Housing Consumption and Investment:

Evidence from Shared Equity Mortgages*

Matteo Benetton¶ Philippe Bracke‖ João F. Cocco§

Nicola Garbarino‡

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¶Haas School of Business, University of California, Berkeley. Email: benetton@berkeley.edu

‖Financial Conduct Authority. Email: Philippe.Bracke@fca.org.uk

§London Business School and CEPR. Email: jcocco@london.edu

‡ifo Institute - Leibniz Institute for Economic Research at the University of Munich, and Bank of England. Email: Garbarino@ifo.de

Abstract

We provide empirical evidence on shared equity mortgages exploiting a UK government-sponsored product. The analysis shows how the interaction of house price growth and leverage regulation promotes product adoption. Following an increase in the equity limit, households use the additional financing to buy more expensive properties rather than reduce leverage. Equity used as complement to debt is likely to be less beneficial for financial stability than when used as substitute. Equity borrowers are less likely to change lenders when refinancing their senior debt. Finally, we measure the equity provider returns, which are impacted by selection and under-valuation at repayment.

1 Introduction

The financial risks that arise from a house purchase are among the largest that a typical household faces over the course of her lifetime. The purchase often leads to a non-diversified portfolio tilted heavily towards housing (Guiso et al., 2001), and it is commonly financed with a mortgage, creating a levered position in real estate that amplifies the effects of house price fluctuations on the household's net worth (Campbell and Cocco, 2003). The risks arise at the individual 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; Favilukis et al., 2017).

Academics, most notably Shiller (1994), have for a long time recognized these risks, and they have proposed alternative financing structures to mitigate them, including shared equity mortgages (SEMs), housing partnerships, and continuous workout mortgages (Caplin et al., 1997, 2007; Shiller, 2014; Mian and Sufi, 2015; Miles, 2015; Greenwald et al., 2017).[1] The main idea is to make the payments required by households contingent on future house values; as house price risk is shared between households and investors, both the amount of straight debt and default probabilities are reduced.[2]

In spite of the large benefits predicted by the models, these hybrid products, with debt and equity features, have not, in reality, become mainstream (Piskorski and Seru, 2018). In this paper we study a notable exception: the Help-to-Buy Equity Loan scheme introduced by the UK government in April 2013, which provided almost £10 billion in equity for the acquisition of £46.5 billion worth of properties until June 2018, and is now an integral part of the UK housing finance system. Equity Loans (ELs) are essentially SEMs with the government providing capital of up to 20% of the property price in exchange for the same share of its future value.[3] We combine administrative data on both EL and traditional mortgage borrowers to

[1]The Great Recession has spurred the academic debate about optimal mortgage design (Campbell, 2013; Campbell et al., 2018; Guren et al., 2017; Eberly and Krishnamurthy, 2014; Piskorski and Tchistyi, 2010, 2017) and the role of mortgage market characteristics for the transmission mechanism of monetary policy (Calza et al., 2013; Beraja et al., 2018; Di Maggio et al., 2017).

[2]Traditional non-recourse mortgages involve risk-sharing in the event of default (Ghent and Kudlyak, 2011; Gete and Zecchetto, 2018). Shared equity mortgages may prevent default and foreclosure externalities (Campbell et al., 2011; Guren and McQuade, 2016).

[3]We will describe the exact features of the scheme in Section 2. In September 2019, the Government

provide empirical evidence on *who* demands equity loans and *why*; *how* borrowers use EL at origination and repay them over time; and *what* are the implications for the EL providers.

A first main contribution of our analysis is to show that the *interaction* of house price increases and leverage regulation can promote the adoption of hybrid products. The house price increases make loan-to-value (LTV) and loan-to-income (LTI) macroprudential limits binding for a significant segment of the population (DeFusco et al., 2020; Acharya et al., 2018; Benetton, 2018), who demand ELs. In the US, in the years leading to the Global Recession there were also large house price increases and optimistic homebuyers, but there was a relaxation of credit standards (Keys et al., 2010). In our setting, as a result of house price increase and tightening of credit standards, we find that an overwhelming proportion of EL borrowers would not have been able to borrow the mortgage amount needed to purchase their property, without the EL or a larger down payment. These borrowers also take mortgages with longer maturities, which relaxes payment-to-income (PTI) constraints. Thus ELs allowed households to overcome macroprudential limits and to increase housing consumption.

We also exploit the discontinuity arising from the scheme's maximum property purchase price threshold of six hundred thousand pounds to study who selects into 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 significantly lower down payment than those who buy properties just above the threshold. The cumulative LTVs and LTIs (including the mortgage loan and the equity loan) are significantly larger below 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 down payment increase and the proportion of first time buyers decreases in a continuous manner with property price.

Our second main contribution is to provide evidence on how homebuyers use the ELs. We exploit a change that took place in February 2016, when the maximum EL contribution for the acquisition of properties in London increased from 20% to 40% of their price. The larger EL limit means that homebuyers may either use ELs: (i) as a substitute to traditional mortgage

of Canada launched the First-Time Home Buyer Incentive (FTHBI), which is a shared-equity mortgage that shares several features of the scheme we study in this paper (https://www.cmhc-schl.gc.ca/en/nhs/first-time-home-buyer-incentive).

financing, i.e. together with a smaller bank mortgage to purchase the same house, with smaller required mortgage payments, and with lower housing investment (due to the larger EL) or, alternatively, (ii) as a complement to a traditional mortgage, i.e. use the same mortgage and the EL to purchase a more expensive property and still satisfy affordability checks which are based on the mortgage amount (excluding the EL).

We use a difference-in-difference methodology to show that a large number of individuals took advantage of the higher scheme contribution to buy more expensive properties, and not to reduce their mortgage debt and house price risk exposure.[4] Most notably, we find that borrowers in London (the treated group) buy more expensive and bigger houses relative to borrowers in the South-East (the control group) after the increase in the maximum EL limit, while we do not find statistically and economically significant differences in mortgage amounts.[5] This result is important since ELs used as a complement to the maximum leverage that households can access are much less useful for financial stability than ELs used by households to reduce their overall indebtedness and house price risk exposure.

A third main contribution of our analysis is to provide evidence on repayment. A significant proportion of those who take out an EL decide to repay it early. We show that those who do so have experienced higher rates of house price appreciation and income growth, and that they increase their mortgage balance by an amount similar to the EL repayment due to the Government. Thus, the EL acts in practice as a form of bridging finance, until the macroprudential constraints that have led individuals to take out the EL in the first place are no longer binding, and borrowers are able to increase their housing investment.

We study government returns on EL-funded properties that are repaid with or without a sale relative to non EL-funded properties located in the same area, and purchased and subsequently sold at the same time, by focusing on repeat sales. We find that EL funded properties that

[4]Borrowers choose the amount of the EL, up to the maximum permitted, so that following the change in the scheme they could still have bought the same house with the same EL and bank mortgage. The fact that individuals take advantage of the scheme to buy more expensive houses instead of reducing bank leverage and mortgage payments may give rise to hand-to-mouth behavior (Kaplan and Violante, 2014).

[5]We also repeat our analysis focusing only on borrowers living at the border between London and the South East and find similar results. Finally we implement two placebos. First we change the implementation date of the policy to the previous year; second we construct two groups of borrowers within the South East (control) based on their distance from London. Both placebo tests yield insignificant results.

are repaid without a sale are valued significantly less than both non-EL funded properties and EL funded properties that are repaid with a sale. Hence, the option for borrowers to repay EL without a sale and the mechanism used for determining the value of their equity stake - an independent surveyor paid by the borrower - affect the returns of the EL provider via both (under)valuation and selection out of the scheme when house appreciation is rapid.

If borrowers who repay without a sale are taking advantage of the appraisal system, it should be visible in the returns that they achieve on their property between EL repayment and subsequent sale. We use transactions data to identify sales of the *same* houses that have taken place after repayment. For these properties we observe both the valuation used for the EL repayment and the subsequent sale price, from which we calculate returns. We find that these returns are on average higher than those of other properties in the same local area, and more so when the properties are sold shortly after EL repayment. Although the products that we study are supplied by the government, this novel large scale evidence on repayment can shed light on the frictions that private providers with an interest in supplying the products may encounter.

The ELs that we study are structured as a junior loan, which may constrain borrowers' ability to refinance their senior mortgage (Bond et al., 2017). Our final empirical contribution is the study of the mortgage refinancing behavior of those borrowers who did not repay the EL. This is of interest since refinancing is a distinctive feature of the UK mortgage market and the inability to refinance can have important macroeconomic consequences (Beraja et al., 2018; Cloyne et al., 2019). We find that borrowers who do not repay the EL are less likely to refinance their mortgage debt with a different bank, but they are still able to refinance with their existing lender.

In addition to those previously cited, our paper contributes to the literature that studies the dual role of housing as a consumption and an investment good (Flavin and Yamashita, 2002; Sinai and Souleles, 2005). The mortgages that we study allow the separation of these two dimensions of owner occupied housing. Our paper is also related to several recent papers studying the UK mortgage market using administrative data (Bahaj et al., 2017; Best et al., 2018; Cloyne et al., 2018; Robles-Garcia, 2018; Cloyne et al., 2019) and those that study the Help-To-Buy scheme using aggregate data (Carozzi et al., 2019). Relative to the former, our paper differs in the focus on ELs. Relative to the latter, we have individual level data on both mortgage debt and equity loans, allowing us to study borrowers' behavior with ELs at a more granular level.

The paper is structured as follows. In Section 2 we describe the scheme and the data sources. In Section 3 we study EL borrowers, to learn about their motivations for taking the product. In Section 4 we study EL repayment behavior and the implications for provider returns. Section 5 is on mortgage refinancing. Section 6 concludes with a discussion of what we learn from our setting and analysis that is of more general applicability.

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 £3.5 billion, but in November 2015 it was increased to £8.6 billion, and in October 2017 the government pledged a further £10 billion. Our data covers the April 2013 to March 2017 period, during which the total value of the equity loans granted was £5.9 billion, for the acquisition of properties totaling £28.5 billion.

Under the scheme, the government provides homebuyers with funds, the equity loan (EL), of up to 20% of the house acquisition price (up to 40% in London from February 2016). Borrowers may choose the EL fraction, but 20% is the most common value and we will use it in our description. Home buyers need a down payment of at least 5%. Households with the minimum down payment and making use of the 20% EL 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 £100 thousand.[6] The right-hand side of the same figure shows a financing structure solely with bank debt (a 95% LTV mortgage) and the same down payment.

Households must meet three conditions to participate in the scheme. First, the EL can only be used to purchase new properties with a price of £600 thousand 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,

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

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 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. During the first five years, the rate of return for the government is essentially equal to to the rate of house price appreciation.[7]

The EL scheme involves a government subsidy: during the first five years, households are entitled to live in the house, but, unless the loan is terminated, no payments other than the annual nominal £1 interest fee are due to the government. In other words, the subsidy arises because households do not have to pay the government for the implicit rent on the part of the house that they do not own. For example, for an EL of 20%, a house value of £240 thousand (the average value in our sample), and a net rental yield of 3%, the annual subsidy is $0.2 \times £240 \times 0.03 = £1.44$ thousand. For an EL of 40% (the maximum value in London since February 2016), a house value of £410 thousand (the average value in London), and the same net rental yield, the annual subsidy is as large as £4.92 thousand. After the first five years there still is a subsidy if rental yields are higher than the interest fee.[8]

The EL has a maturity of twenty five years, but early EL termination can be triggered by 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 (the minimum partial prepayment is 10% of the EL value) or fully, even without a sale, but an independent property valuation is required in order to determine the government payoff. 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 one thousand pounds. In the event of default on the mortgage loan or on the interest payments due on the

[7]In Appendix A we calculate the expected EL IRR for the government as a function of the number of years until EL termination.

[8]The magnitude of the subsidy is also affected by the fact that the interest fee is calculated using the initial EL amount and not the market value of the house.

EL, the government has the right to foreclose, but its position is junior relative to that of the senior lender.

Homebuyers are required to maintain and insure the property, and incur all the related expenses. Shared equity mortgages may induce moral hazard in property maintenance on the part of borrowers but this is less likely to be a concern during the first few years of the loan, when the properties are brand new, require limited maintenance, and are covered by a builder's guarantee (typically 10 years).[9]

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, but 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, and it can be as long as ten years. The interest rate during the fixation period is discounted (teaser rate), and reverts to a higher, floating, rate afterwards. Prepayment penalties apply only during the fixation period. As a result, many borrowers remortgage at the end of the fixation period (Financial Conduct Authority, 2018; Cloyne et al., 2019).

Due to the frequent remortgaging, 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 United States (US). Mortgage loans have typical maturities of between twenty and thirty five years.

Mortgage borrowers must meet minimum down payment requirements and undergo affordability checks. Mortgages with a LTV higher than 95% are rare. Furthermore, many lenders require larger down payments, of around 10%, when lending against new properties. These

[9]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 indexation to local house prices has benefits for risk-sharing and for the resilience of the financial system.

tighter requirements on new properties reflect higher risk (during the Great Recession the value of new properties fell further than the overall market). The loan interest rate depends primarily on the LTV and increases with discrete jumps at LTV thresholds. Borrowers typically bunch just below the LTV threshold to benefit from the lower rate (Best et al., 2018). The other variables that affect loan pricing are borrower type (first-time buyer, home mover, remortgagor) and rate type (length of fixed period). Borrower characteristics, including income and credit score, determine whether borrowers qualify for a given mortgage product, but 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. In June 2014, the Bank of England 's Financial Policy Committee (FPC) issued a recommendation that from October 2014 only up to 15% of the new mortgages originated by each lender should have multiples higher than 4.5 times income. Some lenders already enforced this limit before the FPC announcement.

Mortgage applicants must also 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 her other outstanding debts and fixed monthly recurring expenses, such as those on education and travel. The affordability checks are used to determine the maximum loan amount, but once they are satisfied they do not have a significant effect on the loan cost. Finally, unlike in the US, mortgage interest payments are not income tax deductible, so that there are no tax incentives to take on additional mortgage debt.

2.3 The data

2.3.1 Mortgage data

We obtain information on owner-occupier mortgages from the Product Sales Data (PSD). This is an administrative dataset, collected by the Financial Conduct Authority (FCA), that covers the universe of mortgages originated in the UK. The data starts in 2005, but since the EL scheme started in April 2013 we use the information in the PSD from this month onward. The PSD includes information on loan 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 onward. Before 2015 there are some observations with missing information on interest rate and period of fixation.

The PSD includes information on where the property is located (postcode) and whether it is a new build, which is a requirement for EL financing. The postcode information is very granular: each postcode covers on average around 15 properties. The PSD has information on borrower age, income and employment status at origination, and whether the borrower is a first time buyer or home mover. For our origination analysis, we exclude remortgages from the PSD (loans that are not taken for the purchase of a property). In addition, for the main analysis we restrict the data to mortgages that are used for the acquisition of new properties up to a value of £600 thousand pounds by homebuyers (buy-to-let investments are not recorded in the PSD). These restrictions mean that the acquisitions are eligible for the scheme. For our placebo analysis we also consider: 1) mortgages for new properties above £600 thousand pounds; 2) mortgages for new properties originated before the introduction of the scheme; and 3) mortgages for old properties originated during the period of the scheme.

2.3.2 Equity loan data

Our second main dataset includes information from MHCLG on all ELs originated in England from the scheme's inception in April 2013 until March 2017. This dataset has origination 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 retain information for 99,571 new build properties acquired using the EL scheme. We create a parallel dataset of 157,617 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.

To study how EL prepayment is affected by house price fluctuations, we have also obtained from MHCLG information on EL terminations. Between April 2013 and September 2017 there were 11,596 EL terminations. Out of these, 6,099 were triggered by a property sale and 4 by a property sale after repossession. In addition, there were 5,276 full prepayments of ELs and 217 partial prepayments. The EL terminations dataset 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 information on the new mortgage loan and on 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 individual properties 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 LAs, 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. We use the HM Land Registry Price Paid Data, which includes all residential property transactions in England and Wales until October 2020, to identify transactions that have taken place subsequently to the repayment of the equity loan.

3 The demand for equity loans

ELs allow the separation of the consumption and investment dimensions of housing. Homebuyers can use ELs as a substitute to traditional mortgage financing, in order to reduce leverage and exposure to house price shocks, or in addition to a traditional mortgage, in order to overcome credit constraints and increase housing consumption. In this section, we provide evidence on the drivers of EL demand. In Appendix B we develop a simple framework that guides the empirical analysis. The framework shows how the demand for ELs (which comes primarily from borrowers with low deposits) can increase when: i) house prices are high relative to labor income, and macro-prudential constraints are binding; and ii) the cost of borrowing is high, particularly at high LTVs.

3.1 Mortgage origination characteristics

We begin by presenting in Table 1 origination summary statistics on property transactions *eligible* for EL that are financed with a bank mortgage issued in England between April 2013 and March 2017.[10] We divide the sample between borrowers who did take up EL and those who did not (non-EL). 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. Non-EL borrowers have a gross income that is around thirty percent higher than EL borrowers, which is related to the fact that the latter are on average younger.[11] In order to compare the income of EL borrowers to that of the wider UK population in the same age bracket, we have obtained data from a biennial longitudinal study of UK households, entitled Understanding Society. In Appendix Figure A7 we plot household income percentiles in wave 6 of the data (corresponding to the years of 2014 - 2016), by age group (using the age of the household head). The figure shows that EL borrowers have higher incomes than UK households in the Understanding Society sample (which includes both renters and mortgage holders), but similar incomes to households in the restricted sample of mortgage holders.[12]

Table 1 shows that non-EL borrowers purchase properties that are on average 8% more expensive with a down payment that is around four times that of EL borrowers, which is explained by the fact that non-EL borrowers are on average older. The difference in mortgage amounts across the two groups is smaller than the difference in down payments, with the EL filling in the gap.[13]

[10]The PSD covers the universe of mortgages but cash acquisitions are not included. We exclude transactions that are not eligible for EL: old properties, new properties with a value above £600 thousand, and buy-to-let properties.

[11]For joint mortgage applications, the income measure refers to the income of more than one individual.

[12]The information included and the data collection process is similar to that of the United States Panel Study of Income Dynamics. We focus on borrowers aged between 25 and 49 years since they account for almost all of the EL take-up. The most significant differences occur for the 25-29 and 45-49 age groups at percentile 90 of the distributions, where the income of UK mortgage holders is above that of EL borrowers. This shows that those households with the highest incomes are less likely to make use of ELs.

[13]In Appendix C we compare the origination characteristics of EL and non-EL borrowers, but restricting the sample to FTBs.

Almost all EL borrowers choose a fixed rate mortgage, but a majority of non-EL borrowers (86%) also do so. The average mortgage maturity is substantially longer for EL borrowers, equal to 29 years, compared to 25 years for non-EL borrowers. Longer maturities can be used to lower mortgage payments and improve product affordability. The mean mortgage interest rate is higher for non-EL borrowers, but the median rate (not reported in the table) is lower. Some non-EL borrowers have high LTV bank mortgages and pay a very high interest rate, pushing up the mean value.

Lenders use LTV and LTI ratios to determine the maximum loan amount and as cut-off criteria above which they reject mortgage applications, but the EL is not included in their calculations. For each of these measures, we begin by plotting the distribution for non-EL borrowers who were eligible for the scheme. The left-hand side of Panel A of Figure 2 shows the LTV distribution. Very few mortgages have LTV above 90% and none has LTV above 95%. The right-hand side shows the LTI distribution: very few mortgages are above the 4.5 LTI cut-off.

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 plot Cumulative LTV (CLTV) and Cumulative LTI (CLTI) calculated using mortgage debt plus equity loan amount. 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 down payment (5%). The corresponding CLTV is 95%. The right-hand side of Panel B of Figure 2 shows the LTI and corresponding CLTI distributions. Compared to non-EL borrowers, the LTI distribution of EL borrowers is shifted to the right and bunched towards the 4.5 LTI threshold. This leads to a large mass, equal to 54% of EL borrowers, with CLTI above 4.5. The majority of these EL borrowers would not qualify for a larger mortgage for the same new property with the same down payment.

These calculations implicitly assume that households do not have additional wealth beyond that used for the down payment. In order to investigate the extent to which that is the case, we have obtained (anonymized) administrative data on the checking account balances at the end of the month of a sub-sample of UK residents. These checking account data are collected by a credit reference agency (unfortunately we are not allowed to disclose the name of the agency) and cover 10% of the adult UK population over the 2013-2019 period. The credit records also contain information on the financial products taken by individuals, including mortgages, which we use to match our sample (we give further details on the matching procedure in Appendix D).

We measure the checking account balances one month after the date of the property purchase to ensure that the transaction has been completed and the funds transferred to the seller. We distinguish between those borrowers who did not benefit and those who benefited from the government scheme. For the former, the percentiles 10, 50 and 90 of the distribution of checking account balances are £470, £2,573 and £12,415, respectively. For those who took advantage of the government scheme, the corresponding amounts are £396, £1,972, and £7,265. The median checking account balance of EL borrowers of £1,972 is significantly less than their median monthly income (their median annual income is £44,520 before taxes, corresponding to an after-tax monthly income of £2,826). These numbers show that the vast majority of borrowers have very limited checking account balances left after purchasing a property, and that this is particularly the case for EL borrowers.

The checking account balance is not a comprehensive picture of the wealth available to EL borrowers. In Appendix D we report survey data from a 2016 evaluation of the EL scheme,[14] which shows that EL borrowers did not have access to substantial wealth beyond that used for the down payment. We also calculate how many EL borrowers would have been able, without the EL, to obtain a mortgage for the same new property with the same down payment. We find that 8% of borrowers would have been able to buy the same property with a mortgage below the 90% LTV and 4.5 LTI thresholds. Finally, we compare the distributions of payment-to-income and mortgage maturity of EL and non-EL borrowers. We find that mortgage maturities are significantly longer for EL borrowers than for non-EL borrowers. Stretching mortgage maturity reduces mortgage payments and helps borrowers improve mortgage affordability.

3.2 Bunching and selection at the maximum property price

The EL scheme is only available for the purchase of new properties with a maximum price of £600 thousand, and this limit is more likely to be binding in London, where property prices

[14]Department for Communities and Local Government (2016), Evaluation of the Help to Buy Equity Loan Scheme.

are higher than the in rest of the country. In Figure 3 we plot the distribution of purchase prices for new properties acquired in London during our sample period. Properties below the £600 thousand limit are eligible for (but not necessarily purchased with) an EL; those above the limit are not. While a large number of properties are transacted at prices just below the limit, there is strong evidence of bunching.

We study borrower and contract characteristics around this threshold to provide evidence on selection. In Figure 4 we plot the sample average for each bin (of £20 thousand) and the corresponding confidence intervals for several variables of interest. Our results are estimated on new properties purchased in London with a price between £500 and £700 thousand. The top charts show that, compared to households purchasing properties above the threshold, those buying just below the threshold are on average two years younger (left-hand panel), and are much more likely to be FTBs (right-hand panel). Interestingly, the proportion of FTBs does not decrease with property price as one approaches the limit from below. To the extent that FTBs tend to acquire less expensive homes, in the absence of the scheme one would have expected the proportion of FTBs to decline with property price, as it happens above £600 thousand.

The bottom left chart shows that those buying below the threshold have significantly smaller down payments than those above the threshold: £160 compared to £260 thousand, respectively. The average down payment of £160 thousand (or roughly a quarter of the purchase price) below the threshold may seem high, but the data includes all mortgages for the purchase of new properties, including those buyers who have not made use of the EL, many of whom have access to substantial down payments. The bottom right chart of Figure 4 shows that although the income of those buying just above the threshold is slightly higher than the income of those buying just below the threshold, the difference is not statistically significant. This suggests that, for the sample of borrowers buying properties around the threshold in London, the EL is not being used to buy more expensive houses relative to income (at least not significantly).

Figure 5 focuses on LTVs and LTIs. There is no discontinuity at the threshold in LTV and LTI (top and bottom left panels), but the differences in CLTV and CLTI are statistically and economically meaningful (top and bottom right panels). The CLTV declines from an average of over 70% below the threshold to 58% just above. And the CLTI declines from an average of 4.5 to roughly 3.3. These comparisons show that the EL scheme has allowed young, FTBs, with small down payments to become homeowners. We have also found that the average maturity of mortgages is 29.5 years below the threshold and 27 years above the threshold, a statistically significant difference, allowing EL borrowers to reduce mortgage payments further (these results are included in Appendix E).

We perform placebos on two sets of property transactions not covered by the EL scheme: existing (as opposed to new) properties sold from April 2013 to March 2017 (shown in Figure 6) and new properties sold in 2009-2013 before the EL scheme was launched (in Appendix E). In neither of these placebos we find any discontinuities at the threshold. The age of the buyer, the down payment and her income increase, while the proportion of FTBs decreases continuously with the purchase price (although not shown in Figure 6, there are also no discontinuities in LTV and LTI). In Appendix E we also show that the distributions of prices for the two placebo samples contain no bunching at £600 thousand.

3.3 EL as complement or substitute? The London experiment

In February 2016, the UK Government increased the maximum EL contribution for the acquisition of properties in London from 20% to 40%. Borrowers still have to contribute a minimum 5% down payment, but the larger EL means that they may use a smaller bank mortgage to purchase the same property. Alternatively, EL borrowers may decide to take advantage of the larger EL limit to purchase a more expensive property (and still satisfy affordability restrictions, which are only based on the mortgage amount, excluding the EL).

The increase in the EL limit in London was a response to declines in affordability (and hence an endogenous policy change). In Figure 7 we plot the evolution of house prices in 2015-17 in London, the South East of England (SE, which excludes London) and the rest of England (excluding London and the SE). To analyze the effect of the EL policy change, we use SE as our control group. The SE did not benefit from an increase in the EL, despite house price increases that had been similar to those in London.

In Figure 7 we also plot the EL distribution in London since February 2016. Roughly 60% of ELs originated are for amounts higher than 20%, and the vast majority of them are for the highest possible amount of 40%. Prior to February 2016 almost all EL transactions were for the value of 20%. Following the change in the EL limit, the number of ELs originated grew faster in London than in the SE (18% versus 8%, respectively, in the six months after February

2016 compared to the six months before).

To investigate the effect of a higher maximum EL contribution on purchase prices and on financing structures, we apply a difference-in-difference (DID) approach to compare the changes in EL transactions in the six months before and after the policy change, in London versus the SE.[15] The equation that we estimate is:

$$y_{it} = \alpha_0 + \alpha_1 London_i + \alpha_2 PostJan2016_t + \alpha_3 London_i \times PostJan2016_t + \beta x_{it} + \epsilon_{it}. \quad (1)$$

We consider several alternatives for the dependent variable y_{it}, that we explain below. *London* and *PostJan*2016 are dummy variables that take the value of one for EL transactions in London and after January 2016, respectively. The vector of control variables (x) includes borrower characteristics (age, FTB, income and employment status) and regional house price indices. The results are not sensitive to the inclusion of these control variables. The coefficient of interest is α_3.

Panel A of Table 2 presents the DID estimates. The mean equity loan amount in London increased by an additional £37,240 compared to the SE. The value of the properties purchased with EL 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 between the increases in property value and EL, but the coefficients on these variables are imprecisely estimated. These results provide evidence that borrowers in London took advantage of the increase in EL limit primarily to buy more expensive properties (instead of reducing the mortgage amount and their house price risk exposure).

During the period of analysis house prices were increasing. And even though we control for the evolution of house prices in the regression, we are interested in investigating further the extent to which house price increases versus the purchase of larger or relatively more expensive 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

[15] In Appendix F we compare the characteristics of EL borrowers in London in the six months before and after the EL limit increase. The differences in average age, proportion of FTBs and income are neither statistically significant nor economically meaningful, indicating that the composition of EL borrowers did not change. In the Appendix we also compare the characteristics of London EL borrowers to those in the SE. Although London EL borrowers are different from those outside London (e.g. they have higher income), the pre-post differences are similar for the two groups.

between the beginning of August of 2015, when the data used in the regression begins, and the date of the house purchase. The penultimate column of the top panel of Table 2 presents results for these deflated purchase prices. The estimated positive coefficient on the interaction term of £29,610 confirms that the increase in EL purchase prices cannot be explained by local house price inflation.[16] We test this further in the last column of Table 2, where we show that the size of the EL-financed properties increased by 6.3 square meters in London post January 2016.

Figure 8 shows the averages over time for our dependent variables before and after the increase in the EL limit in London. EL amount and property price follow a parallel trend in London and the SE and start diverging after the change in the limit, while the trend in the mortgage amount is unaffacted by the policy change. While the trends in Figure 8 support our identification approach and in spite of the similarities between London and the SE, one may reasonably argue that there are still significant differences between these two regions.

To address this argument, we estimate a second set of regressions focused on a narrower geographical area that only includes outer London local authorities (treatment group) and SE local authorities neighboring London (control group).[17] To check the parallel-trend assumption for the DID analysis, Figure A13 in the Appendix plots the evolution of the dependent variables. Similarly to the comparison between London and the SE, the increases in EL amount and property price following the change in the limit are clearly visible. In Panel B of Table 2 we report the results for this second set of DID regressions. Despite the reduced sample, the main results are unchanged. EL borrowers inside the London boundary took advantage of the higher EL to buy more expensive houses. Additionally, the dummy for London is less significant than in Panel A and the magnitudes are reduced, as we are now comparing more similar neighboring

[16]The estimated negative coefficients on the $PostJan2016$ may seem strange, given that house prices increased during the sample period. The reason is that in the regressions we are also controlling for the evolution of house prices. When we do not control for the evolution of house prices, the estimated coefficients on the Post January 2016 dummy become positive, but all the other coefficients remain virtually unchanged.

[17]When we consider this narrower area, sorting outside or inside the border based on financing needs may become more prevalent in the data. In Appendix F we compare the characteristics of borrowers in the outer London boroughs in the six months before and after February 2016. We find no significant changes in age, proportion of FTBs, income, and in other borrower characteristics, suggesting that the sorting across the London boundary was not quantitatively important over this period.

properties.

