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Housing consumption and investment: evidence from shared equity mortgages

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Abstract

Academics have proposed hybrid products with equity features for the financing of housing. In spite of their risk-sharing benefits these products have not become mainstream. This paper studies an important exception, a UK government scheme which in the five years since its inception has provided almost £10 billion of equity financing. The analysis of the origination and prepayment behavior of households who have used the scheme highlights housing affordability constraints. A difference-in-difference analysis of an increase in the maximum government equity limit shows that households took advantage of the increase to buy more expensive properties, and not to reduce their mortgage debt and house price risk exposure. A counterfactual study of homebuyers who, instead of using the equity available, relied on high loan-to-value mortgages shows that their financing choices can be rationalized by an expected rate of house price appreciation of 7.7% per year. We draw general implications for how households approach their house purchase and financing decisions, taking advantage of the fact that the shared equity mortgages that we study allow the separation of the consumption and investment dimensions of housing.

Key words: Housing, consumption, investment, affordability, macro-prudential policy, expectations.

JEL classification: D14, R21, R31.

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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, Haliassos, and Jappelli, 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, Rao, and Sufi, 2013; Corbae and Quintin, 2015; Favilukis, Ludvigson, and Van Nieuwerburgh, 2017). In response, regulators around the world have introduced or tightened macroprudential regulations on mortgages, introducing or lowering maximum loan-to-value and loan-to-income limits (DeFusco, Johnson, and Mondragon, 2017; Acharya, Bergant, Crosignani, Eisert, and McCann, 2018; Benetton, 2018).

Academics, most notably Shiller (1994), have for a long time recognized the risks that arise from debt-financed house purchases, and they have proposed alternative financing structures to mitigate them, including shared equity mortgages (SEMs), housing partnerships, and continuous workout mortgages (Caplin, Sewin, Freeman, and Tracy, 1997; Caplin, Carr, Pollock, Yi Tong, Tan, and Thampy, 2007; Shiller, 2014; Mian and Sufi, 2015; Miles, 2015; Greenwald, Landvoigt, and Van Nieuwerburgh, 2017).[1] The proposals differ in their specific features, but the main idea is to make the payoffs to investors who provide financing contingent on future house values across the whole price distribution, and not only in the event of default. As house price risk is shared between households and investors, both the amount of straight debt and default probabilities are reduced.[2]

[1] The Great Recession has spurred the academic debate about the role of mortgage market characteristics for the transmission mechanism of monetary policy (Calza, Monacelli, and Stracca, 2013; Beraja, Fuster, Hurst, and Vavra, 2017; Di Maggio, Kermani, Keys, Piskorski, Ramcharan, Seru, and Yao, 2017) and about optimal mortgage design (Campbell, 2013; Campbell, Clara, and Cocco, 2018; Guren, Krishnamurthy, and McQuade, 2017; Eberly and Krishnamurthy, 2014; Piskorski and Tchistyi, 2010, 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, Giglio, and Pathak, 2011; Guren and McQuade, 2016).

In spite of their large potential benefits, these hybrid products, with debt and equity features, have not become mainstream. An important exception is the recent Help-to-Buy Equity Loan scheme introduced by the United Kingdom (UK) government in April 2013. Equity Loans (ELs) are essentially SEMs with the government (through one of its agencies) providing capital of up to 20% (40% in London since February 2016) of the property purchase price in exchange for the same share of its future value. From the scheme's inception until end of June 2018, the total value of the equity provided by the UK government was £9.9 billion for the acquisition of properties with a total value of £46.5 billion.[3]

In this paper we study the reasons behind the large demand for ELs, to shed light on households' house purchase and financing decisions more generally. Homebuyers can use ELs as an alternative to traditional mortgage financing, in order to reduce their leverage and exposure to house price shocks. But ELs can also be used in addition to a traditional mortgage, in order to overcome credit constraints and purchase more expensive properties.

We characterize the demand for ELs along four dimensions. First, we study the distribution of origination loan-to-value (LTV) and loan-to-income (LTI) ratios to show that an overwhelming proportion of borrowers would not have, without the EL or a larger down payment, been able to borrow the mortgage amount needed to purchase their property. We show that these borrowers also take mortgages with longer maturities, which relaxes payment-to-income (PTI) constraints.

Second, we exploit the discontinuity arising from the scheme's maximum property purchase price threshold of six hundred thousand pounds to study how borrowers select 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 than above the threshold. We perform two placebos: purchase of old properties (for which the EL is not available) in the same years and purchase of new build properties in the years before the scheme was introduced. For the placebos, age and household down payment increase and the proportion of first time buyers decreases in a continuous manner with property price. The large demand for ELs seems to be driven, to a significant extent, by macroprudential regulations and affordability

[3]We will describe the exact features of the scheme in Section 2.

considerations.

Third, to provide causal evidence on how borrowers react to the availability of equity financing, 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. Borrowers still need a minimum 5% down payment, but the larger EL limit, if taken advantage of, means that homebuyers may either: (i) use a smaller bank mortgage to purchase the same house, with smaller required mortgage payments, and with lower house price risk exposure (due to the larger EL) or, alternatively, (ii) they may use the larger 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, instead of reducing their mortgage debt and house price risk exposure. It is important to note that 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).

Fourth, we study the repayment behavior of households who have used ELs. A significant proportion decide to repay the equity loans early. Those who do so have experienced higher rates of house price appreciation and income growth, which have relaxed affordability constraints. We show that those households who have repaid the EL (without a house sale), have increased their mortgage balance by an amount similar to the EL repayment due to the Government. They have used the EL as a form of bridging finance, until the constraints that have led them to take out the EL in the first place are no longer binding.

In spite of its success, a large number of homebuyers who could have taken advantage of the EL scheme and of the government subsidy that it involves, have not done so (we give details on the subsidy in section 2). Instead, they have financed the acquisition of their home using only a bank mortgage (and their down payment). In the second part of the paper we study these homebuyers, to try to learn more about the motives or the frictions that may have led them not to use the scheme. In a first step, we calculate a house price expectations metric of how significant these motives or frictions would have had to be to rationalize their financing

choices. The idea is simple: homebuyers who have not used the EL scheme could have, in our counterfactual scenario, bought the *same* house using the EL and a 20% lower LTV mortgage. Their mortgage payments would have been lower due to both the lower mortgage amount and the fact that a mortgage with a 20% lower LTV has a lower interest rate. We show that for borrowers with an original mortgage LTV over 85% the reduction in monthly (median) mortgage payments would have been substantial: from £823 in the base case to £528 in our counterfactual. On the other hand, in the counterfactual, homebuyers would have had to give 20% of the future value of the house to the government at EL termination.

We calculate the break-even rate of expected house price appreciation that makes those homebuyers who did not take advantage of the scheme indifferent between the actual and counterfactual scenarios. This is the minimum rate that a risk neutral individual, or one that ignores house price risk, requires to be better off without the EL. Our calculations show that for individuals who did not make use of the scheme and took a mortgage with an LTV greater than 85 percent, the average break-even rate of annual house price appreciation is as high as 7.7 percent. Therefore, their financing choices can be rationalized by a high expected rate of house price appreciation, and the ignoring of the risk-sharing benefits of the scheme. In this way our paper contributes to the growing literature that studies the role that house price expectations play in house purchase and financing decisions (Adelino, Schoar, and Severino, 2018; Bailey, Dávila, Kuchler, and Stroebel, 2018; Kaplan, Mitman, and Violante, 2017; Landvoigt, 2017). Alternatively, one may interpret the high implied house price expectations as a proxy for informational or cognitive frictions that affect households' awareness and evaluation of the scheme. Our calculations show that in the absence of a high expected rate of house price appreciation these informational or cognitive frictions would have to be substantial.

The paper is structured as follows. In Section 2 we describe the scheme and the data sources. In Section 3 we characterize the demand for ELs. In Section 4 we calculate the house price expectations of the homebuyers who could have made use of the EL, but who have not done so. In Section 5 we discuss our results and draw more general implications for how households approach their housing purchase and financing decisions, taking advantage of the fact that the shared equity mortgages that we study allow the separation of the consumption and investment dimensions of housing. Section 6 concludes.

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 full use of the EL (20%) need to obtain a mortgage for the remainder 75%. In the left-hand part of Figure 1 we illustrate such a financing structure for the acquisition of a property worth £100 thousand.[4] 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.

In addition to contributing the minimum down payment, households must meet three other key conditions to participate in the scheme. First, the EL can only be used to purchase new properties with a purchase 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, 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

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

plus 1%. Payments of this fee do not amortize the equity loan.[5]

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.[6]

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 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).[7]

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

[6] 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.

[7] 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, Wojakowski, Ebrahim, and Shackleton, 2013). However, this requires that reliable local house price data is available. Otherwise homeowners may become exposed to significant basis

2.2 The UK mortgage market

We briefly describe the characteristics of the UK mortgages that are relevant for our study. The long-term nominal fixed rate loans that are common in the US do not exist. The vast majority of mortgages have an initial period during which the loan interest rate is fixed. The most common period of interest rate fixation is two years, but it can be as long as five years. The interest rate during the fixation period is discounted (teaser rate), and reverts to a higher, floating, rate afterwards. There are prepayment penalties during the period of fixation, but not once this period ends. As a result, many borrowers remortgage at end of the fixation period (Cloyne, Huber, Ilzetzki, and Kleven, 2017; Financial Conduct Authority, 2018).

Due to the frequent remortgaging at the end of the fixation period, when comparing loans, borrowers (and mortgage brokers) focus on the initial rate rather than the annual equivalent rate calculated over the life of the loan. There is some variation across loans in initial fees that cover loan arrangement and property valuation costs, but this variation is considerably smaller than in the US. Mortgage loans have typical maturities of between twenty and thirty 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 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, Cloyne, Ilzetzki, and Kleven, 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 conditional on this they do not affect pricing directly.

The affordability checks that determine whether a borrower qualifies for a given product take the form of both a maximum LTI and limits on the maximum monthly mortgage payments. The most commonly used LTI limit is 4.5. In June 2014, the Bank of England 's Financial

risk. Greenwald, Landvoigt, and Van Nieuwerburgh (2017) show in the context of a general equilibrium model that the indexation of mortgage payments to aggregate house prices increases financial fragility, but that their indexation to local house prices has benefits for risk-sharing and for the resilience of the financial system.

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. Therefore, the calculation of the maximum loan amount requires an analysis of bank and credit card statements of borrowers by lenders. These affordability rules were introduced following a mortgage market review conducted by the Financial Services Authority, and are explained in its Policy Statement PS12/16, October 2012. The maximum loan amount is stress tested: borrowers must still be able to meet their mortgage payments in face of an interest rate increase of three percentage points. 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, 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 data from this month onward. The PSD data 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 interest rate and period of fixation information.

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, we restrict the data to mortgages that are used for the acquisition of new properties up to 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.

2.3.2 Equity loan data

Our second main dataset includes information from MHCLG on all ELs originated in England since 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 157,620 mortgages for house purchases that were eligible for the scheme, but for which an EL was not used. We use these data for our origination analysis.

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 by 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 their income at the time of EL prepayment. This allows us to look further into the motives and sources of funds for prepayment.

2.3.3 House price data

We use the PSD and ELs datasets to obtain the value of the each specific house in our data at origination and at EL termination. To measure local house price appreciation we use the official house price indices from the Office for National Statistics (ONS), measured at the local authority (LA) level. There are 353 LAs in England; LAs are larger than the typical American municipality but smaller than the typical metropolitan area. Greater London is composed of 33 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.

3 Housing affordability and the demand for equity loans

We start to characterize the demand for ELs by providing descriptive statistics that compare homebuyers who joined the scheme with eligible buyers who did not do so (Section 3.1). We then investigate the reasons for taking up an EL in more detail, analyzing four aspects of the behavior of EL borrowers: the distributions of borrowers' combined LTV and LTI (including both the mortgage and the EL, Section 3.2); borrower characteristics just below and just above the maximum EL property price threshold of £600 thousand (Section 3.3); a scheme change in London that allowed larger ELs (Section 3.4); and EL repayment behavior (Section 3.5).

3.1 Origination characteristics

Table 1 presents 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.[8] We exclude transactions that are not eligible for EL: old properties, new properties with a value above £600 thousand, and buy-to-let properties. We then divide the sample between borrowers who did take up EL and those who did not do so (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.

[8]The PSD data that we use covers the universe of mortgages but cash acquisitions are not included.

First, we compare borrower and property characteristics for the two groups. EL borrowers are younger, with an average age of 32 compared to 37 for non-EL borrowers. They are also much more likely to be first time buyers (FTBs): 73% of EL borrowers compared to 43% of non-EL borrowers. EL borrowers have a gross income that is around twenty percent lower than non-EL borrowers, which is likely to be related to the fact that they are on average younger.[9] EL borrowers purchase properties that are on average 7% less expensive but with a down payment that is equal to roughly a quarter of that of non-EL borrowers. The mortgage amounts are similar across the two groups, with the EL filling in the gap.[10]

Second, we consider the features of the mortgage contract. 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.

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

The last row of Table 1 reports estimated average payment-to-*net* income ratios (net PTIs).[11]

[9] Our income measure is the one used in the mortgage application, so that in the case of joint applications it refers to the income of more than one individual.

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

[11] 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

Average net PTI ratios may at first sight seem relatively low compared to, for example, the estimates of DeFusco, Johnson, and Mondragon (2017) for the US. These are however front-end PTIs and mortgage applications are subject to affordability assessments that take into account the servicing of other existing debts and committed expenditures (i.e. back-end PTIs).[12]

3.2 LTV and LTI distributions

Lenders use LTV, LTI and PTI 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 CLTV and CLTI. The LTV distribution, on the left-hand side, shows that the majority of EL borrowers take out a mortgage with 75% LTV, which allows them to purchase the property with the maximum equity loan (20%) and the minimum 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.

