



## The Size of the Affordable Mortgage Market: 2022-2024 Enterprise Single-Family Housing Goals

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## Abstract

This Federal Housing Finance Agency (FHFA) technical report documents the statistical forecast models that the modeling team has developed as part of the process for establishing the affordable housing goal benchmark levels for Fannie Mae and Freddie Mac for 2022 through 2024. The report was prepared by Ken Lam and reviewed by Jay Schultz, Sarah Minster, Omena Ubogu, and Padmasini Raman.

# Table of Contents

<b>1</b>	<b>Introduction</b>	<b>1</b>
<b>2</b>	<b>Sources of Data</b>	<b>4</b>
<b>3</b>	<b>Housing And Mortgage Market Driver Variables</b>	<b>5</b>
3.1	Macroeconomic Outlook Embedded in the Models . . . . .	6
3.2	Expectations Regarding Key Driver Variables . . . . .	8
3.2.1	Interest Rates . . . . .	8
3.2.2	Unemployment, Labor Force Participation, and Inflation . . . . .	9
3.2.3	House Prices and Affordability . . . . .	10
3.2.4	Refinance Share of Mortgage Applications . . . . .	12
3.2.5	Underwriting Standards . . . . .	13
3.2.6	Share of Government-Insured and Guaranteed Mortgages . . . . .	14
<b>4</b>	<b>Econometric Models Of The Single-Family Housing Goals</b>	<b>14</b>
4.1	Market Forecast For Low-Income Home Purchase Goal (LIP) . . . . .	16
4.2	Market Forecast For Very Low-Income Home Purchase Goal (VLIP) . . . . .	19
4.3	Market Forecast for Minority Census Tracts and Low-Income Census Tracts Home Purchase Subgoals . . . . .	20
4.4	Market Forecast For Low-Income Refinance Goal (LIR) . . . . .	25
<b>5</b>	<b>Sensitivity of Model Estimates</b>	<b>28</b>
<b>6</b>	<b>Concluding Remarks</b>	<b>29</b>
	<b>Appendix A</b>	<b>30</b>
	<b>Appendix B</b>	<b>35</b>

## List of Figures

1	Historical and Projected Trends of Key Macroeconomic Driver Variables . . . . .	8
2	Historical and Projected Trends of Mortgage Rates and 10-Year Treasury . . . . .	9
3	Historical and Projected Trends of Unemployment Rate and Annual Growth Rate of Consumer Price Index (CPI) . . . . .	10
4	Historical and Projected Trends of House Prices and Affordability . . . . .	11
5	Historical and Projected Trends of Refinance Share and 30-Year Fixed Mort- gage Rate . . . . .	12
6	Historical and Projected Trends of Mortgage Underwriting Standards . . . . .	13
7	Historical and Projected Trends of Government Shares of Mortgages . . . . .	14
8	Regression Coefficients of Market Forecast Model for the Low-Income Home Purchase Goal . . . . .	17

9	Robustness Test of Market Forecast Model for the Low-Income Home Purchase Goal . . . . .	18
10	Model Forecast for the Low-Income Home Purchase Goal . . . . .	18
11	Historical Performance and Model Forecast for the Low-Income Home Purchase Goal . . . . .	19
12	Regression Coefficients of Market Forecast Model for the Very Low-Income Home Purchase Goal . . . . .	20
13	Robustness Test of Market Forecast Model for the Very Low-Income Home Purchase Goal . . . . .	21
14	Model Forecast for the Very Low-Income Home Purchase Goal . . . . .	21
15	Historical Performance and Model Forecast for the Very Low-Income Home Purchase Goal . . . . .	22
16	Regression Coefficients of Market Forecast Model for Minority Census Tracts Purchase Subgoal . . . . .	23
17	Regression Coefficients of Market Forecast Model for Low-Income Census Tracts Purchase Subgoal . . . . .	24
18	Robustness Test of Market Forecast Model for Minority Census Tracts and Low-Income Census Tracts Subgoals . . . . .	24
19	Model Forecast for Minority Census Tracts and Low-Income Census Tracts Subgoals . . . . .	25
20	Historical Performance and Model Forecast for Minority Census Tracts and Low-Income Census Tracts Subgoals . . . . .	26
21	Regression Coefficients of Market Forecast Model for the Low-Income Refinance Goal . . . . .	27
22	Robustness Test of Market Forecast Model for the Low-Income Refinance Goal . . . . .	27
23	Model Forecast for the Low-Income Refinance Goal . . . . .	28
24	Historical Performance and Model Forecast for the Low-Income Refinance Goal . . . . .	29

# 1 Introduction

The Federal Housing Enterprises Financial Safety and Soundness Act of 1992 (the Safety and Soundness Act), as amended, mandates that the Federal Housing Finance Agency (FHFA) establish annual housing goals for Fannie Mae and Freddie Mac (the Enterprises).<sup>1</sup> Since 2010, FHFA has adopted a two-part approach to establishing and measuring the Enterprise housing goals. The “benchmark” level is set prospectively by rulemaking based on various factors set out in the statute, including FHFA’s forecast of the goals-qualifying market based on the econometric models described in this paper. The actual market level is determined retrospectively by FHFA based on the Home Mortgage Disclosure Act (HMDA) data for the year when it becomes available. Both the benchmark market and the retrospective market levels are determined at the national level and for a full calendar year. In any given year, an Enterprise is deemed to have met the goal if it meets or exceeds either the benchmark level or the retrospective market level. Typically, HMDA data for a given calendar year is released in the second quarter of the following year so that FHFA’s retrospective market level determination of the Enterprise’s housing goals performance is made the following year.<sup>2</sup>

The benchmark level is based on the market forecast model (and other factors) and is set in advance for the goal period to provide a planning target for Enterprise activities. The market forecast model referred to here is the national level statistical model that is estimated using monthly goal-qualifying share data from HMDA and the resulting monthly forecasts are then averaged into an annual forecast for each of the three years in the goal period.

