

ADVISORY PANEL ON CONSUMER PRICES – TECHNICAL

Measuring Mortgage Interest Payments in the Household Costs Indices

Status: Work in progress

Expected publication: Not for publication

Purpose

1. As part of the Household Costs Indices (HCIs) development – a new set of measures that aim to reflect changing prices and costs as experienced by different household groups - this paper reviews potential methods for constructing the index for mortgage interest payments (MIPs). An initial review was presented in the APCP-T(21)07 and APCP-T(21)08 papers.

Action

2. Members of the Panel are invited to:
 - a. comment on the suitability of the three different ways to measure the mortgage interest payments to be included in the OOH class for the Household Costs Indices

Background

3. The Household Costs Indices (HCIs) aim to reflect UK households' experience of changing prices and costs. They are intended to measure how much the nominal disposable income of different household groups would need to change, in response to changes in price and costs, to enable household groups to purchase the same quantities of goods and services at a fixed quality. The broad approach of the HCIs is thus to measure the outgoings of households.
4. The HCIs are in development, and we are producing annual publications of monthly estimates back to 2005 (see [Third preliminary estimates, 2005 to 2019](#)). The focus is on inflation for different subgroups of the population, although we make the necessary assumption that different groups face the same prices and that spending patterns drive the differences between groups.
5. In the most recent publication ([Third preliminary estimates, 2005 to 2019](#)), the HCIs differed from our other inflation measures in the use of democratic weighting, of a payment approach (for OOH, tuition fees/loans and insurance) and of financial debt payments.
6. Following feedback from the Stakeholder Advisory Panel on Consumer Prices, we are reviewing the method for calculating mortgage interest payments for the next publication, due in the first quarter of 2022. Our development plans for the HCIs and be found in our [roadmap](#).
7. We have tested three different methods of measuring mortgage interest payments (MIPs):
 - a. The current MIPs method used in the RPI (Annex A)
 - b. Simple revaluation (Annex B)
 - c. Lender's formula method (Annex C)
8. Alongside including MIPs in the HCIs, discussion has focussed on the appropriateness of also adjusting for capital mortgage repayments which are not part of consumer price inflation

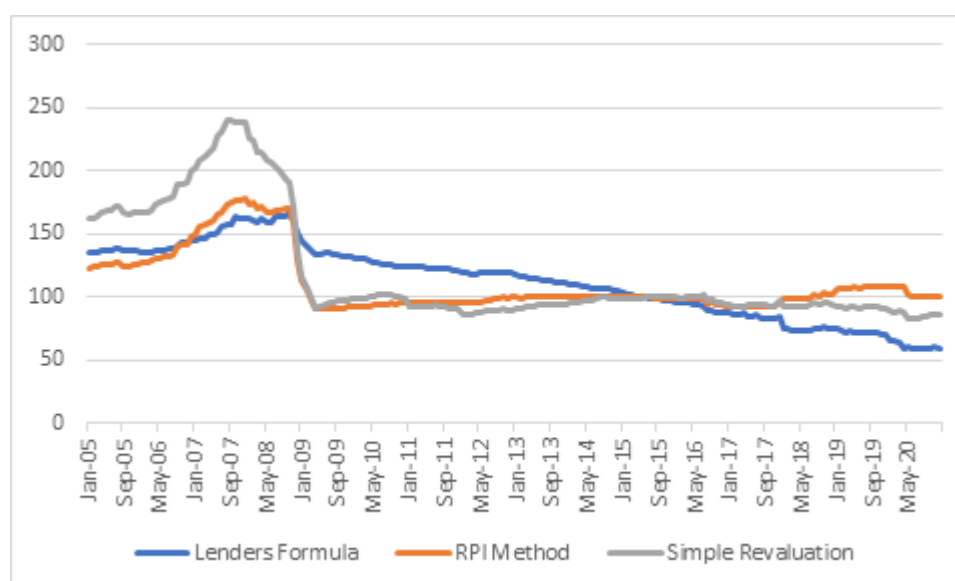
measures as they represent the purchase of assets. In [July 2019](#), the National Statistician decided that the ONS will develop a measure of capital mortgage repayments “in a variant measure, the HCIC (HCI – Capital), after work on the main HCIs has been completed. This will allow users with varying needs to select the best measure for their purpose”.

Proposed methods to measure interest mortgage payments

9. *Current method used in the RPI:* The method uses a time series of average house prices bought on mortgages over a 23-year period. To obtain repayment mortgages, the monthly average house price is multiplied by 0.55, which is a constant loan-to-value ratio (LTV), and by the proportion of debt outstanding on a standard 23-year mortgage. This series is then combined with the corresponding series on endowment mortgages. Further analysis on this method can be found in Annex A.
10. *Simple revaluation:* This is the simplest approach to measuring mortgage interest payments. It uses the index of house prices over time and applies the effective interest rates to calculate an index of mortgage interest payments over time. This approach is used by Stats New Zealand. Further analysis on this method can be found in Annex B.
11. *Lender’s formula method:* When a candidate mortgagor applies for a mortgage, the lenders derive mortgage repayments based on the amount of the loan, the length of the mortgage and the type of interest rate (fixed or variable) which can vary depending on the LTV ratio. We use this method of calculating mortgage repayments to create a mortgage interest payments index. Further analysis on this method can be found in Annex C.
12. A drawback of all three of these methods is that we can’t separate land and dwelling prices.

Comparison of the three methods

Figure 1: Comparison of the three proposed methods to measure mortgage interest payments (2015 = 100)



13. The simple revaluation method shows a greater decline in the index during the economic downturn in 2008. This is partly explained by the use of the house price index (geometric

mean) for all properties sold in the UK, rather than the use of the average house prices from the RPI (arithmetic mean).

14. The Lender's formula method shows a steady decline between 2009 and 2020, this is explored in Annex C.

Current RPI method

15. Sensitivity analysis on the RPI methods suggests that the MIPs index correctly reflects the interest rate used. It follows that an improvement of the RPI could be to use an average of variable and fixed interest rates as the latter has become more prevalent in recent years.
16. The RPI adjusts the mortgage figures using complex information from the Living Costs and Food Survey (LCF) team to derive the weight associated with the mortgage length, currently fixed at 23 years. The complex data requirement did not enable the adjustment for a different mortgage length in this paper.
17. The inclusion of all mortgage households will require further research and collaboration with our internal stakeholders. Based on current survey specifications, as adopted by the RPI, the method does not currently include pensioner households, which derive at least three-quarters of their total income from state pensions and benefits, and high-income households, defined as those households whose total household income lies within the top 4% of all households.

Simple revaluation method

18. The simple revaluation method has the advantage that it is currently used in other countries, enabling international comparability and that it is straightforward to apply.
19. The simple revaluation method does not account for the fact that mortgages last many years (mortgage interest payments aren't only based on the price of houses as of today).

