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When Discounted Rates End: The Cost of Taking Action in the Mortgage Market

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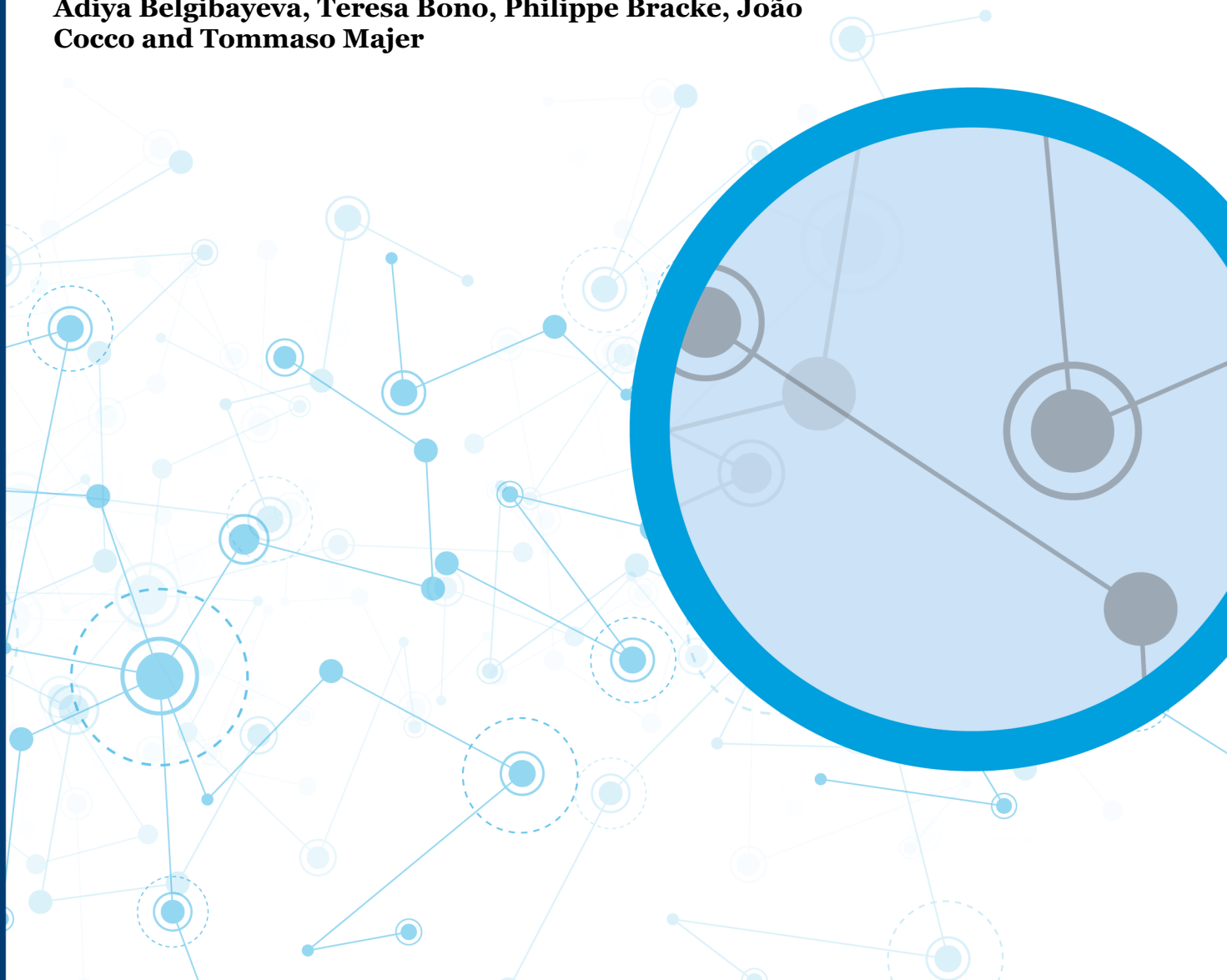

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1 Introduction

There is evidence of household inertia in a variety of settings. In mortgage markets, many individuals fail to refinance their loans even when there seem to be large monetary gains from doing so (Agarwal et al., 2013, and Andersen et al., 2015, provide evidence for the United States and Denmark, respectively). In defined contribution pension plans, inertia is reflected in plan members not deviating from default choices (Madrian and Shea, 2001). There is also evidence of inertia in other retail markets such as energy (Hortaçsu et al., 2017) and health insurance (Handel, 2013).

While there is compelling evidence of household inertia, there is more debate on its drivers. Inertia could be due to household inattention, either irrational or rational. A rationally inattentive individual is someone who has a limited amount of a scarce resource, attention, and who allocates this resource optimally (Sims, 2003; Reis, 2006). There could also be market frictions or constraints that prevent households from taking action. For example, borrowers who have low home equity or who have experienced an income drop may be unable to remortgage.

We provide evidence on the nature and sources of household inertia using UK mortgage market administrative data. Many UK mortgages have an initial period during which the interest rate is fixed (the initial rate), at the end of which it reverts to a variable rate (the reversion rate, usually equal to a base rate plus a margin). The most common length of the initial period is 2 years, and there are no prepayment penalties once it ends. The initial interest rate is significantly discounted (fixed rate), and as a result there are often large increases in mortgage payments when borrowers move to the reversion rate.

Our data is comprehensive and covers the universe of UK mortgages. It allows us to identify and exclude those borrowers who are not able to take action at the end of the fixed rate period because of market constraints (eg they are in arrears or have negative home equity). For the active borrowers, we can measure how long it takes them to remortgage, and the interest rate that they would have had to pay in case of inaction. For the inactive ones, who end up on the reversion rate, in addition to observing the realised changes in mortgage payments, we can use our data to estimate the interest rate that they would have obtained if they had taken action and remortgaged. Therefore, we are able to measure, for all borrowers, the monetary gains

from action and any associated remortgaging fees.[1]

We first show that unconditionally there is only moderate long-term inertia among UK mortgage borrowers: roughly 20% of the original borrowers are on the reversion rate at the end of the sample period. The others have either re-mortgaged (66%) or paid off the loan (14%, which may also be due to a house sale). In general, those who remortgage are those who have higher estimated monetary benefits from doing so.

For those who take action, we zoom in on the exact remortgage date, and compare it to the date when the fixed rate period ends. The question that we investigate is whether borrowers remortgage in response to the actual increase in mortgage payments or in response to the anticipated future increase (ie before the actual increase takes place). Naturally, there is heterogeneity in borrower responses, but we find that, among those borrowers who remortgage, 73% of them do so before there is an increase in mortgage payments. These results show that a significant fraction of UK borrowers are rationally attentive, taking action when it matters most, and in anticipation of the increase in interest rate.

The unconditional proportion of borrowers who end up on the reversion rate hides considerable heterogeneity. For the median monetary benefits of remortgaging (net of fees), measured as a proportion of household income, the fraction of those who fail to take action declines steadily with income: from 35% for the bottom decile to 15% for the top decile of the income distribution. We exploit this heterogeneity to study how costs of taking action vary across households.

Borrowers may remortgage with the same lender from whom they took out the original loan (internal remortgaging) or with a different lender (external remortgaging). The process of internal remortgaging is simpler, since an affordability assessment and proof of income are not required, unless borrowers want to change the loan terms (eg increase the loan amount). This means that borrowers will be able to remortgage internally, unless they are in situation of negative home equity or they are near full repayment of the loan.[2] On the other hand,

[1] The measurement of the monetary gains of refinancing are much harder to estimate for the case of long-term nominal fixed-rate mortgages, such as those that are prevalent in the U.S. and Denmark, due to the options involved (Campbell and Cocco, 2003).

[2] The FCA rules do not require lenders to do affordability checks on internal remortgages unless there is a change in the terms of the loan (see MCOBS 11.6.3, https://www.handbook.fca.org.uk/handbook/MCOB/11/6.html). We also know that, based on the FCA Mortgage Market Study, lenders in our sample do not check

remortgaging with a different lender always involves searching for a new provider, setting up a new loan, and undergoing a full property valuation and an affordability assessment.

Controlling for the monetary benefits of remortgaging, we find that older borrowers and solo income borrowers are more likely to be inactive. And conditional on remortgaging, they are less likely to do so externally. This suggests that the non-pecuniary costs of taking action are higher for these households. We also find that an important driver of external remortgaging is the desire to extract home equity.

In the UK borrowers can either take a loan directly from the lender (direct loan) or through a mortgage broker (intermediated loan, see Robles-Garcia, 2018). We study how the sales channel of the original loan is related to the remortgaging decisions. We find that, compared to those borrowers who take a brokered loan, those who take a loan directly from a lender are much less likely to take action, and if they do remortgage they are much more likely to do so with the same lender. Naturally, the choice of whether to use a broker at the initial date is endogenous, and correlated with borrower and loan characteristics (eg borrowers are more likely to seek help from a broker when the loan amount is larger).

We address these selection issues in two ways. First, we study the relation between intermediation and action, controlling for borrower and loan characteristics and monetary remortgaging benefits. Second, a small proportion of brokers in our sample became inactive (for a variety of reasons, possibly exogenous to the borrower) between the date of the original loan and the date of the expiry of the fixed rate. We compare borrowers who took out an originally intermediated loan but whose broker became inactive in the meantime, with those who also took out an originally intermediated loan but whose broker remained active. We find that the former are much more likely to not remortgage. This provides evidence of the importance of brokers in reducing the non-pecuniary costs from taking action that households face.[3]

Our data allows us to obtain estimates of the monetary gains of remortgaging and of the associated monetary fees. But in addition to these, households incur unobserved costs of taking action, including time costs or simply the disutility that they derive from having to deal with

affordability for internal remortgages without a change in loan terms.

[3]But it may also give rise to an agency problem, if the interests of the broker are not aligned with those of the household (Robles-Garcia, 2018). See also Benetton (2018) for a structural model of the UK mortgage market with lender competition, and how leverage regulation affects equilibrium outcomes. In our analysis we control for lender fixed effects.

the remortgaging process. In the last part of the paper, we build a quantitative structural model to measure these unobserved costs, how they differ across different types of households, and the extent to which brokers help reduce them. We use our estimates of the monetary benefits of remortgaging to parameterise the model. We calibrate the utility remortgaging costs, both internal and external, so as to match the rates of inaction observed in the data. Our model results show that the utility costs of taking action, as measured in consumption equivalent variations, are significantly larger for lower income than for higher income borrowers.

The paper is structured as follows. In Section 2 we describe the features of the UK mortgage market that are most relevant for our analysis. Section 3 gives details on the data, and presents some summary statistics. In Section 4 we estimate the monetary benefits of remortgaging, net of fees, and relate them to household decisions. Section 5 provides additional evidence on the role of brokers for remortgaging outcomes. The structural model is included in Section 6. The final section concludes.

2 The UK mortgage market

In this section, we explain the main characteristics of the UK mortgage market that are relevant for our study. The long-term nominal fixed-rate mortgages that are prevalent in the US do not exist in the UK. In contrast, UK mortgages often have an initial fixed interest rate period lasting until a precise date. The initial fixed-rate period varies between 2 and 10 years, but 2 years is by far the most common. For instance, among all mortgages issued in 2016, roughly 62% were 2-year fixed.

During the initial fixed-rate period the interest rate is often significantly discounted; it is also known as the incentive period. After the end of the fixed period, the interest rate reverts to a variable rate, typically equal to a base rate plus a margin. There often is a large increase in interest rate at the end of the initial period, but there could also be a decrease if the initial rate was not significantly discounted, or when there has been a decline in the base rate since origination. During the initial period there are prepayment penalties (typically between 1 and 3% of the outstanding loan amount), but not once it ends.

There are many products on offer in the market, with different interest rates and qualifying criteria. The criteria are specified in terms of maximum loan-to-value (LTV), loan amount,

whether it is an owner-occupier acquisition or buy-to-let, and whether it is a remortgage or loan for a property acquisition. These criteria together with an affordability assessment are used to determine whether the borrower qualifies for the product on offer, but conditional on this being the case, the interest rate does not vary across borrowers.

An example of a typical 2-year fixed rate mortgage, for the acquisition of owner-occupied housing with a maximum LTV of 85%, has an initial rate of 3.25%, reverting to 4.24% at the end of the incentive period (assuming that the base rate remains at the current level). The loan valuation and arrangement fees are £999 and the prepayment penalties applicable during the fixed rate period are 3% of the outstanding loan amount. For a £200,000 loan and a mortgage maturity of 25-years, the increase in interest rate at the end of the incentive period leads to an increase in monthly mortgage payments from £975 to £1,075.

The loan requirements are different for remortgagors, and they depend on whether borrowers are remortgaging with the same lender that provided the original loan (internal remortgage) or with a different one (external remortgage). They also depend on whether the remortgaging involves changes in the terms of the original loan, such as an increase in the loan amount. For internal remortgages without changes in loan terms, an affordability assessment is not required. Lenders still calculate LTV at the point of remortgaging, but they do so typically using the original house value updated by the evolution of house prices in the local area. Borrowers are able to refinance internally, provided that the loan has a LTV lower than a maximum limit (typically 95%), and provided that the outstanding loan amount is larger and the remaining term longer than the certain minimum values.

In contrast, internal remortgages that involve changes in the loan terms and external remortgages require a detailed affordability assessment. This affordability assessment takes into account not only household income, but also committed expenditures and other outstanding debt. Households need to provide lenders with payslips, bank statements, and other relevant documentation. Borrowers may be required to pay valuation fees, but they may be added to the outstanding loan amount (and they often are waived by lenders, in an attempt to attract new clients). Typical remortgaging fees are between £500 and £1,000.

Figure 1 presents a graphical description of the remortgaging alternatives and the market practices associated with each. These practices have implications for the data that is available. For instance, when the remortgaging does not require an affordability assessment, lenders

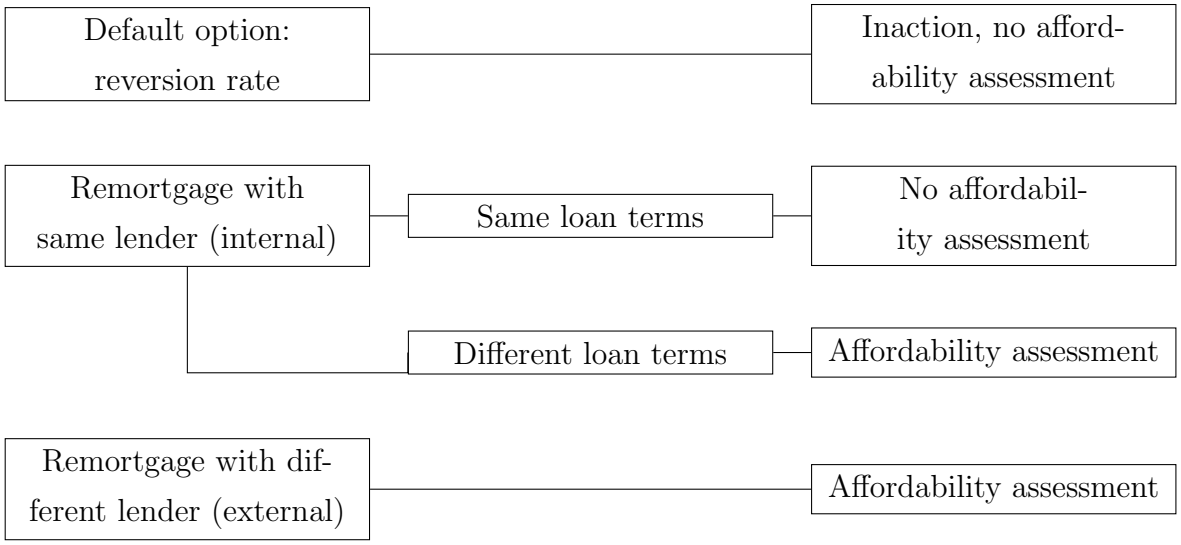


Figure 1: Remortgage types and market practices

typically do not collect information on borrower income.

Lenders are required to contact borrowers in advance of the expiry of the incentive period. More precisely, the Financial Conduct Authority (FCA) requires lenders to give *reasonable* notice of a change in the interest rate and therefore in the payments due.[4] The exact practices vary across lenders: timings of notification may vary from 3-4 months in advance to 1 month in advance. The notification is frequently done by post, but not all borrowers may pay sufficient attention to the content of the letter that they receive. Although loans have early repayment charges before the end of the incentive period, these charges are often waived by lenders for internal remortgagors.