The retrospective market level is based on FHFA’s determination of the goal qualifying market for each year based on HMDA data. This is not a statistical modeling exercise but rather an aggregation based on applying counting rules to HMDA data.

The Safety and Soundness Act sets out seven factors that FHFA is expected to consider when setting the benchmark level.<sup>3</sup> FHFA’s approach has been to incorporate as many of these factors into the statistical forecast model as possible, generating model forecasts for each of the goal years along with confidence intervals. For instance, four of the seven factors (national housing needs; economic, housing, and demographic conditions; other mortgage data; and the size of the conventional purchase money or refinance mortgage segment) are explicitly modeled in the statistical forecast models. Three factors (performance and effort of the Enterprises to lead the industry in making mortgage credit available; the ability of the

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<sup>1</sup>12 U.S.C. 4561(a).

<sup>2</sup>Typically, FHFA will issue a preliminary determination of each Enterprise’s housing goals performance in a given calendar year, in the following October. The Enterprises will have 30 days to respond to the determination and FHFA typically issues a final determination in December.

<sup>3</sup>12 U.S.C. 4562(e)(2).

Enterprises to do so; and the need to maintain sound financial condition of the Enterprises) are not readily quantifiable and there are no public data on these factors. As a result, they are not explicitly modeled in the statistical forecast models. FHFA incorporates these factors into the benchmark setting process while picking the specific point estimate within the model-generated confidence intervals for a given goal year. That process is documented in the preamble to the proposed rulemaking and is beyond the scope of this report. This report focuses on documenting the statistical models and the associated confidence intervals of the estimates.

The single-family goals are limited to conventional conforming mortgages on owner-occupied housing with a total of one to four units. Therefore, jumbo mortgages (with loan amounts above the conforming loan limit), mortgage loans to investors, mortgages on second homes, and non-conventional loans (loans with some form of government insurance on them) are all excluded.

FHFA is required to establish five single-family home purchase goals and one refinance goal. They are defined as follows:

- **Low-Income Home Purchase (LIP) Goal:** This goal measures the share of each Enterprise’s goal-qualifying purchase loans made to families with incomes no greater than 80 percent of Area Median Income (AMI).
- **Very Low-Income Home Purchase (VLIP) Goal:** This goal measures the share of each Enterprise’s goal-qualifying purchase loans made to families with incomes no greater than 50 percent of AMI.
- **Minority Census Tracts Purchase Subgoal:** This goal measures the share of each Enterprise’s goal-qualifying purchase loans made to families with incomes no greater than 100 percent of AMI in minority census tracts.<sup>4</sup>
- **Low-Income Census Tracts Purchase Subgoal:** This goal measures the share of each Enterprise’s goal-qualifying purchase loans made to two subgroups: (1) families (regardless of income) in low-income census tracts<sup>5</sup> that are not minority census tracts, and (2) families with incomes greater than 100 percent of AMI in low-income census tracts that are also minority census tracts.
- **Low-Income Areas Home Purchase (LIA) Goal:** This goal measures the shares of each Enterprise’s goal-qualifying purchase loans that are included in the minority census tracts and low-income census tracts subgoals, plus purchase mortgages made to families with incomes no greater than 100 percent of AMI living in a federally-declared

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<sup>4</sup>Census tracts that have a minority population of at least 30 percent and a median income of less than 100 percent of AMI.

<sup>5</sup>Census tracts where the median income is no greater than 80 percent of AMI.

disaster area.

- **Low-Income Refinance (LIR) Goal:** This goal measures the share of each Enterprise’s goal-qualifying refinance loans made to families with incomes no greater than 80 percent of AMI.

FHFA sets the low-income areas home purchase goal each year based on the sum of the minority census tracts subgoal and low-income census tracts subgoal benchmark levels, plus an additional increment based on federally declared disaster areas over the past three years. As a result, FHFA does not create a separate statistical forecast model for the low-income areas home purchase goal.

The current set of statistical forecast models all use outcome variables (i.e., market share estimates for the four housing goals) that are derived from the HMDA data. We rely on seventeen years of HMDA data: data from 2004 until 2020. As we will discuss in the next section, although HMDA data prior to 2004 is available, those datasets do not contain key variables needed to define the market shares for the outcome variables. The current goal cycle continues the practice established in the 2018-2020 rulemaking cycle of using Moody’s Analytics as the primary data source for the independent or driver variables.<sup>6</sup> As noted previously, not only did this practice streamline the data collection process but it also permitted FHFA to rely on Moody’s Analytics forecasts. There are some exceptions. For some of the variables, Moody’s forecasts were not available. For such cases, we use FHFA’s own forecasts. The goal of FHFA’s statistical forecast models is to provide our best estimate of various affordable market segments for the next housing goal period. This naturally relies on forecasts of the key driver variables for that period.

