpretation is clearly hazardous. It will be interesting to re-examine the effects of macroprudential policy on inequality as

additional waves of HFCS data become available and cover a period which witnessed policy changes over time.

References

Abel, A. and Warshawsky, M. (1988). Specification of the joy of giving: Insights from altruism. *The Review of Economics and Statistics*, 70(1):145–149.

Aiyar, S., Calomiris, C. W., and Wieladek, T. (2012). Does macropru leak? Evidence from a UK policy experiment. Bank of England working papers 445, Bank of England.

Ampudia, M., van Vlokhoven, H., and Zochowski, D. (2014). Financial fragility of euro area households. Working Paper Series 1737, European Central Bank.

Arregui, N., Benes, J., Krznar, I., Mitra, S., and Santos, A. O. (2013). Evaluating the Net Benefits of Macroprudential Policy; A Cookbook. IMF Working Papers 13/167, International Monetary Fund.

Avouyi-Dovi, S., Labonne, C., and Lecat, R. (2014). The housing market: the impact of macroprudential measures in France. *Financial Stability Review*, (18):195–206.

Behn, M., Gross, M., and Peltonen, T. (2016). Assessing the costs and benefits of capital-based macroprudential policy. Working Paper Series 1935, European Central Bank.

Berger, A. N. and Bouwman, C. H. (2013). How does capital affect bank performance during financial crises? *Journal of Financial Economics*, 109(1):146–176.

Bourguignon, F. (1979). Decomposable income inequality measures. *Econometrica*, 47:901–920.

Bover, O., Casado, J. M., Costa, S., Caju, P. D., McCarthy, Y., Sierminska, E., Tzamourani, P., Villanueva, E., and Zavadil, T. (2016). The Distribution of Debt across Euro-Area Countries: The Role of Individual Characteristics, Institutions, and Credit Conditions. *International Journal of Central Banking*, 12(2):71–128.

Carlson, M., Shan, H., and Warusawitharana, M. (2013). Capital ratios and bank lending: A matched bank approach. *Journal of Financial Intermediation*, 22(4):663–687.

Cerutti, E. M., Claessens, S., and Laeven, L. (2016). The use and effectiveness of macroprudential policies: New evidence. *Journal of Financial Stability*, Forthcoming.

Choe, C. and Van Kerm, P. (2014). Foreign workers and the wage distribution: Where do they fit in? Technical Report 2014-02, Luxembourg Institute of Socio-Economic Research, Esch-sur-Alzette, Luxembourg.

Cigno, A., Pestieau, P., and Reesz, Z. (2011). Introduction to the symposium on taxation and the family. *CESifo Economic Studies*, 57(3):203–215.

Claessens, S. (2014). An Overview of Macroprudential Policy Tools. IMF Working Papers 14/214, International Monetary Fund.

Claessens, S., Ghosh, S. R., and Mihet, R. (2013). Macro-prudential policies to mitigate financial system vulnerabilities. *Journal of International Money and Finance*, 39(C):153–185.

Cowell, F. and Van Kerm, P. (2015). Wealth inequality: A survey. *Journal of Economic Surveys*, 29(4):671–710.

Cowell, F. A. (1980). On the structure of additive inequality measures. *Review of Economic Studies*, 47:521–531.

Cowell, F. A. and Flachaire, E. (2007). Income distribution and inequality measurement: The problem of extreme values. *Journal of Econometrics*, 141:1044–1072.

Craig, R. S. and Hua, C. (2011). Determinants of Property Prices in Hong Kong SAR: Implications for Policy. IMF Working Papers 11/277, International Monetary Fund.

Cremer, H. and Pestieau, P. (2011). The tax treatment of intergenerational wealth transfers. *CESifo Economic Studies*, 57(2):365–401.

Deaton, A. and Laroque, G. (2001). Housing, Land Prices, and Growth. *Journal of Economic Growth*, 6(2):87–105.

Dietsch, M. and Welter-Nicol, C. (2014). Do LTV and DSTI caps make banks more resilient? Débats économiques et financiers, Banque de France.