The initial loan and the remortgaged loan may either be sold directly by the lender (direct channel) or through a broker (intermediated channel). Brokers help borrowers search for a mortgage, and they provide advice on qualifying criteria. They usually have a set of lenders, smaller than the whole market, whose mortgages they may recommend. Brokers receive a commission from lenders for whom they originate a mortgage. Borrowers may also pay a fee to the broker, but this is not common.

[4] https://www.handbook.fca.org.uk/handbook/MCOB/7/6.html

3 Data

3.1 Data sources

We use several sources of administrative data. The first is the Product Sales Data (PSD001), which includes origination information for the universe of regulated first-charge residential mortgages sold in the UK. The data are collected by the FCA. The PSD001 data have been used in research on the UK mortgage market by Best et al. (2019) and Cloyne et al. (2019), among others. The data have been collected since 2005, and include origination information such as origination date, the type of mortgage (fixed versus variable rate), the date of the end of incentive period, mortgage term, loan amount, property value, whether the loan is for the acquisition of a property or for remortgaging, initial interest rate, reversion rate, borrower characteristics including age, income, employment status, distribution channel (direct or intermediated), and the identity of the lender and broker (in case of an intermediated loan).

The PSD001 has comprehensive information for external remortgages, but fails to include most loans remortgaged internally. This is because the data only records newly opened accounts, and internal remortgages do not require lenders to open a new account, unless there is a change in loan terms. External remortgages, on the other hand, are always recorded.

Obviously, it is important that we are able to observe all remortgaging activity, including internal remortgages. We complement the information in PSD001, with additional data collected by the FCA for the purpose of the Mortgage Market Study (FCA RFI). The FCA required the 20 major lenders to provide data on all internal remortgages that took place during the years of 2015 and 2016. These lenders represent 95% of the origination market volume for house purchases between July 2013 and June 2014 (96% of the number of loans).[5]

In addition to the above 2 data sources, we use what is known as PSD007 data, available since 2015. It includes detailed information, collected twice per year, on the loan portfolios of lenders. Mortgages are reported with their outstanding balance, the type of interest rate they are on, whether they are delinquent or in arrears, among others. We match PSD001 mortgage originations with PSD007 data using the origination date of the loan, the lender

[5]The internal remortgage dataset contains information similar to PSD001, including main borrower, product type, lender and intermediary characteristics and most importantly, it has information on the dates of remortgaging and end of incentive period.

identity, property postcode, and the date of birth of the primary borrower. The PSD007 data allow us to, every half year, gather information on the borrowers for whom we do not observe a remortgage. In particular, the performance dimension of the data allows us to identify those accounts on the reversion rate and those that have been closed and the mortgage fully repaid (for example because borrowers have sold their home). This allows us to assess how long borrowers stay on reversion rate.[6]

To track the evolution of house values for the properties in our sample, we use the UK House Price Indices produced by the Office for National Statistics (ONS). In particular, we rely on local authority-level indices, the most granular measurement of house price dynamics available among UK official statistics.[7] There are around 390 local authorities in the UK.

To measure whether remortgaging behavior is correlated with living in a deprived neighbourhood, we use the Index of Multiple Deprivation (IMD), which is produced by the Ministry of Housing, Communities and Local Government (MHCLG) and is available for England only. The IMD ranks every Lower-layer Super Output Area (LSOA) from 1 (most deprived area) to 32,844 (least deprived area). LSOAs are designed to be of similar population sizes (they contain an average of 1,500 residents) and are sometimes referred to as 'neighbourhoods' in UK official statistical releases. The IMD combines information from 7 deprivation measures: income, employment, education and skills, health, crime, housing, and living environment.

3.2 Sample construction

The original sample are those borrowers who took out a 2-year fixed rate mortgage for property acquisition between July 2013 and June 2014.[8] Since we only observe internal remortgages for the years of 2015 and 2016, the restriction to 2-year fixed mortgages originated between July 2013 and June 2014 ensures that the end of the fixed rate period is between January 2015 and December 2016. And since most 2-year fixed mortgages have an initial fixed-rate period of

[6]Prior to 2015, the origination data in PSD001 does not contain complete information on the date of the end of incentive period and interest rates. We use the information in the PSD007 to fill in the missing information.

[7]Local authorities are the main local-level government bodies, responsible for functions such as education, waste management, transport and housing.

[8]We define a 2-year fix as a mortgage with an incentive period ending between 18 and 30 months from the origination date.

approximately 24 months, our restriction to mortgages originated between July 2013 and June 2014 also ensures that we can observe remortgages that take place at least 6 months prior and 6 months after the end of the fixed rate period.

The restriction of the original sample to mortgages used for a property acquisition, ie excluding remortgages, makes the original sample of mortgages and borrowers more homogeneous: they have all originally been used for the acquisition of a property.[9]

For all those borrowers for whom we do not observe a remortgage between January 2015 and December 2016, we use four PSD007 snapshots to see whether they are on a reversion rate or whether they have repaid their mortgage instead.[10] Therefore, for our sample of loans originated between July 2013 and June 2014, we are able to observe all potential outcomes up until December 2016: (i) external remortgaging; (ii) internal remortgaging; (iii) no remortgaging and the borrower is on the reversion rate; and (iv) no remortgaging, but the loan has been repaid. Figure 2 illustrates the timeline and the datasets from where we gather the information.

There are 3 groups of borrowers who may have not been able to remortgage, that we exclude from the sample. First, some lenders impose restrictions on the loans that are eligible for remortgaging, including those with low outstanding amounts and with short maturities. We identify all mortgages originated between July 2013 and June 2014 with remaining balance smaller than £25,000 or a maturity shorter than 2 years at the end of incentive period period.[11] Out of all the borrowers we observe between July 2013 and June 2014, 1.3% have such a mortgage.

A second group of borrowers who may not have had the possibility to remortgage at the end of the incentive period are those in arrears or in a forbearance agreement with the lender (eg the lender may have extended the term of the mortgage to reduce payments or suspended payments). There are 0.8% borrowers with missed payments[12] and 0.9% borrowers who entered a forbearance agreement with the lender. Although these are interesting groups of borrowers,

[9] Furthermore, as explained above, during this time period, the PSD001 data includes only comprehensive information on external remortgages.

[10] Those borrowers who repaid their mortgages are no longer included in the loan books of lenders.

[11] Lenders usually vary in their exact criteria, but here we take a conservative approach by choosing the most stringent eligibility thresholds on remaining balance and maturity.

[12] Among these most are officially in arrears—a situation corresponding to missing three monthly payments—and a few have some overdue payments but are not in arrears.

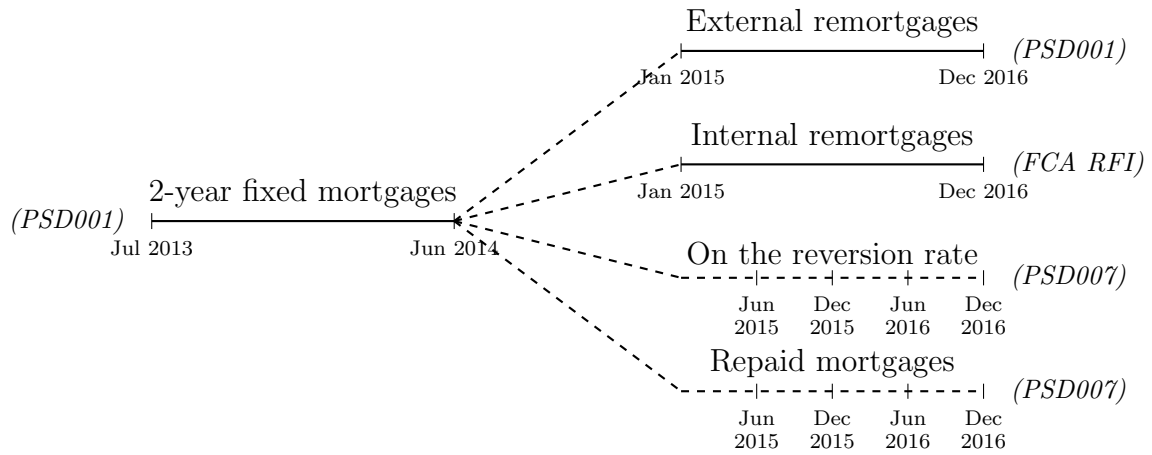


Figure 2: Timeline

The timeline illustrates our sample. We consider first-time buyers and home movers who originated a two-year fixed mortgage to buy a house between July 2013 and June 2014. We track these borrowers and we observe whether and when they remortgage (either internally or externally) between January 2015 and December 2016.

since they are very likely to have been restricted in their remortgaging choices, we exclude them from the sample.

The third of group of borrowers includes those with a too high LTV, due to a decline in house prices between the origination date and the date of the expiry of the incentive period. In order to identify these individuals, we take the house value listed in the original loan, and update it using the evolution of house prices in the local area. This value together with the remaining principal loan amount, allows us to estimate the prevailing LTV. Naturally, this is not a full property valuation, but it is similar to the process that lenders use to update their valuations in case of an internal remortgage. We identify only a very small fraction borrowers (0.03% of the sample) who had an estimated LTV higher than 95% at the end of the incentive period, that we remove from the sample. The reason why their number is so small is that our sample period was one of generally increasing house prices.

It is important to clarify that some borrowers may have experienced a decline in their income between the origination date and the date of the expiry of the incentive period, which we do not always observe. Such borrowers may not be able to remortgage either externally or internally

with a change in loan terms, but they will be able to remortgage internally *without* a change in loan terms. We include them in our analysis, but are careful to take into account the fact that their remortgaging options may have been restricted.

3.3 Origination data: summary statistics

Table 1 shows borrower and loan origination characteristics for the mortgages included in our analysis. The total gross income is equal to roughly £22,000 at 10th percentile increasing to around £92,000 at 90th percentile. The sample includes similar proportions of first time buyers (FTBs) and home movers (HMs). The distribution of loan values is such that 10th percentile is equal to around £68,000 and 90th percentile is equal to around £289,000. The median LTI and LTV are equal to around 3.38 and 0.80, respectively, and they are slightly higher than their average values. The median and average payment-to-income ratios (PTIs) are equal to 0.20, which may seem low, but it is important to remember that these are calculated as a fraction of gross income and they do not include the servicing of debts other than mortgage nor committed expenditures. A large proportion, equal to 70% of the original mortgages are intermediated.

The final row of the table shows that the median value for the Index of Multiple Deprivations (IMD) in our sample is around 18,000, which is slightly larger than the median value in England of 16,422. Thus our sample of mortgagors is located in areas that are slightly less deprived than the median, which might be expected from the fact that our sample includes only homeowners. Naturally, this origination data is available for all borrowers, regardless of remortgaging outcomes (ie regardless of whether individuals remortgage or do not take action and are moved to the reversion rate).

3.4 Remortgaging outcomes

In a first step, we study remortgaging outcomes as of the end of December 2016. Table 2a shows that by this date, 66% of the borrowers had remortgaged their loan, either with the same lender (internal remortgaging equal to 47%) or with a different lender (external remortgaging equal to 19%). The proportion of individuals who had repaid their loan is equal to 14%.[13] Therefore,

[13]There are several reasons why individuals may repay their loan, including the decision to move and sell the property for family or job related reasons, or the receipt of an inheritance.

Table 1: Summary statistics at origination

Table 1 shows origination summary statistics for several borrower and product characteristics. The sample includes all borrowers who took out a two-year fixed rate mortgage for property acquisition between July 2013 and June 2014. Borrowers who may have not been able to remortgage once the two-year period finishes are excluded from the sample. The reasons for exclusion are: (i) low loan value or short maturity; (ii) missed mortgage payments or forbearance agreement with the lender; and (iii) LTV higher than 95%.

	Observations	Mean	SD	p10	Median	p90
Total gross income	268,690	52,514.09	37,211.02	22,183	42,274.5	92,020.1
Joint income applicants	268,690	0.53	0	0	1	1
Main borrower's age	268,690	35.20	9	25	33	48
First-time buyers	268,690	0.51	0	0	1	1
Home movers	268,690	0.49	0	0	0	1
Loan value	268,690	164,388.2	108,497.4	67,823.5	136,850	288,700.1
Mortgage term (years)	268,690	26.42	7	17	25	35
Interest rate	268,690	3.41	0.98	2.19	3.29	4.79
LTI	268,690	3.33	1.05	1.98	3.38	4.58
LTV	268,690	0.76	0.17	0.50	0.80	0.90
PTI	268,690	0.20	0.07	0.13	0.20	0.27
Intermediated mortgage	268,690	0.70	0	0	1	1
IMD	225,971	17,832.75	8,828.909	5,445	18,149	29,696

from the original sample, roughly 1 in 5 borrowers are on a reversion rate in December 2016.

We focus first on those borrowers who took action and remortgaged. Lenders are required to give them *reasonable* notice of a change in the interest rate when it causes a change in payments due. If borrowers do not take action, they move to the reversion rate, leading to potentially much higher monthly mortgage payments, starting 1 month after the end of the incentive period. In Table 2b we study the timing of the remortgage decisions. We distinguish between those who remortgaged before or at the end of the incentive period, between this date and 30 days after the end of the incentive period, between 31 and 90 days, and more than 90 days. This table shows that a large fraction of those who remortgage, equal to 56%, remortgage by the date of the expiry of the incentive period, and the vast majority of them, equal to 73%, remortgage on or before the date that the first mortgage payment associated with the reversion rate is due (ie on or before 30 days from the end of the incentive period). This result is important because it shows that the majority of remortgagors are taking action before any mortgage payment increases are due. In other words, they are taking action in anticipation of the future increase in mortgage payments, consistent with some awareness of how these products work and a judgement that the benefits of acting exceed the costs.

In terms of the type of remortgaging, Table 2b shows that 69% of those who remortgage with the same lender do so before or on the day of expiry of the initial period. On the other hand, a smaller proportion (26%) of those who remortgage externally do so by this date, but an additional 35% remortgage in the 30 days after the end of the initial period. Most mortgages have prepayment penalties during the initial fixed rate period, which may be waived by lenders, but they have an incentive to do so only in case of internal remortgages.

In Figure 3 we plot the distribution of the days of remortgaging, measured as the difference between this date and the date of the end of the incentive period. The top chart does so for internal remortgages. First, we see that borrowers tend to have remortgage dates at regular intervals. Second, there is a significant number of borrowers who remortgage before the day of the expiry of the fixed rate period, consistent with lenders strategically creating incentives for borrowers to remortgage early with them. The bottom panel shows the distribution for external remortgages: there are very few observations for remortgages before the expiry of the fixed rate period and the distribution is smoother.

In Table 2c we take the sample of borrowers who are on the reversion rate in December 2016,

Table 2: Remortgaging outcomes

This table reports the remortgaging outcomes for those borrowers who took out a two-year fixed rate mortgage for property acquisition between July 2013 and June 2014. Table 2a groups borrowers into four categories: (i) those who remortgaged with a different lender (externally); (ii) those who remortgaged with the same lender (internally); (iii) those who did not remortgage and who were on the reversion rate in December 2016; (iv) those that did not remortgage but prepaid the loan by December 2016. Table 2b shows the timing of remortgages, for all those who remortgaged. 'Before or at' shows the proportion of remortgages taking place within 1 day after the end of the incentive period. Table 2c shows, for those borrowers on the reversion rate as of December 2016, the length of time that they have been on it.

