Housing Affordability and Shared Equity Mortgages*

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Abstract

Academics have proposed hybrid products with equity features for the financing of housing. In spite of their risk-sharing benefits these products have not become mainstream. This paper studies an important exception, a UK government scheme which over the last four years has provided £6.72 billion of equity financing. The analysis of the origination and prepayment behaviour of households who have used the scheme highlights housing affordability constraints. A counterfactual study of homebuyers who instead of using the equity available relied on high loan to value mortgages shows that their behavior can be rationalized by a large expected rate of house price appreciation (of over 9% per year). The analysis contributes to the understanding of the roles of affordability and house price expectations in housing finance.

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1 Introduction

The financial risks that arise from a house purchase are amongst the largest that a typical household faces over the course of her lifetime. It often leads to a non-diversified portfolio tilted heavily towards property. Furthermore, the house purchase is commonly financed with a mortgage creating a levered position in real estate (Campbell and Cocco, 2003). The debt amplifies the effects of house price fluctuations on the net worth of households, making them more vulnerable to negative house price and income shocks. The risks arise at the household level, but often are correlated across households and have aggregate consequences, as evident during the Great Recession (Mian and Sufi, 2009; Mian et al., 2013; Corbae and Quintin, 2015; Guren and McQuade, 2016). In response regulators around the world have introduced or tightened macroprudential regulations on mortgages, introducing or lowering maximum loan-to-value and loan-to-income limits.

Academics, most notably Shiller (1994), have for a long time recognized the risks. They have studied and proposed alternative housing financing structures to mitigate them, including shared equity mortgages (SEMs), housing partnerships, and continuous workout mortgages (Caplin et al., 1997, 2007; Shiller, 2014; Greenwald et al., 2017).[1] Although the products differ in their specific features, the main idea is to make the payoffs to investors who provide financing contingent on future house values. The amount of straight debt needed and default probabilities are reduced, as house price risk is shared between households and investors.

In spite of their large potential benefits, these hybrid products, with debt and equity features, have not become mainstream. An important exception is the recent Help-to-Buy Equity Loan scheme introduced by the United Kingdom (UK) government on the 1 of April of 2013. We will describe the exact features of the scheme in section 2, but the Equity Loans (ELs) are essentially SEMs with the government (through one of its agencies) providing capital of up to 20% of the property purchase price in exchange for a share of its future value. From the

[1]The Great Recession has spurred the academic debate about the role of mortgage market characteristics for the transmission mechanism of monetary policy (Calza et al., 2013; Beraja et al., 2017; Di Maggio et al., 2017) and about optimal mortgage design (Cocco, 2013; Campbell, 2013; Miles, 2015; Campbell et al., 2018). Several recent papers have studied alternative mortgage products, such as option adjustable rate mortgages, fixed rate mortgages with underwater refinancing and convertible fixed rate mortgages (Piskorski and Tchistyi, 2010; Eberly and Krishnamurthy, 2014; Piskorski and Tchistyi, 2017; Guren et al., 2017).

scheme's inception until 31 June 2017 134,558 properties were bought using it. The total value of the equity provided by the UK government was £6.72 billion for the acquisition of properties with a total value of £32.37 billion.

In this paper we study the reasons behind the large demand for ELs.[2] The characterization of the borrowers who have used them show that they are disproportionately young, first-time buyers. Lenders use loan-to-value (LTV), loan-to-income (LTI) and payment-to-income (PTI) ratios as cut-off criteria above which they reject mortgage applications and for determining the maximum loan amount. We study the distribution of origination LTVs, LTIs, and PTIs to show that an overwhelming proportion of borrowers would not have, without the EL or a larger down payment, been able to borrow the mortgage amount needed to purchase their property. And interestingly, we show that these borrowers also take mortgages with longer maturities, which relaxes PTI constraints. Therefore, the large demand for ELs seems to be driven by affordability considerations.

An alternative to using the EL is to buy a less expensive house for which a smaller, more affordable mortgage loan is needed. However, such a house may not be adequate to the consumption needs of the household. To provide evidence on the margins of adjustment we exploit a change in the scheme that took place in February 2016, when the maximum EL contribution for the acquisition of properties in London increased from 20% to 40%. Borrowers still need a 5% down payment, but the larger EL means that they now need a smaller bank mortgage for the purchase of the same house. Alternatively, a larger EL may allow them to purchase a more expensive property and still satisfy affordability restrictions, which are calculated on the mortgage amount (excluding the EL). We use a difference in differences methodology to show that a large number of individuals took advantage of the higher scheme contribution to buy more expensive (and larger) properties.

The EL scheme only applies to new build properties with a maximum price of £ 600 thousand. We exploit this threshold using a regression discontinuity design to provide further causal evidence on the effects of the scheme. We show that those who buy properties just below the threshold are significantly younger, much more likely to be first buyers, and they use a sig-

[2] In a related paper Benetton et al. (2018) exploit another source of variation from the Help-to-Buy Equity Loan scheme to study the effect of down payment size on mortgage rates and decompose the role of house price risk vs idiosyncratic risk on lenders' pricing.

nificantly lower deposit than those who buy properties just above the threshold. We perform two placebos: purchase of old properties (for which the EL is not available) in the same years and purchase of new build properties in the years before the scheme was introduced. For the placebos age and household deposit increase and proportion of first time buyers decreases in a continuous manner with property price.

We study the repayment behavior of households who used ELs to provide further evidence of the role of affordability. Those who decide to repay their loans have experienced higher rates of house price appreciation and more importantly of income growth. The latter relaxes affordability constraints and increases the maximum mortgage loan amount. We show that these households increase their mortgage balance by an amount similar to the EL repayment due to the Government. They use the EL as a form of bridging finance until the affordability constraints are relaxed.

In spite of its success, a large number of individuals who could have made use of the EL scheme to buy their property did not do so. Instead, they financed the acquisition using a mortgage with higher LTV and interest rate. We use information on these borrowers to perform a counterfactual exercise, comparing their expected payoffs with and without the EL. These payoffs depend on both the interest rate they would have paid on the lower-LTV mortgage and the expected evolution of house prices. We use our data to calculate the former. We then calculate a break-even rate of house price appreciation that makes individuals indifferent between the two alternatives. This is the minimum rate of house price appreciation that a risk neutral individual, or one that ignores house price risk, requires to be better off without the EL.

Interestingly, we find that for a quarter of the individuals who did not make use of the scheme the average break-even rate of annual house price appreciation is as high as 9 percent. This value reflects not only the savings that borrowers make on their mortgage payments if they make use of the EL, but also the government subsidy of the scheme.[3] Our calculations show that these home buyers' choices can be rationalized by a high expected rate of house price appreciation among individuals who ignore the risk-sharing benefits of the scheme. When the

[3]In the first five years households are entitled to live in the house, but they do not have to pay the government for the implicit rent on the part of the house that they do not own.

latter are taken into account, an even higher rate of house price appreciation is needed.[4]

Due to the binding affordability constraints we cannot calculate such a break-even rate of house price appreciation for those individuals who have made use of the scheme. However, a high expected rate of house price appreciation is not inconsistent with their decision to use the EL and may in fact contribute positively towards it. Such expectations, together with insufficient financial assets to purchase their desired house using a standard bank mortgage, may push them to use the EL.

Our empirical analysis shows how affordability constraints and expectations regarding future house price gains affect household behavior and the potential demand for shared equity mortgages. The factors that are driving the demand for the loans in the U.K. are likely to be at work in many countries around the world. Large increases in house prices combined with slow growth in household incomes means that many first time buyers find it difficult to take the first step onto the property ladder. And the recent tightening of macro prudential regulations has made it more difficult and costly for households to obtain high loan-to-value and loan-to-income mortgages. The UK product is provided by the Government and it involves a subsidy. But the evidence that we provide can be helpful for the design of products that may be of interest to private providers such as pension funds who would like to gain exposure to residential real estate prices.

The paper is structured as follows. In Section 2 we describe the scheme and the data sources. In Section 3 we study the characteristics of those households who have taken the EL. In section 4 we focus instead on borrowers who could have made use of the EL to finance their property acquisition, but did not do so. The final section concludes.

[4] An alternative explanation is that those individuals who did not make use of the scheme were not aware of it. We think that this is implausible, at least for a large number of individuals, since the scheme only applies to newly built properties, and it is very widely advertised by property developers, in their marketing and sales efforts.

2 The scheme and data description

2.1 The scheme

The Help To Buy: Equity Loan scheme was launched in April 2013 by the UK Ministry for Housing, Communities and Local Government (MHCLG). Initially the government set a maximum budget for ELs of £3.7 billion, but in October 2017 it pledged a further £10 billion and promised to continue the scheme until at least 2021.

Under the scheme, the government provides home buyers with funds, the equity loan (EL) of up to 20% of the house acquisition price (up to 40% in London from February 2016 onwards). Borrowers may choose the EL fraction, but 20% is the most common value so that we use it in our description of the scheme. Home buyers need a down payment of at least 5%. This means that at the time of the house purchase households with the minimum down payment and making full use of the EL (20%) need to obtain a mortgage for the remainder 75%. In the left-hand part of Figure 1 we illustrate such a financing structure for the acquisition of a property worth £200 thousand.[5] The right-hand part of the same figure compares the EL financing structure to one financed solely with bank debt (a 95% LTV mortgage) and the same down payment.

In addition to contributing at least the minimum down payment, households must meet three other key conditions to participate in the scheme. First, the EL can only be used to purchase new build properties with a purchase price of £600,000 or less (one of the objectives of the scheme is to incentivize property construction). Second, the scheme is available to both first-time buyers and home movers, but not for second homes or buy-to-let investment. Third, borrowers who take out the EL must meet affordability requirements to ensure that they will be able to repay the mortgage provided by the bank (the affordability measures do not include the EL).

In exchange for the financing, the government is entitled to receive the same fraction of the value of the house at loan termination (i.e. 20% of the future value in case of an EL for the financing of 20% of the acquisition price). In addition, households must pay annual EL interest fees. The interest fees are a symbolic £1 per annum during the first five years. Afterwards, the

[5]This is a typical financing structure, but households may make a larger down payment and take out a smaller mortgage or equity loan.

annual interest fee is 1.75% of the original EL value, increasing each year in line with inflation plus 1%. Payments of this fee do not amortize the equity loan. Appendix Figure A1 shows the expected EL IRR for the government as a function of the number of years until termination. The expected IRR is essentially equal to the expected house price growth during the first five years, but increases slowly afterwards as a result of the interest fees. The scheme involves a government subsidy, most evident during the first five years. Households have the right to live in the house and to receive all of the "dividends" from the asset. But during this period, unless the loan is terminated, no payments (other than an annual nominal £1 interest fee) are due.

The events that trigger EL termination are a house sale, prepayment, or default. In the event of a house sale, 20% of the sale price is due to the scheme. The loan can be prepaid partially or fully, which requires an independent property valuation to determine the government interest. There are no prepayment fees due to the scheme but the valuation is paid for by the borrower, and the costs can be as high as £1,000. The minimum partial prepayment is 10%. In the event of default on the senior mortgage loan or on the interest payments due on the EL, the government has the right to foreclose, but its position is junior relative to that of the senior lender. Naturally, the question arises of whether it would be politically feasible for the government to foreclose on homeowners. The EL has a maturity of twenty five years.

Home buyers are required to maintain and to insure the property, and incur all the expenses associated with this. A feature of shared equity mortgages is that they may induce moral hazard in property maintenance on the part of the borrowers.[6] This is less likely to be a concern in our setting during the first few years of the loan. The properties are brand new so that they will require less maintenance than an old property and they are covered by a builder's guarantee (typically 10 years).

[6]This moral hazard can be addressed by using as reference in the contract an index of local house prices instead of the specific house value (Shiller et al., 2013). However, this requires that reliable local house price data is available. Otherwise homeowners may become exposed to significant basis risk. (Greenwald et al., 2017) show in the context of a general equilibrium model that the indexation of mortgage payments to aggregate house prices increases financial fragility, but that their indexation to local house prices has benefits for risk-sharing and for the resilience of the financial system.

2.2 The UK mortgage market

We briefly describe the characteristics of the UK mortgages that are relevant for our study. The long-term nominal fixed rate loans that are common in the US do not exist. The vast majority of mortgages have an initial period during which the loan interest rate is fixed. The most common period of interest rate fixation is two years, but it can be as long as five years. The interest rate during the fixation period is discounted (teaser rate), and reverts to a higher, floating, rate after this period ends. There are prepayment penalties during the period of fixation, but not once this period ends. As a result, many borrowers remortgage at end of the fixation period.

Due to the possibility of remortgaging at the end of the discounted period, when comparing loans, borrowers (and mortgage brokers) focus on the initial rate rather than the annual equivalent rate calculated over the life of the loan. There is some variation across loans in initial fees that cover loan arrangement and property valuation costs, but this variation is considerably smaller than in the US. Mortgage loans have typical maturities of between twenty and thirty years.

Mortgage borrowers face LTV and affordability constraints. Mortgages with a LTV higher than 95% are rare. Furthermore, many lenders require larger down payments, of around 10%, when lending against new build properties. These tighter requirements on new build properties reflect higher risk, since there was a larger fall in their value when compared to the overall market during the Great Recession. The loan interest rate depends primarily on the LTV: it increases with discrete jumps at LTV thresholds at regular intervals. Borrowers typically bunch just below the LTV threshold to benefit from the lower rate (Best et al., 2015). The other variables that affect loan pricing are borrower type (first-time buyer, home mover, remortgager) and rate type (length of fixed period). Borrower characteristics, including income and credit score, determine whether borrowers qualify for a given mortgage product, but conditional on this they do not affect pricing directly.

The affordability checks, that determine whether a borrower qualifies for a given product, take the form of both a maximum LTI and limits on the maximum monthly mortgage payments. The commonly used LTI limit is 4.5. Although some lenders already enforced this limit before June 2014, at this time the Financial Policy Committee of the Bank of England issued the recommendation that from October 2014 only 15% of the new mortgages originated by each

lender should have multiples higher than 4.5 times income. Following this announcement, and even though it was issued as a recommendation, mortgages with a LTI multiple higher than 4.5 have become mostly unavailable.

Mortgage applicants must undergo an affordability assessment to evaluate their ability to meet the required monthly mortgage payments. In this assessment lenders are required to take into account not only the borrower's income but also his/her other outstanding debts and fixed monthly recurring expenses such as education related expenses and travel. Therefore the calculation of the maximum loan amount requires an analysis of bank and credit card statements of borrowers by lenders. These affordability rules were introduced following a mortgage market review conducted by the Financial Services Authority, and are explained in its Policy Statement PS12/16, October 2012. Finally, the maximum loan amount is stress tested: borrowers must still be able to meet their mortgage payments in face of interest rate increase of three percentage points. The affordability criteria are used to determine the maximum loan amount, but once they are satisfied they do not have a significant effect on the loan cost.

2.3 The data

In this section, we describe the sources for mortgage, EL and house price data.

2.3.1 Mortgage data

We obtain mortgage information from the Product Sales Data (PSD) on owner-occupier loans collected by the Financial Conduct Authority (FCA). It is meant to cover the whole universe of bank mortgages originated in the UK, using information collected from lenders. The data starts in 2005; since the EL scheme started in 4/2013 we use the information in the PSD data from this month onwards. The PSD data includes the typical loan information: date, property value, loan amount, whether it is a loan for property acquisition or a remortgage, loan maturity and interest rate (both initial and reversion), and initial period of fixation. Information on loan fees is included, but only from 2015 onwards. Furthermore before 2015 there are some observations with missing interest rate and period of fixation information.

The PSD data includes information on property location (postcode) and whether it is a new build. The postcode information is very granular: each postcode covers an average of around 15

properties. The new build variable is important since the EL can only be used for the purchase of such properties. With respect to the borrower, the PSD data has information on his/her age, income, employment status, and whether the borrower is a first time buyer or home mover. For our origination analysis, we exclude remortgages from the PSD data (loans that are not taken for the purchase of a property). In addition, we restrict the data to mortgages that are used for the acquisition of new build properties up to value of £600,000 pounds by home buyers (buy-to-let investments are not recorded in the PSD). These restrictions guarantee that the acquisitions are eligible for the scheme.

2.3.2 Equity loans data

The PSD has bank mortgage information, but not on whether an EL was used. Our second main dataset includes information on all ELs originated in England since the scheme's inception (in April 2013) until March 2017, that we have obtained from the Ministry for Housing, Communities and Local Government (MHCLG). This data has information on the date, property price and location, the equity loan amount, and the identity of the mortgage lender for 120,874 acquisitions. We merge the EL data with the PSD by property location, price, and lender. After dropping implausible matches and duplicate entries we have information, including for the senior debt, for 99,571 new build properties acquired using the EL scheme. We create a parallel dataset of 157,620 mortgages for house purchases that were eligible for the scheme, but for which an EL was not used. We use these data for our origination analysis.