Essama-Nssah, B. and Lambert, P. (2012). Influence functions for policy impact analysis. *Research on Economic Inequality*, 20(6):135–159.

European Central Bank (2014). Household finance and consumption survey. Statistical micro-level database, European Central Bank, Frankfurt am Main, Germany.

Firpo, S., Fortin, N., and Lemieux, T. (2009). Unconditional quantile regressions. *Econometrica*, 77(3):953–973.

Galbraith, J. K. (2012). *Inequality and Instability: A Study of the World Economy Just Before the Great Crisis*. Oxford University Press.

Gary-Bobo, R. J. and Nur, J. (2015). Housing, Capital Taxation and Bequests in a Simple OLG Model. CEPR Discussion Papers 10774, C.E.P.R. Discussion Papers.

Gross, M. and Poblacion Garcia, F. J. (2016). Assessing the efficacy of borrower-based macroprudential policy using an integrated micro-macro model for European households. Working Paper Series 1881, European Central Bank.

Hampel, F. (1974). The influence curve and its role in robust estimation. *Journal of the American Statistical Association*, 69(346):383–393.

Igan, D. and Kang, H. (2011). Do Loan-To-Value and Debt-To-Income Limits Work? Evidence From Korea. IMF Working Papers 11/297, International Monetary Fund.

Jimenez, G., Ongena, S., Peydro, J.-L., and Saurina, J. (2013). Macroprudential policy, countercyclical bank capital buffers and credit supply: Evidence from the Spanish dynamic provisioning experiments. Economics Working Papers 1315, Department of Economics and Business, Universitat Pompeu Fabra.

Kelly, R., McCann, F., and O'Toole, C. (2015). Credit conditions, macroprudential policy and house prices. Research Technical Papers 06/RT/15, Central Bank of Ireland.

Kopczuk, W. (2013). In Auerbach A., Chetty R., F. M. S. E., editor, *Handbook of Public Economics*, chapter Taxation of intergenerational transfers and wealth, pages 329–390. Elsevier.

Kuttner, K. N. and Shim, I. (2013). Can non-interest rate policies stabilise housing markets? Evidence from a panel of 57 economies. BIS Working Papers 433, Bank for International Settlements.

Lim, C., Columba, F., Costa, A., Kongsamut, P., Otani, A., Saiyid, M., Wezel, T., and Wu, X. (2011). Macroprudential Policy: What Instruments and How to Use them? Lessons From Country Experiences. IMF Working Papers 11/238, International Monetary Fund.

McDonald, C. (2015). When is macroprudential policy effective? BIS Working Papers 496, Bank for International Settlements.

Perugini, C., Hölscher, J., and Collie, S. (2016). Inequality, credit and financial crises. *Cambridge Journal of Economics*, 40(1):227–257.

Pestieau, P. and Thibault, E. (2012). Love thy children or money - reflections on debt neutrality and estate taxation. *Economic Theory*, 20:31–57.

Reiter, J. P. (2003). Inference for partially synthetic, public use microdata sets. *Survey Methodology*, 29:181–188.

Shorrocks, A. F. (1980). The Class of Additively Decomposable Inequality Measures. *Econometrica*, 48(3):613–625.

Stiglitz, J. E. (2015). New Theoretical Perspectives on the Distribution of Income and Wealth among Individuals: Part IV: Land and Credit. NBER Working Papers 21192, National Bureau of Economic Research, Inc.

Tressel, T. and Zhang, Y. S. (2016). Effectiveness and channels of macroprudential instruments; lessons from the euro area. IMF Working Papers 16/4, International Monetary Fund.

Vandenbussche, J., Vogel, U., and Detragiache, E. (2012). Macroprudential Policies and Housing Price: A New Database and Empirical Evidence for Central, Eastern, and Southeastern Europe. IMF Working Papers 12/303, International Monetary Fund.

Verbruggen, J., van der Molen, R., Jonk, S., Kakes, J., and Heeringa, W. (2015). Effects of further reductions in the LTV limit. DNB Occasional Studies 1302, Netherlands Central Bank, Research Department.