Outcomes	Number	Percentage (%)
External remortgage	52,677	19
Internal remortgage	125,836	47
On reversion in Dec 2016	52,741	20
Mortgage repaid before Dec 2016	37,436	14
Total	268,690	100

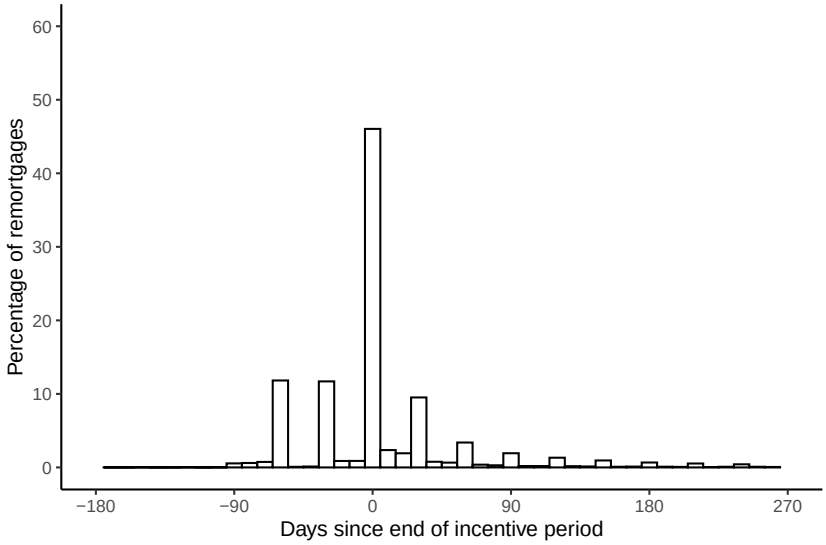
(a) Outcomes

	Remortgaging date with respect to the end of incentive period			
	Before or at	2-30 days	31-90 days	>90 days
All	0.56	0.17	0.16	0.11
Rem. externally	0.26	0.35	0.22	0.17
Rem. internally	0.69	0.09	0.14	0.09

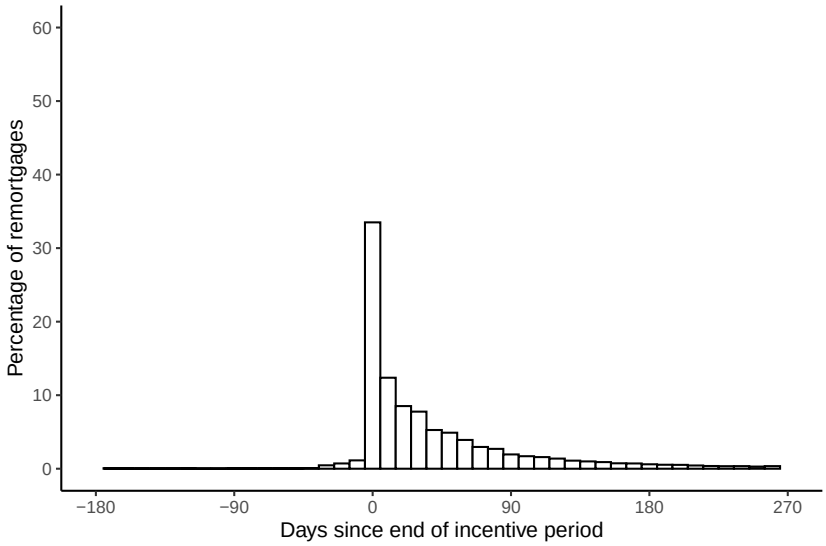
(b) Timing of remortgage

Time on the reversion rate	Number	Percentage (%)
Less than 6 months	2,599	5
Between 6 and 9 months	10,895	21
Between 9 and 12 months	10,459	20
More than 12 months	28,788	55
Total	52,741	100

(c) Time on the reversion



(a) Internal remortgages



(b) External remortgages

Figure 3: Time of remortgage

The figure shows the distributions of the difference in number of days between the end of the incentive period and the date of the remortgage. A negative value means that borrowers remortgaged before the end of the incentive period. Panel A shows the results for internal remortgages and Panel B for external remortgages.

and calculate the number of months during which they have been on this rate. Roughly half of them have been on the reversion rate for over 12 months. Thus, even though the majority of borrowers remortgage, and many early on, there is a significant proportion of 20% that end up on the reversion rate, many of which for a long period of time.

Table 3 shows the number of borrowers who extracted equity, which is the most common reasons to change the terms of the loan.[14] 39% of external remortgagors and 18% internal remortgagors in our sample extracted equity, suggesting that, once a borrower is set on extracting equity, the relative benefits of searching for a new lender are greater.

Table 3: Equity extraction and remortgaging

This table shows that 39% of borrower who remortgage externally extract equity compared to 18% of those who remortgage internally

	External remortgages	(%)	Internal remortgages	(%)
Equity extraction	20,453	39	22,062	18
No equity extraction	32,224	61	103,774	82
Total	52,677	100	125,836	100

3.5 Origination characteristics by remortgaging outcomes

In Table 4 we report summary statistics for origination characteristics, by remortgaging outcomes. We do not report data for those who decided to pay off the loan, as this may be driven by factors unrelated to the mortgage, such as the decision to sell the house. In Panel A we report data for those who remortgaged externally, in Panel B for those who remortgaged internally, and finally in Panel C for the inactive borrowers.

There are several interesting patterns, visible both at the mean and throughout the distributions. External remortgagors have a higher origination income and are more likely to be joint-income earners than internal remortgagors, who in turn earn more and are less likely to be single-income earners than borrowers who ended on reversion.[15] Borrowers on reversion are

[14] Affordability checks for internal remortgages may be required also in other circumstances, for example when borrowers shorten the term of the loan.

[15] These statistics are consistent with results from other markets, in which borrowers who are single, older

Table 4: Summary statistics at origination, by outcome

This table shows summary statistics for the mortgages in our sample. The statistics are reported for different groups of individuals, that depend on the observed remortgaging outcome: (i) those who remortgaged externally; (ii) those who remortgaged internally; and (iii) those who did not remortgage, and were on the reversion rate as of December 2016.

	Observations	Mean	p10	Median	p90
Panel A: Remortgaged externally					
Total gross income	52,677	58,706.9	25,304.6	48,000	102,562.2
Joint income applicants	52,677	0.58	0	1	1
Main borrower's age	52,677	34.16	25	33	45
First-time buyers	52,677	0.49	0	0	1
Loan value	52,677	192,928	85,000	159,995	340,000
LTI	52,677	3.46	2.25	3.48	4.63
LTV	52,677	0.79	0.59	0.85	0.90
Mortgage term (years)	52,677	27.72	20	28	35
Mortgage intermediated	52,677	0.85	0	1	1
IMD	46,414	19,033.8	6,748.8	19,648.5	30,241
Panel B: Remortgaged internally					
Total gross income	125,836	50,945.17	22,200	41,546.5	88,000
Joint income applicants	125,836	0.53	0	1	1
Main borrower's age	125,836	35.30	25	34	48
First-time buyers	125,836	0.52	0	1	1
Loan value	125,836	163,361.1	70,295	137,500	281,245
LTI	125,836	3.40	2.09	3.44	4.62
LTV	125,836	0.75	0.51	0.80	0.90
Mortgage term (years)	125,836	26.39	17	25	35
Mortgage intermediated	125,836	0.68	0	1	1
IMD	104,797	17,857.95	5,497	18,208	29,648.4
Panel C: Borrowers on the reversion rate					
Total gross income	52,741	46,581.48	19,509	36,694	82,128
Joint income applicants	52,741	0.45	0	0	1
Main borrower's age	52,741	35.63	25	34	50
First-time buyers	52,741	0.55	0	1	1
Loan value	52,741	137,085	55,000	112,500	238,850
LTI	52,741	3.17	1.74	3.19	4.49
LTV	52,741	0.74	0.44	0.80	0.90
Mortgage term (years)	52,741	25.69	15	25	35
Mortgage intermediated	52,741	0.59	0	1	1
IMD	42,247	16,158.37	3,757.2	15,964	28,839.8

more likely to be first-time buyers. Loan values, LTV, LTI and mortgage terms are highest for external remortgagors, followed by internal remortgagors, and lowest for borrowers on reversion. Therefore, when the benefits of remortgaging are higher, as measured by loan value or LTI, borrowers are more likely to take action. Similarly, external remortgagors are significantly more likely to have used a mortgage intermediary when they purchased their house and are less likely to live in a more deprived neighbourhood (as explained above, the analysis of local deprivation is limited to borrowers who live in England).

Table 4 leads naturally to asking what the observed differences between groups of borrowers tell us about the drivers of remortgaging behavior. An analysis of such drivers requires an estimate of the monetary gains of remortgaging, net of any remortgaging fees faced by borrowers, to which we turn next.

4 Drivers of remortgaging and inertia

4.1 Monetary gains of remortgaging

In a rational setting, the decision to remortgage is taken by comparing the benefits and costs of doing so. Let t denote the expiry date of the fixed rate period, and D the outstanding loan amount, the (annual) monetary gains from remortgaging, net of fees (denoted F) are equal to:

$$\text{Annual monetary gains net of fees}_{ijt} = [R_{it}^{\text{reversion}} - R_{ijt}^{\text{remortgage}}] \times D_{it} - F_{ijt}/2 \qquad (1)$$

where $R_{it}^{\text{reversion}}$ denotes the reversion rate that borrower i will pay in case of inaction, $R_{ijt}^{\text{remortgage}}$ denotes the interest rate in case of action, which may depend on the type of remortgage that the consumer does (j=internal, external). The remortgaging fees are one-off, whereas the interest rate benefits are in annual terms, so that in the above equation we divide the fees by 2 to obtain an annual value. The implicit assumption is that the individual pays the one-off fees to benefit from a lower interest rate over the following 2 years. We first investigate the role of loan amount, before turning attention to interest rates and fees.

and with a lower income are more likely to be inactive. See for instance Andersen et al. (2015) on the Danish mortgage market.

4.1.1 Loan value

In Panel A of Table 5, we report the proportion of borrowers on the reversion rate (as a proportion of those who remortgaged plus those who are on the reversion rate). We divide the borrowers into deciles according to loan value outstanding at the end of the incentive period and gross income, and in each cell of this 10×10 matrix we report the proportion of borrowers on the reversion rate. The empty cells refer to instances in which the number of observations is smaller than 300.[16] Recall that we observe gross income at loan origination for all borrowers, but for those on the reversion rate or remortgage internally we do not observe income at a later stage. Therefore, we use origination income.

There are several interesting patterns. First, there is very significant variation in the proportion of those on the reversion rate in the different cells: from 0.42 in the bottom left corner to 0.15 in the top right corner. Second, for each income decile, shown in the columns, there is a significant monotonic decline with loan amount in the proportion of those on the reversion rate. This decline is consistent with households responding to the size of the expected benefits from remortgaging, which are more significant for larger loans. In contrast, conditional on loan amount, in each row, there is less variation in the proportion on the reversion rate with gross income, although an increase is noticeable in some of the rows. This means that, for a given loan amount, higher income households are slightly less likely to remortgage.

To further explore the role of remortgaging benefits in relation to household income, in Panel B of Table 5, we report the proportion of those on the reversion rate, as a function of LTI and income. There are very clear patterns. Conditional on a given income decile, there is a large monotonic decrease with LTI in the proportion of those on the reversion rate. And conditional on a given LTI decile, there is a very large monotonic decrease with income in the proportion of those who are inactive. For instance, for the fifth LTI decile, the proportion on the reversion rate decreases from 0.39 for those in the bottom income decile to 0.13 for those in the top income decile.[17]

It is important to emphasize that these differences between low and high income groups do

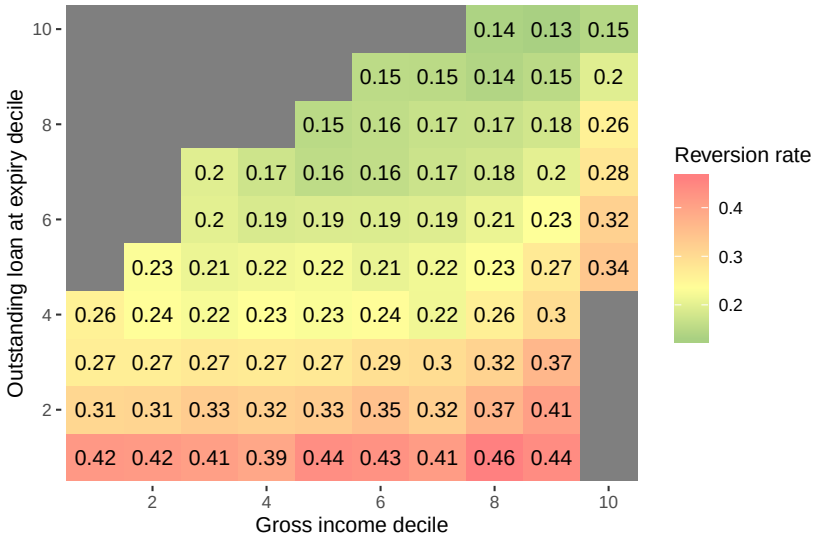
[16] Naturally, borrowers with low income tend not to borrow the highest loan amounts. We report the number of observations in each cell in Table A1 of Appendix C.

[17] We have performed t-tests for the differences between the top and bottom deciles of income, and the differences are significant (t-stats between 3 and 11).

Table 5: Proportion of inactive borrowers (on the reversion rate), by income and loan deciles

Panel A shows the proportion of borrowers on the reversion rate (inactive borrowers), as of December 2016, as a function of loan value outstanding at the expiry of the incentive period (vertical axis) and borrower income (horizontal axis). We group borrowers into deciles of loan value and income based on the distributions of the respective variables. Income is measured at origination. Cells with fewer than 300 borrowers are shaded grey. Panel B reports the proportion of borrowers on the reversion rate, as a function of LTI and income.

Panel A: Loan value (£)



Panel B: Loan value as multiple of income (LTI)

not arise as a result of the inability of low income individuals to remortgage, due to for example a negative income shock. Lenders in our sample do not assess affordability or verify income for internal remortgages without a change in loan terms, so that is an option for borrowers who have suffered negative income shocks.

4.1.2 Interest rate and fees

As shown in equation (1), the interest rate benefits of remortgaging are simply equal to the difference between the reversion rate and the interest rate that the borrower would be able to achieve if she remortgaged. We first calculate a measure of the interest rate benefits of remortgaging internally, with the same lender without a change in loan terms, since such remortgaging is available to all borrowers in our sample.

In the UK, lenders price mortgages by LTV band: all the approved loans of a given type and within a given LTV band have the same interest rate, and there are discrete increases in interest rate at specified LTV thresholds (Best et al., 2019). For the calculation of the interest rate benefits, we assume that borrowers would refinance to a mortgage with the same loan amount outstanding at the expiry date of the incentive period. We also calculate the value of the property on this date using the initial house value and the change in the local authority house prices since the origination date. We then use the newly calculated property value to generate the LTV on the remortgaged loan.[18]

Our estimate of the internal remortgaging rate is equal to the median interest rate offered by the same lender on 2-year deals originated in the same quarter and in the same LTV band. We search for the median rate offered by the lender only among internal remortgagors. Naturally, this measure is only an estimate: some borrowers will be able to achieve a lower rate and others will pay a higher rate. The differences may arise, for example, as a result of fluctuations in interest rates and/or mortgage premia within a given quarter.

We obtain an estimate of the internal remortgaging rate for all borrowers, regardless of whether they remortgaged internally. However, for those who did so, we can evaluate the accuracy of our estimates by comparing them with the realised interest rate on the remortgaged loans. Naturally, there are differences between the two. However, the median difference between

[18] Although this is not a full valuation, internal remortgages also do not require a new house valuation, and lenders use a similar procedure to the one that we use to calculate the LTV on the remortgaged loan.

the estimated and realised rates is zero, and it is equal to -25 and 35 basis points at 10th and 90th percentiles of the distribution of the differences. We give further details in Appendix B, where we also show that the differences between estimated and realised rate are not correlated with borrower and loan characteristics (median differences are always zero).

The process of remortgaging may also involve monetary fees (denoted F in equation (1)). (We provide summary statistics in Appendix C.) In order to estimate the fees, when identifying the mortgage with the median interest rate offered by the same lender, we obtain the loan fees that correspond to that contract.[19] It is important to note that remortgaging fees can be added to the outstanding loan balance without implying a change in loan terms. Therefore, borrowers will not be excluded from remortgaging internally because they lack the cash needed to pay them.

With the interest rate and fees estimates, we can finally calculate measures of the benefits of remortgaging. As before, we divide the borrowers into deciles of remortgaging benefits and of income, and for each cell of this 10×10 matrix we report the proportion of those on the reversion rate. Table 6 shows the results. In Appendix Table B4 we report the cut-offs for the different deciles. There is significant variation across deciles. For instance, the lower cut-offs of the annual monetary benefits of internal remortgaging are £1,000 for 2nd decile, £1,939 for 5th decile, and £4,097 for 9th decile.