FHFA’s models include the best-fit model specifications and key driver variables for all goal-qualifying shares while following generally accepted professional practices and standards adopted by economists at other federal agencies. The models not only fit the historical data well but are also robust (as indicated by the out-of-sample tests). However, as is the case with any forecasting model, whether the models yield “accurate” forecasts is crucially dependent on the accuracy of the forecasts for the driver variables that are inputs to the models. Moreover, the length of the forecast period is important: the longer out the forecast period, the wider the confidence bands around the forecasts.

This report provides technical documentation of the market models used to generate the single-family housing goal forecasts for the 2022–2024 period. It assumes familiarity with econometric methods and forecasting practices that are commonly used by economists. The report is organized as follows: Section 2 describes the mortgage market and economic forecast

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<sup>6</sup>The variables on the right-hand-side of a forecast model are often referred to as the driver variables, while they are also called independent variables and covariates in statistics and economics.

data used to construct the econometric models. Section 3 identifies the model driver variables and uses them to provide an overview of the housing and macro-economic environments that shape the mortgage market. Section 4 and Section 5 present the model for each of the four housing goals. Finally, concluding remarks are provided in Section 6. Technical appendices on sensitivity analysis and data sources are attached at the end.

## 2 Sources of Data

The historical monthly time-series data used in estimating the Enterprise housing goals forecast models are produced by a variety of sources. We use HMDA data to construct the outcome variables—that is, the estimates for the goal-qualifying market shares for the two home purchase goals, one home purchase subgoal, and one refinance goal. Our Home Mortgage Disclosure Act (HMDA) dataset is provided by the Consumer Financial Protection Bureau (CFPB).<sup>7</sup> The dataset contains loan-level records of mortgage originations that occurred during a calendar year, including the month of mortgage origination. HMDA data is considered to be broadly representative of the mortgage market in the United States. For the purpose of estimating the single-family mortgage market for goal-qualifying loans, we limit the HMDA records to originations of conventional conforming first lien, prime home purchase (or refinance) mortgages.<sup>8</sup> We further limit the data to originations since January 2004 because HMDA records from the pre-2004 time period do not include a number of variables that are critical in identifying the originations that are relevant to the housing goals. In particular, the pre-2004 HMDA data do not identify property type, lien status, Home Ownership Equity Protection Act (HOEPA) status, and the Average Prime Offer Rate (APOR) rate spread. The pre-2004 data were also less precise in identifying manufactured housing loans and high-priced mortgages. Since 2004, HMDA data began including: (1) rate-spread information for high-cost loans, (2) an indicator for manufactured housing loans, and (3) an identifier for first-lien mortgages. The rate-spread and manufactured housing information help to better identify subprime and chattel loans. HMDA data through December 2020 are used in these models.

Historical and forecast values of the model driver variables were downloaded from Moody’s

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<sup>7</sup>Prior to 2018, HMDA data was processed and released by the Federal Reserve Board on behalf of Federal Financial Institutions Examination Council (FFIEC), an interagency body empowered to administer HMDA. Beginning with the 2018 HMDA data, it has been processed and released by CFPB; in addition, new data elements on loan, borrower, and property characteristics were added as part of the reporting requirements.

<sup>8</sup>For the purpose of this analysis, prime mortgage loans are defined as mortgage originations that are not high-priced. In HMDA data, we identify high-priced loans as those with a spread (difference) between the Annual Percentage Rate (APR) of the loan and the applicable Average Prime Offer Rate (APOR) of 1.5 percentage points or greater.



Analytics web site. Moody's Analytics obtains the historical values of the variables from various government agencies and industry trade groups and then generates forecasts for the variables using statistical models. Specifically, the unemployment rate, labor force participation rate, consumer price index, and new housing sales come from the Census Bureau and the Bureau of Labor Statistics. Constant maturity interest rates on Government notes and bonds are generated by the U.S. Department of the Treasury, while mortgage interest rates are obtained from Freddie Mac's Primary Mortgage Market Survey. The Housing Affordability Index (HAI) is provided by the National Association of Realtors (NAR) to Moody's. To measure house price changes, we use FHFA's House Price Index (HPI) (for all transactions and for home purchase loans, separately). The refinance rate and the government market share information are calculated from the HMDA data. The volume of refinance applications is captured by the refinance application index released by the Mortgage Bankers Association. The household debt service burden variable is collected by the Federal Reserve System. Per capita income information is released by the Bureau of Economic Analysis. Finally, a measure of the tightness of underwriting standards is constructed from data from the Senior Loan Officer Opinion Survey on Bank Lending Practices. The survey is conducted by the Federal Reserve System. For a complete list of data sources, see Appendix B.

The modeling team used Moody's forecasts published on September 12, 2021 (specifically the Consensus Forecast scenario) for the macroeconomic drivers where available. The Consensus Forecast scenario is designed by Moody's to incorporate the central tendency of baseline forecasts produced by reputable institutions and professional economists, including the Congressional Budget Office (CBO), the Philadelphia Federal Reserve Survey of Professional Forecasters, and the Federal Reserve System. For the share of low-income refinance goal, model forecasts based on the Baseline scenario are also provided. Model results based on other alternative forecast scenarios are reported in the Appendix section of the report. In cases where Moody's forecasts were not available (in particular, for the government share of home purchases and refinances), the team generated and tested its own forecasts.