We perform some simple calculations to evaluate the regulatory implications of this mass. According to Table 1, roughly 40% of mortgage-funded property transactions for new build are funded through the EL scheme. This implies that 22% (=40% $\times$ 54%) of the mortgage transactions in the new build market have a CLTI above 4.5. The new build market is 10% of the

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.

[12] In Appendix B we calculate back-end PTIs for a small subsample of lenders that have provided data on other debts and committed expenditures (for the years of 2016 and 2017). They are considerably larger than front-end PTIs.

whole property market. Therefore, we estimate that as a result of the EL scheme an additional 2.2% of the whole market is above the 4.5 threshold. The Bank of England recommendation is that no more than 15% of the market be above the 4.5 LTI limit.

In Table 2 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 2 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.

In Appendix C we provide further evidence on affordability, by comparing 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. To summarize, the evidence in this section shows that, had the EL scheme not been available, the vast majority of EL borrowers would not have been able to obtain a standard mortgage sufficient to buy the same house with the same down payment. This does not mean that they would not have been able to buy a less expensive house with the same down payment (in pounds, higher in proportion). It is likely that the scheme has an effect along the extensive margin (allowing households to buy a house), and the intensive margin (allowing households to buy a more expensive house than they would otherwise have been able to do). In the next subsections we exploit the features of the scheme to provide evidence on its effects along the different margins of adjustment.

3.3 Bunching at the maximum property price

The EL scheme is only available for the purchase of new properties with a maximum price of £600 thousand. We focus on London where property prices are higher and this limit is more likely to be binding. In Figure 3, we plot the distribution of purchase prices for new properties acquired in London during our sample period, and included in our mortgage data. Properties below the £600 thousand limit are eligible for (but not necessarily purchased with) EL; those above the limit are not eligible. While a large number of properties are transacted at prices well below the limit, there is strong evidence of bunching just below the £600 thousand limit.

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 tends to increase 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, that allows EL borrowers to reduce mortgage payments further (these results are included in Appendix D).

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 D). In neither of these two placebos we find any discontinuities at the threshold. The age of the buyer, the down payment and her income increase and 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).

3.4 Difference in differences: the London experiment

We exploit a change in the scheme to provide further evidence on how house buyers react to an increase in the availability of equity finance and, more generally, on the determinants of the demand for ELs. 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 equity loan 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 8 we 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).

In Appendix E 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, at least along these dimensions. In the Appendix we also compare the characteristics of London EL borrowers to those in the SE. Although EL London borrowers are different from those outside London (e.g. they have higher income), the pre-post differences are similar for the two groups.

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. We compare the changes in EL transactions in the six months before and after the policy change, in London versus the SE. 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 $PostJan2016$ 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 3 presents the DID estimates. The mean equity loan in London increased by an additional £36,940 compared to the SE. The property value increased by a slightly smaller amount, of £33,610. The increase in down payment of £0.35 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 EL London borrowers took advantage of the in-

crease 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 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 3 presents results for these deflated purchase prices. The estimated positive coefficient on the interaction term of £28,470 confirms that the increase in EL purchase prices cannot be explained by local house price inflation.[13] We test this further in the last column of Table 3, where we show that the size of the EL-financed properties increased by 6.5 square meters in London post January 2016.

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). In Appendix E we give further details on the areas included in each set of regressions. 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 E 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.

In Panel B of Table 3 we report the results for this second set of DID regressions. Despite the reduced sample (2000 observations) the main results are unchanged. EL borrowers inside

[13]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.

the London boundary took advantage of the higher EL to buy more expensive houses. To check the parallel-trend assumption for the DID analysis, in Figure 9 we plot the evolution of the dependent variables. The increases in EL amount and property price following the change in the limit are clearly visible.[14]

In Appendix E 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. Without the increase in EL financing the alternatives for these households would have been to buy a smaller/less expensive house or to rent.[15]

3.5 Equity loan repayment behavior

To shed additional light on the drivers of the demand for ELs, we analyze EL repayment behavior (even though only a small number of years have passed since its inception). Figure 10 plots cumulative EL repayments as a function of the number of years since origination. Each line corresponds to a 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 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 refinance their bank mortgage. In contrast, repayments triggered by a property sale (right-hand side panel) increase more smoothly with the number of years since origination.

[14] In Appendix E we include a similar figure, comparing the evolution over time of the outcome variables for London and the SE.

[15] A larger EL limit does not mean that the household is able to immediately buy a more expensive property, because for a more expensive property the minimum 5% down payment translates into a larger amount of savings (pounds) needed.

We focus on ELs issued between April 2013 and March 2015, for which at least two years have passed since origination. In Appendix F 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.[16] The left-hand side of Figure 11 plots the results. This was a period of rapid house appreciation, and borrowers who repaid without a sale 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.[17] 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 since origination.[18] The right hand panel of Figure 11 shows that those borrowers who repaid

[16]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. But since our objective is to compare these to those ELs which have not been repaid, we use local authority indices for both. In Appendix G we compare the distribution of appreciation based on the actual house values recorded by the scheme—to determine the amount of EL repayment due by the borrower—to the distribution based on local house price indices. The distribution of actual house appreciation is to the left of the distribution based on local house price indices.

[17]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.

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

the EL (without a sale) have benefited from higher income growth than those who did not do so. House price and income growth relaxes LTV and affordability constraints and reverses the factors that initially motivated households to finance the property acquisition with the EL. 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 amount than required to refinance their existing mortgage loan, and use equity extraction (the difference between the new mortgage loan and the outstanding balance on the old one) to repay the EL. The left chart of Figure 12 shows that those borrowers who repay the EL extract substantial amounts of equity. Moreover, the distribution of equity extracted is similar to that of EL revalued at the moment of repayment (i.e. the amount due to the government). These borrowers take advantage of higher house prices and relaxed affordability constraints to terminate the government loan. The right-hand chart of the same figure shows 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. This can also be seen by the line that shows equity extracted net of the amount used to repay the equity loan (minus EL share). Therefore, among those who repay the EL, refinancing and home equity extraction are primarily driven by a desire to repay the EL, and not to finance higher non-housing consumption.

We cannot rule out that house price expectations are also at work in the decision to repay the EL. For instance, EL borrowers who have in the past experienced fast house appreciation may be concerned about further future forgone capital gains, in case house price trends continue. In the next section, we investigate the role of house price expectations in the decision to take an EL loan.

4 The lack of demand for equity loans

In spite of the large demand for ELs, the majority of eligible borrowers (61%, see Table 1) have not used the scheme, forgoing the opportunity to reduce their mortgage payments and to benefit from the government subsidy. But these households retain the full value of the property that

they acquired, and they may do so in expectation of a high rate of house price appreciation. Alternatively, these households may be unaware of the scheme, or they may lack the knowledge or the ability to evaluate it. In this section we focus on eligible homebuyers who do not use the scheme, and calculate a measure of how large the expected rate of house price appreciation has to be for them to be better off buying the same house without the EL than with the EL. This metric can also be interpreted as reflecting the magnitude of the informational or cognitive frictions needed to rationalize their financing choices.

4.1 A counterfactual scenario: break-even rates of house price growth

We calculate the level of expected house price growth that makes risk-neutral non-EL borrowers indifferent between financing the acquisition of their property with and without the EL. A simple numerical example helps understand the calculations. 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.[19] Her cash-flows at the initial date would be the same.

In the counterfactual scenario, the homebuyer needs to make smaller monthly mortgage payments, due to both the smaller bank mortgage and the lower interest rate on a 65% LTV mortgage compared to an 85% LTV mortgage. However, at the time of EL termination, the homebuyer has to give 20% of the terminal value of the house to the government (but there are also differences in the mortgage principal outstanding in the actual and counterfactual scenarios).[20] In both the actual and the counterfactual scenarios the house is the same, and so are the consumption services that the household derives from it.

At the break-even rate the benefits of higher expected capital gains offset the benefits from lower interest payments and the government subsidy in the EL counterfactual. We calculate the break-even rate η_{BE} by equating the future value of the cash-flows at EL termination (date T) between the two scenarios:[21]

[19] The counterfactual is 40% in London from February 2016 onwards.

[20] This description is valid for the first five years, when no interest payments are due to the government.

[21] Appendix H gives further details. We restrict the sample to mortgages with an original LTV greater than 20%.

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

where the left-hand side is the future value of the house due to the government (in case of EL) and the right-hand side is the future value of the mortgage payment savings in the EL compared to no-EL. In the above equation P_0 is the date 0 value of the house, Q is the value of the outstanding mortgage amount, mp denotes the monthly mortgage payments, $s_{\overline{T}|\delta}$ is the future value of a constant annuity with T payments and rate δ. The subscripts T and EL indicate the time horizon and the counterfactual scenario with EL, respectively. The rate δ is required to bring forward (to date T) the mortgage payment savings in the counterfactual scenario. For values above (below) the break-even rate of house price appreciation (η_{BE}) a risk-neutral individual is better (worse) off without the EL.

The above 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.[22]

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. After this period households do not face prepayment fees and they usually refinance their bank mortgage. Our calculations assume that the EL is repaid at this point. We start by focusing on borrowers who purchased their property in 2013-2015 with a standard mortgage with a two-year fixation period. This allows us us to calculate realized gains/losses at the end of the fixation period. We also provide evidence on households who purchased a property in 2016-17 to see how the break-even rate has changed over time.[23]

The rate δ used to calculate the future value of the mortgage payments is set equal to the actual (non-EL) mortgage rate. 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. We also show results for a representative credit card rate of 20%.

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

[23] Mortgages with a two-year fixation period represent 41% of eligible mortgages that did not take up the EL.

4.2 Results

In the counterfactual, households use an EL to finance 20% of the purchase price, and there is a corresponding reduction in the LTV of the mortgage. Mortgage payments are lower due to both a lower mortgage amount and a lower mortgage interest rate (due to a lower LTV).

Mortgage rates decrease more than proportionally with LTV, and a 20 percentage point reduction in the LTV ratio results in a much larger reduction in mortgage rates for borrowers starting with a higher LTV. This can clearly be seen in the left-hand panel of Figure 13, where we plot predicted mortgage interest rates as a function of original (not counter-factual) LTV. The interest rate schedule is fairly flat for LTVs below 80%, but it increases steeply with increases in LTV above this level. The predicted 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.[24] The dots measure the number of observations in the corresponding LTV bin.[25] In this figure we distinguish between mortgages originated in 2013-2015 and in 2016-2017, a distinction which we will come back to.

We obtain a counterfactual interest rate for each eligible non-EL borrower by calculating 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). In Appendix H we give further details and provide summary statistics on the interest rate reductions, which are substantial for mortgages with an original LTV above 85% (median reduction of 1.34% for those originated in 2013-2015) but negligible for those with an original LTV below 75%.[26]

We use the counterfactual interest rates (and mortgage amount) to calculate counterfactual

[24] Best, Cloyne, Ilzetzki, and Kleven (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.

[25] The charts in Figure 13 do not display discrete jumps of mortgage rates just after the thresholds (e.g. 80%, 85%) because rates are aggregated in LTV bins.

[26] In a related paper Benetton, Bracke, and Garbarino (2018) investigate whether lenders charge higher mortgage rates to homebuyers that use the EL scheme, conditional on LTV and other observable borrower characteristics. Focusing only on 75-percent LTV mortgages, they find an average rate premium for EL borrowers of 20 basis points, corresponding to just one tenth of the average spread between mortgages with 75- and 95-percent LTV. Our results are robust to adding 20 basis points to all counterfactual mortgages.

mortgage payments. Figure 14 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 £823 in the actual to £528 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.

We make use of the counterfactual mortgage payments to calculate, for each eligible homebuyer who did not use the EL, a break-even rate of annual house price appreciation. In the right hand chart of Figure 13 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 and LTV greater than 85% is 7.7%).

In Figure 13 we also compare the results for mortgages originated in 2013-2015 to those originated in 2016-2017. The left hand chart shows that 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. This has led to a significant reduction in the median break-even rates of house price appreciation shown in the right hand panel. These results show how a reduction in the cost of high LTV mortgages (due for example to a government subsidy), has the potential to crowd out the demand for ELs.

4.3 Realized gains and losses for non-EL borrowers

For the mortgages originated in 2013-2015 with a two-year fixed-rate period, we can use the realized house price changes to calculate the distribution of "money left on the table"—the difference in payoffs for the household under the actual financing structure (no EL) and the counterfactual EL scenario:

$$\Delta NV_T = Q_T - Q_{EL,T} + (mp - mp_{EL}) \cdot s_{\overline{T}|\delta} - 0.2P_T. \quad (3)$$

In Table 4 we calculate the money left on the table in pounds and as a ratio to household income. Positive values indicate that the borrower would have been better off with an EL. Focusing first on the mortgages with LTV greater than 85% we see that the mean (median) is £-300 (£900). On average (at the median) borrowers would have been worse off (better off) with an EL. There is considerable dispersion, ranging from -£6.1 thousand at percentile 10 to £6.4 thousand at percentile 90. In terms of ratios to monthly gross income, the percentile 10 to 90 range is -1.2 months to 1.7 months. As expected, money left on the table decreases with the LTV, and increases 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, particularly those with LTV lower than 85%. But even with large ex-post realized house price gains, many high LTV borrowers leave on the table a significant sum.

4.4 House price volatility and EL take-up

We are interested in evaluating the extent to which house price volatility affects the demand for ELs. On the one hand, higher house price volatility may lead to higher demand for ELs by risk-averse homebuyers who wish to reduce their exposure to house price risk. On the other hand, the use of an EL reduces the hedging benefits of homeownership (Sinai and Souleles, 2005). To the extent that these hedging benefits are larger when house price volatility is higher, volatility may reduce the demand for ELs. This hedging argument requires, however, that we hold the house purchased fixed. Homebuyers with a strong hedging motive may be able to use the EL to buy a more expensive house, consume more housing services, and receive the same hedging benefits. We elaborate on this point further in the next section.