[19] In the data, these fees only include product fees and not additional fees like property valuation fees, but the latter are likely to be small or zero for internal remortgages.

Table 6: Proportion of inactive borrowers (on the reversion rate), by remortgaging monetary benefits and income

Panel A shows the proportion of borrowers on the reversion rate (inactive borrowers), as of December 2016, as a function of estimated monetary internal remortgaging benefits based on outstanding loan amount at the expiry of the incentive period (vertical axis) and borrower income (horizontal axis). We group borrowers into deciles of benefits and income based on the distributions of the respective variables. Cells with fewer than 300 borrowers are shaded grey. Panel B reports the proportion of borrowers on the reversion rate, as a function of monetary benefits measured as a proportion of income.

Panel A: Expected savings (£)

Panel B: Expected savings (as % of income)

Table 6 shows that, when keeping constant the expected benefits of switching in pounds, higher income borrowers are more likely to end up on a reversion rate, although the increase is mainly visible for the top income deciles. However, when we divide the expected monetary benefits of switching by income at origination, the patterns changes and becomes pronounced: high-income borrowers are significantly less likely to end on a reversion rate.

4.2 Regression analysis

We analyse the drivers of inertia using regression analysis. The dependent variable is a dummy equal to 1 if a consumer ends on reversion. We exclude consumers who repay their mortgage, so that the dummy equals zero if a consumer remortgages, either internally or externally. In the first column of Table 7, we regress this variable on 100 dummies corresponding to the 100 cells of the 10×10 matrix of the remortgaging benefits (in £) and income (ie each explanatory variable takes the value of one for borrowers in that cell, and zero otherwise). We also include as explanatory variables a dummy for FTB (vs HM), a dummy for single (vs joint applicant) and 3 age dummies (the base group is those younger than 30 years old).

Interestingly, we see that, controlling for remortgaging benefits and income, FTBs are more likely to end up on the reversion rate. This may be due to the fact that FTBs do not have previous experience of remortgaging. Also interesting is the fact that joint income borrowers are significantly less likely to end up on the reversion rate. The estimated coefficient is -0.026, which is 13% of the unconditional mean of the dependent variable. This suggests that the unobserved remortgaging costs are lower for dual earner households, than for single earner ones. While there is a small negative effect of the 30-40 age dummy (as compared to the baseline category of borrowers below 30 years old) the predominant effect coming out of the age dummies is an increase in the likelihood of inaction for older borrowers. The effect is quantitatively large: controlling for the monetary remortgaging benefits, borrowers over the age of 50 are 5.7 percentage points more likely to end up on the reversion rate (recall the unconditional mean of the variable is 0.2). This could be due to older individuals facing higher utility costs of taking action. Alternatively, it could also be due to a selection effect, if more active individuals pay down their mortgage faster.

The next 3 columns of Table 7 show the coefficients of different specifications, obtained by

Table 7: Regression for the likelihood of inaction

The dependent variable is a dummy variable that takes a value of one if the borrower does not remortgage (inaction), and zero if the borrower remortgages either internally or externally by December 2016. Borrowers who repaid the loan are not included. Throughout we include as explanatory variables, 100 dummy variables that take the value of one if the borrower is in a given cell of the 10×10 matrix of monetary benefits of remortgaging and of income, and zero otherwise. The columns differ in the borrower characteristics and in the sets of fixed effects included. Intermediated is a dummy variable that takes the value of one for borrowers who have used the services of a broker in the original loan, and zero otherwise. The model is estimated by ordinary least squares.

	Dependent variable:				
	On reversion				
	(1)	(2)	(3)	(4)	(5)
First-time buyer	0.008^{***}	0.009^{***}	0.007^{***}	0.001	0.002
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Joint income	-0.024^{***}	-0.025^{***}	-0.024^{***}	-0.016^{***}	-0.014^{***}
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Age in [30, 40)	-0.004^{**}	-0.005^{**}	-0.005^{**}	-0.006^{***}	-0.004^{*}
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Age in [40, 50)	0.015^{***}	0.014^{***}	0.014^{***}	0.011^{***}	0.012^{***}
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Age 50 or higher	0.057^{***}	0.055^{***}	0.054^{***}	0.050^{***}	0.049^{***}
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
intermediated					-0.072^{***}
					(0.002)
Income and savings grid	Yes	Yes	Yes	Yes	Yes
Year-month origination FE	No	Yes	Yes	Yes	Yes
Postcode area FE	No	No	Yes	Yes	Yes
Lender FE	No	No	No	Yes	Yes
Observations	221,314	221,314	221,314	221,314	221,314
R^2	0.046	0.049	0.050	0.072	0.076
Adjusted R^2	0.046	0.049	0.049	0.071	0.076

Note: *p<0.1; **p<0.05; ***p<0.01

adding fixed effects, 1 set at a time: time fixed effects, postcode fixed effects and lender fixed effects, in this order. The effects of the former 2 sets of fixed effects on the adjusted R-squared is small, but lender fixed effects have more explanatory power. This suggests that unobserved actions or characteristics of lenders (eg, the timing and the format of the communication to borrowers), as captured by these fixed effects, have a significant impact on consumer inertia.

We can use the estimate of the coefficients of the lender fixed effects to evaluate how lender specific characteristics vary in explaining inaction. Panel A of Table B6 in the Appendix shows a marked variation in the fixed effects coefficients: the difference between the lenders in the top and the bottom quartile, controlling for remortgaging benefits and income, is an 11% increase in probability of inaction.

In the last specification we add a binary explanatory variable corresponding to whether the borrower used a mortgage broker in her first transaction (ie when she originally purchased a house). The estimated coefficient is very large, equal to -0.072, and there is a significant increase in adjusted R-squared. Therefore, consumers who use an intermediary in their first transaction are much less likely to end on reversion rate. It is important to note that this is an effect estimated controlling for remortgaging benefits. In spite of this, there naturally are selection issues that we try to address below, in Section 5.

In Appendix Table B7 we show the estimated coefficients on the 10×10 dummies for the remortgaging benefits and income. The general patterns are similar to before. In Appendix Table B8 we report the results of similar regressions, aimed at explaining the likelihood that individuals end up on the reversion rate, but using a 10×10 matrix based on expected monetary benefits of remortgaging as a fraction of income (rather than in pounds). The results are similar.

4.3 External remortgaging

The previous section focused on explaining inertia, using the estimated benefits of internal remortgaging. In this section, we focus on the drivers of external remortgaging: why do some individuals decide to remortgage with another lender, compared to remortgaging with the same lender.

4.3.1 Monetary gains of external remortgaging

We first calculate a measure of the monetary benefits of remortgaging externally. The interest rate benefits of remortgaging externally are potentially higher than those of doing so internally, since the borrower will be choosing among products offered by different lenders in the market, and not only by its current lender. Naturally, search costs of remortgaging externally may be higher as well. On the other hand, an external remortgage is always treated as a new loan: it requires affordability assessment and a full property valuation. (The unobserved utility costs of remortgaging externally are also likely to be higher than those of remortgaging internally).

We obtain an estimate of the interest rate the individual would be able to achieve remortgaging externally. For each individual in our sample, we identify the 2-year deals originated in the quarter when the previous incentive period expires, with the same LTV band and sold to external remortgagors in the same geographical region. We assume that an individual would be able to get a deal with the median interest rate and the corresponding fees. Table 8 shows that the estimated monetary benefits of external remortgaging are higher than those of internal remortgaging. For instance, the median values are £2,620 and £2,324, respectively.

We divide the individuals by deciles of *the difference in* benefits of external and internal remortgaging, and by income, and in each cell we report the proportion of individuals who remortgaged externally (as a fraction of those who remortgaged either internally or externally). Panel A of Table 9 shows the percentage of borrowers who remortgaged externally, as a function of the the external-internal difference in expected savings computed in pounds on the vertical axis and income on the horizontal axis. Although those with higher expected benefits and with higher incomes are more likely to remortgage externally, this relation is not always monotonic.

Panel B of Table 9 groups individuals based on the external-internal difference in expected savings as % of income on the vertical axis. There is again significant variation across the cells: 22% for borrowers in the bottom left corner, compared to 51% for those in the right hand corner. As before, and although generally those with higher monetary benefits of remortgaging externally are more likely to do so, the patterns are not monotonic. There are several possible reasons for this. First, and unlike for the comparison between internal remortgaging and staying on the reversion rate, we do not know if all the individuals who remortgaged internally would have been able to do so externally. Some of them may have suffered a negative income shock that may have prevented them from borrowing from a different lender. Second, the calculations

Table 8: Expected annual monetary gains of remortgaging internally and externally

The table shows the expected savings from remortgaging internally (Panel A) and externally (Panel B). We define expected benefits as the difference between the reversion rate and the estimated rate, times the balance at the end of the incentive period, minus the one-off fees (which we assume are spread over two years). For some consumers, we are not able to compute the measure. This happens when we are unable to find the estimated rate.

	Observations	Mean	p10	Median	p90
Panel A: Savings measures based on *internal* remortgages					
Annual expected savings (£)					
All	221,314	3047.71	1000.00	2293.00	5768.00
Internal	121,726	2973.61	1053.50	2324.00	5518.00
External	48,244	3984.96	1248.00	2864.00	7825.10
Reversion	51,344	2342.70	800.00	1788.00	4386.00
Expected savings (% of gross income)					
All	221,314	6.05	3.03	5.60	9.15
Internal	121,726	6.06	3.15	5.70	9.07
External	48,244	6.83	3.41	5.99	10.41
Reversion	51,344	5.29	2.55	5.02	8.36
Panel B: Savings measures based on *external* remortgages					
Annual expected savings (£)					
All	230,991	3385.25	1179.00	2620.00	6364.00
Internal	125,674	3307.99	1240.00	2620.00	6073.00
External	52,672	4319.45	1565.00	3386.00	8130.90
Reversion	52,645	2635.02	918.00	2027.00	4913.60
Expected savings (% of gross income)					
All	230,991	6.73	3.57	6.53	9.86
Internal	125,674	6.73	3.67	6.56	9.72
External	52,672	7.51	4.21	7.20	11.08
Reversion	52,645	5.95	2.88	5.78	9.01

Table 9: Proportion of borrowers remortgaging externally, income and difference between external and internal savings

Panel A shows the proportion of borrowers remortgaging externally, as of a fraction of those who remortgaged either externally or internally by December 2016. The proportion is shown as a function of the difference between the expected monetary benefits of external and internal remortgaging (vertical axis) and of borrower income (horizontal axis). We group borrowers into deciles of benefits and income based on the distributions of the respective variables. Cells with fewer than 300 borrowers are shaded grey. Panel B reports the proportion of borrowers remortgaging externally, as a function of monetary benefits measured as a proportion of income.

Panel A: Expected savings (£)

Panel B: Expected savings (as % of income)

assume that the loan amount is unchanged, which may not always be the case. We focus on equity extraction in relation to external remortgaging next.

4.3.2 Home equity extraction

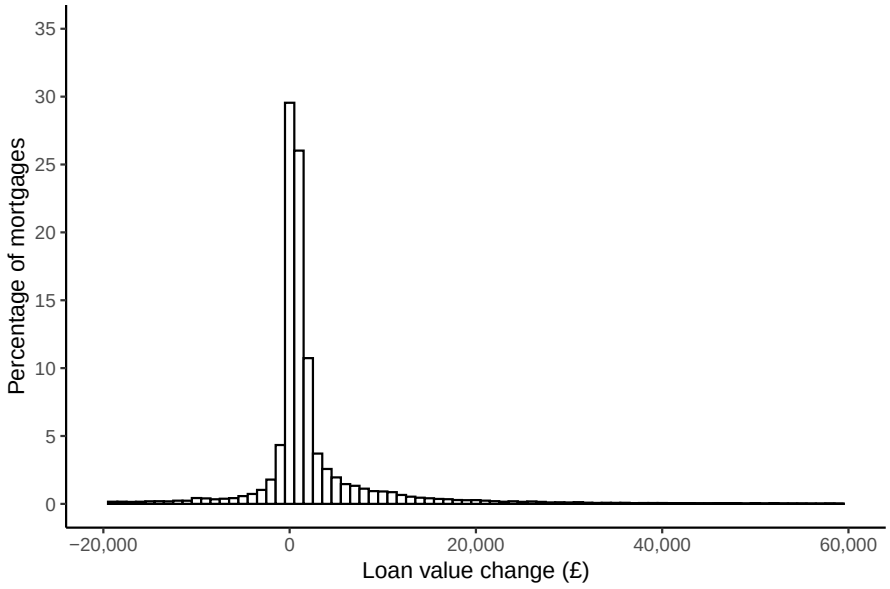
The calculations in Table 9 assume that the loan amount is unchanged. But some borrowers do extract home equity during the remortgaging process. In this case, the calculations understate the remortgaging benefits.[20] In Figure 4a and 4b we plot the changes in loan value, at the end of the incentive period, for external and internal remortgages, respectively. There is a significantly larger number of internal remortgages, but the vast majority of them do not entail a change in loan value. In contrast, a significantly larger proportion of the external remortgages are associated with equity extraction (18% of internal remortgages extracted equity compared to 39% of external remortgagors).

In Figures 5a and 5b we plot again home equity extraction conditional on the nature of the remortgaging, but as a function of the realised house price growth between the origination and remortgaging dates. On the vertical axis, equity extraction is measured as the log difference between the outstanding loan at the end of the incentive period and the loan after remortgaging multiplied by 100. On the horizontal axis, property price growth is measured as the log difference between the origination and the end of the incentive period multiplied by 100. Figure 5a uses property values as reported by the lenders in our dataset (PSD001/FCA RFI), and Figure 5b uses property values imputed using changes in the ONS local house price indices. We see that external remortgagors are much more likely to extract home equity, with a difference relative to internal mortgagors that increases with the realised property price change.

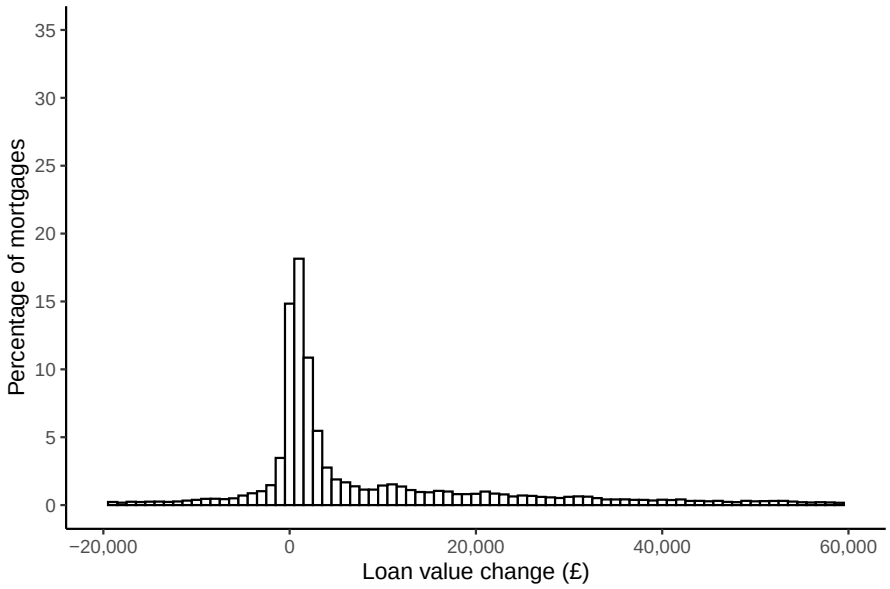
4.3.3 Regression analysis

Table 10 shows the results for an econometric model of external remortgaging. The dependent variable is a dummy that takes the value of 1 for borrowers who remortgaged externally, and 0 for those who remortgaged internally. The sample includes only those borrowers who remortgaged, either internally or externally. In the first column we include as explanatory variables dummy

[20] This happens for 2 reasons: (i) they assume a lower loan amount; and (ii) borrowing constrained individuals who wish to extract home equity for consumption purposes, may have large marginal utility gains from remortgaging, even when the interest payment gains are small or non-existent.