In Appendix F we report the results of two placebo tests. In the first test, we compare London to the SE one year *before* the policy change. We find no statistically nor economically significant differences with the exception of house size (in square meters) which was lower in London than in the SE, post January 2015. In the second placebo test we compare SE local authorities on the London boundary against other SE local authorities (further away from London boundary), and we find no statistically significant effects. The results of our analysis show that EL borrowers in London used the additional EL financing to buy more expensive properties instead of reducing bank leverage and house price risk exposure. The evidence in this section supports the view that the significant demand for ELs is driven primarily by the objective of increasing housing consumption, and not of reducing housing investment.

3.4 Equity loan versus debt with a government guarantee

An important question is how the demand for ELs differs from the demand for other products that benefit from government down payment assistance, such as the provision of government debt insurance, which is widely used in the US by borrowers participating in the Federal Housing Administration (FHA) market. The insurance protects lenders against losses in case of default, and it allows borrowers with small down payments, including FTBs, to access mortgage finance at LTVs and interest rates that would not be accessible to them in the absence of the government guarantees. In our sample of EL takers there is a high prevalence of FTBs.

Notably, the ELs that we study differ from government guarantees in terms of the mortgage payments required from borrowers. In order to show this, in Figure 9 we plot the distribution of initial mortgage payments relative to income (net of taxes) for EL borrowers in our sample. We also plot the distributions for two counterfactual scenarios. In the first, we assume that, instead of using the EL, borrowers take a larger standard mortgage with an amount equal to the actual mortgage amount plus the value of the EL. As previously shown, for most EL borrowers, this implies a mortgage with a 95% LTV, and we use the correspondingly higher mortgage interest rate. Therefore, in Figure 9 the distribution of required mortgage payments for this scenario (labeled standard 95%) is to the right of the EL base case for two reasons: a higher mortgage amount and a higher interest rate. In this and in the next counterfactual scenario we assume that the mortgage maturity is the same as in the base case with the EL.[18]

The second counterfactual scenario corresponds to the case in which borrowers benefit from a government mortgage guarantee (MG). More precisely, we still assume that borrowers replace the original mortgage and the EL amount with a mortgage for the whole amount, but the mortgage is insured by the government for the part of the loan above 75% LTV. This means that the loan amount and LTV are those of a high LTV mortgage (as high as 95%), but the interest rate that borrowers pay is that of a 75% LTV mortgage (that we calculate from our data). We assume that no mortgage insurance premium (MIP) is payable to the guarantee provider, but it would be straightforward to do the calculations adding an annual insurance premium to the loan rate.[19] In Figure 9 the distribution of mortgage payments to income for this mortgage guarantee scenario is to the left of the standard 95% distribution (due to the lower mortgage rate).

Compared to an EL, a MG scheme may lead to higher required mortgage payments and unaffordable debt. Naturally, mortgage guarantees can be combined with ability-to-repay restrictions, such as those in the Dodd-Frank act, requiring lenders to consider a borrower's ability to repay the mortgage before extending credit. However, debt and a MG with ability-to-repay restrictions may prevent FTBs from qualifying for the scheme and becoming homeowners. The EL is an alternative that helps borrowers access external financing while keeping mortgage payments affordable.[20]

It is important to point out that our comparison of the EL and MG does not try to set the government assistance to the same level in the two alternatives. The measurement of the assistance requires a model of the default and refinancing decisions of borrowers for the different possible realizations of interest rates, house prices, and household incomes, and for each of the

[18]It is important to note that this counterfactual scenario is a hypothetical scenario since it would lead many EL borrowers in our data to go above the maximum 4.5 LTI limit.

[19]For example, the current annual FHA MIP is 0.80% (1%) for loan amounts $\leq$ (>) $625,500.

[20]The mortgage payments to income (PTIs) shown in Figure 9 are front-end PTIs that do not take into account the servicing of other debts and committed expenditures. If EL borrowers are constrained in their ability to meet mortgage payments, then one might expect that in addition to taking the EL they make use of other avenues to reduce the required mortgage payments. One way of doing so is by stretching the maturity of the mortgage. In Appendix D we show that mortgage maturities are significantly longer for EL borrowers than for non-EL borrowers.

two alternatives. But in the EL alternative the suppliers of finance benefit from the expected house price appreciation. Therefore, for a given level of government assistance, the required debt payments will be lower than those in a pure debt contract (where the suppliers of finance do not benefit from the potential upside on the equity component of the financing).[21] In Section 4.2 we provide evidence on the realized returns for the EL provider.[22]

3.4.1 Mortgage guarantees: the UK evidence

To provide additional evidence on down payment assistance, we compare EL to a MG scheme that was launched by the UK government in October 2013 (shortly after the EL). The MG scheme insured lenders against loan losses on LTVs between 80% and 95% (for seven years after origination), in order to support the supply of high-LTV mortgages, which had declined after the Great Recession. Similarly to the EL scheme, eligibility was limited to loans used to finance the purchase of a main residence with a maximum price of £600 thousand, and (from June 2014) a maximum LTI of 4.5. Unlike the EL scheme, MG could also be used to offer loans on existing properties. Lenders who wanted to participate in the MG scheme had to pay a one-off upfront fee for the insurance, which increased with the LTV of the loan.[23] Other than the upfront fee, no other payments were due to the government.

The government had originally made available up to £12 billion of guarantees, but only

[21]The higher the expected rate of return on housing and the more the EL provider values exposure to residential real estate, the lower the required debt payments compared to those required of a pure debt contract with a government guarantee. The presence of the EL may also introduce additional costs, if it makes remortgaging more difficult or if it leads to moral hazard in home maintenance. We present evidence on these below.

[22]In Appendix B we include a simple numerical example that shows the circumstances in which an EL is preferred by borrowers compared to a high LTV mortgage with government insurance. Borrowing-constrained individuals with high marginal utility of consumption value the lower servicing requirements of the EL financing structure.

[23]Lenders retained a five per cent share of net losses above the 80% threshold. The initial fees were: 28bps for loans in the 80-85% LTV bracket; 46bps for 85-90%; and 90bps for 90-95%. Lenders could purchase insurance from the government for loans in one or more of these buckets. But if the lender did so, all the loans originated by the lender within that bucket had to be placed into the scheme (the aim was to avoid adverse selection). In the UK MG scheme the role of the government was not always visible to borrowers, who could take a high LTV loan from a bank, with a given interest rate, without knowing whether the lender had purchased insurance on the loan.

£2.3 billion were used. Lenders gradually opted out of the MG scheme, preferring to offer high LTV products without using the guarantee, and the scheme was closed in December 2016. Even though we do not have information on the individual loans that benefited from a MG, we were able to obtain aggregate data.[24]

Figure 10 compares the distributions of property price (Panel A) and borrower income (Panel B), for both the MG and the EL schemes. ELs were used to purchase houses that were considerably more expensive than those purchased with a MG, but the differences in the distributions of borrower income are smaller. Thus, the ELs allowed borrowers to buy more expensive houses relative to their income within the macroprudential limits in place.

4 Equity loan repayment and returns

The previous section considered the demand for EL, and borrower behavior at mortgage origination. In this section, we study the drivers of EL repayment and their implications for provider returns. We show that there are significant return differences between repayments triggered by a property sale, for which the sale price is used to determine the value of the government's equity stake, and repayments without a sale and assessed property values. We identify subsequent sales of the latter group of properties, and calculate returns since EL repayment, to show evidence consistent with under-valuation in assessed property values. At the end of the section, we use realized house prices during our sample period to calculate the ex-post monetary gains/losses of ELs for borrowers.

4.1 Selection into equity loan repayment

We begin by studying equity loan repayment behaviour as a function of the number of years since origination. Figure 11 shows the cumulative EL repayments over time separately for each cohort of ELs originated in a given calendar year. For example, out of the ELs that were originated in 2013 (the first year of the scheme), one in four had been repaid after four years (11% and 16% for repayment without and with a sale, respectively). For repayments without a sale (left-hand

[24]The data are from the HM Treasury, Help to Buy: Mortgage Guarantee Scheme, Quarterly Statistics, Data from 8 October 2013 to 30 June 2017 (some pre-approved loans were completed in the first half of 2017).

side panel), larger increases in repayment are visible at around two and three years, the most common periods of interest rate fixation, and when many borrowers remortgage. In contrast, repayments triggered by a property sale (right-hand side panel) increase more smoothly with the number of years since origination.

We focus on ELs issued between April 2013 and March 2015, for which at least two years have passed since origination. In Appendix J we compare the origination characteristics of the EL borrowers by repayment outcome (repaid with a sale, repaid without a sale, did not repay). EL borrowers who repaid without a property sale are more likely to be younger and FTBs at origination. Affordability constraints are likely to be more binding for these groups of individuals, and these constraints may be relaxed by the subsequent evolution of house prices and household incomes.

To investigate these effects we calculate, for each repayment outcome, the distribution of the annualized rate of local house price appreciation in the two years following origination, using official house price indices measured at the local authority level.[25] The top left-hand side of Figure 12 plots the results. This was a period of rapid house appreciation, and borrowers who repaid without a sale (also called staircasing) experienced the highest rates of house appreciation, followed by those who repaid due to a sale, and finally those who did not repay.

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—without an increase in household income these constraints may actually become more binding.[26] For a subsample of households who remortgaged with a different lender, our data has income information at the time of remortgaging, which we use to calculate income growth

[25] For the cases in which the loan has been repaid, we have information on the individual house price used to compute the amount due to the government. We study these in the next section. Our objective here is to compare borrowers who have repaid the EL against those who have not, so that we use local authority indices for both.

[26] A simple numerical example helps 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 its value 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.

since origination.[27] The top right hand panel of Figure 12 shows that those borrowers who repaid the EL (without a sale) have benefited from higher income growth than those who did not do so. This relaxes the macroprudential constraints that have led borrowers to take the EL in the first place, and they respond by repaying it and increasing their housing investment. For these households the EL is used as a form of bridging finance.

Finally, we investigate the sources of funds for the repayment of the EL. If constraints become less binding, households can borrow a larger mortgage amount than that 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) to repay the EL. The bottom panel of Figure 12 shows that those borrowers who repay the EL extract substantial amounts of equity, and 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).

4.2 Implications for equity provider returns

The analysis in the previous section highlights that local house price growth can relax borrowing constraints and facilitate EL repayment. These selection effects could impact the returns to the EL providers, which might be also affected by agency problems related to maintenance and property valuations (required when the EL repayment is not linked to a property sale). We start assessing these factors by using local house price indices to measure the realized annual return in the two years following the house purchase. As in the previous section, we take the sample of properties purchased with an EL between April 2013 and March 2015. We perform similar calculations for the sample of new build properties eligible for an EL, but purchased without.

Table 3 reports the average annual returns, calculated from local house price indices, by EL status (EL used or not) and, for those in which an EL was used, by EL repayment outcome (EL not repaid, EL repaid, also distinguishing between repayment with and without a sale). First, the realized average annual return for non EL-funded purchases is equal to 5.28%, marginally higher than the value of 5.13% for EL-funded purchases. This suggests that EL-funded pur-

[27]Income information is not captured in the PSD when the remortgaging is with the same lender. This explains the smaller number of observations.

chases are located primarily in areas with high house prices that witnessed lower subsequent increases, but the difference between the two values is economically small.

The differences in average returns by repayment status are larger. First, the average annual return for EL-funded (but not repaid) properties is 4.90%, compared to 6% for properties whose owners repaid the EL, reflecting borrowers' decisions to repay the EL in local areas where house prices have been increasing faster. Second, there are significant differences in returns between EL repayments with and without a property sale, which are equal to 5.46% and 6.65%, respectively. In other words, repayments without a sale tend to occur in local areas where house prices have been rising the fastest.

For the subset of properties financed by an EL that has been repaid, we can measure the realized *actual* government returns using the sale value of the individual property (for repayments with a sale) and the valuation of the property used to determine the government interest (for repayments without a sale, also known as staircase). Table 3 shows that for ELs repaid with a sale, the actual average annual government return was 5.48%, very similar to the 5.46% calculated using local house price indices. However, for ELs repaid without a sale the realized government returns were 3.88%, a value that is -2.77% lower than the annual returns calculated using local house price indices. This suggests that too low a valuation is being given to the properties. (We provide additional evidence on valuations in the next subsection.)

The differences in unconditional averages between potential and actual government returns from Table 3 may also arise from variation in the timing of the purchase (we use all purchases between April 2013 and March 2015) and in the location of the purchased properties. To account for these factors, we focus on repeat sales, thus controlling for all property characteristics that are time-invariant. For the ELs repaid without a sale, we have the valuation of the property that is used to determine the amount due to the government as the "sale" price of the property. We estimate a fixed-effect model controlling for local house price trends through the interaction of purchase year, sale year, and local authority dummies. Thus, our identification of the differential effect of EL-funded purchases that were repaid with or without a sale comes from variation in prices relative to non EL-funded properties located in the same area (and purchased and subsequently sold at the same time).

Table 4 reports the results. Column (1) shows the results for EL repaid with a sale. The idiosyncratic component of house price changes does not differ significantly between EL properties and other non-EL funded new homes. This result is consistent with the previously reported averages. It is also evidence that EL buyers did not pay more for their properties relative to non-EL buyers of new homes (such overpayment would imply a significant negative effect in the first column of Table 4).[28] Furthermore, the results do not support the hypothesis that there has been significantly lower maintenance by EL buyers (the estimated coefficient should be negative). However, two caveats should be noted. First, this evidence is only for ELs with a sale, and not for other EL funded properties. Second, it is important not to generalize this result to shared equity schemes in general, since we are only able to measure appreciation for new homes sold after a relatively short holding period.

Column (2) of Table 4 shows that EL-funded properties that were repaid without a sale had a realized house price growth that is 6.7% lower than other non-EL funded new homes. Recall that the difference in average annual returns calculated using local price indices was -2.77%. The estimated difference in the second column of Table 4 is the total difference between property purchase and EL repayment (between two and three years for most EL staircase repayments in our data), so that the magnitudes are comparable. This means that EL funded properties that are repaid without a sale are valued significantly less than non-EL funded properties. In column (3) of Table 4 we repeat the analysis keeping all EL-funded properties that have been repaid. We find that EL funded properties that are repaid without a sale are valued significantly less than both non-EL funded properties and EL funded properties that are repaid with a sale.

In spite of the under-valuation, during the period of our analysis, the realized government investment returns were fairly attractive: an annual 5.48% (3.88%) for EL repayments with (without) a sale. The weighted average of the two figures is 4.75%, which compares very favorably to the yield on UK government bonds (for instance, at the end of December 2015, the yield on 2-years (20-years) bonds was 0.68% (2.71%)). In addition, many governments (including the US and the UK) want to promote homeownership, and as we show the EL scheme is used by young, FTBs with low down payments to make the transition from renting to homeownership. The caveat is that the realized government returns are likely to look very

[28] The analysis presented in Section 4.4 implicitly assumes that borrowers would not pay a higher price for the same property, should they decide to fund their purchase partly with an EL instead of relying only on a standard mortgage. In other words, sellers do not price differentiate between EL and non-EL funded transactions. This evidence shows that this is a reasonable assumption.

different in a crisis.

4.2.1 Property valuation for equity loan repayment

The previous section showed significant return differences between repayments with and without a sale. In this section, we study the source of the differences. When an EL is repaid without a sale a valuation is carried out by an independent surveyor paid for by the borrower, and the literature has shown that surveyors' incentives can be a significant factor driving their valuations (Agarwal et al., 2017). In this case, a higher valuation triggers a larger repayment by the borrower, who therefore would like to understate actual house price growth. Alternatively, in the presence of incomplete information, surveyors could choose to use the latest transaction price as the starting point for their valuation. Because of a lack of effort (moral hazard) or because of genuine uncertainty, surveyors then deviate from this default valuation only when they can point to additional information implying substantial appreciation or depreciation of the property.

In order to provide evidence on these alternative hypothesis, Figure 13 compares the whole distribution of appreciation rates based on the actual house values recorded by the scheme after repayment (either via a sale or staircase repayment) to the distribution based on local house price indices. A bump is visible around zero in the distribution for repayments based on a valuation, but not in the distribution for repayments triggered by a sale.

If borrowers are taking advantage of the appraisal system, it should be visible in the ex-post returns, i.e. in the returns that they achieve on their property between EL repayment and subsequent sale.[29] We use data from the HM Land Registry Price Paid Data, which includes all residential property transactions in England and Wales until October 2020, to identify transactions of the *same* houses that have taken place after EL repayment.

We focus on repayments without a sale since the evidence of borrowers gaming the appraisal system refers to these. We are able to identify 1,109 instances of the same house being subsequently sold.[30] For these properties we observe both the valuation used for the EL repayment and the subsequent sale price, from which we calculate an annual return. (Naturally, the dates

[29] We would like to thank an anonymous referee for this suggestion.

[30] The number of observations is of course limited by the fact that the EL is a relatively recent scheme, by the number of repayments that have occurred, and by the end date.

of the EL repayment and subsequent sale, and the time between repayment and subsequent sale differ across properties. We explore this further below.)

In the first column of the first panel of Table 5 we compare the annual return between repayment and sale for individual properties to the annual house price return during the same time period and in the same area (we use local house price indices). The actual average return for the properties that were previously EL-financed was 7.46%, compared to an appreciation of 3.96% in local house price indices. This is consistent with an undervaluation of the property for EL repayment and the gaming of the appraisal system.

In the remaining panels of Table 5 we exploit the time that has elapsed between EL repayment and subsequent sale of the property. In the second (third) panel we calculate returns using only those transactions for which at most (at least) 6 months have passed between the two dates. The idea is that if on a given date the EL is repaid using a certain valuation and shortly after the same property is sold using a significantly higher valuation, this may constitute further evidence of gaming of the appraisal system. We say may since it is possible that after the EL is repaid but prior to the sale of the property, the homeowner engages in property improvements that we do not observe. However, the likelihood of this being the case is reduced by the fact that the properties in our analysis are new and covered by a builder's guarantee.[31]

In the first column of the second panel of Table 5 we see that EL borrowers who sell shortly after repayment are able to achieve very high returns (of 25.34% annualized). This high value is in part explained by the fact that we are reporting an annualized figure. The actual not-annualized return is 4.86%, and the properties in this group are sold on average 110 days after the EL is repaid. For the properties that were sold at least six months after repayment, the actual average return was 5.42%, more comparable but still significantly higher than the appreciation of 3.67% recorded in local house price indices. These returns are consistent with (at least some) EL repayers gaming the appraisal system: they achieve higher returns than other properties in the local area and more so if they sell soon after buying out the government.

In the second column of Table 5 we provide further evidence on the gaming of the appraisal system, by calculating returns for sales that follow a zero change in valuation. More precisely,

[31]An alternative explanation is that there are differences in the expected returns of the properties. However, in this case, households would have to be ex-ante choosing properties with initially lower expected returns (between origination and repayment), followed by higher expected returns (between repayment and sale).

we calculate returns between EL repayment and subsequent sale using only those observations for which the property valuation used for the repayment is exactly the same as the original purchase price of the property (i.e. at EL origination). The hypothesis behind this test is that zero change valuations are relatively more likely to refer to instances of gaming. Consistent with this hypothesis, we find that the differences between the actual property returns and the local area returns are higher for repayments with a zero change in valuation. As before, the differences are larger for sales that occur shortly after repayment.[32]

Overall, the results show that the option for borrowers to repay without a sale affect the returns of the provider via both (under)valuation and selection out of the scheme when house appreciation is rapid. In our case, the EL provider is a public scheme, but similar factors may affect the returns of potential private suppliers. The evidence highlights the importance of the mechanism used for determining the value of the provider's equity stake.

4.3 Future property returns after equity loan repayment

We have shown that EL borrowers repay in response to past house price appreciation. This raises the questions of whether they are expecting the appreciation to continue and are able to time the loan repayment to coincide with higher future house prices.[33] We investigate whether repayment is concentrated in periods and local areas where there is higher house price appreciation *after* the repayment. We focus on EL repayments without a sale (staircasing), for which repayment unambiguously results in increased exposure to local house appreciation, and (as a comparison group) on properties with an EL that was not repaid. In the case of repayment in combination with a sale, we do not know if the EL borrower has bought a bigger house in the same local area and in this way takes advantage of future house price increases. Throughout, we compare the evolution of local house price indices to abstract from return effects arising from valuation appraisals.

For properties with repayment (staircasing), we calculate returns in the 12 and 24 months

[32]The actual not-annualized return for those properties that were sold less than 6 months after a repayment without a change in value, i.e. the value that corresponds to the 52.25% annualized figure, is 8.19%, and these properties were sold on average 130 days after the EL was repaid.

[33]How house price expectations affect household behavior has been studied by Case and Shiller (2003); Landvoigt (2017); Kaplan et al. (2017); Adelino et al. (2018); Bailey et al. (2018).

period subsequent to repayment. For properties without repayment, we calculate returns in the 12 and 24 months starting two years after EL origination. Most bank mortgages in the UK have an initial rate that is fixed for two years, after which pre-payment penalties no longer apply. Columns (1) and (2) of Table 6 show the results, respectively.

We find that annual local house price growth was on average 4.39% in the 12 months (2.99% in the 24 months) following an EL repayment via staircasing, against local house price growth of 4.91% (3.84%) for EL properties without repayment (all return figures are annualized). Thus EL borrowers who repaid their loans experienced lower subsequent local house price appreciation than those who did not repay. The absolute difference in returns between repayment and no repayment is larger at the 24-month (0.85%) than 12-month (0.52%) horizon, but both differences are statistically significant (at the 1% level). We have previously shown that EL borrowers repay their loans in response to past high house price appreciation. The results in Table 6 show that the past high appreciation tends to be followed by relatively lower appreciation compared to that experienced by those EL borrowers who did not repay (particularly so at the 24-month horizon).

The return differences between columns (1) and (2) may be due to: (i) the location of the properties for which the EL is repaid; or (ii) the timing of repayment. In order to disentangle the two, in column (3) we measure the 12- and 24-month future returns for a matched sample of ELs that have not been repaid, where for each observation of EL repayment we randomly match one observation of non-EL repayment. This ensures that for repaid and matched ELs we calculate future returns over the same time period, with return differences arising solely from the location of the properties. The return differences are smaller, but still economically and statistically significant. This shows that both the location and timing of the repayments explain the lower future local area returns for properties associated with EL repayment.

4.4 Ex-post borrower monetary gains/losses

In this section we construct a measure of the (ex-post) monetary gains for borrowers from the use of the EL. We do so by calculating their ex-post wealth with EL minus without EL. The EL financing structure has lower mortgage balances and required payments, but borrowers must share house price gains with the government.

We perform these calculations for all borrowers, including EL and non-EL takers. For EL takers, their wealth in the non-EL scenario is calculated assuming that they purchase the same property without the EL and the funds sourced through mortgage debt instead. The vast majority of these hypothetical loans have a LTV of 95%, and in our calculations we use a correspondingly higher mortgage interest rate. They assume a scenario with relaxed credit constraints, in which EL borrowers would qualify for the larger mortgage debt. For non-EL takers, their wealth under the EL scenario is calculated assuming that the household buys the same property with the same down payment, an equity loan and a correspondingly smaller mortgage amount.[34]

It is important to note that our calculations compare two financing structures with the same level of housing consumption assuming that households do not have a preference for full, exclusive ownership of their house. In other words, we take a purely investment perspective, and assume that households do not derive disutility from the government having an equity stake in their house.[35] We also abstract from moral hazard in maintenance arising from partial ownership. With an EL, households may under-maintain their property, and some may prefer not to use the loan as a commitment device to engage in the optimal level of maintenance. EL-financed properties are new and covered by a builder's guarantee, so that moral hazard may be less relevant during the first few years of the loans, but it will become increasingly important as the properties age.

We first calculate a threshold level of house price appreciation, at which the benefits from lower interest payments in the EL are equal to the house price gains that accrue to the EL provider. We calculate this break-even rate η_{BE} by equating the future value of the cash-flows of the EL and non-EL financing structures at terminal date T:[36]

$$0.2P_0(1+\eta_{BE})^T = Q_T - Q_{EL,T} + (mp - mp_{EL}) \cdot s_{T\delta} \qquad (2)$$

[34]For example, suppose that an eligible homebuyer does not use the EL scheme and purchases a £100 property with a 15% downpayment and a 85% LTV bank mortgage. Alternatively, this homebuyer could buy, in a counterfactual scenario with EL, the *same* property with the same 15% downpayment, a 20% EL, and a 65% LTV bank mortgage. The counterfactual is 40% in London from February 2016 onwards.

[35]In reality, there may be social/cultural motives for preferring full rather than partial ownership. These could be related to the social status granted by home ownership, which may diminished by the presence of EL.

[36]Appendix H gives further details.

where the left-hand side is the future value of the house due to the EL provider and the right-hand side is the future value of the mortgage payment savings in the EL compared to no-EL. $Q_T - Q_{EL,T}$ is the time T difference in mortgage principal outstanding without and with EL respectively, and $mp - mp_{EL}$ is the difference in monthly mortgage payments. The latter are capitalized to date T using the constant annuity formula $s_{T\delta}$ with rate δ. In the calculations we set the horizon T equal to the fixation period of the initial mortgage interest rate, which typically varies between two and five years. The rate δ used to calculate the future value of the mortgage payments is set equal to the actual mortgage rate.[37] For values below (above) η_{BE} a risk-neutral individual is better (worse) off with the EL.

The EL financing structure has lower mortgage balances and interest rates. The left hand chart of Figure 14 plots mortgage interest rates as a function of LTV, distinguishing between mortgages originated in 2013-2015 and 2016-2017. The interest rate schedule is fairly flat for LTVs below 80%, but it increases steeply with increases in LTV above this level.[38] The dots measure the number of observations in the corresponding LTV bin. We use these mortgage rates for the calculations. For instance, for non-EL borrowers, and for the hypothetical EL financing structure, we use the mortgage rate that corresponds to the reduced LTV.

In the right hand chart of Figure 14 we plot the median break-even rate as a function of the original LTV. Focusing first on the mortgages originated in 2013-2015, we see that the break-even rates for loans with an (original) LTV over 85% are substantial: over 5% for those in the 85% LTV bin and almost 8% for those in the 90% LTV bin (the median value across all the borrowers with LTV greater than 85% is 7.7%).

In Figure 14 we also compare the results for mortgages originated in 2013-2015 to those

[37] This is the rate at which the household is borrowing, and we assume that it reflects the value of an additional pound today for the household. After the initial period of fixed rates households do not face prepayment fees and they usually refinance their bank mortgage. The formula is valid for up to a maximum horizon 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.

[38] The mortgage interest rate is estimated for each LTV from a regression of the individual level interest rate on LTV bin and interacted with product level-time fixed effects. Best et al. (2018) use a similar specification to identify the interest rate jumps at maximum LTV limits in a sample of remortgagors in the UK. Benetton (2018) shows that the product level-time fixed effect capture approximately 85% of the individual level variation in mortgage rates in the UK. The charts in Figure 14 do not display discrete jumps of mortgage rates just after the thresholds (e.g. 80%, 85%) because rates are aggregated in LTV bins.

originated in 2016-2017. Interest rate differentials were large at the beginning of the scheme, and fell later together with a reduction in credit spreads between high- and low-LTV mortgages, leading to a significant reduction in the median break-even rates shown in the right hand panel. These results show how a reduction in the cost of high LTV mortgages (due for example to government guarantees), has the potential to crowd out the demand for housing finance products with an equity component.

For the mortgages originated in 2013-2015 with a two-year fixed-rate period, we use the realized house price changes at the end of this period to calculate the difference in wealth with and without EL. We use local house price indices, so that we abstract from gains that EL borrowers may be able to achieve due to lower property valuations being used for repayment. Panel A of Table 7 shows the differences in pounds (in Panel B they are expressed as multiples of monthly household income). In each of the panels, we first show the results for non-EL borrowers. Both at the mean and at the median the sample of *all* non-EL borrowers are ex-post better off without the EL: if they had used the EL they would have had £4,100 and £2,400 less, respectively. These results are due to the rapid house price appreciation that occurred during the sample period. It is mostly non-EL borrowers with high LTV loans (higher than 85%) who would have been better off with the EL: a median gain of £900, but even among this group the use of the EL would lead to an average loss of £300 (second row of Panel A).

The bottom part of each panel shows the results for EL borrowers. As before, we report results for all EL borrowers in the first row, and by LTV band in the remaining rows (the amount borrowed in the non-EL scenario includes the original mortgage amount plus the equity loan, which we refer to as CLTV). The LTV bands are the same as those for non-EL borrowers, but it is important to note that the number of observations in each band is significantly different. The vast majority of EL borrowers have a CLTV in the 85%-95% bracket, since most of them put down the minimum 5% down payment.

Focusing on actual EL borrowers in this highest LTV band, we see that their mean gain from using the EL is £500. This compares to a mean gain of £-300 for actual non-EL borrowers. A t-test of the comparison of means has a p-value of less than one percent. Thus, borrowers who decided to use the EL are on average those who ex-post benefited more from their use. As expected, the differences in wealth between EL and non-EL increase when we set the discount rate equal to the credit card rate (the savings in monthly mortgage payments provided by the

EL are more valuable). It is important to emphasize that these are ex-post calculations. This was a period of large house price increases and many individuals are ex-post better off without EL. But even with large realized house price gains, many high LTV borrowers did not to use the EL and left on the table a significant sum.

5 Mortgage refinancing frictions

The previous section has shown that mortgage refinancing is important for EL repayment, and hence for borrower and government returns. In this section, we investigate whether the presence of an EL makes it more difficult for mortgage holders to refinance.[39]

Refinancing frictions can have important macroeconomic consequences. In particular, monetary policy transmission is hampered when borrowers are unable to refinance their mortgages in response to lower interest rates (Beraja et al., 2018; Di Maggio et al., 2020). The refinancing difficulties may arise from payment to income restrictions (Greenwald, 2018), employment documentation requirements and out-of-pocket closing costs (DeFusco and Mondragon, 2020). Particularly relevant for our setting, Bond et al. (2017) show how the presence of junior loans constrains borrowers' ability to refinance a senior mortgage. This is particularly important for borrowers who do not repay the EL loan: as explained in subsection 2.2, frequent refinancing is a distinctive feature of the UK mortgage market.