Lender's formula method

20. The strength of the Lender's formula method lies in the application of the exact formula used by lenders, so capturing the payments received by banks holding the defining criteria (price advanced, type of interest, mortgage lifespan). It can be reasonably argued that the further an estimation method is away from the actual method, the larger is the risk of bias.
21. As the lender's formula entails the computation of capital payments (see Equation 3), the method could be taken into consideration for the development of the planned HCIC's capital variant measure.
22. There are certain limitations to the method which warrant discussion. First, in the absence of cohort weights by type of mortgage, the interest payments resulting from variable and fixed rates contribute similarly which may not reflect the true pattern if the weights are significantly different. Secondly, the average advance may be biased between 1995 and 2004 when it was based on a small sample. These two limitations will be potentially addressed through bespoke data from the FCA. Thirdly, the method is based on the most common type of fixed rates for which the BoE publishes the series, whereas less frequent interest rates are not available. This limitation is however diminished by the fact that, being typical, the available series of interest rates account for most mortgages.

Conclusion

23. If the construction of the indices under the RPI method is deemed to be a good method, no change will be required for the computation of the MIPs index for the aim of the HCIs. Alternatively, the more straightforward simple revaluation approach could be used to derive the MIPs index which uses the same interest rate series as the RPI method.
24. If it is preferred to use a method that fully originates from the mortgage formula adopted by lenders for the computation of monthly payments, the lender's formula method can be adopted.

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October 2021

List of Annexes

Annex A	Current method used in the RPI
Annex B	Simple revaluation approach
Annex C	Lender's formula approach
Annex D	Lender's formula methodology

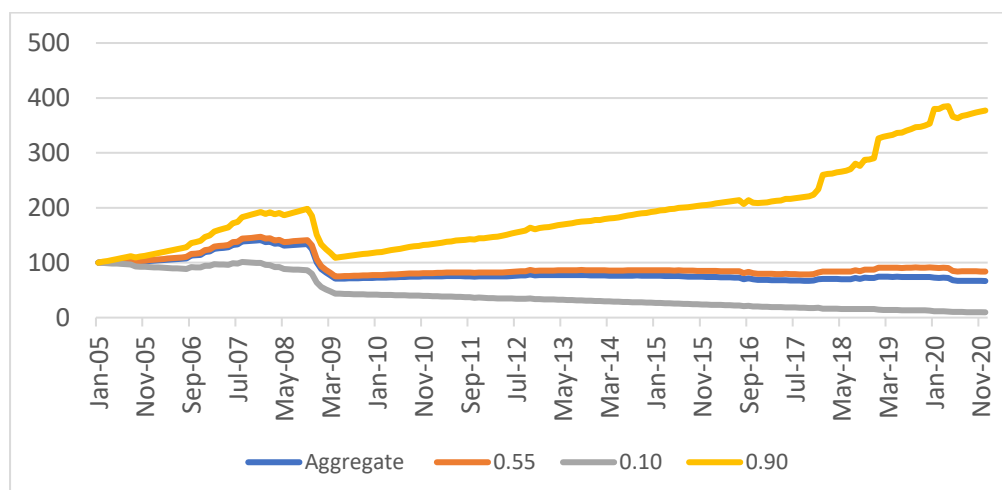
Annex A: Current method used in the RPI

25. The RPI aims to treat mortgage interest in a manner consistent with a fixed basket approach. Average payments are calculated in successive months for a fixed stock of mortgages representing those existing in the January base period. This base period stock of mortgages is uprated monthly to reflect changing house prices, and then interest payments are calculated using the prevailing interest rates in the period.
26. The current RPI method for calculating mortgage interest payments starts with a time series of average house prices bought on mortgages over a 23-year period and the average is weighted to reflect the constant mix of house types.
27. For each month, the average house price is multiplied by the proportion of the house price covered by the mortgage. This figure is called the advance/price ratio and is a constant (0.55). This constant has not been updated for many years. This series is then used to calculate two separate debt series, a series for repayment mortgages and a series for endowment mortgages.
28. For repayment mortgages, the debt is multiplied by the proportion of debt outstanding on a standard 23-year mortgage, worked out using a standard annuity calculation.
29. The debt on endowment mortgages does not decrease over time and therefore it is not altered.
30. The two series are then summed to give the average current debt outstanding on mortgages of different types and vintages.
31. The series is then multiplied by the proportion of index households that have mortgages and this gives the average mortgage debt for index households with a new or existing mortgage.

Index households are defined as all private households (not those living in institutions such as prisons, retirement homes or student accommodation, for example) excluding pensioner households, which derive at least three-quarters of their total income from state pensions and benefits, and high-income households, defined as those households whose total household income lies within the top 4% of all households, as measured by the Living Costs and Food Survey (LCF). This new series is then scaled using LCF data to reflect households that have outstanding mortgage debt.

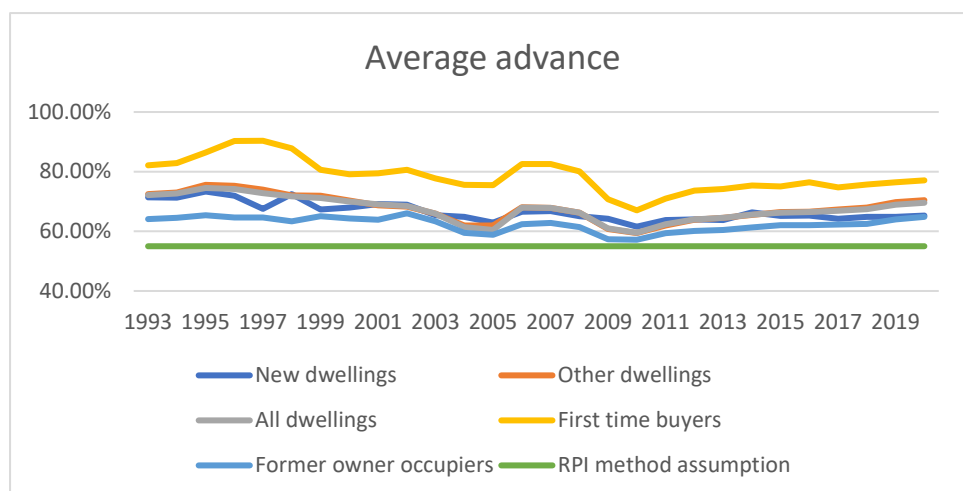
32. The scaled series is then multiplied by the current period mortgage interest rates to derive an average weekly payment per household. An index is then produced using the average weekly payments. The method for deriving the mortgage interest rates varies and is described below. A full description of the method can be found in the [Consumer Prices Indices Technical Manual](#).
33. We build off the work presented in the previous paper, *APCP-T(21)08 Current mortgage interest payments methodology: a review* where we compared alternative prices advanced in the year of the index (e.g., January to December 2019 for 2019 index) (Figure 1A).

