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Fixed vs. adjustable-rate mortgages and attention

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ABSTRACT

The aim of this paper is to analyze the attention of households to fixed-rate and adjustable-rate mortgage loans depending on the evolution of interest rates. We hypothesize that a high level of general interest rates would lead to a higher attention to adjustable-rate mortgages. Using Google Trends tool to capture this attention, we demonstrate using VAR models that upsurges in interest rates precede a larger attention on Google searches related to adjustable-rate mortgages, but not for fixed-rate mortgages.

1. Introduction and theoretical background

The mortgage market is a key element in the U.S. economy (Ahn et al., 2022). According to FRED data, the outstanding debt for all kind of mortgages surpasses $19 trillion by Q3 2022. During the last decades, homebuyers tend to choose a Fixed-Rate Mortgage (FRM, hereinafter), especially the 30 years Fixed-Rate Mortgages rates (30-yr FRM). In this sense, the Adjustable-Rate Mortgages (ARM, hereinafter) share among all mortgages stayed below 10 % since 2010, with values lower than 3 % during 2020 and 2021[1]. It seems pretty clear that in a low interest rates scenario (the 30-yr FRM has ranged between 2,66 % and 5,21 % between January 2010 and December 2020[2]), homebuyers are more prone to choose FRM and avoid uncertainty.

However, recent events have risen the interest rate structure and have impacted the fundamentals of this market. In this sense, the more expensive interest rate market after the sequential increases in the interest rates to control inflation, has led to a different scenario. Thus, the 30-yr FRM rates have reached 7,08 % in autumn of 2022. Thereby, in May, 2022, the CNBC entitled like this: *"adjustable-rate mortgage demand surges to 14-year high, as homebuyers try to afford this pricey spring market"*. In this new context, the mortgage market has been turned upside down and homebuyers seem to opt for an ARM and the share of this kind of mortgages has sharpely increased reaching again double figures.

The analysis of the optimal mortgage choice, usually between FRM and ARM, has been deeply studied in the previous literature (Ahn et al., 2022; Posey and Yavas, 2001). Campbell and Cocco (2003) suggest that this choice is basic and complex at the same time; basic because it is an inevitable decision for all the potential homebuyers; and complex because it involves many paramateres. In this

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[1] This is statement is based on Core Logic data.

[2] According to weekly data from Freddie Mac's Primary Mortgage Market Survey (PMMS).

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sense, we focus our study, not on the choice itself, but in the attention to both of the alternatives depending on the evolution of interest rates. Specifically, in this paper we attempt to shed light about the relationship between the evolution and changes in the interest rates, namely, the 30-yr FRM rates, and the homebuyers' attention to FRM and ARM. Koijen et al. (2009) indicate that when facing high interest rates, FRM payments are higher and ARM become more attractive to potential homebuyers. Therefore, ex-ante expectations are for an increase in the attention to ARM whether 30-yr FRM rates are high. Thus, the contribution of the paper is twofold. First, to the best of our knowledge, this is the first paper that relates homebuyers' attention and mortgage choice. Second, using Google Trends data to measure the attention, we empirically analyse and demonstrate that the upsurges in the fixed interest rates lead to a larger attention to ARM, which, eventually, will result in a larger share of ARM. In short, we study the transmission channel between the rise in the 30-yr FRM rates and the attention to their competition: ARM.

The paper unfolds as follows. Section 2 presents the data and the preliminary results. Section 3 presents the empirical analysis and the main results of the study. Finally, Section 4 concludes the paper.