### **3 Housing And Mortgage Market Driver Variables**

This section describes the historical and forecasts of key driver variables and the macroeconomic environment that has shaped the mortgage market for the forecast period.

### 3.1 Macroeconomic Outlook Embedded in the Models

There are many factors that impact the affordable segments of the housing market. Interest rates are arguably one of the most important variables in determining the trajectory of the mortgage market. In an effort to continue its support of the U.S. economy and promote maximum employment and price stability, the Federal Reserve at its September 2021 meeting reiterated its commitment to seeking inflation at 2 percent in the long run by maintaining its target for the federal funds rate at between 0 percent to 0.25 percent until inflation targets are achieved.<sup>9</sup> The target was first lowered to this level in March 2020 to mitigate the effects of the COVID-19 pandemic. Moody's September 2021 forecast assumes that this target is maintained until the early 2023 and then projects that mortgage interest rates—in particular the 30-year fixed rate, which is closely tied to the federal funds rate and the 10-year Treasury note yield—will rise gradually from the historic low of 3.1 percent in 2020 to 3.7 percent by 2024.

Moody's forecast also projects that the unemployment rate will gradually fall from its 2020 peak to 3.9 percent in 2024. Moody's also forecasts a modest increase in per capita disposable nominal income growth—from \$55,200 in 2021 to \$59,300 in 2024. Inflation is expected to be elevated at 4.3 percent for 2021, but Moody's estimates that the inflation rate will fall to the 2.3–2.8 percent range for the 2022–2024 period.

The combination of low interest rates, high pent-up deferred demand, and low supply fueled by the pandemic pushed house prices up by 18.5 percent in the third quarter of 2021 relative to the same time the previous year, according to FHFA's purchase-only House Price Index (HPI).<sup>10</sup> Despite this rapid rate of increase, Moody's is predicting a slow down in HPI increases over the next few years. Its September 2021 forecast of the same HPI index expects house prices to increase at the annual rates of 4.0, 1.2, and 0.2 percent in 2022, 2023, and 2024, respectively.

Everything else being equal, the expected increase in mortgage interest rates and house prices will likely affect the ability of low- and very low-income households to purchase homes. Housing affordability, as measured by Moody's forecast of the National Association of Realtors' Housing Affordability Index (HAI), is projected to decline from an index value high of 166.8 in 2020 to 151.6 in 2024. (Lower values of the HAI imply that affordability has worsened). Affordable housing supply—the third main factor in housing affordability—has not kept pace with the growth of demographic demand even prior to the onset of the COVID-19 pandemic.

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<sup>9</sup><https://www.federalreserve.gov/newsevents/pressreleases/monetary20210922a.htm>

<sup>10</sup><https://www.fhfa.gov/Media/PublicAffairs/Pages/US-House-Prices-Rise-18pt5-Percent-over-the-Last-Year-Up-4pt2-Percent-from-2Q.aspx>

Low interest rates coupled with rising house prices created an incentive for many homeowners to refinance, resulting in a surge in the overall refinance activity in 2020. (In many ways, 2020 was an unusual year as it saw both record volumes of home purchase and home refinance loans). The refinance share of overall mortgage originations increased from a low of 28.2 percent in 2018 to 61.0 percent in 2020. Moody’s forecasts this share to decline to 59.2 percent in 2021 but tick up to 63.8 percent in 2022 and eventually drop to 50.6 percent and 37.7 percent in 2023 and 2024 respectively.

The economic outlook from Moody’s described above is largely consistent with the outlook provided by other forecasters. For instance, the Bureau of Economic Analysis (BEA) notes that following two quarters of losses, real Gross Domestic Product (GDP) grew by 33.8 percent and 4.5 percent in the third and fourth quarters of 2020, respectively. In addition, according to the latest estimate released by BEA, GDP grew by 6.7 percent in the second quarter of 2021, and 2.1 percent in the third quarter of 2021.<sup>11</sup> According to the most recent estimate published by the Congressional Budget Office (CBO) in July 2021, GDP is projected to grow by 7.4 percent in 2021, after which GDP growth is projected to decline to 3.1 percent in 2022 then remain under 2 percent through 2031.<sup>12</sup> The unemployment rate peaked at 14.8 percent in April 2020 and fell to 4.6 percent in October 2021 according to the Bureau of Labor Statistics (BLS).<sup>13</sup> CBO projects this number to be 4.6 percent in the fourth quarter of 2021 and that employment will surpass its pre-pandemic level in mid-2022.<sup>14</sup>

Congress passed the Coronavirus Aid, Relief, and Economic Security Act (CARES Act) in March 2020 to address some of the most pressing impacts of the economic disruption, including the extension of unemployment benefits.<sup>15</sup> Follow-up packages, such as the American Rescue Plan, aim to support the economy through 2021. FHFA continues to monitor how these changes and proposals may impact various segments of the market, including those targeted by the housing goals.