Figure 1A: MIPs index (Jan05=100) from alternative LTV ratios (0.10 to 0.90) as compared to the 0.55 LTV ratio from the RPI and the aggregate index from the alternative LTV ratios



Source: APCP-T(21)08 Current mortgage interest payments methodology: A review

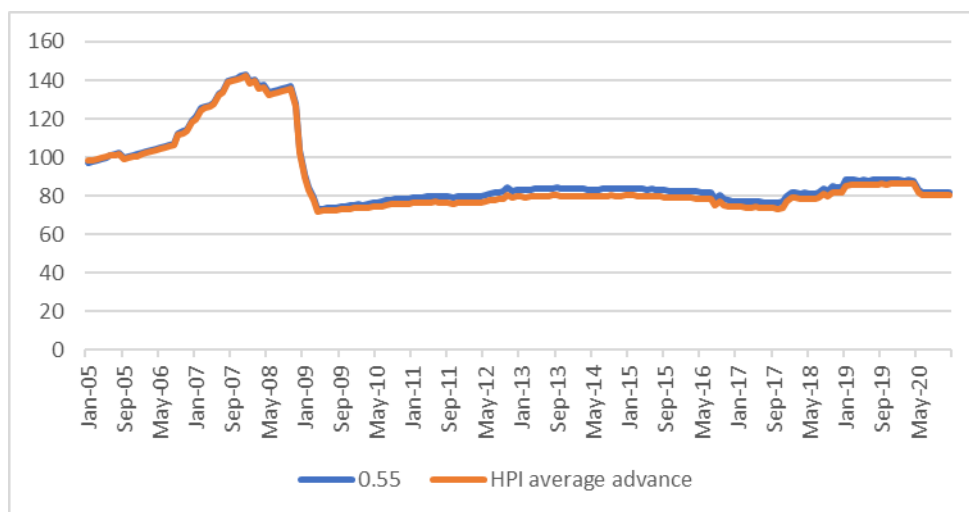
34. Because the advance/price ratio changes through time, the assumption of a change in the current year only is reviewed in this paper where we use advance/price ratios from the [HPI's quarterly tables](#) throughout the full time series (e.g. 2005 to 2019 for the 2019 MIPs index). This is in line with the HCIs aim of capturing optimally consumer behaviour, as manifested here in the amount of mortgage requested to a lender.
35. Data from the analysis on the ONS HPI quarterly tables (Table 15) shows that between 1993 and 2020, the loan-to-value ratio (or advance/price ratio) amounted to 0.67 for 'new dwellings', 0.68 for 'other dwellings', 0.67 for 'all dwellings', 0.79 for 'first time buyers' and 0.62 for 'former owner occupiers'. This shows that the 0.55 figure used in the current MIPs method consistently underestimates the proportion of price advanced for all types of dwellings and buyers.

Figure 2A: Loan-to-value ratio based on HPI publication. 1993 to 2020

Source: own analysis on [ONS HPI publication, Table 15](#) (formerly published by DCLG)

36. We were advised by the technical panel to use the average advance for the ‘all dwellings’ group in our analysis. One issue we encountered is that the dataset only goes back to 1993, whereas the MIPs method has data from 1982 as a result of using a mortgage length of 23 years and starting the time series in 2005. To overcome this, from 1982 to 1992, we used the 1993 figure.
37. The [HPI’s annual tables](#) (Table 30) provides advance/price ratios for each year from 1969 onwards. The advance/price ratio is calculated for each observation and then aggregated, which is different to how we have calculated the advance/price ratios in this analysis. This analysis calculates them using the average price, and average advance for all buyers in quarter 1 of the relevant year, and then calculates the advance/price ratios. This is because January is the base period, and so we take a fixed stock of housing debt in the base period and revalue the debt payments each month using the changes in the interest rate. Fixing the stock of debt makes it a ‘price’ index rather than an expenditure index. So, we would want our advance/price ratio to be fixed in January too. However, we do use annual (y-1) weights at higher levels, so it may be interesting to see the difference using the annual advance/price ratios.
38. When we replaced the 0.55 proportion from the current method with the loan-to-value ratios from the HPI publication, we obtained an index with a very similar shape to the index produced using 0.55 as the proportion of price advanced (Figure 3A).

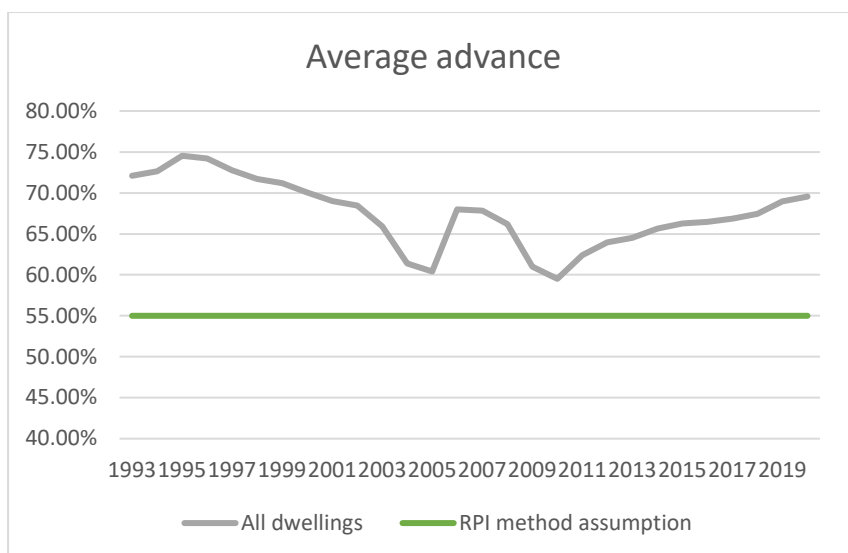
Figure 3A: MIP index (2005=100) obtained using LTV ratios from the HPI tables



Source: Own analysis, RPI, [ONS HPI publication, Table 15](#) (formerly published by DCLG)

39. Despite the advance/price ratios being different (as shown in Figure 4A), the shape of the index remained very similar. This prompted us to carry out further analysis to identify which variables (LTV ratio or house prices) were having a significant impact on the shape of the index.

Figure 4A: Average advanced on all dwellings (HPI tables) between 1993 to 2020 compared to the RPI assumption