We have also obtained from the MHCLG information on EL terminations. Between 4/2013 and 9/2017 there were 11,596 EL terminations. Out of these, 6,099 were triggered by a property sale and 4 by a property sale by repossession. In addition, there were 5,276 full prepayments of ELs and 217 partial prepayments. We use this information to study how EL prepayment is affected by house price fluctuations. The EL terminations data has information on the house value that is used to calculate the government interest. It is equal to the sale price of the property or, in case of prepayment without a sale, to the one obtained from a valuation. Finally, for those individuals who prepaid the EL (without a sale) and remortgaged at the same time we are able to obtain from the PSD data information on the new mortgage loan and on their income at the time of EL prepayment. This allows us to look further into the motives and sources of funds for prepayment.

2.3.3 House price data

We use the PSD and ELs datasets to obtain the value of the each specific house in our data at origination and at EL termination. To measure local house price appreciation we use the official house price indices from the Office for National Statistics (ONS), measured at the local authority (LA) level. There are 353 LAs in England; LAs are larger than the typical American municipality but smaller than the typical metropolitan area. Greater London is composed of 33 local authorities, called boroughs. The indices are computed monthly based on all residential properties transactions recorded in the Land Registry. Indices are quality-adjusted using hedonic regressions – property attributes are gathered by the ONS from several sources including local tax data and energy performance certificates.

3 Equity loan borrower behavior

We characterize the borrowers who have used an EL and compare them to those who could have made use of the scheme but did not do so. We focus first on origination characteristics and behavior. In the last subsection we analyze prepayment.

3.1 Origination characteristics

Table 1 presents origination summary statistics on mortgages *eligible* for EL, i.e. mortgages issued in England between April 2013 and March 2017 on new properties with value below £600,000, excluding buy-to-let properties. We divide the sample between borrowers who did take up EL (columns two and three) and those who did not (columns four and five). The last column reports the difference in mean values between EL and non-EL borrowers and the statistical significance of t-tests of equality of means.

EL borrowers are younger, with an average age of 32 compared to 37 for non-EL borrowers. They are also much more likely to be first time buyers (FTBs): 73% of EL borrowers compared to 43% of non-EL borrowers. EL borrowers have a gross income that is around twenty percent lower than non-EL borrowers, which is likely to be related to the fact that they are on average younger. Our income measure is the one used in the mortgage application, so that in the case of joint applications it refers to the income of more than one individual. EL borrowers purchase

properties that are on average 7% less expensive but with a down payment that is equal to roughly a quarter of that of non-EL borrowers. The mortgage amounts are similar across the two groups, with the EL filling in the gap.

For most of the variables shown in the table, the dispersion among EL borrowers is smaller than among non-EL borrowers. In other words, there is less heterogeneity among the former than among the latter group of individuals. This is the reason why on average the mortgage interest rate is higher for non-EL borrowers: some of these borrowers, with high LTV mortgages, pay a very high mortgage rate pushing up the mean value. Although not reported in the table, the median rate paid by non-EL borrowers is lower than the one paid by EL borrowers.

Interestingly, the average mortgage maturity is substantially longer for EL borrowers, equal to 29 years, compared to 25 years for non-EL borrowers. We will report details on the maturity distributions in the next section. Longer maturities can be used to lower mortgage payments and improve product affordability. Almost all EL borrowers choose a fixed rate mortgage, but a majority of non-EL borrowers (86%) also do so.

Origination LTVs and LTIs are on average higher for EL borrowers than non-EL borrowers, with the differences becoming economically very significant when we add the equity loan amount to the mortgage value to calculate combined LTV and LTI (CLTV and CLTI). The average CLTV among EL borrowers is 91% compared to 65% among non-EL borrowers. The average CLTIs are 4.6 and 3.1, respectively. Perhaps surprisingly, the average payment-to-income ratios are similar for the two groups. This is in part explained by the similar mortgage amounts and by the longer average mortgage maturity for EL borrowers.

Our data includes information on gross income. We calculate net income using the income tax schedule and national insurance contribution rates. For sole applicants this does not require that we make any further assumptions. However, for joint applicants we only observe total household income. For these cases we divide the gross income by two and apply the tax schedule to the individual income, and then multiply the net value by two to obtain household net income.[7] The last row of Table 1 reports average payment-to-net income ratios (PTIs).

These average ratios may at first sight seem relatively low. But potential borrowers face affordability assessments that take into account the servicing of other existing debts and com-

[7]This is an approximation: if the income is not equally distributed among the household members the tax bill may be higher due to the progressivity of the tax schedule.

mitted expenditures. Even though our data does not have comprehensive information on the latter, the information is available for a small subsample of lenders. In Table 2 we investigate their effects. In Panel A we report PTIs for the full sample. In Panel B we report PTIs as in Panel A (but for the subset of lenders for which we have more comprehensive information). In the last two rows we calculate PTIs net of other debt servicing and committed expenditures. The average PTIs are substantially larger, especially when we subtract the latter. In addition, borrowers must also be able meet the mortgage payments in case of an increase in interest rates of three percent. As for loan maturity, in the next section we study the whole LTV, LTI and PTI distributions.

In an environment of increasing house prices, first-time buyers maybe more constrained in terms of their downpayment, since unlike some home movers they will not have obtained equity gains from the sale of their previous property. With this in mind, Table A1 compares EL and non-EL FTBs. Borrowers become more similar in age and incomes. But interestingly, and contrary to the results in Table 1, FTBs who made use of the EL scheme buy more expensive properties than those who did not use the EL. To buy these more expensive properties they use a much smaller down payment and rely on the maximum value of the EL.

The higher average house values among FTBs who made use of the EL scheme could potentially be explained by such buyers being disproportionately located in more expensive regions. In order to investigate this, and for the full sample of FTBs, we have regressed house values on a dummy that takes the value of one for EL borrowers (and zero otherwise) and on region and year fixed effects. The estimated coefficient on this dummy variable was a significant 23.3 thousand pounds, showing that the difference in house values between EL and non EL borrowers is not solely explained by regional differences.

3.2 Affordability restrictions

To provide further evidence on the reasons for the large demand for ELs we study the origination distributions of LTV, LTI and PTI. Lenders use these ratios as cut-off criteria above which they reject mortgage applications and for determining the maximum loan amount. As before we restrict the sample to mortgages for new properties with a value below £600,000 purchased between April 2013 and March 2017 (we exclude remortgaging).

We start with non-EL borrowers to understand the cut-off criteria for mortgages in our sample. The left-hand side of Panel A of Figure 2 shows the LTV distribution for non-EL borrowers. Very few mortgages have an LTV above 90% and none has an LTV above 95%. The right-hand side shows the LTI distribution: very few mortgages are above the 4.5 LTI cut-off. The distributions indicate that lenders applied cutoffs at 90%-95% LTV and 4.5 LTI.

In Panel B of Figure 2 we report the distributions for EL borrowers. In addition to LTV and LTI ratios calculated using the mortgage debt, we also plot CLTV and CLTI. The LTV distribution, on the left-hand side, shows that the majority of EL borrowers take out a mortgage with 75% LTV, which allows them to purchase the property with the maximum equity loan (20%) and the minimum downpayment (5%). The corresponding CLTV is 95%. The high incidence of CLTVs above 90% suggests that, without the equity loan, many of these borrowers would have struggled to finance the purchase of the same property—unless they had been able to substantially increase their downpayment.

The right-hand side of Panel B of Figure 2 shows the LTI and corresponding CLTI distributions for EL borrowers. Comparing their LTI distribution to that of non-EL borrowers, we see that of EL borrowers is shifted to the right, bunched towards the 4.5 LTI threshold. This leads to a large mass of EL borrowers with CLTI above 4.5. These borrowers would not have been able to finance the purchase of the same property with the same down payment.

In Table 3 we bring together the analysis of CLTV and CLTI. We calculate how many EL borrowers would have been able, without the EL, to obtain a mortgage for the same new property with the same downpayment. They would have been able to do so if the CLTV is below 95% (or 90% since lenders use stricter criteria for new build properties) and the CLTI is below 4.5. We report results for the whole sample of EL borrowers and for FTBs.

Panel A of Table 3 shows results with 95% loan-to-value and 4.5 loan-to-income thresholds: 54% of the borrowers would not have been able to buy the same property (the proportion is similar among FTBs). In Panel B we change the LTV threshold to 90%. Even though mortgages with LTV above 90% exist in the market, lenders are reluctant to grant them, and not many are available for the purchase of new build properties. The top left entry of Panel B shows that only a small proportion of 8% of EL borrowers (6% of FTBs) have CLTV and CLTI below the thresholds.

In Figure 3 we plot PTI and mortgage maturity distributions. As before, in Panel A we plot

the distributions for non-EL borrowers. For PTI we plot both the actual distribution and the stress tested distribution in which we calculate mortgage payments for a 3% higher interest rate. In order for the loan to be approved borrowers must be able to afford these higher payments. The right hand part of Panel A shows that the most common mortgage maturity is 25 years, but that there is considerable dispersion.

In Panel B we plot the distributions for EL borrowers. There are several interesting differences. Mortgage maturities are longer than for non-EL borrowers, particularly visible in the proportion of borrowers who take mortgages with 30 and 35 years maturities. Stretching mortgage maturity is a mechanism for reducing mortgage payments and improving affordability. In spite of the longer maturities the modes of the PTI and the stress tested distributions for EL borrowers are similar to those of non-EL borrowers, although the former have less dispersion than the latter.

The red lines in the bottom left figure show the PTI distributions that would result in case borrowers would take a mortgage loan for the amount of the CLTV but with the same maturity. In this case mortgage payments would be higher both because of the larger loan amount and a higher mortgage interest rate. We assume that the interest rate would be higher by 200 basis points, which is the average difference between mortgages with a 5% and a 25% down payment. The distributions are shifted significantly to the right. The mode of the distribution is roughly 35% (50% for the stress tested one). Unlike for the LTI, for the PTI there is not a clear cut-off above which mortgage loan applications are rejected and affordability assessments take into account borrower committed expenditures (which we do not observe).

To summarise, the evidence in this section shows that, had the equity loan not been available, the vast majority of EL borrowers would not have been able to obtain a standard mortgage sufficient to buy the same property with the same down payment. This does not mean than they would not be able to buy a less expensive property with the same down payment (in pounds, higher in proportion) and a smaller mortgage loan. It is likely that the scheme has an effect along the extensive (allowing households to buy a house) and the intensive margins (allowing households to buy a more expensive house than they would otherwise have been able to do). We provide evidence on these margins in the next section.

3.3 The nature of affordability restrictions: the London experiment

In February 2016 there was an increase in the maximum EL contribution for the acquisition of properties in London from 20% to 40%. Borrowers still need the 5% down payment, but the larger equity loan means that they now need a smaller bank mortgage for the purchase of the same house. Alternatively, this may allow them to purchase a more expensive property and still satisfy affordability restrictions. This is because such restrictions are calculated based on the mortgage (excluding the equity loan).

We explore the increase in limit to understand the role of the EL. It is important to note that this is an endogenous policy change, a response to larger declines in affordability in London. Figure 4 plots the evolution of house prices in London before and after the policy change. It compares it to the evolution of house prices in the South-East (SE, which excludes London) and in the rest of England (excluding London and the South-East). We will use the South East as our control group: the EL limit was not increased there, even though the house price increases had been relatively similar to those in London. These large increases in prices are likely to have an effect along several dimensions of the house purchase decision that we discuss below.

As a first step, in the bottom right panel of Figure 5 we plot the EL distribution in London since February 2016. Roughly 60% of ELs originated are for amounts higher than 20%, suggesting that the previous limit was binding for a large proportion of households. Furthermore, the majority of ELs are for the highest possible amount of 40%. A larger EL limit does not mean that the household is able to immediately buy a more expensive property: a 5% down payment and more savings (in pounds) are needed.

In case of a binding EL limit we would also expect to see an increase in the number of loans originated after the increase. We have calculated the percentage difference in loans originated in the six months before and after February 2016. There was an 18% increase in London compared to an 8% increase in the South-East. In the appendix we compare the characteristics of EL borrowers in the six months before and after the EL limit change, in London and and in the South-East (Tables A3 and A4). Although EL London borrowers are different from those outside London (e.g. they have higher income), the pre-post differences in incomes are similar for the two groups.

There are increases in the South-East between pre and post in property values, down payments and mortgage loans of roughly 6% and in equity loan amount of 13%. This is likely to be

the result, at least in part, of the increases in house prices that took place during this period. The differences in LTV, LTI, PTI although statistically significant are not economically meaningful. The differences in London in property values and in financing before and after the EL limit change are much more significant: the value of properties financed with the EL increases by roughly 15% and so does the down payment, the average EL amount increases by 57%, but the increase in average mortgage amount is a much more modest 3%.

To investigate the effect of higher EL contributions on mortgage transactions, we apply a difference in differences approach. We compare the changes in EL transactions in the six months before and after the policy change, in London versus the South-East. The equation that we estimate is:

$$y_{it} = \alpha_0 + \alpha_1 London_{it} + \alpha_2 PostJan2016_{it} + \alpha_3 London_{it} \times PostJan2016_{it} + \beta x_{it} + \epsilon_{it}. \quad (1)$$

We consider several alternatives for the dependent variable. London and Post Jan 2016 are dummy variables that take the value of one for EL transactions in London and after January 2016, respectively. The vector x includes several control variables. The coefficient of interest is α_3

Table 4 shows the results. In the top panel we control for borrower characteristics (age, FTB, income and employment status) and regional house price indices. The mean equity loan in London increased by an additional £37,240 compared to the South East. The property value increased by a slightly smaller amount, of £34,820. The increase in down payment of £1.27 thousand and the small decrease in mortgage amount of £3.7 thousand are approximately equal to the difference in the increases in property value and EL, but the estimated coefficients on these variables are imprecisely estimated. These results provide evidence that EL London borrowers took advantage of the increase in EL limit primarily to buy more expensive properties (instead of reducing the mortgage amount).

During the period of analysis house prices were increasing. And even though we control for the evolution of house prices in the previous regressions, we are interested in investigating further the extent to which house price increases versus the purchase of larger houses contributed to the increase in purchase price in London after January 2016. To do so we deflate the purchase price of each house by the increase in local house prices that took place between the beginning

of August of 2015, when the data used in the regression begins, and the date of the house purchase. The estimated positive coefficient on the interaction term of £29,610 shown in the last column of the top panel of Table 4 shows that there was a large positive effect on house size, that explains most of the increase.

The estimated negative coefficients on the Post January 2016 may at first come as a surprise since property prices increased during the sample period. The reason is that we are controlling for the evolution of prices in the regression. When in the bottom panel we exclude this explanatory variable the estimated coefficients on the the Post January 2016 dummy become positive.

The results of our analysis show that EL borrowers in London used the additional EL financing to buy more expensive and larger properties, suggesting that prior to increase in the EL cap, affordability constraints were binding for these households. Without the increase in EL cap the alternatives would have been to buy a smaller/less expensive house or to rent.

3.4 Regression discontinuity design

The scheme is only available for the purchase of new build properties with a maximum price of £600 thousand. We explore this threshold to provide causal evidence on the scheme effects. The pounds 600 thousand limit is fairly high, so that we focus the analysis on London where property prices are higher. We first evaluate the extent to which there is bunching below the limit. The top panel of Figure 6 plots the distribution of purchase prices of all new builds (regardless of whether their purchase was financed with an EL) in London by year. The bottom panel of the same Figure plots the distributions of purchase prices only for the properties that were financed with an EL. The Figure shows that there is indeed some bunching more visible after 2015 and particularly in 2016 and 2017. The figure also shows that even in London there is a large number of properties transacted at prices well below the six hundred thousand pounds limit.

In our regression discontinuity design we focus on new properties purchased in London in 2015-2017 with a price of between five hundred and seven hundred thousand pounds. In Figure 7 we plot the estimation results for several variables of interest. We plot the sample average for each bin (of twenty thousand pounds) and the corresponding confidence intervals. The top left

hand panel shows the results for the age of the buyer. Those buying below the threshold are on average significantly younger than those buying properties with a price just above the threshold (an average difference of two years). They are more likely to use a smaller down payment to buy the property and to be FTBs (bottom two panels). The average down payment of £140 thousand (or 25% of purchase price) for those below the threshold may at first sight seem high, but the data includes all purchases of new builds, including those buyers who have not made use of the EL, many of which have access to substantial down payments.

The top right panel of Figure 7 shows the results for the income of the buyer. Interestingly, there is no discontinuity around the threshold, but purchase price is more sensitivite to household income above than below the limit. In fact we cannot reject the null hypothesis that below the limit the slope of the polynomial is zero.

We perform two placebos. The first is old properties (not covered by the EL scheme) in the same years of 2015-2017. The results are shown in Figure 8. For none of the variables considered there is a discontinuity at £600 thousand. The age of the buyer, his/her income and the down payment increase the proportion of FTBs decreases continuously with the purchase price. The slopes of the polynomial fits are similar below and above the limit. The second placebo is new properties in the years of 2011-2012, before the EL scheme became available. The conclusion is similar: there are no discontinuities either in the levels or the slopes (Figure 9). The top right hand panel of each the pacebo test figures shows income increasing monotonically with property price throughout the range, including below the threshold in contrast with the results for new properties in London in 2015-2017.