Exhibit 1 provides summary statistics on key macroeconomic indicators and the driver variables that are used in the forecast models. Variables that are forecasted by Moody’s are presented in the first panel of the Exhibit, while those that are forecasted by FHFA are presented in the second panel of the Exhibit.

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<sup>11</sup><https://www.bea.gov/news/2021/gross-domestic-product-3rd-quarter-2021-second-estimate-corporate-profits-3rd-quarter>

<sup>12</sup>Congressional Budget Office (CBO), An Update to the Budget and Economic Outlook: 2021 to 2031. Published in July 2021. <https://www.cbo.gov/publication/57339>

<sup>13</sup>U.S. Bureau of Labor Statistics “Employment Situation Summary,” November 2021, Release Number: USDL-21-1930, available at: <https://www.bls.gov/news.release/empsit.nr0.htm>

<sup>14</sup>Congressional Budget Office (CBO), An Update to the Budget and Economic Outlook: 2021 to 2031. Published in July 2021. <https://www.cbo.gov/publication/57339>

<sup>15</sup>Public Law 116–136.

## Exhibit 1: Historical and Projected Trends of Key Macroeconomic Driver Variables

	Historical Trends					Projected Trends			
	2016	2017	2018	2019	2020	2021	2022	2023	2024
Real GDP Growth Rate.....	1.7	2.3	2.9	2.3	-3.4	6.0	4.6	2.5	1.9
Unemployment Rate.....	4.9	4.3	3.9	3.7	8.1	5.5	4.2	4.0	3.9
Labor Force Participation Rate.....	62.8	62.8	62.9	63.1	61.7	61.7	62.2	62.4	62.5
Inflation Rate (Change in CPI).....	1.3	2.1	2.4	1.8	1.2	4.3	2.8	2.3	2.3
Consumer Confidence Index.....	99.8	120.5	130.2	128.3	101.0	116.0	119.7	113.4	113.6
30-Year Mortgage Fixed Rate.....	3.6	4.0	4.5	3.9	3.1	2.9	3.1	3.4	3.7
Per Capita Disposable Income (1,000s \$).....	\$43.7	\$45.5	\$47.8	\$49.4	\$52.8	\$55.2	\$54.8	\$57.0	\$59.3
Household Debt Service Ratio.....	4.4	4.2	4.1	4.1	3.9	4.1	4.4	4.4	4.4
Existing Home Sales (1,000s).....	4,822	4,904	4,735	4,750	5,079	5,355	5,253	5,576	5,962
Net Percent of Banks Tightening Standards.....	-7.7	-6.6	-7.9	-0.6	18.1	-5.0	-0.6	5.9	2.6
Refinance Mortgage Application Share.....	55.3	42.4	36.0	50.6	63.5	60.6	67.1	55.7	44.0
Housing Affordability Index.....	166.5	159.3	143.5	165.7	166.8	156.4	151.2	150.0	151.6
Percent Change in House Prices (Purchase Only) <sup>1</sup> .....	5.9	6.3	5.7	5.4	11.0	11.8	4.0	1.2	0.2
Percent Change in House Prices (All Transactions) <sup>2</sup> .....	5.5	5.6	4.9	5.0	6.2	11.1	5.6	2.0	0.1
Refinance Mortgage Share.....	48.1	35.2	28.2	42.8	61.0	59.2	63.8	50.6	37.7
Percent Gov. Insured Home Purchase Loans.....	33.9	31.6	28.3	28.6	28.6	24.2	22.6	24.1	27.9
Percent Gov. Insured Refinance Loans.....	22.7	22.4	17.5	21.1	17.9	15.0	12.9	13.0	15.1

Note: Historical values and projected trends are provided by Moody's Analytics. Government shares of the home purchases and refinances are forecasted by FHFA.

<sup>1</sup> Purchase transactions only (Q4/Q4 % Change)

<sup>2</sup> All transactions (Q4/Q4 % Change)

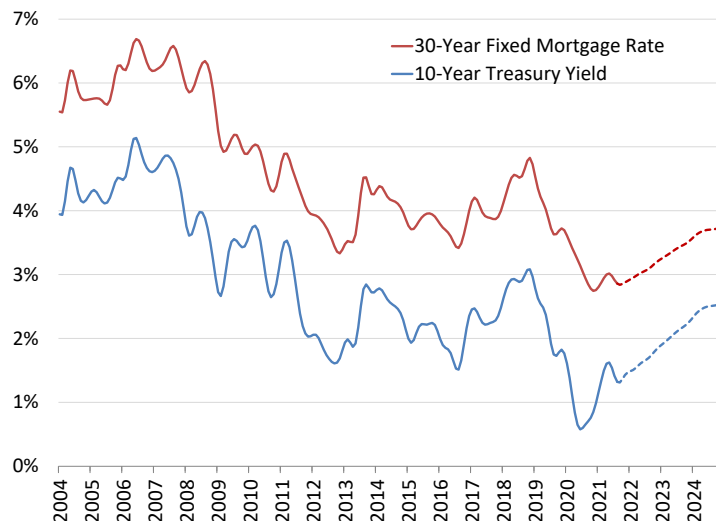
## 3.2 Expectations Regarding Key Driver Variables

### 3.2.1 Interest Rates

Interest rates are affected by many demand and supply factors. Trends in interest rates on longer-term financial instruments such as mortgages typically follow the fluctuations of the 10-Year Treasury note yield, with approximately a 110 to 160 basis point spread between the 1-year and 10-year Treasury yields reflecting the differences in liquidity and credit risk expected for the 2022 through 2024 period. This expected rate spread is higher than what was experienced during the past five years. Interest rates are heavily influenced by the monetary policies of the Federal Reserve Board's Federal Open Market Committee (FOMC). Since mid-2008, the FOMC has maintained an accommodative monetary policy in support of its dual mandate of fostering maximum employment and price stability. While near-term risks to the economic outlook appear roughly balanced, the FOMC monitors the inflation rates closely. Exhibit 2 shows the historical and forecast values of the 30-year fixed mortgage interest rate (FRM) and the 10-year Treasury yield.