In order to study the links between the demand for ELs and house price volatility, we start by constructing a cross-sectional measure of EL take-up that corresponds to the fraction of eligible buyers in a local authority that used ELs, over the whole sample period (recall that there are 353 local authorities in England). We focus on cross-sectional take-up since there is no

time-series variation in the volatility measure (or the instruments) that we use. Our measure of house price volatility is the standard deviation of the one-year house price growth at the local authority level from 1996 (the local-authority house price indices are available since 1995) to 2012, the year before the introduction of the EL scheme.

The top panel of Table 5 reports the results for Tobit regressions. The estimated coefficients on house price volatility are not statistically significant. In this table, in addition to volatility, we use the rates of past house price appreciation to explain EL take-up. Past house price appreciation is computed as the percentage growth of the local-authority level index over the previous 12 and 24 months for each transaction, averaged by local authority over the sample period. The estimated coefficients on the past house price appreciation measures are negative, implying that high past house price appreciation reduces EL take-up. One possible explanation, is that homebuyers extrapolate future house price changes from the recent past, and are more reluctant to share the equity in the house with the government when they expect house prices to increase.[27]

The bottom panel of Table 5 reports IV estimates. The instruments that we use, at the local authority level, are the refusal rate of development projects, the fraction of already developed land, and the difference in max-min altitude (Saiz, 2010; Hilber and Vermeulen, 2015). The estimated coefficient on the instrumented house price volatility measure is now positive and statistically significant, indicating higher EL take-up in more volatile areas. However, the statistical significance of the estimated coefficient is significantly reduced (and it is only marginally significant) when we also include the rate of past house price appreciation among the explanatory variables. This suggests a limited role for house price volatility as a determinant of EL take-up. On the other hand, the estimated coefficients on the the past house price appreciation variables remain negative and statistically significant.

5 Discussion

We have used a house price expectations metric to quantify the motives and frictions behind the decision not to use ELs as part of the financing structure. However, housing (as opposed to

[27] As before, this argument requires that we keep the house purchased fixed. Please see the discussion in Section 5.

purely financing) choices are difficult to explain even when expected house price appreciation is high. To understand why, it is helpful to go back to the simple example in Section 4.1, in which the household buys a £100 house with a £15 down payment and a £85 bank mortgage. In the counterfactual £20 of the bank mortgage is replaced with an EL. This is a change in the financing structure, holding the house fixed.

In a different counterfactual where both the house and the financing structure change, the homebuyer uses the EL to buy a *more expensive* house. The £15 down payment and the £85 bank mortgage are unchanged, but the household uses a £25 EL and buys a £125 property. The down payment corresponds to 12% of the property value and the bank mortgage has a 68% LTV. 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 house prices as in the base case without the EL and a smaller house. To see why suppose that house prices go up (down) by 10%. For a household who finances the acquisition of a property originally worth £100 without the EL, the gain (loss) is £10 (-10). On the other hand, for a household who finances the acquisition of a property originally worth £125 with a 20% EL, the gain (loss) is $0.8 \times$ £12.5 = £10 (-10).

Therefore, from a purely house price/investment exposure perspective the two alternatives are broadly similar. We say broadly, since the risk-return characteristics of more expensive properties may be different from those of smaller properties, the acquisition of more expensive properties is likely to entail higher transaction costs (taxes and brokerage fees), and higher maintenance and insurance costs.[28]

Putting these caveats aside, we try to understand why some individuals buy their house without an EL, and not a more expensive house with an EL (taking advantage of the government subsidy).[29] We exploit the counterfactual calculations from Section 4.2 on homebuyers who do

[28]Furthermore, for the specific shared equity mortgages that we study, after five years households have to pay interest fees to the government (but they would also be living in a more expensive house, and due to the low level of the fees, there still is a government subsidy after the first five years).

[29]Naturally, it may be the case that a more expensive new build property is not available in the local area at

not make use of the EL. In Table 6 we order them 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 0.66% for buyers in the bottom quartile, 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 6). These are the two sets of buyers who need more external financing for the property purchase, either in the form of a mortgage with a high LTV (non-EL borrowers with a high break-even rate) or a mortgage together with an EL.

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 is clear in the penultimate row of Table 6, 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.

Without the EL, such individuals would have been able to buy a less expensive house. However, such a house may not be adequate for their consumption needs and, in the absence of the EL, they may have decided to rent. Furthermore, EL borrowers may also have a high expected rate of house price appreciation, and such expectations may lead them to take the EL. They cannot buy their desired house 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. The decision to buy with the EL leads to a higher housing investment

the time that the buyer decides to purchase her home.

exposure than in the alternative rental case.

We calculate a measure of housing investment exposure for non-EL borrowers by dividing the value of the house that they have bought by their income (for these individuals housing exposure is equal to housing consumption). For EL borrowers, the housing investment exposure is based on the fraction of the house value that the individual owns (for these individuals housing exposure is lower than housing consumption). The last two columns of Table 6 show that the housing exposure 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 larger for the latter.

Naturally, this is a simplistic view of the data, that is unlikely to characterize every single household. Some of them may not take the EL because they are not informed of the scheme's existence. However, if this was the sole explanation, the information costs would have to be substantial. For example, for an expected rate of house price appreciation of 2%, a break-even rate of 9%, a house value of £200 thousand, and an EL of 0.2 of the property price, the annual information costs would have to be (9%-2%) $\times$ 0.20 $\times$ 200 = £2.8 thousand, corresponding to a total of £14 thousand over the first five years of the EL (assuming no discounting). We think that such high information costs are unlikely as the scheme is widely advertised by developers.

An alternative explanation is that households do not take the EL because they do not understand the scheme's benefits (even if they were aware of it), or they lack the cognitive skills needed to evaluate it, and properly compare economic outcomes. While this may be the case for certain homebuyers, again the cognitive frictions would have to be substantial. And importantly, most mortgage originations in the sample of eligible non-EL borrowers were intermediated by a broker—the fraction is around 75% in both 2016 and 2017 (the only years for which the breakdown is available). Mortgage brokers help borrowers search for the best mortgage and provide financial advice (Robles-Garcia, 2018). They are aware of the EL scheme and are able compare different alternatives.

6 Conclusion

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, Johnson, and Mondragon, 2017; Acharya, Bergant, Crosignani, Eisert, and McCann, 2018; Benetton, 2018), and have made the path to homeownership more difficult, especially for first-time buyers facing rising house prices and stagnating incomes.

In this paper, we provide evidence that these affordability considerations 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. Furthermore, we provide evidence of a link between a relaxation of affordability constraints and the prepayment of SEMs.

In spite of the large demand for ELs, a significant proportion of eligible homebuyers have not taken advantage of them. A possible explanation is that these homebuyers do not want to share expected house price increases with the government. Our calculations show that a high rate of expected house price appreciation is necessary to rationalize the financing choices of those who rely on high LTV mortgages. This rate is reduced when the credit spreads and the cost of high LTV mortgages are lower. An implication of these results is that the subsidization of high LTV mortgages (e.g. due to government guarantees as it is the case for the US), may crowd out forms of housing finance with an equity component and mortgage market innovation more generally. In this dimension, our paper contributes to the understanding of the role of credit spreads and house price expectations in housing finance.

The equity products that we study are provided by the government and they involve a subsidy. This has important implications. First, these products may reduce default and foreclosure externalities in situations of declining house prices, but at the same time give rise to substantial government losses. Their macroeconomic effects depend on the extent to which, in such situations, the government is in a better position to absorb losses in the housing market than homeowners and financial institutions. Second, the demand for equity products would be lower without the government subsidy, but the evidence that we present can be useful for the

design of products by private providers, such as pension funds, who would like to gain exposure to residential real estate prices.

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TABLES AND FIGURES

Table 1: Comparison EL vs. non-EL 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)	37.17	(9.91)	-5.23***
First time buyers (%)	0.73	(0.44)	0.41	(0.49)	0.32***
Gross income (£.000)	49.74	(35.29)	65.08	(250.94)	-15.34***
Property value (£.000)	237.87	(101.23)	285.00	(167.63)	-47.13***
Down payment (£.000)	22.05	(26.86)	102.23	(108.60)	-80.18***
Equity loan (£.000)	49.11	(27.48)	0.00	(0.00)	49.11***
Mortgage value (£.000)	167.10	(68.31)	181.47	(107.96)	-14.38***
Interest Rate (%)	2.57	(0.65)	2.74	(0.89)	-0.18***
Maturity (Years)	29.15	(6.47)	24.58	(7.45)	4.57***
2-year fixed (%)	0.46	(0.50)	0.41	(0.49)	0.05***
Other fixed (%)	0.53	(0.50)	0.44	(0.50)	0.08***
LTV	71.19	(8.23)	64.43	(21.91)	6.76***
Combined LTV	91.48	(7.72)	64.43	(21.91)	27.05***
LTI	3.51	(0.73)	3.06	(1.06)	0.45***
Combined LTI	4.55	(1.01)	3.06	(1.06)	1.49***
Payment-To-Gross income (%)	17.23	(4.13)	18.29	(14.97)	-1.06***
Payment-To-Net income (%)	23.45	(5.46)	25.16	(18.44)	-1.70***
N	99,571		157,620		257,191

Table 2: 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%	45,781	(46%)	53,508	(54%)	33,328	(46%)	39,582	(54%)
CLTV $>$ 95%	157	(0%)	119	(0%)	126	(0%)	100	(0%)

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

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

Table 3: Effect of the introduction of London EL 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 those dwellings that can be matched in the Energy Performance Certificate dataset. (The data and the matching procedure are explained in Appendix E.) 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	36.94***	33.61***	0.35	-3.68	28.47***	6.48**
	(5.95)	(8.96)	(2.42)	(3.60)	(8.32)	(3.25)
London	7.77***	42.54***	11.75***	23.02***	41.99***	-21.61***
	(1.79)	(8.78)	(2.97)	(4.47)	(8.65)	(2.97)
Post Jan 2016	-6.03***	-10.08**	-2.28	-1.77	-9.53**	2.26
	(1.32)	(4.27)	(1.52)	(2.44)	(4.12)	(1.83)
Borrower characteristics	Yes	Yes	Yes	Yes	Yes	Yes
Regional house price index	Yes	Yes	Yes	Yes	Yes	Yes
r2	0.46	0.56	0.12	0.63	0.55	0.18
N	10,147	10,147	10,147	10,147	10,147	9,968

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 4: Money left on the table

Summary statistics for money left on the table for a sample of borrowers with a two-year fixed period mortgage issued between April 2013 and March 2015 for purchase of new-built properties with value below £600,000 and with a loan-to-value above 20%. Money left on the table is defined as the gain for borrowers *if* they had taken an equity loan (see Section 4 for details on how the gain is calculated). Negative values indicate that borrowers would have been worse off with an equity loan. In panel A, under the first five columns the borrower's discount rate is set equal to the interest rate for the actual mortgage (without EL). In the remaining columns the discount rate is set equal to an illustrative 20% credit card rate.

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

Table 5: The correlation between house price volatility, past appreciation, and equity loan (EL) take-up at the local authority level

The top table reports the Tobit estimates. The bottom table reports the IV estimates. The dependent variable is the share of EL transactions in a local authority among all new build sales in the sample from April 2013-March 2017. As measure of volatility we use the standard deviation of one year house price growth at the local authority level from 1996 (the local-authority house price indices are available since 1995) to 2012, the year before the introduction of the EL scheme. Past house price appreciation is computed as the percentage growth of the local-authority level index over the previous 12 and 24 months (annualized) for each transaction, averaged by local authority over the sample period. As instruments we use three measures from Hilber and Vermeulen (2016) at the local authority level: the refusal rate of development projects, the fraction of already developed land, and the difference in max-min altitude.

Panel A: Tobit estimates

	(1)	(2)	(3)	(4)	(5)
Standard deviation past hp appreciation	0.011			0.002	-0.000
	(0.011)			(0.010)	(0.008)
Past house price appreciation (1 year)		-0.011***		-0.011***	
		(0.002)		(0.003)	
Past house price appreciation (2 years)			-0.014***		-0.014***
			(0.003)		(0.003)
Mean Y	0.35	0.35	0.35	0.35	0.35
SD Y	0.12	0.12	0.12	0.12	0.12
N	329	329	329	329	329

Panel B: IV estimates

	(1)	(2)	(3)	(4)	(5)
Standard deviation past hp appreciation	0.045***			0.026*	0.024*
	(0.013)			(0.016)	(0.014)
Past house price appreciation (1 year)		-0.018***		-0.012**	
		(0.004)		(0.006)	
Past house price appreciation (2 years)			-0.019***		-0.014**
			(0.004)		(0.006)
F stat 1	36			36	36
F stat 2		90		90	
F stat 3			96		96
Mean Y	0.35	0.35	0.35	0.35	0.35
SD Y	0.12	0.12	0.12	0.12	0.12
N	301	301	301	301	301

Table 6: 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 (%)	0.66	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	35.85	34.15	32.20
Gross income (£.000)	65.06	52.52	58.72	53.01	47.03
Down payment (£.000)	126.14	98.35	50.17	30.38	18.84
Interest Rate (%)	2.18	2.65	3.28	3.96	2.99
Mortgage value (£.000)	189.64	139.84	162.76	167.78	153.75
Maturity (Years)	23.15	22.43	25.96	27.30	28.42
Property value (£.000)	317.41	238.21	212.94	198.07	215.33
LTV	60.26	57.25	72.12	84.08	71.80
Combined LTV	60.26	57.25	72.12	84.08	91.71
LTI	3.28	2.95	3.03	3.27	3.43
Combined LTI	3.28	2.95	3.03	3.27	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	5.76	5.50	4.17	3.96	4.88
Housing exposure to income	5.76	5.50	4.17	3.96	3.91

Figure 1: Equity Loan (EL) 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 £95 (q_2) from the bank with a standard 95% loan-to-value mortgage.