2. Data

We collect the 30-yr FRM rates from Freddie Mac's Primary Mortgage Market Survey (PMMS) as Ahn et al. (2022). We focus on the FRM market since, according to 2021 data from Home Mortgage Disclosure Act (HDMA), 30-yr FRM represent 70 % of the U.S. mortgage market. Regarding attention by homebuyers, we use Google Trends data considering that internet queries through Google represent U.S. internet population (Chauvet et al., 2016). Google Trends data have been shown as a good indicator of attention (Costola et al., 2020; Da et al., 2011, 2015; Kou et al., 2018; Zhang and Tao, 2019). This variable does not provide the total number of searches for keywords, but it provides an index between 0 and 100, usually called Google Search Volume Index (GSVI, hereafter). To build this index, Google starts by dividing the number of searches for a given keyword by the total number of searches for a given time unit (day, week or month). This gives a ratio that is then normalized by multiplying it by a scaling factor $F = 100/r^*$, where r* is a fraction of the largest value (Dergiades et al., 2015). Thus, numbers start at zero in January 2004 and subsequent values represent changes compared to the search on that date (Jun et al., 2016), where 100 is the point at which the number of queries reached the highest search intensity. This means that the higher the index value, the higher the number of people searching for those terms. Thus, the GSVI at time t can be indicated as:

$$GSVI_t = \frac{N^s_{j,t}}{N^s_{g,t}} \times \frac{100}{r^*} \tag{1}$$

where, $N^s_{k,t}$ is the number of searches for a given keyword (j) at time t, and $N^s_{g,t}$ is the global number of searches (g) in the same time unit t and r^* is the highest value of the GSVI. With this normalization method, Google reduces the noise and bias in the results that can occur when using absolute values, because in this case the increase in the total number of queries can be due to the increase in Internet traffic. In addition, Google takes into account the fact that users can search with the same keyword repeatedly; thus, this behavior is removed from the data to avoid manipulation (Jun et al., 2016). This GSVI can be narrowed by filtering data by region. With the help of the regional filter, we can get information about the countries or even regions of each country that we choose. In our case, we restrain our searches to the United States. Specifically, we use the following keywords related to the ARM (ARM keywords): *mortgage adjustable, mortgage adjustable rate* and *adjustable rate*; and to the FRM (FRM keywords): *mortgage fixed, mortgage fixed rate* and *fixed rate*[3]. We gather this data at a weekly frequency since January 2018 to January 2023. The frequency of the data is due to data availability[4].

Fig. 1 shows the evolution of the 30-yr FRM rates and the GSVI for the ARM and FRM keywords (the descriptive statistics for these variables are displayed in Table 1). The correlation between the 30-yr FRM and the GSVI for ARM keywords is 38.45 % (p-value 0.000). On the other hand, the correlation between the 30-yr FRM rates and the GSVI for FRM keywords is −0.02 % (p-value 0.971).

These preliminary results show that there is a positive and significant relationship between the 30-yr-FRM rates, and the number of searches related to ARM while this relationship becomes almost inexistent and non-significant for the number of searches related to fixed rates. This is in line with ex ante expectations, i.e., in the face of an increase in the fixed rates' structure, people tend to perform queries for ARM.

[3] We consider the keywords together including a plus sign (+) between them as in Chauvet et al. (2016). Therefore, we look for the Google Trends data for the following keywords: *mortgage adjustable+mortgage adjustable rate+adjustable rate* and the same for the FRM.

[4] PMMS data for the 30-yr FRM rates are weekly observations as of every Thursday. On the other hand, Google Trends data are weekly data as of every Sunday. To harmonize both series, we have considered calculating the medium point for PMMS data. Therefore, to match the first date of Google data, which is February 11th, 2018 (Sunday) with the PMMS, we have taken the value for the PMMS on February 8th, 2018 (Thursday) and February 15th, 2018 (Thursday) and have approximated the value for February 11th, 2018 (Sunday) by calculating the average between both Thursdays (8th and 15th) and so on.