3.5 Equity loan repayment behavior

The previous sections provided evidence that ELs are used by households to overcome affordability constraints. In this section we study EL repayment behavior. The evidence is limited by the fact that only five years have passed since the beginning of the scheme.

In Figure 10 we plot cumulative EL repayments (without and with a property sale) as a function of the number of years since origination. Each line corresponds to a cohort of ELs originated in a given calendar year. The horizontal axis refers to the number of years since origination. For repayments without a sale larger increases are visible at around two and three

years. Two years is the most common period of interest rate fixation, at the end of which many borrowers refinance their mortgage loans. The figure shows that some of them use the opportunity to repay the EL. In contrast, repayments triggered by a property sale increase more smoothly with the number of years since origination. Out of the ELs that were originated in 2013 (the first year of the scheme), one in four have been repaid after four years (roughly 11% and 16% for repayment without and with a sale, respectively).

In order to provide more evidence on repayment we now focus the analysis on the cohort of ELs issued in the first two years (April 2013 to March 2015). For these loans more than two years have passed since origination and as previously explained most mortgage loans have an initial period of interest fixation of two years, at the end of which they are likely to be refinanced. For those who do so we are able to obtain information on their circumstances (including income and amount borrowed) at the point of mortgage refinancing.

Table 5 reports the means of several origination variables for borrowers who repaid their loan because of a sale, those who repaid without a sale, and those who did not repay. We rely on the PSD data to obtain information on origination characteristics. The last column of the table reports the difference in means between those who repaid the EL without a sale and those who still have the EL. This is a cleaner comparison since there is no house move associated with the decision to repay. EL borrowers who repaid are more likely to be FTBs, to have higher origination income and to have purchased a more expensive house (but not relative to their income). The differences in LTV, LTI, PTI, and mortgage maturity although sometimes statistically significant, are not economically meaningful.

We explore the role of house price appreciation in repayment decisions. We take the same sample of ELs that were originated between April 2013 and March 2015 and calculate the annualized rate of local house price appreciation in the following two years. In the left hand side of Figure 11 we plot the distributions of house price appreciation by EL outcome. There were large increases in house prices during this period. Interestingly, we see that those borrowers who repaid without a sale experienced the highest rates of house price appreciation, followed by those who repaid due to a sale, and finally those who did not repay. The differences are economically meaningful.

For the ELs that were terminated our data records the actual value of the house at this time, used to determine the Government interest. In Figure A2 in the appendix we compare

these house prices (solid line) to local house price indices (dotted line). The left-hand chart refers to borrowers who sold the property, whereas the right-hand chart refers to borrowers who repaid the EL without a sale (staircasing). As it can be seen from the figure the distribution of actual house price appreciation is to the left of that of local house price indices. This is in part explained by a lower appreciation of new build properties relative to the overall local housing market. In each of the charts the dashed line reports appreciation according to an index for new build properties that was estimated by the authors. The index takes all repeat sales in the Land Registry where the first sale concerns a new build.

In spite of this there still are some differences in the distributions, particularly for repayments that did not involve a sale (right hand panel of Figure A2). The distribution of idiosyncratic house price appreciation has relatively more mass at values around zero relative to both the local prices and the new build index. In these instances the valuation is carried out by an independent surveyor paid for by the borrower.

An increase in house prices leads to the accumulation of home equity by EL borrowers and a relaxation of LTV constraints. But this does not mean that LTI or PTI constraints are also relaxed. A simple numerical example helps to explain this. Suppose that the household bought a house for 100 with a down payment of 5, an EL of 20, and a mortgage of 75. If one year later the value of the house increases to 110, the household is entitled to 80% of the value of the house minus the mortgage debt outstanding. Assuming an interest-only mortgage loan this implies a payoff of 13, or 11.8% of the new house value. This is a higher down payment than initially. But in order to repay the EL the household would now need a mortgage loan of 97 which is larger than the initial mortgage loan value plus the EL. The difference of 2 arises because house appreciation increases the repayment value due to the government. Without an increase in household income LTI constraints may actually become more binding.

For a subsample of the households who remortgaged with a different lender our data has income information at the time of remortgaging, which we use to calculate income growth since origination.[8] The right hand panel of Figure 11 shows that those borrowers who repaid the EL (without a sale) have benefited from higher income growth than those who did not do so. Income growth relaxes affordability constraints and reverses the factors that initially motivated households to finance the property acquisition with the EL. For these households the EL is

[8]Income information is not captured in the PSD when the remortgaging is with the same lender.

used as a form of bridging finance.

Finally, we consider equity extraction. If constraints become less binding, households can borrow a larger amount than required to refinance their existing mortgage loan, and use equity extraction (the difference between the new mortgage loan and the outstanding balance on the old one) for consumption or to repay the EL. The top left chart of Figure 12 shows that there is some equity extraction by borrowers who do *not* repay the EL, but also that there is a significant fraction of individuals who do not extract any significant amount of home equity. In contrast, those borrowers who do repay the EL extract substantial amounts of equity (top right chart). Moreover, the distribution of equity extracted is similar to that of EL revalued at the moment of repayment (i.e. the amount due to the Government). Therefore, these borrowers take advantage of higher house prices and relaxed affordability constraints to terminate the government interest.

Panel B of the same figure shows the differences in LTVs (instead of pounds) between the new LTV (of the refinanced loan) and the counterfactual LTV (based on the previous mortgage loan amount oustanding, in case mortgage refinancing had not taken place). Borrowers who repaid the EL tend to increase LTV by around 20%.

In spite of the evidence presented, we cannot rule out that factors other than a relaxation of affordability constraints may also be at work in the decision to repay the EL. For instance, EL borrowers who experience fast house appreciation may be concerned about further foregone capital gains, if house price trends continue. In the next section, we investigate the role of house price expectations in the decision to take an EL loan.

4 A lower bound on house price expectations

In spite of the large demand for ELs, the majority of eligible borrowers did not use the loans (61% of them, see Table 1). These borrowers could have bought the same house with the 20% EL and reduced the mortgage loan accordingly. They forgo the government subsidy of the scheme and the opportunity to reduce their mortgage payments, but retain the full value of their house. They may want to do so if they expect a high rate of house price appreciation. In this section we focus on these home buyers who did not take up the equity loan to learn about their house price expectations.

We perform a counterfactual exercise to calculate the level of expected house price growth that makes risk-neutral non-EL borrowers indifferent between using or not the EL. At this break-even rate the benefits of higher capital gains offset the benefits from lower interest payments in the EL counterfactual. Under household risk aversion this expected house price growth is a lower bound. For risk-averse individuals a higher expected house price growth may be required to compensate them for giving up the risk-sharing benefits of the EL scheme.

We proceed in three steps. First, we summarise the household's cash flows with a standard mortgage. Second, we show how the cash flows change with an EL. Finally, we calculate the break-even expected rate of house price appreciation. We also use realized house price changes to calculate "money left on the table," the net gains/losses, at a specific period T, e.g. at the end of the fixed-rate period, for the borrowers who chose not to take a EL.

The cash-flows that we describe below and the counterfactual exercise that we perform is valid up to a maximum horizon of T equal to five years. After this date the borrower needs to pay interest on the EL (see Section 2.1 for details). During the first five years there is only a £1 interest fee that we abstract from.

4.1 A counter-factual exercise: framework

4.1.1 Cash flows with a standard mortgage (no EL)

The mortgage has an initial value of Q_0 and maturity N. The initial period of fixed interest rate is T. This is also the horizon at which we perform the calculations. The interest rate r and the mortgage payments mp are fixed during this period. The purchase price of the property is P_0.

The cash flows for the household are as follows. To purchase the property at $t{=}0$ the household must contribute a downpayment (equity) equal to $E_0 = P_0 - Q_0$. In each period between purchase and the end of the fixed rate period ($0 < t \leq T$) the household must make a mortgage payment equal to $mp = Q_0 \cdot a_{\overline{N}|r}$, where $a_{\overline{N}|r}$ is the present value of a constant annuity with N payments and interest rate r. Finally, the household payoff at ($t{=}T$) is the difference between the property value P_T and the outstanding balance on the loan Q_T: $E_T = P_T - Q_T$

4.1.2 Cash flows with a EL

We now discuss how the EL changes the household's cash flows. The equity loan provider (the Help To Buy scheme in our case) contributes equity to finance 20% of the purchase price of the property: $EL_0 = 0.2P_0$. In exchange, the provider receives 20% of the house value when the EL is repaid. We focus on the effect of substituting part of the mortgage with an EL, and assume that the household purchases the same property at price P_0, and that it provides the same downpayment E_0. This is something that the household could have done, but did not do.

The household's cash flows with the EL are as follows. At time of purchase (t=*0*), the household's cash flow is unchanged relative to the no EL scenario. The household contributes the same downpayment E_0. The equity loan is used to reduce the mortgage size: $Q_{EL,0} = Q_0 - EL = Q_0 - 0.2P_0$. Between purchase and EL termination (i.e. for t: $0 < t \leq T$) the household has to make mortgage payments mp_{EL}. These mortgage payments are lower than with the no EL ($mp - mp_{EL} > 0$) for two reasons: (i) a smaller mortgage $Q_{EL,0} < Q_0$; and (ii) a lower loan interest rate as a result of the lower loan-to-value ratio ($r_{EL,0} < r_0$).

At the end of the period of interest rate fixation (t=T), the household payoff is such that it must forgo 20% of the house value, which goes to the equity provider. But the outstanding balance on the mortgage is also lower. The household receives the difference between 80% of the value of the property and outstanding balance on the loan Q_T: $E_{EL,T} = 0.8 \cdot P_T - Q_{EL,T}$.

Note that borrowers are not required to repay the EL at the end of the initial period of interest rate fixation. The above counterfactual scenario assumes that this happens simply to compare the household payoffs across the two scenarios.

4.1.3 Break-even rate of house price appreciation and money left on the table

To calculate the net gains/losses under the EL counterfactual, we add the value at time T of the cash flow differences. The time zero cash-flows are the same under the two alternatives so that they cancel out. The share of the house value and the outstanding loan balances are already calculated at T. But bringing forward the difference in mortgage payments in each period prior to t ($mp - mp_{EL}$) requires a discount rate δ. This rate reflects the marginal utility of having an extra pound of cash available. It should be equal to the interest rate that the household has on an alternative investment opportunity with the same risk or the rate on alternative forms

of borrowing that can be reduced (e.g. credit cards) as result of the lower required mortgage payments.

The net gains/losses are given by:

$$\Delta NV_T = -0.2 \cdot P_T + Q_T - Q_{EL,T} + (mp - mp_{EL}) \cdot s_{\overline{T}|\delta} \tag{2}$$

Where $s_{\overline{T}|\delta}$ is the future value of a constant annuity with N payments and interest rate δ. A higher interest rate δ increases the the future value of the mortgage savings and ΔNV_T. For a given value of realized house prices at T the above equation gives the ex-post money left on the table by an individual who did not use the EL.

If we set $\Delta NV_T = 0$ we can solve for the date T break-even level of house prices $P_{T,BE}$. The (annualized) break-even rate η_{BE} of house price appreciation can be obtained by dividing this by the initial house value $P_0 = EL_0/0.2$.

$$\eta_{BE} = \left(\frac{Q_T - Q_{EL,T} + (mp - mp_{EL}) \cdot s_{\overline{T}|\delta}}{EL_0} \right)^{1/T} - 1. \tag{3}$$

For values above (below) this rate of house price appreciation a risk-neutral individual is better (worse) off with the EL.

4.2 Break-even rates of house price growth

We calculate the break-even rate of house appreciation for each household who did not use an EL to buy their property but could have done so. In the counterfactual scenario with EL households purchase the same property with the same downpayment, but substitute a standard mortgage with the EL to finance 20% of the purchase price (40% in London after February 2016). The break-even rate is different for each household so that the output of our exercise is a distribution of break-even rates of house price appreciation.[9]

We perform calculations for two subsamples of non-EL borrowers, those who purchased the property in 2013-2015 and those who purchased it in 2016-2017. This allows us to set T equal to 2 years and calculate money left on the table for the mortgages originated in 2013-2015 and

[9]We do not perform a counterfactual exercise for EL borrowers, i.e. calculate the break-even rate that makes them indifferent between using or not the EL, since as we have seen in the previous section most of them could not have purchased the same property without the EL due to affordability constraints.

to study how the distribution has changed over time. We start by showing the benefits in the EL counterfactual in terms of lower interest rates and mortgage payments.

If households used an EL to finance 20% of the purchase price, there would been a corresponding reduction in the LTV of the mortgage. Therefore we need to calculate a counterfactual interest rate. We do so by using our data and taking the median rate for a mortgage issued to the same borrower type (first-time buyer or home mover), by the same lender, with the same period of initial rate fixation, in the same month and with a 20% smaller maximum LTV (40% in London after February 2016).

Table 6 shows summary statistics for the distributions of interest rate gains by actual (not counterfactual) LTV. Panel A shows the results for mortgages originated in 2013-2015. We see that there are substantial interest rate gains, on average of around 150 basis points, for borrowers with LTV>85. These interest rate gains decline with LTV and they are negligible for LTVs below 75. This happens not only at the mean. The distribution of the interest rate differential shifts to the left as the original LTV decreases. The interest rate gain is smaller for borrowers who have a lower LTV. Mortgage rates increase more than proportionally with LTV ratios, and a 20p.p. reduction in loan-to-value ratio results in a much larger reduction in mortgage rates for borrowers starting with a LTV ratio above 85%.

For lower LTVs and at percentile 10 of the distribution the counterfactual interest rate under EL is higher. This reflects measurement error that may arise from, for example, mortgage rate changes within a given month. All else equal, lenders do not offer higher interest rates for lower loan-to-value ratios. The measurement error in our data may also be due to fact that for the early part of the sample we do not have information loan fees. To assess the potential impact of this we study mortgages issued in 2015-2017 (the only years for which we have fee data).

In the first three rows of Panel C of Table 6 we calculate the interest rate gains for mortgages originated in 2015-2017 calculating the counterfactual interest rate as we previously did for mortgages originated in 2013-2015. In the bottom three rows we generate instead a counterfactual interest rate by adding a fee dummy to the other criteria for matching (adding dummies for different fees size yields similar results). Interestingly, there is almost no difference at the median, but at percentile 10 the interest gains are increased by between 10 and 15 basis points when we take into account the fees. This suggests that some measurement error arises from the lack of fee information but that it is limited.

Comparing Panels A and C it is interesting to note that the interest rate gains were significantly reduced from 2013-2015 to 2015-2017. This reflects the decline in credit spreads for high LTV mortgages.

Lower interest rates in the EL counterfactual translate into lower mortgage payments, but there is also an additional reduction in payments due to the smaller mortgage amount. Figure 13 compares the distribution of actual monthly mortgage payment (true rate, true loan) with the distribution in the EL counterfactual (EL rate, EL loan) for borrowers with a LTV>85. The figure also plots the distribution for mortgage payments for the lower counterfactual interest rate but keeping the loan amount fixed (EL rate, true loan). For LTV>85 mortgages both factors, reduced interest rate and loan amount, contribute to the substantial shift of the distribution to the left. Although not shown in the Figure, for mortgages with LTV<75 the reduction in mortgage payments in the counterfactual comes mainly from the reduced loan amount (the interest gains are small).

We make use of the counterfactual mortgage payments to calculate the break-even rate of house price appreciation. The break-even rate is calculated as in equation (3) setting T equal to the length of the fixed-rate period (2 years) and the discount rate δ equal to the actual (non-EL) mortgage rate. The rationale is that the mortgage rate is the rate at which the household is borrowing, and so we assume that it reflects the value of an additional pound for the household.

The left hand panel of Figure 14 shows the distributions of annualized house price appreciation for households with a LTV$\leq$85 and LTV>85. Focusing first on the latter, we see that households with mortgage loans with LTV>85 would have had to expect high rates of house price appreciation not to take up the EL: rates above 5% for the majority of them and above 10% for a significant proportion. These rates are a lower bound: under risk-aversion a higher expected rate of house price appreciation may be needed to compensate households for giving up the risk-sharing benefits of the scheme. The distribution of house price appreciation for LTV>85 is bimodal. This is due to the fact that mortgage rates vary with LTV bands, with a much higher rate for those with LTV$\geq$90 than those with a LTV<90. Due to this higher rate the former require a much higher rate of house price appreciation to break-even. The rates of break-even house price appreciation for borrowers with a LTV$\leq$85 are considerably lower, but there is still a significant proportion of them with break-even rates above 5%.

To understand the characteristics of households with different break-even rates of house

price appreciation, Table 7 shows, for all LTV mortgages, summary statistics by quartile of break-even rate. Borrowers in the top quartile are younger, more likely to be FTBs, and they buy less expensive properties but with substantially smaller down payments (higher LTV) and longer loan maturities. The higher LTV makes the loans more expensive contributing to a higher break-even rate, of on average of 9.3% for individuals in this top quartile.