The 30-year fixed-rate mortgage interest rate fell to a low of 3.3 percent in November 2012 and rose to a high of 4.5 percent in September 2013, before eventually falling to its

## Exhibit 2: Historical and Projected Trends of Mortgage Rates and 10-Year Treasury



another low of 3.4 percent in August 2016. Over the following two years, the rate gradually rose to another high of 4.8 percent in November 2018. The rate has dropped sharply since then and it reached a historic low of 2.7 percent in December 2020. For the forecast period, that rate is expected to rise gradually to 3.4 percent in 2023 and then 3.7 percent in 2024.

### 3.2.2 Unemployment, Labor Force Participation, and Inflation

In addition to being a general indicator of the economy's health, changes in employment also directly affect the housing market because buying a house is, for many households, the single largest investment and a long-term commitment that requires stable employment. The unemployment rate had fallen steadily from 9.1 percent in August 2011 to around 3.5 percent in last quarter of 2019. The rate then rose sharply in the first quarter of 2020 and peaked at 14.8 percent in April 2020 due to the pandemic and related economic shutdowns. Due to the aggressive fiscal and monetary policies, the unemployment rate has fallen back down to 4.6 percent in October 2021.

The labor force participation rate was rising gradually in the past few years prior to the pandemic and reached 63.1 percent in 2019. As expected, the rate dropped noticeably in 2020 (to 61.7 percent) because of the recession. Based on Moody's forecasts, it is expected to rise steadily over the next few years to 62.5 percent in 2024 as the economy continues to recover.

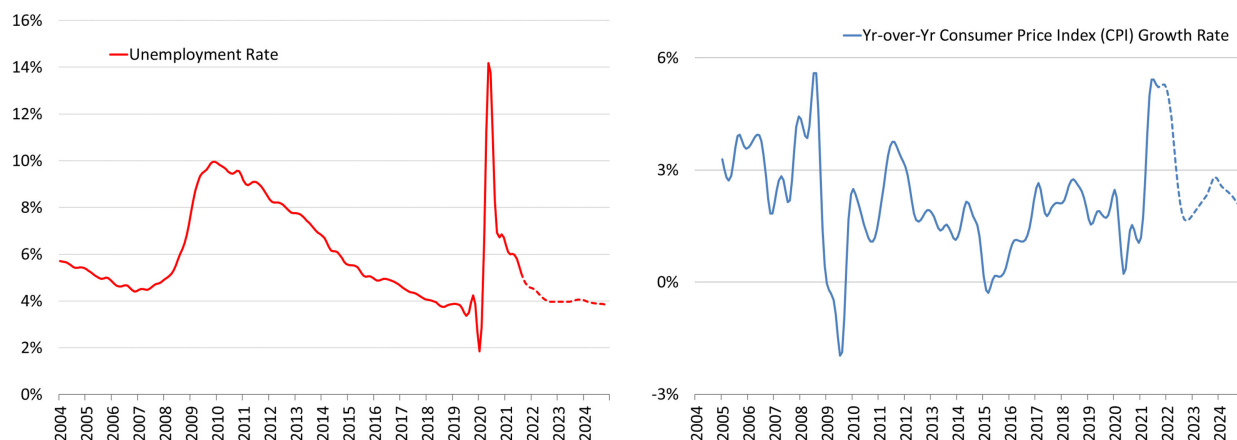
One of the stated objectives of the FOMC's interest rate policy is fostering maximum employment. Given the foreseeable monetary policy and the continued growth in the economy, the unemployment rate is expected to average about 4 percent for the 2022 to 2024 period

according to Moody’s forecasts. Its impact on the affordable home purchase market will depend on the composition of the unemployment rate and could be expected to be greater if the unemployment rate of lower-wage earners substantially drives change in the overall unemployment rate.

The second stated objective of the FOMC in determining its interest rate policy is maintaining price stability. While the inflation rate is elevated in 2021 due to transitory factors related to supply and demand imbalances, Moody’s forecast predicts inflation will gradually return to the pre-pandemic level over next few years, averaging around 2.3 to 2.8 percent through 2024.

Exhibit 3 plots the history and forecasts of the unemployment rate and the annual growth rate of the consumer price index (CPI).