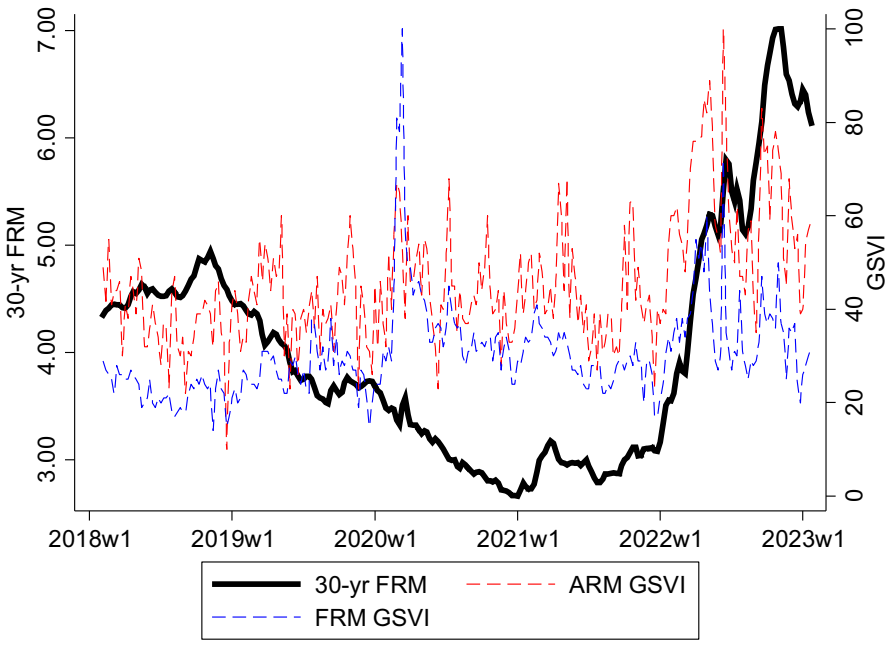

Fig. 1. Evolution of the 30-year Fixed-Rate Mortgages rates (30-yr FRM) and the Google Search Volume Index (GSVI) for the keywords related to Adjustable-Rate Mortgages (ARM GSVI) and Fixed-Rate Mortgages (FRM GSVI).

Table 1
Descriptive statistics.

Variable	Mean	S.d.	Max.	Min.	N	Source
30-yr FRM rates	4.004	1.077	7.015	2.660	259	PMMS
ARM GSVI	45.61	13.36	100	10	259	Google Trends
FRM GSVI	30.55	10.22	100	14	259	Google Trends

The table shows the descriptive statistics for the variables included in the analysis: the 30-year Fixed-Rate Mortgages rates (30-yr FRM) and the Google Search Volume Index (GSVI) for the keywords related to Adjustable-Rate Mortgages (ARM GSVI) and Fixed-Rate Mortgages (FRM GSVI). Namely we show the mean, standard deviation (S.d.), maximum (Max.), minimum (Min.) and the number of observations (N). The last column shows the source of the data (PMMS stands for Primary Mortgage Market Survey from Freddie Mac's).

3. Results and discussion

To measure the relationship between the 30-yr FRM rates and the homebuyers' attention to FRM and ARM keywords, we apply a VAR model[5]. Therefore, we must check initially that our series have the same level of integration, i.e., that they are stationary, and they do not contain a unit root. For this purpose, we apply the Dickey–Fuller test (Dickey and Fuller, 1979). Ex ante expectations are that the 30-yr FRM are non-stationary as financial series usually are, while both GSVI series are supposed to be stationary. Table 2 shows the results for this test.

According to the Dickey–Fuller test, we can observe that the 30-yr FRM rates shows the expected unit root. Thus, we proceed to calculate the first difference of this variable and after that the series becomes stationary (panel B). Once all our series are stationary, we proceed to perform the VAR model following Eqs. (2) and (3).

$$y_t = \alpha_0 + \beta_1 y_{t-1} + \beta_2 y_{t-2} + \ldots + \beta_j y_{t-j} \; + \; \gamma_1 GSVI_{t-1} \; + \; \gamma_2 GSVI_{t-2} + \ldots + \; \gamma_j GSVI_{t-j} + e_{1t} \tag{2}$$

$$GSVI_t = a_0 + b_1 GSVI_{t-1} + b_2 GSVI_{t-2} + \ldots + b_j GSVI_{t-j} \; + \; c_1 y_{t-1} \; + \; c_2 y_{t-2} + \ldots + \; c_j y_{t-j} + e_{2t} \tag{3}$$