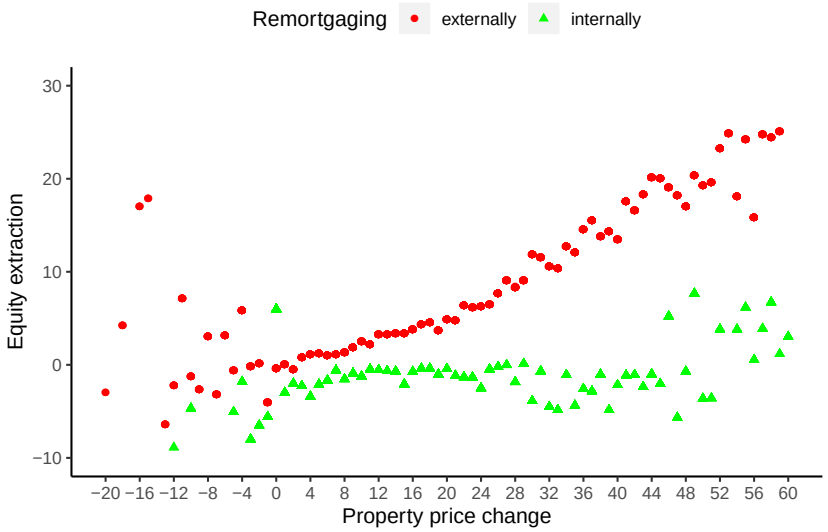
(a) Internal remortgagors



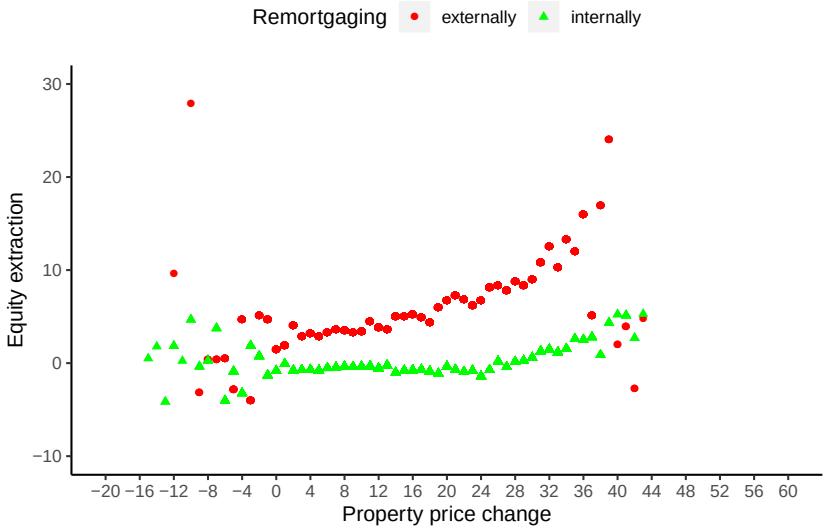
(b) External remortgagors

Figure 4: Equity extraction for external and internal remortgagors

Loan value change is calculated as the difference between the loan recorded in PSD1/RFI for the remortgage minus the remaining balance at the end of the incentive period of the previous mortgage. Positive values indicate equity extractions.



(a) Equity extraction vs. house price growth (PSD001/RFI)



(b) Equity extraction vs. house price growth (HMLR)

Figure 5: Equity extraction and property price growth

On the vertical axis, equity extraction is measured as the log difference between the outstanding loan at the end of the incentive period and the loan after remortgaging multiplied by 100. On the horizontal axis, property price growth is measured as the log difference between the origination and the end of the incentive period multiplied by 100. Figure 5a uses property values from PSD001/RFI and Figure 5b uses property values from HM Land Registry.

variables for the monetary benefits of external remortgaging (difference to internal), and we also control for borrower characteristics. First time buyers, those with joint income, and older borrowers are less likely to remortgage externally. The age effects are particularly large.

In the second column, we add dummies for origination LTV bands, and in the third column for house price growth in the local area between origination and the date of the end of the incentive period. The estimated coefficients are positive and large: borrowers with a large origination LTV and located in an area where there has been larger house price growth are significantly more likely to remortgage externally. These results speak to the importance of borrowing constraints and home equity extraction as a driver of the decision to remortgage externally. As previously explained, the process of external remortgaging is in general more onerous, but if borrowers wish to extract home equity, the process of internal remortgage also becomes more cumbersome.

In the fourth column we include as controls dummies for interactions between the LTV and house price growth band dummies. These are mostly non-significant so that even though we control for them, we do not report the estimated coefficients. In the remaining columns of Table 10 we include several sets of dummies, year-month of origination, postcode area and lender fixed effects. We are able to estimate these separately from the house price growth dummies, since individuals take the initial loan at different points in time. The increase in adjusted R-squared is most significant for the lender fixed effects.

Similar to the analysis of the variation of the lender fixed effects in explaining inaction, we can look at external remortgaging. Panel B of Table B6 in the Appendix reveals a marked distribution: the difference between the lenders in the top and the bottom quartile is an 8% increase in probability of switching externally.

In the final column, we add a dummy to indicate mortgages in which the first loan was intermediated: the estimated coefficient is large and positive, so that the presence of a broker in the original loan makes it much more likely that borrowers remortgage externally (there is also a significant increase in R-squared). Naturally, the use of a broker in the first loan is endogenous and potentially correlated with borrower and loan characteristics. We address this issue in the next section.

Table 10: Regression for the likelihood of remortgaging externally

The dependent variable is a dummy variable that takes a value of one if the borrower remortgage externally, and zero if the borrower remortgages internally. Borrowers who repaid the loan or ended up on the reversion rate are not included. Throughout we include as explanatory variables, 100 dummy variables that take the value of one if the borrower is in a given cell of the 10×10 matrix of external-internal difference in monetary benefits of remortgaging and of income, and zero otherwise. The columns differ in the borrower characteristics and in the sets of fixed effects included. Intermediated is a dummy variable that takes the value of one for borrowers who have used the services of a broker in the original loan, and zero otherwise. The model is estimated by ordinary least squares.

	Dependent variable:							
	External remortgage							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
First-time buyer	−0.013***	−0.023***	−0.029***	−0.029***	−0.028***	−0.030***	−0.019***	−0.019***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Joint income	−0.005**	−0.012***	−0.009***	−0.009***	−0.009***	−0.009***	−0.010***	−0.014***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Age in [30, 40)	−0.006**	−0.001	−0.003	−0.003	−0.003	−0.003	−0.006**	−0.010***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Age in [40, 50)	−0.067***	−0.046***	−0.046***	−0.046***	−0.045***	−0.046***	−0.049***	−0.051***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Age 50 or higher	−0.141***	−0.104***	−0.104***	−0.104***	−0.103***	−0.104***	−0.109***	−0.106***
	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)
LTV in [60, 80)		0.080***	0.082***	0.084***	0.080***	0.082***	0.074***	0.077***
		(0.003)	(0.003)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)
LTV 80 or higher		0.115***	0.118***	0.119***	0.117***	0.117***	0.112***	0.109***
		(0.003)	(0.003)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)
dHP in [0.08, 0.19)			0.025***	0.027***	0.027***	0.012**	0.015***	0.015***
			(0.003)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)
dHP 0.19 or higher			0.055***	0.055***	0.053***	0.010	0.023***	0.021***
			(0.003)	(0.005)	(0.005)	(0.006)	(0.006)	(0.006)
Intermediated								0.143***
								(0.003)
Income and savings grid	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
dHP x LTV grid	No	No	No	Yes	Yes	Yes	Yes	Yes
Year-month FE	No	No	No	No	Yes	Yes	Yes	Yes
Postcode area FE	No	No	No	No	No	Yes	Yes	Yes
Lender FE	No	No	No	No	No	No	Yes	Yes
Observations	169,969	169,969	169,969	169,969	169,969	169,969	169,969	169,969
R^2	0.035	0.046	0.047	0.047	0.049	0.051	0.078	0.093
Adjusted R^2	0.035	0.045	0.047	0.047	0.048	0.050	0.077	0.092

Note: *p<0.1; **p<0.05; ***p<0.01

5 The role of brokers

The previous section showed that borrowers who used a broker at the initial date are more likely to be active and remortgage, and they are more likely to do so externally. The effects are significant even when controlling for the remortgaging monetary benefits. This suggests that brokers reduce the non-pecuniary costs of remortgaging, possibly because their commission revenues depend on borrowers taking action. But the choice to use a broker at the time of property acquisition (and also subsequently) is endogenous, so that selection issues arise.

In this section, we provide further evidence on the role of brokers in the remortgaging process. If borrowers used a mortgage broker at the time of the house purchase, then brokers will have information on the details of the mortgage, including the date of expiry of the fixed rate. Furthermore, brokers have the incentive to contact borrowers at this time: they will receive a commission if borrowers use their services to remortgage.

5.1 Summary statistics

Table 11 shows the matrix of outcomes for our sample of mortgages, conditional on whether the original loan was sold directly or through a broker. As previously shown, 30% of the original loans were sold directly, and the remaining through a broker. Among those who took an original loan directly with a lender, the probability of an external remortgage is only 10%, compare to a 49% probability of an internal remortgage. The overwhelming majority of internal remortgages are done directly with the lender (96% of the internal remortgages), and only 4% remortgage through a broker.

Among those who took the initial loan through a broker, 24% decide to remortgage externally, compared to 46% who remortgage internally. Among those who remortgage externally, a majority of 87% of them also use a broker for the remortgaging process. On the other hand, among those who remortgage internally, the majority (71%) do so directly with the lender, ie without making use of the services of a broker. Therefore, when loans are intermediated at the initial date, it is more likely that borrowers remortgage with a different lender, and that they make use of the services of a broker to do so.

Interestingly, Table 11 also shows that the proportion of borrowers who end up on the reversion rate on December 2016 is higher if the initial mortgage was sold directly than if it was

sold through an intermediary, 26% versus 17%, respectively. The difference becomes even larger if we exclude from the calculations those that repaid the loan. The corresponding proportions are 31% versus 19%, respectively. Naturally, these differences in outcomes could be due to borrower selection at origination, and not the result of the actions taken by brokers.

Table 11: Outcomes by channel

This table shows the distribution of outcomes by channel of the first mortgage (i.e., direct versus intermediated). For each channel, the table also shows the distribution of channel of the remortgage, both as the number of mortgages and as a proportion of mortgages in each outcome.

Channel of 2nd mortgage	External remortgage		Internal remortgage		Reversion rate		Mortgage repaid	
	Number	%	Number	%	Number	%	Number	%
Total	7,923	0.1	39,805	0.49	21,370	0.26	12,428	0.15
Direct	4,380	0.55	38,392	0.96				
Intermediated	3,543	0.45	1,413	0.04				

(a) Outcomes if the first mortgage is **direct**

Channel of 2nd mortgage	External remortgage		Internal remortgage		Reversion rate		Mortgage repaid	
	Number	%	Number	%	Number	%	Number	%
Total	44,754	0.24	86,031	0.46	31,371	0.17	25,008	0.13
Direct	5,649	0.13	60,749	0.71				
Intermediated	39,105	0.87	25,282	0.29				

(b) Outcomes if the first mortgage is **intermediated**

In Table 12 we compare the origination characteristics of those individuals who took out the initial loan directly from the lender and through a broker. We report the average values for several variables (standard deviation in parenthesis), and in the last column we report the p-value of a t-test of the equality of means. All of the differences considered are highly statistically significant because of the large number of observations in our data. Some of the economic differences are not very large. In general, those with higher LTIs and LTVs, and

borrowing larger amounts are more likely to use a broker at the initial date.

Table 12: Borrower characteristics at origination by sales channel

This table shows the characteristics of borrowers at the origination of the first mortgage depending on the sales channel

	Direct	Intermediated	p-value
Total gross income (mean (SD))	52138.81 (38490.21)	52677.55 (36638.76)	0.001
Main borrower's age (mean (SD))	35.94 (9.69)	34.87 (8.66)	<0.001
Joint applicants (mean (SD))	0.51 (0.50)	0.54 (0.50)	<0.001
FTB (mean (SD))	0.49 (0.50)	0.52 (0.50)	<0.001
HM (mean (SD))	0.51 (0.50)	0.48 (0.50)	<0.001
LTI (mean (SD))	3.24 (1.14)	3.37 (1.01)	<0.001
LTV (mean (SD))	0.73 (0.19)	0.77 (0.16)	<0.001
Remaining term (y) (mean (SD))	24.91 (7.43)	27.07 (6.43)	<0.001
Loan value (mean (SD))	157162.61 (108231.44)	167535.57 (108462.87)	<0.001

5.2 The effect of intermediation: brokers who became inactive

The usage of a broker in the first transaction may affect the likelihood of remortgaging because brokers often follow up with their clients when the initial fixed period is about to expire. However, brokers that go out of business will presumably not contact their clients once they have become inactive. They might notify their clients before closing their shop, and redirect them towards other intermediaries. Whatever the approach of inactive brokers, the process for their clients will become more cumbersome (they will need to switch broker, possibly incurring in some search costs) and this might impact their likelihood of remortgaging. In this subsection, we use brokers becoming inactive to identify borrowers who may have missed a reminder to take action. We look at 2 outcomes: remortgaging versus not remortgaging, and remortgaging externally versus internally.

To identify brokers that have become inactive, we use the following approach. We take the list of all intermediaries that were used for the first transaction between July 2013 and June 2014. We define a broker that has become inactive as an intermediary who is not associated with

any loan for house purchase or remortgage for at least 2 consecutive quarters in the relevant period of our analysis, between January 1, 2015 and December 31, 2016 (we perform some robustness checks on these criteria below).

If people who are less likely to remortgage choose a broker who is more likely to become inactive, the coefficient for inactive brokers would be upward biased. Therefore, to understand if there are any meaningful differences between borrowers associated with brokers who stay active, and borrowers whose first mortgage in the data was intermediated by brokers who became inactive, Panel A of Table 13 compares the characteristics of the first transactions. Although there are statistically significant differences, the economic differences are generally small. An exception is that borrowers with brokers who became inactive have slightly larger loan amounts (a difference of 4%). But to the extent that households who borrow larger loan amounts are more likely to take action, this difference would work against finding an effect of broker inactivity on not remortgaging. Panel B replicates Panel A using a different definition for inactive brokers.[21]

We return to our regressions with the dependent variable for being on a reversion rate, and in the first column of Table 14 we repeat the results of the last column of Table 7. This regression shows that the first loan being intermediated reduces the likelihood that borrowers end up on the reversion rate by 7.2 percentage points. In the second column, we include among the explanatory variables the dummy for inactive brokers. The dummy for an inactive broker takes value 0 when the first mortgage is intermediated and the broker is still active, or the first mortgage is direct. It takes value 1 when the first mortgage was intermediated and the broker became inactive before the remortgaging due date. The estimated positive coefficient shows that the probability that borrowers end on the reversion is higher in case of broker inactivity. Thus borrowers who use a broker at the initial date are much less likely to end up on the reversion rate, but that the effect is reduced by roughly a half if the original broker has become inactive. This suggests that the actions of brokers are important in reducing borrower inaction. The third column shows that the results are similar when we consider a different measure of broker inactivity.

Clearly, brokers that stop trading are not a random sample of all mortgage brokers. Some

[21]Panel A defines as inactive brokers that did not sell any mortgage for 2 or more quarters and Panel B defines inactive brokers as those that did not sell any mortgage for 4 or more quarters.

Table 13: Summary statistics, mortgages with brokers who stayed active vs brokers who became inactive

This table compares the origination characteristics of borrowers that took a loan from a broker that remained active to the origination characteristics of borrowers who took a loan from a broker who became inactive. A broker is classified as inactive if it does not originate any mortgage in two or four consecutive quarters between January 2015 and December 2016. The summary statistics are computed on the first transaction, which takes place between July 2013 and June 2014.