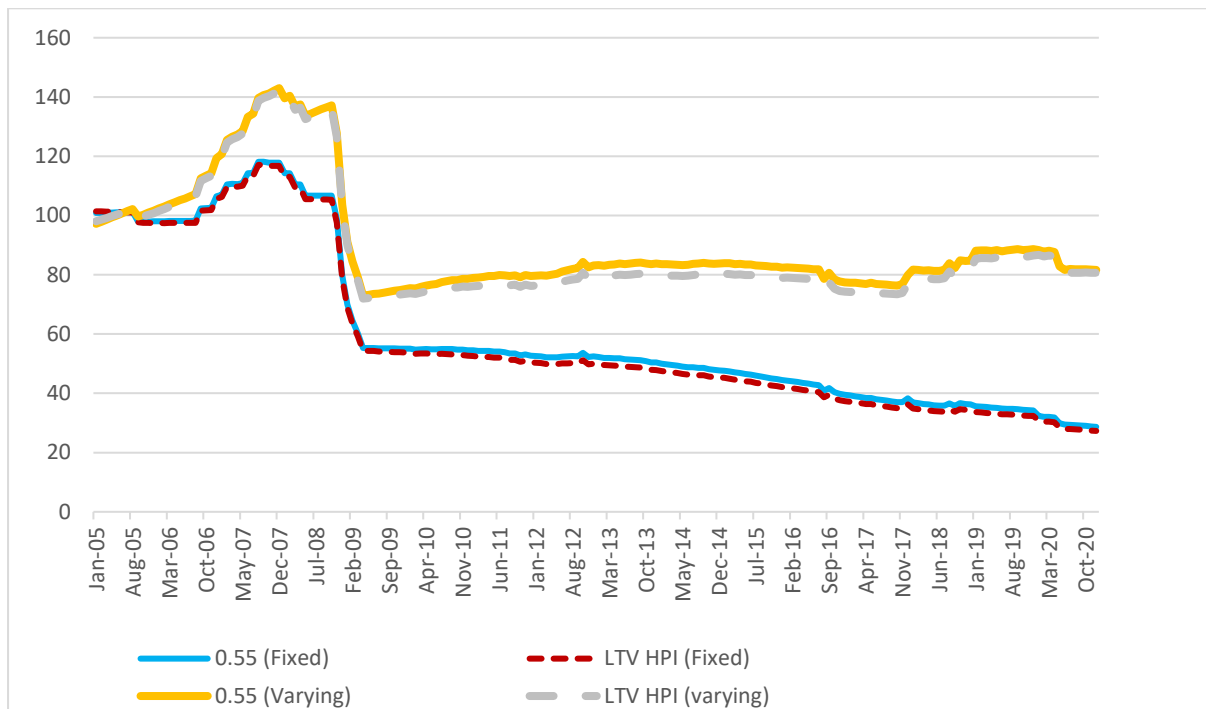
40. To see what the effect the LTV ratio and house prices would have on the index, we produced the MIPs index holding the house price constant (fixed at £100,000) throughout the whole series, while allowing the LTV ratio to vary.

41. We compared the new MIPs indices with the indices plotted in Figure 3A, that is when the LTV ratio and the house prices vary. We observed that the indices are very close regardless of the

LTV ratio used. The comparison of the indices under constant and varying house prices show that house prices have an impact on the MIPs index calculated using the RPI approach. As expected, the MIPs index using constant house prices follows the slightly decreasing interest rate after 2009.

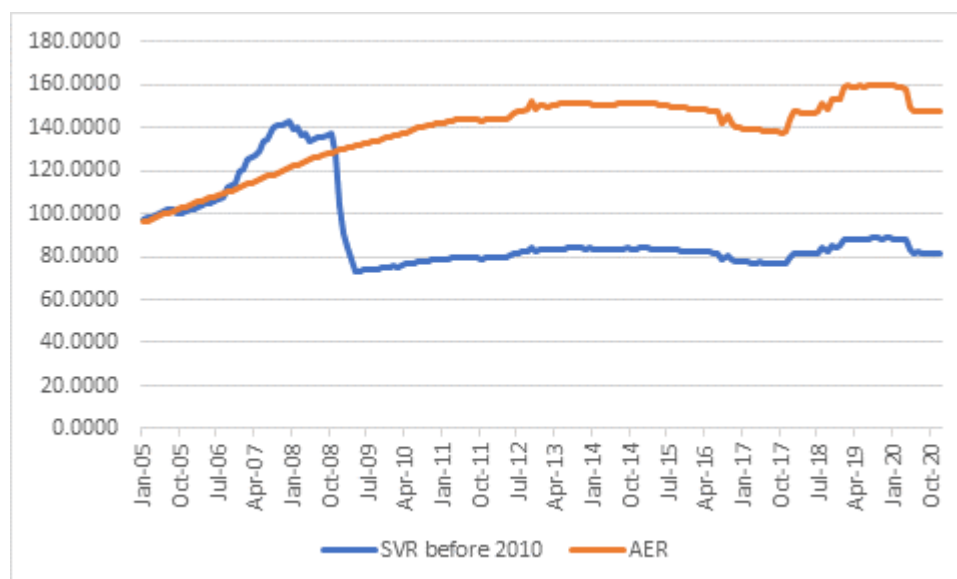
- 42. This suggests that the impact of the LTV ratio is negligible using the RPI method, whereas the house prices do have an impact.

Figure 5A: MIPs index (2005=100) obtained using fixed and varying house prices



- 43. As advised by stakeholders, Figure 6A displays the current MIPs index from the RPI and the MIPs index obtained using only the AER across time, where 2005 = 100.

Figure 6A: MIP index (2005=100) from the current RPI and using the AER across time.



Further areas to consider

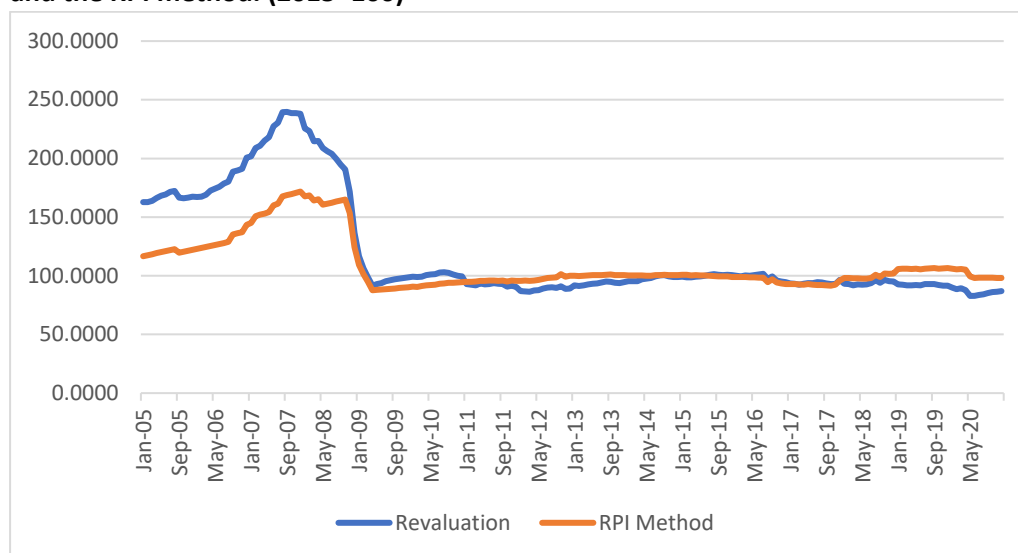
45. Using the average house price from HPI rather than what is used for the RPI (geometric mean rather than arithmetic mean).
46. Mortgage length (we would need to investigate whether weights from the LFS allow for this).
47. The inclusion of all mortgage households will require further research and collaboration with our internal stakeholders. Based on current survey specifications as adopted by the RPI, the method does not currently include pensioner households, which derive at least three-quarters of their total income from state pensions and benefits, and high-income households, defined as those households whose total household income lies within the top 4% of all households.