[5] Two elements allow us to simplify the empirical analysis. First, the objective of the paper is to analyze the impact on attention related to mortgages after changes in the 30-yr FRM, but not the inverse relationship since it is not plausible that rates levels are determined by attention. Second, a rise in rates should lead to a unidirectional impact over attention in studying the conditions of the mortgage market and the permanence of the shock over time.

Table 2
Dickey–Fuller unit root tests.

	Statistic	1 % critical value	5 % critical value	10 % critical value	N
Panel A					
30-yr FRM rates	0.459	−3.990	−3.430	−3.130	258
ARM GSVI	−8.429***	−3.990	−3.430	−3.130	258
FRM GSVI	−6.165***	−3.990	−3.430	−3.130	258
Panel B					
30-yr FRM rates (first differences)	−7.877***	−3.990	−3.430	−3.130	257

Panel A shows the Dickey–Fuller augmented test including a trend in the estimation for the 30 years Fixed-Rate Mortgages rates (30-yr FRM rates) the Google Search Volume Index (GSVI) for the keywords related to the Adjustable-Rate Mortgages (ARM GSVI) and the Google Search Volume Index (GSVI) for the keywords related to the Fixed-Rate Mortgages (FRM GSVI). The null hypothesis is that the variable contains a root test (I(1)), while the alternative is that the variable is stationary (I(0)). Panel B shows the results for the test for the variable 30-yr FRM in first differences.
*** Significant at 1 %.
** Significant at 5 %.
* Significant at 10 %.

Table 3
VAR models.

	ARM GSVI		FRM GSVI	
	30-yr FRM rates$_t$	GSVI$_t$	30-yr-FRM rates$_t$	GSVI$_t$
30-yr FRM rates$_{t-1}$	**1.007*** **	**23.65** **	**0.967*** **	−6.759
	(0.065)	**(11.10)**	**(0.059)**	(7.093)
30-yr FRM rates $_{t-2}$	**−0.729*** **	−16.30	**−0.677*** **	7.729
	(0.086)	(14.71)	**(0.075)**	(8.951)
30-yr FRM rates $_{t-3}$	**0.489*** **	**29.24** **	**0.408*** **	−3.844
	(0.086)	**(14.72)**	**(0.058)**	(6.983)
30-yr FRM rates $_{t-4}$	−0.067	−10.26		
	(0.063)	(10.92)		
GSVIs$_{t-1}$	0.0004	**−0.493*** **	0.0007	**−0.218*** **
	(0.0003)	**(0.063)**	(0.0005)	**(0.064)**
GSVIs$_{t-2}$	-4.0×10^{-4}	**−0.383*** **	0.0004	−0.058
	(0.0004)	**(0.069)**	(0.0005)	(0.066)
GSVIs$_{t-3}$	−0.0005	**−0.298*** **	−0.0007	**−0.196*** **
	(0.0004)	**(0.070)**	(0.0005)	**(0.064)**
GSVIs$_{t-4}$	−0.0004	**−0.266*** **		
	(0.0003)	**(0.063)**		
N	254	254	255	255

This table reports the VAR estimation results for the relationship between the 30-years Fixed-Rate Mortgages rates (30-yr FRM rates) and the Google Search Volume Index (GSVI) for the keywords related to the Adjustable-Rate Mortgages (ARM GSVI) and the GSVI for the keywords related to the Fixed-Rate Mortgages (FRM GSVI). VAR for each GSVI keywords is arranged in two columns: the 30-yr FRM rates equation is given in the first column, and the GSVI equation is given in the second column. Hannan–Quinn criterion has been used for the selection of the optimal number of lags. We use small-sample options in the specifications of the VAR models. Estimated coefficients are followed by the standard errors in parentheses.
*** Significant at 1 %.
** Significant at 5 %.
* Significant at 10 %.