5.1 Types of refinancing

There are several types of mortgage refinancing available to UK borrowers (even in the absence of the EL), which differ in their requirements. Borrowers may refinance with the same lender (internal remortgage) or with a different lender (external remortgage). Refinancing with the same lender without a change in loan terms (e.g. without equity extraction) is a simpler process; it does not require a full property valuation nor an affordability assessment. It must still be the case that borrowers have positive home equity, but the current value of the house is determined using its value at origination and the recent evolution of local house price indices. Borrowers'

[39] We are grateful to an anonymous referee for encouraging us to investigate this question. Several papers in the literature have studied household refinancing of traditional debt contracts (Agarwal et al., 2015; Andersen et al., 2015; Keys et al., 2016).

ability to repay the loan is not assessed and income documentation is not required. This simpler form of refinancing is often designated as product transfer. On the other hand, refinancing with the same lender but with equity extraction, or with a different lender, requires a full property valuation, income documentation and affordability assessment.

We now consider how the EL may constrain the refinancing opportunities available to borrowers. The constraints may arise either from the EL provider or from banks. We explain these in turn. Borrowers do not need government approval to refinance the senior bank debt, as long as they stay with the same lender and do not extract equity. For external remortgages without equity extraction, the EL provider does not require a property valuation, only evidence of the mortgage offer in order to check that the loan amount has not increased.[40] Both internal and external remortgages with equity extraction require government approval, which will only be granted after a property valuation and if all the equity extracted is used to repay the EL. It takes a maximum of five days for the EL provider to respond to a borrowers' request for a permission to refinance with equity extraction.[41]

The refinancing opportunities available to EL borrowers may also be constrained by the actions of mortgage lenders. Due to the extra layer of approval required, banks may be less willing to refinance a senior mortgage when an EL is present. A Financial Times article on EL remortgaging states that: "only eight out of 25 lenders said that they would offer remortgages to new customers who had yet to pay off their government loans."[42] It is important to point out that the article explicitly mentions "new customers," suggesting that lenders may treat internal and external remortgagors differently. We analyze how refinancing frictions are reflected in refinancing behavior.

5.2 Refinancing behavior

We study the refinancing behavior of EL borrowers in our data, and compare it to non-EL borrowers. As before, we focus on senior mortgages issued between April 2013 and March

[40] However, the new lender will require a property valuation.

[41] Borrowers also have to pay an administration fee of £200 if they want to extract equity and repay the EL, or £115 if they want to switch lender. Information on the refinancing process for EL borrowers is available at https://www.myfirsthome.org.uk/.

[42] "Help to Buy Property Owners Need Help to Refinance," Financial Times, August 2, 2018.

2015, for which at least two years have passed since origination. More precisely, in Table 8 we estimate how the refinancing behavior of borrowers who bought a new home with a two-year fixed in the relevant subsample period (2013-2015) depends on whether they used an EL. The dependent variable is a dummy that takes the value of one if borrowers refinanced their mortgages after the end of the initial period of discounted rates and up to December 31, 2017, and zero otherwise.[43] In columns (1) and (2) the dependent variable takes a value of one for all refinanced mortgages as of December 31, 2017, regardless of the type of refinancing. The independent variable is a dummy that takes the value of one for the EL borrowers in our sample, and zero for the non-EL borrowers. Therefore, the estimated coefficients measure the difference in refinancing rates between EL and non-EL borrowers. Columns (1) and (2) differ in the set of controls included among the explanatory variables; in column (2) we control for loan and borrower characteristics, and local authority and sale month fixed effects.

Columns (1) (and (2)) shows that the refinancing rate is 0.079 (0.037) higher for EL borrowers than for non-EL borrowers. The effect is statistically significant and economically meaningful (it corresponds to roughly 9.9% (4.7%) of the mean of the dependent variable which is equal to 0.80). It is important to point out that the higher refinancing propensity for EL borrowers does not imply that they do not face refinancing frictions or constraints. As we have shown, EL borrowers are more likely to be liquidity constrained, so that their marginal utility and the utility benefits of refinancing are higher, incentivizing them to do so in spite of the costs or difficulties that they may face.

In order to investigate this issue further, in the remainder columns of Table 8 we compare the internal and external refinancing behavior of EL and non-EL borrowers. The dependent variable in columns (3) and (4) (in (5) and (6)) is a dummy that takes the value of one for refinancing with the same (a different) lender, and zero otherwise. The estimated coefficients show that EL borrowers are much more likely to refinance with the same lender and much less likely to refinance with a different lender. The estimated coefficients are economically large: for

[43]We merge data on mortgage origination with data on mortgage performance that contains a snapshot of all mortgages on lenders' books as of December 31, 2017. The performance data contains information on whether the loan is on a reversion rate, indicating that the initial fixed rate period has expired but the loan has not been refinanced yet. The mortgage performance data is available biannually, on June 30 and December 31, information that we use below to study the timing of the different refinances.

the regressions with more controls, there is a difference of 0.163 in the internal remortgaging rate (the mean of the dependent variable is 0.61) and -0.126 in the external remortgaging rate (the mean of the dependent variable is 0.18). These results show that the refinancing frictions that EL borrowers face arise in their ability to refinance with a different lender, but they are still able to refinance with their existing lender. Naturally, this will be costly for EL borrowers if the interest rates offered by external lenders are lower than those offered by their existing lender. In Appendix H.5 we use our data to measure these costs, which compared to the no refinancing alternative are relatively small.

In Table 9 we study the timing of the refinances. We start with the same set of all two-year fixed mortgages that were used to purchase a new home eligible for EL between April 2013 and March 2015, but divide these into cohorts based on origination date. More precisely, we define cohorts of mortgages originated in each calendar year up to June 30 and between July 1 and December 31. The mortgage performance data that allows us to measure whether the loan has been remortgaged is available bi-annually, on June 30 and December 31 of each year.[44] We then construct a dummy variable that takes the value of one for loans that have been remortgaged as soon as we observe them after the end of the initial 2-year period of discounted rates, and zero otherwise. For example: the dummy variable will take a value of one for loans originated between July 1 and December 31 2013 that have been remortgaged by December 31 2015; for loans originated between January 1 and June 30 2014 that have have been remortgaged by June 30 2016; and so on.

In Panel A of Table 9 we regress this dummy variable on the indicator for EL financing. As before, the columns differ based on whether the dependent variable takes the value of one for all remortgages, or only for same lender and different lender remortgages, and in the controls that are included among the explanatory variables. Panel A reveals a similar pattern to that of Table 8: EL borrowers are more likely to remortgage with the same lender and less likely to remortgage with a different lender. More interesting is what happens in the remaining panels of Table 9.

In Panel B we define the cohorts of mortgages in such a way that we allow an extra 3 months before we measure whether borrowers have remortgaged their loan. For example, one

[44]For internal refinancing the mortgage performance data allows us to measure whether the loan has been remortgaged, but not the exact date of the remortgaging.

of the cohorts includes mortgages originated between October 1 2013 and March 31 2014 and the dependent variables takes the value of one if the loans have been remortgaged by June 30 2016. And in Panel C we define cohorts so as to allow an extra 6 months before we measure whether borrower have remortgaged.

Interestingly, Table 9 shows that the difference in overall refinancing rate between EL and non-EL borrowers decreases as we increase the time that we allow for refinancing to take place: from 0.112 in column (2) of Panel A to 0.054 in Panel C. This shows that EL borrowers refinance faster than non-EL borrowers. This is explained by the fact that EL borrowers tend to refinance with the same lender, and the process is simpler. This can also be seen in the last column of Table 9: the absolute difference in external refinancing rates between non-EL and EL borrowers increases from 0.022 in Panel A to 0.106 in Panel C.

While the evidence above focuses on the refinancing rates, in Appendix K we study the extent to which EL and non-EL homebuyers have different housing tenures and make different mortgage origination choices, possibly in anticipation of the refinancing frictions that they may face. We do not find significant differences in housing tenure, but EL borrowers are relatively more likely to choose mortgages with an initial period of discounted rates equal to five years. Five years is also the duration of the initial period of the EL when interest payments are not due to the government.

6 Discussion

After the Great Recession, regulators in many countries, including the UK and the US, have implemented quantitative macro prudential tools, such as loan- and mortgage payment-to-income limits, to regulate household leverage and improve financial stability. These regulations have had an impact on household credit availability (DeFusco et al., 2020; Acharya et al., 2018; Benetton, 2018).

In this paper, we provide evidence that these affordability considerations, and the desire to become homeowner at a higher level of housing consumption, are behind the large demand for the SEMs recently introduced by the UK Government. Using the scheme's maximum property price limit, we show that households who take advantage of the equity financing to purchase their houses are disproportionately young, first time buyers who would not be able to afford the same property without the EL. Exploiting the increase in the maximum EL contribution in London, we show with a difference-in-difference identification strategy that individuals take advantage of the increase to buy more expensive houses, and not to reduce bank leverage and house price risk exposure. Our analysis shows how government sponsored products with an equity component are an alternative to government guaranteed high LTV mortgages, that may be preferred by borrowers buying more expensive houses relative to their income.

We also present novel evidence on EL repayment and equity provider returns. Borrowers repay the loans in response to house price and income increases. Repayments can be triggered by a property sale, but many borrowers decide to repay even in the absence of a sale, increasing their mortgage balance by the amount needed to repay the EL. Interestingly, the realized equity provider returns are significantly lower in ELs repaid without a sale than in those triggered by a sale. We perform several tests to identify the source of the difference. The results point towards an under-valuation of the property by the appraisal carried out to determine, in the absence of a sale price, the amount due to the equity provider.

Our analysis provides several general insights for how households approach their housing decisions that can inform the design and concrete implementation of SEMs. First, the demand for ELs is not incompatible with house price increases and expectations of future increases, when binding leverage limits are in place. These constraints can be sufficiently important to lead a significant number of households to use forms of housing finance with an equity component, overcoming informational or cognitive frictions, or any suspicions that they may have of these innovative products. A direct implication is that the subsidization of high LTV mortgages (e.g. due to government guarantees as it is the case for the US), is likely to crowd out forms of housing finance with an equity component and mortgage market innovation more generally.

Second, the financial stability benefits of ELs depend on the use borrowers make of equity as complement versus substitute of traditional mortgage loans. Most of them use the equity as a complement. This means that the financial stability benefits of the ELs will be reduced, unless their introduction is accompanied by more restrictive leverage regulation (or the removal of subsidies on high LTV loans).

Third, in an environment of house price increases, households wish to increase their housing investment exposure and repay the ELs early. This gives rise to selection in repayment and, for those ELs that are repaid without a property sale, potential agency problems in property valuation. Therefore, the mechanism used for determining the value of the stake of the equity provider has a significant impact on its returns.

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TABLES AND FIGURES

Table 1: Comparison of equity loan and non-equity loan borrowers

The table reports the summary statistics for several variables for EL and non-EL borrowers. Data for mortgages originated between April 2013 and March 2017 for purchase of new homes 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***
Gross income (£.000)	49.74	(35.29)	59.81	(256.00)	-10.07***
Property value (£.000)	237.87	(101.23)	256.36	(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***
N	99,571		157,617		257,188

Table 2: Effect of the introduction of the London equity loan scheme

Panel A shows results from regressing the dependent variable on three terms: a dummy variable indicating transactions in the London Area (London), a dummy variable indicating transactions after January 2016 (Post Jan 2016), and the interaction between the two. The sample is made of EL transactions taking place between six months before and after 1 February 2016 in either London or the South East of England. In Panel B the sample is restricted to EL transactions taking place in one of the local authorities on the boundary between London and the South East. Borrower characteristics are age, borrower type (first-time buyer or home mover), gross income and employment status. The fifth column uses as dependent variable the purchase price deflated by the official regional house price index normalized to August 2015. The last column uses the floor area of the property for dwellings that can be matched in the Energy Performance Certificate dataset. (The data and the matching procedure are explained in Appendix F.) Standard errors in parentheses clustered at the postcode district level. Values in thousands of pounds in columns (1) through (5).

Panel A: London versus the South-East

	(1) Equity loan	(2) Purchase price	(3) Down payment	(4) Mortgage amount	(5) Deflated purchase price	(6) Square meters
London × Post Jan 2016	37.24***	34.82***	1.27	-3.69	29.61***	6.31*
	(5.93)	(8.77)	(2.18)	(3.60)	(8.14)	(3.22)
London	7.51***	41.16***	10.85***	22.80***	40.69***	-21.39***
	(1.75)	(8.57)	(2.68)	(4.50)	(8.47)	(3.01)
Post Jan 2016	-5.84***	-8.98**	-1.70	-1.44	-8.50**	2.10
	(1.30)	(4.15)	(1.42)	(2.43)	(4.03)	(1.82)
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	0.55	0.18
N	10,037	10,037	10,037	10,037	10,037	9,858

Panel B: Outer London versus the neighboring local authorities in the South-East

	(1) Equity loan	(2) Purchase price	(3) Down payment	(4) Mortgage amount	(5) Deflated purchase price	(6) Square meters
London × Post Jan 2016	37.80***	40.89***	3.35	-0.27	36.54***	6.14
	(7.71)	(13.07)	(3.16)	(6.13)	(12.35)	(6.95)
London	3.57	20.94*	6.25*	11.12	20.70*	-14.68**
	(2.69)	(12.48)	(3.64)	(7.05)	(12.35)	(6.14)
Post Jan 2016	-10.38**	-0.54	1.95	7.89	0.71	-7.51
	(4.44)	(11.97)	(3.38)	(7.26)	(11.50)	(7.88)
Borrower characteristics	Yes	Yes	Yes	Yes	Yes	Yes
Regional house price index	Yes	Yes	Yes	Yes	Yes	Yes
r2	0.38	0.49	0.11	0.55	0.48	0.17
N	2,020	2,020	2,020	2,020	2,020	1,979

Table 3: Equity provider returns

The table reports average annual returns by EL status (EL used or not) and by EL repayment status (EL not repaid, EL repaid, also distinguishing between repayment with and without a sale). The sample includes new properties purchased between April 2013 and March 2015, financed without or with an EL. The potential return is the realized annual house price appreciation in the two years subsequent to the property acquisition, calculated using a local area price index constructed using repeated sales of new properties. The actual return is the annual growth rate of the individual house value from the purchase price to the date of repayment of the equity loan, either via a sale or staircasing (EL repayment without a sale). In the case of staircasing, the return is calculated using the property valuation. The last row reports the difference between the actual and potential return; *** denotes statistical significance at the 1% level.

	By EL status		By EL repayment status			
	Non EL	EL	EL not repaid	EL repaid		
				All	Sale	Staircase
	(1)	(2)	(3)	(4)	(5)	(6)
Potential return, % (Local authority price index)	5.28	5.13	4.90	6.00	5.46	6.65
Actual return, % (Individual house value)				4.75	5.48	3.88
Actual - Potential return, percentage points				-1.25***	0.02	-2.77***

Table 4: House price effect: equity loan vs non-equity loan within new homes

The table reports the estimated coefficients of regressions of house price changes between repeat sales on an indicator of EL funded purchases and repayment status. The sample includes all new homes first sold between April 2013 and March 2017, financed either with or without an EL, for which a repeat sale (or an instance of staircasing) is recorded. The variable EL sale is a dummy variable that takes the value of one for EL funded purchases that were repaid due to a subsequent sale, and zero otherwise. The variable EL staircasing is a dummy variable that takes the value of one for EL funded purchases that were repaid without a sale, and zero otherwise. The first column reports results when staircasing is excluded from the sample, the second column reports results when EL sales are excluded from the sample, and the third column reports results from the complete sample. All regressions are run with double-clustered standard errors on local authority and sale month; *** denotes statistical significance at the 1% level.

	(1)	(2)	(3)
	Δ log Price	Δ log Price	Δ log Price
EL sale	-0.005		-0.007
	(0.006)		(0.006)
EL staircasing		-0.067***	-0.070***
		(0.009)	(0.009)
Fixed effects	Purchase year X Sale year X LA	Purchase year X Sale year X LA	Purchase year X Sale year X LA
SE clustering	LA, sale month	LA, sale month	LA, sale month
r2	0.25	0.25	0.24
N	37,887	35,082	41,373

Table 5: Property valuation and returns after equity loan repayment

The table reports the average annual return for individual properties financed with an EL that has been repaid without a sale (also known as staircasing) and that subsequently to the EL repayment have been sold. The return is calculated using the property valuation used for EL repayment and the subsequent sale price. The table also reports the annual return for other properties in the same local area and during the same time period (using local authority house price indices). The first column shows returns for all identified properties with EL repayment and a subsequent sale (before October 2020). The second column shows returns for a sub-sample of properties for which the valuation used for the EL repayment was exactly the same as the original purchase price of the property (i.e. at EL origination). In Panel B (Panel C) we calculate returns using only those transactions for which at most (at least) 6 months passed between the EL repayment and subsequent sale.

	All properties	No-change valuation
Panel A: All observations		
Actual return, % (individual house value)	7.46	11.85
Potential return, % (local authority index)	3.96	4.78
Panel B: Maximum 6 months between EL repayment and sale		
Actual return, % (individual house value)	25.34	52.25
Potential return, % (local authority index)	6.38	7.76
Panel C: Minimum 6 months between EL repayment and sale		
Actual return, % (individual house value)	5.42	6.39
Potential return, % (local authority index)	3.67	4.36

Table 6: Local area returns after equity loan repayment

The table compares the average property returns (using local-authority price indices) in the 12- and 24-month after a given date. For properties for which the EL was repaid, we measure returns in the 12 and 24-months following EL repayment. We only include EL repayments that are not accompanied by a sale of property (staircasing). For properties associated with an EL that has not been repaid, in column (2) we measure the 12- and 24-month return starting two years after EL origination (most mortgages in the UK have an initial rate that is fixed for 2-years, after which pre-payment penalties no longer apply). In column (3) we measure the 12- and 24-month future returns for ELs that have not been repaid starting on the same month for which we have an observation for an EL that has been repaid (without a sale). We do so by constructing a matched sample of ELs that have not been repaid: for each observation of EL repayment we randomly match one observation of EL non-repayment. This ensures that we calculate future returns over the same time period, with return differences arising solely from the location of the properties. The return differences between the matched sets of not repaid and staircased properties are statistically significant with a p-value of less than 1% for both the 12- and the 24-month horizons. The 24-month returns are annualized.

	EL repaid	EL not repaid	EL not repaid (matched)
	(1)	(2)	(3)
12-month potential return, % (local authority index)	4.39	4.91	4.62
24-month potential return, % (local authority index)	2.99	3.84	3.54

Table 7: Difference in ex-post wealth with EL

The table shows the difference in wealth between EL financing and non-EL financing (and a larger mortgage instead). A negative value indicates that borrowers are worse off with an EL. Panel A (Panel B) shows differences in thousands of pounds (divided by the monthly gross income of the borrower (in %)). In each of the panels, we first report the results for non-EL borrowers. In the first five columns the borrower's discount rate is set equal to the interest rate for the actual mortgage. In the remaining columns the discount rate is set equal to an illustrative 20% credit card rate. The sample includes 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 LTV above 20%.

	δ: Mortgage rate					δ: Cr. card r.	
	Mean	SD	p10	p50	p90	Mean	SD
Panel A: £1,000							
Non-EL borrowers							
All	-4.1	8.5	-12.6	-2.4	3.0	-2.7	8.3
$85 < LTV \leq 95$	-0.3	10.5	-6.1	0.9	6.4	1.1	10.4
$75 < LTV \leq 85$	-3.7	9.3	-11.3	-1.5	2.7	-2.4	9.1
$LTV \leq 75$	-5.8	6.3	-14.4	-4.1	0.2	-4.5	6.1
EL borrowers							
All	-0.2	4.5	-5.7	0.4	4.3	1.1	4.7
$85 < CLTV \leq 95$	0.5	4.0	-4.4	0.8	4.4	1.8	4.1
$75 < CLTV \leq 85$	-5.3	4.9	-11.5	-4.5	0.2	-4.4	4.8
$CLTV \leq 75$	-6.0	5.3	-12.4	-4.2	-0.7	-4.9	5.1
Panel B: × monthly gross income (%)							
Non-EL borrowers							
All	-0.9	1.7	-2.8	-0.6	0.8	-0.5	1.7
$85 < LTV \leq 95$	0.2	1.4	-1.2	0.2	1.7	0.5	1.5
$75 < LTV \leq 85$	-0.6	1.3	-2.1	-0.4	0.7	-0.3	1.3
$LTV \leq 75$	-1.4	1.7	-3.5	-1.1	0.1	-1.1	1.7
EL borrowers							
All	-0.1	1.2	-1.6	0.1	1.2	0.3	1.2
$85 < CLTV \leq 95$	0.2	0.9	-1.1	0.2	1.3	0.5	1.0
$75 < CLTV \leq 85$	-1.6	1.3	-3.4	-1.6	0.1	-1.3	1.3
$CLTV \leq 75$	-2.1	1.7	-4.4	-1.8	-0.4	-1.8	1.7

Table 8: Refinancing probability

The table shows the estimated coefficients on an indicator for borrowers using an equity loan (EL) in a regression in which the dependent variable is a dummy that takes the value of one if borrowers refinanced their mortgages after the end of the initial period of discounted rates and up to December 31, 2017, and zero otherwise. The table reports results for refinancing with any lender, the same lender, or a different lender. The sample is made of all two-year fixed mortgages used to purchase a new home eligible for EL between April 2013 and March 2015. These mortgages are matched with a dataset of mortgage performance which contains a snapshot of all mortgages on lenders' books as of December 31, 2017. The average for the dependent variable in our sample is 0.80 for all refinancing, 0.61 for same-lender refinancing and 0.18 for different-lender refinancing. Regression controls include gross income at origination (in logs), the age of the main borrower, whether the borrower is a first time buyer or a home mover, whether the main borrower is employed or self-employed, whether the mortgage is jointly held, the purchase price of the property, and lender fixed effects. *LA* corresponds to fixed effects for local authority, and *time* to fixed effects for the month-year in which the mortgage was first originated.

	(1) All	(2) All	(3) Same lender	(4) Same lender	(5) Different lender	(6) Different lender
EL	0.079***	0.037***	0.214***	0.163***	-0.135***	-0.126***
	(0.012)	(0.009)	(0.014)	(0.015)	(0.007)	(0.012)
Regression controls		Yes		Yes		Yes
Fixed effects		LA, time		LA, time		LA, time
SE clustering	LA, time	LA, time	LA, time	LA, time	LA, time	LA, time
r2	0.01	0.08	0.03	0.13	0.02	0.15
N	19,375	19,375	19,375	19,375	19,375	19,375

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 9: Time to refinancing

The table shows the estimated coefficients on an indicator for borrowers using an equity loan (EL) in a regression in which the outcome variables records whether borrowers have refinanced their loan. The panels differ in amount of time that we allow before we measure whether borrowers have refinanced their loans: an additional three months in Panel B (six months in Panel C). The columns differ in whether the dependent variable takes the value of one for refinancing with any lender (and zero otherwise), for refinancing with the same lender only, and for refinancing with a different lender only. The regression controls are the same as in Table 8. The sample includes all two-year fixed mortgages used to purchase a new home eligible for EL between April 2013 and March 2015.

	(1) All	(2) All	(3) Same lender	(4) Same lender	(5) Different lender	(6) Different lender
Panel A: Baseline						
EL	0.196***	0.112***	0.225***	0.133***	-0.029***	-0.022***
	(0.026)	(0.017)	(0.024)	(0.015)	(0.005)	(0.006)
Regression controls		Yes		Yes		Yes
Fixed effects		LA, time		LA, time		LA, time
SE clustering	LA, time	LA, time	LA, time	LA, time	LA, time	LA, time
r2	0.03	0.13	0.03	0.15	0.00	0.17
N	18,436	18,436	18,436	18,436	18,436	18,436
Panel B: Additional 3 months						
EL	0.129***	0.082***	0.198***	0.136***	-0.069***	-0.055***
	(0.013)	(0.014)	(0.012)	(0.011)	(0.007)	(0.010)
Regression controls		Yes		Yes		Yes
Fixed effects		LA, time		LA, time		LA, time
SE clustering	LA, time	LA, time	LA, time	LA, time	LA, time	LA, time
r2	0.01	0.12	0.03	0.12	0.01	0.15
N	19,674	19,674	19,674	19,674	19,674	19,674
Panel C: Additional 6 months						
EL	0.115***	0.054***	0.202***	0.160***	-0.086***	-0.106***
	(0.014)	(0.009)	(0.011)	(0.015)	(0.009)	(0.010)
Regression controls		Yes		Yes		Yes
Fixed effects		LA, time		LA, time		LA, time
SE clustering	LA, time	LA, time	LA, time	LA, time	LA, time	LA, time
r2	0.01	0.13	0.03	0.12	0.01	0.16
N	19,441	19,441	19,441	19,441	19,441	19,441

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Standard errors in parentheses.

Figure 1: Equity loan vs. standard mortgage

The figure shows two ways for a borrower to buy a new house (h) worth £100K with a down payment of £5K. The left-hand side household borrows £20K from the government through the EL scheme (e) and uses a standard 75% loan-to-value bank mortgage for the remaining part of the purchase (q_1). The right-hand side household, by contrast, borrows £95K (q_2) from the bank with a standard 95% loan-to-value mortgage.

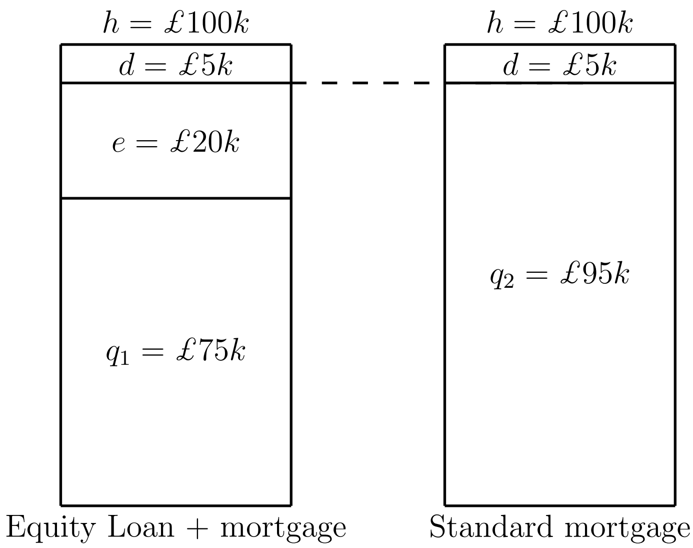
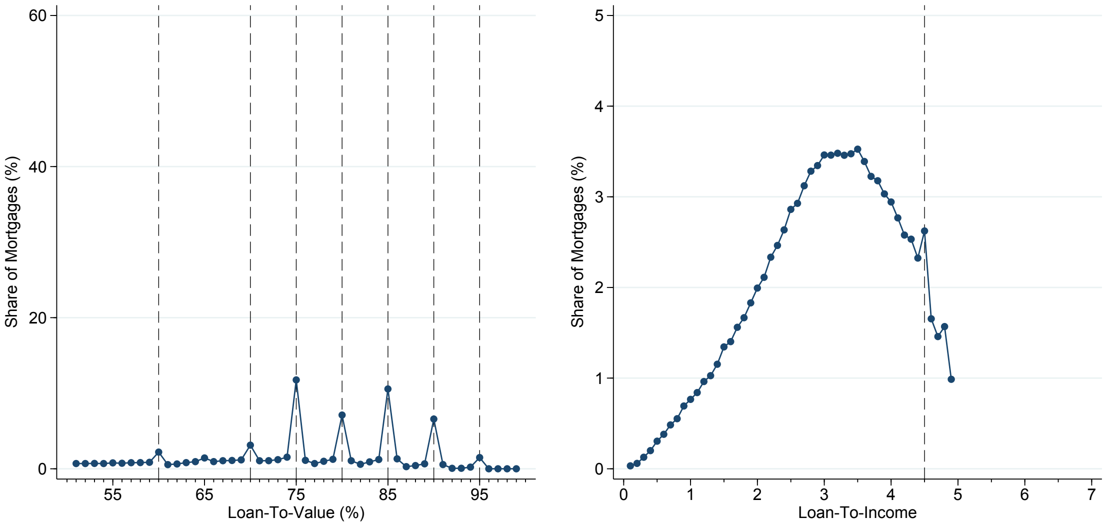


Figure 2: Loan to value and loan to income

The figure shows the distribution of loan-to-value (LTV) and loan-to-income (LTI) ratios for non EL borrowers (Panel A) and EL borrowers (Panel B). For EL borrowers we calculate ratios both 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 the purchase of new homes with value below £600,000.

Panel A: Non-EL borrowers



Panel B: EL borrowers

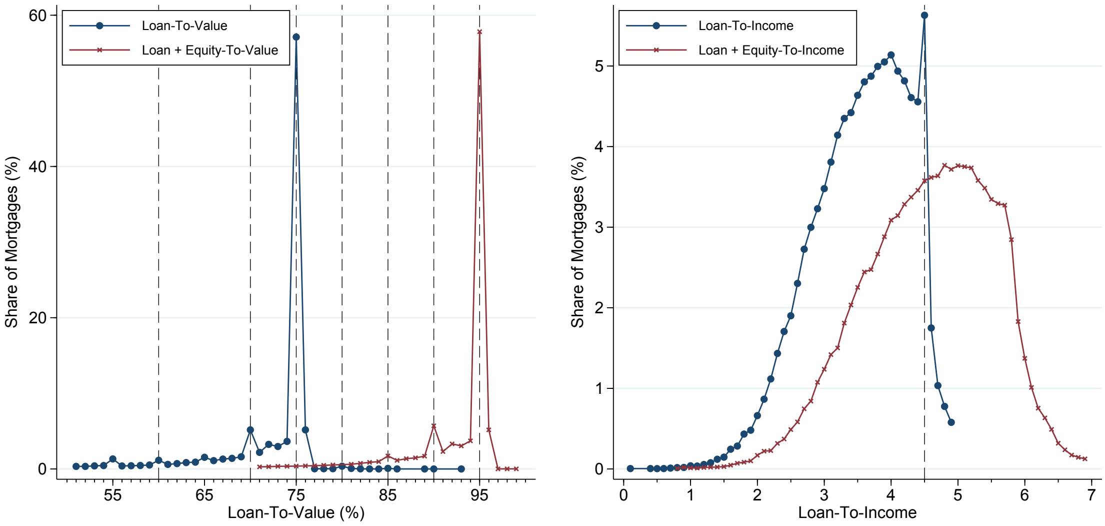


Figure 3: Bunching of property prices: London

Data on mortgage transactions from the Product Sales Data (PSD) by the Financial Conduct Authority. The histogram includes all sales of new homes in London between April 2013 and March 2017.