Tables and Figures

Table 1: **Household net worth distribution and mean and median LTV (households aged 25–59)**

		Household net worth								LTV		
Country	N	mean	median	P10/P50	P25/P50	P75/P50	P90/P50	M2MR	Gini	HSCV2	mean	median
Austria	1,447	292,298	76,410	0.01	0.14	3.71	8.03	3.83	0.77	4.46	0.58	0.56
Belgium	1,339	290,068	181,260	0.01	0.16	2.04	3.43	1.60	0.61	1.46	0.83	0.84
Cyprus	960	734,811	297,630	0.06	0.38	2.24	5.23	2.47	0.69	3.21	0.73	0.74
Germany	1,986	188,770	44,129	0.00	0.12	4.14	9.09	4.28	0.78	7.41	0.71	0.70
Spain	2,962	268,920	177,633	0.02	0.39	1.77	3.14	1.51	0.58	2.78	0.86	0.88
Greece	2,007	159,851	112,314	0.02	0.27	1.89	3.29	1.42	0.56	0.79	0.81	0.85
Italy	4,050	247,970	162,000	0.02	0.14	1.89	3.33	1.53	0.62	1.46	0.75	0.76
Luxembourg	667	580,147	279,795	0.01	0.13	2.11	4.10	2.07	0.70	4.22	0.78	0.78
Malta	472	403,339	225,175	0.10	0.48	1.72	2.90	1.79	0.61	7.87	0.70	0.73
Netherlands	698	138,732	85,937	-0.14	0.12	2.51	4.27	1.61	0.69	1.00	0.88	1.00
Portugal	2,317	134,225	74,176	0.01	0.21	2.14	3.79	1.81	0.64	2.23	0.84	0.96
Slovakia	1,571	83,030	62,528	0.19	0.61	1.64	2.62	1.33	0.46	0.57	0.77	0.75

M2MR stands for mean-to median ratio. HSCV2 stands for half the squared coefficient of variation. LTV statistics are for households with active mortgage only.

Table 2: **Household net worth distribution and mean and median LTV (households aged 60–84)**

		Household net worth								LTV		
Country	N	mean	median	P10/P50	P25/P50	P75/P50	P90/P50	M2MR	Gini	HSCV2	mean	median
Austria	768	251,252	109,857	0.03	0.15	2.26	4.63	2.29	0.70	3.52	0.45	0.36
Belgium	844	461,294	288,978	0.04	0.52	1.89	3.37	1.60	0.56	1.01	0.70	0.70
Cyprus	251	592,038	227,295	0.02	0.28	2.52	6.39	2.60	0.69	1.93	0.45	0.48
Germany	1,376	224,677	97,679	0.03	0.15	2.68	5.07	2.30	0.69	3.23	0.63	0.65
Spain	2,971	337,805	200,286	0.15	0.52	1.88	3.49	1.69	0.56	3.20	0.82	0.83
Greece	734	136,741	90,957	0.11	0.55	1.82	3.10	1.50	0.52	0.70	0.66	0.63
Italy	3,532	327,508	204,000	0.04	0.38	1.79	3.17	1.61	0.59	2.03	0.69	0.60
Luxembourg	256	1,051,089	633,503	0.15	0.64	1.75	2.98	1.66	0.54	2.13	0.98	0.92
Malta	352	303,966	190,923	0.06	0.36	2.03	3.82	1.59	0.56	0.77	0.29	0.29
Netherlands	592	242,256	179,090	0.03	0.20	1.96	3.04	1.35	0.55	0.71	0.72	0.78
Portugal	1,900	186,233	80,921	0.02	0.36	2.14	4.25	2.30	0.69	10.44	0.78	0.93
Slovakia	340	75,742	58,632	0.38	0.63	1.52	2.33	1.29	0.40	0.49	0.53	0.22

M2MR stands for mean-to median ratio. HSCV2 stands for half the squared coefficient of variation. LTV statistics are for households with active mortgage only.