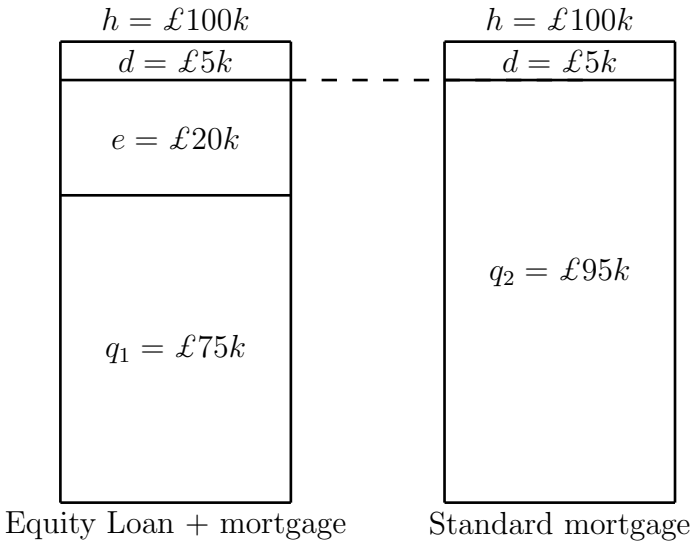
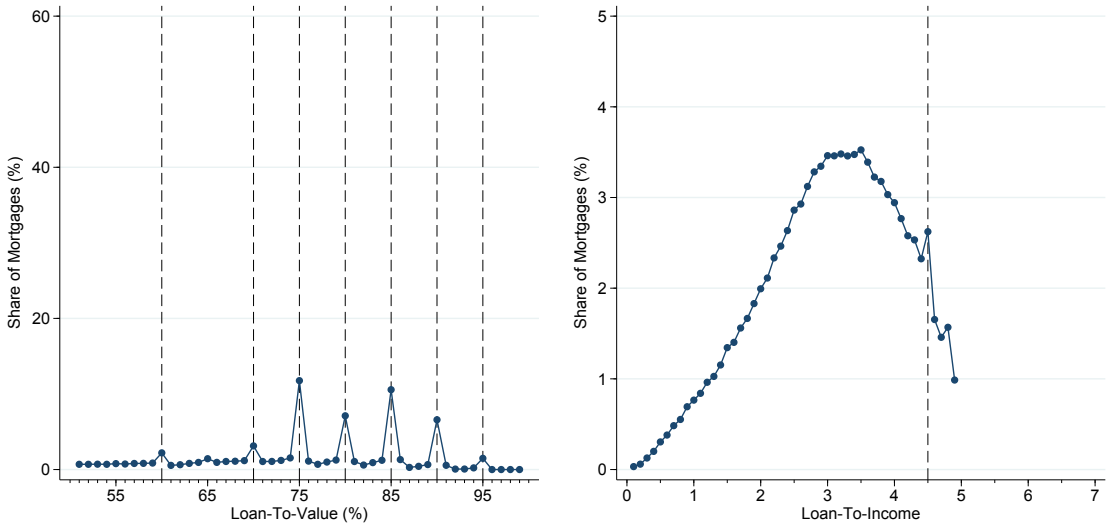


Figure 2: Loan to value and loan to income

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 the figures show both ratios including and excluding the equity loan from the government. For LTV we round to the nearest integer bin. For LTI we round to the nearest 0.10 bin. Data for mortgages originated between April 2013 and March 2017 for the purchase of new homes with value below £600,000.

Panel A: Non-EL borrowers



Panel B: EL borrowers

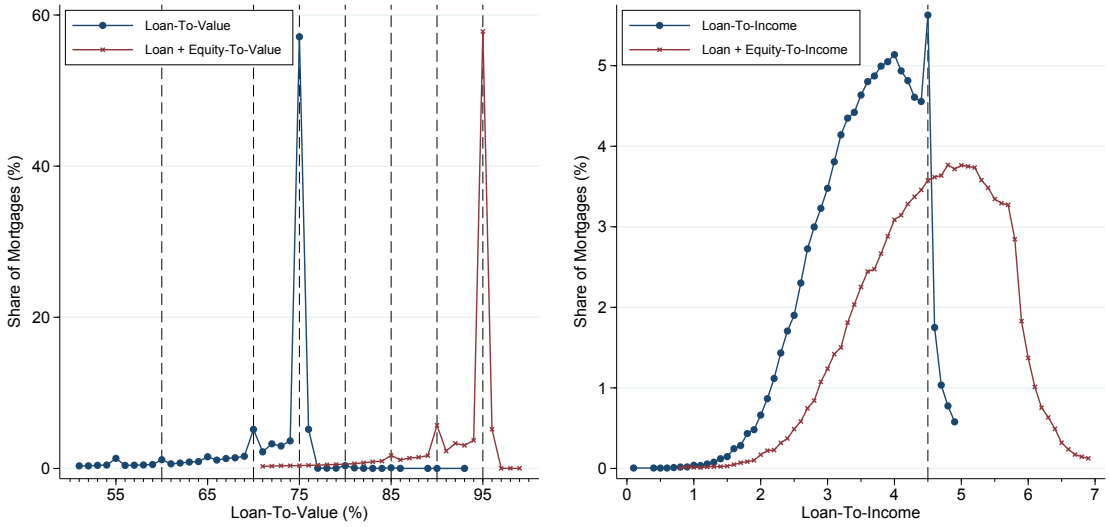


Figure 3: Bunching of property prices: London

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

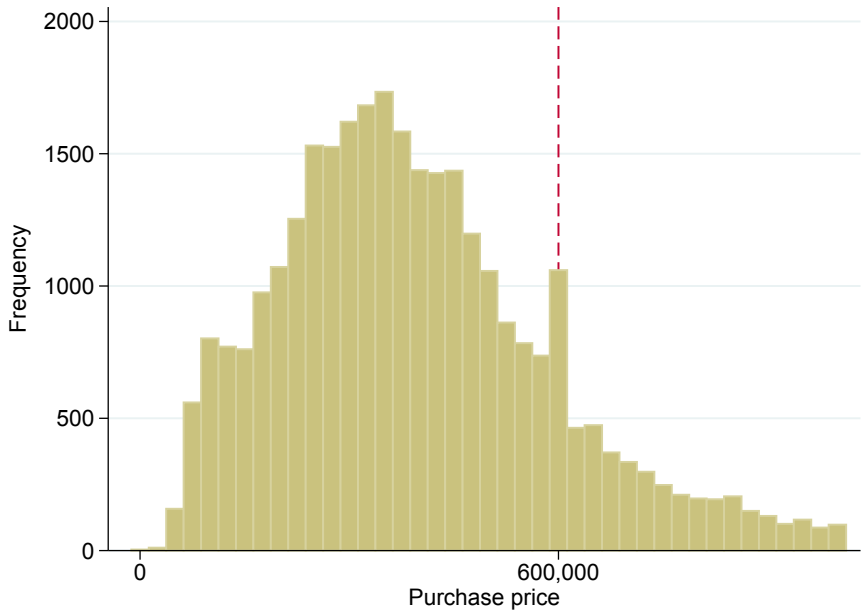


Figure 4: Selection around the £600,000 limit in London: Borrower characteristics
The figure shows the distribution of age, fraction of first-time buyers, deposit and income for mortgages originated in the sample period (April 2013 to March 2017) in London, for the acquisition of new homes, with a purchase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

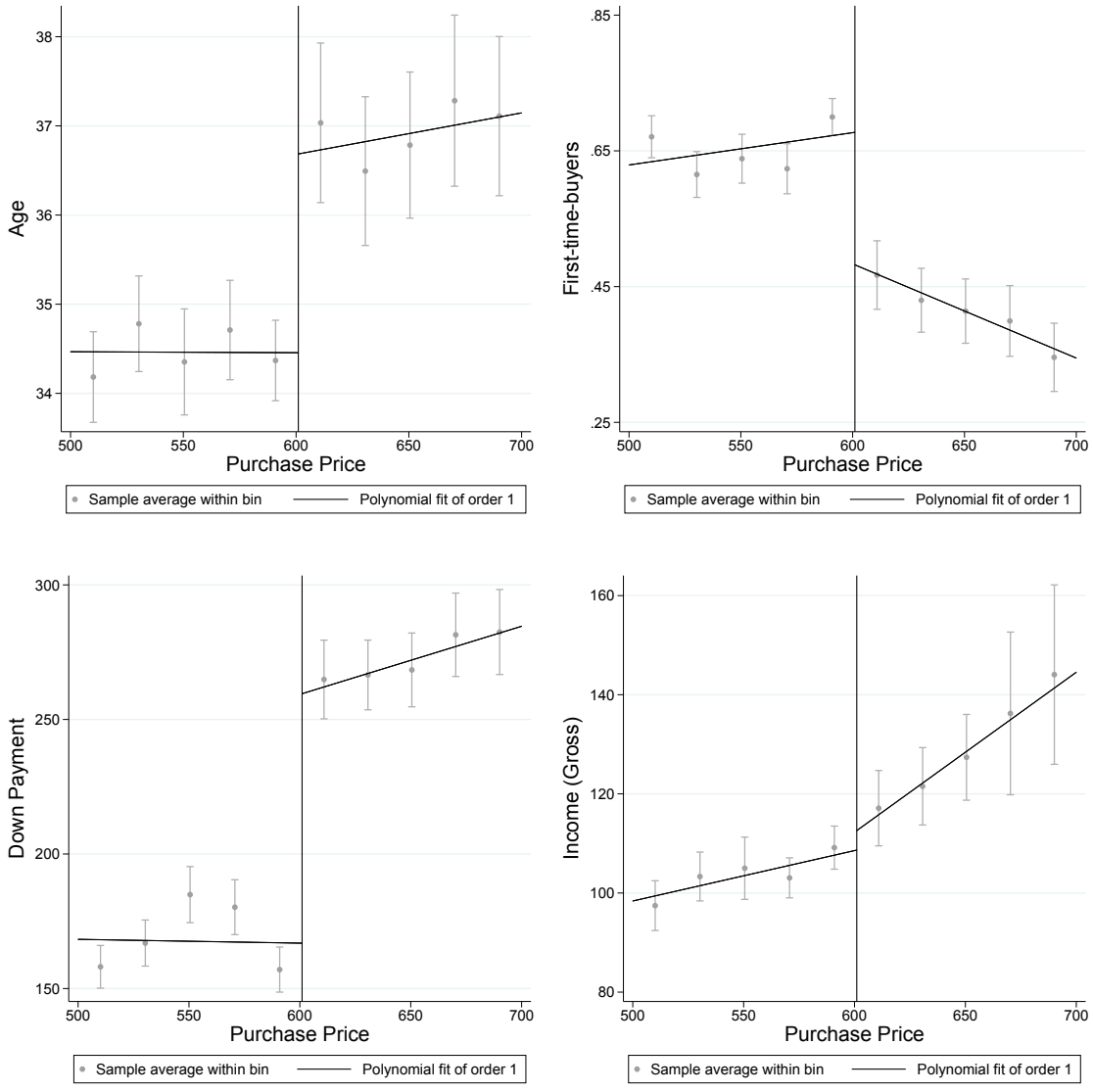


Figure 5: Selection around the £600,000 limit in London: Leverage

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.

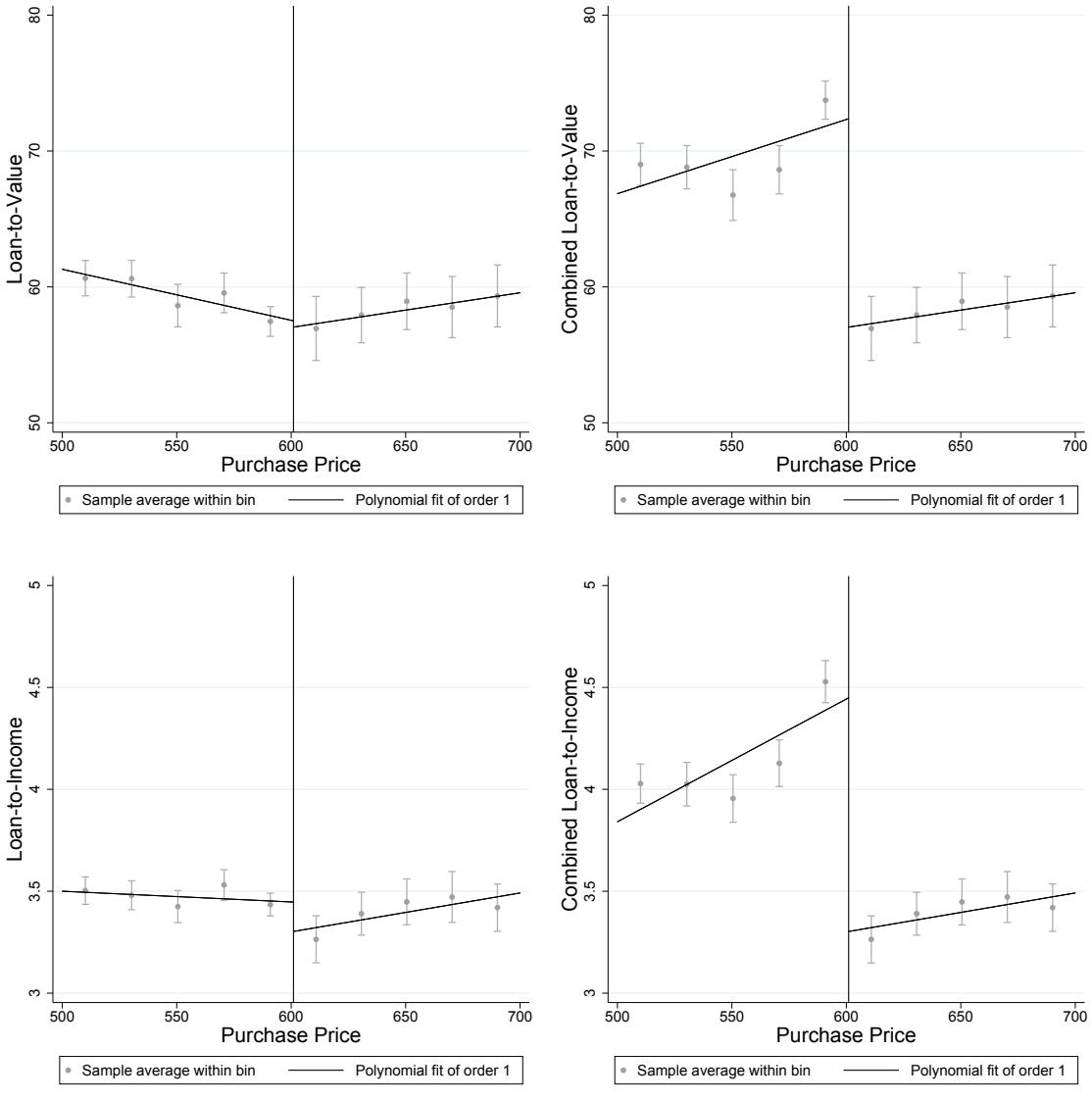


Figure 6: Selection around the £600,000 limit in London (Placebo: existing houses)
The figure shows the distribution of age, income, deposit and the fraction of first-time buyers for mortgages originated in the sample period (April 2013 to March 2017) in London with a purchase price between £500,000-700,000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