Annex B: Simple revaluation approach

48. The simple revaluation approach uses the index of house prices over time and applies the effective interest rates to calculate an index of mortgage interest payments over time. We used the standard variable rate (SVR) prior to 2010 the annual effective rate (AER) after 2010, as is done in the RPI method. We also experimented with using the AER throughout the whole series:
 - a. The interest rate and house price index are both re-referenced to the same period (2005 = 100)
 - b. The interest rate index is then adjusted to inflation by taking the current month's interest rate index divided by the January of the same year's interest rate index, we then multiply that by the current month HPI index divided by the January of the same year's HPI index and multiply it by 100.
 - c. The resulting index is then chain linked.
49. Figure 1B shows the MIPs index under the current RPI method and under the simple revaluation approach adopted in New Zealand. It appears that the two indices generally follow the same shape across the series. However, prior to 2009, the indices differ significantly in terms of the index values. The revaluation MIPs index is much greater prior to 2009, with an average difference of 44.54 between January 2005 – July 2009. However, the difference is

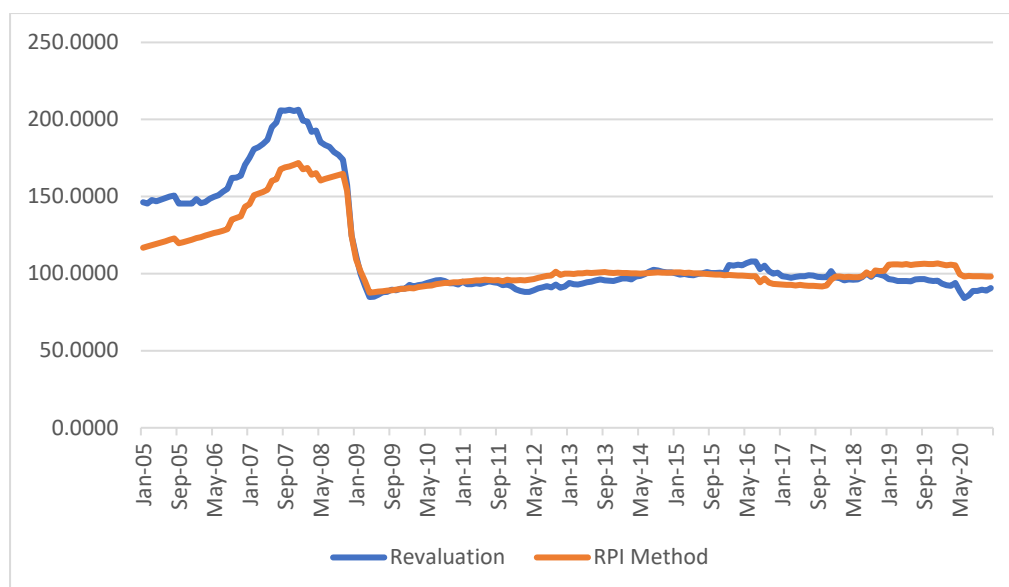
much less pronounced for the rest of the index with the average difference between August 2009 – December 2020 is -3.5999.

Figure 1B: Comparison between the MIPs index produced using the revaluation method and the RPI method. (2015=100)



50. We also produced the simple revaluation MIPs index using house prices from the RPI method rather than the HPI index (Figure 1B). We once again see a similar result to the one seen in Figure 1B with a significant difference prior to 2009. However, in this method, the difference is not as great. Notable, we do see some more differences later in the series. From January 2005 – July 2009, the average difference is 22.6059 and from August 2009-December 2020 the average difference is -2.1268.

Figure 2B: Comparison between the MIPs index produced using the revaluation method (with house prices from the RPI) and the RPI method. (2015=100)



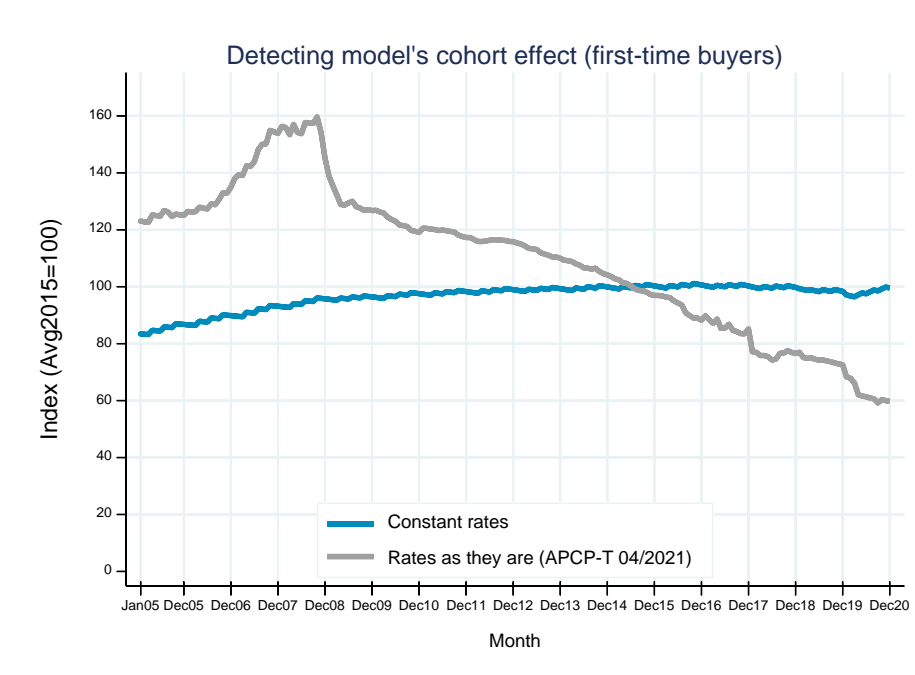
Annex C: Lender's formula approach

51. The application of the lender's formula requires three types of data:
 - a. Interest rate
 - b. Mortgage lifespan
 - c. Price advanced (i.e. amount of mortgage)
52. Mortgage interest rates are published by the Bank of England. To best approximate true interest payments, we accounted for both variable and fixed rates.
53. As a variable rate, we used the revert-to-rate series (IUMTLMV) which exists continuously since January 1995 and can be considered as the standard variable rate.
54. Fixed rates vary depending on the loan-to-value (LTV) ratio, with rates increasing with the LTV ratio to offset the risk of insolvency.
55. To test the method, for the APCP-T(21)07 paper, we used:
 - a. Monthly interest rate of UK monetary institutions (excl. Central Bank) sterling 2 year (75% LTV) fixed rate mortgage to households (in percent) not seasonally adjusted (IUMB34), from January 1995
 - b. Monthly interest rate of UK monetary institutions (excl. Central Bank) sterling 5 year (75% LTV) fixed rate mortgage to households (in percent) not seasonally adjusted (IUMB42), from January 1995
56. The method which was firstly introduced in the APCP-T(21)07 paper can be found in Annex D.
57. This section addresses comments on the APCP-T(21)07 paper, *Lender's formula for mortgage interest repayments*, discussed in April 2021.
58. In particular, we address the following comments:
 - impact of mortgage cohorts on the MIPs index;
 - coverage for all-time buyers;
 - assumption of same type of rates (e.g. 5-year fixed) through time;
 - identifying information on mortgage length;
 - identifying information on weight by type of mortgage rate.