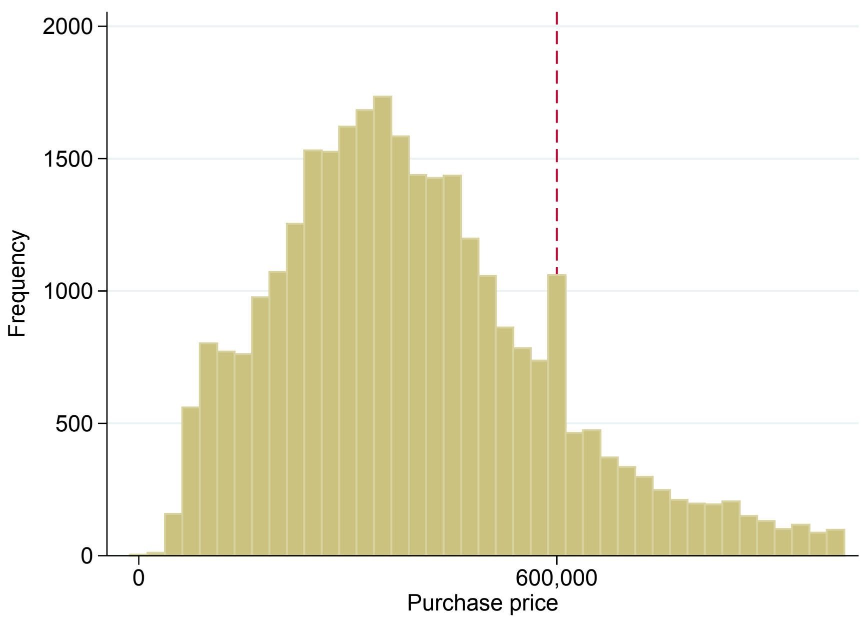


Figure 4: Selection around the £600,000 limit in London: Borrower characteristics
The figure shows the distribution of age, fraction of first-time buyers, deposit and income for mortgages originated in the sample period (April 2013 to March 2017) in London, for the acquisition of new homes, with a purchase price between £500,000-700,000.

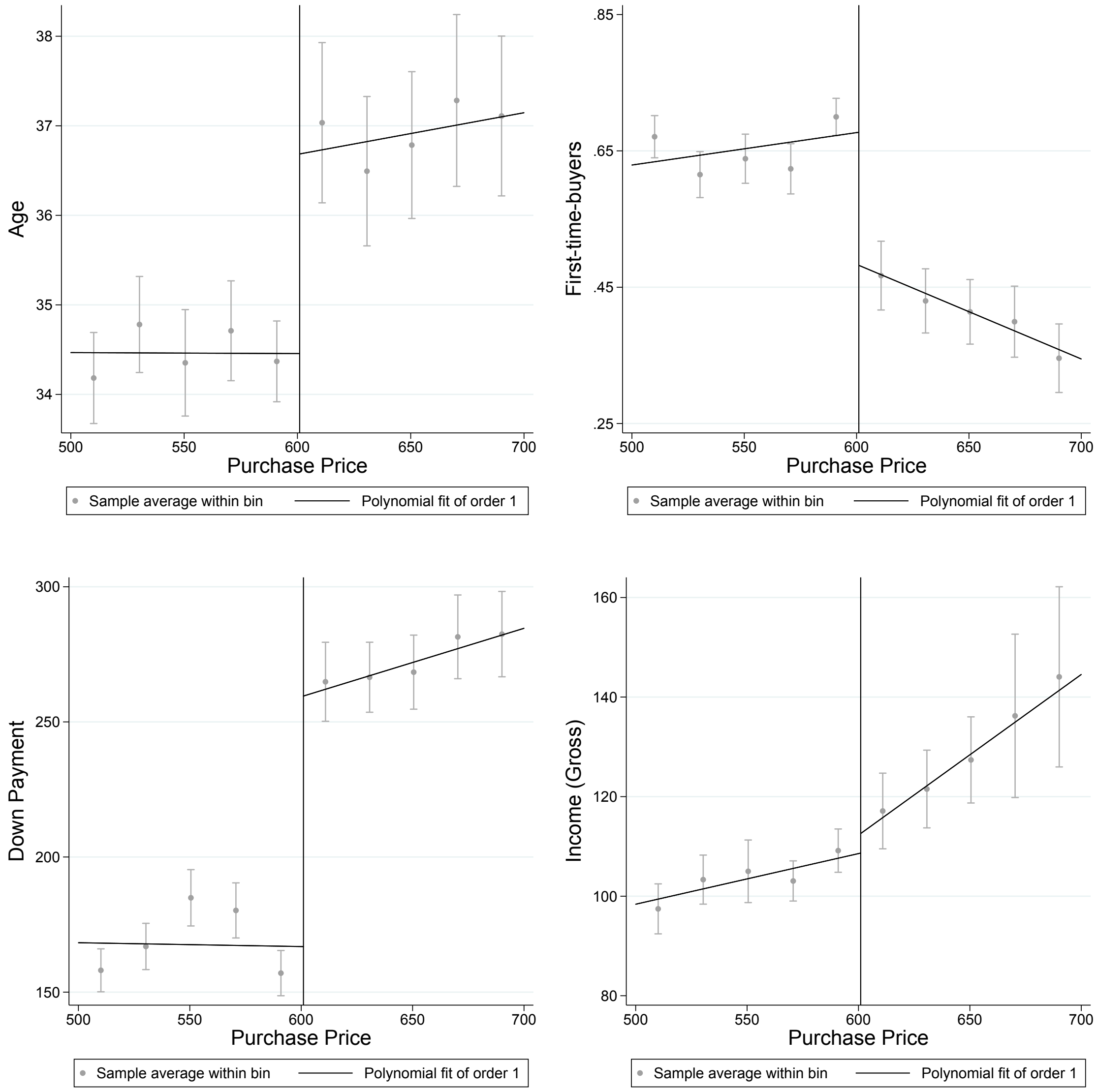


Figure 5: Selection around the £600,000 limit in London: Leverage

The figure shows the distribution of LTV, CLTV, LTI and CLTI for mortgages originated in the sample period (April 2013 to March 2017) in London, for the acquisition of new homes, with a purchase price between £500,000-700,000.

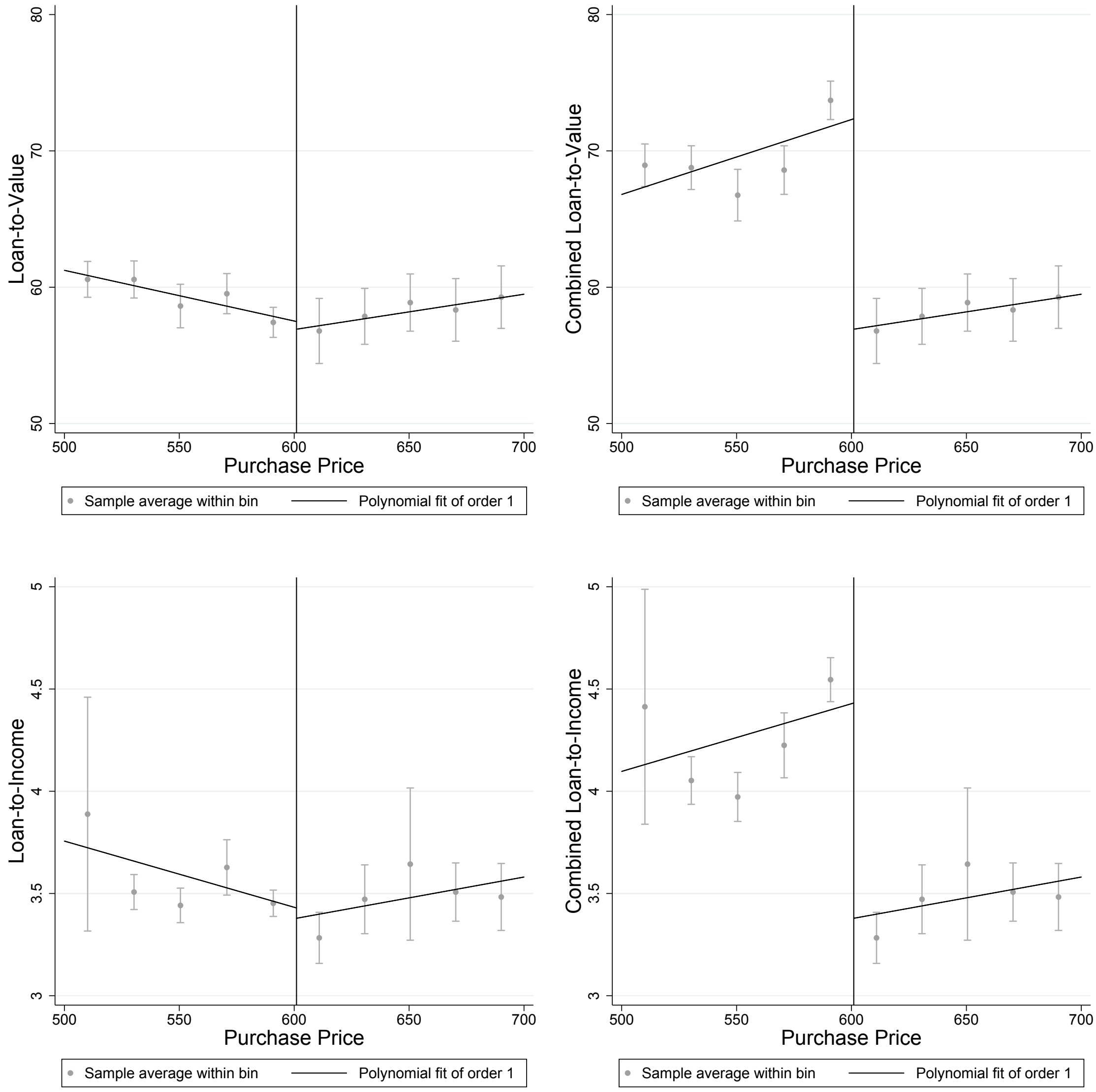


Figure 6: Selection around the £600,000 limit in London (Placebo: existing houses)
The figure shows the distribution of age, fraction of first-time buyers, deposit and income for mortgages originated in the sample period (April 2013 to March 2017) in London with a purchase price between £500,000-700,000 for existing houses.

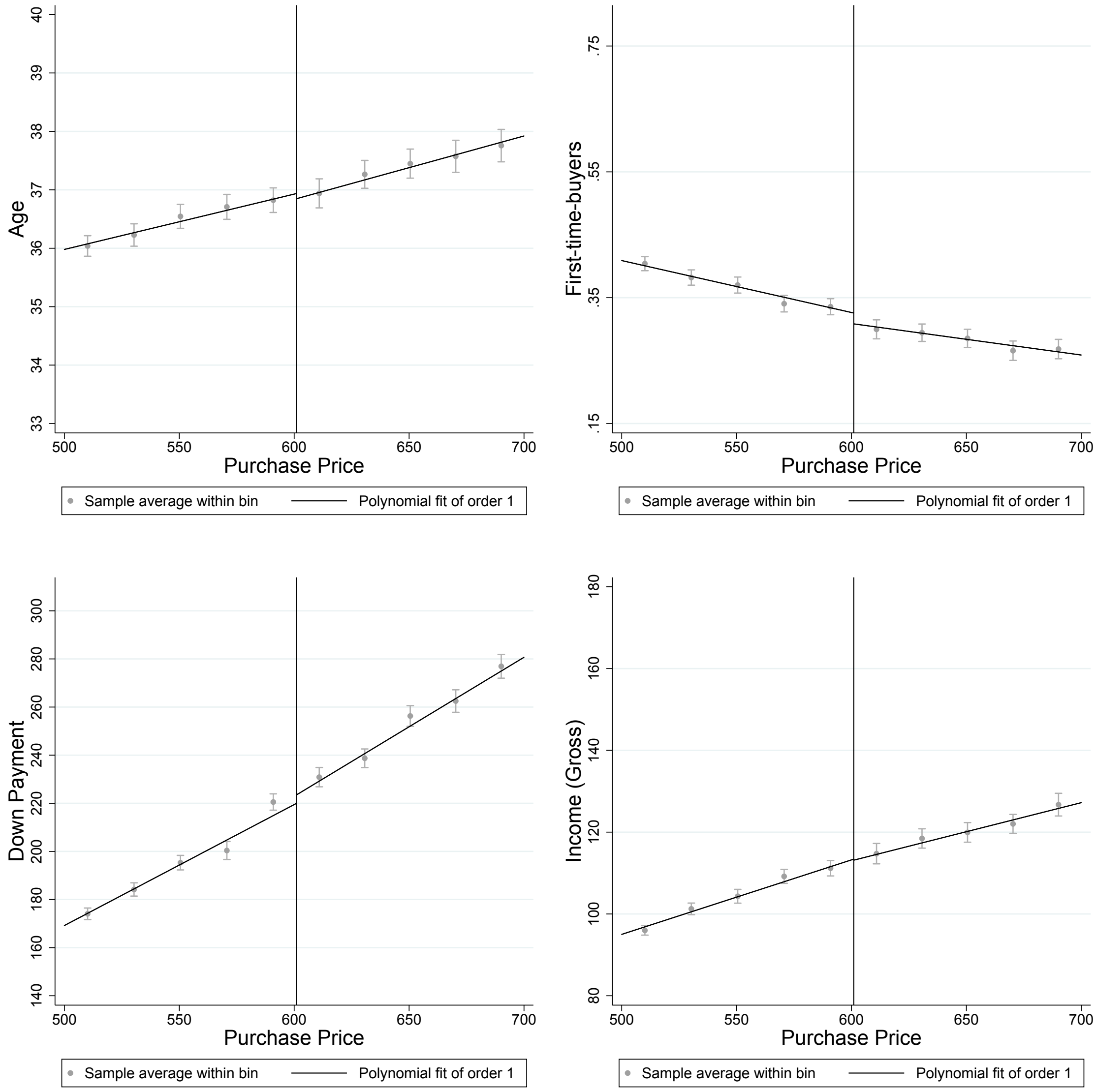


Figure 7: House prices in the South East of England and London. Down payment to value and equity loan to value distribution

Top chart: 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. *Bottom charts:* The distributions refer to EL transactions in London since 1 February 2016.

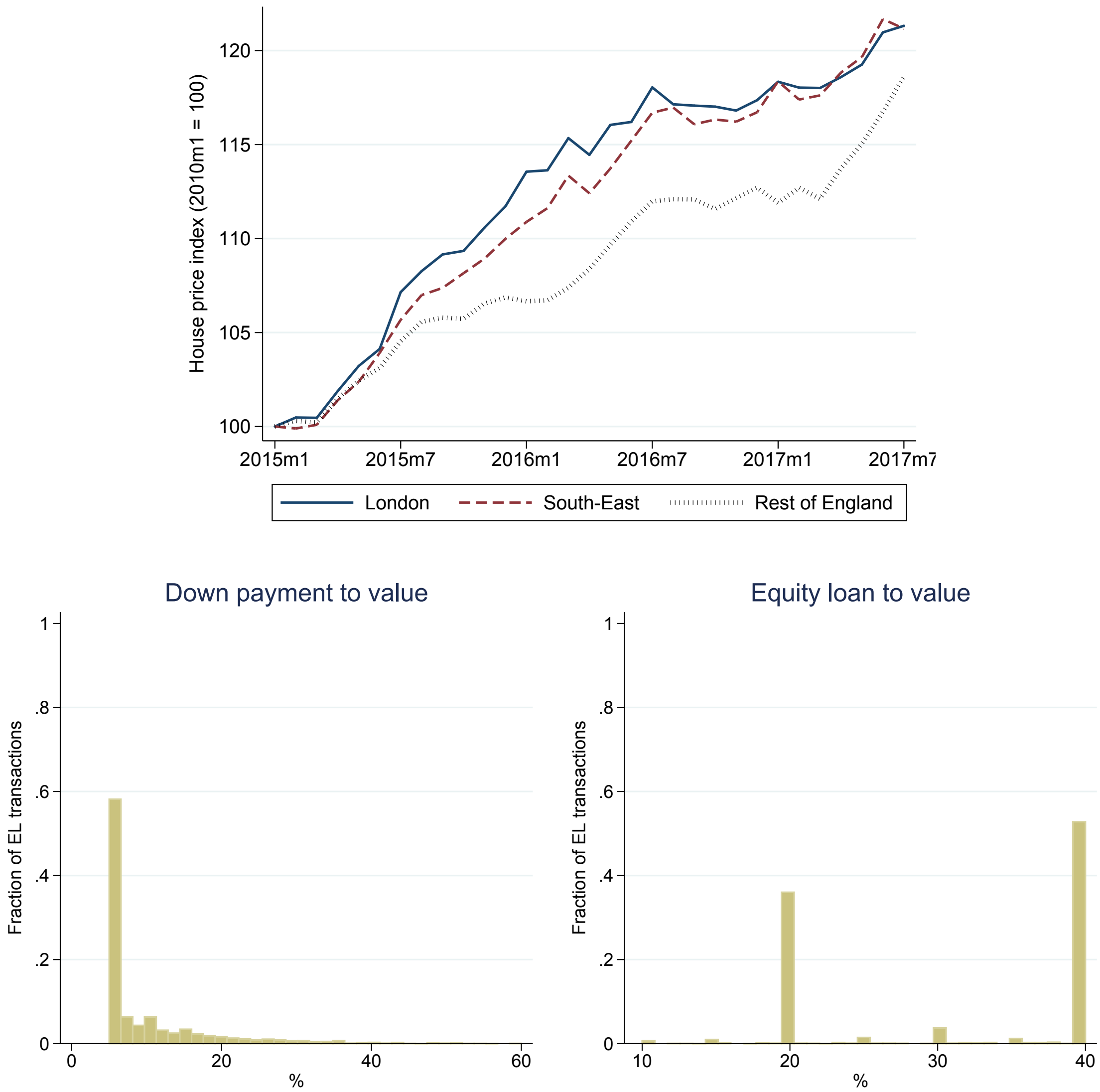


Figure 8: London vs the South East of England: dependent variables

The figure plots the average monthly values of the dependent variables used in the regressions of Panel A in Table 2, distinguishing between London and the South East. All values on the vertical axis are in thousands of pounds except for the last chart which is in square meters.

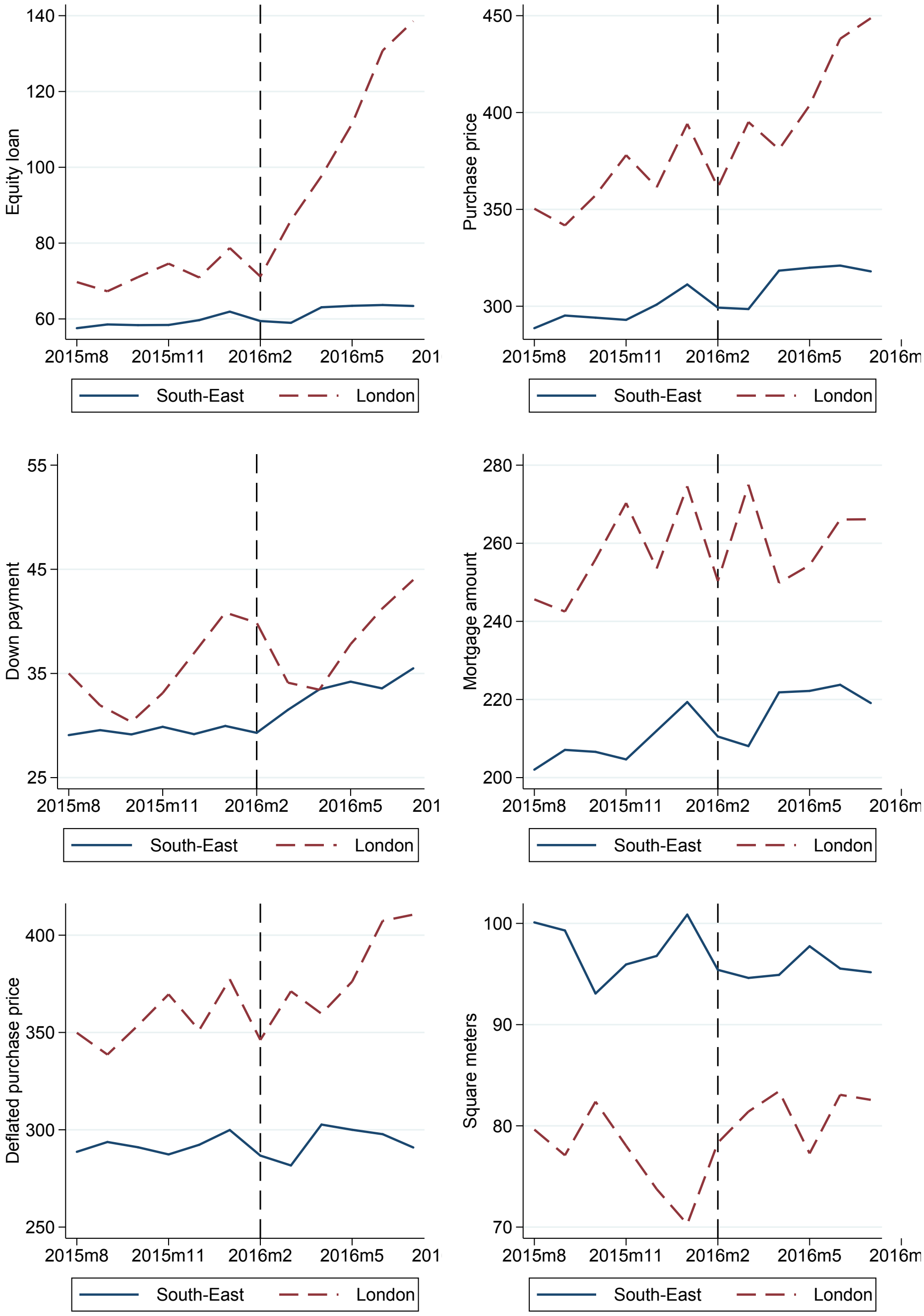


Figure 9: Mortgage payments with equity loan compared to mortgage guarantee The figure shows the distribution of mortgage payments relative to income (net of taxes) for EL borrowers compared to two scenarios. In the first, we assume that, instead of using the EL, borrowers take a standard mortgage for the whole amount, and pay the interest rate that corresponds to a 95% LTV mortgage. (In reality, for many EL borrowers in our data the resulting loan amount would be above the 4.5 LTI limit). In the second scenario, we assume that instead of using the EL borrowers take a mortgage for the whole amount, i.e. the LTV is 95%, but this mortgage benefits from a government guarantee for LTV above 75%. Therefore, when calculating the mortgage payments we use the loan amount corresponding to the 95% LTV but the interest rate on a 75% LTV mortgage. In both scenarios we assume that the mortgage maturity is the same as in the base case with the EL.

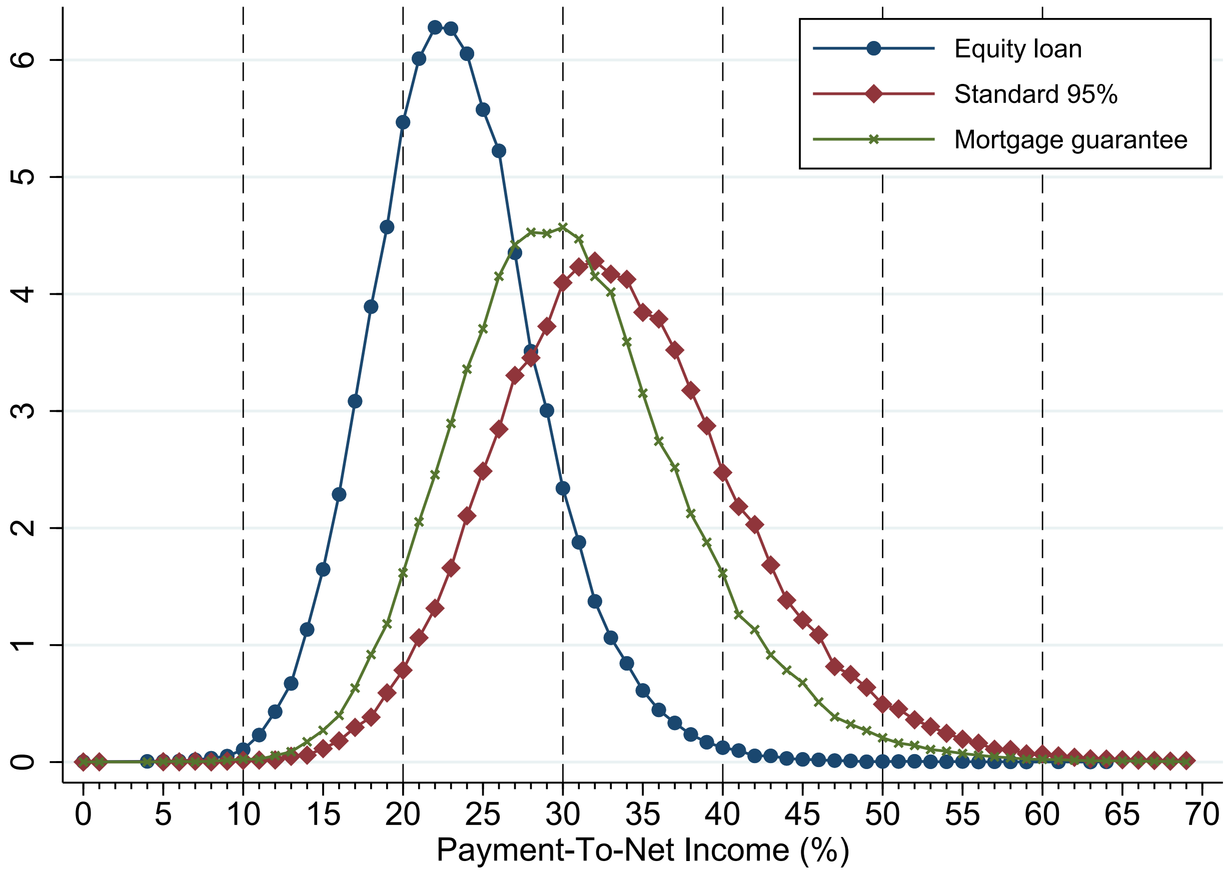


Figure 10: Borrower income and property purchase price for acquisitions financed with the equity loan and a mortgage guarantee

Panel A shows the distribution of property prices (in pounds) for acquisitions financed with an equity loan (EL) and a mortgage guarantee (MG). Panel B shows the distributions for borrower income. The period covered is April 2013 to June 2017 for EL, and October 2013 to June 2017 for MG. The data for the MG scheme is from the HM Treasury, Help to Buy: Mortgage Guarantee Scheme, Quarterly Statistics, Data from 8 October 2013 to 30 June 2017. The data for the equity loan scheme is from the Department for Communities and Local Government, Help to Buy (Equity Loan scheme), data to 30 June 2017.

Panel A: Property price

Panel B: Income

Figure 11: Cumulative redemptions

The two charts show cumulative redemptions as a percentage of total loans by origination year for two outcomes: repayment of the equity loan without and with 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 redemptions data for the universe of ELs 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).

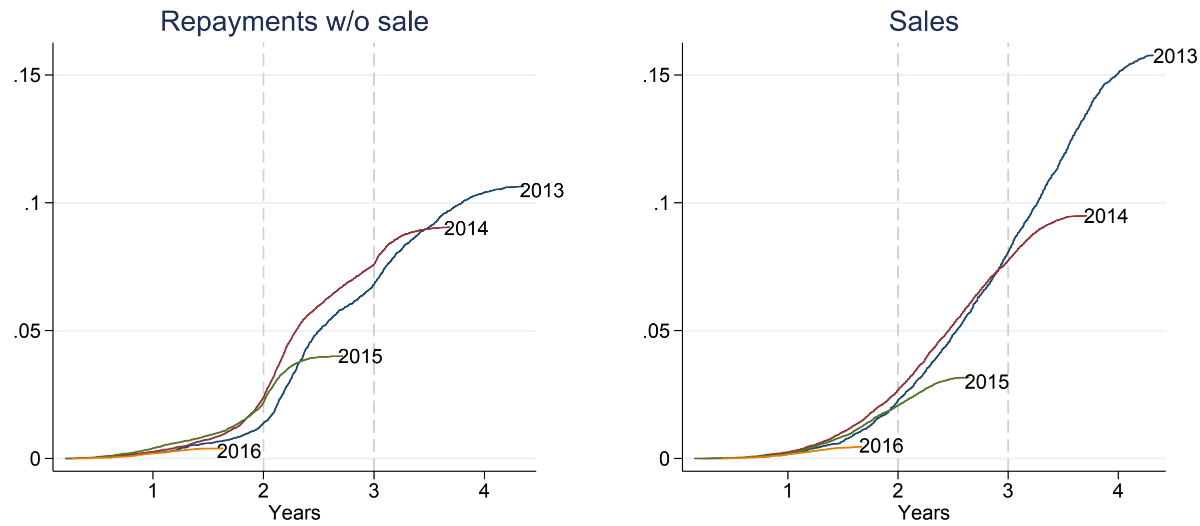


Figure 12: House appreciation, income growth and equity extraction

The top left-hand chart is constructed from the main sample of EL borrowers. The dotted line shows the distribution of annualized local house price appreciation in the two years 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 top right-hand and bottom charts are also 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. We compute the income growth between the two mortgages, the outstanding balance at the moment of the refinance and the new mortgage balance. In the top right panel, the dashed line shows the distribution of annualized 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. The bottom chart shows that borrowers who repaid the EL extracted amounts that were very similar to the size of the outstanding EL. We compute the outstanding balance at the moment of the refinance, and compare it with the new mortgage to estimate equity extraction.