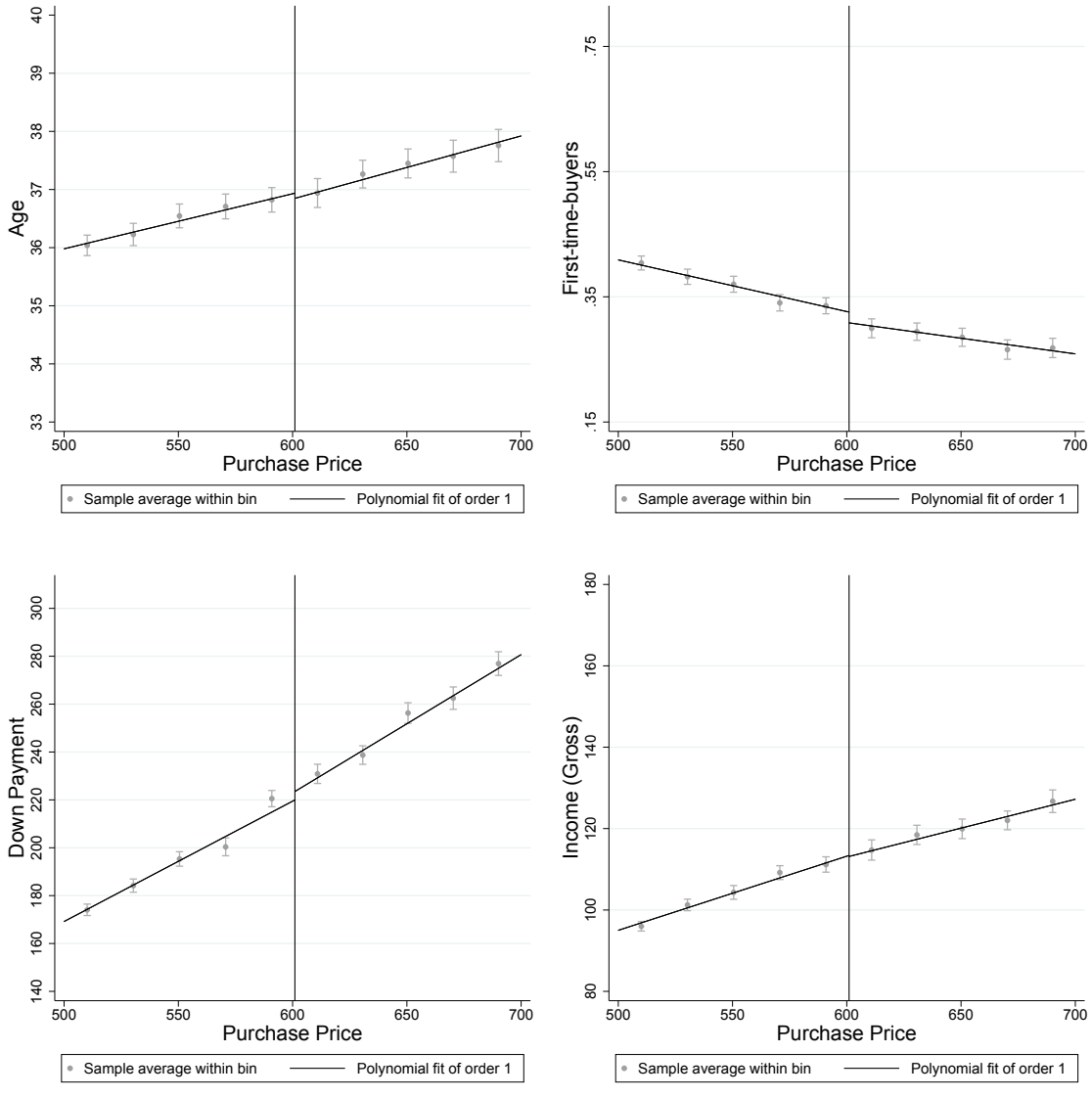


Figure 7: House prices in the South East of England and London

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

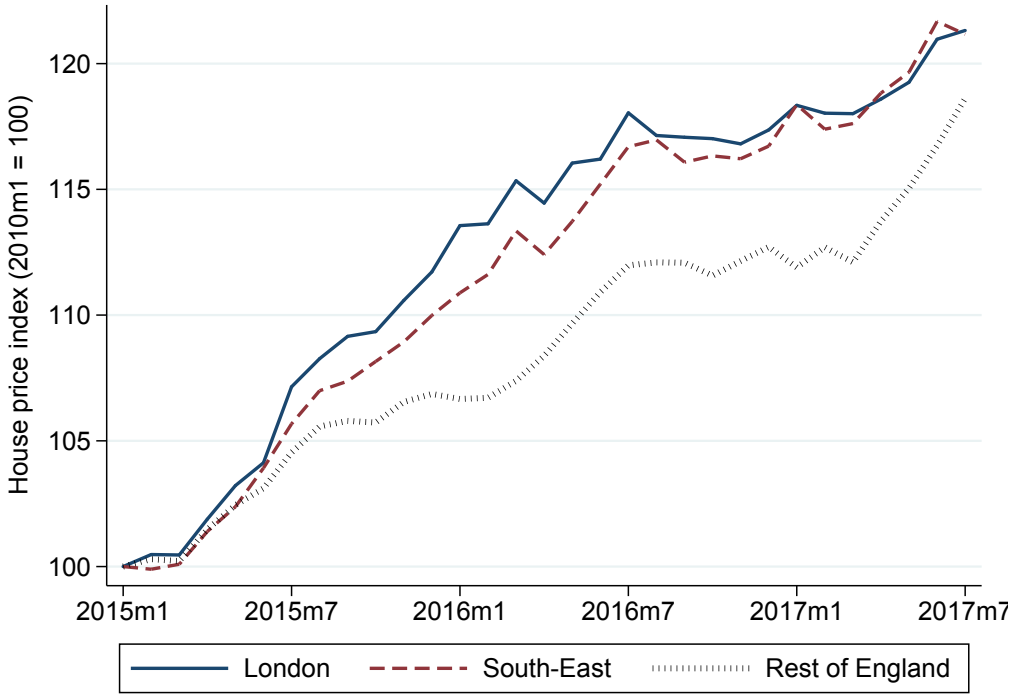


Figure 8: Down payment to value and equity loan (EL) to value distribution

The chart includes EL transactions in London since 1 February 2016.

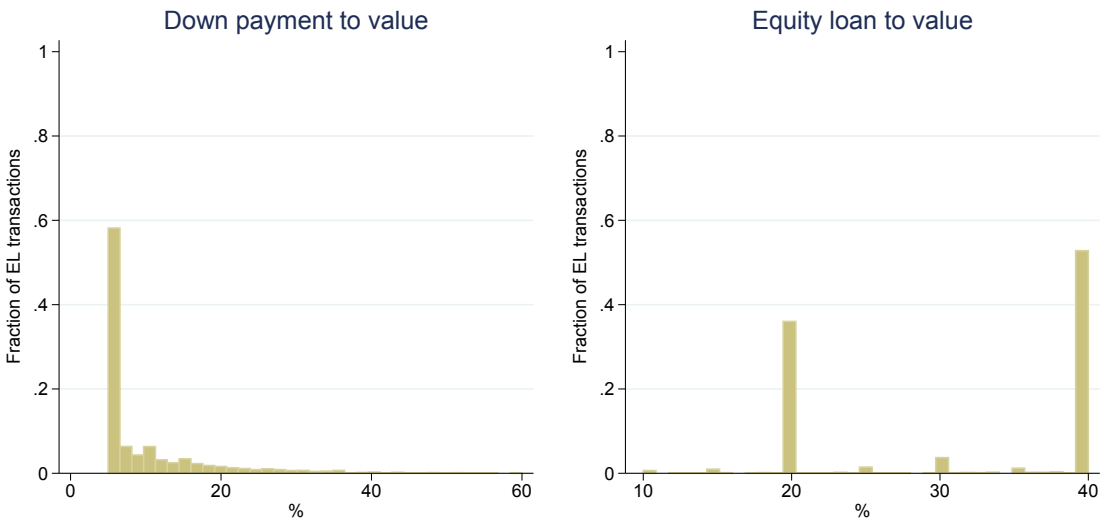


Figure 9: Outer London vs neighboring local authorities: dependent variables

The figure plots the average monthly values of the dependent variables used in the regressions of Panel B in Table 3, 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.

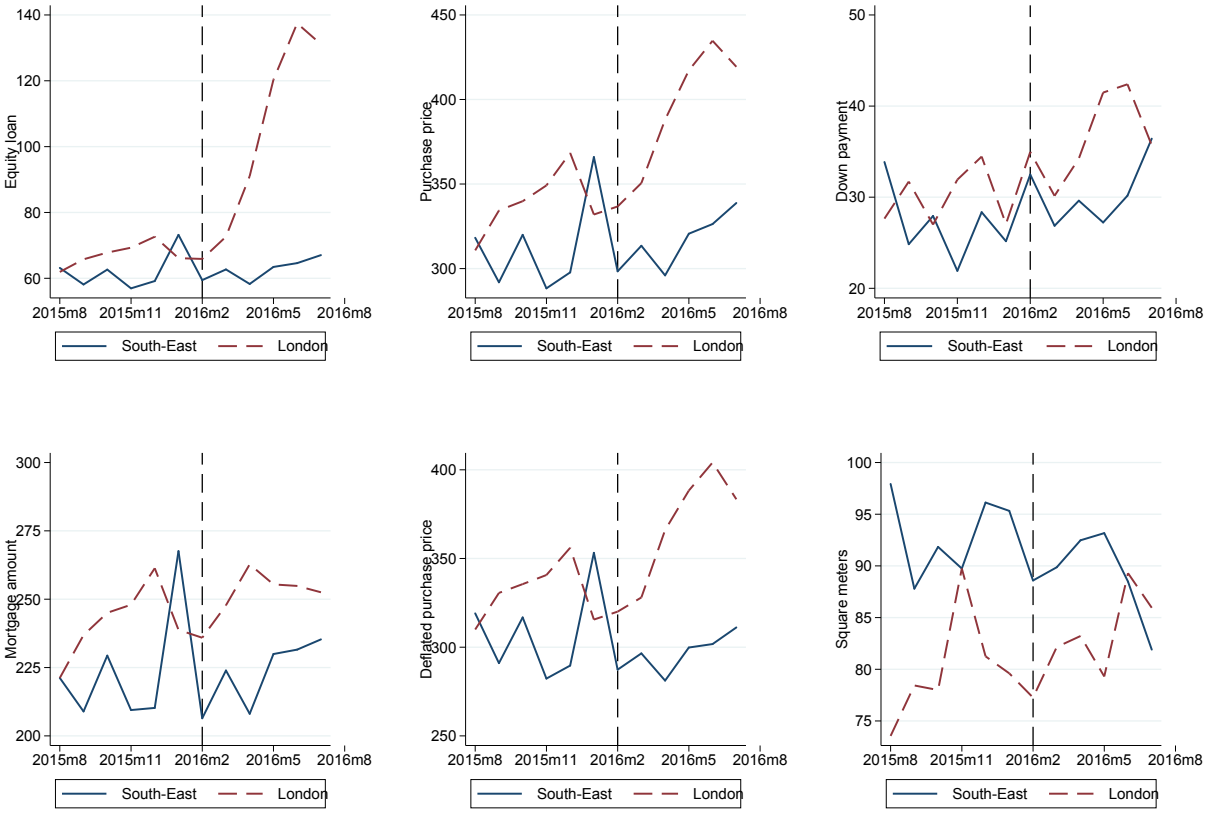


Figure 10: Cumulative redemptions

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 the MHCLG redemptions data for the universe of EL issued until March 2017. The left chart includes all instances where either full or partial repayment of the EL took place (4,384 cases). The right chart includes all instances where there was a repayment through sale (5,123 cases).