Cohort effect in lender's formula method

59. Mortgagors pay according to the Lender's formula, with interest payments larger over the first half of the loan. It follows that, in the Lender's method presented in the APCP-T(21)07 paper, the decreasing MIPs index through time might reflect the pattern of decreasing interest payments rather than the variation in mortgage interest rates.
60. This potential drawback was verified as follows: we constructed a MIPs index using constant mortgage rates and compared it to the MIPs index presented in the APCP-T(21)07 paper. Reasonably, if the MIPs index is shaped by decreasing interest payments, we will observe a decreasing MIPs index independently of the mortgage rates used (whether constant or actual).
61. The comparison method consisted of replacing the fixed rates and the monthly variable rates with the rate at the time of the initial mortgage terms.
62. Figure 1C, plotting the two indices under comparison, does not corroborate the assumption of an MIPs index shaped by decreasing interest payments through time. Indeed, the constant-rate MIPs index exhibits a slight upward trend in line with increasing house prices.

Figure 1C. MIPs index from APCP-T(21)07 and from constant rates. Q1 1995 to Q4 2020.



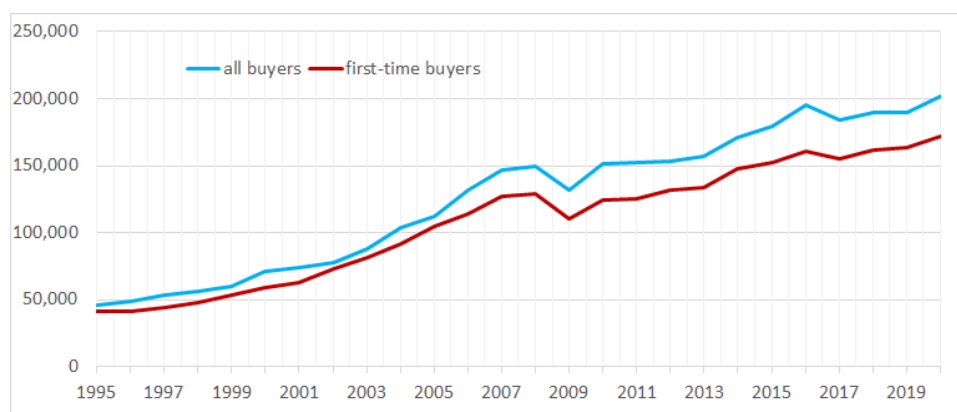
Source: own analysis

Lender's formula for all buyers

63. As an initial application of the Lender's formula, for the APCP-T(21)07 paper, we derived the MIPs index for first time buyers. This is because the first-time buyers' category could be included in the HCIs separately from former owner-occupiers as they face the full inflationary cost of house purchase. In particular, separating first-time buyers from former owner-occupiers would enable a different treatment for down payments in future development.

64. As the OOH costs class of spending, which incorporates MIPs, refers to all owner occupiers, whether first-time or former buyers, the rest of this paper focuses on all buyers.
65. The computation of the MIPs index, from 2005 to 2020, for all buyers was similar to that for first-time buyers and is described below:
- Fix the price advanced within a calendar year
 - From 1995, create a series of interest repayments for a 5-year fixed rate
 - Repeat step (2) four times a year (January, April, July, October)
 - Run each mortgage series up to 300 months (i.e. 25 years).
 - Obtain a summary value of interest payments for each mortgage cohort as a weighted average of the fixed and variable rate products in the mortgagor population for that specific cohort.
 - Average out all mortgage cohorts contributing to interest payments from January 2005 onwards
 - Derive mortgage interest repayment index from January 2005 onwards as the change in average repayments
66. The price advanced for all buyers was extracted from Table 15 of the HPI publication (i.e. average advance for all dwellings instead of average advance for first-time buyers) and is plotted in Figure 2C, alongside the average advance for first-time buyers.

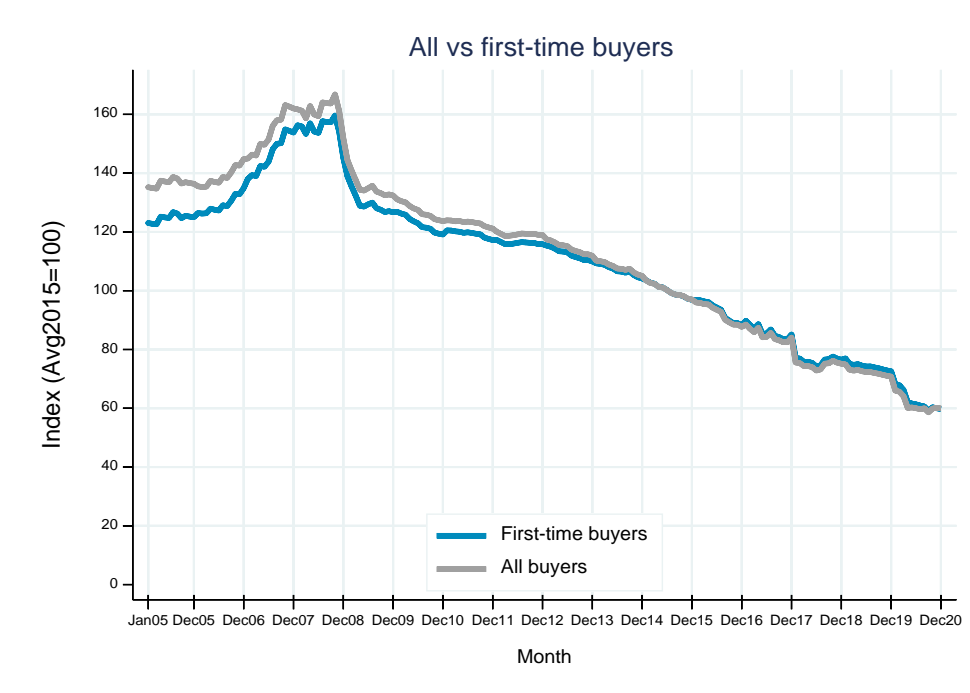
Figure 2C. Average advance for all dwellings and first-time buyers.



Source: ONS HPI, formerly published by DCLG

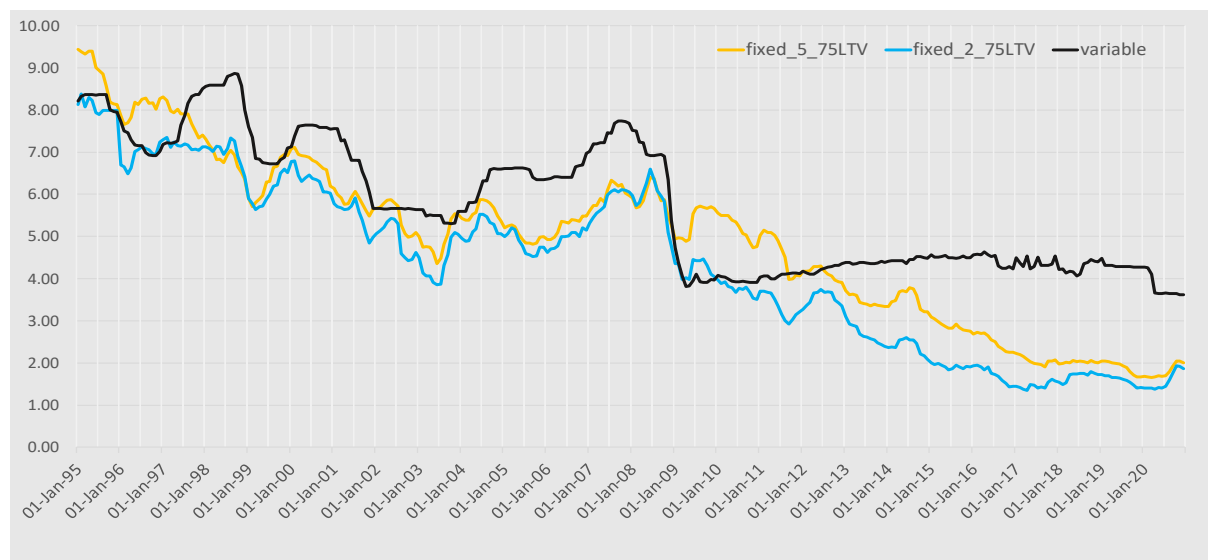
67. The MIPs index for all buyers and for first-time buyers is displayed in Figure 3C, where we observe a higher index, gradually overlapping through time, for the former group. This pattern could be explained with the higher interest rates at the beginning of the series (Figure 4C).