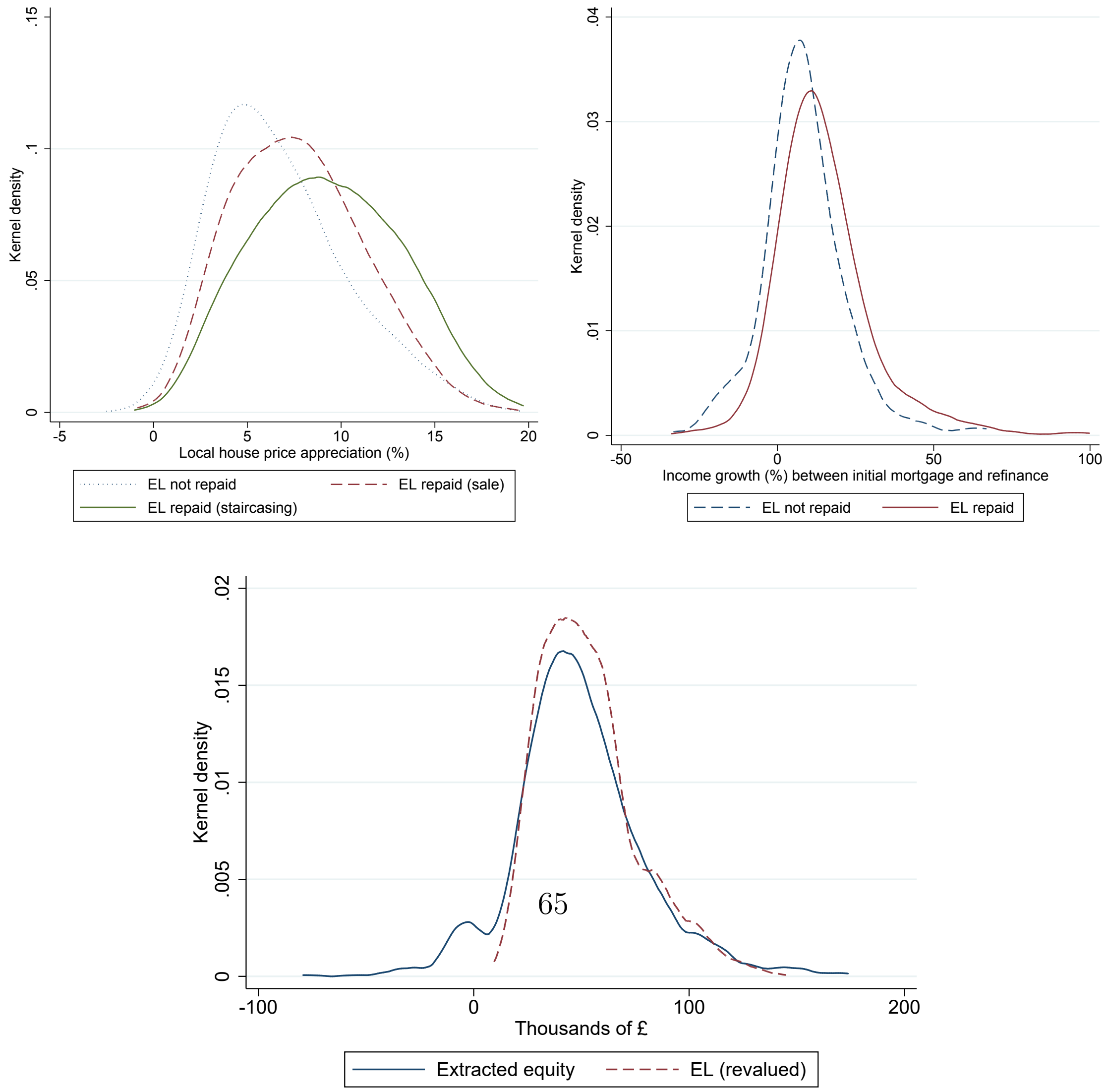


Figure 13: Local area vs individual house appreciation by equity loan outcome

The figure is constructed from the sample of borrowers who took on a mortgage and an EL between April 2013 and March 2015 and repaid the EL 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 dashed line reports appreciation according to an index for new homes that was estimated by the authors from repeat sales in the Land Registry. 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.)

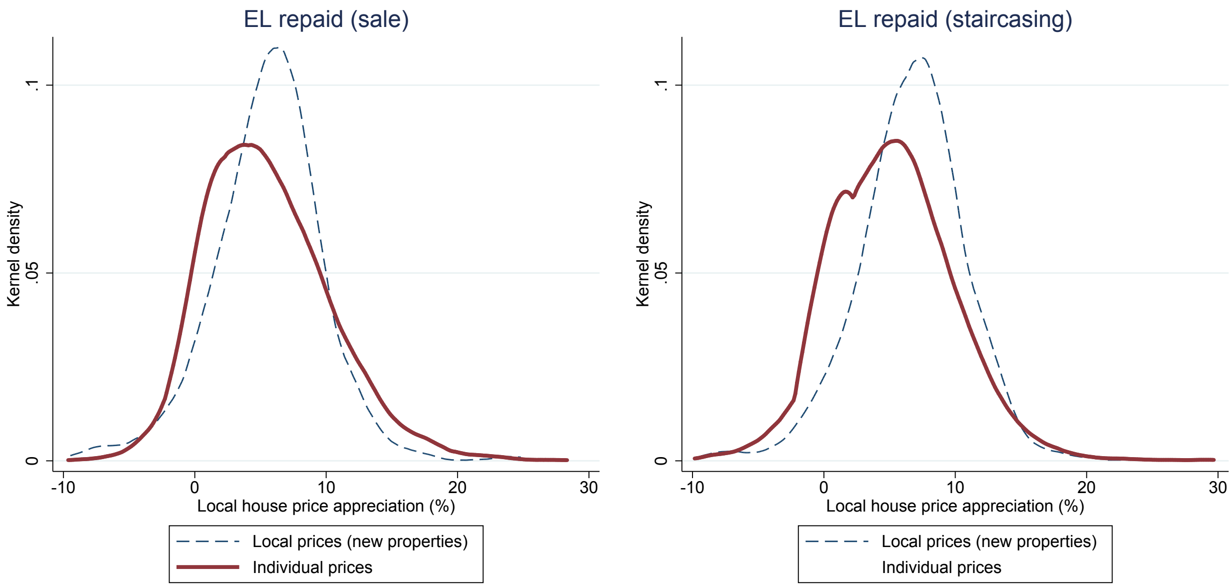
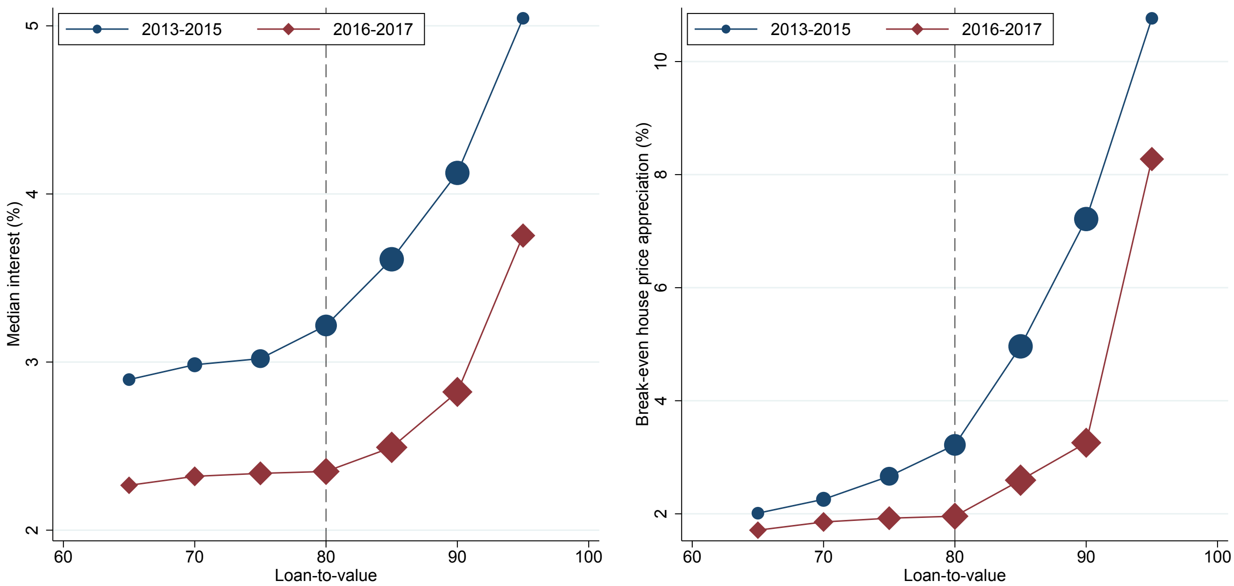


Figure 14: Interest rate and break-even house price appreciation (2-year fixed)
The figure shows the median predicted interest rate (left chart) and break-even house appreciation (right chart) for each LTV bin. The predicted interest rate is the predicted rate for each LTV from a regression of the individual level interest rate on LTV bin and interacted with product level-time fixed effects. Larger dots correspond to LTV bins with more observations. Data for *non-EL* mortgages with two-year fixed-rate period for purchase of new homes with value below £600,000 originated in 2013-2015 and in 2016-2017.



Appendix to "Housing Consumption and Investment: Evidence from Shared Equity Mortgages"

A Equity IRR for the government

At the initial date the government provides equity financing of up to 20% of the value of the property (40% in London from February 2016). 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, the government receives annual EL interest fees. The interest fees are a symbolic £1 per annum during the first five years. In the sixth year the annual interest fee is 1.75% of the original EL value (i.e. the value at origination). In each of the subsequent years the annual interest fee increases with inflation plus 1%. That is: for an inflation rate of 2% the annual interest fee in the seventh year is equal to 1.80% (=1.75% × 1.03). The payments of this fee do not amortize the equity loan.

To illustrate the payoffs to the government we first calculate its expected cash-flows assuming an annual rate of house price growth of 3% and an inflation rate of 2% (corresponding to an annual one percent real house price growth). We then calculate the expected EL internal rate of return (IRR) for the government as a function of the number years until termination. The maximum number of years is twenty-five but EL borrowers may repay the government loan at any time without penalties. These annual IRRs are plotted in Figure A1. The expected IRR is essentially equal to the expected house price growth of 3% during the first five years, but it increases slowly afterwards as a result of the interest fees. The figure also plots the IRR for an an annual rate of house price growth of 4%.

B A simple framework

We develop a simple framework that guides the empirical analysis in the paper. We start by a two-period framework, but then extend it to three periods. The extended framework shows how even in the presence of subsidized high LTV debt (due to government guarantees), there may be demand for ELs by constrained borrowers with high marginal utility of consumption who benefit from the lower required mortgage payments.

B.1 Two-period model

Consider a simple two period model ($'$ indicates period two, and there is no discounting). Let c denote non-durable consumption, whose price is normalized to one, and h denote housing services. The representative borrower wishes to purchase a house of size h^{high}, but loan-to-value (LTV) and loan-to-income (LTI) constraints may prevent her from borrowing the mortgage amount (m) needed to purchase the desired house at the initial date. In the second period the individual derives utility from housing and from terminal wealth (w'). She maximizes:

$$u(c, h, w', h') = u(c, h) + E[v(w', h')] \tag{3}$$

$$\text{subject to} \qquad \frac{m}{p \times h} \leq \theta^{LTV} \quad \text{and} \quad \frac{m}{y} \leq \theta^{LTI} \tag{4}$$

where p and y denote the initial period price of one unit of housing and borrower income, respectively, and θ^{LTV} and θ^{LTI} denote the LTV and LTI limits. In addition, the borrower is subject to the budget constraints that depend on the case considered. Throughout we assume that there are no first period savings, other than those held in housing. We analyze four different cases:

1 Buy a large house in period one with mortgage with interest rate r and EL equal to fraction ϕ of house value:

$$c + \underbrace{ph^{high}}_{\text{Buy large house}} = \underbrace{y}_{\text{Income}} + \underbrace{m}_{\text{Loan amount}} + \underbrace{\phi ph^{high}}_{\text{Equity loan}} \tag{5}$$

$$w' = \underbrace{y'}_{\text{Income}} - \underbrace{(1+r)m}_{\text{Loan payment}} + \underbrace{(1-\phi)p'h^{high}}_{\text{House value}} \tag{6}$$

The borrower uses the EL in the initial period to purchase the house, but she has to give up an equal fraction of its future value. In the numerical example we also consider an extension in which the borrower pays rent on the EL.

2 Buy a large house in period one with debt only. This requires taking a mortgage m with interest rate r and possibly an additional junior loan Δm with interest rate ι:

$$c + \underbrace{ph^{high}}_{\text{Buy large house}} = \underbrace{y}_{\text{Income}} + \underbrace{m}_{\text{Loan amount}} + \underbrace{\Delta m}_{\text{Junior loan}} \tag{7}$$

$$w' = \underbrace{y'}_{\text{Income}} - \underbrace{(1+r)m}_{\text{Loan payment}} - \underbrace{(1+\iota)\Delta m}_{\text{Junior loan payment}} + \underbrace{p'h^{high}}_{\text{House value}} \tag{8}$$

The macro prudential constraints limit the maximum senior loan amount, so that individuals with low period one income may not be able to buy a large house with a mortgage only. They may be able to borrow additional funds using a junior or an unsecured loan, that will carry a higher interest rate ($\iota > r$). This additional loan may not be available ($\iota = \infty$) and the borrower may not be able to buy the large house in period one. Compared with the EL alternative, the borrower benefits fully from any increase in house prices, but she has higher leverage and loan costs.

3 Buy a smaller starter home (h^{low}) in period one, trade up in period two, assuming that the house sale is subject to transaction cost μ of house value:

$$c + ph^{low} = \underbrace{y}_{\text{Income}} + \underbrace{m}_{\text{Loan amount}} \tag{9}$$

$$w' + \underbrace{p'h^{high}}_{\text{Buy large house}} = \underbrace{y'}_{\text{Income}} - \underbrace{(1+r)m}_{\text{Loan payment}} + \underbrace{p'h^{low}}_{\text{Sale of starter home}} - \underbrace{\mu p'h^{low}}_{\text{Transaction cost}} + \underbrace{p'h^{high}}_{\text{House value}} \tag{10}$$

The agent purchases a large house in the second period, but this purchase has no terminal wealth effect since the term $p'h^{high}$ appears in the left and right hand side of the equation. The purchase of a starter home means that the borrower derives utility from a smaller value of housing services in period one, and that she has to incur transaction costs to trade up. Compared to the EL case, whether a smaller loan amount is needed at the initial date and whether there is less house price exposure depends on how h^{high} and ϕ relate to h^{low}. To simplify, we are not explicitly modeling the mortgage loan taken in period two to buy the house. The implicit assumption is that y' will be sufficiently high for the individual to be able to take the required loan and buy the house.

4 Rent a large house in period one, at proportional rental cost λ, and buy large house in period two:

$$c = \underbrace{y}_{\text{Income}} - \underbrace{\lambda p h^{high}}_{\text{Rental cost}} \tag{11}$$

$$w' + \underbrace{p' h^{high}}_{\text{Buy large house}} = \underbrace{y'}_{\text{Income}} + \underbrace{p' h^{high}}_{\text{House value}} \tag{12}$$

Renting in period one means that the individual does not benefit from any increase in price that may occur between periods one and two.

B.2 Numerical example

We construct a simple numerical example, informed by our institutional setting, to provide intuition on the trade-offs of the above four cases. Housing services can be $h^{high} = 100$ or $h^{low} = 80$, the desired level is $h^{high} = 100$. The period one house price is normalized to one. The borrower has relatively low initial initial income, $y = 16.(6)$, which together with $\theta^{LTI} = 4.5$ means that the maximum mortgage amount is $m = 75$. The mortgage interest rate r is equal to 2% for loans with a LTV of 75, and it increases to 4% for those with a LTV greater than 90. The EL faction is $\phi = 20\%$. The rental yield (λ) and the transaction cost of a house sale (μ) are both equal to 5%.

Constrained borrower

We first consider the case of a constrained individual, who has a down payment of five that can be put towards the house purchase in period one. This down payment can be thought of as the part of the initial income the borrower is able to put towards the house purchase. All of the remaining period one income is consumed in this period. The individual is constrained, in the sense that the down payment plus the maximum mortgage amount are not sufficient to purchase the house h^{high}. Under these assumptions, the first period consumption (c) is the same for all of the four cases considered (the five are either used as a down payment in cases 1 to 3, or to meet the rental cost in case 4). This means that we can compare the alternatives by simply looking at the second period terminal wealth w', which depends on p'. The left chart of Figure A2 compares the four cases for a level of second period income equal to thirty (this value has the same level effect for all the cases, and plays no role in the relative comparison).

Renting in period one means that households do not benefit from increases in house prices. In our simple example, it is the best alternative for households who expect significant declines in house prices, or for those who do not want exposure to house price fluctuations (the payoff line is horizontal). Buying a starter home gives the individual exposure to house prices. In fact, it gives the same exposure as the EL case, since $h^{low} = (1-\phi)h^{high} = 80$. However, the household incurs transaction costs to climb the property ladder which reduce the attractiveness of this alternative (and furthermore the household consumes less housing in period one).

Let us now focus on the comparison between the EL and the debt only alternative, where the debt comprises a senior mortgage loan of 75 with interest rate $r = 2\%$ and a junior loan of 20 with rate $\iota = 11.5\%$. For these values, the weighted average cost of the senior 75 LTV mortgage and the 20 junior loan is equal to the cost of 95 LTV mortgage.[45] This reflects a situation in which there is no LTI restriction on the maximum loan amount. The left chart of Figure A2 shows that, as a result of the higher leverage, the payoff for the debt only alternative is more sensitive to the evolution of house prices (the payoff line is steeper) than the EL case. Comparing the levels, we see that the debt only alternative has the highest payoff only for large values of house price growth (above 11.5%). This means that taking the EL is an attractive alternative for households expecting significant positive house price growth, but not the highest house price growth.

We now consider the effects of the introduction of a government guarantee (MG) on loan values above 75 and up to 95. We assume that the guarantee reduces the cost of the junior loan, making it equal to that of the senior loan ($\iota = 2\%$). We simplify the analysis by assuming that there is no fee associated with the MG, but it would be straightforward to add an annual mortgage insurance premium (MIP) to the cost of the junior loan. Figure A3 plots terminal wealth as a function of the period two price of housing for: (i) the debt-only alternative without a guarantee ($\iota = 11.5\%$); (ii) the MG; and (iii) the EL alternatives. The introduction of the

[45] The cost of the junior loan $\iota = 11.5\%$ calculates from:

$$0.04 = \frac{75}{95} \times 0.02 + \frac{20}{95} \times \iota. \tag{13}$$

guarantee lowers the period two house price threshold above which homebuyers are better off with the debt-only alternative than with the EL (from 11.5% to 2%). Thus, government down payment assistance in the form of a MG is preferred by borrowers for a wider range of terminal house prices and crowds out the demand for ELs.

In Figure A4 we extend our baseline example (without the MG) in two other ways. First, we plot the payoff of the debt only alternative when the interest rate on the junior loan is higher, equal to $\iota = 20\%$. This has the opposite effects of the MG. The EL alternative becomes relatively more attractive, and its payoff is higher than the debt only alternative even at high levels of period two prices. In the limit, when a junior loan (or other types of borrowing) are not available, even households who expect high price growth will demand ELs. Second, the EL as we have modeled in this example (and in reality) involves a subsidy: households do not need to make a rental payment on the part of the house that they do not own. In Figure A4 we investigate the effects on the removal of the subsidy on the payoffs of the EL alternative. More precisely, for the EL no subsidy alternative, we require that borrowers pay $\lambda \phi p h^{high} = 0.05 \times 0.20 \times 100 = 1$ in period two, corresponding to the rental payment. The debt only alternative becomes the preferred alternative at lower levels of house price growth. Thus the EL subsidy leads to an increase in the demand for ELs, but even without the subsidy there is a range of house prices for which borrowers are better off with the EL than with debt only (and this range is larger when the cost of the junior debt is higher).

Unconstrained borrower

We now consider the case of a borrower who is unconstrained: she has a large deposit available, equal to 25, and is therefore able to purchase the house with this deposit and a 75 LTV mortgage. In the right hand chart of Figure A2 we plot the payoff of this deposit and debt alternative (labeled debt), and compare it to the EL alternative, i.e. the financing of the house with a 75 LTV mortgage, a 20 EL and a 5 down payment, and the 75 LTV mortgage and a 25 down payment. For the EL alternative, and since the individual has an additional 20 in the first period that are not used as a down payment, we add 20×1.02 to the terminal wealth (the implicit assumption is that the individual would invest the 20 in the first period at an interest rate of 2%).

Figure A2 shows that for second period house prices above 1.02 the individual is better off without the EL, so that the availability of significant deposits and the expectation of house price increases should dampen the demand for ELs. There is however an additional effect: the flatter payoff line shows that the individual faces lower house price risk exposure in the EL case. If the value function is concave in w', even unconstrained individuals benefit from a reduction in house price risk exposure, and this may lead them to demand ELs. But for the market to work, it would have to be the case that EL providers are in better position to hold house price risk than home buyers.

B.3 Implications

Below we state some of the implications of our simple two-period framework for the empirical analysis:

1. Interaction of macro-prudential and affordability constraints: High house prices relative to labor income together with binding macro-prudential constraints increase the demand for ELs, which comes primarily from borrowers with low deposits. Borrowers with large deposits may demand EL if they wish to reduce their house price risk exposure.

2. Trading: ELs allow households to trade houses less frequently, and incur lower transaction costs when climbing the property ladder. Similarly, a larger EL limit, if taken advantage of, allows constrained households to buy a larger house, to trade houses less frequently, and incur lower transaction costs when climbing the property ladder.

3. Expectations: The expectation of large house price increases generates demand for ELs from constrained borrowers for whom the alternative is renting, but decrease demand from unconstrained borrowers.

4. Pricing of equity and debt: The existence of a EL subsidy makes the demand for EL larger, but there there may be demand even in the absence of a subsidy. A higher cost of borrowing, particularly at high LTVs, increases the demand for ELs.

B.4 Three-period model

In the two-period example the individual derives utility from terminal wealth (net of debt repayments that comprise principal plus interest). The first period consumption is the same for all the alternatives considered, so that it suffices to compare terminal wealth. We now extend the example to three periods, so that required mortgage payments play a role other than through terminal wealth (in the intermediate period).

In this extended example, period one is unchanged. In period two the agent receives income and makes the required mortgage payments calculated using the annuity formula (with loan amount, interest rate and mortgage maturity as inputs). We compare two alternatives: (i) EL equal to 20 plus loan amount 75 with interest rate 2%; and (ii) loan amount 95 with interest rate 2% (MG alternative). We use a mortgage maturity of 30 years, but we will report results for other maturities. Because of the difference in mortgage amounts, the required mortgage payments in the intermediate period in the EL and MG cases differ: they are equal to 3.45 and 4.24, respectively.

Period two consumption is equal to income minus mortgage payments. This captures the behavior of agents who are constrained: they use all of their cash-on-hand net of mortgage payments for consumption. In the third and final period, the individual receives income (equal to 30 in the base case), sells the house and repays external finance providers. The individual derives utility from terminal wealth, which depends on the period three price of housing and on the financing alternative chosen.

The individual derives utility from each period consumption according to a power utility function with risk aversion coefficient of two. Overall utility is equal to the sum of the utility in each of the three periods (for simplicity, we assume no discounting). Figure A5 plots overall utility as a function of period three house prices (for the EL and MG cases). The vertical line shows the threshold level of house prices above which home buyers are better off with the MG than with the EL; it is equal to 1.15 or a 7% annual house price appreciation rate.

Recall that in the two-period example, the house price appreciation above which the MG is preferred to the EL is much lower (equal to 2%). The reason for the higher threshold now is that in the three-period example the marginal utility of consumption in period two is high, which makes the EL alternative more valuable, as lower mortgage payments free up cash for intermediate consumption. This can be clearly seen in some simple comparative statics exercises. In the first panel of Table A1 we report the threshold annual rate above which the MG is preferred to the EL for different levels of period three income (ranging from the base case of 30 to 35). The higher period three income, the more the agent would like to increase consumption in the earlier periods, and the more valuable (in utility terms) is the reduction in required mortgage payments of the EL compared to MG. This leads to an increase in the range for which the EL is preferred.

The bottom panel of Table A1 shows the thresholds for different mortgage maturities (and the baseline level of income). The shorter the maturity, the larger the required mortgage payments and the larger the utility benefit from the reduction in intermediate payments in the EL compared to the MG scenarios. Therefore, a shorter maturity translates into a higher threshold level of period three house prices below which the EL is preferred to the MG.

In the previous example the levels of period three income and house prices are such that the agent is always able to repay the loan. This, together with an assumption of recourse debt allows us to abstract from default. Let us now briefly consider the case of non-recourse debt. The agent defaults when period three home equity is negative, i.e. when the value of his/her claim to the asset (80% of its value in the case of the EL) is less than the outstanding debt. Figure A6 plots the government payoff as a function of period three house prices. For the EL we subtract the initial government outlay of 20. The figure shows how the EL generates an upside in the government payoff, with a slope of 0.20, in case of house price increases. The government incurs EL losses for period three house prices below one (the period one level). On the downside, in the range in which there is borrower default, the EL payoff line has a slope of one since the government incurs losses ahead of the bank. For the MG, and for house price levels just below one, the homebuyer still has positive home equity (because of the down payment) and the government payoff is zero. A mortgage insurance premium (MIP) equal to a proportion of the loan amount shifts the MG government payoff line upwards in a parallel manner. This is also illustrated in the figure.

C Summary statistics

Section 3.1 describes the origination characteristics of all mortgages eligible for EL, dividing the sample between borrowers who did take up an EL and those who did not. This section complements that analysis by providing origination characteristics for FTBs only. FTBs make up 73% of EL borrowers compared to 43% of non-EL borrowers.

Table A2 shows that, when the sample is restricted to FTBs, EL and non-EL borrowers become more similar in age and income, compared to the aggregate statistics in Table 1, although there are still differences between the two groups in these and other variables. EL FTBs use a smaller down payment and rely on the maximum value of the EL. They choose longer mortgage maturities, pay a lower rate on their mortgages and have higher LTVs and LTIs. As in Table 1, EL FTBs end up with a lower average PTI. The bottom row of the table shows that, among FTBs, EL borrowers slightly outnumber non-EL borrowers.

In Table A3, we check that these differences among FTBs are not driven exclusively by a concentration of EL borrowers in more expensive regions or specific years. We control for region and origination-year fixed effects in a regression of characteristics on an EL indicator variable. The results obtained are similar to the unconditional analysis of the previous table, except for incomes and payment-to-income (PTI) ratios, which are now statistically indistinguishable between the two groups.

The PTIs shown in Tables A2 and A3 are front-end PTIs and do not take into account the servicing of other debts and committed expenditure.[46] The fact that they are front-end PTIs explains why they may seem relatively low compared to, for example, the estimates of DeFusco et al. (2020) for the US. In Table A4 we calculate back-end PTIs (i.e. that take into account the servicing of other existing debts and committed expenditures), for a small subsample of lenders for which we have data. Panel A of the table again reports front-end PTIs for the entire sample of banks, whereas Panel B displays data from three banks which have reported data on other debt and committed expenditure. While the front-end PTIs for this subgroup of banks are similar to the statistics for the entire sample—if not slightly lower—the back-end PTIs become considerable larger when including committed expenditure. It is also worth keeping in mind that, in addition to computing these PTIs, the regulations also require lenders to "stress-test" borrowers to make sure that they are able to meet mortgage payments in case of a three-percent increase in interest rates.

[46]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. 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.

D Further evidence on LTV and LTI constraints, payment to income and mortgage maturity

In the main paper we use administrative data on the checking account balances of a subsample of UK residents. These checking account data are collected by a credit reference agency. The data also contains information on the financial products taken by individuals, including mortgages, which we use to perform the match to our sample.

More precisely, for each mortgage in the credit files we know: (i) the year of birth of the borrower; (ii) the "lower-layer super output area" (LSOA) where the borrower lives; (iii) the origination year and month; (iv) the mortgage balance at origination; and (v) the name of the lender. UK LSOAs contain, on average, 1,500 residents - they are sometimes called "neighborhoods" in official statistical publications. For the matching, we proceed in rounds. In the first round, we identify exact matches along the five variables listed above. For joint mortgages, we attempt a match with the year of birth of both the first and the second borrowers (and ignore potential additional borrowers). We perform a final matching round allowing for looser matches on mortgage balance (approximating it to the nearest £1,000).[47] While a perfect match and complete data would lead to around 25,700 observations (corresponding to 10% of the sample in Table 1 of the paper), we end up with roughly 17,500 matches.

In the main paper we discuss survey data from a 2016 evaluation of the EL scheme.[48] The survey covered 501 households who used the EL scheme to purchase a property between April 2013 and January 2015. The survey data show that EL borrowers had on average £15,300 in savings before they started considering a house purchase (74% of respondents declared that they only started looking to move less then 12 months before the purchase), and the actual down payment was just over £17,000. First-time buyers had, on average, £14,800 in savings at the beginning of the process, compared to a down payment of £15,100. The survey values for the down payment are fairly close to those in our data. We find a mean downpayment for 2013-2014 (the years of the survey) of £17,322 for EL borrowers and of £14,393 for EL borrowers who are first-time buyers. In the survey, about a third of first-time buyers also reported benefiting from informal sources of finance, e.g. a loan or gift from parents for the savings used for the

[47] The mortgage balance at origination may be recorded with or without the initial fees added.

[48] Department for Communities and Local Government (2016), Evaluation of the Help to Buy Equity Loan Scheme.

down payment. These survey figures show that EL borrowers did not have substantial wealth beyond that used for the down payment.

In Table A5 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 down payment. We use loan cut-off thresholds at 95% CLTV (or 90% since lenders use stricter criteria for new properties) and 4.5 CLTI. We report results for the whole sample of EL borrowers and for FTBs. Panel A of Table A5 shows results with 95% LTV and 4.5 LTI thresholds: the top left hand entry shows that 46% of the borrowers would 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 very few 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.