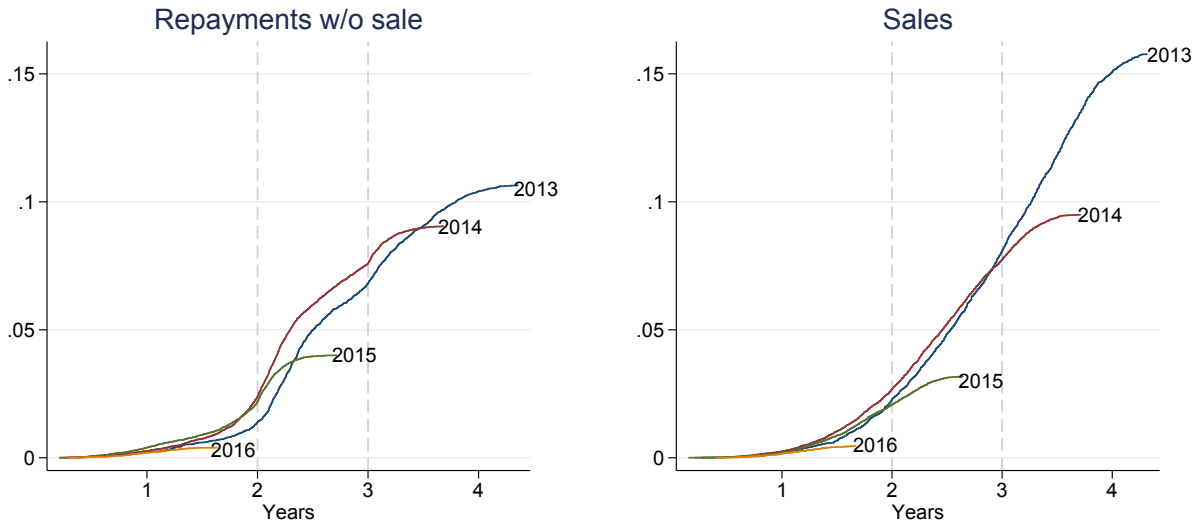


Figure 11: House appreciation and income growth by EL outcome

The left-hand chart is constructed from the main sample of EL borrowers. The dotted line shows the distribution of annualized local house price appreciations in the two 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 right-hand chart is 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. Because the PSD records the income of the borrower at the moment of refinancing, we can compute the income growth between the two mortgages. The dashed line shows the distribution of 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.

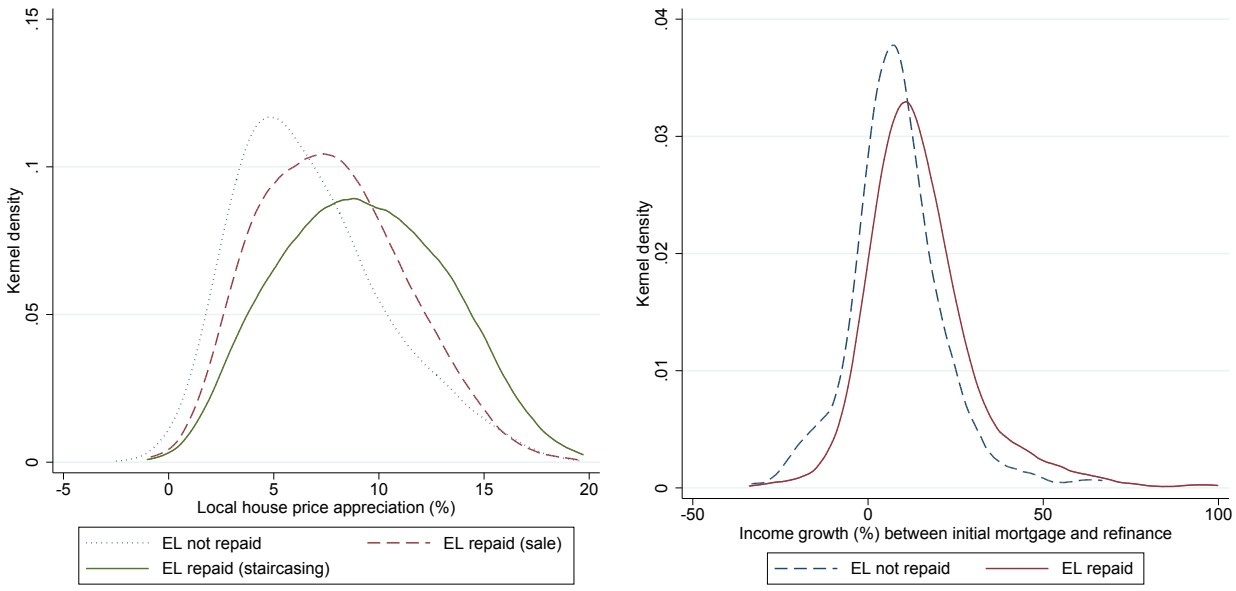


Figure 12: Equity extraction at refinance

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.) The left hand side chart shows that borrowers who repaid the EL extracted amounts that were very similar to the size of the outstanding EL. The right hand side chart shows the difference in LTV between the actual LTV when the EL is repaid and the counterfactual LTV, if no action is taken.

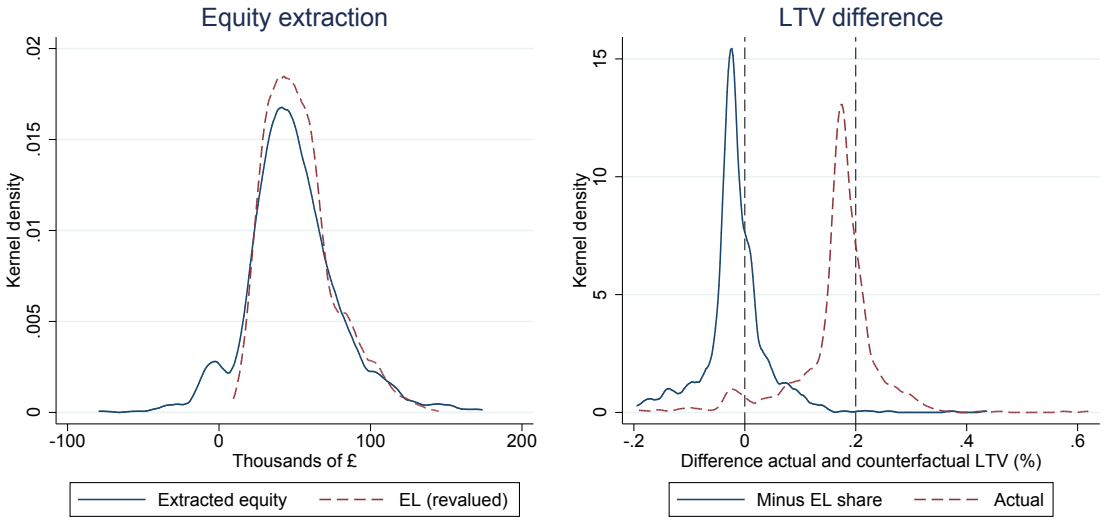


Figure 13: Interest rate and break-even house price appreciation (2-year fixed)
The figure shows the median predicted interest rate and break-even house appreciation for each LTV bin. The predicted interest rate is the predicted rate for each LTV from a regression of the individual level interest rate 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.

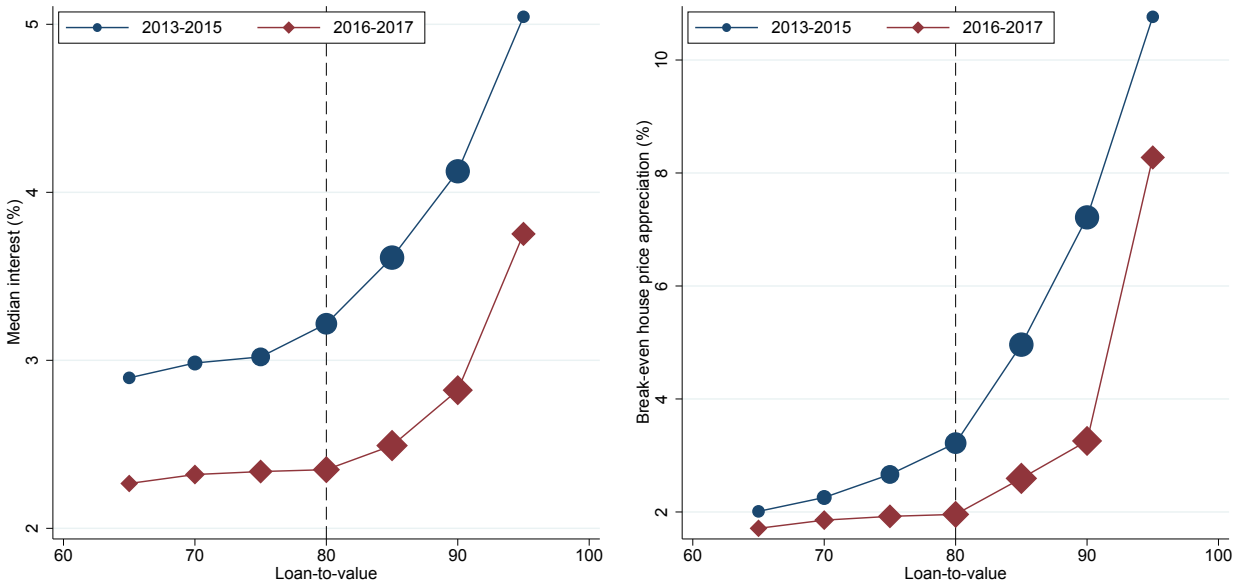
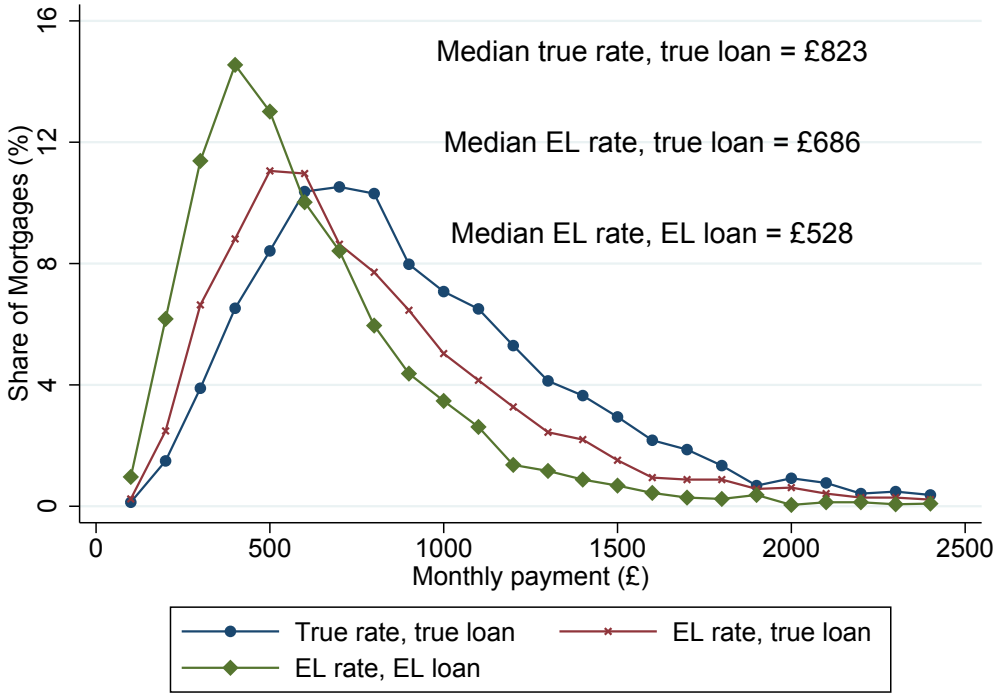


Figure 14: Monthly mortgage payments (2-year fixed, 2013-2015, LTV>85%)

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%.



Appendix to "Housing Affordability, House Price Expectations and 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 onwards). 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% $\times$ 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 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. Table 1 shows that first time buyers (FTBs) make up 73% of EL borrowers compared to 43% of non-EL borrowers. This section complements that analysis by providing origination characteristics for FTBs only.

Table A1 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 A2, 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, and property values which are now higher for EL than for non-EL FTBs.

The PTIs shown in Tables 1, A1 and A2 are front-end PTIs and do not take into account the servicing of other debts and committed expenditure. In Table A3 we calculate back-end PTIs 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.

C Payment to income and mortgage maturity

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 A2). 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).

D 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 A3 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 A4 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 decreases with property purchase price.

E Further evidence on the London experiment

In Table A4 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 A5 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 A4 and A5 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 A5 we map the geographical areas that we consider. Tables A6 and A7 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 A6 we plot the evolution over time, for a comparison of pre-trends, of the outcome variables for London and the SE.

One of the regressions reported in Table 3 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 A8 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.

F Equity loan repayment behaviour: origination characteristics

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 A9 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.

G House prices

The paper contains comparisons of house prices for different groups of properties. This part of the Appendix provides additional material to support the analysis in the main body of the paper.

G.1 House price appreciation by EL outcome

The left-hand chart of Figure 11 shows that EL borrowers who decided to pay back the equity loan without selling their property enjoyed higher local house price appreciation, on average, than EL borrowers who repaid the equity loan by selling their property. These borrowers in turn enjoyed higher local house price appreciation than borrowers who did not repay their equity loan. This result supports the view that house price growth is a determinant of the decision to pay back equity loans and exit the scheme.

For EL borrowers who decided to repay their equity loans (either by selling their property or by continuing living in the same house), we observe from administrative data the amount repaid to the Government, which gives us a direct measure of the rate of annual house price appreciation realized in these transactions. We compare this idiosyncratic house price growth with the aggregate one derived from local-authority indices. This also allows us to evaluate the accuracy of relying on official indices, given that for properties for which the EL was not repaid we do not have access to the administrative data on price changes.

Figure A7 shows this comparison, and also adds an estimate of local-authority level house price growth for new homes only (as opposed to all properties, both new and old). Because new properties are thought to often sell at a premium (Coulson et al, 2018), their appreciation could on average be lower than the rest of the market. We construct the new-home index by running a repeat sales analysis on all pairs of transactions in the England Land Registry in which the first transaction involves a new home.

Figure A7 shows that the distribution of actual appreciation of properties financed using an EL (labeled individual properties) is to the left of the distribution based on local house price indices, and this is in part explained by a lower appreciation of new homes relative to the overall local housing market. However, even when using the index based on new properties only, there still are differences between actual and estimated distributions, particularly for property prices obtained from a valuation at the time of repayment, that did not involve a sale (right hand chart). In this case, the distribution of idiosyncratic house price appreciation has relatively more mass at values around zero relative to both the local prices and the new-home index. In these instances the 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.