Figure 3C. MIPs index for first-time and all buyers. Q1 1995 to Q4 2020.



Source: own analysis

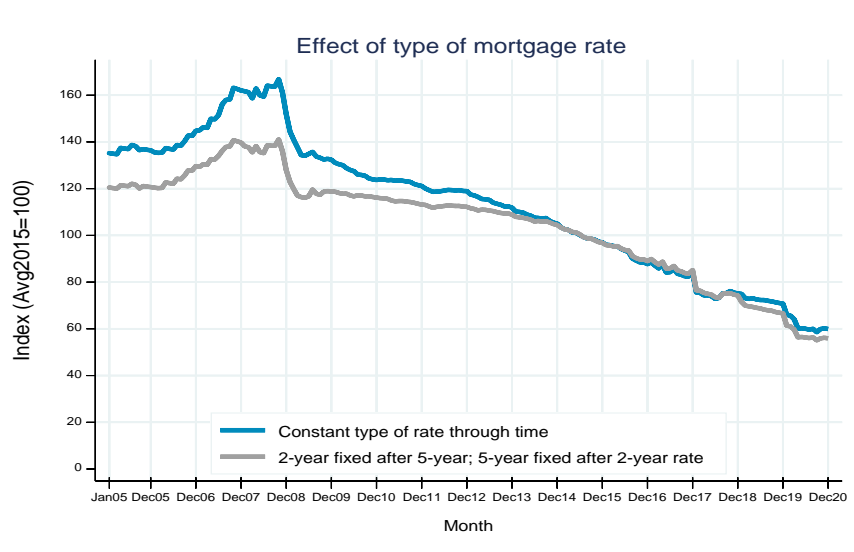
Figure 4C. Mortgage interest rates used for the application of the lenders formula.



Changes in type of mortgage rates through time

68. Since mortgagors can apply for a fixed or variable rate, the Lender’s formula method adopted here takes into account both options over the duration of a mortgage. At the end of a fixed rate period, the option for a mortgagor is either a new fixed rate period, of similar or different length than previously, or a variable rate.

69. For the sake of simplicity, in APCP-T(21)07 paper, it was assumed that at the end of the first time period the terms were constantly renewed for an interest rate of similar type and length up to the 25th year (e.g. 2-year fixed rate mortgages were renewed every two years), with the new rate extracted from the corresponding BoE series.
70. For this paper, it was tested whether the alternative fixed-mortgage after the first time period (e.g. a 2-year fixed rate after a 5-year fixed rate) would produce different results compared to those presented in the APCP-T(21)07 paper. The method was as follows:
1. Fix the price advanced within a calendar year
 2. From 1995, create a series of interest repayments for a 5-year fixed rate. At the end of the first term, assume that the new rate is a 2-year fixed rate for the rest of the mortgage.
 2. From 1995, create a series of interest repayments for a 2-year fixed rate. At the end of the first term, assume that the new rate is a 5-year fixed rate for the rest of the mortgage.
 2. From 1995, create a series of interest repayments for a monthly variable rate.
 3. Repeat step (2) four times a year (January, April, July, October)
 4. Run each mortgage series up to 300 months (i.e. 25 years).
 5. Obtain a summary value of interest payments for each mortgage cohort as a weighted average of the fixed and variable rate products in the mortgagor population for that specific cohort.
 6. Average out all mortgage cohorts contributing to interest payments from January 2005 onwards
 7. Derive mortgage interest repayment index from January 2005 onwards as the change in average repayments
71. The MIPs index with a change in the type of fixed rates is plotted in Figure 5 alongside the simplified approach. Both approaches have in common the monthly variable rate, therefore any difference is due to changing the type of mortgage rate after the first time period.
72. Figure 5C points to changes in the MIPs index under the alternative approach, with a lower index from 2005 to 2013.
73. Two conclusions can be drawn from this finding. The first is that the MIPs index is sensitive to the interest rate used, which provides evidence on the appropriateness of the Lender's formula for the computation of a MIPs index. The second conclusion is that a simplified approach tends to provide a biased index and therefore a more complex set of mortgage rates should be used to approximate the real MIP index in the mortgagor population.

Figure 5C. MIPs index for changes in the fixed rate after the first time period.

Source: own analysis

Mortgage length

74. Currently the lender's formula method assumes that the length of a mortgage is 25 years. The duration of the mortgage has no impact on the interest payment index, provided the same length is applied uniformly across the mortgage cohorts. However, the assumption of a constant length may not hold across the quarterly mortgage cohorts from 1995 to 2020.
75. The method could be improved by using [ONS HPI tables](#) that publish average mortgage period between 1990 and 2002, and from 2006. The modal mortgage length is 22 years (see Table 1).

Table 1. Annual average mortgage length from ONS HPI tables.

	Average mortgage period years
1990	24
1991	23
1992	23
1993	22
1994	22
1995	22
1996	22
1997	22
1998	22
1999	22
2000	22
2001	22
2002	23
2003	..
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2005	..
2006	24
2007	24
2008	23
2009	22
2010	22
2011	23
2012	24
2013	24
2014	25
2015	25
2016	26
2017	26
2018	27
2019	27
2020	27

Source: HPI Annual tables, Table 20

76. Other data sources are the British Household Panel Survey (BHPS) and the subsequent Understanding Society Survey (USS).
77. The BHPS, a multi-purpose study, began in 1991 when the wave 1 panel consisted of some 5,500 households and 10,300 individuals drawn from 250 areas of Great Britain. Additional samples of 1,500 households in each of Scotland and Wales were added to the main sample in 1999, and in 2001 a sample of 2,000 households was added in Northern Ireland, making the panel suitable for UK-wide research. The BHPS was replaced by the Understanding Society Survey (USS) in 2008. The USS, also known as the UK Household Longitudinal Study, is commissioned by the Economic and Social Research Council and led by the Institute for Social and Economic Research at the University of Essex. The study started in 2008-10 (Wave 1) when about 40,000 households were interviewed and re-visited each year afterward, with the latest available survey run in 2017-19 (Wave 9). Additional cohorts were added through time such as the Immigrant and Ethnic Minority Boost Sample (IEMBS) which was introduced at Wave 6.
78. The main USS sample consists of a new large General Population Sample (GPS). The GPS consists of a two-stage sample of residential addresses in England, Scotland and Wales and of a single stage systematic sample of addresses in Northern Ireland. As for Great Britain, the sample was obtained by firstly randomly selecting postcode sectors as the primary sampling units and then by selecting addresses within each sector. The former BHS sample was incorporated into Understanding Society from Wave 2 onward. Weights consist of a design weight and a cross-sectional weight.
79. As an example for the aim of improving the lender's formula method, mortgage length was estimated for the households participating in Wave 7 (2015-2017) and is shown in Table 2. The length was computed by combining two variables (*when the mortgage was taken out; years left*) for each household. Noteworthy, by using all waves, it would be possible to estimate a mortgage length based on a larger sample.