We provide further evidence on the role of affordability in the decision to take out an EL, by comparing the PTI and mortgage maturity distributions of EL and non-EL borrowers (Figure A8). Stretching mortgage maturity is a mechanism for reducing mortgage payments and improving affordability. 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. 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. Mortgage maturities are longer than for non-EL borrowers, which is particularly visible in the proportion of borrowers who take 30- and 35-year mortgages. The lines in the bottom left chart show the PTI distributions that would have resulted in case EL borrowers had taken a mortgage loan for the amount of the CLTV with the original maturity. The mortgage payments would have been higher both because of the larger loan amount and because of a higher mortgage interest rate. We assume that the interest rate would have been 200 basis points higher, which is the average difference between mortgages with a 5% and a 25% down payment. The distributions shift significantly to the right. The mode of the distribution is roughly 35% (50% for the stress tested one).

E Bunching at the maximum property price

We provide additional details on the analysis that exploits the maximum property price of £600 thousand to be eligible for the EL scheme. In the main paper we have shown that there is a discontinuity in several variables at the threshold. In Figure A9 we show that there is also a discontinuity in the maturity of mortgages used to finance the acquisition of new properties in London. Those just below the threshold have an average maturity of almost 30 years compared to an average maturity of 27 years for those just above the threshold. An increase in mortgage maturity does not have an impact on LTV and LTI, but makes the loans more affordable by spreading out principal repayments over more years. This is further evidence that the scheme was used by households to overcome affordability constraints.

We have previously reported the results for a placebo test, on the sample of existing homes (i.e. not new and therefore not eligible for the EL scheme). In Figure A10 we plot the results for a second placebo test, on new properties sold in the years of 2009-2012, before the EL scheme was launched. There are no discontinuities at the threshold: age, deposit and income increase, and proportion of FTBs monotonically decrease with property purchase price.

Similar to Figure 3 in the main text, which shows the distribution of transaction prices for new properties in the relevant sample period, Figure A11 shows the transaction price distribution for the two placebo samples. For the placebos, there is no excess mass of sales just below the £600 thousand limit.

F Further evidence on the London experiment

In Table A6 we compare the characteristics of EL borrowers in London in the six months before and after the EL limit change. The differences in average age, proportion of FTBs and income are not statistically significant nor economically meaningful. This shows that there were no significant changes along these dimensions in the characteristics of borrowers using ELs. There is however a significant difference in the price of the properties acquired using ELs: the average increases from £360 to £413 thousand. There are also significant differences in the financing structure.

In Table A7 we report similar data for EL transactions in the SE of England (excludes London), where there was no change in the EL scheme maximum contribution. The changes in borrower age and income, although statistically significant are not economically meaningful. There was however an economically significant increase in the average property acquisition price, from £297 to £315 thousand, even though the EL did not increase there. (Property prices were increasing during this period.)

The comparison of Tables A6 and A7 shows that EL London borrowers are different from those in the SE along several dimensions: they tend to have higher income and are more likely to be FTBs. For this reason we have also estimated regressions where we compare the borrowers in the outer areas of London with those in the SE but in areas adjacent to London. In Figure A12 we map the geographical areas that we consider. Tables A8 and A9 show the same variables for borrowers in the outer areas of London and the neighboring local authorities in the SE, respectively. As expected, the differences in borrower and mortgage characteristics are attenuated as we are comparing more similar markets. And in Figure A13 we plot the evolution over time, for a comparison of pre-trends, of the outcome variables for outer areas of London and the neighboring ones in the SE.

One of the regressions reported in Table 2 uses a property's square meters as the dependent variable. This information is publicly available for all properties that were sold or rented in England and Wales since 2008, through Energy Performance Certificates (EPC). The EPC dataset can be downloaded online (at https://epc.opendatacommunities.org) and contains the exact address of the property together with the date in which the certificate was issued. We add this information to our dataset by merging on the full six-digit postcode and, for each full-postcode set of matches, select the match with the minimum distance, in days, between the certificate issuance and the sale of the property. (Certificates are always issued before the sale transaction takes place.) With this approach 98 percent of the new build transactions in our dataset are matched with a corresponding floor area.

Finally, in Table A10 we show the results of two placebo tests. In the upper panel we compare London to the SE one year before the policy change. In the lower panel we compare the SE local authorities on the London boundary against the other local authorities in the SE. Reassuringly, almost all differences are neither statistically nor economically significant. The only exception is house size in London compared to the SE post January 2015, which explains why we have also considered narrower geographical areas.

G Evidence on expectations

We provide evidence on house price expectations in England during our sample period. The data are from the Bank of England NMG survey from 2014 to 2017. Each semester, roughly three thousand households are asked about their house price expectations for the following year.[49] The data includes information on the local area of residence of the respondent, but we are not able to match it with the EL and mortgage debt data. In spite of this, we think that the data is informative and it provides context for the analysis in the paper.

The survey results indicate high house price expectations during this period, particularly in areas where house prices had been increasing the most. For example, in the Greater London area, more than 35% of households expected house prices to increase by 5% or more over the following year. In contrast, less than 15% said that they expected house prices to decline (a similar proportion responded "Don't know"). Given the large house price increases observed during the period, and the evidence on extrapolative house price expectations (Glaeser and Nathanson, 2017; Kuchler and Zafar, 2019), a plausible explanation is that English households extrapolated from the recent experience.

In order to test this hypothesis, we construct individual level and local area expectation measures. The former is a dummy variable that takes the value of one for individuals who expect house prices to increase (or to increase by more than 5%) over the following year, and zero otherwise. The latter is equal to the fraction of respondents in a given local area who expect house prices to increase (or to increase by more than 5%) over the following year. We then regress these measures on past house price appreciation in their local areas of residence (we use both the past two and one years), controlling for local area and time fixed effects. Columns (1) to (6) of Table A11 show the results. The positive and statistically significant estimated coefficients on past house price appreciation are consistent with extrapolative expectations driving optimism about future house prices.

In the remaining columns we add future house price appreciation to the set of explanatory variables. The estimated coefficients on past house price appreciation are almost unchanged in terms of both magnitude and statistical significance when we include the future house price change among the explanatory variables. Therefore, the evidence in support of extrapolative

[49] Respondents have to select among one of nine predetermined intervals (with "Don't know" as the tenth possible answer).

expectations is robust to the addition of these explanatory variables. In addition, the estimated coefficients on future house price appreciation are mostly non-significant, with the exception of the individual level regression shown in column (8), where the dependent variable is a dummy variable that takes the value of one if the individual expects future house price appreciation in excess of 5%, and zero otherwise. However, these results are based on house price expectations data from the Bank of England NMG survey, a bi-annual survey of roughly three thousand households, that we are unable to match with the EL and mortgage data. In the main paper we study the relation between EL repayment decisions and future house price returns.

H Ex-post borrower monetary gains with the equity loan

We give more details on the calculations of the ex-post monetary gains of EL. We start by discussing the borrower cash-flows in each of the two scenarios considered.

H.1 Cash flows with a standard mortgage (no EL)

We start by considering the cash flows of a household 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 down payment (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 $mp = Q_0 \cdot a_{Nr}$, where a_{Nr} 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: $E_T = P_T - Q_T$

H.2 Cash flows with an 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 down payment E_0.

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 down payment 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 the end of the fixed interest rate period (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 calculations assumes that this happens simply to compare the household payoffs across the two scenarios. In addition, the above cash-flows are valid for $T \leq 5$. After this time interest payments are due on the EL. Table A12 compares the cash-flows with EL and with no EL.

H.3 Break-even rate of house price appreciation and monetary gains with EL

To calculate the net gains/losses with EL, 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 from the EL are given by:

$$\Delta NV_T = Q_T - Q_{EL,T} + (mp - mp_{EL}) \cdot s_{T\delta} - 0.2 \cdot P_T, \tag{14}$$

where $s_{T\delta}$ is the future value of a constant annuity with T 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 monetary gain from using an 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 $P_0 = EL_0/0.2$.

$$\eta_{BE} = \left(\frac{Q_T - Q_{EL,T} + (mp - mp_{EL}) \cdot s_{T\delta}}{EL_0} \right)^{1/T} - 1. \tag{15}$$

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

H.4 Counterfactual interest rates: summary statistics.

For non-EL borrowers, the counterfactual mortgage interest rate is equal to 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% lower LTV (40% in London after February 2016). Table A13 shows summary statistics for the distribution of interest rate reductions by actual (not counterfactual) LTV. Panel A shows the results for mortgages originated in 2013-2015. For borrowers with LTV>85, the interest rate reductions are substantial, on average around 150 basis points. The reductions decline with LTV and are negligible for LTVs below 75. The reductions are not only at the mean: the whole distribution of the interest rate differential shifts to the left as the original LTV decreases.

All else equal, lenders do not offer higher interest rates for lower loan-to-value ratios. But as Table A13 shows, for very low LTVs and at percentile 10 of the distribution, the counterfactual interest rate under EL is higher—reflecting measurement error that may arise from, for example, mortgage rate changes within a given month. The measurement error may also be due to fact that for the early part of the sample we do not have information on loan fees. To assess its potential impact, 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 A13, we calculate the interest rate gains for mortgages originated in 2015-2017, calculating the counterfactual interest rate as before. 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). 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, suggesting that limited measurement error arises from the lack of fee information.

We use the counterfactual interest rates (and mortgage amount) to calculate counterfactual mortgage payments. Figure A14 compares the actual mortgage payments distribution for borrowers with an LTV greater than 85% (true rate, true loan) with two counterfactual distributions: in the first, only the interest rate varies, while the loan amount is fixed (EL rate, true loan); in the second, the loan amount also varies (EL rate, EL loan). Both factors, reduced interest rate and loan amount, contribute to the substantial shift of the distribution to the left. The reduction in mortgage payments is substantial: the median monthly payment declines from £820 in the actual to £521 in the counterfactual scenario. Although not shown in the figure, for LTV values lower than 85%, the reduction in mortgage payments is smaller, and mainly due to the reduction in loan amount.

For EL borrowers, we perform similar calculations to calculate the counterfactual mortgage interest rate, i.e. it is equal to the median rate for a mortgage issued with a 20% higher LTV.

H.5 Break-even rate with refinancing frictions

Our previous calculation assumed a two-year fixed period with EL repayment at the end of this period. Two years is the most frequent period of initial interest rate fixation in the UK market, at which point most borrowers remortgage their loans. However, some borrowers may not wish or be able to repay the EL after two years, and their ability to remortgage the bank debt may be affected by the presence of the EL. We extend our framework to quantify the impact of these refinancing frictions on the break-even rate of house price appreciation. We do so by assuming that borrowers still take a mortgage with an initial period of interest rate fixation of two years, but that the horizon is four years (i.e. in the counterfactual scenario the EL is only repaid after four years).[50] Those borrowers who do not refinance after two years, when the initial period of

[50]Households may repay the EL by borrowing additional funds or through a property sale.

discounted rates ends, start paying the higher reversion rate. Those who refinance can do so with the same lender (internal remortgage) or with a different lender (external refinance). The interest rate that borrowers can obtain by searching among all lenders is usually lower than the one they are able to achieve when they are restricted to remortgaging with the same lender.

Table A14 shows the cash-flows for this extended horizon. We assume that borrowers with a standard mortgage remortgage externally after two years (labeled standard + external rmgt in the table). Even though in reality not all of them do so, they face fewer constraints than EL borrowers, and they are more likely to be able to take advantage of external remortgaging opportunities. We compare this to the EL case, and to three different refinancing outcomes at date $t = 2$: In the first ($j = reversion$), the EL borrower is unable to remortgage at the end of the initial period of discounted rates and pays the higher reversion rate for the remainder of the horizon. In the second ($j = internal$), the EL borrower is able to remortgage, but only with same lender. Finally, in the third case ($j = external$), the EL borrower does not face refinancing frictions and remortgages externally.

In Table A14 the refinancing frictions and associated costs are captured by two parameters. First, the potential higher fixed cost of remortgaging with an EL relative to a standard loan $c_{EL,j} > c$ (for j=internal, external). Second, depending on whether the EL borrowers are able to refinance and the type of refinance, they may end up paying a higher interest rate. Hence we have that $mp - mp_{EL} \geq mp^{refi} - mp^{refi}_{EL,j}$, which implies that the reduction in monthly debt payments with an EL is lower after the end of the initial period due to the higher interest rate on reversion and on internal remortgage relative to external refinancing.[51]

We calculate the break-even rate η_{BE} by equating the future value of the cash-flows at date $T = 4$ in the no EL and EL scenarios. The break-even rate depends on the scenario assumed for the refinancing in the presence of the EL (j= reversion, internal, external):

$$0.2P_0(1+\eta_{BE})^4 = Q_4 - Q_{EL,j,4} + (mp - mp_{EL})s_{2,\delta}(1+\delta)^2 + (c - c_{EL,j})(1+\delta)^2 + (mp^{refi} - mp^{refi}_{EL,j})s_{2,\delta}, \quad (16)$$

[51]Note that the monthly payment could still be higher even after the end of the initial fixed period for the borrower taking a standard mortgage and refinancing externally, because while the interest rate is lower the loan balance is higher. In addition, in the calculations shown in Table A14, for simplicity, we assume that there are no changes in the loan balance at the time of remortgaging.

with $P_4 = P_0(1 + \eta_{BE})^4$ and where $s_{2,\delta}$ is the annuity formula that calculates the future value of twenty-four monthly payments (2 years of payments) using annual rate δ. The value of these payments at time $T = 2$, i.e. $(mp - mp_{EL})s_{2,\delta}$ needs to be capitalized to $T = 4$. For those periods after $T = 2$, the monthly mortgage payments in the EL case depend on j.

For values above (below) this rate of house price appreciation a risk-neutral individual is worse (better) off with the EL, accounting for the additional refinancing costs of alternative EL+ j. We can also use the above formula to calculate Δ wealth, i.e. terminal wealth with EL minus terminal wealth without EL, taking into account any additional refinancing costs. For simplicity, we assume that the rate δ that allows us to calculate the future value of the cash-flows is fixed throughout.

We use administrative data from January 2015 to December 2016 to calculate the interest rate differentials that apply to our counterfactual scenario, in each of the refinancing alternatives. EL borrowers who do not remortgage at time $T = 2$ start paying the higher reversion rate. Most lenders set the reversion rate equal to their standard variable rate (SVR), which does not depend on the LTV. This generates differences between reversion and internal remortgaging rates that decrease with LTV: a median difference of 1.92% for LTVs up to 70% decreasing to 1.35% for LTVs over 90%. The median differences between internal and external remortgaging rates are considerably smaller: 0.27% for LTVs up to 70% and essentially no difference for LTVs over 90%. Thus lenders give a better rate to external than internal remortgagors, but they are less willing to do so at high LTVs. These differences show that borrowers achieve substantial gains from taking action and remortgaging with same lender, but the interest rate benefits of going external and remortgaging with a different lender are considerably smaller.

Figure A15 plots the break-even rates as a function of the initial LTV. Recall that for values above the break-even rate borrowers are better off without the EL. As expected, the refinancing cost imposed by the EL is highest for the case in which the EL prevents borrowers from refinancing, so that they have to pay the reversion rate for the remainder of the horizon (the break-even rates above which borrowers are better off without the EL are lowest).

The figure also shows that if the EL prevents borrowers from refinancing externally, it has an added cost relative to an internal remortgage. However, the vertical difference between the two lines is significantly smaller than the one between internal remortgaging and reversion. This reflects the fact that the difference between the typical reversion and internal remortgage rates is significantly larger than the difference between the external and internal ones.

Section 5 shows that the presence of the EL makes it difficult for borrowers to remortgage with a different lender; Figure A15 shows that this is costly. However, these costs are an order of magnitude smaller than if the EL also made it difficult for borrowers to remortgage with the same lender. The results in Table 8 show that EL borrowers do refinance with the same lender, and they are more likely to do so than non-EL borrowers.

I Comparison of non-EL and EL borrowers

In the calculations of the ex-post monetary gains for non-EL borrowers, in the EL scenario we have kept the house that the individual buys fixed and have changed *only* the financing structure (£20 of the bank mortgage is replaced with an EL). One could consider a different counterfactual, where both the house and the financing structure change. For example, the household uses a £25 EL and buys a £125 property, with the same £15 down payment and £85 bank mortgage. In this case, during the first five years of the loan, when no interest payments are due to the government, the homebuyer consumes more housing services (those corresponding to a house worth £125 instead of £100), for the same cash flows (or potentially lower mortgage payments due to a reduction in the mortgage interest rate due to the lower LTV, in spite of the same loan amount). Importantly, in this alternative counterfactual, and from an investment perspective, the household has the same exposure to housing as in the base case without the EL.[52]

To study more in depth utility differences in housing consumption and investment, we exploit the break-even calculations on homebuyers who do not make use of the EL and compare them to EL borrowers. More precisely, in Table A15 we order non-EL borrowers by the different quartiles of the distribution of break-even rates of house price appreciation, and we compare them with borrowers who take an EL (shown in the last column). The average break-even rates, shown in the first row of the table, range from 0.67% for buyers in the bottom quartile,

[52]Note that once we change the house choice it may well be the case that a more expensive new build property is not available in the local area at the time that the buyer decides to purchase her home. Furthermore, some costs (e.g. administrative expenses or taxes) may be higher with more expensive properties. For these reasons our simple counterfactual that keeps the house unchanged has the advantage of considering an option that is more likely to be in the household's actual choice set.

to 9.32% for those in the top quartile.

Compared with the lower quartiles of break-even rate, non-EL borrowers in the top quartile are younger, more likely to be first-time buyers, and they buy properties with substantially smaller down payments (higher LTV) and longer mortgage maturities. In terms of these characteristics, the non-EL borrowers in the top quartile of break-even rates are the most similar (albeit not identical) to EL borrowers (shown in the last column of Table A15).

Some of the differences between non-EL borrowers in the top quartile of break-even rates and EL borrowers are as expected: EL borrowers are on average younger, more likely to be FTBs, and they contribute lower down payments. There is, however, another important difference: in spite of their lower average incomes, EL borrowers buy on average more expensive houses than non-EL borrowers in the top quartile of the break-even rates. As a result, they buy and consume more expensive houses relative to their income. This can be seen in the penultimate row of Table A15, where we report the value of the house purchased (i.e. housing consumption) divided by household income. This suggests that households who use the EL have a consumption preference for larger/more expensive properties relative to their income and their savings, that they would not be able to afford without the EL.

We also calculate a measure of housing investment for non-EL borrowers by dividing the value of the house that they have bought by their income (for these individuals housing investment is equal to housing consumption). For EL borrowers, the housing investment is based on the fraction of the house value that the individual owns (for these individuals housing investment is lower than housing consumption). Interestingly, the last two columns of Table A15 show that the housing investment relative to income is similar, equal to 3.96 and 3.91, for non-EL borrowers in the top quartile of break-even rates and EL borrowers, respectively. On the other hand, the housing consumption relative to income is much smaller for non-EL borrowers than for EL borrowers, equal to 3.96 and 4.88, respectively.

These results suggest that the housing consumption motives may have led EL borrowers to overcome any information or cognitive frictions associated with using a non standard mortgage product to purchase their house. These motives are not incompatible with housing investment motives. After all, FTBs EL borrowers do become homeowners, with housing investment equal to a significant fraction of the value of the house that they purchased. Furthermore, these borrowers may have a high expected rate of house price appreciation, and such expectations may lead them to take the EL. As in the numerical example of appendix section B.2, they cannot buy the house that achieves their desired level of housing consumption without the EL, and they worry about reduced affordability in the future, arising from expected future house price increases, if they remain renters any longer.

J Equity loan repayment behaviour

We focus on ELs issued between April 2013 and March 2015, for which at least two years have passed since origination. For these mortgages, Table A16 reports the means of several origination variables for borrowers by repayment outcome (repaid with a sale, repaid without a sale, did not repay). The last column of the table reports the difference in means between borrowers who repaid the EL without a sale and those who still have the EL, which 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 younger and FTBs. Affordability constraints are likely to be more binding for these groups of individuals, but younger individuals may also face higher income growth, which when later on is realized relaxes affordability constraints. Those who repaid tend to have higher origination income and to have purchased a more expensive house but the differences in LTV, LTI, PTI, and mortgage maturity, although sometimes statistically significant, are not economically meaningful.

In the main paper we have shown that, at the point of EL repayment, the distribution of equity extracted (in pounds) by those who repay the EL is similar to the amount due on the EL. In Figure A16 we plot the differences in LTVs (instead of pounds) between the new LTV (for the refinanced loan) and the counterfactual LTV (based on the mortgage balance outstanding for the previous mortgage and the updated house value recorded for the refinanced mortgage). Borrowers who repaid the EL tend to increase LTV by around 20%, which is the financing needed to repay the EL. We also plot in the figure the a line that shows equity extracted net of the amount used to repay the EL (minus EL share).

K Refinancing frictions

The paper presents evidence on the refinancing behavior, by type of refinancing, of EL and non-EL borrowers. We provide additional evidence on the choices that they make, possibly in anticipation of the refinancing frictions that they face. In Figure A17 we compare the housing tenure of EL and non-EL borrowers. More precisely, we plot the cumulative probability of a house sale for each of the two groups by year of mortgage origination. The probabilities of a house sale are slightly higher for non-EL borrowers during the first three years after origination, but the differences are not large and they decrease with time. Therefore we do not find evidence in support of the hypothesis that those who stay in their houses longer are less inclined to take the EL. However, it is important to keep in mind that EL and non-EL borrowers are different in several dimensions that may be related to their housing tenure. In addition, as we have shown, EL borrowers use the financing to buy larger houses, which may reduce their desire to sell the house to move to a bigger property.

It may also be the case that EL borrowers adjust along other dimensions, in anticipation of refinancing frictions. If an EL borrower plans to stay in the house for long, and anticipates that it will be difficult to remortgage the bank debt, then she may choose a mortgage with a longer initial period on the discounted rate, so as to reduce the refinancing frequency (the rate however increases with the length of the initial period). In order to investigate this hypothesis, in Figure A18 we compare the maturity of the initial period of fixed discounted rates for EL and non-EL borrowers.

The figure shows that EL borrowers are relatively more likely to choose 5-year fixed mortgages than non-EL borrowers. EL borrowers are less likely to choose 3-year, 4-year, 7-year and 10-year fixed rate mortgages than non-EL borrowers (the proportion of 2-year fixed mortgages is similar for the two groups). Five years is also the duration of the initial period of the EL when interest payments are not due to the government. This suggests that some EL borrowers use the initial EL period as a reference point to set the length of the initial fixed-rate period of their mortgage.

Table A1: Comparison of mortgage guarantee and equity loan: threshold levels of annual house price appreciation

The table reports threshold rates of annual house price appreciation above which the agent is better off with the debt only alternative with a mortgage guarantee than with the equity loan. The table reports the thresholds for different levels of period three income (for a mortgage maturity of 30 years) and for different mortgage maturities (for the a period three income of 30).

Period three income	30	33	35
Annual house price growth	0.072	0.098	0.120
Mortgage maturity (years)	25	30	35
Annual house price growth	0.131	0.072	0.056

Table A2: Comparison EL vs. non-EL borrowers: First-time buyers

The table reports, for first-time buyers only, summary statistics for EL and non-EL borrowers. Data for mortgages originated between April 2013 and March 2017 for purchase of new homes 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***
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)	67.67	(21.25)	24.85***
LTI	3.53	(0.72)	3.20	(0.98)	0.33***
Combined LTI	4.57	(1.25)	3.22	(1.51)	1.35***
Payment-To-Gross income (%)	17.02	(3.97)	17.54	(8.89)	-0.53***
Payment-To-Net income (%)	22.99	(5.21)	23.50	(11.01)	-0.51***
N	73,140		67,052		140,192

Table A3: 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 $y = \alpha + \beta_1 EL + \gamma_j + \lambda_t + \epsilon$, 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 column shows $\hat{\alpha} + \hat{\beta}_1$ (standard deviation in parenthesis), the third column $\hat{\alpha}$ and the fifth column $\hat{\beta}_1$ (the stars come from the p-value for mean-difference test). Data for mortgages originated between April 2013 and March 2017 for purchase of new homes with value below £600,000. *** denotes statistical significance at the 1% level.

	EL		Non-EL		
	Mean	SE	Mean	SE	Difference
Age (Years)	31.17	(0.05)	32.15	(0.05)	-0.97***
Gross income (£.000)	56.80	(1.94)	57.74	(2.09)	-0.94
Property value (£.000)	292.12	(0.61)	268.63	(0.66)	23.50***
Down payment (£.000)	31.12	(0.35)	72.64	(0.38)	-41.51***
Equity loan (£.000)	51.39	(0.09)	0.00	(0.00)	51.39***
Mortgage value (£.000)	204.98	(0.47)	188.50	(0.51)	16.48***
Interest Rate (%)	2.35	(0.01)	2.47	(0.01)	-0.11***
Maturity (Years)	30.36	(0.04)	28.52	(0.05)	1.84***
2-year fixed (%)	0.62	(0.00)	0.67	(0.00)	-0.05***
Other fixed (%)	0.37	(0.00)	0.26	(0.00)	0.11***
LTV	70.01	(0.11)	66.16	(0.12)	3.85***
Combined LTV	92.07	(0.06)	66.16	(0.12)	25.91***
LTI	3.73	(0.01)	3.38	(0.01)	0.35***
Combined LTI	4.81	(0.01)	3.38	(0.01)	1.43***
Payment-To-Gross income (%)	17.37	(0.05)	17.31	(0.06)	0.07
Payment-To-Net income (%)	24.41	(0.07)	24.41	(0.07)	0.00

Table A4: Payment to income, credit commitments and expenditures

Panel A 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 (PTI) ratio net of other credit commitments and of other committed 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 A5: Distribution of cumulative LTV and LTI for EL borrowers

The table shows, for EL borrowers, the number of loans (and fraction of the total in parenthesis) with combined loan-to-value (CLTV) and combined loan-to-income (CLTI) ratios below/above a given threshold. CLTV and CLTI are calculated by adding mortgage loan and equity loan. The CLTI threshold is 4.5 and the CLTV threshold is either 95 (Panel A) or 90 (Panel B). Data for mortgages originated between April 2013 and March 2017 for purchase of new homes 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%	45,785	(46%)	53,510	(54%)	33,330	(46%)	39,584	(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%	7,820	(8%)	16,189	(16%)	4,073	(6%)	9,760	(13%)
CLTV > 90%	38,122	(38%)	37,440	(38%)	29,383	(40%)	29,924	(41%)

Table A6: Comparison pre vs. post-London EL scheme: EL borrowers in London
The table reports summary statistics (mean and standard deviation) and the results of t-tests of equality of means between EL borrowers who bought in London in the six months before and after 1 February 2016, the date of the introduction of the London EL scheme. *** denotes statistical significance at the 1% level.

	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
Property value (£.000)	360.70	(107.22)	412.67	(117.07)	51.97***
Down payment (£.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)	255.66	(78.77)	261.94	(76.23)	6.29*
Interest Rate (%)	2.37	(0.49)	2.19	(0.51)	-0.18***
Maturity (Years)	29.72	(4.74)	30.47	(4.85)	0.75***
2-year fixed (%)	0.62	(0.49)	0.70	(0.46)	0.08***
Other fixed (%)	0.36	(0.48)	0.29	(0.45)	-0.07***
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	(0.62)	-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***
Payment-To-Net income (%)	25.73	(4.69)	24.74	(4.42)	-0.99***
N	1,010		1,187		2,197

Table A7: Comparison pre vs. post-London EL scheme: EL borrowers in the South East of England

The table reports summary statistics (mean and standard deviation) and the results of t-tests of equality of means between EL borrowers who bought in the South East of England in the six months before and after 1 February 2016, the date of the introduction of the London EL scheme. *** denotes statistical significance at the 1% level.

	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***
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 (%)	25.14	(4.98)	25.16	(4.83)	0.02
N	3,783		4,093		7,876

Table A8: Comparison pre vs. post-London EL scheme: EL borrowers in Outer London

The table reports summary statistics (mean and standard deviation) and the results of t-tests of equality of means between EL borrowers who bought in outer London in the six months before and after 1 February 2016, the date of the introduction of the London EL scheme. *** denotes statistical significance at the 1% level.

	Pre		Post		
	Mean	SD	Mean	SD	Difference (%)
Age (Years)	32.40	(5.55)	32.30	(5.85)	-0.10
First time buyers (%)	0.91	(0.28)	0.92	(0.27)	0.01
Gross income (£.000)	70.37	(33.39)	71.28	(25.39)	0.91
Property value (£.000)	342.24	(90.12)	399.21	(101.60)	56.97***
Down payment (£.000)	30.37	(26.70)	37.58	(33.80)	7.21***
Equity loan (£.000)	67.84	(18.24)	109.06	(56.09)	41.22***
Mortgage value (£.000)	244.29	(66.96)	253.13	(68.60)	8.83**
Interest Rate (%)	2.35	(0.48)	2.20	(0.55)	-0.16***
Maturity (Years)	29.50	(4.73)	30.48	(4.86)	0.98***
2-year fixed (%)	0.66	(0.48)	0.73	(0.44)	0.08***
Other fixed (%)	0.32	(0.47)	0.26	(0.44)	-0.06**
LTV	71.52	(6.97)	64.50	(12.08)	-7.01***
Combined LTV	91.33	(6.98)	90.92	(7.56)	-0.41
LTI	3.71	(0.71)	3.69	(0.63)	-0.02
Combined LTI	4.75	(0.94)	5.33	(1.19)	0.58***
Payment-To-Gross income (%)	17.69	(3.60)	16.85	(3.25)	-0.83***
Payment-To-Net income (%)	25.52	(4.96)	24.69	(4.43)	-0.83***
N	511		528		1,039

Table A9: Comparison pre vs. post-London EL scheme: EL borrowers in the neighboring local authorities in the South East of England

The table reports summary statistics (mean and standard deviation) and the results of t-tests of equality of means between EL borrowers who bought in the neighboring London local authorities in the South East of England in the six months before and after 1 February 2016, the date of the introduction of the London EL scheme. *** denotes statistical significance at the 1% level.