G.2 House price effect: Equity Loan vs non-Equity Loan within new builds

The counterfactual analysis presented in Section 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 a setting where the final price of a real estate transaction is decided through a bargaining process between the property developer and the prospective buyer, there are reasons why the presence of an EL could change the behavior of the two parties. The buyer could be more willing to make a high offer given that the acquisition is partially financed by someone else. The developer is aware of this possibility and could discriminate between EL and non-EL purchasers. On the other hand, EL and non-EL transactions often occur in the same developments or buildings, and it would be quite likely to encounter both types of transactions in adjacent apartments or houses. In this context price dispersion is likely to be limited, given that prospective buyers, or their agents or surveyors, can check the price of nearby sales on the Land Registry. The fact that properties in a new development tend to all sell in a restricted time window makes price comparisons easier.

Motivated by these arguments, we test whether new homes bought under the EL scheme are purchased for a higher price compared to similar new homes bought without an EL. We start from the Land Registry Price Paid data, which records all sales in England and Wales, and only keep the transactions of new homes that took place after 2012. We match these sales with our Help to Buy dataset, which lists all the ELs issued between the introduction of the scheme in April 2013 and March 2017, and tag the matched transactions as EL-funded.

Out of all transactions of newly built properties in the Land Registry (both EL-funded and not), we only keep those for which a second (repeat) sale has been recorded. (We have information on all Land Registry transactions until April 2018.) By restricting our attention to repeat sales, we control for all property characteristics that are time-invariant. Given our focus on new homes and a restricted time window (five years between April 2013 and April 2018), property values in our sample are unlikely to be significantly affected by time-varying property characteristics such as maintenance conditions. In this setting, differences in the appreciation rate of properties between the two transactions can be attributed to differences in over- or under-valuation at the time of purchase, because when the second sale occurs neither group of houses (EL-funded and other properties) are eligible for the scheme anymore.

Table A10 reports the coefficient of a regression of house price changes between repeat sales on an indicator of EL-funded purchases. The first column shows that properties bought with an EL appreciate on average 3 percent less than other new homes. This difference is only slightly affected if we control for the years in which the houses were bought and sold, and the time elapsed between the two events (this is done in the second column through an interaction between purchase-year and sale-year fixed effects). Adding local-authority fixed effects reduces the gap by one percentage point (third column), whereas interacting all the fixed effects makes the difference statistically not different from zero (fourth column). Given that house price growth may differ substantially across years and local markets, we put special weight on the last regression specification, and conclude that ELs do not seem to have a statistically significant effect on the price of properties bought under the scheme, compared to similar new homes.

H Counterfactual calculations

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 $mp = Q_0 \cdot a_{\overline{N}|r}$, where $a_{\overline{N}|r}$ is the present value of a constant annuity with N payments and interest rate r. Finally, the household payoff at ($t{=}T$) is the difference between the property value P_T and the outstanding balance on the loan Q_T: $E_T = P_T - Q_T$

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 above counterfactual scenario 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.

H.3 Break-even rate of house price appreciation and money left on the table

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

The net gains from the EL are given by:

$$\Delta NV_T = Q_T - Q_{EL,T} + (mp - mp_{EL}) \cdot s_{\overline{T}|\delta} - 0.2 \cdot P_T, \tag{4}$$

where $s_{\overline{T}|\delta}$ 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 ex-post money left on the table by an individual who did not use the EL.

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

$$\eta_{BE} = \left(\frac{Q_T - Q_{EL,T} + (mp - mp_{EL}) \cdot s_{\overline{T}|\delta}}{EL_0} \right)^{1/T} - 1. \tag{5}$$

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.

We obtain a counterfactual interest rate for each eligible borrower who did not use the EL by calculating 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 A11 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 A11 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 A11, 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.

Additional references

Coulson, Edward N., Morris, Adele C. and Helen R. Neill, 2018, "Are New Homes Special?" *Real Estate Economics*, forthcoming.

Agarwal, Sumit, Song, Changcheng and Vincent Yao, 2017 "Relational Contracts, Reputational Concerns, and Appraiser Behavior: Evidence from the Housing Market", working paper.

Table A1: 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)	31.55	(7.67)	-1.28***
Gross income (£.000)	47.33	(37.92)	54.03	(383.13)	-6.69***
Property value (£.000)	223.87	(97.56)	229.29	(144.63)	-5.42***
Down payment (£.000)	17.71	(19.91)	69.85	(89.62)	-52.13***
Equity loan (£.000)	46.86	(28.74)	0.00	(0.00)	46.86***
Mortgage value (£.000)	159.66	(66.33)	158.69	(95.46)	0.96**
Interest Rate (%)	2.58	(0.64)	2.93	(0.89)	-0.35***
Maturity (Years)	29.73	(6.28)	27.43	(6.15)	2.30***
2-year fixed (%)	0.45	(0.50)	0.42	(0.49)	0.04***
Other fixed (%)	0.53	(0.50)	0.50	(0.50)	0.03***
LTV	72.11	(7.04)	67.23	(21.37)	4.87***
Combined LTV	92.53	(6.16)	67.23	(21.37)	25.29***
LTI	3.53	(0.72)	3.20	(0.99)	0.33***
Combined LTI	4.56	(1.02)	3.20	(0.99)	1.36***
Payment-To-Gross income (%)	17.02	(3.97)	17.56	(9.02)	-0.54***
Payment-To-Net income (%)	22.99	(5.21)	23.64	(11.30)	-0.64***
N	73,140		67,052		140,192

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

The table reports coefficients and standard errors from the regression $y = \alpha + \beta_1 EL + \gamma_j + \lambda_t + \epsilon$, 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)	31.19	(0.05)	32.25	(0.05)	-1.06***
Gross income (£.000)	57.17	(1.92)	59.94	(2.06)	-2.77*
Property value (£.000)	293.86	(0.71)	279.55	(0.76)	14.32***
Down payment (£.000)	31.93	(0.42)	78.23	(0.45)	-46.30***
Equity loan (£.000)	51.55	(0.09)	0.00	(0.00)	51.55***
Mortgage value (£.000)	206.11	(0.51)	193.85	(0.55)	12.26***
Interest Rate (%)	2.35	(0.01)	2.45	(0.01)	-0.10***
Maturity (Years)	30.35	(0.04)	28.46	(0.05)	1.90***
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	69.99	(0.11)	65.94	(0.12)	4.05***
Combined LTV	92.07	(0.06)	65.94	(0.12)	26.13***
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)	17.32	(0.06)	0.05
Payment-To-Net income (%)	24.40	(0.07)	24.49	(0.07)	-0.08

Table A3: 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 A4: 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 A5: 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 A6: 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 A7: 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 A8: Effect of the introduction of London EL scheme: Placebo tests

Panel A replicates the analysis of Table 3 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 3 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	1.81	9.43	2.43	5.20	7.17	-9.48**
	(2.26)	(11.51)	(2.77)	(7.52)	(11.48)	(3.74)
London	8.70***	45.31***	8.96***	27.65***	45.59***	-11.14***
	(2.28)	(11.78)	(3.03)	(7.45)	(11.91)	(3.29)
Post Jan 2015	1.68**	8.89**	1.79	5.41*	9.15**	3.18*
	(0.84)	(4.18)	(1.21)	(2.93)	(4.07)	(1.77)
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	6,837	6,837	6,837	6,837	6,837	6,690

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 A9: 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	Repaid	Kept EL	Difference
	Mean	Mean	Mean	Repaid - Kept EL
Age (Years)	29.80	31.26	31.97	-0.71***
First time buyers (%)	0.77	0.80	0.74	0.06***
Gross income (£.000)	42.10	51.29	44.13	7.16***
Property value (£.000)	196.52	241.23	206.96	34.28***
Down payment (£.000)	15.21	22.33	17.40	4.93***
Equity loan (£.000)	39.17	47.76	41.27	6.49***
Mortgage value (£.000)	142.13	171.14	148.30	22.85***
Interest Rate (%)	3.20	3.06	3.19	-0.13***
Maturity (Years)	27.84	27.56	27.87	-0.31***
2-year fixed (%)	0.10	0.17	0.16	0.01
Other fixed (%)	0.90	0.82	0.84	-0.01*
LTV	72.61	71.28	72.13	-0.85***
Combined LTV	92.55	91.10	92.07	-0.98***
LTI	3.54	3.55	3.54	0.01
Combined LTI	4.53	4.57	4.53	0.04**
Payment-To-Gross income (%)	18.66	19.01	18.80	0.22
Payment-To-Net income (%)	24.24	25.66	24.70	0.96***
N	3,389	2,767	25,392	28,159

Table A10: House price effect: Equity Loan vs non-Equity Loan within new builds

The table reports the estimated coefficient of a regression of house price changes between repeat sales on an indicator of EL-funded purchases. All regressions are run with double-clustered standard errors on local authority and sale month. The columns differ in the fixed effects included. The sample includes the new home first sold between April 2013 and March 2017 for which a repeat sale is recorded.

	(1)	(2)	(3)	(4)
	Δ log Price	Δ log Price	Δ log Price	Δ log Price
EL	-0.033***	-0.027***	-0.018***	-0.005
	(0.008)	(0.006)	(0.005)	(0.006)
Fixed effects		Purchase year X Sale year	Purchase year X Sale year, LA	Purchase year X Sale year X LA
SE clustering	LA, sale month	LA, sale month	LA, sale month	LA, sale month
r2	0.00	0.01	0.06	0.24
N	38,864	38,863	38,863	37,887

Standard errors in parentheses

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

Table A11: 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

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%.

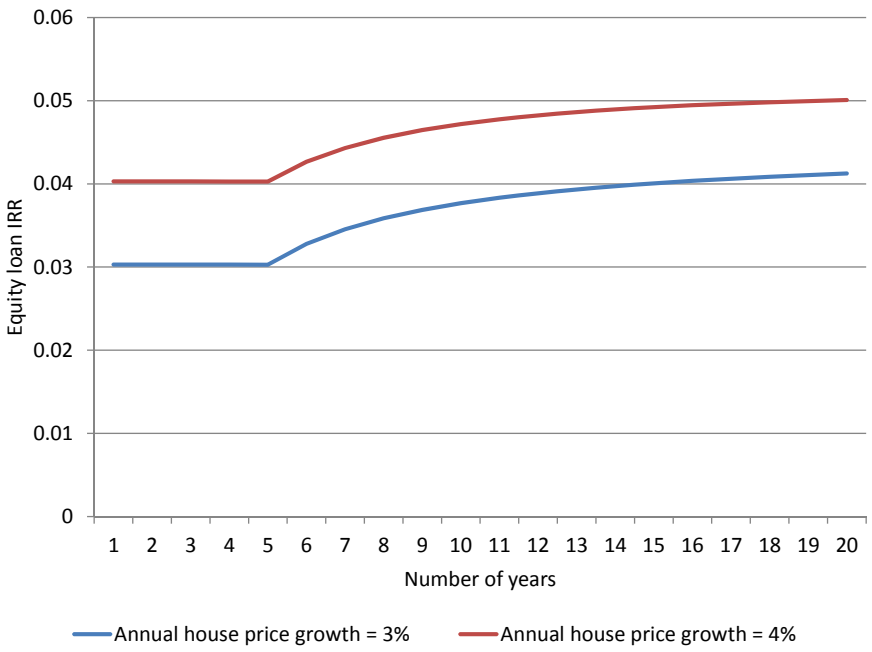
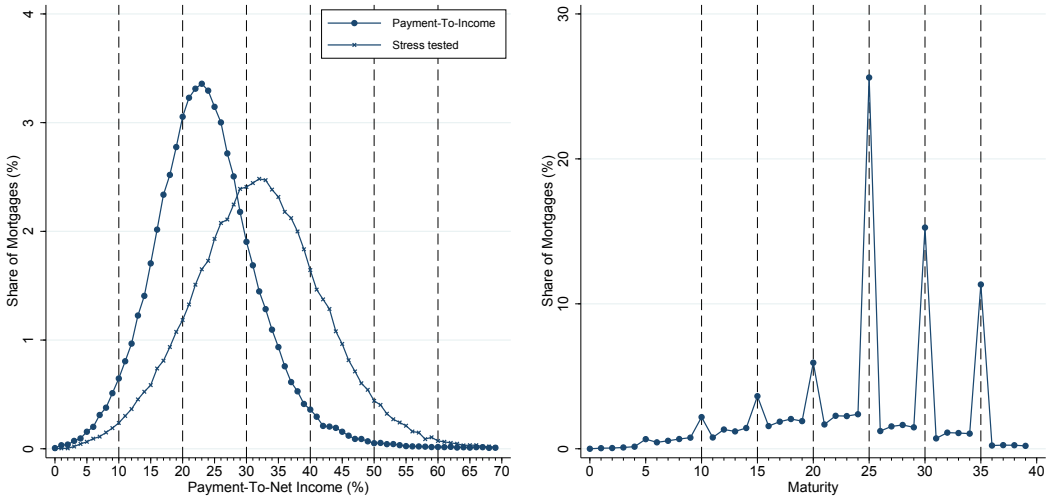


Figure A2: Payment to income and maturity

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

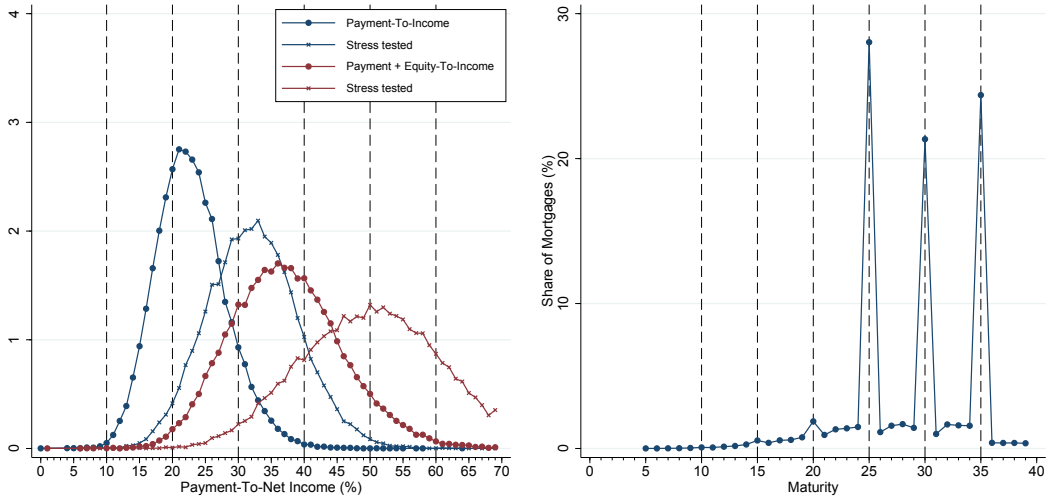


Figure A3: Selection around the £600,000 limit in London

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.