Table 2. Mortgage length by start year of mortgage. Wave 7, USS.

Year (mortgage taken out)	Mortgage length (average)	Number of respondent households
1995	20	1
1996	25	1
1999	22	2
2001	22	2
2002	19	2
2003	31	2
2004	22	2
2005	26	1
2006	27	4
2007	28	2
2008	27	1
2010	23	2
2011	30	2
2012	27	3
2013	24	3
2014	23	10
2015	23	15
2016	22	11

Source: own analysis on USS, wave 7

Mortgage cohort weights

80. The method assumes that fixed and variable rates have a similar proportion of mortgages. This is due to data limitation. Indeed, at present the weights associated with fixed (as a whole) and variable rates are available from Q1 2008 from the Financial Conduct Authority (FCA) website, whereas the current lenders method starts from 1995 to minimise loss of information in capturing interest payments. Table 3 shows the information currently available from Q1 2008.
81. Additional data will allow the improvement of the method in generating average payments, currently based on a simple rather than weighted average. An initial analysis based on the information in Table 2 from 2008 onwards suggest however small changes in the index when adjusting for weights (Figure 1).

Table 3. Characteristics of new lending in latest quarter. Percentages

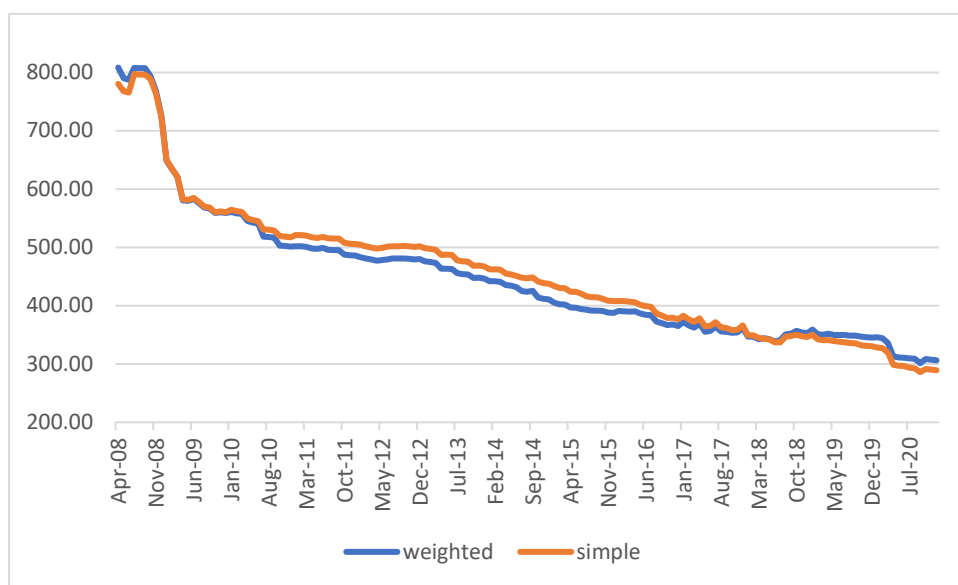
	Banks	Building societies	Other lenders	All Sectors
Gross advances				
Per cent at fixed rates	38.83	59.30	59.05	45.88
Per cent at variable rates	61.17	40.40	40.95	54.12

Balances

Per cent at fixed rates	46.94	60.00	59.67	51.57
Per cent at variable rates	53.06	40.00	40.33	48.44

Source: FCA, MLAR statistics: detailed tables, Table 2.2

Figure 6C. Mortgage interest payments from Lender's formula. Simple vs weighted average.



Source: own analysis

Annex D: Lender's formula method

Financial formula for mortgage repayments

82. When a candidate mortgagor applies for a mortgage, the lenders derive mortgage repayments based on the amount of the loan, the length of the mortgage and the type of interest rate (fixed or variable) which can vary depending on the loan-to-value (LTV) ratio.
83. Lenders use the following financial formula which, by design, provides the exact payment at each point in time that will enable the full debt to be paid off by the end of the mortgage:

$$T = \frac{\text{Loan} * R^n}{(R^n - 1)} (R - 1) \quad \text{Equation 1}$$

Where

T is the total monthly repayment

$$R = \left(1 + \text{interest rate} * \frac{1}{12} \right)$$

n is the mortgage length in months (e.g. 300 for a 25-year mortgage)

84. If the mortgage rate was fixed over the full duration of the mortgage, the monthly mortgage repayments would only be computed at the start of the loan. In the absence of interest rates of such length, Equation 1 is rerun at the end of each interest rate period to provide the new monthly payment. It follows that the equation is rerun every month for a variable rate and every k years for a k -year fixed interest rate.
85. While for the first repayment the 'balance' consists of the loan itself, subsequently it consists of the remaining debt after adjusting for payments to date. The following equations illustrate the computation of the monthly payment and of the balance after the first time period.

$$T = \frac{\text{Balance} * R^n}{(R^n - 1)} (R - 1) \quad \text{Equation 2}$$

$$\text{Balance}_2 = \text{Loan} - \text{Principal}_1$$

$$\text{Principal}_1 = \text{Loan} - \text{Total payment}_1$$

86. To note, the 'Principal' is the capital payment.
87. The equation for the balance can be generalised as follows for any month over the duration of a mortgage:

$$\text{Balance}_{i+1} = \text{Balance}_i - \text{Principal}_i \quad i = 1, \dots, n \quad \text{Equation 3}$$

n = length of mortgage in months

$\text{Principal}_i = \text{Payment}_i - \text{Interest portion}_i$

88. The monthly interest portion is given by:

$$I = \text{Loan} \frac{\text{rate}}{12} \quad \text{for first time period}$$

$$I = \text{Balance} \frac{\text{rate}}{12} \quad \text{for subsequent periods}$$

89. For the sake of simplicity, equation 1 and 2 are simplified as follows:

$$K = \frac{R^n}{(R^n - 1)} (R - 1)$$

$$T = \text{Loan} * K \quad \text{Equation 1.1}$$

$$T = \text{Balance} * K \quad \text{Equation 2.1}$$

Appendix

Figure A. MIPs index. Lender's formula (all buyers) and RPI's method (AER).