Table 3: **Net wealth of different adult household groups (25–59 years old) (divided by median wealth in each country)**

	No house owner	House owner without active mortgage	house acquired up to 5 years ago				house acquired $5-10$ years ago				house acquired >10 years ago			
LTV:			<0.75	0.75-1.0	>1.0	Total	<0.75	0.75-1.0	>1.0	Total	<0.75	0.75-1.0	>1.0	Total
Austria	0.91	7.48	4.29	0.63	1.06	3.49	6.75	3.63	5.35	5.96	7.81	3.51	1.95	6.42
Belgium	0.35	2.89	1.77	1.07	1.09	1.33	1.80	1.68	1.66	1.72	2.83	1.97	1.51	2.23
Cyprus	0.71	3.72	1.96	0.94	0.90	1.50	2.22	1.63	0.69	1.84	6.13	4.89	1.05	5.17
Germany	1.02	13.42	6.47	2.48	1.16	4.53	4.88	3.02	3.01	4.02	4.59	4.22	4.42	4.47
Spain	0.42	2.15	1.68	0.80	0.35	0.98	2.30	1.27	0.63	1.41	2.29	1.36	1.13	1.65
Greece	0.36	2.09	1.20	0.96	0.36	0.99	1.23	1.02	2.60	1.24	2.18	1.85	1.05	1.84
Italy	0.27	2.36	2.40	1.06	0.20	1.60	2.19	0.84	0.69	1.50	2.91	1.28	0.88	2.03
Luxembourg	0.47	5.31	2.15	1.51	0.59	1.57	2.54	2.17	0.78	2.21	2.25	2.33	1.09	2.23
Malta	0.30	1.81	1.31	0.68	0.47	1.08	1.26	1.02	0.00	1.15	1.24	1.23	0.49	1.15
Netherlands	0.51	4.47	1.00	0.47	0.94	0.84	2.46	1.50	0.63	1.49	4.08	2.85	1.58	2.91
Portugal	0.46	2.84	2.98	1.00	0.97	1.56	2.92	1.49	0.89	1.95	4.05	1.60	1.42	2.22
Slovakia	0.20	1.49	1.00	0.62	0.47	0.78	1.91	0.92	1.89	1.58	3.11	1.07	0.88	1.68

Table 4: **Gini RIF regression coefficients on LTV ratio for net worth inequality among households aged 25–59**

Country	LTV			Gini	(Coef/100)/Gini %
	Coef	s.e.	n		
Austria	0.125	(0.087)	164	0.771	0.16%
Belgium	0.183***	(0.07)	404	0.613	0.30%
Cyprus	0.128**	(0.065)	245	0.691	0.19%
Germany	0.24***	(0.077)	342	0.779	0.31%
Spain	0.197***	(0.073)	756	0.578	0.34%
Greece	0.32***	(0.068)	254	0.559	0.57%
Italy	0.3***	(0.062)	351	0.617	0.49%
Luxembourg	0.232***	(0.069)	235	0.697	0.33%
Malta	0.222***	(0.079)	62	0.615	0.36%
Netherlands	0.145	(0.264)	210	0.691	0.21%
Portugal	0.013	(0.121)	644	0.642	0.02%
Slovakia	0.227**	(0.097)	128	0.457	0.50%

*sig. at 10%, **sig. at 5%, ***sig. at 1%. Robust standard errors are in parenthesis. Each row contains the coefficient of OLS regressions performed on household Recentered Influence Function (IF) for each country. The RIF of each household was computed, in a first stage, as the influence of the household net wealth on the Gini index of net wealth in the country. Other covariates included in the regressions are sex, age and education level of the reference person in the household, household gross income and its square, dummies of year periods for the acquisition of the household main residence.

Table 5: **Gini RIF regression coefficients on LTV ratio and mortgage cost for net worth inequality among households aged 25–59**