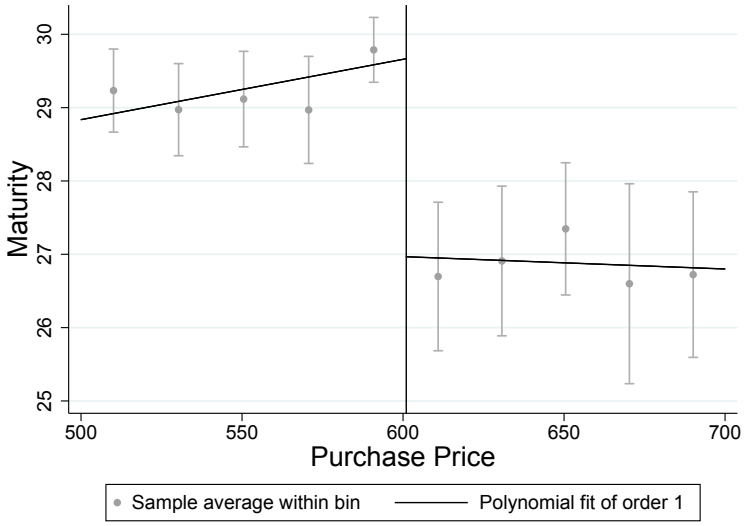


Figure A4: Selection around the £600,000 limit in London (Placebo: new properties, 2009-2012)

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.

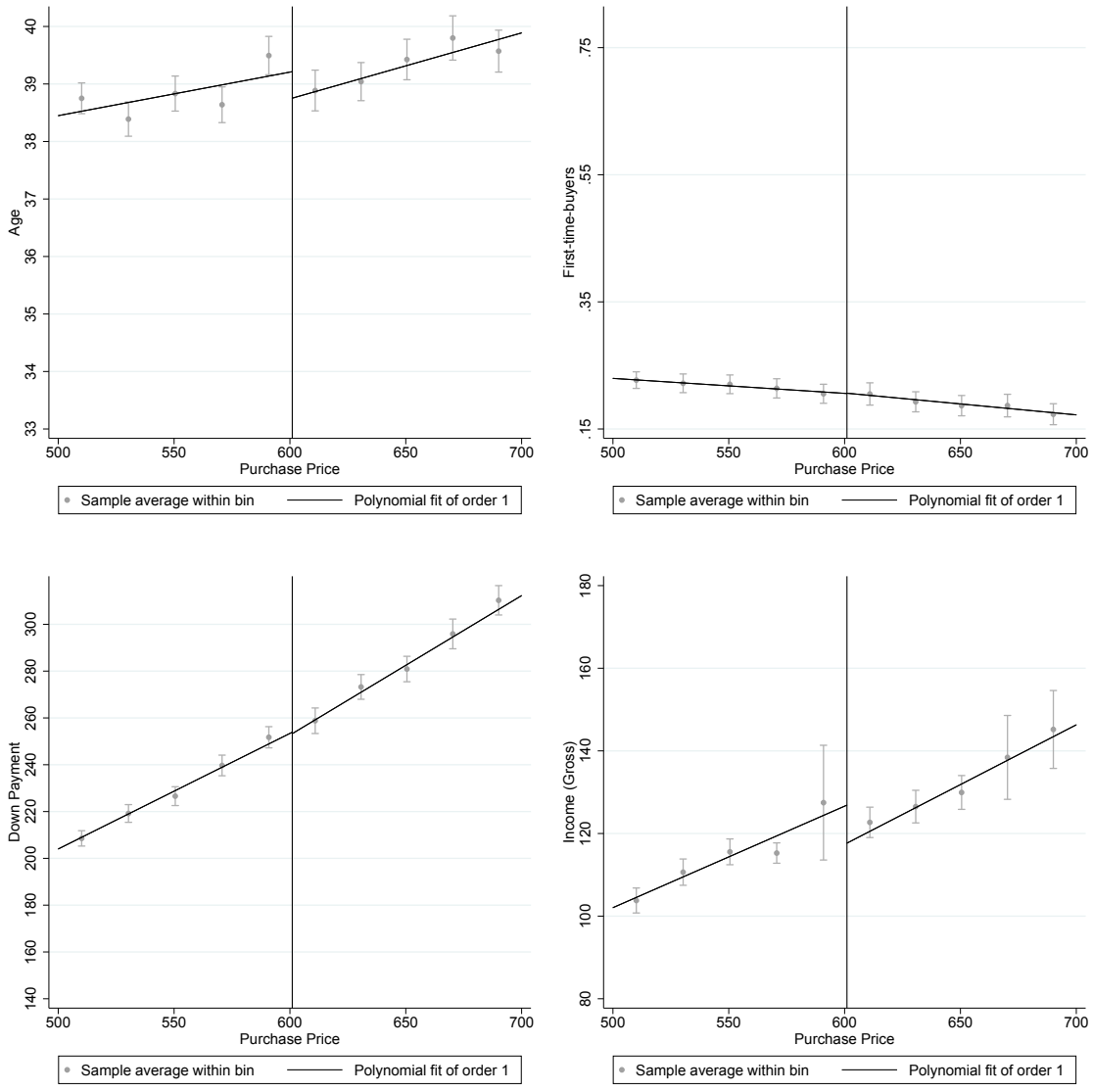


Figure A5: London experiment: border analysis

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

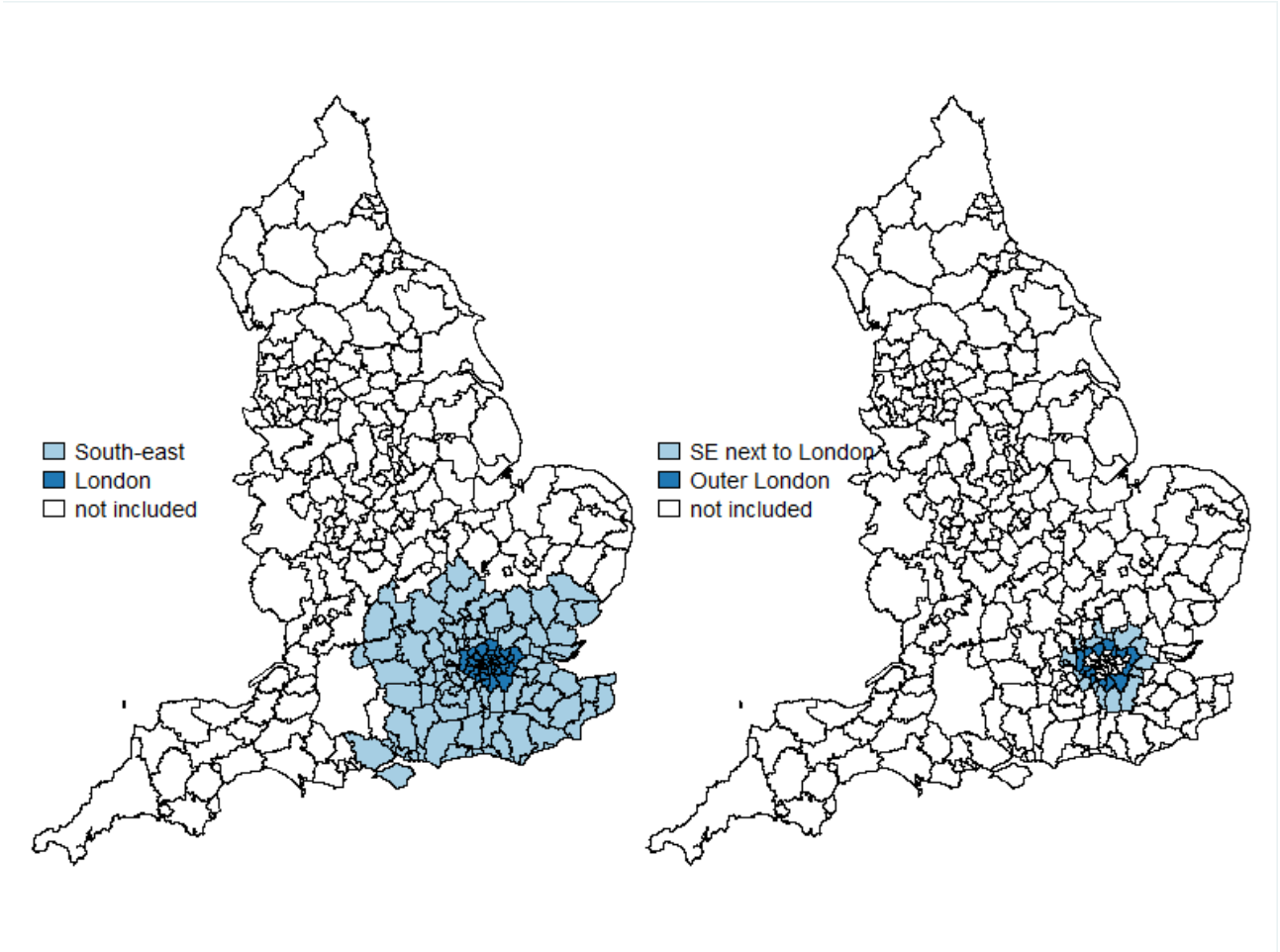


Figure A6: London vs the South East of England: dependent variables

The figure plots the average monthly values of the dependent variables used in the regressions of Panel A in Table 3, 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.

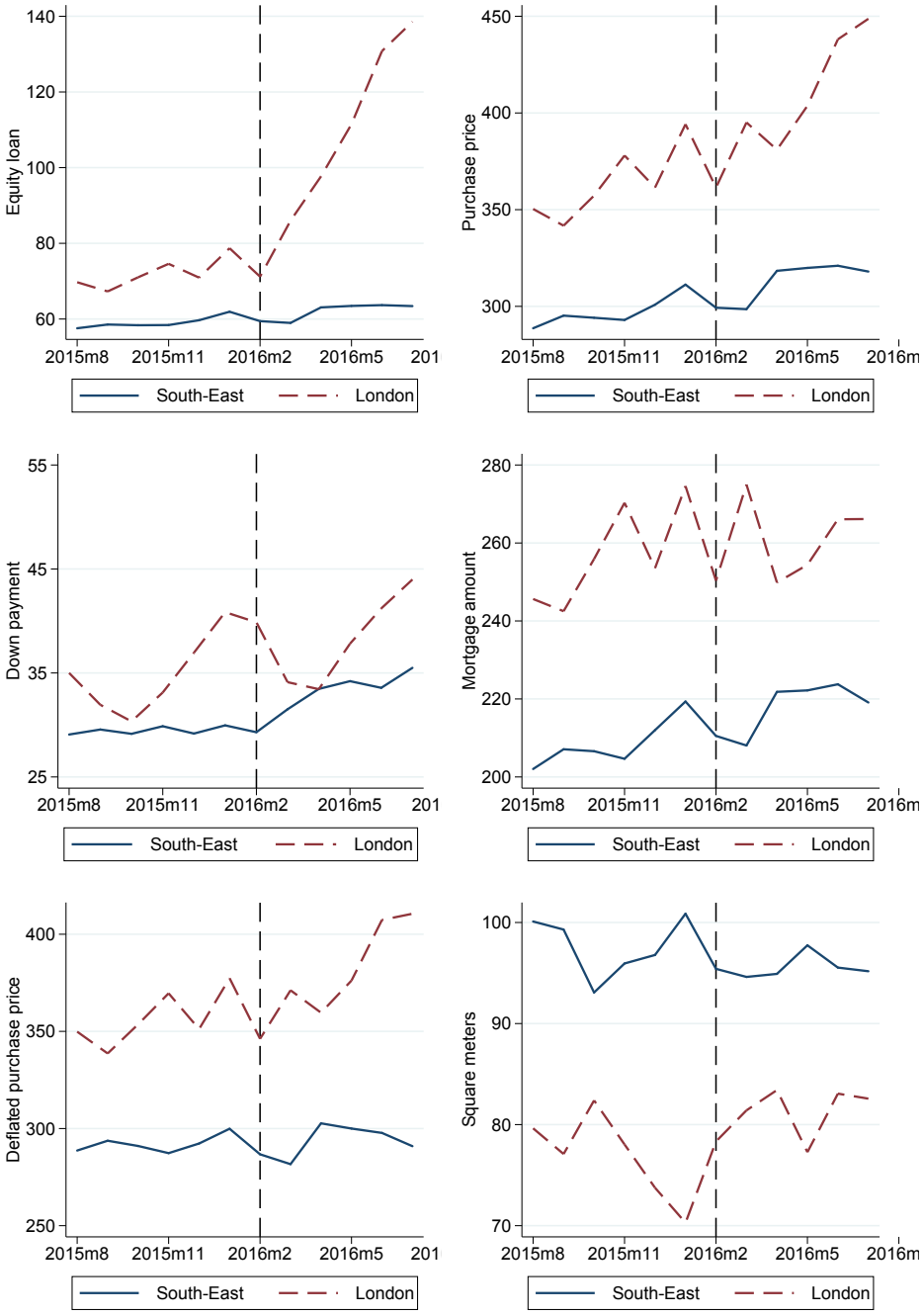


Figure A7: Local vs idiosyncratic house appreciation by EL outcome

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 dotted line shows the distribution of realized house price appreciation according to the official local-authority house price index. The dashed line reports appreciation according to an index for new homes that was estimated by the authors from repeat sales in the Land Registry. Finally, the solid line reports the actual appreciation as measured at the moment the EL was repaid. (This appreciation is recorded in the EL official data as it is used to compute the amount due to the Government.)