In the right hand panel of Figure 14 we compare the break-even distributions for LTV>85 mortgages originated in 2016-2017 to that of mortgages originated in 2013-2015. There are several visible patterns. The distribution shifts to the left in the latter period. Interest rate differentials were larger at the beginning of the scheme, and fell later with a reduction in credit spreads between high- and low-LTV mortgages. This is also the reason why the bimodal pattern of the distribution becomes less pronounced in the latter period. This shows how reductions in credit spreads for high LTV mortgages can potentially reduce the demand for shared-equity mortgages. In spite of this the median break-even rate in the latter period for LTV>85 mortgages is still a significant 5.2%.

4.3 Realized gains/losses

For the mortgages originated in 2013-2015 and by looking two years ahead we can compare the break-even expected rates of house appreciation to the realized rates. This is done in Figure 15. In the left chart we use break-even rates calculated using the mortgage rate to calculate the future value of mortgage payments. Each dot corresponds to a mortgage and house purchased by a household that was eligible for the EL scheme but did not use it. The dashed line is the 45 degrees line. Points above the line mean that the realized rate of house price appreciation was higher than the break-even one: ex-post individuals are better off without than with the EL. The vast majority of the points are above the 45 degrees line reflecting the high realized house price gains between 2015 and 2017. There are however many households with high break-even rates who ex-post would have been better off with the EL.

In the right chart of Figure 15 we plot realized against break-even rates calculated using a representative credit card rate of 20% to calculate the future value of the mortgage savings with the EL (instead of the mortgage rate). This is a more appropriate rate for individuals who use their credit cards to borrow. Although not easily visible in the figure the number of

points below the 45 degrees line increases.

We calculate the distribution of "money left on the table"—the difference in payoffs for the household under the actual loan (no EL) and a counterfactual EL loan. We calculate such difference in pounds and as a ratio to household income. Panel A of Table 8 shows the results as a function of LTV. Positive values indicate that the borrower would have been better off with an EL. Focusing first on the LTV>85 mortgages we see that the median is £900. There is however considerable dispersion, ranging from £-6.1 thousand at percentile 10 to £6.4 thousand at percentile 90. In terms of ratios to monthly gross income the percentile 10 to 90 range is -1.2 months to 1.7 months. The money left on the table increases when we set the discount rate equal to the credit card rate. On the other hand the money left on the table decreases for lower LTV mortgages.

To isolate the two factors that determine net gains/losses, savings in mortgage payments and change in equity value, equation (2) can be rewritten as:

$$\Delta NV = E_{EL,T} - E_T + (mp - mp_{EL}) \cdot s_{\overline{T|\delta}} \tag{4}$$

where E denotes household equity calculated as the difference between the time T value of the house that the household is entitled to and the outstanding mortgage loan principal at the same date.

Panel B of Table 8 shows the decomposition of net gains/losses into difference in equity gains and savings on mortgage payments. To better illustrate the effects we report average values for individuals above (and below) percentile 90 of the distribution of money left on the table. The source of money left on the table is the forward value of mortgage payments, more so at higher levels of LTV.

5 Conclusion

As a response to the Great Recession regulators in many countries around the world, including in the UK and in the US, have used quantitative macro prudential tools such as loan to income and mortgage payment limits to regulate household leverage and improve financial stability. These regulations have had an impact on household credit availability (DeFusco et al., 2017) and for some households have made the path to homeownership more difficult, especially in situations

of rising house prices and stagnating incomes. In this paper we have provided evidence that these affordability considerations are behind the large demand for the shared equity mortgages recently introduced by the UK government. We have shown that those who have used the equity financing to purchase their house are disproportionately young, first time buyers who would not have been able to buy the property without the equity because they would not meet affordability criteria. We have exploited changes in the scheme and the its maximum property price limit for identification. Furthermore, we have provided evidence of a link between a relaxation of affordability constraints and the prepayment of the shared equity mortgages.

The products that we study are provided by the government and they involve a subsidy. This has important implications. First, for them to improve macroeconomic stability it has to be the case that the government is in a better position to absorb potential losses in the housing market than homeowners and financial institutions that provide standard mortgages (and which will incur losses in case of borrower default). Second, since the products involve a subsidy, the question of how large the demand would be without it arises. This subsidy is also part of the reason why, as we show, a very high rate of expected house price appreciation is needed to rationalize the behaviour of those borrowers in our data who relied on a high loan to value mortgage to finance the acquisition of their home instead of using the shared equity mortgage available. In this aspect our paper contributes to the understanding of the role of house price expectations in housing finance.

References

Benetton, M., P. Bracke, and N. Garbarino (2018). Down payment and mortgage rates: evidence from equity loans. *Bank of England Staff Working Paper No. 713*.

Beraja, M., A. Fuster, E. Hurst, and J. Vavra (2017). Regional heterogeneity and monetary policy. Technical report, National Bureau of Economic Research.

Best, M. C., J. Cloyne, E. Ilzetzki, and H. J. Kleven (2015). Interest rates, debt and intertemporal allocation: Evidence from notched mortgage contracts in the uk. *Bank of England Staff Working Paper No. 543*.

Calza, A., T. Monacelli, and L. Stracca (2013). Housing finance and monetary policy. *Journal of the European Economic Association 11*(suppl_1), 101–122.

Campbell, J. Y. (2013). Mortgage market design. *Review of finance 17*(1), 1–33.

Campbell, J. Y., N. Clara, and J. Cocco (2018). Structuring mortgages for macroeconomic stability. *Working Paper Harvard University*.

Campbell, J. Y. and J. F. Cocco (2003). Household risk management and optimal mortgage choice. *The Quarterly Journal of Economics 118*(4), 1449–1494.

Caplin, A., J. H. Carr, F. Pollock, Z. Yi Tong, K. M. Tan, and T. Thampy (2007). Shared-equity mortgages, housing affordability, and homeownership. *Housing Policy Debate 18*(1), 209–242.

Caplin, A., C. Sewin, C. Freeman, and J. Tracy (1997). *Housing Partnerships: A New Approach to a Market at a Crossroads*. Mit Press.

Cocco, J. F. (2013). Evidence on the benefits of alternative mortgage products. *The Journal of Finance 68*(4), 1663–1690.

Corbae, D. and E. Quintin (2015). Leverage and the foreclosure crisis. *Journal of Political Economy 123*(1), 1–65.

DeFusco, A. A., S. Johnson, and J. Mondragon (2017). Regulating household leverage.

Di Maggio, M., A. Kermani, B. J. Keys, T. Piskorski, R. Ramcharan, A. Seru, and V. Yao (2017). Interest rate pass-through: Mortgage rates, household consumption, and voluntary deleveraging. *American Economic Review 107*(11), 3550–88.

Eberly, J. and A. Krishnamurthy (2014). Efficient credit policies in a housing debt crisis. *Brookings Papers on Economic Activity 2014*(2), 73–136.

Greenwald, D., T. Landvoigt, and S. Van Nieuwerburgh (2017). Financial fragility with SAM? *Working Paper*.

Guren, A. M., A. Krishnamurthy, and T. J. McQuade (2017). Mortgage design in an equilibrium model of the housing market.

Guren, A. M. and T. J. McQuade (2016). How do foreclosures exacerbate housing downturns?

Mian, A., K. Rao, and A. Sufi (2013). Household balance sheets, consumption, and the economic slump. *The Quarterly Journal of Economics 128*(4), 1687–1726.

Mian, A. and A. Sufi (2009). The consequences of mortgage credit expansion: Evidence from the us mortgage default crisis. *The Quarterly Journal of Economics 124*(4), 1449–1496.

Miles, D. (2015). Housing, leverage, and stability in the wider economy. *Journal of Money, Credit and Banking 47*(S1), 19–36.

Piskorski, T. and A. Tchistyi (2010). Optimal mortgage design. *Review of Financial Studies 23*(8), 3098–3140.

Piskorski, T. and A. Tchistyi (2017). An equilibrium model of housing and mortgage markets with state-contingent lending contracts. Technical report, National Bureau of Economic Research.

Shiller, R. J. (1994). *Macro markets: creating institutions for managing society's largest economic risks*. OUP Oxford.

Shiller, R. J. (2014). Why is housing finance still stuck in such a primitive stage? *American Economic Review 104*(5), 73–76.

Shiller, R. J., R. M. Wojakowski, M. S. Ebrahim, and M. B. Shackleton (2013). Mitigating financial fragility with continuous workout mortgages. *Journal of Economic Behavior & Organization 85*, 269–285.

TABLES AND FIGURES

Table 1: Comparison EL vs. non-EL borrowers: All

The table reports the results of t-tests of equality of means between EL and non-EL borrowers. Data for mortgages originated between April 2013 and March 2017 for purchase of new-built properties with value below £600,000. The last column reports the difference in means; *** denotes statistical significance at the 1% level.

	EL		Non-EL		
	Mean	SD	Mean	SD	Difference
Age (Years)	31.94	(7.30)	36.95	(9.92)	-5.01***
First time buyers (%)	0.73	(0.44)	0.43	(0.49)	0.31***
Gross income (£.000)	49.74	(35.29)	59.81	(256.00)	-10.07***
Employed (%)	0.95	(0.23)	0.90	(0.30)	0.04***
Self-employed (%)	0.05	(0.22)	0.08	(0.27)	-0.03***
Property value (£.000)	237.87	(101.23)	256.35	(122.86)	-18.48***
Down payment (£.000)	22.05	(26.86)	87.93	(84.59)	-65.88***
Equity loan (£.000)	49.10	(27.48)	0.00	(0.00)	49.10***
Mortgage value (£.000)	167.00	(67.93)	168.11	(90.01)	-1.11***
Interest Rate (%)	2.57	(0.65)	2.78	(0.89)	-0.21***
Maturity (Years)	29.15	(6.47)	24.68	(7.44)	4.47***
2-year fixed (%)	0.46	(0.50)	0.41	(0.49)	0.05***
Other fixed (%)	0.53	(0.50)	0.45	(0.50)	0.08***
LTV	71.19	(8.23)	65.04	(21.77)	6.16***
Combined LTV	91.48	(7.72)	65.04	(21.77)	26.45***
LTI	3.51	(0.73)	3.06	(1.05)	0.46***
Combined LTI	4.55	(1.01)	3.06	(1.05)	1.49***
Payment-To-Gross income (%)	17.23	(4.13)	18.18	(14.29)	-0.95***
Payment-To-Net income (%)	22.88	(5.38)	24.43	(19.49)	-1.55***
N	99,571		157,620		257,191

Table 2: Payment to income, credit commitments and expenditures

The table reports the payment to gross income and net income for all lenders in out dataset in 2016-2017. Panel B reports the same variables for a group of three banks and also the payment to income net of other credit commitments and of other expenditures.

	Obs.	Mean	Sd	p1	Median	p99
Panel A - All						
PTI (gross)	87,588.0	17.1	4.9	6.3	16.9	30.5
PTI (net)	87,596.0	24.3	7.7	9.0	23.5	49.1
Panel B - Three banks						
PTI (gross)	19,150.0	16.6	4.4	6.3	16.7	28.2
PTI (net)	19,151.0	22.7	6.2	8.5	22.6	39.9
PTI (net - other debt)	19,151.0	23.2	6.6	8.5	23.0	42.4
PTI (net - other debt - exp.)	19,151.0	42.9	13.9	15.5	41.7	87.9

Table 3: Distribution of cumulative LTV and LTI for EL borrowers

The table shows the distribution of combined loan-to-value (CLTV) and combined loan-to-income (CLTI) ratios for EL borrowers. CLTV and CLTI are calculated by adding mortgage loan and equity loan. We fix the maximum CLTI at 4.5 and the maximum CLTV at both 95 (Panel A) and 90 (Panel B). Data for mortgages originated between April 2013 and March 2017 for purchase of new-built properties with value below £600,000.

Panel A: Loan cut-offs at CLTV=95%, CLTI=4.5

	All				First time buyers			
	CLTI $\leq$ 4.5		CLTI $>$ 4.5		CLTI $\leq$ 4.5		CLTI $>$ 4.5	
CLTV $\leq$ 95%	45,781	(46%)	53,508	(54%)	33,328	(46%)	39,582	(54%)
CLTV $>$ 95%	157	(0%)	119	(0%)	126	(0%)	100	(0%)

Panel B: Loan cut-offs at CLTV=90%, CLTI=4.5

	All				First time buyers			
	CLTI $\leq$ 4.5		CLTI $>$ 4.5		CLTI $\leq$ 4.5		CLTI $>$ 4.5	
CLTV $\leq$ 90%	7,819	(8%)	16,188	(16%)	4,073	(6%)	9,759	(13%)
CLTV $>$ 90%	38,119	(38%)	37,439	(38%)	29,381	(40%)	29,923	(41%)

Table 4: Effect of the introduction of London EL scheme

This table shows results from regressing the dependent variable (whose value is expressed in thousands of pounds) on three terms: a dummy variable indicating transactions in the Greater London Area (London), a dummy variable indicating transactions after January 2016 (Post Jan 2016), and the interaction between the two. The sample is limited to EL transactions taking place between six months before and after 1 February 2016 in either London or the South East of England. Borrower characteristics are age, borrower type (first-time buyer or home mover), gross income and employment status. The last column uses as dependent variable the purchase price deflated by the official regional house price index normalised to August 2015. The regional house price index is collected from the Office for National Statistics. Standard errors in parentheses clustered at the postcode district level.

	Values in £1,000					
	(1) Equity loan	(2) Purchase price	(3) Down payment	(4) Mortgage amount	(5) Monthly payment	(6) Deflated purchase price
London × Post Jan 2016	37.24***	34.82***	1.27	-3.69	-0.03**	29.61***
	(5.93)	(8.77)	(2.18)	(3.60)	(0.01)	(8.14)
London	7.51***	41.16***	10.85***	22.80***	0.07***	40.69***
	(1.75)	(8.57)	(2.68)	(4.50)	(0.02)	(8.47)
Post Jan 2016	-5.84***	-8.98**	-1.70	-1.44	-0.01	-8.50**
	(1.30)	(4.15)	(1.42)	(2.43)	(0.01)	(4.03)
Borrower characteristics	Yes	Yes	Yes	Yes	Yes	Yes
Regional house price index	Yes	Yes	Yes	Yes	Yes	Yes
r2	0.45	0.56	0.12	0.62	0.65	0.55
N	10,037	10,037	10,037	10,037	10,037	10,037

	Values in £1,000					
	(1) Equity loan	(2) Purchase price	(3) Down payment	(4) Mortgage amount	(5) Monthly payment	(6) Deflated purchase price
London × Post Jan 2016	37.32***	34.88***	1.26	-3.71	-0.03**	29.58***
	(6.02)	(8.97)	(2.20)	(3.61)	(0.01)	(8.21)
London	7.73***	41.67***	10.95***	23.00***	0.07***	40.90***
	(1.78)	(8.64)	(2.71)	(4.51)	(0.02)	(8.51)
Post Jan 2016	2.51***	13.38***	4.16***	6.71***	0.00	-0.98
	(0.52)	(2.51)	(0.86)	(1.45)	(0.01)	(2.41)
Borrower characteristics	Yes	Yes	Yes	Yes	Yes	Yes
Regional house price index	No	No	No	No	No	No
r2	0.45	0.55	0.12	0.62	0.65	0.55
N	10,073	10,073	10,073	10,073	10,073	10,037

Table 5: Summary Statistics Repayment

The table is constructed from the sample of EL borrowers who bought their property between April 2013 and March 2015, matched with the full MHCLG redemptions dataset. This table lists the characteristics of borrowers who have sold their properties, repaid the EL without selling or kept the EL.