Country	LTV ratio			Mortgage cost		Gini	(Coef/100)/Gini %
	Coef	s.e.	n	Coef	s.e.		
Austria	0.109	(0.097)	155	-0.029	(0.081)	0.771	0.14%
Belgium	0.211***	(0.063)	324	0.093	(0.084)	0.613	0.34%
Cyprus	0.093	(0.069)	186	-0.019	(0.069)	0.691	0.13%
Germany	0.222***	(0.077)	321	0.167*	(0.088)	0.779	0.29%
Spain	0.179**	(0.081)	751	0.069	(0.059)	0.578	0.31%
Greece	0.337***	(0.068)	250	-0.024	(0.039)	0.559	0.60%
Italy	0.218***	(0.081)	184	0.173**	(0.074)	0.617	0.35%
Luxembourg	0.214***	(0.064)	234	0.097	(0.112)	0.697	0.31%
Malta	0.223***	(0.08)	62	0.014	(0.066)	0.615	0.36%
Netherlands	-0.08	(0.253)	175	-0.462*	(0.249)	0.691	-0.12%
Portugal	0.106	(0.144)	425	0.1***	(0.03)	0.642	0.17%
Slovakia	0.253**	(0.107)	107	-0.011	(0.062)	0.457	0.55%

*sig. at 10%, **sig. at 5%, ***sig. at 1%. Robust standard errors are in parenthesis. Each row contains the coefficient of OLS regressions performed on household Recentered Influence Function (IF) for each country. The RIF of each household was computed, in a first stage, as the influence of the household net wealth on the Gini index of net wealth in the country. Other covariates included in the regressions are sex, age and education level of the reference person in the household, household gross income and its square, dummies of year periods for the acquisition of the household main residence.

Table 6: **Gini RIF regression coefficients on LTV ratio and bequest for net worth inequality among households aged 25–59**

Country	LTV ratio			Bequest		Gini	(Coef/100)/Gini %
	Coef	s.e.	n	Coef	s.e.		
Austria	0.128	(0.085)	164	0.04	(0.097)	0.771	0.17%
Belgium	0.193***	(0.074)	404	0.036	(0.037)	0.613	0.31%
Cyprus	0.112*	(0.065)	245	-0.054	(0.037)	0.691	0.16%
Germany	0.187**	(0.079)	342	-0.13***	(0.039)	0.779	0.24%
Spain	0.198***	(0.072)	756	0.134*	(0.071)	0.578	0.34%
Greece	0.321***	(0.068)	254	0.084	(0.071)	0.559	0.57%
Italy						0.617	0.00%
Luxembourg	0.216***	(0.072)	235	-0.063*	(0.038)	0.697	0.31%
Malta	0.215***	(0.076)	62	-0.075**	(0.037)	0.615	0.35%
Netherlands	0.118	(0.269)	210	-0.189	(0.128)	0.691	0.17%
Portugal	-0.04	(0.136)	644	-0.122**	(0.056)	0.642	-0.06%
Slovakia	0.228**	(0.097)	128	0.005	(0.066)	0.457	0.50%

*sig. at 10%, **sig. at 5%, ***sig. at 1%. Robust standard errors are in parenthesis. Each row contains the coefficient of OLS regressions performed on household Recentered Influence Function (IF) for each country. The RIF of each household was computed, in a first stage, as the influence of the household net wealth on the Gini index of net wealth in the country. Other covariates included in the regressions are sex, age and education level of the reference person in the household, household gross income and its square, dummies of year periods for the acquisition of the household main residence.

Table 7: **Gini RIF regression coefficients on LTV ratio and house price variation for net worth inequality among households aged 25–59**

Country	LTV ratio			House price Δ		Gini	(Coef/100)/gini %
	Coef	s.e.	n	Coef	s.e.		
Austria	0.141*	(0.085)	164	-0.16	(0.19)	0.771	0.18%
Belgium	0.19***	(0.07)	404	-0.228*	(0.132)	0.613	0.31%
Cyprus	0.154**	(0.061)	245	-0.501***	(0.174)	0.691	0.22%
Germany	0.279***	(0.078)	342	-0.732***	(0.227)	0.779	0.36%
Spain	0.218***	(0.075)	756	-0.855**	(0.34)	0.578	0.38%
Greece	0.344***	(0.067)	254	-0.989***	(0.271)	0.559	0.62%
Italy	0.307***	(0.06)	351	-0.206	(0.205)	0.617	0.50%
Luxembourg	0.221**	(0.087)	235	0.248	(0.689)	0.697	0.32%
Malta	0.272***	(0.084)	62	-1.214***	(0.339)	0.615	0.44%
Netherlands	0.165	(0.271)	210	-1.061	(1.371)	0.691	0.24%
Portugal	0.024	(0.121)	644	-1.338***	(0.435)	0.642	0.04%
Slovakia	0.248**	(0.108)	128	-0.158	(0.297)	0.457	0.54%