	Pre		Post		
	Mean	SD	Mean	SD	Difference (%)
Age (Years)	32.93	(6.38)	32.11	(6.55)	-0.82**
First time buyers (%)	0.84	(0.37)	0.88	(0.33)	0.04*
Gross income (£.000)	61.91	(26.72)	61.11	(22.92)	-0.80
Property value (£.000)	306.92	(103.76)	316.76	(90.31)	9.83
Down payment (£.000)	27.03	(28.67)	29.85	(32.50)	2.82
Equity loan (£.000)	60.80	(20.69)	62.82	(18.44)	2.02
Mortgage value (£.000)	219.32	(72.51)	224.76	(64.64)	5.44
Interest Rate (%)	2.51	(0.52)	2.30	(0.56)	-0.21***
Maturity (Years)	28.86	(4.55)	29.42	(4.85)	0.57*
2-year fixed (%)	0.62	(0.49)	0.70	(0.46)	0.08***
Other fixed (%)	0.38	(0.49)	0.29	(0.45)	-0.09***
LTV	71.96	(6.69)	71.37	(8.02)	-0.59
Combined LTV	91.79	(6.79)	91.20	(8.05)	-0.59
LTI	3.69	(0.65)	3.82	(0.63)	0.13***
Combined LTI	4.71	(0.85)	4.91	(0.85)	0.19***
Payment-To-Gross income (%)	18.24	(3.64)	18.17	(3.41)	-0.07
Payment-To-Net income (%)	25.89	(5.14)	25.88	(4.78)	-0.01
N	463		518		981

Table A10: Effect of the introduction of London EL scheme: Placebo tests

Panel A replicates the analysis of Table 2 on a different sample: London versus the South East (SE) of England in the year before the policy change. Panel B replicates the analysis of Table 2 on a different sample: the local authorities in the SE that border with London, relative to the ones in the SE that do not.

Panel A: London versus the SE in the year before the policy change

	Values in £1,000					
	(1) EQUITY LOAN	(2) PURCHASE PRICE	(3) DOWN PAYMENT	(4) MORTGAGE AMOUNT	(5) DEFLATED PURCHASE PRICE	(6) SQUARE METERS
London × Post Jan 2015	2.02	10.45	2.52	5.91	8.21	-9.42**
	(2.27)	(11.56)	(2.78)	(7.60)	(11.52)	(3.79)
LONDON	8.44***	44.06***	8.89***	26.73***	44.31***	-11.39***
	(2.22)	(11.53)	(3.04)	(7.20)	(11.65)	(3.29)
POST JAN 2015	1.77**	9.32**	1.76	5.79*	9.58**	3.54**
	(0.85)	(4.24)	(1.21)	(2.98)	(4.12)	(1.78)
BORROWER CHARACTERISTICS	Yes	Yes	Yes	Yes	Yes	Yes
REGIONAL HOUSE PRICE INDEX	Yes	Yes	Yes	Yes	Yes	Yes
r2	0.36	0.37	0.11	0.37	0.37	0.17
N	6,770	6,770	6,770	6,770	6,770	6,621

Panel B: Authorities in the SE that border with London relative to the ones that do not

	Values in £1,000					
	(1) EQUITY LOAN	(2) PURCHASE PRICE	(3) DOWN PAYMENT	(4) MORTGAGE AMOUNT	(5) DEFLATED PURCHASE PRICE	(6) SQUARE METERS
Close to London × Post Jan 2016	0.43	0.86	0.38	0.05	0.39	-0.91
	(1.65)	(7.93)	(2.66)	(4.75)	(7.78)	(5.79)
CLOSE TO LONDON	1.84	10.40	0.72	7.84	10.32	-3.21
	(2.12)	(10.50)	(2.68)	(6.07)	(10.49)	(4.18)
POST JAN 2016	-0.60	-2.06	-0.80	-0.65	-2.37	1.71
	(0.95)	(4.51)	(1.49)	(2.49)	(4.38)	(1.87)
BORROWER CHARACTERISTICS	Yes	Yes	Yes	Yes	Yes	Yes
REGIONAL HOUSE PRICE INDEX	Yes	Yes	Yes	Yes	Yes	Yes
r2	0.50	0.53	0.15	0.60	0.52	0.17
N	8,178	8,178	8,178	8,178	8,178	8,049

Table A11: Extrapolative expectations

The table reports the results of regressions of house price expectations on past house price appreciation. In the individual level regressions, the dependent variable is a dummy equal to one if the household expects an increase (or an increase of more than 5%, in column (2)) in house prices over the following year, and zero otherwise. In the local authority regressions, the dependent variable is the fraction of respondents in the local area who expect an increase (or an increase of more than 5%) in house prices over the following year. The past appreciation in house prices is measured in the local area of residence of the respondents, over the previous one or two years.

	Past appreciation						Past and future appreciation					
	Individual level		Local authority level				Individual level		Local authority level			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	>0	≥5%	>0	≥5%	>0	≥5%	>0	≥5%	>0	≥5%	>0	≥5%
Past appreciation (2 years)	0.23**	0.36***	0.26***	0.34***			0.23**	0.40***	0.24***	0.34***		
	(0.10)	(0.07)	(0.09)	(0.08)			(0.10)	(0.08)	(0.09)	(0.08)		
Past appreciation (1 year)					0.25**	0.53***					0.27**	0.51***
					(0.11)	(0.10)					(0.11)	(0.10)
Future appreciation (2 years)							0.04	0.18***	-0.08	0.05		
							(0.07)	(0.06)	(0.08)	(0.08)		
Future appreciation (1 year)											-0.13	-0.00
											(0.12)	(0.11)
Year-Semester f.e.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Local authority f.e.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
ymean	0.63	0.25	0.64	0.25	0.64	0.25	0.63	0.25	0.63	0.25	0.63	0.25
ysd	0.48	0.43	0.22	0.20	0.22	0.20	0.48	0.43	0.22	0.20	0.22	0.20
r2	0.09	0.11	0.54	0.54	0.54	0.54	0.09	0.11	0.54	0.54	0.54	0.55
N	29,355	29,355	2,261	2,261	2,261	2,261	28,056	28,056	2,155	2,155	2,155	2,155

Table A12: Cash-flows with EL repayment at $T = 2$

The table compares the cash-flows for a property purchase financed with only a standard mortgage (no EL) with the cash-flows for purchase financed with a combination of mortgage and EL financing (with EL equal to 0.2 of the property price). In both cases, the mortgage has an initial period of interest rate fixation of two years, at which point the EL is repaid. The EL repayment amount is 0.2 of the property price at T=2 (denoted by P_T).

Period:	0	$0 < t \leq 2$	$T = 2$ years
EL	$-E_0$	-mp_{EL}	$0.8P_T - Q_{EL,T}$
Standard mortgage	$-E_0$	-mp	$P_T - Q_T$
Δwealth (EL - standard)	0	$mp - mp_{EL}$	$-0.2P_T + (Q_T - Q_{EL,T})$

Table A13: Mortgage interest rate reduction with EL for non-EL borrowers

The table shows the price difference in percentage points between the actual mortgage rate paid by non-EL borrowers and the counterfactual rate for a mortgage issued for a new home 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 (40% in London after February 2016). Panel A shows results for the subsample of two-year fixed mortgages issued in the first two years of the EL scheme (April 2013- March 2015) with an LTV 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 A14: Cash-flows with refinancing

The table compares the cash-flows for a property purchase financed with only a standard mortgage (no EL) with the cash-flows for purchase financed with a combination of mortgage and EL financing (with EL equal to 0.2 of the property price). In the no EL case, the loan has an initial period of interest rate fixation of two years, at which point the standard mortgage is refinanced externally. The refinancing costs payable at time t=2 are denoted by c. For the EL case we consider three scenarios, denoted by j: the household does not refinance and must pay the higher reversion rate for the remainder of the horizon; remortgage with the same lender (internal remortgage); and remortgage with a different lender (external). At the end of the horizon, $T = 4$, the EL is repaid. The EL repayment amount is 0.2 of the property price at T=4 (denoted by P_T).

Period:	0	$0 < t \leq 2$	$t = 2$	$2 < t \leq 4$	$T = 4$
EL + j = reversion, int. or ext. rmgt	$-E_0$	-mp_{EL}	$-c_{EL,j}$	-$mp_{EL,j}^{refi}$	$0.8P_T - Q_{EL,j,T}$
Standard + external rmgt	$-E_0$	-mp	$-c$	-mp^{refi}	$P_T - Q_T$
Δwealth (EL - standard)	0	$mp - mp_{EL}$	$c - c_{EL,j}$	$mp^{refi} - mp_{EL,j}^{refi}$	$-0.2P_T + (Q_T - Q_{EL,j,T})$

Table A15: Summary statistics for non-EL borrowers by break-even quartile and for EL borrowers (2-year fixed, 2013-15)

In the first four columns, the table reports the mean of the variable of interest for each quartile of the distribution of break-even house price appreciation. Data for *non-EL* mortgages with two-year fixed-rate period originated between April 2013 and March 2015 for purchase of new homes with value below £600,000 and with a loan-to-value above 20%. In the fifth column, the Table reports the same means for the subsample of EL borrowers with two-year fixed-rate period originated between April 2013 and March 2015 for comparability.

	Mean values				
	Non-EL borrowers				EL
	1st quartile	2nd quartile	3rd quartile	4th quartile	borrowers
Break-even hp appreciation (%)	0.67	3.01	5.10	9.32	
First time buyers (%)	0.31	0.32	0.43	0.47	0.69
Age (Years)	39.51	39.97	35.86	34.15	32.20
Gross income (£.000)	65.05	52.52	58.73	53.01	47.03
Down payment (£.000)	126.15	98.32	50.18	30.38	18.84
Interest Rate (%)	2.18	2.65	3.28	3.96	2.99
Mortgage value (£.000)	189.58	139.86	162.78	167.78	153.80
Maturity (Years)	23.14	22.43	25.96	27.30	28.42
Property value (£.000)	317.36	238.19	212.97	198.07	215.33
LTV	60.24	57.27	72.12	84.08	71.80
Combined LTV	60.24	57.27	72.12	84.11	91.71
LTI	3.28	2.95	3.03	3.27	3.43
Combined LTI	3.30	2.97	3.06	3.32	4.40
Payment-To-Gross income (%)	19.53	19.04	18.16	20.67	18.33
Payment-To-Net income (%)	26.66	24.93	24.29	27.40	24.29
Housing consumption to income	5.77	5.50	4.17	3.96	4.88
Housing exposure to income	5.77	5.50	4.17	3.96	3.91

Table A16: Summary statistics for EL repayments

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 reports the mean values of the characteristics at origination of borrowers who have sold their properties triggering repayment, repaid the EL without selling the property or kept the EL.

	Sold Mean	Repaid Mean	Kept EL Mean	Difference 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***
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	4.55	4.63	4.54	0.09***
Payment-To-Gross income (%)	18.66	19.01	18.80	0.22
Payment-To-Net income (%)	24.48	25.66	24.70	0.96***
N	3,389	2,767	25,392	28,159

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 the number of years until loan termination. The annual inflation rate is assumed to be 2%. Two scenarios are considered: annual nominal house price growth of 3% and of 4%.

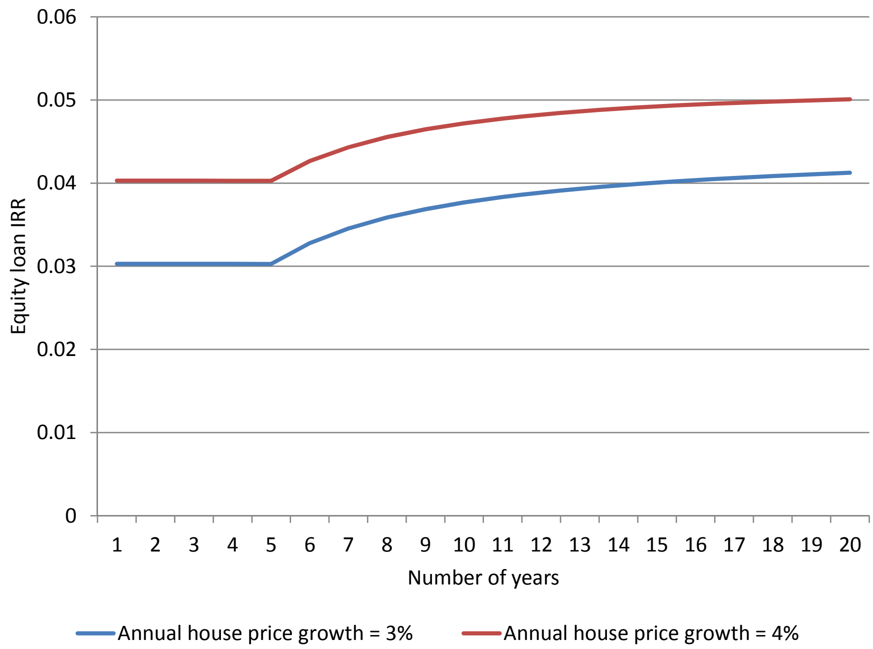


Figure A2: Framework: terminal wealth for constrained and unconstrained households

The figure shows terminal wealth in our numerical example in Section B for the different cases considered. The left chart shows terminal wealth for households who only have a deposit of five to put towards the house purchase in period one (the constrained households). The right chart shows terminal wealth for households who have a period one deposit of twenty five.

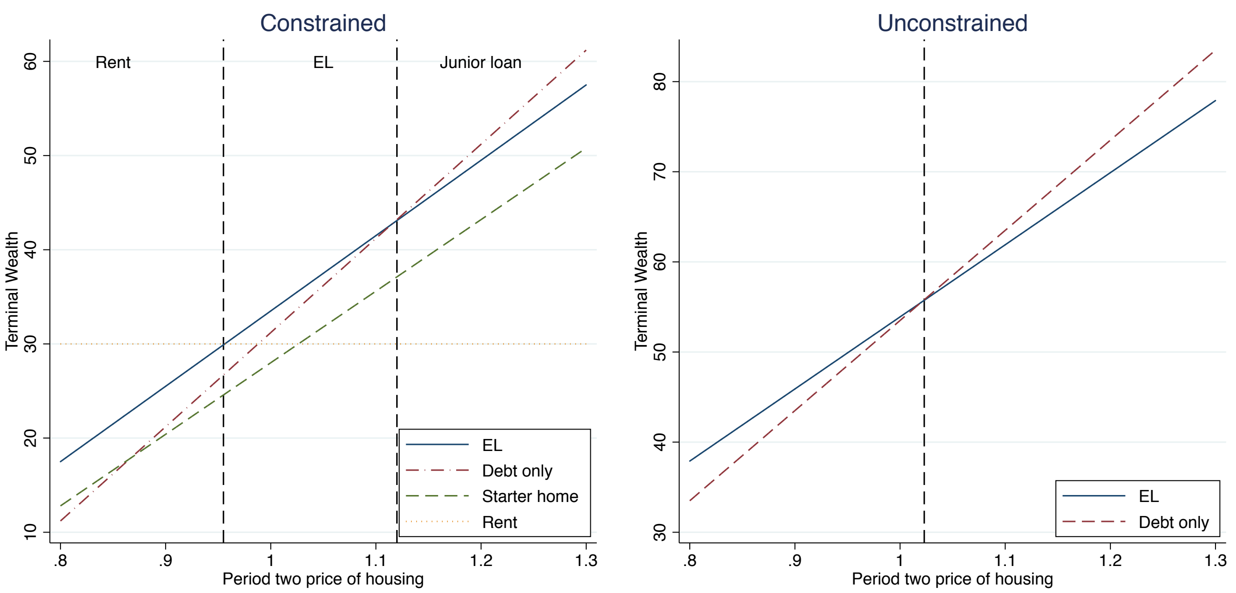


Figure A3: Terminal wealth for constrained borrowers: mortgage guarantee compared to equity loan.

The figure compares terminal wealth in the two period example for constrained borrowers (those with a down payment of 5 at the initial date) for the cases of: (i) debt only financing without a mortgage guarantee (the cost of the junior loan is 11.5%); (ii) debt financing with a government guarantee for LTVs above 75 (the cost of the junior loan is equal to 2%); and (iii) equity loan combined with debt financing.

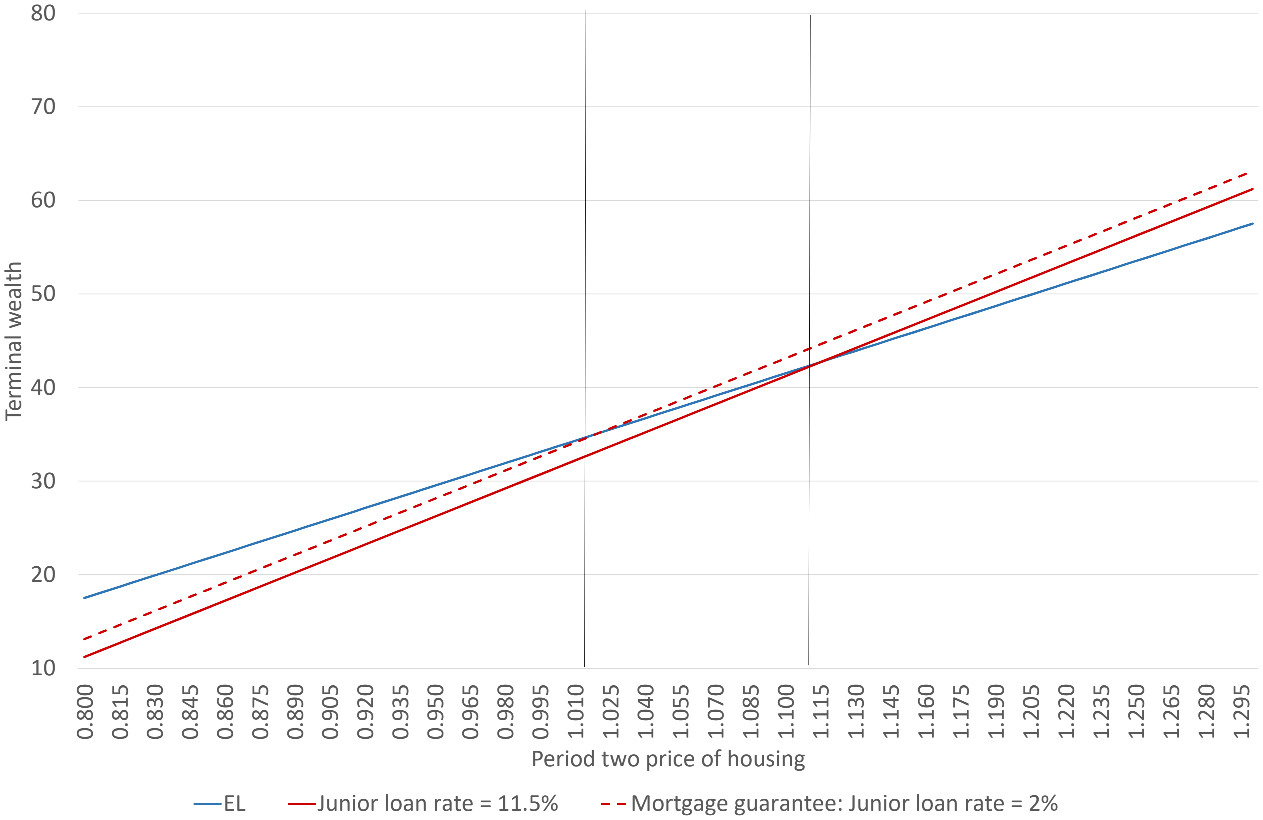


Figure A4: Framework extensions: terminal wealth for different pricing of equity and debt

The figure shows terminal wealth in our numerical example in Section B for the two different extension cases considered. The left chart shows terminal wealth for the case with EL that includes a rental payment. The right chart shows terminal wealth for the case with a more expensive junior rate.

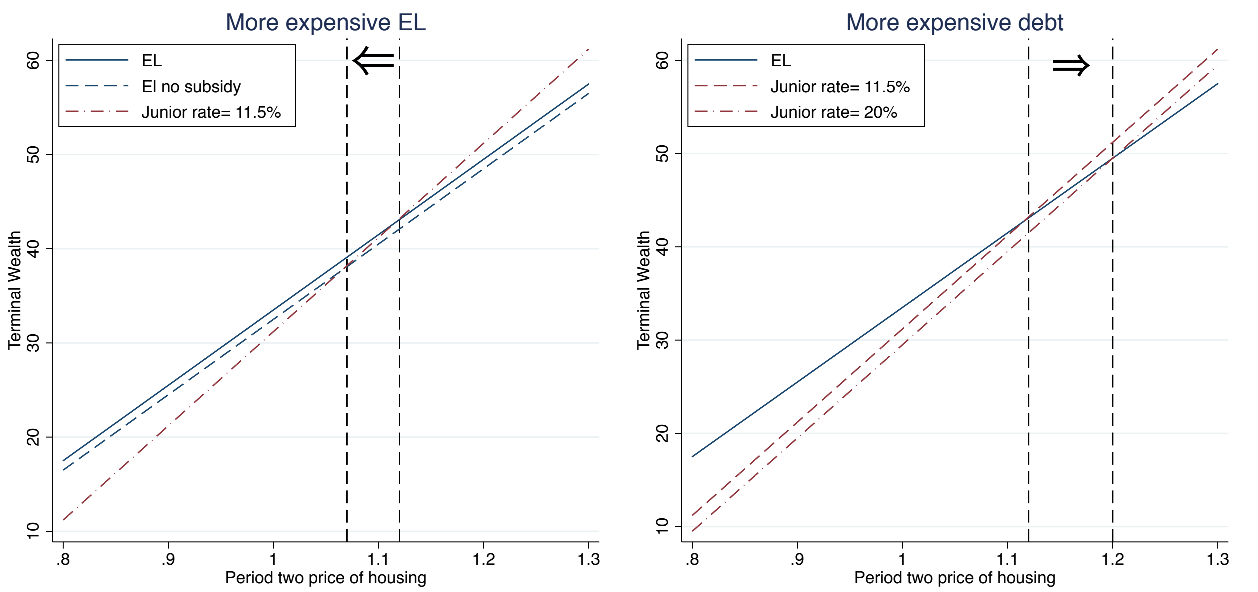


Figure A5: Borrower utility for the mortgage guarantee and equity loan alternatives

The figure plots overall utility as a function of terminal house prices for the three period numerical example, for the mortgage guarantee and the equity loan financing alternatives.

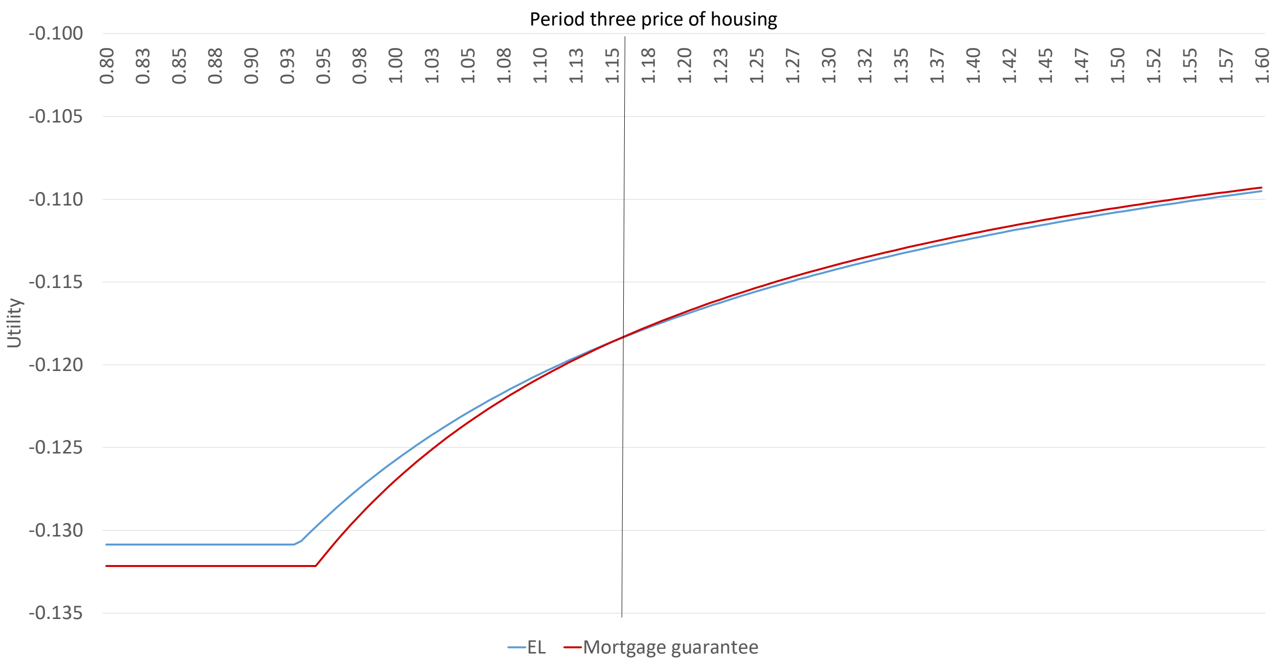


Figure A6: Government payoffs

The borrower defaults at the terminal date when his/her claim to the value of the asset is less than the outstanding debt. The figure plots the government payoff for the mortgage guarantee and the equity loan as a function of period three house prices. In the EL alternative, we subtract the initial 20 of capital provided to obtain the government payoff. The figure also plots the government payoff for the mortgage guarantee alternative when a mortgage insurance premium equal to a proportion of the loan amount is payable to the government.

Figure A7: Income distributions by age group.

The figure compares income distributions by age group for three different samples of UK households: (i) a sample of all UK households, obtained from wave 6 of the Understanding Society longitudinal survey (corresponding to the years of 2014 - 2016); (ii) a subsample of UK households holding a mortgage, obtained from the same wave of the Understanding Society survey; (iii) households using EL between April 2013 and March 2017.

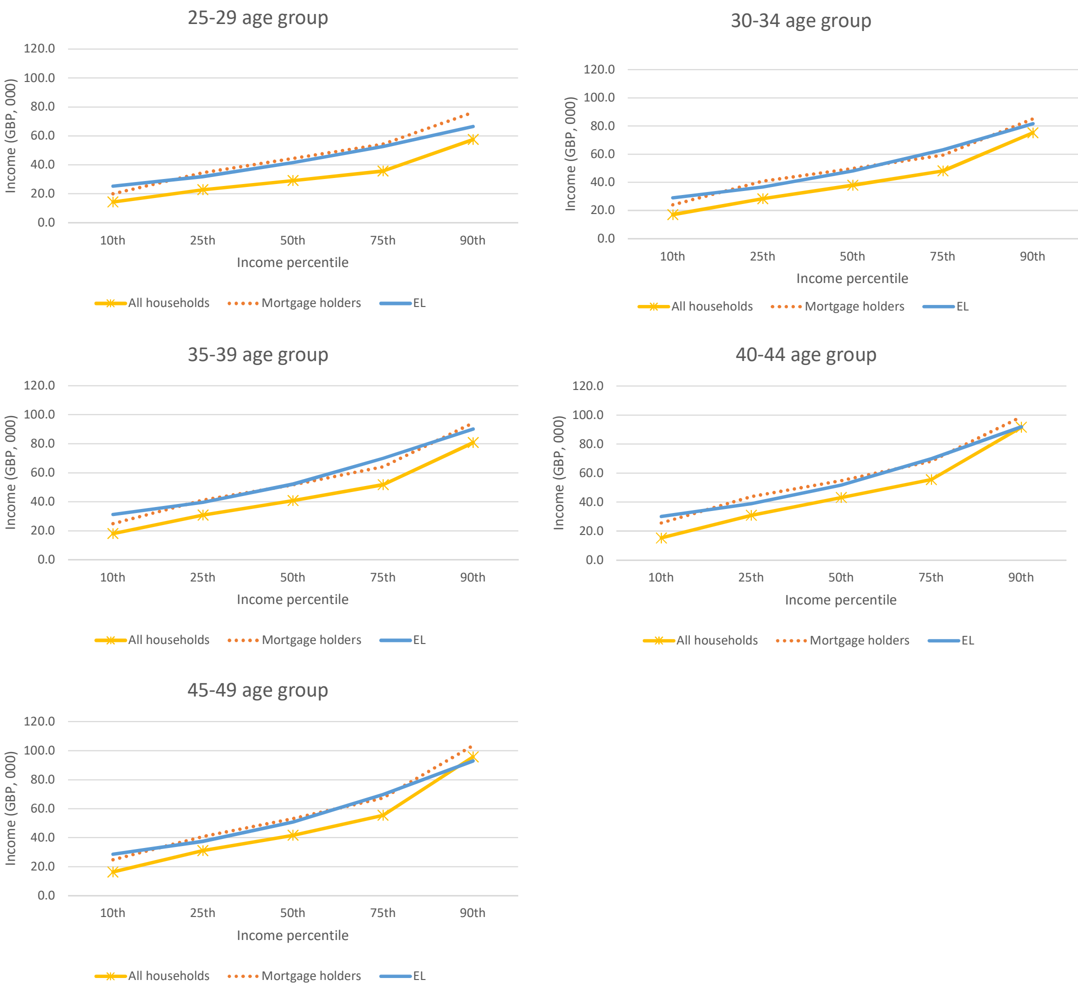
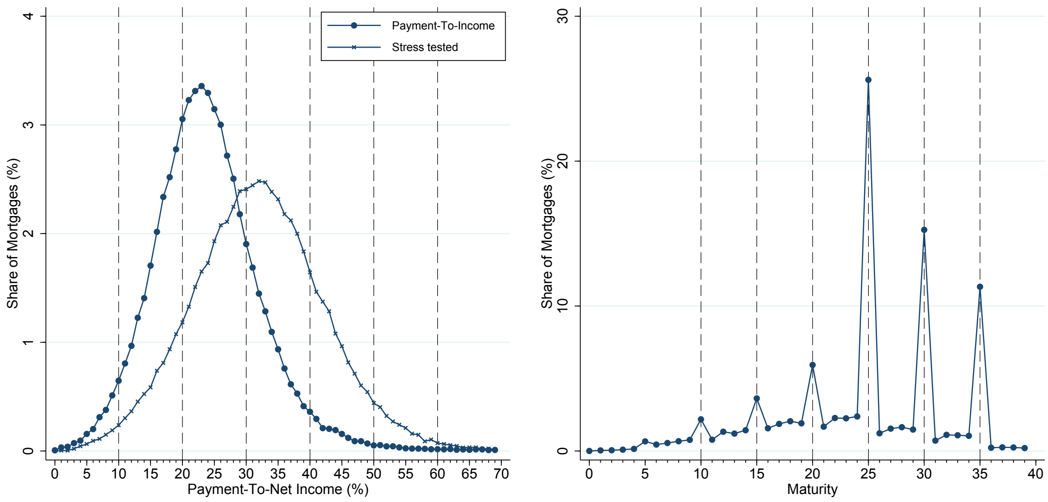


Figure A8: Payment to income and maturity

The figure shows the distribution of payment-to-net income (PTI) ratio and maturity for non EL borrowers (Panel A) and EL borrowers (Panel B). For EL borrowers the PTI figure shows 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 homes with value below £600,000.