	Sold	Repaid	Kept EL	Difference
	Mean	Mean	Mean	Repaid - Kept EL
Age (Years)	29.80	31.26	31.97	-0.71***
First time buyers (%)	0.77	0.80	0.74	0.06***
Gross income (£.000)	42.10	51.29	44.13	7.16***
Employed (%)	0.96	0.94	0.95	-0.00
Self-employed (%)	0.04	0.06	0.05	0.00
Property value (£.000)	196.52	241.23	206.96	34.28***
Down payment (£.000)	15.21	22.33	17.40	4.93***
Equity loan (£.000)	39.17	47.76	41.27	6.49***
Mortgage value (£.000)	142.13	171.14	148.30	22.85***
Interest Rate (%)	3.20	3.06	3.19	-0.13***
Maturity (Years)	27.84	27.56	27.87	-0.31***
2-year fixed (%)	0.10	0.17	0.16	0.01
Other fixed (%)	0.90	0.82	0.84	-0.01*
LTV	72.61	71.28	72.13	-0.85***
Combined LTV	92.55	91.10	92.07	-0.98***
LTI	3.54	3.55	3.54	0.01
Combined LTI	4.53	4.57	4.53	0.04**
Payment-To-Gross income (%)	18.66	19.01	18.80	0.22
Payment-To-Net income (%)	24.24	25.21	24.28	0.94***
N	3,389	2,767	25,392	28,159

Table 6: Interest rate gains with EL for Non-EL borrowers

The table shows the price difference in percentage points between the actual rate paid by non-EL borrowers and the counterfactual rate for a mortgage issued for a new build property to the same borrower type, by the same lender, with the same fixed-rate period, in the same month and with a 20% smaller maximum LTV. Panel A shows results for the subsample of two-year fixed rate period mortgages issued in the first two years of the EL scheme (April 2013- March 2015) with a loan-to-value above 20%. Panel B shows results for the full sample from April 2013 to March 2017. Panel C compares results obtained with this method with results when the counterfactual rate is obtained by matching also the fee band. Information on fees is available only in 2015-2017.

	mean	**sd**	**p10**	**p50**	**p90**
Panel A: Two-year fixed rate (2013- 2015)					
LTV $>$ 85	1.47	0.71	0.65	1.34	2.50
75 $<$ LTV $\leq$ 85	0.69	0.63	-0.10	0.75	1.40
LTV $\leq$ 75	0.04	0.58	-0.60	0.00	0.75
Panel B: Full sample (2013-2017)					
LTV $>$ 85	1.11	0.82	0.00	1.18	2.15
75 $<$ LTV $\leq$ 85	0.47	0.63	-0.21	0.45	1.25
LTV $\leq$ 75	0.08	0.54	-0.45	0.00	0.70
Panel C: Full sample (2015-2017)					
LTV $>$ 85	1.07	0.79	0.10	1.07	2.10
75 $<$ LTV $\leq$ 85	0.30	0.52	-0.28	0.26	0.90
LTV $\leq$ 75	0.06	0.49	-0.40	0.00	0.55
LTV $>$ 85 (match with fee band)	1.09	0.70	0.25	1.10	1.90
75 $<$ LTV $\leq$ 85 (match with fee band)	0.31	0.48	-0.15	0.30	0.80
LTV $\leq$ 75 (match with fee band)	0.07	0.43	-0.28	0.00	0.46

Table 7: Summary statistics for non-EL borrowers by break-even quartile (2-year fixed, 2013-15)

The table reports the mean of the variable of interest for each quartile of the distribution of break-even house price appreciation. The break-even rate is calculated as in equation 3 setting T equal to the length of the fixed-rate period (24 months) and the discount rate δ equal to the actual (non-EL) mortgage rate. Data for *non-EL* mortgages with two-year fixed-rate period originated between April 2013 and March 2015 for purchase of new-built properties with value below £600,000 and with a loan-to-value above 20%.

	Mean values			
	1st quartile	2nd quartile	3rd quartile	4th quartile
Break-even hp appreciation (%)	0.67	3.01	5.10	9.32
Age (Years)	39.51	39.97	35.86	34.15
First time buyers (%)	0.31	0.32	0.43	0.47
Gross income (£.000)	65.04	52.52	58.76	53.01
Employed (%)	0.85	0.85	0.91	0.91
Self-employed (%)	0.13	0.11	0.08	0.07
Property value (£.000)	317.36	238.19	212.97	198.07
Down payment (£.000)	126.15	98.32	50.18	30.38
Mortgage value (£.000)	189.58	139.86	162.78	167.78
Interest Rate (%)	2.18	2.65	3.28	3.96
Maturity (Years)	23.14	22.43	25.96	27.30
LTV	60.24	57.27	72.12	84.08
LTI	3.28	2.95	3.03	3.27
Payment-To-Gross income (%)	19.53	19.04	18.16	20.67
Payment-To-Net income (%)	26.61	24.69	24.21	27.03

Table 8: Money left on the table

Summary statistics for money left on the table for a sample of borrowers with a two-year fixed period mortgage issued between April 2013 and March 2015 for purchase of new-built properties with value below £600,000 and with a loan-to-value above 20%. Money left on the table is defined as the net gain/loss for borrowers *if* they had taken an equity loan (see Section 4.1 for details on how the net gain/loss is calculated). Negative values indicate that borrowers would have been worse off if with an equity loan. In panel A, under the first five columns the borrower's discount rate is set equal to the interest rate for the actual mortgage (without EL). In the remaining columns the discount rate is set equal to an illustrative 20% credit card rate. In panel B, the discount rate used is the mortgage rate. All numbers are in £,000.

Panel A: Money left on the table

	δ: Mortgage rate					δ: Cr. card r.	
$LTV > 85$	Mean	SD	p10	p50	p90	Mean	SD
Money left on the table (£1,000)	-0.3	10.5	-6.1	0.9	6.4	1.1	10.4
Money left on the table (× monthly gross income)	0.2	1.4	-1.2	0.2	1.7	0.5	1.5
$75 < LTV \leq 85$							
Money left on the table (£1,000)	-3.7	9.3	-11.3	-1.5	2.7	-2.4	9.1
Money left on the table (× monthly gross income)	-0.6	1.3	-2.1	-0.4	0.7	-0.3	1.3
$LTV \leq 75$							
Money left on the table (£1,000)	-5.8	6.3	-14.4	-4.1	0.2	-4.5	6.1
Money left on the table (× monthly gross income)	-1.4	1.7	-3.5	-1.1	0.1	-1.1	1.7

Panel B: Decomposition

	Money left on the table	Forward value mortgage payment	Equity position
LTV>85			
Money left>p90	9.17	12.09	-3.37
Money left $\leq$ p90	-1.32	7.40	-8.72
75 < LTV $\leq$ 85			
Money left>p90	4.53	8.46	-4.06
Money left $\leq$ p90	-4.57	6.67	-11.24
LTV $\leq$ 75			
Money left>p90	1.76	6.48	-4.59
Money left $\leq$ p90	-6.68	7.47	-14.14

Figure 1: Equity Loan (EL) vs. standard mortgage

The figure shows two ways for a borrower to buy a new house (h) worth £200K with a down payment of £10K. The left-hand side household borrows £40K from the government through the EL scheme (e) and uses a standard 75% mortgage for the remaining part of the purchase (q_1). The right-hand side household, by contrast, borrows £190 (q_2) from the bank with a standard 95% mortgage.

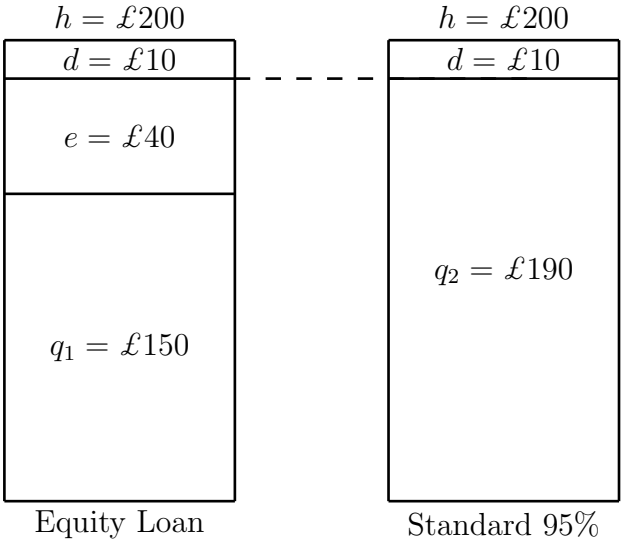
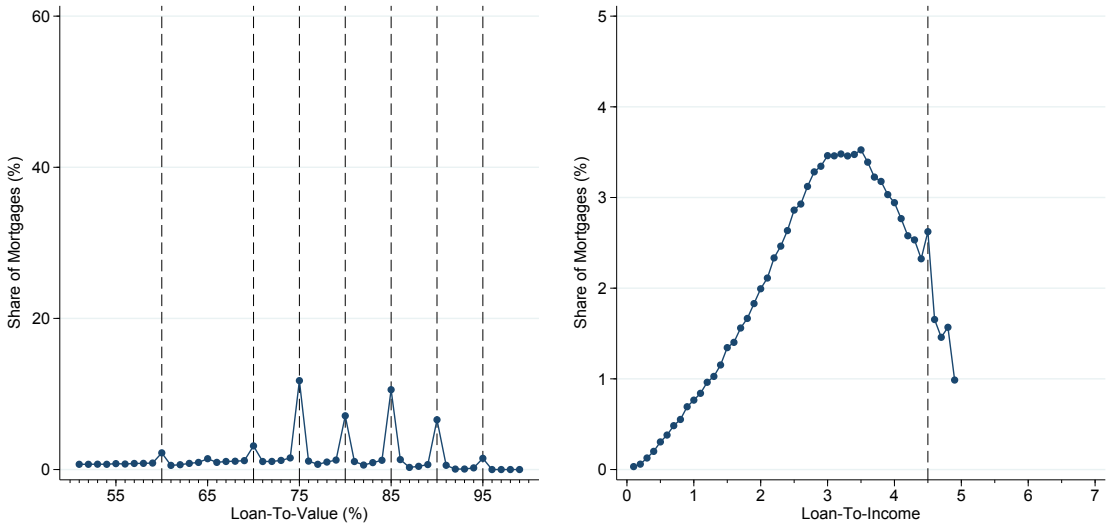


Figure 2: Loan-to-value and loan-to-income

The figure shows the distribution of loan-to-value (LTV) and loan-to-income (LTI) for non EL borrowers (Panel A) and EL borrowers (Panel B). For EL borrowers the figures show both ratios including and excluding the equity loan from the government. For LTV we round to the nearest integer bin. For LTI we round to the nearest 0.10 bin. Data for mortgages originated between April 2013 and March 2017 for purchase of new-built properties with value below £600,000.

Panel A: Non EL borrowers



Panel B: EL borrowers

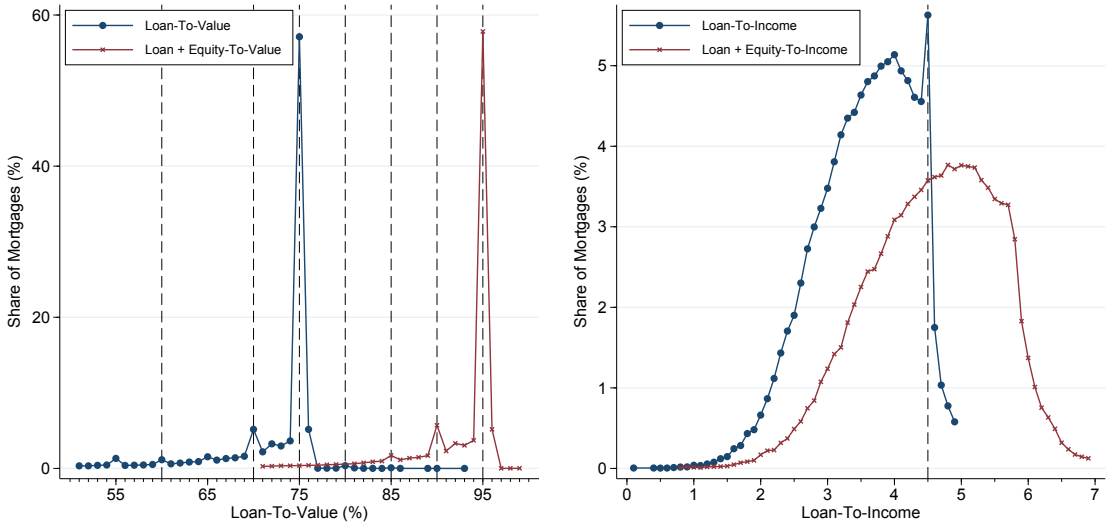
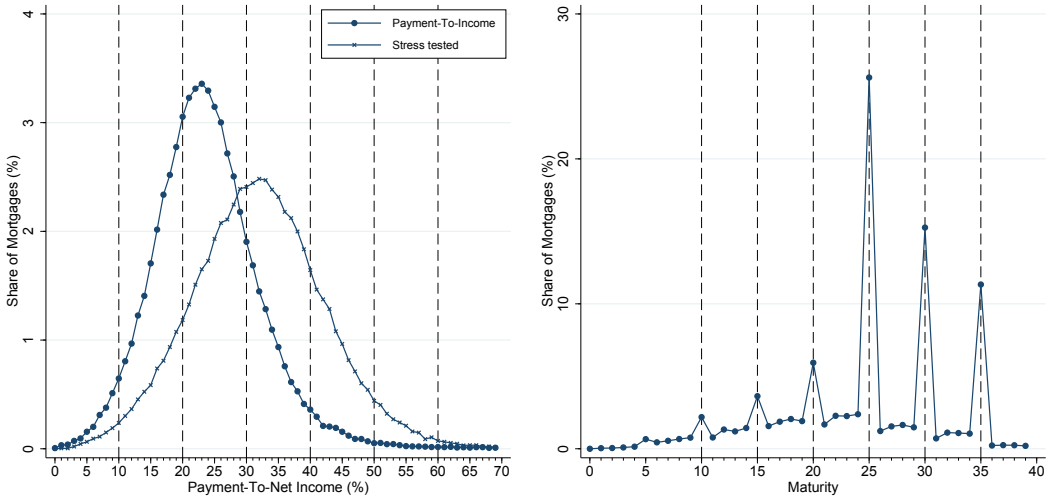


Figure 3: Payment-to-income and maturity

The figure shows the distribution of payment-to- net income (PTI) and maturity for non EL borrowers (Panel A) and EL borrowers (Panel B). For EL borrowers the PTI figure shows both ratios including and excluding the equity loan from the government. The payment + equity-to-income is constructed adding the equity part to the original loan amount and an interest rate higher by 200 basis points, which is the average difference between mortgages with 5 relative to 25 down payment. For both EL and non EL borrowers we also report the stress tested PTI by adding 300 basis points to the initial interest rate. For both PTI and maturity we round to the nearest integer bin. Data for mortgages originated between April 2013 and March 2017 for purchase of new-built properties with value below £600,000.

Panel A: Non EL borrowers



Panel B: EL borrowers

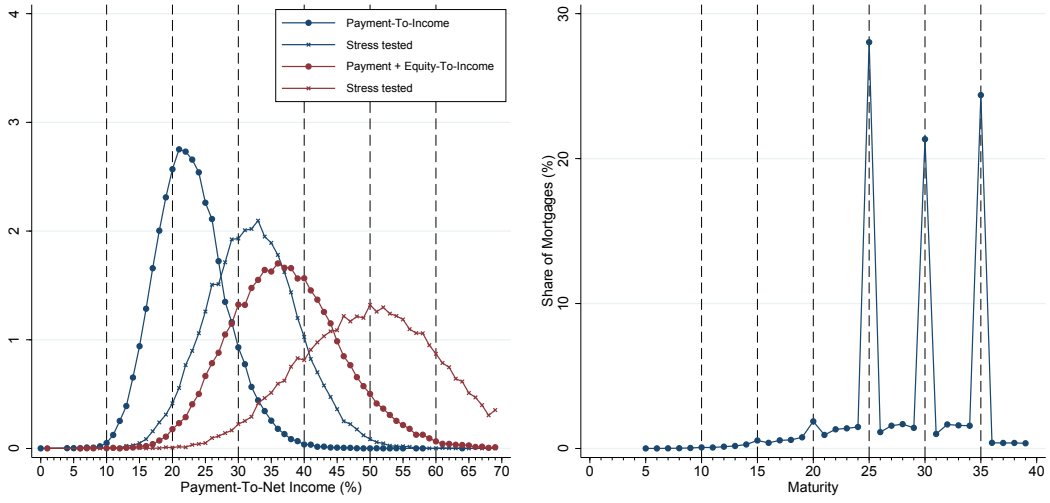


Figure 4: House prices in South-East and London

Data from the official UK house price indices by the Office for National Statistics. All indices are nominal and rescaled to 100 in January 2015.