*sig. at 10%, **sig. at 5%, ***sig. at 1%. Robust standard errors are in parenthesis. Each row contains the coefficient of OLS regressions performed on household Recentered Influence Function (IF) for each country. The RIF of each household was computed, in a first stage, as the influence of the household net wealth on the Gini index of net wealth in the country. Other covariates included in the regressions are sex, age and education level of the reference person in the household, household gross income and its square, dummies of year periods for the acquisition of the household main residence.

Table 8: **Gini RIF regression coefficients on ranges of LTV ratios for net worth inequality among households aged 25–59**

	LTV [0.6,0.8[	LTV [0.8,0.98[	LTV [0.98,1.02[	LTV >= 1.02
	coeff	coeff	coeff	coeff
Austria	0.027	0.08	0.056	0.045
Belgium	0.053	0.09	0.147**	0.181***
Cyprus	0.103**	0.086*	0.09	0.081
Germany	0.089*	0.111**	0.208**	0.198***
Spain	0.007	-0.023	0.098	0.185***
Greece	0.077*	0.156***	0.183***	0.286***
Italy	-0.027	0.14***	0.205***	0.289***
Luxembourg	0.019	0.092	0.081	0.189***
Malta	0.078	0.091	0.066	0.254***
Netherlands	0.335	0.028	0.074	0.233
Portugal	-0.134	-0.13	-0.04	0.092
Slovakia	0.099	0.151**	0.287***	0.275***

*sig. at 10%, **sig. at 5%, ***sig. at 1%. Robust standard errors are in parenthesis. Each row contains the coefficient of OLS regressions performed on household Recentered Influence Function (IF) for each country. The RIF of each household was computed, in a first stage, as the influence of the household net wealth on the Gini index of net wealth in the country. The reference variable for the LTV dummies is a dummy variable taking value 1 if LTV < 0.6, and 0 otherwise. Other covariates included in the regressions are sex, age and education level of the reference person in the household, household gross income and its square, dummies of year periods for the acquisition of the household main residence.

Table 9: **Gini RIF regression coefficients on ranges of LTV ratios and mortgage cost for net worth inequality among households aged 25–59**

	LTV [0.6,0.8[	LTV [0.8,0.98[	LTV [0.98,1.02[	LTV >= 1.02	financial cost
	coeff	coeff	coeff	coeff	coeff
Austria	0.022	0.074	0.059	0.033	-0.03
Belgium	0.1	0.113**	0.211**	0.184***	0.083
Cyprus	0.084	0.087	0.079	0.048	-0.019
Germany	0.096*	0.092*	0.188**	0.193***	0.161*
Spain	0.014	-0.021	0.098	0.181***	0.06
Greece	0.088**	0.159***	0.191***	0.343***	-0.026
Italy	-0.028	0.088	0.151**	0.249***	0.163**
Luxembourg	0.017	0.073	0.074	0.176***	0.087
Malta	0.087	0.095	0.044	0.279***	0.077
Netherlands	0.372	-0.002	0.089	0.071	-0.471*
Portugal	-0.101	-0.102	-0.014	0.089	0.101***
Slovakia	0.069	0.193**	0.305***	0.308***	-0.001

*sig. at 10%, **sig. at 5%, ***sig. at 1%. Robust standard errors are in parenthesis. Each row contains the coefficient of OLS regressions performed on household Recentered Influence Function (IF) for each country. The RIF of each household was computed, in a first stage, as the influence of the household net wealth on the Gini index of net wealth in the country. The reference variable for the LTV dummies is a dummy variable taking value 1 if LTV < 0.6, and 0 otherwise. Other covariates included in the regressions are sex, age and education level of the reference person in the household, household gross income and its square, dummies of year periods for the acquisition of the household main residence.