Panel A: Non EL borrowers



Panel B: EL borrowers

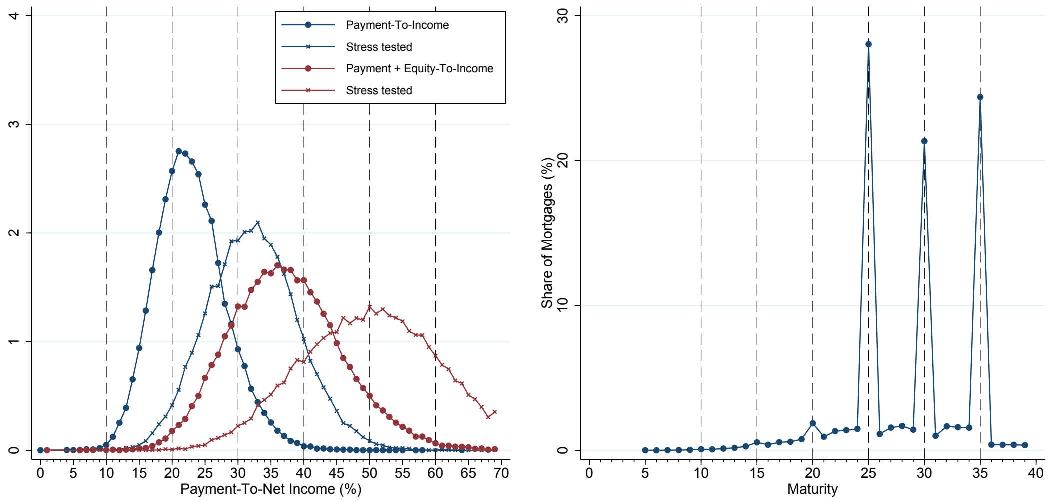


Figure A9: Selection around the £600,000 limit in London

The figure shows the distribution for maturity for mortgages originated in the sample period (April 2013 to March 2017) in London, for the acquisition of new homes, with a purchase price between £500,000-700,000.

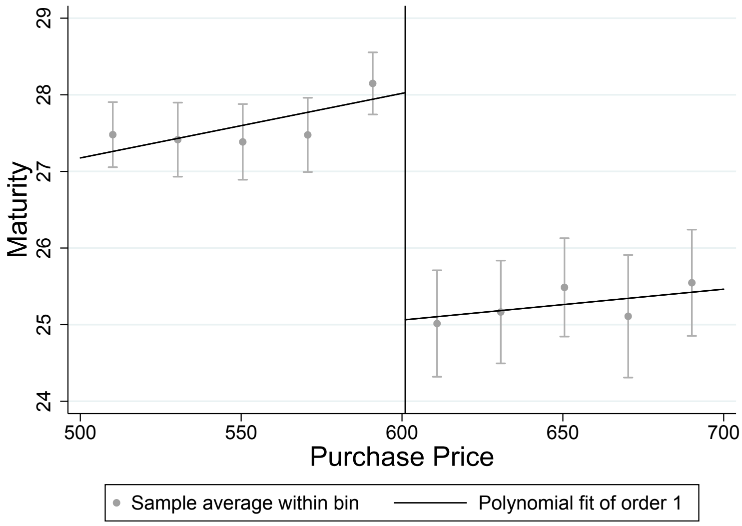


Figure A10: Selection around the £600,000 limit in London (Placebo: new properties, 2009-2012)

The figure shows the distribution of age, income, deposit and the fraction of first-time buyers for mortgages originated in 2009-2012 in London, for the acquisition of new homes, with a purchase price between £500,000-700,000.

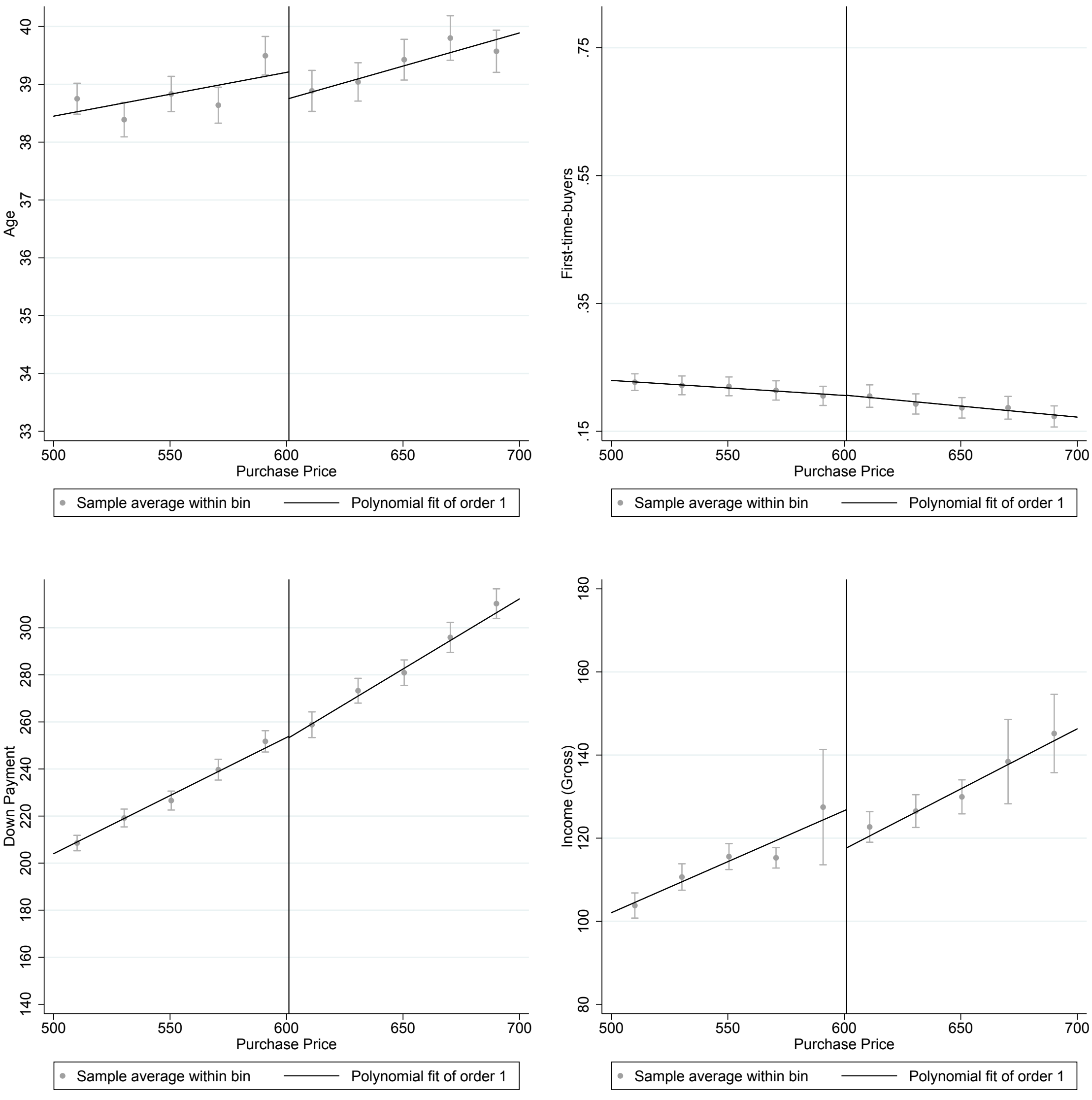


Figure A11: Bunching of property prices: London (Placebo: existing properties, 2013-2017; new properties, 2009-2012

Data on mortgage transactions from the Product Sales Data (PSD) by the Financial Conduct Authority. The left panel includes all sales of existing homes in London between April 2013 and March 2017. The right panel includes all sales of new homes in London between January 2009 and December 2012.

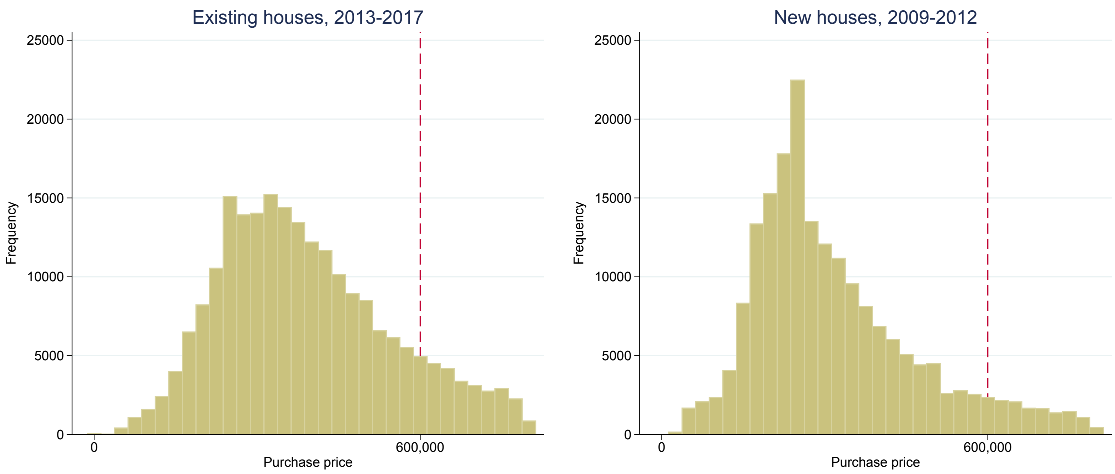


Figure A12: London experiment: border analysis

The figure shows the postcode areas in London and the South East of England that we use for our difference-in-difference analysis.

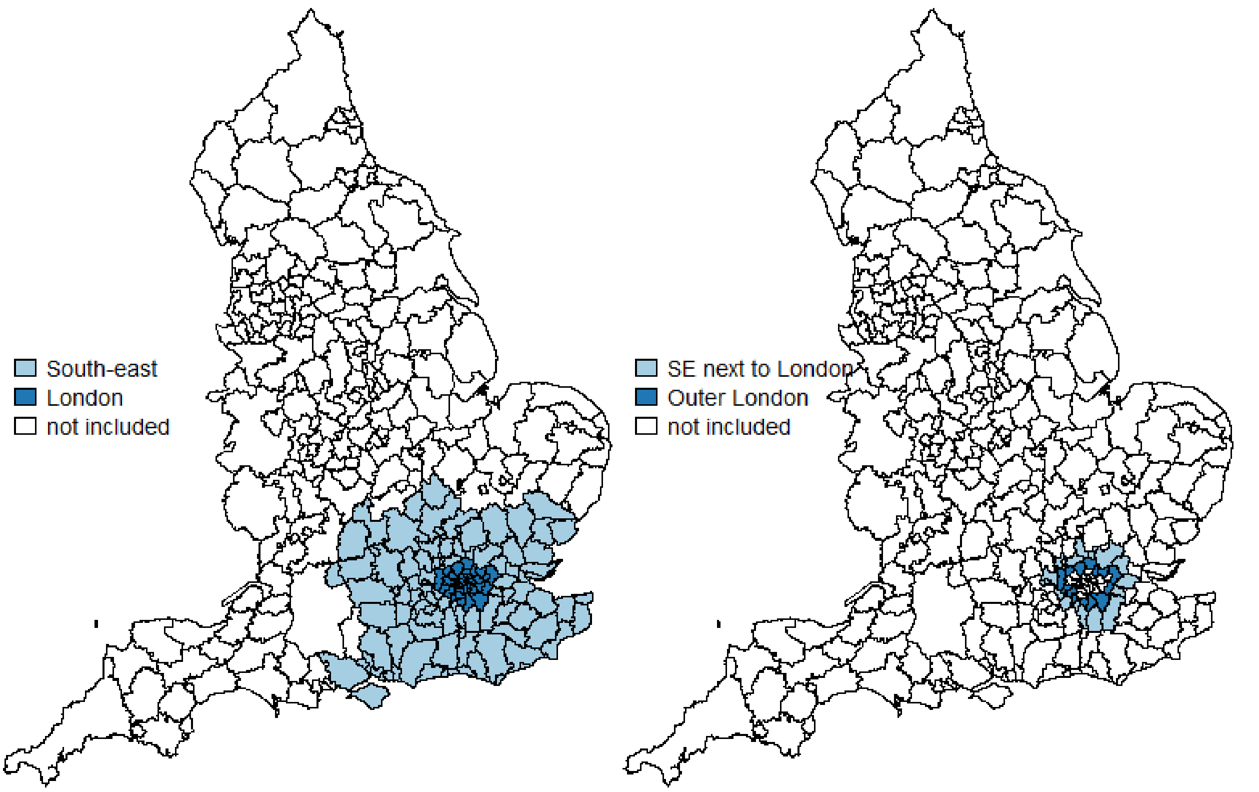


Figure A13: Outer London vs neighboring local authorities: dependent variables

The figure plots the average monthly values of the dependent variables used in the regressions of Panel B in Table 2, distinguishing between Outer London and the neighboring local authorities in the South East of England. All values on the vertical axis are in thousands of pounds except for the last chart which is in square meters.

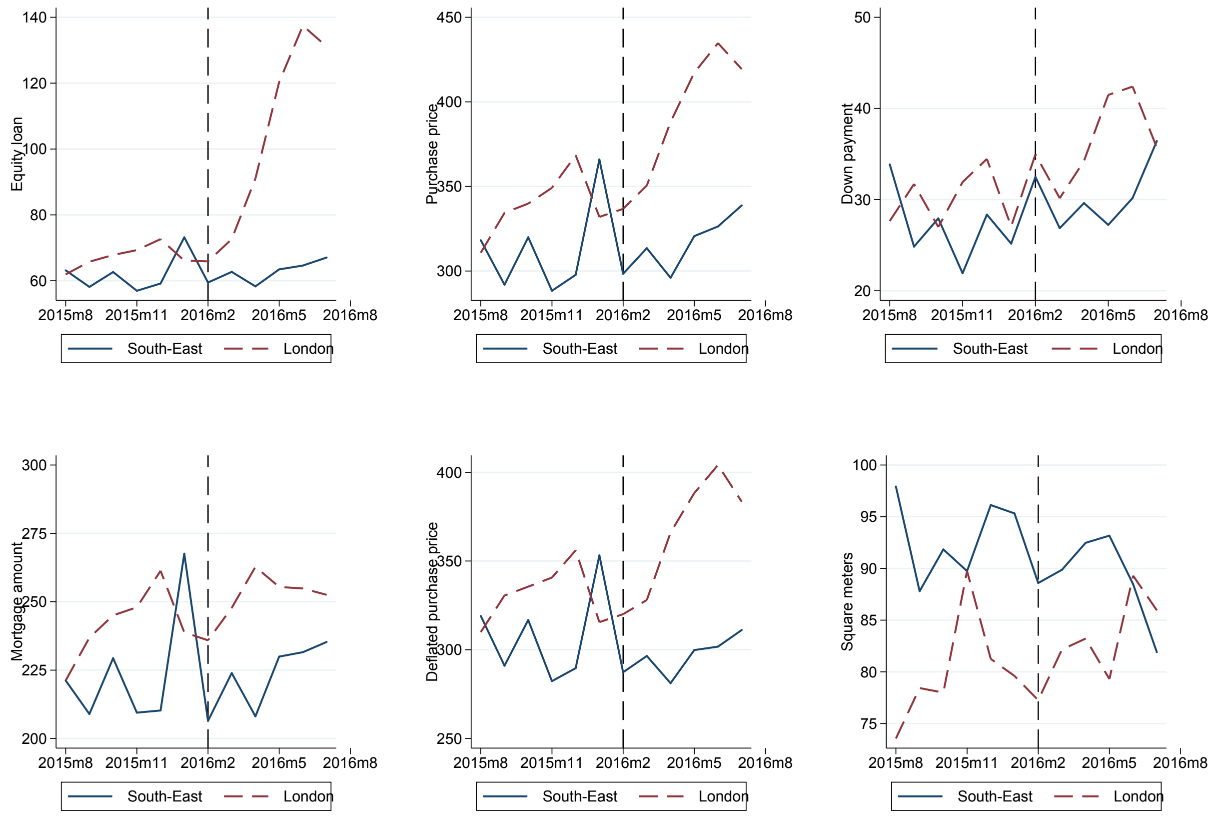


Figure A14: Monthly mortgage payments (2-year fixed, 2013-2015, LTV>85%)
The figure shows the actual monthly mortgage payment, the counterfactual monthly payment with the same loan size and the counterfactual interest rate, and the counterfactual monthly payment with both the counterfactual interest rate and loan size. Data for 2-year fixed mortgages originated between April 2013 and March 2015 for purchase of new homes with value below £600,000 and with a loan-to-value above 85%.

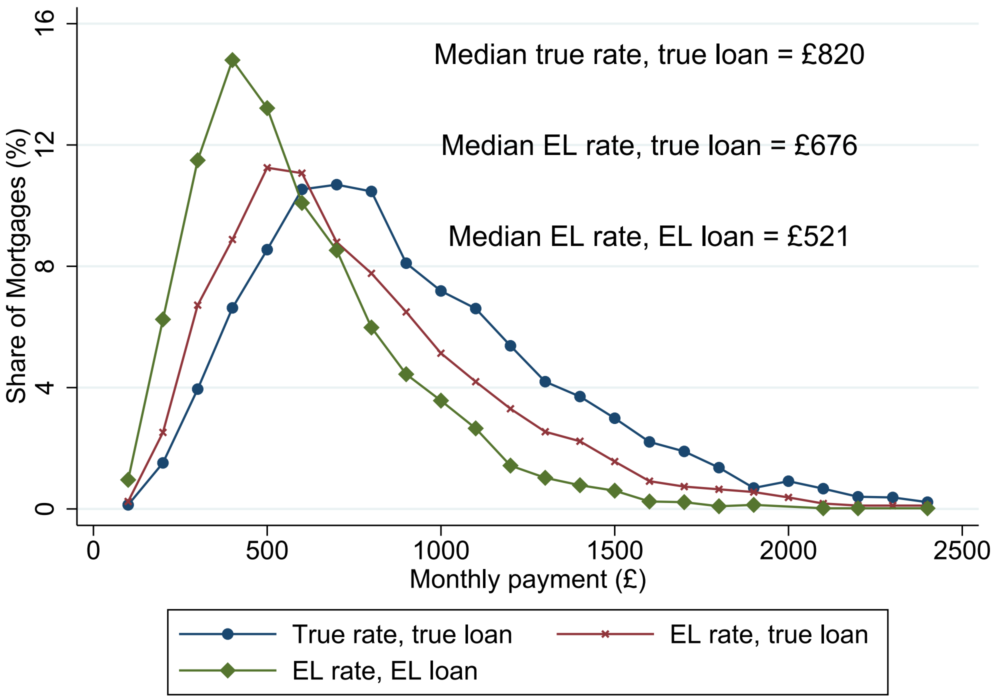


Figure A15: Break-even house price appreciation with refinancing

The figure shows the break-even rate of house price appreciation as a function of initial loan-to-value for different refinancing scenarios at the end of year two for borrowers with an EL. In the reversion scenario, borrowers do not refinance and must pay the reversion rate for the remainder of the horizon. In the internal (external) scenario, borrowers remortgage with the same (a different) lender. House price appreciation above the break-even value means that borrowers are better off without an EL.

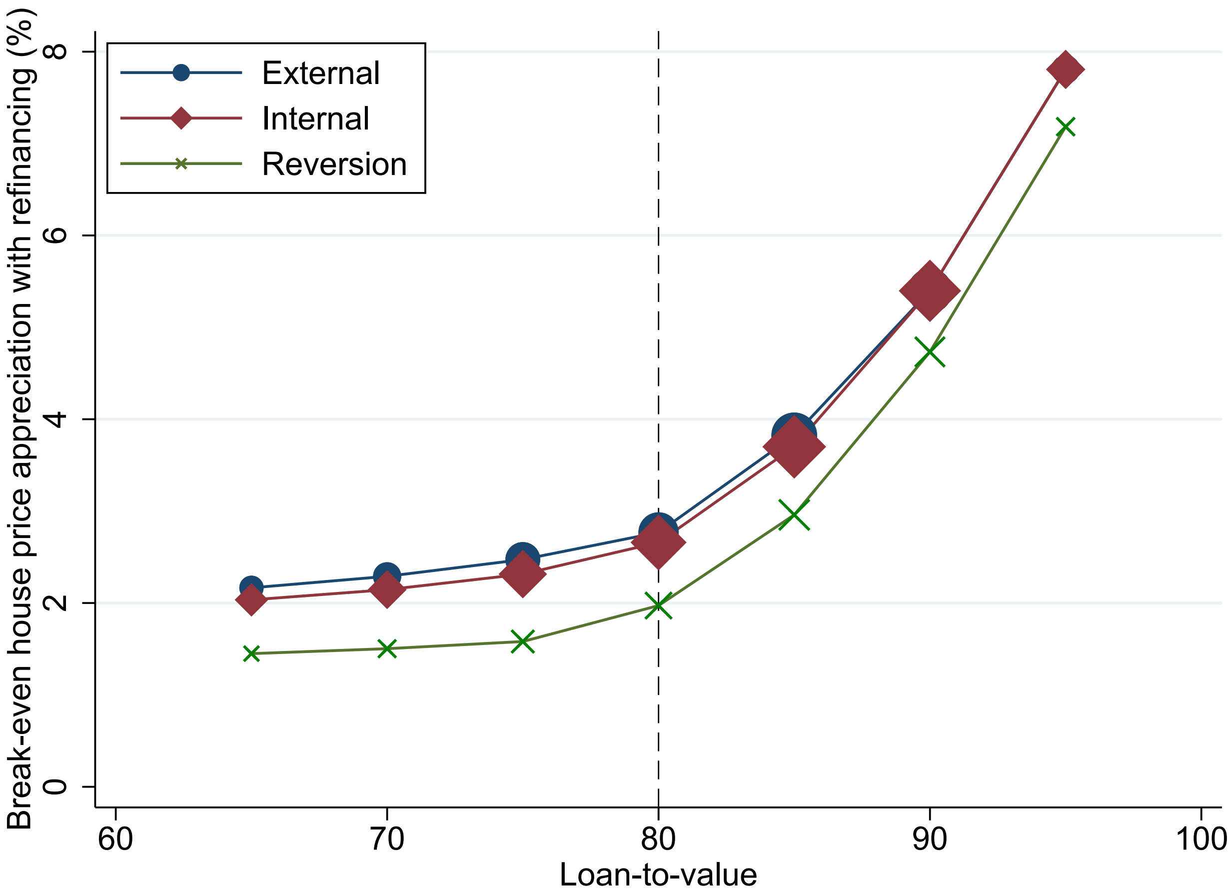


Figure A16: Equity extraction at refinance: difference in LTV

This figure is constructed from the sample of EL borrowers who bought their property between April 2013 and March 2015, repaid their equity loan (EL), 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.) Thechart shows the difference in LTV between the actual LTV when the EL is repaid and the counterfactual LTV, if no action is taken.

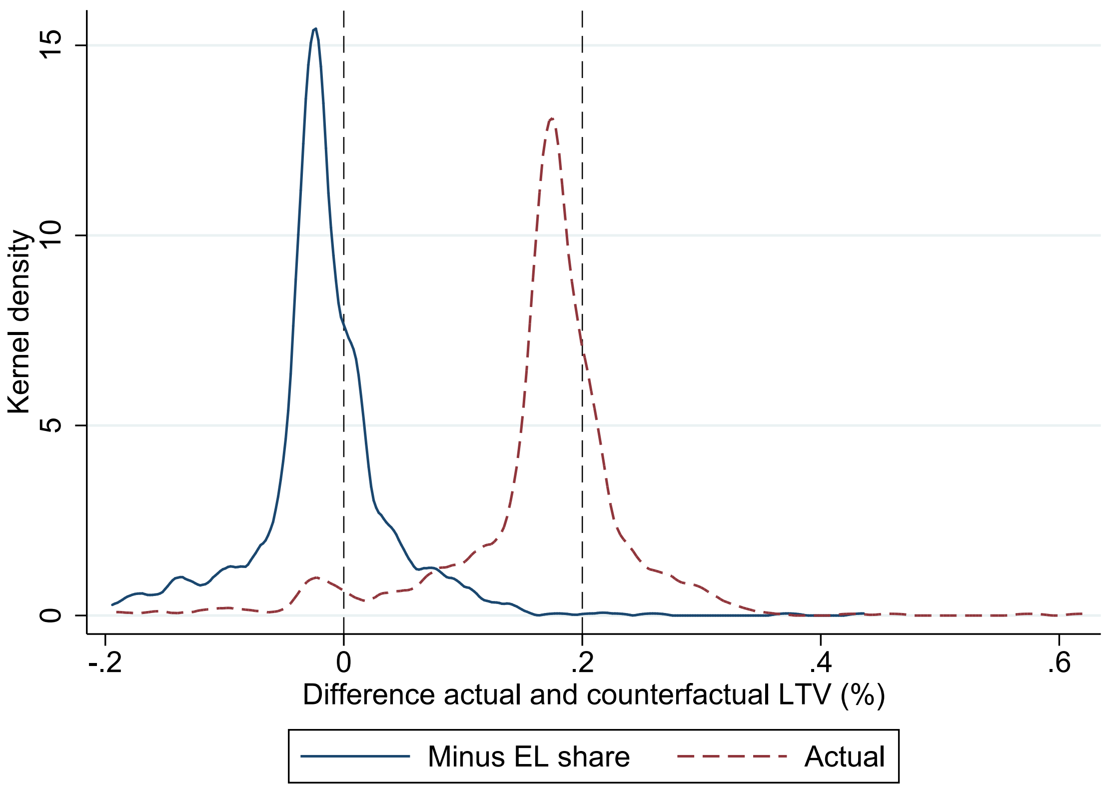


Figure A17: Cumulative sales, by year of property purchase (cohort)

The charts compare the housing tenure of EL and non-EL borrowers, plotting the cumulative probability of a house sale for each of the two groups as a function of the number of years since property purchase (and mortgage origination). The several charts plot the probabilities of a sale by year of property purchase.

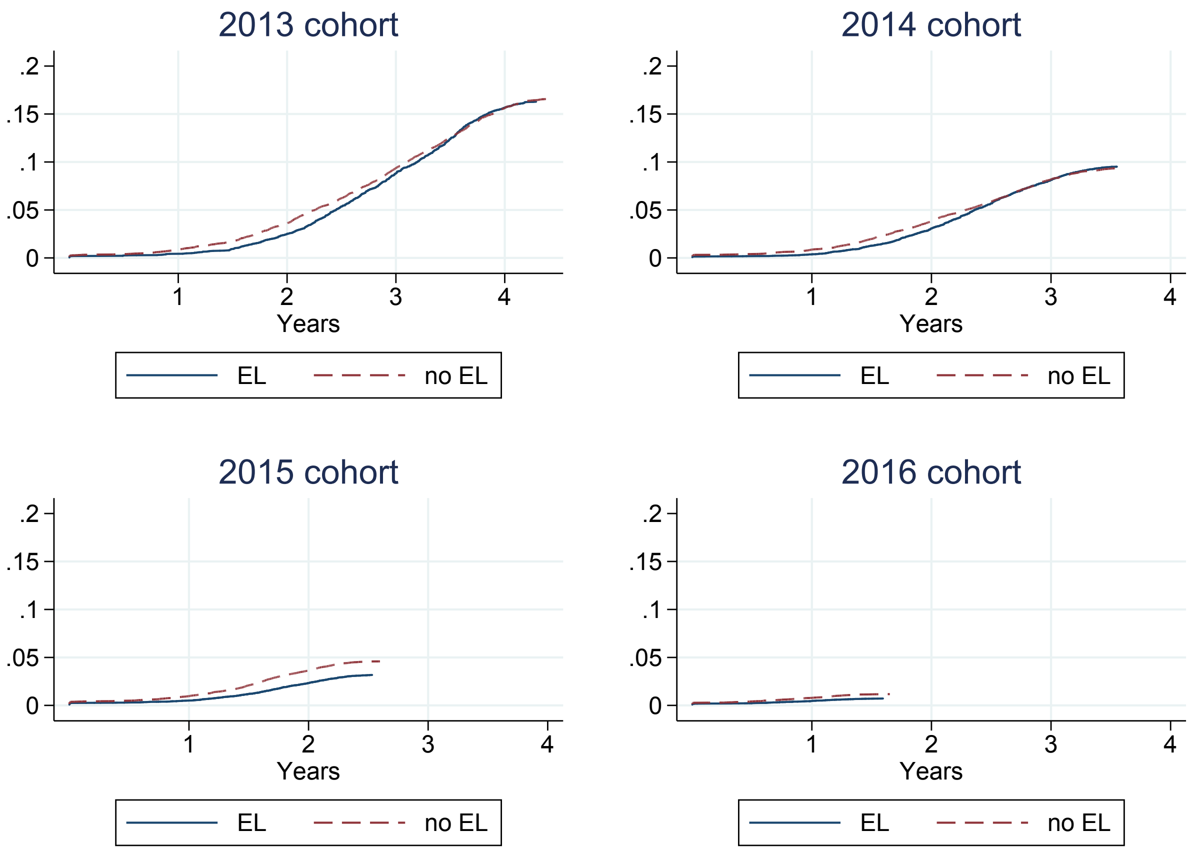


Figure A18: Length of initial period with discounted rate.

The chart plots the distributions for EL and non-EL loans of the length of the initial period with a discounted rate. Data for mortgages originated between April 2013 and March 2017 for purchase of new homes with value below £600,000. Only fixed rate loans with an initial period of discounted rate are included.