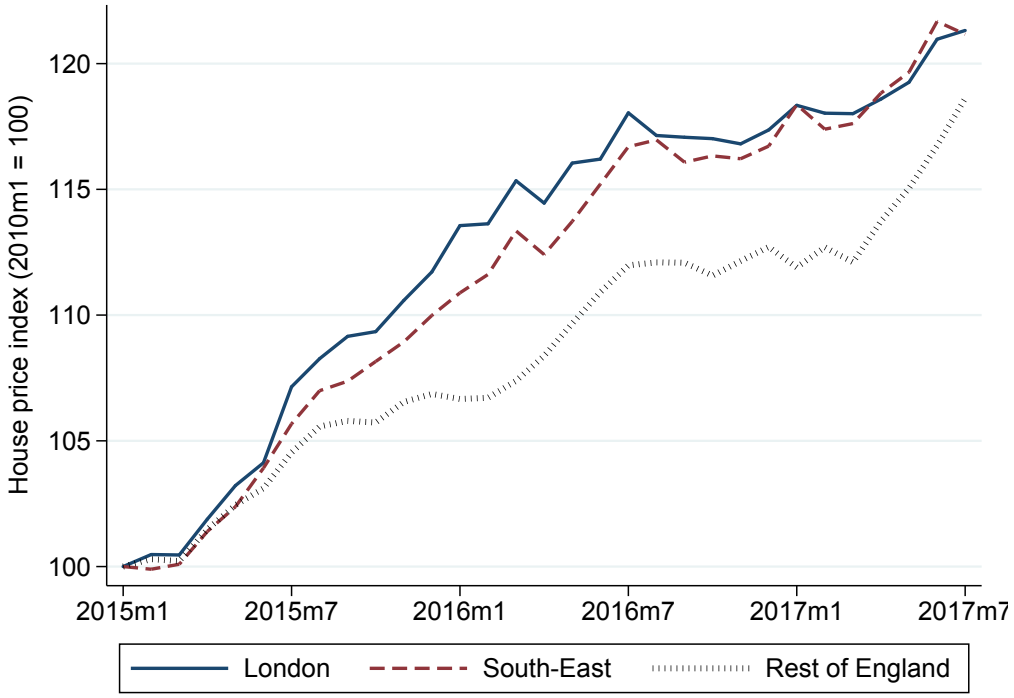
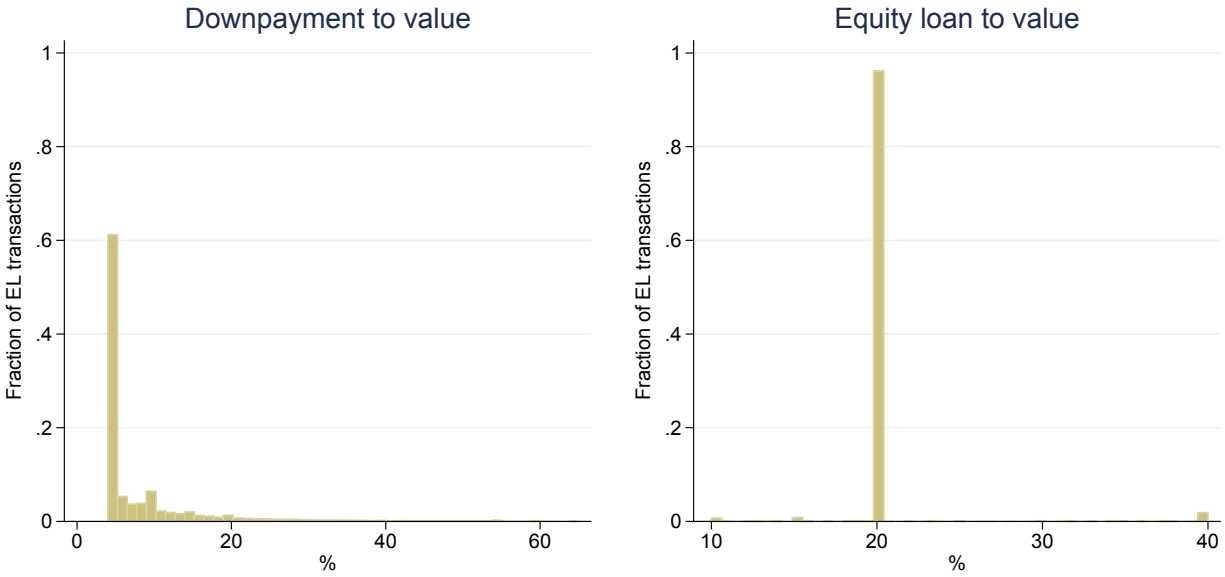


Figure 5: Down payment to value and EL to value distribution

Panel A: All EL transactions (99,565 observations)



Panel B: EL transactions in London since 1 February 2016 (3,473 observations)

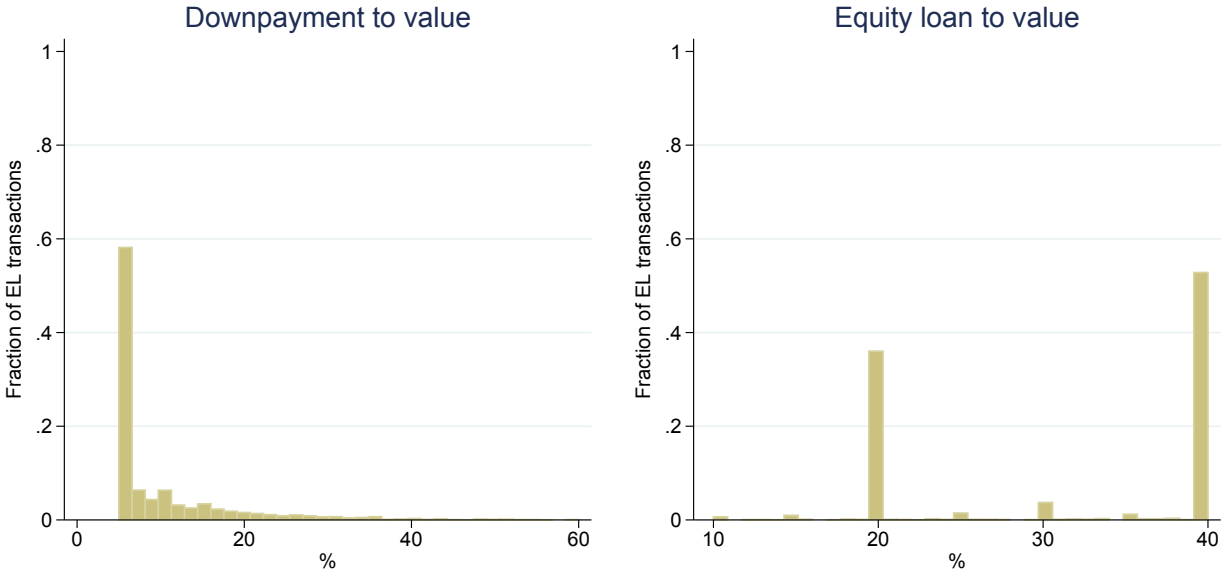


Figure 6: Bunching: London

Data from the Land Registry and HCA-MHCLG.

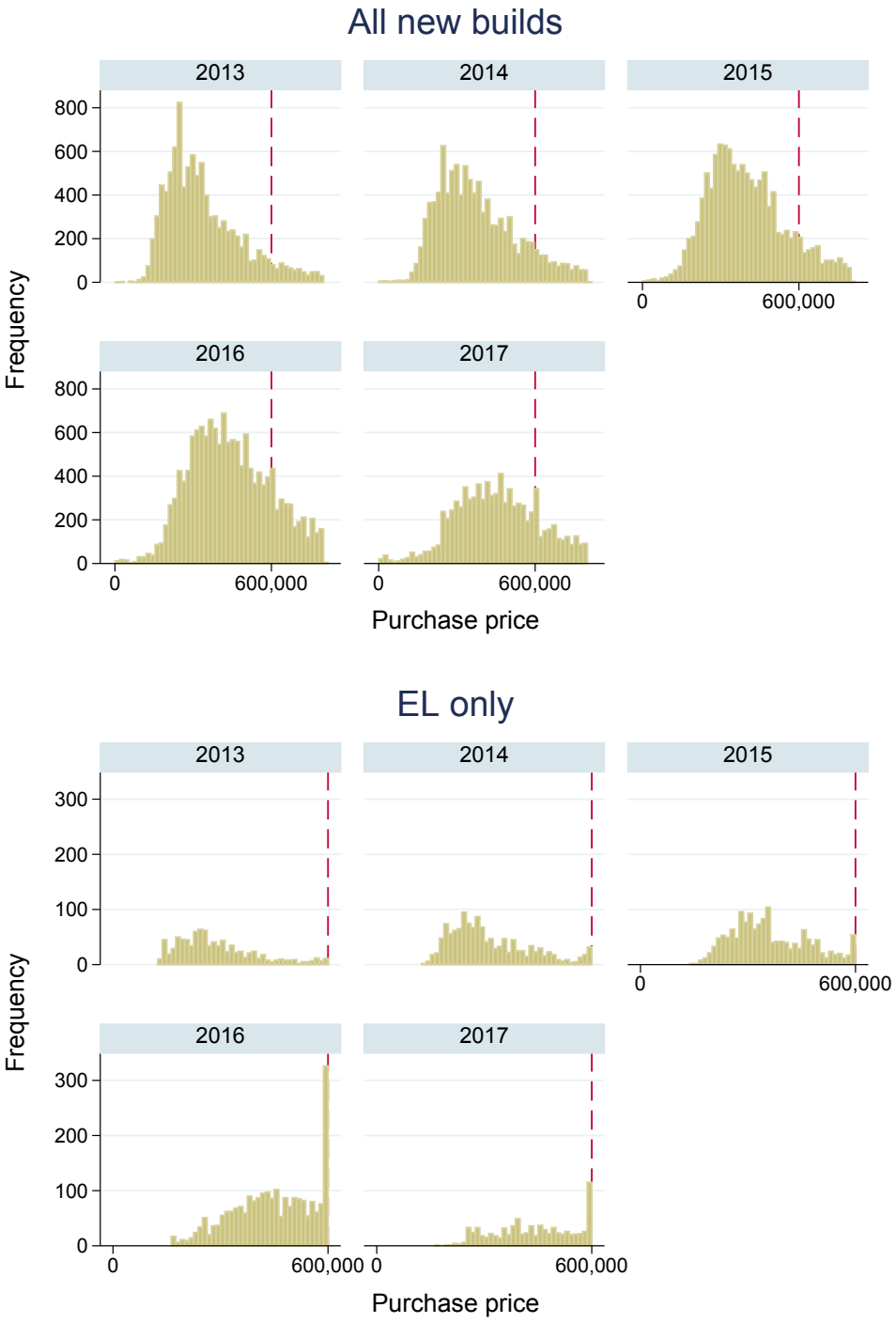


Figure 7: Bunching at £600,000 Limits in London (2015-2017)

The figure shows the distribution of age, income, deposit and the fraction of first-time-buyers for mortgages originated in 2015-2017 in London with a purchase price between £500,000-700,000.

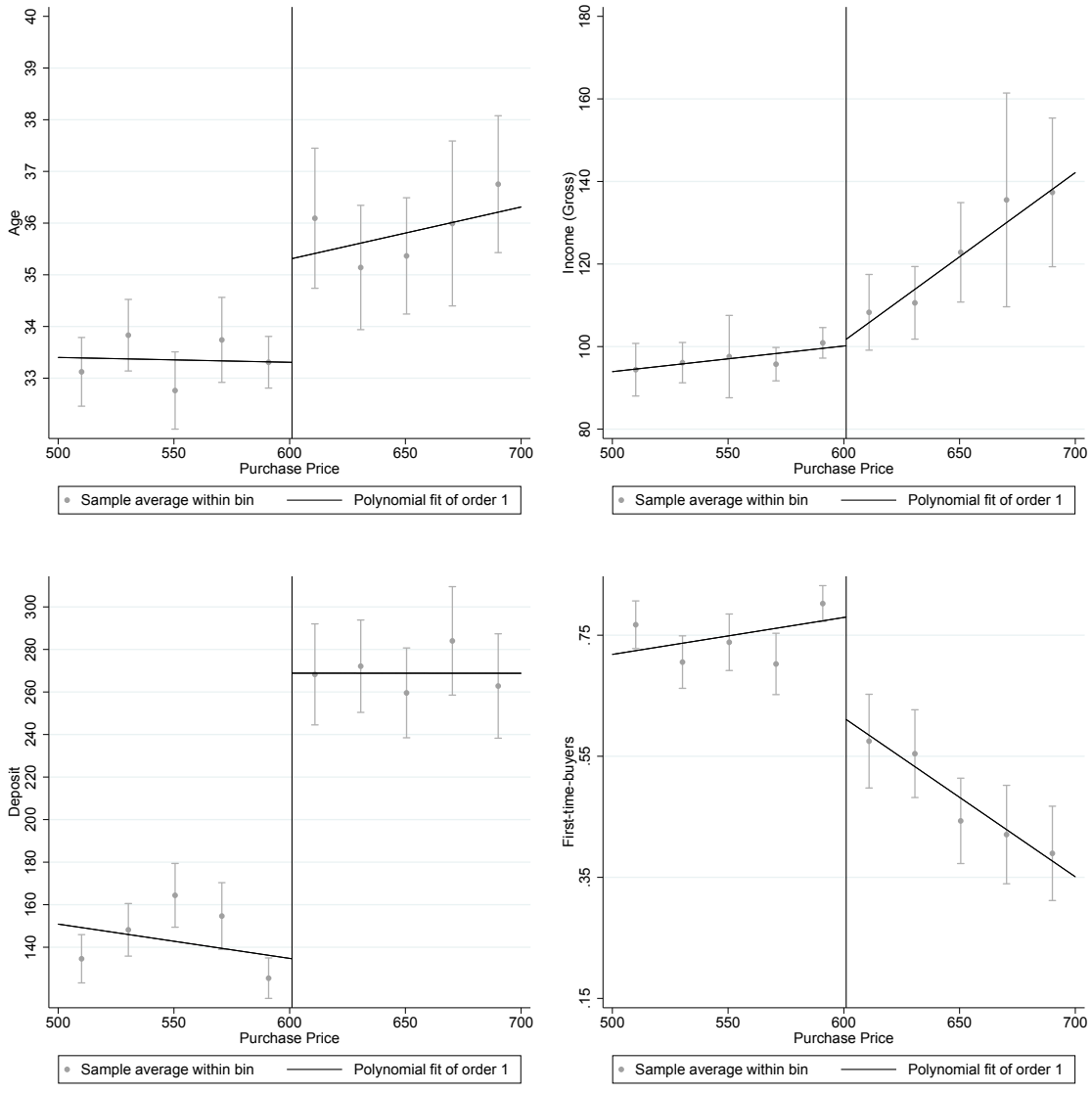


Figure 8: Bunching at £600,000 Limits in London (Placebo: old, 2015-2017)

The figure shows the distribution of age, income, deposit and the fraction of first-time-buyers for mortgages originated in 2015-2017 in London with a purchase price between £500,000-700,000 for old houses.

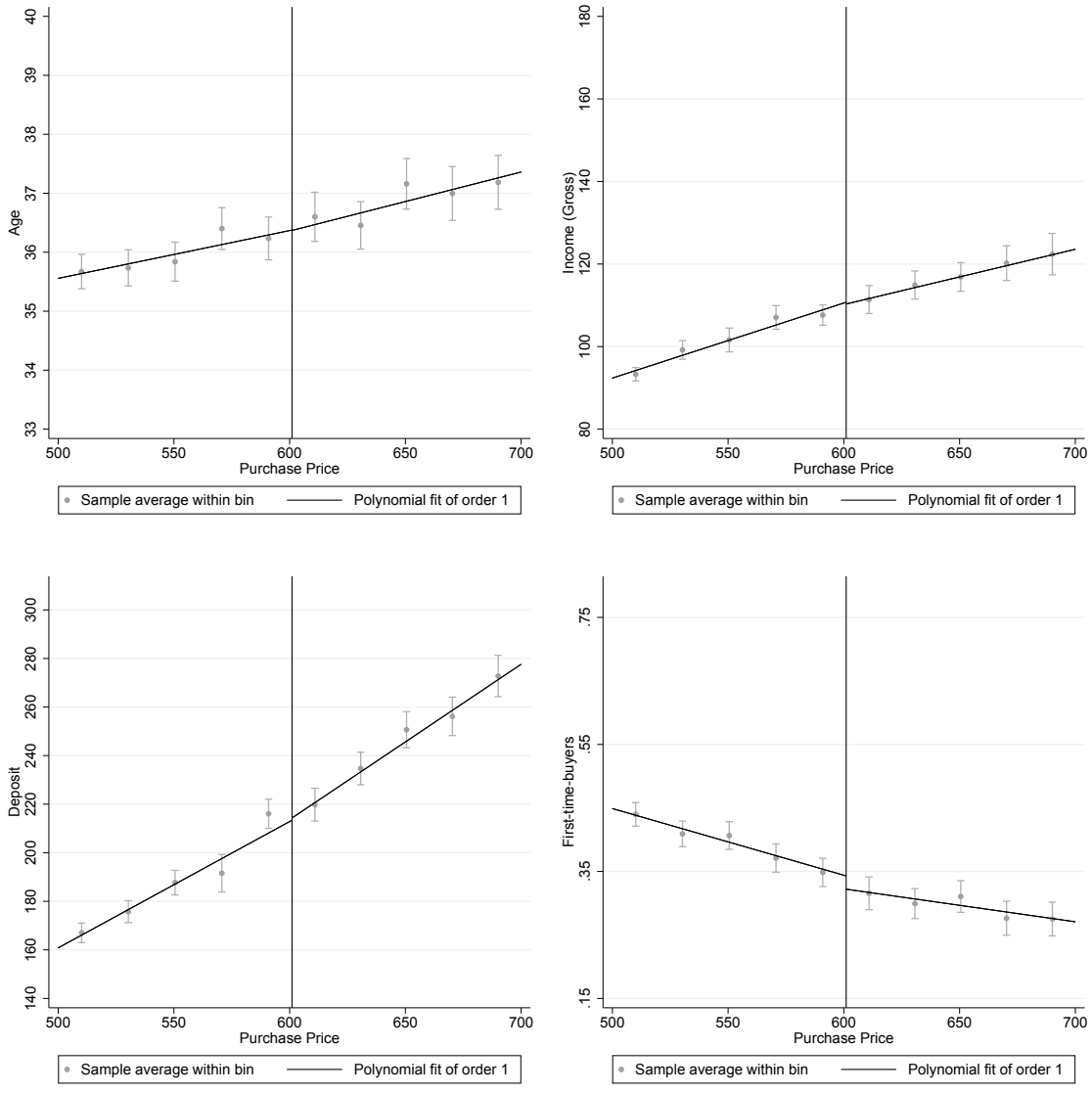


Figure 9: Bunching at £600,000 Limits in London (Placebo: new, 2011-2012)
The figure shows the distribution of age, income, deposit and the fraction of first-time-buyers for mortgages originated in 2011-2012 in London with a purchase price between £500,000-700,000.