where, $y_t$represents 30-yr FRM rates, GSVI denotes the attention of homebuyers to fixed or adjustable rates and j denotes the number of lags according to Hannan and Quinn (1978) criterion[6]. The results for this VAR models are shown in Table 3. The results confirm our expectations. It seems that the evolution of 30-yr FRM rates has an impact on ARM GSVI. Specifically, first and third lag are statistically significant and with the assumed positive sign, i.e., when the fixed interest rates increase, homebuyers' attention switch to ARM and then the GSVI for the keywords associated to this kind of mortgages increase. Moreover, the results also indicate that there is not a feedback relationship and the GSVI changes do not have any impact on the 30-yr FRM rates as GSVI coefficients are not significant in the 30-yr FRM rates equations which is in line with our expectations.

Moreover, in Table 4 we show the Granger causality tests for the relationship between the 30-yr FRM rates and the GSVI for the ARM and FRM keywords. We proceed with this test for the VAR models shown in Table 3. Results indicate that 30-yr FRM rates do cause the GSVI related to ARM (ARM GSVI), since we can reject the null hypotheses. Moreover, according to the value of the

[6] We use Hannan-Quinn criterion (HQC) since, according to Liew (2004). for samples over 120 observations, as our series ($N = 258$), HQC outperforms the rest of criteria in identifying the correct lag length. The VAR models meet the no autocorrelation hypothesis according to Lagrange-multiplier test and the stability condition.

Table 4
Pairwise Granger causality tests.

Null hypothesis	Lags	F-statistic	*p*-value	γ coefficients
30 yr $FRM_t \rightarrow ARM\ GSVI_t$	4	2.382	0.052*	26.33
$ARM\ GSVI_t \rightarrow$ 30-yr FRM_t	4	1.181	0.319	−0.0005
30 yr $FRM_t \rightarrow FRM\ GSVI_t$	3	0.335	0.799	−2.873
$FRM\ GSVI_t \rightarrow$ 30-yr FRM_t	3	1.612	0.186	0.0004

This table shows the Granger causality tests for the bivariate VAR models between 30-years Fixed-Rate Mortgages rates (30-yr FRM) and the Google Search Volume Index (GSVI) for the keywords related to the Adjustable-Rate Mortgages (ARM GSVI) and the GSVI for the keywords related to the Fixed-Rate Mortgages (FRM GSVI). Hannan-Quinn criterion has been used for the selection of the optimal number of lags. We use small-sample options in the specifications of the VAR models. The Null hypothesis is that the first variable in each pair does not Granger cause the second one. A rejection of the null hypothesis, i.e., a significant *p*-value, indicates Granger causality. The last column shows the sum of all the coefficients of the VAR model. A positive (negative) value would indicate an expected direct (inverse) relationship.
*** Significant at 1 %.
** Significant at 5 %.
* Significant at 10 %.