	Active brokers	Inactive brokers	p-value
Panel A: Broker inactive for 2 or more quarters			
Total gross income (mean (SD))	52412.54 (37161.50)	54627.14 (38167.07)	<0.001
Main borrower's age (mean (SD))	35.19 (9.01)	35.34 (8.77)	0.066
Joint applicants (mean (SD))	0.53 (0.50)	0.56 (0.50)	<0.001
FTB (mean (SD))	0.51 (0.50)	0.47 (0.50)	<0.001
HM (mean (SD))	0.49 (0.50)	0.53 (0.50)	<0.001
LTI (mean (SD))	3.33 (1.05)	3.32 (0.97)	0.294
LTV (mean (SD))	0.75 (0.17)	0.77 (0.15)	<0.001
Remaining term (y) (mean (SD))	26.41 (6.84)	26.60 (6.31)	0.002
Loan value (mean (SD))	164054.76 (108372.12)	171326.26 (110848.39)	<0.001
Panel B: Broker inactive for 4 or more quarters			
Total gross income (mean (SD))	52465.72 (37194.87)	54128.57 (37712.88)	<0.001
Main borrower's age (mean (SD))	35.19 (9.01)	35.39 (8.88)	0.051
Joint applicants (mean (SD))	0.53 (0.50)	0.56 (0.50)	<0.001
FTB (mean (SD))	0.51 (0.50)	0.47 (0.50)	<0.001
HM (mean (SD))	0.49 (0.50)	0.53 (0.50)	<0.001
LTI (mean (SD))	3.33 (1.05)	3.30 (0.98)	0.002
LTV (mean (SD))	0.75 (0.17)	0.77 (0.15)	<0.001
Remaining term (y) (mean (SD))	26.41 (6.83)	26.50 (6.31)	0.254
Loan value (mean (SD))	164279.59 (108525.01)	168013.78 (107513.93)	0.003

Table 14: The effect of inactive brokers on the likelihood of inaction

We consider specification (5) in Table 7—repeated in this table in column (1)—and we add two dummies identifying inactive brokers. One dummy is equal to 1 if the broker used for the initial mortgage became inactive for two or more quarters (i.e., with two or more consecutive quarters without a single transaction in the 2015-2016 period). One dummy is equal to 1 if the broker used for the initial mortgage became inactive for four or more quarters (i.e., with four or more consecutive quarters without a single transaction in the 2015-2016 period). The dummy small broker is equal to 1 of a broker has sold less than 120 mortgages between July 2013 and June 2014.

	Dependent variable:				
	On reversion				
	(1)	(2)	(3)	(4)	(5)
First-time buyer	0.002	0.002	0.002	0.002	0.002
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Joint income	−0.014***	−0.014***	−0.014***	−0.014***	−0.014***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Age in [30, 40)	−0.004*	−0.004*	−0.004*	−0.004*	−0.004*
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Age in [40, 50)	0.012***	0.012***	0.012***	0.012***	0.012***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Age 50 or higher	0.049***	0.049***	0.049***	0.049***	0.049***
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Intermediated	−0.072***	−0.074***	−0.073***	−0.060***	−0.058***
	(0.002)	(0.002)	(0.002)	(0.003)	(0.003)
Broker inactive for 2 quarters		0.033***		0.023***	
		(0.004)		(0.005)	
Broker inactive for 4 quarters			0.034***		0.022***
			(0.005)		(0.005)
Small broker				0.018***	0.019***
				(0.003)	(0.003)
Income and savings grid	Yes	Yes	Yes	Yes	Yes
Year-month origination FE	Yes	Yes	Yes	Yes	Yes
Postcode area FE	Yes	Yes	Yes	Yes	Yes
Lender FE	Yes	Yes	Yes	Yes	Yes
Observations	221,314	221,314	221,314	221,314	221,314
R^2	0.076	0.077	0.077	0.077	0.077
Adjusted R^2	0.076	0.076	0.076	0.076	0.076

Note: *p<0.1; **p<0.05; ***p<0.01

brokers may retire, while others may simply change job for a variety of reasons. In Appendix, in Table D1 we show that brokers who became inactive sold fewer mortgages between July 2013 and June 2014 than other brokers. We therefore add to the regressions in Table 14 a dummy equal to 1 if a broker sells less than 120 mortgages between July 2013 and June 2014. (If we ranked all the borrowers in our dataset according to the number of sales of their brokers in the relevant period, 120 would correspond to the 25th percentile of this distribution. In other words, this dummy flags borrowers using small brokers.) The estimated coefficients on the broker size variable are positive and statistically significant, so that those using smaller brokers are more likely to end up on the reversion rate. However, the estimated coefficients on the broker inactivity dummies are still statistically and economically significant.

In the Appendix we include results for additional robustness checks. In Table D2 we investigate the effects of broker inactivity when we restrict the data to the sample of loans that were originally originated through an intermediary, which makes the sample more homogeneous. And in Table D3 we further restrict the sample to intermediated mortgages sold only by small brokers. The results are similar.

Table 15 shows the results of the regressions with the dependent variable that takes the value of 1 for external remortgaging (and 0 for internal remortgaging), but now also including among the explanatory variables the dummy for an inactive broker. The previous results, on the effects of intermediation on the likelihood of external remortgaging, are replicated in the first column: the coefficient of intermediated is positive and significant, so that borrowers who used a broker for the first mortgage are more likely to remortgage externally. The dummy for an inactive broker is negative and significant, so that if the broker becomes inactive borrowers are less likely to remortgage externally. The quantitative effect corresponds to roughly one tenth of the effect of using a broker in the first transaction. Interestingly, the estimated coefficients on the inactivity dummies increase when we control for broker size, and the estimated coefficient on the small broker dummy, albeit small, is positive and statistically significant. This shows that the clients of small brokers are less likely to rely on the same lender for the remortgaging process than the clients of large brokers, but in the Appendix Table D4 we show that this result is not robust to the restriction of the sample to mortgages that were originally intermediated. However, the results for the inactivity dummies are unchanged.[22]

[22]In Appendix Table D5 we restrict the data further to intermediated mortgages sold by small brokers. The

Table 15: The effect of inactive brokers on likelihood to remortgage externally

We consider specification (8) in Table 10, repeated on this table in column (1). In the subsequent columns, we add two dummies identifying inactive brokers and a dummy to identify small brokers as described in Table 14.

	Dependent variable:				
	External remortgage				
	(1)	(2)	(3)	(4)	(5)
First-time buyer	−0.019***	−0.019***	−0.019***	−0.019***	−0.019***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Joint income	−0.014***	−0.014***	−0.014***	−0.014***	−0.014***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Age in [30, 40)	−0.010***	−0.010***	−0.010***	−0.010***	−0.010***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Age in [40, 50)	−0.051***	−0.051***	−0.051***	−0.051***	−0.051***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Age 50 or higher	−0.106***	−0.106***	−0.105***	−0.106***	−0.106***
	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)
LTV in [60, 80)	0.074***	0.074***	0.074***	0.074***	0.074***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
LTV 80 or higher	0.114***	0.115***	0.115***	0.114***	0.114***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
dHP in [0.08, 0.19)	0.015***	0.015***	0.015***	0.015***	0.015***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
dHP 0.19 or higher	0.023***	0.023***	0.022***	0.023***	0.023***
	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)
Intermediated	0.143***	0.144***	0.144***	0.148***	0.149***
	(0.003)	(0.003)	(0.003)	(0.004)	(0.004)
Broker inactive for 2 periods		−0.014***		−0.017***	
		(0.005)		(0.005)	
Broker inactive for 4 periods			−0.025***		−0.029***
			(0.006)		(0.007)
Small broker				0.006*	0.007**
				(0.003)	(0.003)
Income and savings grid	Yes	Yes	Yes	Yes	Yes
Year-month FE	Yes	Yes	Yes	Yes	Yes
Postcode area FE	Yes	Yes	Yes	Yes	Yes
Lender FE	Yes	Yes	Yes	Yes	Yes
Observations	169,969	169,969	169,969	169,969	169,969
R^2	0.093	0.093	0.093	0.093	0.093
Adjusted R^2	0.092	0.092	0.093	0.093	0.093

Note: *p<0.1; **p<0.05; ***p<0.01

The results in this section, for the differences in outcomes for clients of brokers who became inactive, suggest that brokers play a role in the remortgaging process, in lowering the non-pecuniary costs that borrowers face when remortgaging. In order to be able to measure these non-pecuniary costs, in the next section we develop a structural model of remortgaging choices.

6 The Model

We have obtained estimates of the monetary benefits of remortgaging that take into account the monetary fees involved in the remortgaging process, but not other costs incurred by households, such as time or utility costs. Furthermore, the evidence that we have provided suggests that, for constrained borrowers, the ability to extract home equity and achieve higher non-housing consumption is an important driver of remortgaging decisions. An evaluation of the non-pecuniary costs of taking action and the unobserved marginal utility benefits of remortgaging, and how they differ across different types of households, requires a model. In this section we set up and solve such a model, which benefits from a clean mapping of the most relevant features of the UK mortgage market.

6.1 Basic setup

Time is discrete and indexed by $t = 0, 1, 2, .., T$. Time 0 is the initial date at which individual i purchases a house of size $\overline{H_i}$ for price $P^H_{i,0} \times \overline{H_i}$. The size of the house should be interpreted broadly, to reflect not only its physical size, but also its quality. The term P^H_{it} denotes the period t price per unit of housing. The index i in the house price allows for the possibility that different individuals face different house price movements, due to location differences. The individual takes a mortgage loan at time 0 of amount $D_{i,0}$ that she uses to finance the purchase of the house, together with previously accumulated savings that are used as a down payment. We let $Y_{i,0}$ denote initial income. Therefore, the initial LTV and LTI are given by:

$$LTV_{i,0} = \frac{D_{i,0}}{P^H_{i,0} \times \overline{H_i}} \tag{2}$$

results are unchanged.

$$LTI_{i,0} = \frac{D_{i,0}}{Y_{i,0}}. \tag{3}$$

In order to simplify the analysis, and to be able to model with more realism the remortgaging process, we do not model the periods before the house purchase. However, we can capture, within the context of our model, the correlations that exist between origination LTVs and LTIs and other model primitives. For instance, younger, FTBs tend to have higher expected income growth, and are less likely to have accumulated substantial down payments when they buy their house.

The loan has an initial discounted interest rate that is fixed for the first 2 periods, and equal to $R_{i,0}^{loan}$. The loan interest rate is indexed by i to reflect the fact that it may vary across borrowers, and in particular it may depend on LTV. After the first 2 years, the loan interest rate reverts to a variable rate, equal to the 1-year riskless rate, R_t, plus a premium ι_i, so that:

$$R_{it}^{loan} = R_{it}^{loan} \qquad \text{for t}\leq 2 \tag{4}$$

$$R_{it}^{loan} = R_{it} + \iota_i \qquad \text{for t}>2 \tag{5}$$

We simplify the analysis by assuming that the mortgage is interest only. This assumption is a reasonable approximation for most mortgages in our data: their long maturity means that, during their initial period, most of the mortgage payments are interest due. Therefore, during the initial period, the required mortgage payments (denoted M_{it}) are equal to $D_{i,0} \times R_i^{loan}$. In the absence of remortgaging, they change to $D_{i,0} \times (R_t + \iota_i)$ from $t > 2$ onward.

There are several sources of risk in the model, including house prices, interest rates, and labour income. Without loss of generality, we can normalise the initial price per unit of housing to 1. We assume that this price follows a random walk with drift. If lower case letters denote the log of their equivalent upper case letters, $p_{it}^H \equiv log(P_{it}^H)$, and $\Delta p_{it}^H = p_{it}^H - p_{i,t-1}^H$ then:

$$\Delta p_{it}^H = \mu_H + \zeta_{it} \tag{6}$$

where ζ_{it} is a normally distributed white noise process with mean zero and variance σ_ζ^2. We assume that the log of the gross short rate, $r_t = log(1 + R_t)$, follows an $AR(1)$ process such that:

$$r_t = \mu_r + \phi_r r_{t-1} + \varepsilon_t \tag{7}$$

where ε_t is a normally distributed white noise process with mean zero and variance σ^2_ε. Finally, log household income, $y_{it} \equiv log(Y_{it})$, is subject to permanent shocks (η_{it}) and temporary shocks (ϵ_{it}):

$$y_{it} = \mu^y_{it} + v_{it} + \epsilon_{it} \tag{8}$$

$$v_{it} = v_{i,t-1} + \eta_{it} \tag{9}$$

where μ^y_{it} is the deterministic component of the labour income process, ϵ_{it} is normally distributed with mean zero and variance σ^2_ϵ, and η_{it} is normally distributed with mean zero and variance σ^2_η. We assume that labour income is taxed at rate τ.

6.2 The remortgaging

The loan can be remortgaged once the initial fixed rate period ends, so that we are particularly interested in the choices at time $t = 2$. The alternatives are inaction, in which case the borrower will move to the reversion rate, internal or external remortgaging. We assume that in the case of remortgaging the individual takes a new 2-year fixed rate mortgage. We let R^{loan}_{it} denote the interest rate on the remortgaged loan, and F_{it} the corresponding monetary remortgaging fees. We assume that the rate of the remortgaged loan is fixed for the first 2 periods, reverting to a variable rate after that.

If the borrower decides to remain inactive in period 2, then she is allowed to remortgage in subsequent periods. We let 1^{int}_{it} and 1^{ext}_{it} denote indicator functions that take the value of 1 if borrower i remortgages internally or externally in period t, respectively, and 0 otherwise. The main feature of external remortgaging that we focus on in our model, is that it involves a change in loan terms and conditions, and in particular the possibility that borrowers draw down additional funds. Therefore, in case of an external remortgage, the borrower must also decide the loan amount. We let D^-_{it} denote the principal debt outstanding at time t, after the mortgage payment for that period, but before the remortgaging decision. We let D^+_{it} denote the

principal amount outstanding just after the remortgage decision, and define $\Delta D_{it} \equiv D_{it}^{+} - D_{it}^{-}$.[23]

Remortgaging involves non-pecuniary costs, denoted Z_i^{int} and Z_i^{ext}. We model these as utility costs; they can be interpreted as the disutility associated with the remortgaging process, including the need to pay attention, engage with the process, put together all the required paperwork, and approach the lender. We allow for the possibility that the costs are different for different borrowers (indexed by i), and for internal and external remortgages. In reality, external remortgages require an affordability assessment and additional paperwork on the part of borrowers.

For both internal and external remortgaging, borrowers face a leverage constraint, that takes the form of a maximum LTV (denoted ($LTV^{\max}$). Furthermore, those remortgaging externally face an affordability constraint: the LTI on the remortgaged loan must be smaller than the upper limit $LTI^{\max}$. In contrast, borrowers remortgaging internally do not face such LTI constraint, and they will be able to remortgage even if their income has declined since origination.

6.3 The optimisation problem

In each period the household must choose how much to consume C_{it}. In addition, when permitted, the household must decide whether to remortgage and whether to do it internally or externally, and in case of external remortgage, how much home equity to draw down. We are interested in the remortgaging decisions, so that we simplify the analysis by assuming that the house that the agent owns remains fixed throughout, and that preferences are separable in housing and non-durable consumption. We assume that there are maintenance expenses, equal to fraction α of current house value. The household makes choices so as to maximise the present discounted value of utility:

$$\max_{C_{it},1_{it}^{\text{int}},1_{it}^{\text{ext}},D_{it}} \sum_{t=1}^{T} \beta^{t-1}[\frac{C_{it}^{1-\gamma}}{1-\gamma} - 1_{it}^{\text{int}} Z_i^{\text{int}} - 1_{it}^{\text{ext}} Z_i^{\text{ext}}] + \beta^{T+1}\phi\frac{W_{i,T+1}^{1-\gamma}}{1-\gamma} \tag{10}$$

where $W_{i,T+1}$ is terminal wealth, β is the discount factor, γ is the coefficient of relative risk

[23] We plan to generalise the model in future versions of our paper to allow for other differences between internal and external remortgaging. The focus on the home equity extraction dimension is motivated by our empirical analysis.

aversion, and ϕ denotes the importance of terminal wealth for utility. We let X_{it} denote beginning of period cash-on-hand. In periods when the household does not remortgage, its evolution is given by:

$$X_{i,t+1} = (X_{it} - C_{it} - R_{it}^{loan} D_{it} - \alpha P_{it}^{H} \overline{H_i})(1 + R_t(1-\tau)) + (1-\tau) Y_{i,t+1}. \tag{11}$$

Financial savings earn interest, that is taxed at rate τ. In periods when there is a remortgage, either internal or external, the household benefits from the new interest rate, pays the remortgaging fees, and there may also be a change in the value of the debt outstanding (in case of external remortgage):

$$X_{i,t+1} = (X_{it} - C_{it} - R_{ijt}^{loan} D_{it} - F_{ijt} + \Delta D_{it} - \alpha P_{it}^{H} \overline{H_i})(1 + R_t(1-\tau)) + (1-\tau) Y_{i,t+1} \tag{12}$$

Finally, terminal wealth includes financial wealth plus the value of the house net of outstanding mortgage debt:

$$W_{i,T+1} = X_{i,T+1} + P_{i,T+1}^{H} \overline{H_i} - D_{i,T+1}. \tag{13}$$

We do not explicitly model default. Mortgages in the UK are recourse, which makes our modeling choice a better approximation than if mortgages were non-recourse.[24] We assume that transfers from government or family ensure that households are able to achieve in each period a minimum level of non-durable consumption ($\underline{C}$).