Table 10: **Gini RIF regression coefficients on ranges of LTV ratios and bequest for net worth inequality among households aged 25–59**

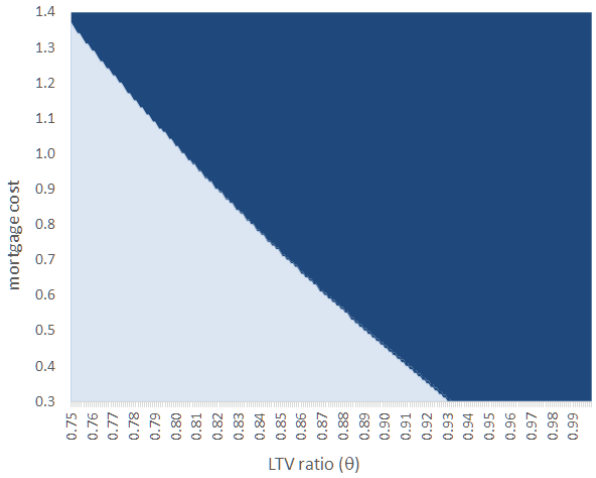
	LTV [0.6,0.8[	LTV [0.8,0.98[	LTV [0.98,1.02[	LTV >= 1.02	bequest motive
	coeff	coeff	coeff	coeff	coeff
Austria	0.025	0.084	0.06	0.054	0.042
Belgium	0.052	0.094	0.153**	0.188***	0.038
Cyprus	0.102**	0.081*	0.081	0.065	-0.061*
Germany	0.078*	0.085*	0.178**	0.159**	-0.131***
Spain	0.004	-0.012	0.11*	0.184***	0.137*
Greece	0.081*	0.159***	0.183***	0.292***	0.09
Italy					
Luxembourg	0.03	0.097	0.067	0.184***	-0.069*
Malta	0.088	0.079	0.093	0.228***	-0.067
Netherlands	0.33	0.026	0.06	0.221	-0.19
Portugal	-0.144	-0.139	-0.074	0.062	-0.116**
Slovakia	0.101	0.154**	0.291***	0.277***	0.016

*sig. at 10%, **sig. at 5%, ***sig. at 1%. Robust standard errors are in parenthesis. Each row contains the coefficient of OLS regressions performed on household Recentered Influence Function (IF) for each country. The RIF of each household was computed, in a first stage, as the influence of the household net wealth on the Gini index of net wealth in the country. The reference variable for the LTV dummies is a dummy variable taking value 1 if LTV < 0.6, and 0 otherwise. Other covariates included in the regressions are sex, age and education level of the reference person in the household, household gross income and its square, dummies of year periods for the acquisition of the household main residence.

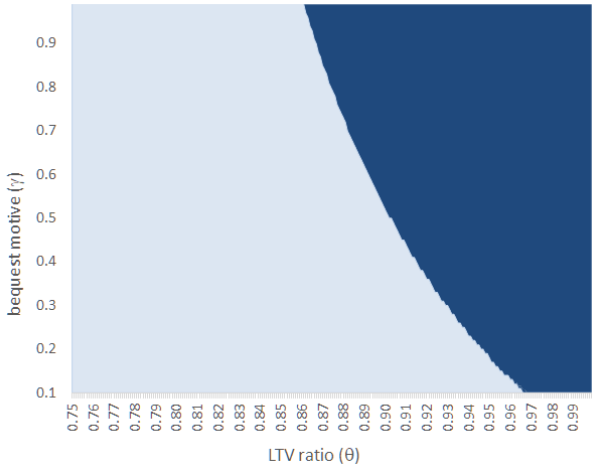
Table 11: **Gini RIF regression coefficients on ranges of LTV ratios and house price variation for net worth inequality among households aged 25–59**