**Exhibit 3:** Historical and Projected Trends of Unemployment Rate and Annual Growth Rate of Consumer Price Index (CPI)



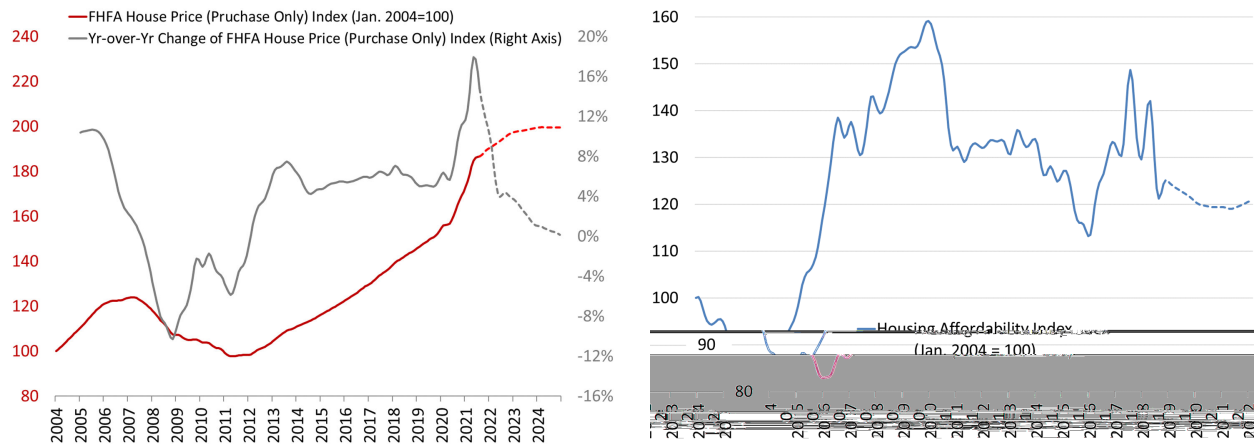
### 3.2.3 House Prices and Affordability

Trends in house prices influence the housing and mortgage markets. In periods of house price appreciation, home sales and mortgage originations may increase as the expected return on investment rises. In periods of price depreciation and/or price uncertainty, home sales and mortgage originations tend to decrease as risk-averse homebuyers are reluctant to enter the market. To measure house price appreciation, we use FHFA’s purchase-only House Price Index (HPI). In the left-hand-side panel of Exhibit 4, we plot the level of the HPI (red line, represented by the left axis) and the year-over-year growth rate of the HPI (grey line, represented by the right axis) over the 2004–2024 period. As the graph shows, house prices fell dramatically during the 2007 financial crisis but have recovered and increased since 2012 with price increases in excess of 5.0 percent per year. The growth rate began to accelerate

in the beginning of 2020 and reached 10+ percent on a year-over-year basis during the fall quarter of 2020. According to Moody’s, the housing markets are expected to remain robust for the forecast period, with house price appreciation rate at 4.0 percent and 1.2 percent for 2022 and 2023. Moody’s expects the growth rate to decline to 0.2 percent in 2024 as the housing markets cool down.

The expected rise in interest rates and house prices will contribute to a decrease in housing affordability. To measure housing affordability, we use the housing affordability index (HAI) published by the National Association of Realtors and provided by Moody’s. This index takes general house prices, mortgage interest rates, and borrower incomes into consideration. Higher HAI values means that housing is more affordable. The right panel of Exhibit 4 presents the history and trends of the index. It shows that housing affordability has been increasing since early 2019, largely due to falling interest rates. Despite the economic downturns caused by the pandemic, housing affordability remained high during 2020 due to the historic low interest rates. However, affordability is expected to decline for the 2022–2024 period because of rising interest rates, robust house prices, supply shortage, and demand pressures created by the increasing share of Millennial-generation households entering homeownership.<sup>16</sup>

**Exhibit 4: Historical and Projected Trends of House Prices and Affordability**



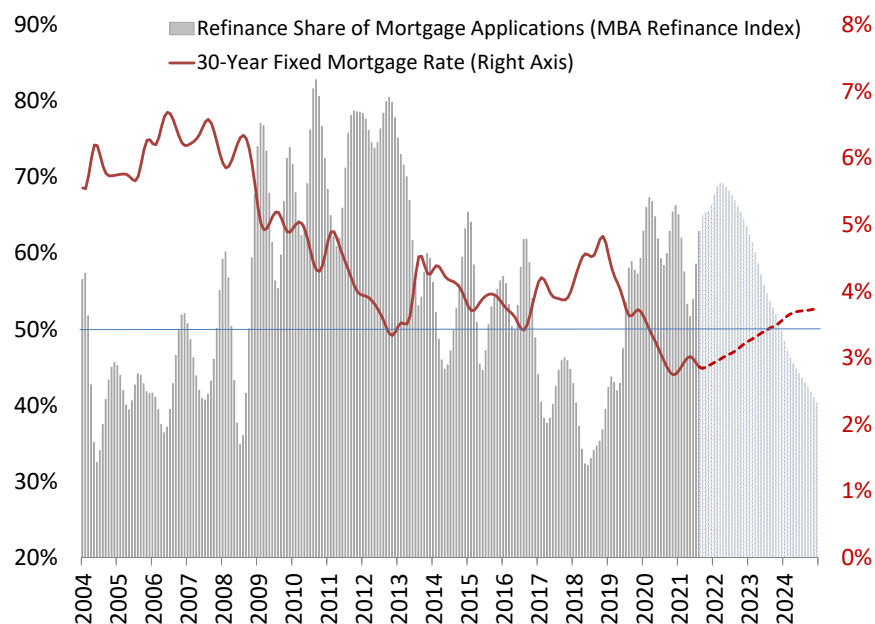
<sup>16</sup>According research by CoreLogic, the largest generation of households—the Millennials have made up the largest share of home purchase mortgage applications for the past five years, rising about 2 to 4 percentage points each year. However, during 2020, the Millennial share in mortgage applications increased around 7 percentage, from 33 percent in 2014 to 47 percent in 2019 to 54 percent in 2020. As CoreLogic notes, “while half of the increase is consistent with the natural growth rate seen since 2014, the additional half of the 2020 jump was likely driven by the pandemic. In other words, the increase was accelerated by record low mortgage interest rate and flexibility to work remotely.” See the CoreLogic blog post: “Millennials Lead the Pack for Home Purchases”: <https://www.corelogic.com/blog/2021/4/millennials-lead-the-pack-for-home-purchases.aspx>