The state variables of the problem are: time, cash-on-hand, outstanding debt, the level of house prices, interest rate, permanent income, and the period of the mortgage (which matters for whether the borrower is allowed to remortgage, and the interest rate that she has to pay). Other variables, such as the loan premia, may vary across individuals (depending on the initial LTV and LTI), but they are assumed to be fixed throughout. In other words, for a given borrower's problem, they are model parameters.

The techniques that we use to solve the model are standard. We discretise the state and choice variables, approximate the random variables using Gaussian quadrature, and solve the

[24] In a recourse mortgage, the lender can pursue a borrower in arrears and seize her assets or income to recoup its losses. As a result, default rates for such mortgages are usually lower.

model by backward induction. Given the large number of state variables, and in order to be able to solve the problem, we only allow for 2 possible realisations for interest rates, house price changes, and income innovations (low/high). This means that the levels of house prices and permanent income can be determined using state variables that track the number of past high realisations.

6.4 Parameterisation and target moments

We use several sources of data to parameterize the stochastic process for real interest rates, house prices, and income. We include the parameter values in the top 3 panels of Table 16. In the bottom panel we also report other model parameters and the maximum LTV and LTI. The latter are based on market data and regulations.

We want our model to capture the decisions observed in the data for different groups of individuals, that differ in their income, initial LTI and LTV, initial mortgage rate, and so on. Therefore, we take 2 groups of individuals who differ in these dimensions, and we solve our model separately for each of these. More precisely, the 2 groups that we consider are those with the median estimated internal remortgaging benefits, and in deciles three and eight of the income distribution. In Table 17 we label these groups as low and high income, respectively. We then take the median property values, loan amount and gross income from the data. The initial loan and reversion rates are also taken from the data, but we make small adjustments to the latter to ensure that the £ remortgaging benefits (net of fees) are the same for the 2 groups of individuals. Naturally, a given value for the pounds benefits implies a larger value of monetary benefits relative to income for the low than for the high income group.

In the model solution there are 2 possible values for interest rates, but when generating simulated data we set the realisation of interest rates to low to reflect their value during the sample period. Furthermore, since our sample period was one of generally increasing house prices, with very large increases in some areas, we set the realisations of house prices such that the average increase over the 2 years is 15%, with a range between 5% and 25% (over the 2 years, not annualised).

The last 4 rows of Table 17 show the data moments that we aim to match in our simulated data. They include, for each of the income groups, the proportions of borrowers who were

Table 16: The model parameterisation

Panel A: Real house prices		
Mean log growth	μ_H	0.025
Standard deviation	σ_ζ	0.086
Panel B: Real interest rates		
Mean log real rates	μ_r	0.018
Standard deviation	σ_r	0.027
Autoregression coefficient	ϕ_r	0.83
Panel C: Real income		
Mean log growth	μ_{it}^y	0.02
St. dev. permanent shocks	σ_η	0.05
St. dev. temporary shocks	σ_ϵ	0.10
Panel D: Other model parameters		
Max LTV	$LTV^{\max}$	0.90
Max LTI	$LTI^{\max}$	4.5
Tax rate	τ	0.20
Min consumption	$\underline{C}$	£1,000
Maintenance expenses	α	0.02

Table 17: Descriptive statistics for low- and high-income borrowers and target moments

The low and high-income borrowers are those with the median estimated internal remortgaging and respectively in deciles three and eight of the income distribution

	Low income	High income
Panel A: Model parameters		
Initial property value	£150k	£190k
Initial loan amount	£120k	£150k
Initial income	£30k	£60k
Initial LTV	0.80	0.83
Initial LTI	4.00	2.50
Loan premium initial	0.033	0.034
Loan premium reversion	0.049	0.047
Remortgaging benefits £	£1,920	£1,920
Remortgaging gain relative to income	0.064	0.032
Panel B: Target moments		
Reversion	0.21	0.22
Internal remortgage	0.59	0.54
External remortgage	0.20	0.24
Equity extraction	0.09	0.09

inactive, who remortgaged internally and externally, and the home equity extraction defined as the percentage change in loan amount among those who extracted home equity.

We are mainly interested in the remortgaging decisions taken at time $t = 2$, and in matching these to the data. We set $T = 6$. This is a compromise between explicitly modeling some of the periods subsequent to time $t = 2$, without a very large increase in the state space, which grows exponentially with the time horizon. Furthermore, to simplify, we set β equal to 0.98 and γ equal to 2.

The values that we calibrate so as to match the target moments are the unobserved utility costs of remortgaging, Z_i^{int} and Z_i^{ext} and the preference parameter ϕ_i, that measures the importance of terminal wealth for utility. The latter parameter is an important driver of equity extraction within the context of the model.

6.5 Results

Panel A of Table 18 compares the target moments to the model generated moments for the calibrated parameters. The model is able to match the target moments reasonably well, but it over-predicts the magnitude of home equity extraction among the low income group and the intensity of external remortgaging among the high income group. In Panel B we report the calibrated parameters. It is important to note that the values of Z are not directly comparable across the 2 groups, since their income, consumption and utility values are different.

Therefore, we translate the utility costs into consumption equivalent variations. More precisely, we first calculate the constant consumption stream that gives the individual the same lifetime expected utility as in the model solution with the calibrated remortgaging costs. We then solve our model setting the remortgaging costs equal to zero, and again calculate the constant consumption stream that gives the individual the same lifetime expected utility as in the model with zero remortgaging costs (both the internal and the external). We then calculate the percentage difference in these constant consumption streams, which tells us the percentage consumption that the individual is willing to give up to eliminate remortgaging costs. We do this for each of the 2 income groups, and for an initial value of the interest rate equal to low (to reflect the fact that interest rates were low throughout our sample period).

The first row of Panel C shows the welfare results. The value for the low income group

suggests that borrowers would will be willing to give up 4.7% of their consumption stream in order to eliminate the utility costs of remortgaging. In contrast, the value for the high income group is significantly smaller, and equal to 3.4%. This implies the non-pecuniary costs associated with remortgaging are higher for low income individuals.

Table 18: Target moments vs. model moments

	Low income		High Income	
	Target	Model	Target	Model
Panel A: Target versus model moments				
Reversion	0.21	0.22	0.22	0.22
Internal remortgage	0.59	0.60	0.54	0.48
External remortgage	0.20	0.18	0.24	0.30
Equity extraction	0.09	0.15	0.09	0.07
Panel B: Calibrated model parameters				
Utility costs internal rem Z_i^{int}		0.008		0.0018
Utility costs external rem Z_i^{ext}		0.0195		0.00201
Utility term wealth ϕ_i		10.6		10.0
Panel C: Utility costs measured in consumption equivalent variations				
Zero remortaging costs		0.047		0.034

6.5.1 Model discussion

In reality, the remortgaging process is complex, and the model that we have solved is only able to capture some of the dimensions of the process. For instance, one could explicitly model the differences in monetary benefits of internal and external remortgaging, and the additional search costs that remortgaging externally entails. Furthermore, even though we are able to use our model to measure the utility costs of remortgaging with and without a broker, a more complete analysis would require that we explicitly model the decision to use a broker, the benefits and costs of doing so. This raises the question of how costly it is for households to find a broker in the first place. Survey data shows that they rely on referrals from relatives, friends and real

estate agents.[25] Our analysis has focused on the decision to remortgage from the point of view of the household, so as to measure the utility costs of action. Therefore, it complements that of Robles-Garcia (2018), who models the incentives of brokers, and Benetton (2018) who focuses on lender competition.

7 Conclusion

In this paper we exploit a specific feature of the UK mortgage market to study the sources of household inertia. In the UK, mortgages have an initial short period (usually 2 years) with a low interest rate (fixed rate), which reverts to an adjustable (and usually significantly higher) rate when the initial period expires. At that point, households incur in substantially higher payments if they do not remortgage, either with their existing lender (internal remortgage) or with a different one (external remortgage). While external remortgages require higher effort because of paperwork and required affordability checks, internal remortgages are typically available to all borrowers and the process is straighforward. Also, search costs may be higher for external remorgages as a borrower may have to compare deals from different lenders.

Our data allow us to follow the cohort of all UK borrowers who bought a property with a 2-year fixed mortgage between July 2013 and June 2014. As of December 2016, 20% of these borrowers were on the reversion rate and forgo significant monetary amounts. We show that borrowers on reversion rates are more likely to earn slightly lower incomes than the borrowers who remortgaged. They are also more likely to be older and in a single-earner household. These differences hold when controlling for other confounding factors (such as the time when the mortgage was originated, the geographical area where the property is located and the identity of the lender) in a regression setting.

We also study the decision to remortgage externally, as opposed to remortgage with the existing lender. We find that on average external remortgages yield better outcomes for borrowers. We also find that home equity extraction plays a significant role in the decision to remortgage externally. Regression results show that, after controlling for monetary benefits, borrower char-

[25] The most common reasons for choosing a broker include recommendations from a friend or relative (29%) or having used the intermediary before and being happy with the service (26%). See Financial Conduct Autority (2017) (Question M48)

acteristics and a rich set of fixed effects, borrowers with high LTV and high realised house price appreciation are more likely to remortgage externally.

In a rational setting, the monetary benefits of remortgaging are counteracted by non-pecuniary costs, which imply that some borrowers may choose not to act or not to exert maximum effort in searching for a remortgaging deal. Consistent with this view, we show that brokers, who help borrowers searching for a mortgage and provide advice on qualifying criteria, have a positive effect on the likelihood to both remortgage and change lender (remortgage externally).

To estimate the non-pecuniary costs involved in the decision to remortgage, we set up and solve a structural model. When calibrated to our data, our computations show that the costs of taking action are higher for low-income households.

The UK mortgage market compares favourably to other countries and markets in terms of the observed levels of inertia. The end of the fixed rate is salient to households (a large proportion of whom remortgages in advance of the first increase in payments) and the widespread usage of brokers provides an additional trigger for borrowers to take action. However, such a setting and the prevalence of 2-year fixed rates make households spend a non-negligible amount of effort to avoid ending up on the reversion rate.

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A Appendix

A Additional details on loan values and remortgaging

Table A1: Number of mortgages by income and loan deciles

	Gross Income Deciles										
Loan value deciles	1	2	3	4	5	6	7	8	9	10	Total
1	11,461	4,315	2,547	1,578	1,128	728	519	376	296	187	23,135
2	7,573	5,549	3,490	2,340	1,523	1,072	715	446	285	191	23,184
3	3,532	6,023	4,340	3,180	2,193	1,518	960	667	397	247	23,057
4	562	5,070	5,499	4,303	3,328	2,400	1,520	919	508	250	24,359
5	72	1,776	4,399	4,385	3,759	2,992	2,160	1,396	703	308	21,950
6	39	137	2,556	4,535	4,463	4,032	3,331	2,365	1,152	476	23,086
7	23	28	268	2,604	4,627	4,881	4,454	3,442	2,037	743	23,107
8	21	15	10	182	2,002	4,538	5,642	5,576	3,871	1,447	23,304
9	27	9	14	14	93	955	3,731	6,738	7,552	3,852	22,985
10	18	3	3	4	9	8	93	1,253	6,271	15,425	23,087
Total	23,328	22,925	23,126	23,125	23,125	23,124	23,125	23,178	23,072	23,126	231,254

Table A2: Remortgaging outcomes by income and PTI

The table shows the relation between income at origination, PTI and the outcome of interest, the percentage of borrowers ending on a reversion rate. Green cells indicate a lower share of borrowers ending on the reversion rate (i.e., a higher share of borrowers switching).

B Additional results on drivers of remortgaging

For consumers who remortgaged, we can evaluate the accuracy of our estimated interest rate, by comparing their estimated rate to the realised interest rate on the remortgaged loan. We only do the comparison for those individuals who remortgaged with the same lender, without a change in mortgage term, type of the mortgage, and without equity extraction. Relevant for background when thinking about savings is to look at characteristics of the new loans for those who remortgage. Table B1 shows that when remortgaging 94% of borrowers get a fixed rate product and Table B2 shows that, of these 94%, 71% choose again a 2-year fixed.

Table B3 reports several percentiles of the distribution of the difference between the estimated and realised rate, and also reports the distribution of this difference by borrower characteristics. These conditional distributions show that the difference is centered around zero across all characteristics.[26]

[26]It is important to clarify that here we compare, conditional on the decision to remortgage internally, the estimated and realised internal remortgage rate. Naturally, the sample of those who do decide to remortgage internally, without a change in loan terms, is a selected sample, that differs from those on the reversion rate and those who remortgage externally. For instance, we expect that those who decide to remortgage externally are those who would benefit the most from doing so. Below, we expand the analysis to study the drivers of external remortgaging.

Table B1: Remortgaging outcomes - interest rate type

The table shows the interest rate types of the remortgages in our sample.

Interest rate type	Number of mortgages	Percentage (%)
Fixed Rate	168,471	94.4
BoE base rate tracker	7,146	4
Tracker	1,464	0.8
Discounted variable rate	694	0.4
Standard variable rate	411	0.2
Other	322	0.2
Capped rate	2	0
LIBOR tracker	2	0
Other tracker	1	0
Total	178,513	100

Table B2: Remortgaging outcomes - length of incentive period

The table shows the length of the incentive period for remortgages with fixed rate.

Length incentive period	Number of mortgages	Percentage (%)
2-year fixed	119,521	71
5-year fixed	29,119	17
Other	10,191	6
3-year fixed	8,478	5
10-year fixed	1,162	1
Total	168,471	100

Table B3: The estimated interest rate compared to the realised rate, by borrower characteristics

This table compares the estimated internal remortgaging interest rates and the realised ones. The former is calculated as the median rate by i) quarter of origination, ii) revised LTV (calculated with the revised house price at expiry date), and iii) lender. The latter is taken directly from our data, from those borrowers who did remortgage internally without a change in the terms and type of loan. We tabulate statistics on the difference between realised and estimated rates. The table shows several percentiles of the difference for the whole sample, and also when we condition on borrower and loan characteristics. High, medium and low are defined according to the terciles of the corresponding distributions.

Characteristics	10th	25th	Mean	Median	75th	90th
Outcome						
Internal switch	-0.25	-0.10	0.02	0.00	0.10	0.35
Borrower type						
First time buyer	-0.20	-0.05	0.04	0.00	0.15	0.40
Home movers (2nd or subsequent buyers)	-0.30	-0.10	-0.00	0.00	0.10	0.30
Total gross income						
Low income	-0.10	0.00	0.08	0.00	0.20	0.40
Medium income	-0.20	-0.05	0.04	0.00	0.15	0.35
High income	-0.40	-0.15	-0.04	0.00	0.05	0.25
Loan value						
Low loan value	-0.10	0.00	0.07	0.00	0.20	0.40
Medium loan value	-0.15	0.00	0.06	0.00	0.15	0.40
High loan value	-0.40	-0.15	-0.06	-0.00	0.05	0.24
Intermediated						
FALSE	-0.25	-0.10	0.02	0.00	0.14	0.30
TRUE	-0.25	-0.07	0.02	0.00	0.10	0.35
Joint income vs single income						
FALSE	-0.25	-0.05	0.03	0.00	0.15	0.40
TRUE	-0.25	-0.10	0.02	0.00	0.10	0.30

Table B4: Values for cut-offs (expected savings are based on the assumption that a borrower remortgage internally)

These are the minimum values for the decile cut-off for the Table 6. The cut-offs on any individual row do not necessarily refer to the same borrower.