	LTV [0.6,0.8[	LTV [0.8,0.98[	LTV [0.98,1.02[	LTV >= 1.02	price variation
	coeff	coeff	coeff	coeff	coeff
Austria	0.033	0.083	0.059	0.061	-0.124
Belgium	0.05	0.09	0.148**	0.186***	-0.228*
Cyprus	0.089*	0.091**	0.109	0.09	-0.456**
Germany	0.09*	0.133***	0.216***	0.241***	-0.731***
Spain	0.029	-0.008	0.102*	0.21***	-0.835**
Greece	0.093**	0.167***	0.194***	0.311***	-0.976***
Italy	-0.025	0.139***	0.207***	0.293***	-0.175
Luxembourg	0.017	0.088	0.077	0.179**	0.19
Malta	0.08	0.106*	0.096	0.311***	-1.274***
Netherlands	0.335	0.021	0.076	0.23	-0.982
Portugal	-0.138	-0.13	-0.038	0.087	-1.338***
Slovakia	0.093	0.153**	0.298***	0.303***	-0.208

*sig. at 10%, **sig. at 5%, ***sig. at 1%. Robust standard errors are in parenthesis. Each row contains the coefficient of OLS regressions performed on household Recentered Influence Function (IF) for each country. The RIF of each household was computed, in a first stage, as the influence of the household net wealth on the Gini index of net wealth in the country. The reference variable for the LTV dummies is a dummy variable taking value 1 if LTV < 0.6, and 0 otherwise. Other covariates included in the regressions are sex, age and education level of the reference person in the household, household gross income and its square, dummies of year periods for the acquisition of the household main residence.



(a) Effects on inequality by LTV ratio and mortgage cost. All the combinations of LTV ratios and mortgage falling on the darker (lighter) area indicate a negative (positive) effect of LTV ratio on inequality (with β=0.90; γ=0.90)



(b) Effects on inequality by LTV ratio and bequest motive. All the combinations of LTV ratios and the strength of the bequest motive falling on the darker (lighter) area indicate a negative (positive) effect of LTV ratio on inequality (with β=0.90; r=0.70)

Figure 1: Effects of LTV ratio changes (θ) on within inequality (I_w)

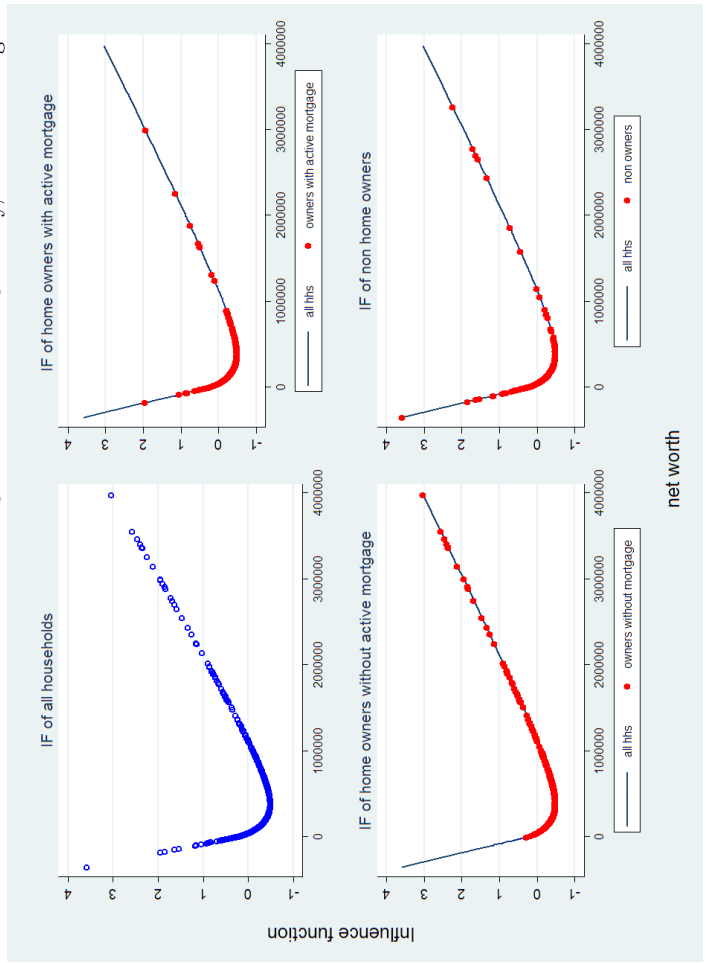


Figure 2: Influence function for the net worth Gini coefficient for Germany, households aged 25–59