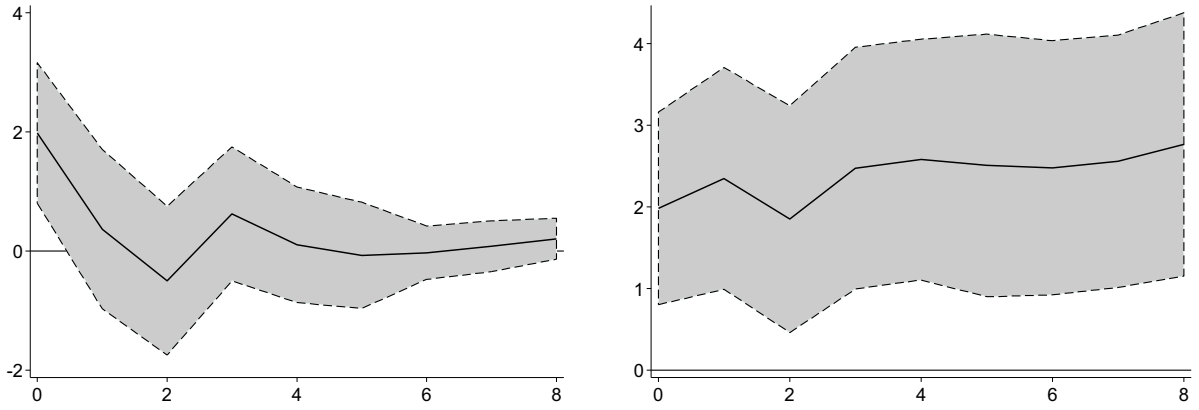

Fig. 2. Impulse Response Functions for the GSVI for Adjustable-Rate Mortgages keywords (response) after a change of one standard deviation in 30-yr Fixed-Rate Mortgages rates (impulse). Left panel shows the simple orthogonalized Impulse Response Function and right panel shows the cumulative orthogonalized Impulse Response Function.

coefficients the relationship seems direct as the VAR model indicated. For the rest of tests, we cannot reject that the each of the variables does not Granger cause the other.

To complete the analysis, we show in Fig. 2 the Impulse Response Functions (IRFs) for the VAR model in which the 30-yr FRM rates is the dependent variable and the GSVI for the ARM (ARM GSVI) is the independent variable since it is the only relationship that has shown significant results. In the left panel we observe that a change of one standard deviation in 30-yr FRM rates leads to a significant increase of 2 % in GSVI for the ARM, although this significant response disappears after one week. The right panel shows the accumulated response that indicates an upsurge in the GSVI for ARM keywords between 2 and 3 % during the next eight weeks.

4. Conclusions

This paper follows recent studies on the analysis of the mortgage market (Ahn et al., 2022) and specifically explores how the attention of homebuyers regarding FRM or ARM change when variations on the evolution of mortgage interest rates occur. Looking at the data, we can observe that when interest rates are high, homebuyers are more prone to select ARM, whilst in a scenario of low interest rates, they go for FRM. Therefore, we check whether in the face of interest rate upsurges also the attention to ARM increases. To check this, we use Google searches tool, which has been proved in the literature as a good proxy for attention and the 30-yr FRM rates as a measure of the evolution of interest rates. Thus, we download a set of keywords related to FRM and ARM and run several VAR models.

The results from the different methodologies and tests show that, as expected, there exists a direct relationship between the evolution of 30-yr FRM rates and the Google searches related to ARM. Moreover, we do not observe a significant relationship for any other pair of variables. In light of this results, we can indicate that Google searches can be used as an early indicator of the demand of ARM. This result can be used by financial institutions to anticipate an increase in the demand of ARM and adapt the mortgage offering in advance.

Future scope of the research can deep into the analysis of the relationship between the number of FRM and ARM and the attention of potential homebuyers. For this purpose, we will need a more comprehensive database of individual mortgages contracts and test

whether attention can predict accurately the number of each type of mortgages.

CRediT authorship contribution statement

Marcos González-Fernández: Writing – original draft, Validation, Software, Methodology, Formal analysis, Data curation, Writing – review & editing, Conceptualization. **Francisco José Sáez Trujillo:** Writing – review & editing, Writing – original draft, Validation, Software, Methodology, Formal analysis, Data curation, Conceptualization. **Carmen González-Velasco:** Writing – original draft, Validation, Methodology, Formal analysis, Data curation, Writing – review & editing, Conceptualization.

Data availability

Data will be made available on request.

Authorship statement

All persons who meet authorship criteria are listed as authors, and all authors certify that they have participated sufficiently in the work to take public responsibility for the content, including participation in the concept, design, analysis, writing, or revision of the manuscript. Furthermore, each author certifies that this material or similar material has not been and will not be submitted to or published in any other publication before its appearance in the *Finance Research Letters*.

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