Decile	Total gross income (£)	Loan value (£)	Exp savings (% of income)	Exp savings (£)	LTI
1	12279.54	26000.00	0.00	11.45	0.14
2	22001.00	68011.00	0.03	1000.37	2.04
3	27093.00	87609.00	0.04	1320.22	2.51
4	31737.00	104270.00	0.04	1621.95	2.85
5	36403.00	119996.00	0.05	1939.60	3.14
6	41572.00	136422.00	0.06	2293.22	3.42
7	47601.00	155999.00	0.06	2721.45	3.69
8	55423.00	181545.00	0.07	3276.52	3.96
9	67090.00	216019.00	0.08	4097.45	4.26
10	90200.00	288955.00	0.09	5768.39	4.60

Table B5: Values for cut-offs (expected savings are based on the assumption that a borrower remortgage externally)

These are the minimum values for the cut-offs for the Table 9. The savings difference is calculated as the difference between the estimated monetary benefits of external and internal remortgaging. The cut-offs on any individual row do not necessarily refer to the same borrower.

Decile	Total gross income (£)	Loan value (£)	Delta savings (% income)	Delta savings (£)	LTI
1	12279.54	26000.00	-0.17	-14448.57	0.18
2	23001.00	74039.00	-0.01	-285.00	2.14
3	28410.00	94503.00	-0.00	-103.19	2.59
4	33199.00	110595.00	0.00	2.57	2.91
5	38032.00	126410.00	0.00	140.57	3.19
6	43338.00	144020.00	0.01	272.34	3.45
7	49540.00	163950.00	0.01	410.80	3.71
8	57501.00	189895.00	0.01	573.66	3.98
9	69524.00	225017.00	0.02	783.88	4.27
10	92730.00	300045.00	0.02	1167.23	4.62

Table B6: Lender fixed effects

Distribution of the lender fixed effects coefficients based on the regression specifications in Table 7 and Table 10

Panel A: Inaction regressions

	Min	1st Qu	Median	Mean	3rd Qu	Max
Inaction regression	-0.07	0.06	0.11	0.13	0.17	0.53

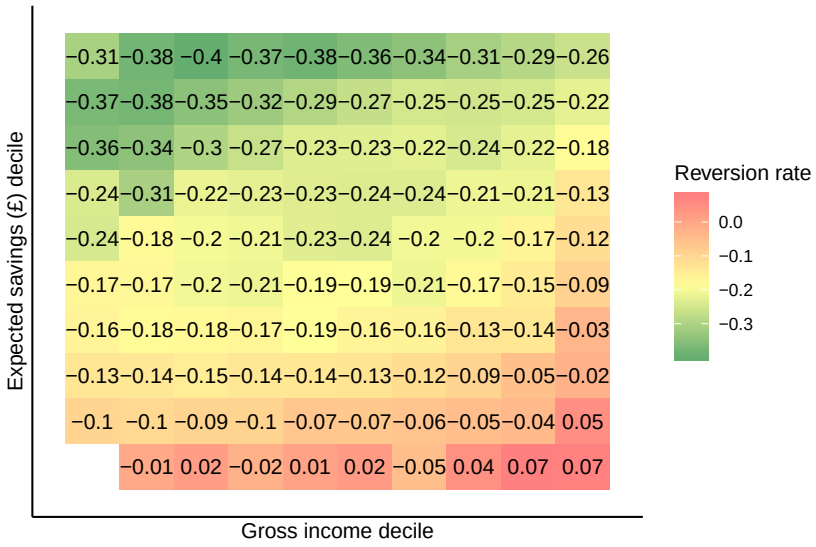
Panel B: Regression on external remortgaging

	Min	1st Qu	Median	Mean	3rd Qu	Max
External rmg regression	-0.50	-0.34	-0.30	-0.25	-0.26	0.26

Table B7: Remortgaging outcomes (proportion of borrowers on the reversion rate) by income and expected savings: regression coefficients

The tables show the the coefficients on the 10x10 grid of effects in the regression with ending up on the reversion rate as the dependent variable.

Panel A: Expected savings (£)



Panel B: Expected savings (as % of income)

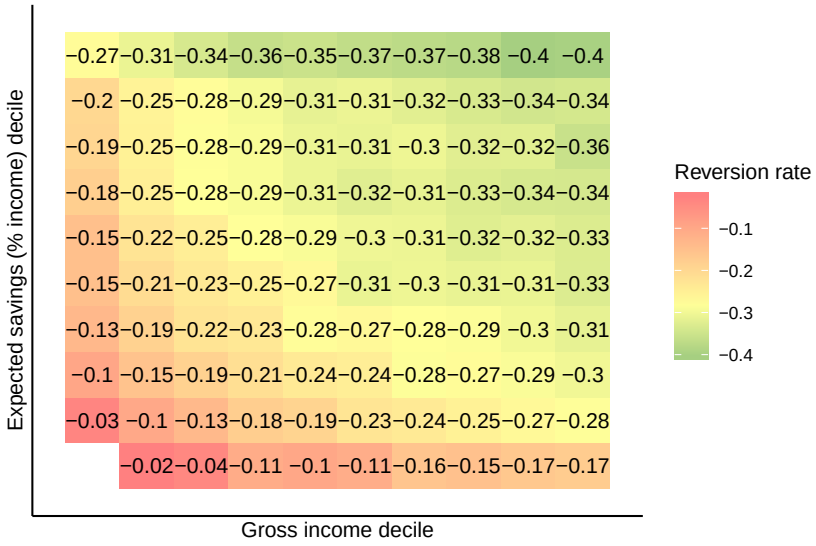


Table B8: Regression for the likelihood of inaction: monetary gains relative to income

The dependent variable is a dummy variable that takes a value of one if the borrower does not remortgage (inaction), and zero if the borrower remortgages either internally or externally. Borrowers who repaid the loan are not included. Throughout we include as explanatory variables, 100 dummy variables that take the value of one if the borrower is in a given cell of the 10×10 matrix of monetary benefits of remortgaging relative to income and of income, and zero otherwise. The columns differ in the borrower characteristics and in the sets of fixed effects included. Intermediated is a dummy variable that takes the value of one for borrowers who have used the services of a broker in the original loan, and zero otherwise. The model is estimated by ordinary least squares.

	Dependent variable:				
	On reversion				
	(1)	(2)	(3)	(4)	(5)
First-time buyer	0.009***	0.010***	0.008***	0.002	0.003
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Joint income	−0.026***	−0.027***	−0.026***	−0.018***	−0.016***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Age in [30, 40)	−0.006**	−0.006***	−0.006***	−0.007***	−0.005**
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Age in [40, 50)	0.013***	0.012***	0.012***	0.010***	0.011***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Age 50 or higher	0.056***	0.053***	0.053***	0.050***	0.049***
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
intermediated					−0.072***
					(0.002)
Income and savings grid	Yes	Yes	Yes	Yes	Yes
Year-month origination FE	No	Yes	Yes	Yes	Yes
Postcode area FE	No	No	Yes	Yes	Yes
Lender FE	No	No	No	Yes	Yes
Observations	221,314	221,314	221,314	221,314	221,314
R^2	0.045	0.048	0.049	0.071	0.076
Adjusted R^2	0.044	0.048	0.048	0.070	0.075

Note: *p<0.1; **p<0.05; ***p<0.01

C Additional details on interest and fees

Table C1: Summary statistics on remortgage product fees

The table shows average, standard deviation and selected percentiles of product fees for internal and external remortgages in our data.

	Observations	Mean	SD	p10	Median	p90
External remortgages	53,449	528.56	567	0	370	1089
Internal remortgages	121,797	79.09	217	0	0	225

(a) Unconditional fees

	Observations	Mean	SD	p10	Median	p90
Fees for loans *smaller* than the median loan						
External remortgages	20,679	208.65	370	0	0	999
Internal remortgages	66,585	43.25	121	0	0	195
Fees for loans *greater* than the median loan						
External remortgages	32,770	730.42	577	0	995	1260
Internal remortgages	55,202	122.32	289	0	0	225

(b) Fees conditional on loan size

	Observations	Mean	SD	p10	Median	p90
Fees for loans *smaller* than the median interest rate						
External remortgages	34,194	639.56	581	0	810	1225
Internal remortgages	53,415	110.28	270	0	0	225
Fees for loans *greater* than the median interest rate						
External remortgages	19,255	331.42	482	0	30	1025
Internal remortgages	68,329	54.75	161	0	0	195

(c) Fees conditional on interest rate

Table C2: Difference in product offerings to internal and external remortgagors, controlling for lender

We compute the median interest rate by lender, origination quarter and LTV band for all remortgages in our sample. We run the calculation for internal and external remortgages separately, and then compute the difference between the two. Panel A reports on those differences. We then collect information on the fees associated with mortgages with the median rate in each cell, and compute their median value. We then compute again the difference between the values for internal and external remortgages, and report results in Panel B.

Panel A: Differences in mortgage rates

Mean	p10	1st tercile	Median	2nd tercile	p90
-0.02	-0.50	-0.15	0.05	0.30	0.67

Panel B: Differences in fees associated with the median rate

Mean	p10	1st tercile	Median	2nd tercile	p90
-309.35	-999.00	-670.00	0.00	0.00	225.00

D Further analysis on brokers

Table D1: Size of active vs. inactive brokers

The table shows the number of transactions brokered in the period between July 2013 and June 2014 by two groups of intermediaries: those who were still active in 2015-2016 and those who were not

	p10	1st tercile	Median	2nd tercile	p90
Brokers who stayed active	6	16	25	41	119
Brokers who became inactive	2	5	7	12	30

Table D2: The effect of inactive brokers on the likelihood of borrower inaction (dataset with intermediated mortgages only)

The sample is restricted to those mortgages that were intermediated at origination. We replicate the regression in Table 14.

	Dependent variable:				
	On reversion				
	(1)	(2)	(3)	(4)	(5)
First-time buyer	0.004*	0.004*	0.004*	0.005**	0.005**
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Joint income	−0.012***	−0.012***	−0.012***	−0.012***	−0.012***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Age in [30, 40)	−0.004	−0.004	−0.004	−0.004	−0.004
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Age in [40, 50)	0.014***	0.014***	0.014***	0.014***	0.014***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Age 50 or higher	0.047***	0.047***	0.047***	0.047***	0.047***
	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)
Broker inactive for 2 quarters		0.028***		0.021***	
		(0.004)		(0.004)	
Broker inactive for 4 quarters			0.029***		0.021***
			(0.005)		(0.005)
Small broker				0.012***	0.014***
				(0.003)	(0.003)
Income and savings grid	Yes	Yes	Yes	Yes	Yes
Year-month origination FE	Yes	Yes	Yes	Yes	Yes
Postcode area FE	Yes	Yes	Yes	Yes	Yes
Lender FE	Yes	Yes	Yes	Yes	Yes
Observations	152,996	152,996	152,996	152,996	152,996
R^2	0.062	0.062	0.062	0.062	0.062
Adjusted R^2	0.061	0.061	0.061	0.061	0.061

Note: *p<0.1; **p<0.05; ***p<0.01

Table D3: The effect of inactive brokers on remortgaging (dataset with intermediated mortgages and small brokers only)

The sample is restricted to intermediated mortgages and brokers that sold less than 120 mortgages between July 2013 and June 2014. We replicate the regression in Table 14.

	Dependent variable:		
	On reversion		
	(1)	(2)	(3)
First-time buyer	0.011**	0.011**	0.011**
	(0.004)	(0.004)	(0.004)
Joint income	−0.026***	−0.026***	−0.026***
	(0.004)	(0.004)	(0.004)
Age in [30, 40)	0.006	0.006	0.006
	(0.005)	(0.005)	(0.005)
Age in [40, 50)	0.024***	0.023***	0.024***
	(0.006)	(0.006)	(0.006)
Age 50 or higher	0.036***	0.035***	0.035***
	(0.008)	(0.008)	(0.008)
Broker inactive for 2 quarters		0.019***	
		(0.004)	
Broker inactive for 4 quarters			0.018***
			(0.005)
Income and savings grid	Yes	Yes	Yes
Year-month origination FE	Yes	Yes	Yes
Postcode area FE	Yes	Yes	Yes
Lender FE	Yes	Yes	Yes
Observations	40,609	40,609	40,609
R^2	0.078	0.079	0.079
Adjusted R^2	0.075	0.075	0.075
Note:			*p<0.1; **p<0.05; ***p<0.01

Table D4: The effect of inactive brokers on likelihood to remortgage externally (dataset with intermediated mortgages only)

The sample is restricted to those mortgages that were intermediated at origination. We replicate the regression in Table 15.

	Dependent variable:				
	External remortgage				
	(1)	(2)	(3)	(4)	(5)
First-time buyer	−0.021***	−0.021***	−0.021***	−0.022***	−0.022***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Joint income	−0.012***	−0.012***	−0.012***	−0.012***	−0.012***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Age in [30, 40)	−0.012***	−0.012***	−0.012***	−0.012***	−0.012***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Age in [40, 50)	−0.049***	−0.049***	−0.048***	−0.048***	−0.048***
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Age 50 or higher	−0.114***	−0.114***	−0.114***	−0.114***	−0.114***
	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)
LTV in [60, 80)	0.090***	0.090***	0.090***	0.091***	0.091***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
LTV 80 or higher	0.138***	0.138***	0.138***	0.138***	0.138***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
dHP in [0.08, 0.19)	0.017***	0.017***	0.017***	0.017***	0.017***
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
dHP 0.19 or higher	0.017***	0.017***	0.017***	0.017***	0.017***
	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)
Broker inactive for 2 periods		−0.024***		−0.020***	
		(0.005)		(0.006)	
Broker inactive for 4 periods			−0.035***		−0.030***
			(0.007)		(0.007)
Small broker				−0.008**	−0.008**
				(0.003)	(0.003)
Income and savings grid	Yes	Yes	Yes	Yes	Yes
Year-month FE	Yes	Yes	Yes	Yes	Yes
Postcode area FE	Yes	Yes	Yes	Yes	Yes
Lender FE	Yes	Yes	Yes	Yes	Yes
Observations	122,852	122,852	122,852	122,852	122,852
R^2	0.082	0.082	0.083	0.083	0.083
Adjusted R^2	0.081	0.081	0.081	0.081	0.081

Note: *p<0.1; **p<0.05; ***p<0.01

Table D5: The effect of inactive brokers on likelihood to remortgage externally (dataset with intermediated mortgages and small brokers only)

We replicate the regression in Table 15 restricting the dataset to intermediated mortgages and small brokers.

	Dependent variable:		
	External remortgage		
	(1)	(2)	(3)
First-time buyer	−0.023***	−0.023***	−0.023***
	(0.006)	(0.006)	(0.006)
Joint income	0.004	0.004	0.004
	(0.006)	(0.006)	(0.006)
Age in [30, 40)	−0.017**	−0.017**	−0.017**
	(0.007)	(0.007)	(0.007)
Age in [40, 50)	−0.063***	−0.063***	−0.063***
	(0.008)	(0.008)	(0.008)
Age 50 or higher	−0.160***	−0.160***	−0.160***
	(0.012)	(0.012)	(0.012)
LTV in [60, 80)	0.038***	0.038***	0.038***
	(0.007)	(0.007)	(0.007)
LTV 80 or higher	0.087***	0.087***	0.087***
	(0.007)	(0.007)	(0.007)
dHP in [0.08, 0.19)	0.005	0.005	0.005
	(0.008)	(0.008)	(0.008)
dHP 0.19 or higher	0.001	0.001	0.001
	(0.012)	(0.012)	(0.012)
Broker inactive for 2 periods		−0.023***	
		(0.006)	
Broker inactive for 4 periods			−0.035***
			(0.007)
Income and savings grid	Yes	Yes	Yes
Year-month FE	Yes	Yes	Yes
Postcode area FE	Yes	Yes	Yes
Lender FE	Yes	Yes	Yes
Observations	30,923	30,923	30,923
R^2	0.084	0.085	0.085
Adjusted R^2	0.080	0.080	0.081

Note: *p<0.1; **p<0.05; ***p<0.01