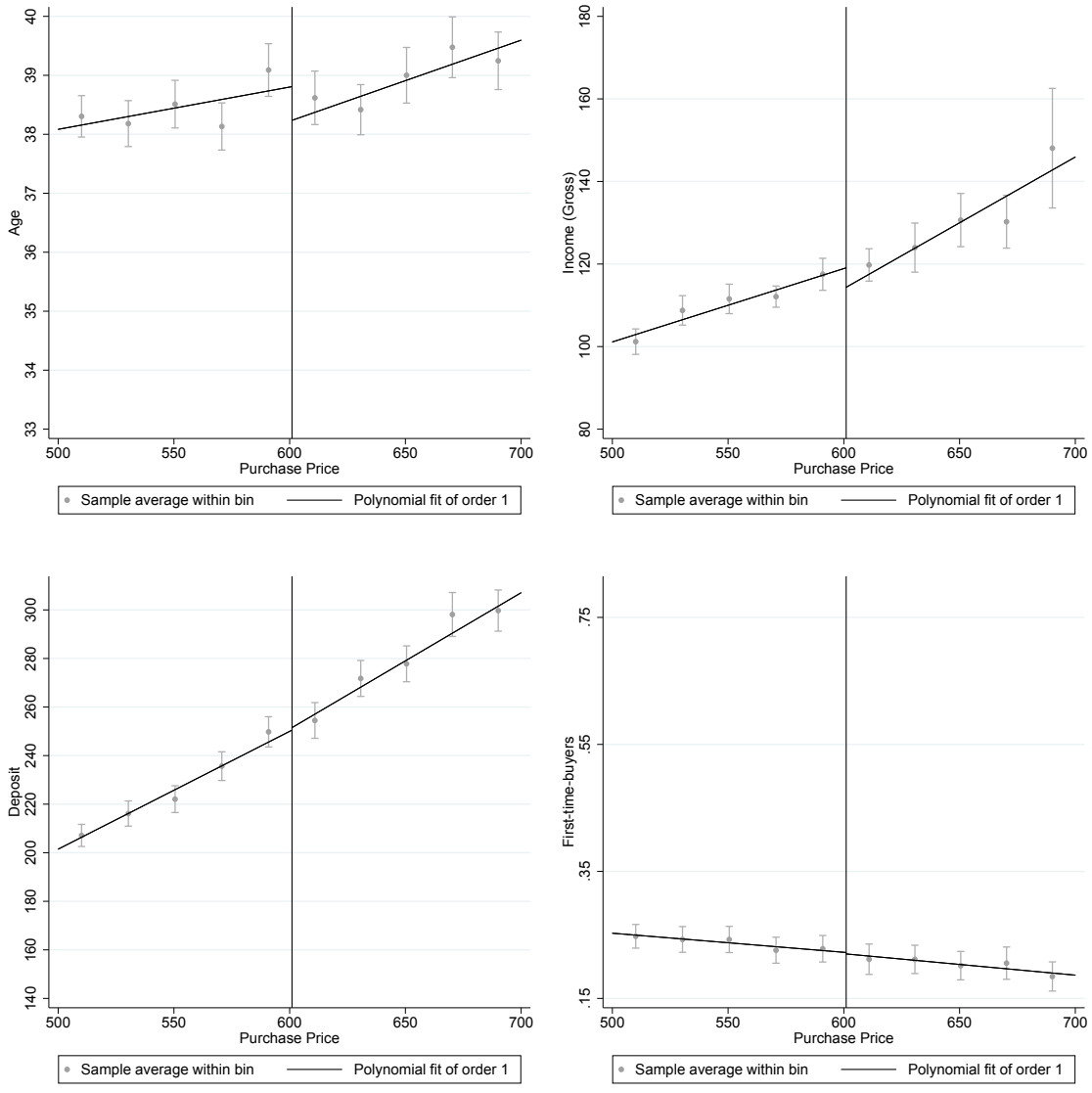


Figure 10: Cumulative redemptions

The two charts show the cumulative redemption as a percentage of total loans for two outcomes: repayment of the equity loan and sale of the property. The vertical dash lines indicate the end of the most common incentive periods for UK mortgages. The figure is based on the MHCLG redemptions data for the universe of EL issued until March 2017. The left chart includes all instances where either full or partial repayment of the EL took place (4,384 cases). The right chart includes all instances where there was a repayment through sale (5,123 cases).

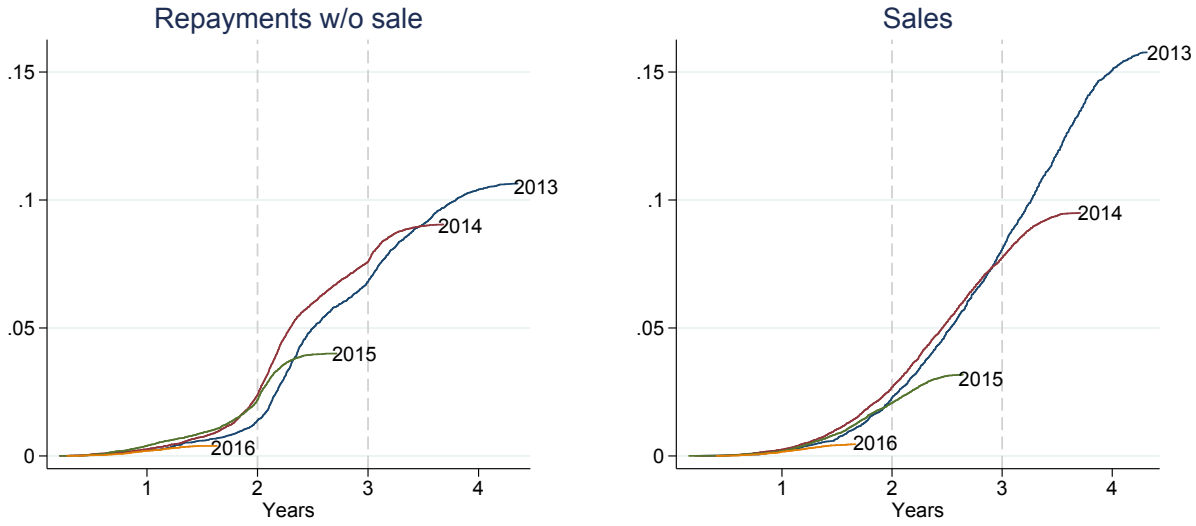


Figure 11: House appreciation and income growth by EL outcome

The left hand chart is constructed from the main sample of EL borrowers. The dotted line shows the distribution of annualized local house price appreciations in the two year following the purchase of the property for those borrowers who did not repay the EL and bought a house between April 2013 and March 2015 (34,265 borrowers). The dashed line represents those borrowers who repaid the EL through selling their property (4,751 borrowers). The solid line restricts the sample to those borrowers who fully or partially repaid the EL without a sale (staircasing, 4,008 borrowers).

The right hand chart is constructed from the sample of EL borrowers who bought their property between April 2013 and March 2015. For those borrowers, we look for a subsequent remortgage in the PSD. We are able to do so for 1,168 mortgages. Because the PSD records the income of the borrower at the moment of refinancing, we can compute the income growth between the two mortgages. The dashed line shows the distribution of income growth for the sample of EL borrowers who did not pay back the EL. The solid line restricts the sample to those borrowers who fully or partially repaid the EL.

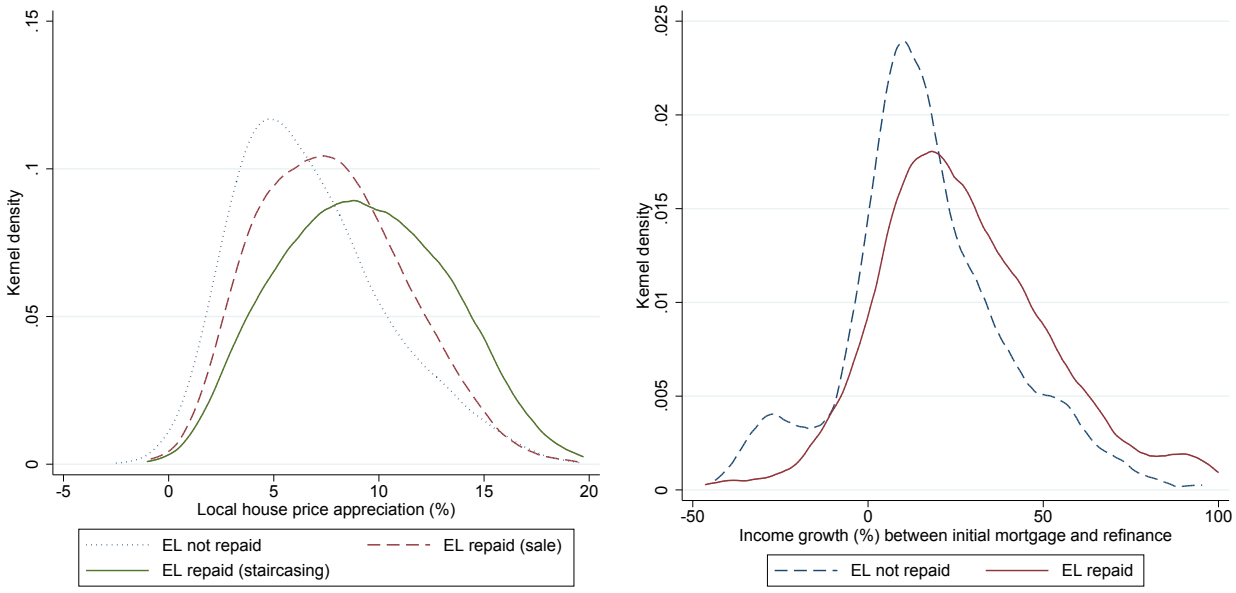


Figure 12: Equity extraction at refinance by EL outcome

The first figure is constructed from the sample of EL borrowers who bought their property between April 2013 and March 2015 and for whom we can find a subsequent remortgage in the PSD. For each of these borrowers, we compute the outstanding balance at the moment of the refinance, and compare it with the new mortgage to estimate equity extraction. (Given that only two years have elapsed since the start of the mortgage, for those borrowers where we do not have interest rate information we assume that the remaining balance is the same as the initial balance.) The left hand side chart in Panel A shows that most borrowers who did not repay extract zero equity. The subsequent chart shows that borrowers who repaid the EL extracted amounts that were very similar to the size of the outstanding EL.

The two charts in Panel B show the difference in LTV between the actual LTV when EL repay and the counterfactual LTV, if no action is taken. Given that only two years have elapsed since the start of the mortgage, for those borrowers where we do not have interest rate information we assume that the remaining balance is the same as the initial balance.

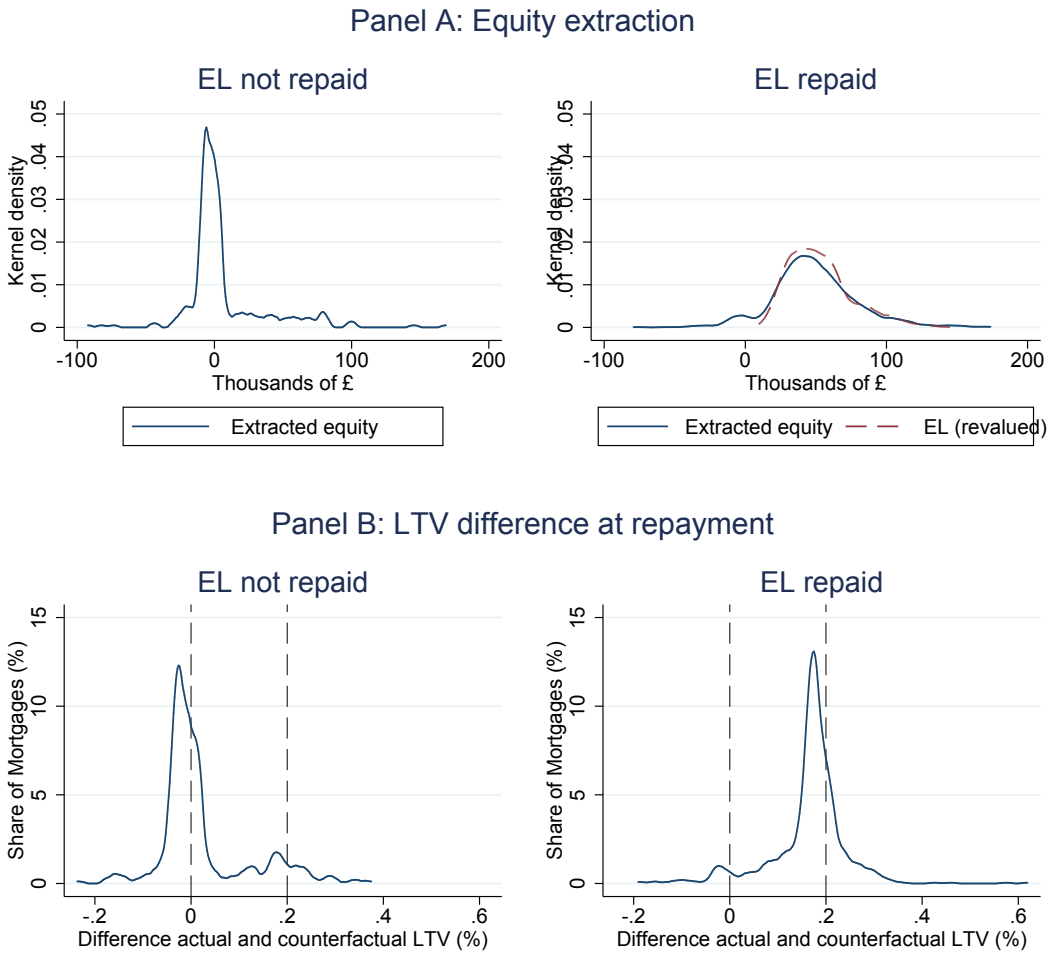


Figure 13: Monthly payment (2013-2015, 2-year fixed)

The figure shows the true monthly payment; the counterfactual monthly payment with the same loan size and the counterfactual interest; and the counterfactual monthly payment with both the counterfactual interest and loan size. Data for 2-year fixed mortgages originated between April 2013 and March 2015 for purchase of new-built properties with value below £600,000 and with a loan-to-value above 85%.

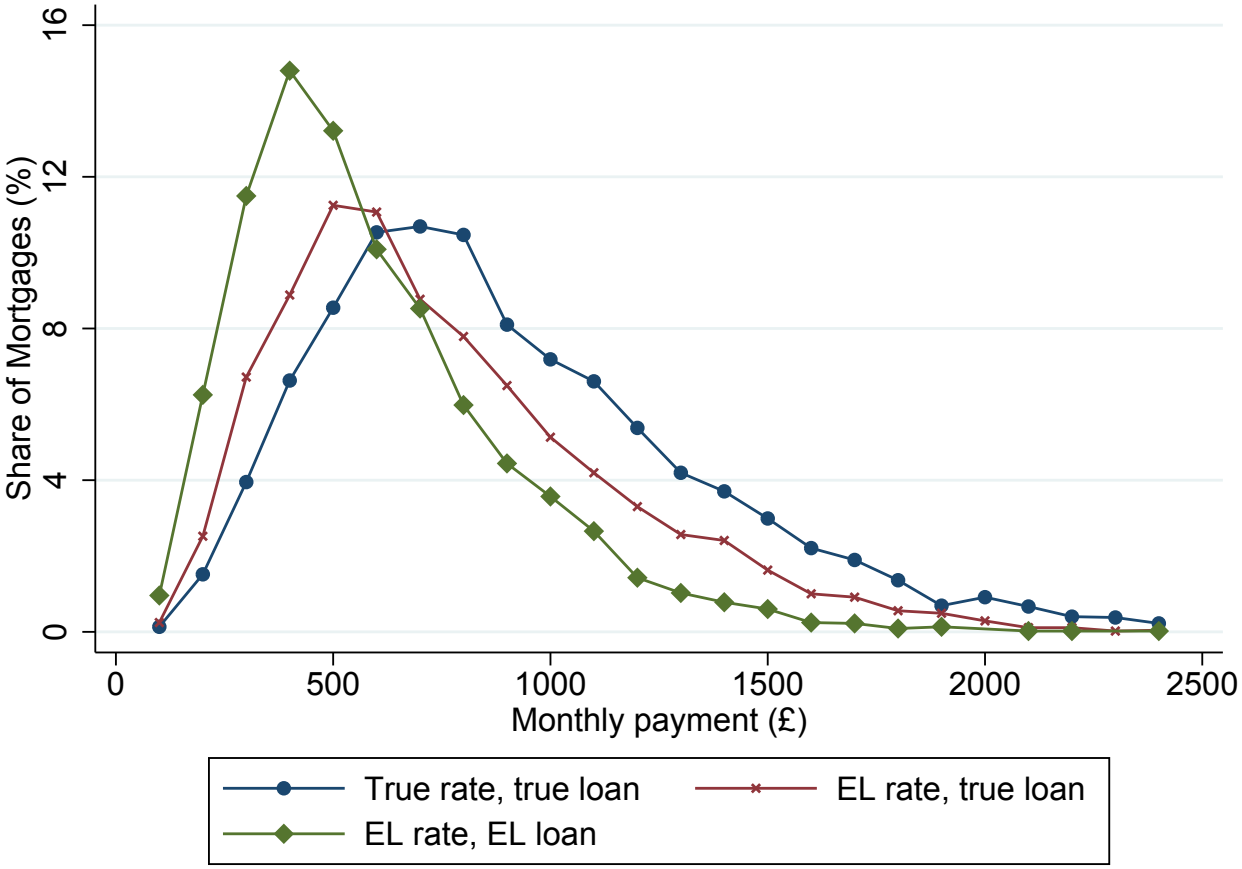


Figure 14: Break-even house price appreciation (2013-2015, 2-year fixed)

The left hand chart shows the house appreciation required for break-even between non-EL and EL mortgages. The break-even rate is calculated as in equation 3 setting T equal to the length of the fixed-rate period and the discount rate δ equal to the actual (non-EL) mortgage rate (solid line) or an illustrative credit card rate of 20 percent (dashed line). Data for *non-EL* mortgages with two-year fixed-rate period originated between April 2013 and March 2015 for purchase of new-built properties with value below £600,000 and with a loan-to-value above 20%.

The right hand chart shows house appreciation required for break-even between non-EL and EL mortgages. The break-even rate is calculated as in equation 3 setting T equal to the length of the fixed-rate period and the discount rate δ equal to the actual (non-EL) mortgage rate (on the LHS) or an illustrative credit card rate of 20 percent (on the RHS). Data for *non-EL* mortgages originated between April 2013 and March 2017 for purchase of new-built properties with value below £600,000.

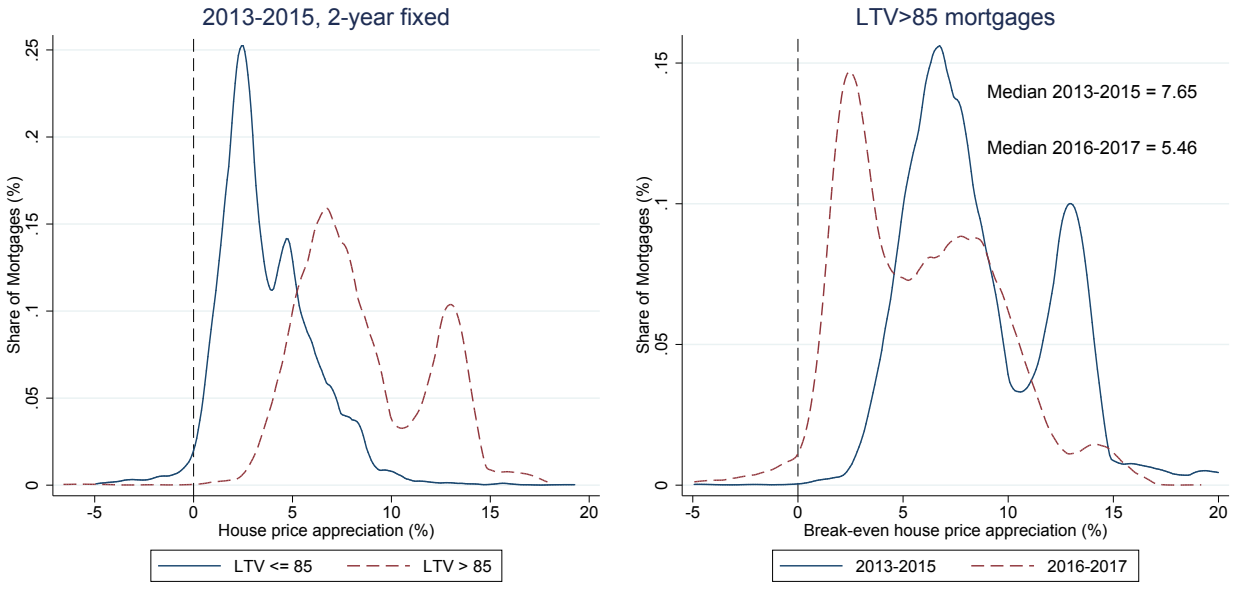
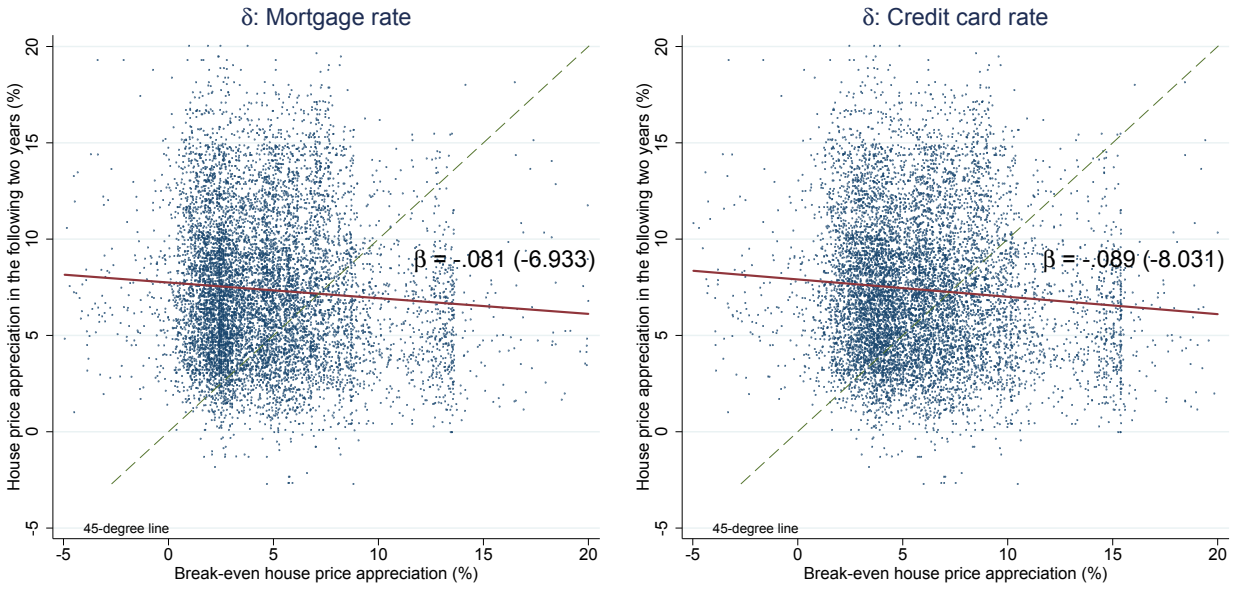


Figure 15: Break-even and actual house price appreciation (2013-15, 2-year fixed)
The figure shows the break-even house appreciation and the realized house price appreciation. House price gains estimated using local house price indices. The break-even rate is calculated as in equation 3 setting T equal to the length of the fixed-rate period and the discount rate δ equal to the actual (non-EL) mortgage rate. Data for *non-EL* mortgages with two-year fixed-rate period originated between April 2013 and March 2015 for purchase of new-built properties with value below £600,000 and with a loan-to-value above 20%.



Appendix

Table A1: Comparison EL vs. non-EL borrowers: First-time buyers

The table reports, for first-time buyers only, the results of t-tests of equality of means between EL and non-EL borrowers. Data for mortgages originated between April 2013 and March 2017 for purchase of new-built properties with value below £600,000. The last column reports the difference in means; *** denotes statistical significance at the 1% level.

	EL		Non-EL		
	Mean	SD	Mean	SD	Difference
Age (Years)	30.27	(6.48)	31.42	(7.61)	-1.15***
Gross income (£.000)	47.33	(37.92)	51.14	(388.25)	-3.81***
Employed (%)	0.95	(0.22)	0.94	(0.23)	0.01***
Self-employed (%)	0.05	(0.21)	0.05	(0.22)	-0.00***
Property value (£.000)	223.87	(97.56)	214.15	(115.81)	9.72***
Down payment (£.000)	17.71	(19.90)	62.42	(73.67)	-44.70***
Equity loan (£.000)	46.86	(28.74)	0.00	(0.00)	46.86***
Mortgage value (£.000)	159.56	(65.94)	151.47	(83.24)	8.10***
Interest Rate (%)	2.58	(0.65)	2.95	(0.89)	-0.37***
Maturity (Years)	29.73	(6.28)	27.49	(6.11)	2.24***
2-year fixed (%)	0.45	(0.50)	0.41	(0.49)	0.04***
Other fixed (%)	0.53	(0.50)	0.51	(0.50)	0.02***
LTV	72.11	(7.04)	67.66	(21.13)	4.45***
Combined LTV	92.53	(6.16)	67.66	(21.13)	24.87***
LTI	3.53	(0.72)	3.20	(0.98)	0.33***
Combined LTI	4.56	(1.02)	3.20	(0.98)	1.36***
Payment-To-Gross income (%)	17.02	(3.97)	17.55	(8.89)	-0.53***
Payment-To-Net income (%)	22.38	(5.17)	22.93	(10.12)	-0.55***
N	73,140		67,052		140,192

Table A2: Comparison EL vs. non-EL borrowers: First-time buyers (Controlling for region and year fixed effects)

The table reports coefficients and standard errors from the regression $y = \alpha + \beta_1 EL + \gamma_j + \lambda_t$, where the dependent variable y is the characteristic of interest written on the left of the table, γ_j represent a set of region dummies and λ_t are year dummies. The first pair of columns show $\hat{\alpha} + \hat{\beta}_1$, the second pair of columns $\hat{\alpha}$ and the third pair of columns $\hat{\beta}_1$. Data for mortgages originated between April 2013 and March 2017 for purchase of new-built properties with value below £600,000.

	EL		Non-EL			
	Mean	SD	Mean	SD	Difference	
Age (Years)	31.17	(0.05)	32.15	(0.05)	-0.97***	(0.04)
Gross income (£.000)	56.81	(1.94)	57.74	(2.09)	-0.93	(1.52)
Employed (%)	0.94	(0.00)	0.93	(0.00)	0.01***	(0.00)
Self-employed (%)	0.06	(0.00)	0.06	(0.00)	-0.00***	(0.00)
Property value (£.000)	292.12	(0.61)	268.63	(0.66)	23.50***	(0.48)
Down payment (£.000)	31.12	(0.35)	72.64	(0.38)	-41.51***	(0.27)
Equity loan (£.000)	51.39	(0.09)	0.00	(0.00)	51.39***	(0.09)
Mortgage value (£.000)	204.98	(0.47)	188.50	(0.51)	16.48***	(0.37)
Interest Rate (%)	2.35	(0.01)	2.47	(0.01)	-0.11***	(0.00)
Maturity (Years)	30.36	(0.04)	28.52	(0.05)	1.84***	(0.03)
2-year fixed (%)	0.62	(0.00)	0.67	(0.00)	-0.05***	(0.00)
Other fixed (%)	0.37	(0.00)	0.26	(0.00)	0.11***	(0.00)
LTV	70.01	(0.11)	66.16	(0.12)	3.85***	(0.08)
Combined LTV	92.07	(0.06)	66.16	(0.12)	25.91***	(0.10)
LTI	3.73	(0.01)	3.38	(0.01)	0.35***	(0.00)
Combined LTI	4.81	(0.01)	3.38	(0.01)	1.43***	(0.01)
Payment-To-Gross income (%)	17.37	(0.05)	17.31	(0.06)	0.06	(0.05)

Table A3: Comparison pre vs. post-London EL scheme: EL borrowers in London

	Pre		Post		
	Mean	SD	Mean	SD	Difference (%)
Age (Years)	31.95	(5.55)	31.85	(5.61)	-0.10
First time buyers (%)	0.92	(0.27)	0.92	(0.27)	0.00
Gross income (£.000)	72.37	(32.57)	73.99	(28.07)	1.62
Employed (%)	0.94	(0.23)	0.96	(0.20)	0.01
Self-employed (%)	0.05	(0.22)	0.04	(0.20)	-0.01
Property value (£.000)	360.70	(107.22)	412.67	(117.07)	51.97***
Downpayment (£.000)	33.78	(34.57)	38.85	(36.57)	5.06***
Equity loan (£.000)	71.27	(21.65)	111.87	(59.85)	40.60***
Mortgage value (£.000)	256.28	(80.15)	262.84	(78.24)	6.57*
Interest Rate (%)	2.37	(0.49)	2.19	(0.52)	-0.18***
Maturity (Years)	29.72	(4.74)	30.47	(4.85)	0.75***
LTV	71.21	(7.90)	64.88	(12.09)	-6.33***
Combined LTV	90.98	(7.97)	91.00	(7.66)	0.02
LTI	3.73	(0.67)	3.69	(0.63)	-0.04
Combined LTI	4.79	(0.91)	5.30	(1.14)	0.51***
Payment-To-Gross income (%)	17.72	(3.40)	16.84	(3.25)	-0.88***
N	1,010		1,187		2,197

The table reports the results of t-tests of equality of means between EL borrowers who bought before and after 1 February 2016 , the date of the introduction of the London EL scheme. The sample for this table is restricted to borrowers who bought within six months of 1 February 2016 (before or after) in the Greater London Area.

Table A4: Comparison pre vs. post-London EL scheme: EL borrowers in the South East of England

	Pre		Post		
	Mean	SD	Mean	SD	Difference (%)
Age (Years)	33.03	(7.06)	32.72	(7.00)	-0.31**
First time buyers (%)	0.71	(0.45)	0.71	(0.45)	0.00
Gross income (£.000)	59.65	(25.87)	61.51	(26.06)	1.86***
Employed (%)	0.94	(0.24)	0.95	(0.22)	0.01*
Self-employed (%)	0.06	(0.23)	0.05	(0.22)	-0.01
Property value (£.000)	297.40	(94.57)	315.00	(96.10)	17.59***
Down payment (£.000)	29.51	(33.06)	33.20	(35.77)	3.69***
Equity loan (£.000)	59.10	(19.11)	62.47	(19.68)	3.37***
Mortgage value (£.000)	209.23	(67.48)	219.94	(68.15)	10.71***
Interest Rate (%)	2.45	(0.51)	2.33	(0.53)	-0.12***
Maturity (Years)	29.09	(5.07)	29.76	(5.07)	0.68***
2-year fixed (%)	0.59	(0.49)	0.64	(0.48)	0.05***
Other fixed (%)	0.39	(0.49)	0.34	(0.47)	-0.05***
LTV	70.86	(8.56)	70.36	(8.88)	-0.49**
Combined LTV	90.72	(8.56)	90.20	(8.92)	-0.52***
LTI	3.67	(0.66)	3.73	(0.65)	0.06***
Combined LTI	4.72	(0.88)	4.81	(0.87)	0.09***
Payment-To-Gross income (%)	17.98	(3.62)	17.70	(3.46)	-0.28***
Payment-To-Net income (%)	24.37	(4.86)	24.25	(4.54)	-0.12
N	3,783		4,093		7,876

The table reports the results of t-tests of equality of means between EL borrowers who bought before and after 1 February 2016 , the date of the introduction of the London EL scheme. The sample for this table is restricted to borrowers who bought within six months of 1 February 2016 (before or after) and excludes EL transactions in the Greater London Area, which were affected by the new scheme.

Figure A1: Internal rate of return for equity loans

The figure plots the IRR of the EL provided by the UK Government as a function of years since purchase. Two scenarios are considered: annual house price growth of 3% and annual house price growth of 4%.

Figure A2: Local vs idiosyncratic house appreciation by EL outcome

The figure is constructed from the sample of borrowers who took on a mortgage between April 2013 and March 2015 and repaid it before the end of September 2017. The left-hand chart refers to borrowers who sold the property, whereas the right-hand chart refers to borrowers who repaid the EL without a sale (staircasing). The dotted line shows the distribution of realized house price appreciation according to the official local-authority house price index. The dashed line reports appreciation according to an index for new build properties that was estimated by the authors. The index takes all repeat sales in the Land Registry where the first sale concerns a new build. Finally, the solid line reports the actual appreciation as measured at the moment the EL was repaid. (This appreciation is recorded in the EL official data as it is used to compute the amount due to the Government.)