### 3.2.4 Refinance Share of Mortgage Applications

The size of the refinance mortgage market has an impact on the affordable share of refinance mortgages. Historically, refinance mortgage volume increases when the refinancing of mortgages is motivated by low interest rates (“rate-and-term” refinances). Higher-income borrowers tend to make up a greater share of this increased volume. As a result, in periods of low interest rates, the share of lower-income borrowers among all refinancers tends to decrease. Likewise, refinancing that occurred when interest rates were high tends to have a higher proportion of lower-income homeowners who refinance to consolidate their debts or draw equity out of their homes for other uses.

Exhibit 5 plots the historical and projected values of the 30-year fixed mortgage rate and refinance share of mortgage applications (measured by MBA’s refinance index). As expected, it shows a roughly negative correlation between the refinance share and mortgage rate. The refinance share had consistently exceeded 50 percent of the mortgage applications for the period between 2009 and 2016 because of the low interest rate. 2020 represented another solid “refinance boom” year due to the historic low mortgage rates. However, according to Moody’s forecasts, as interest rates are projected to rise gradually during the 2022–2024 period, the refinance share will drop below 50 percent in July 2023 and eventually reach the 34-percent mark by the end of 2024.

**Exhibit 5:** Historical and Projected Trends of Refinance Share and 30-Year Fixed Mortgage Rate

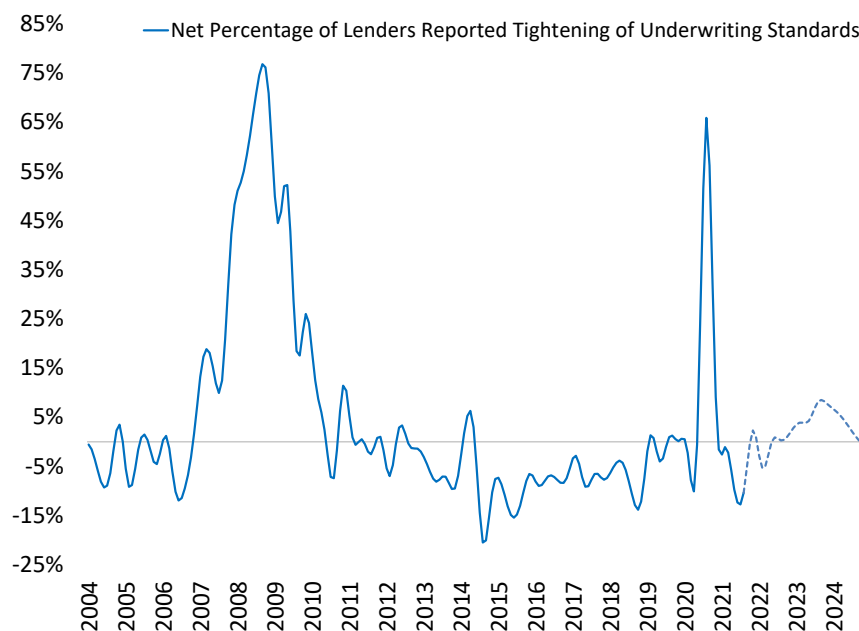




### 3.2.5 Underwriting Standards

Mortgage underwriting standards clearly have an impact on mortgage originations. One measure of the tightness of underwriting standards is the net percentage of lenders who reported a tightening of underwriting standards in the Federal Reserve Board’s Senior Loan Officer Opinion Survey on Bank Lending Practices. If the net percentage is greater than zero, it means that there is a higher percentage of lenders reporting a tightening of underwriting standards than lenders reporting a loosening of underwriting standards. Conversely, a negative net percentage implies that more lenders are reporting a loosening of underwriting standards. The variable is a qualitative assessment by nature but very useful in capturing underwriter attitudes as well as the use of credit score overlays and other mechanisms in which underwriting standards might tighten. Exhibit 6 plots the series over time. During the housing boom years, as can be seen from the graph, underwriting standards loosened. The graph shows that, following the housing bust in 2007, lenders tightened underwriting standards considerably for a number of years. The underwriting standards in 2020, as indicated by this variable, are almost as tight as those during the 2007–2009 period. Moody’s forecasts that underwriting standards will be relatively less tight for 2021 and 2022. Underwriting standards are forecast to tighten again in 2023 and 2024, although they will not be as tight as the conditions in 2020.

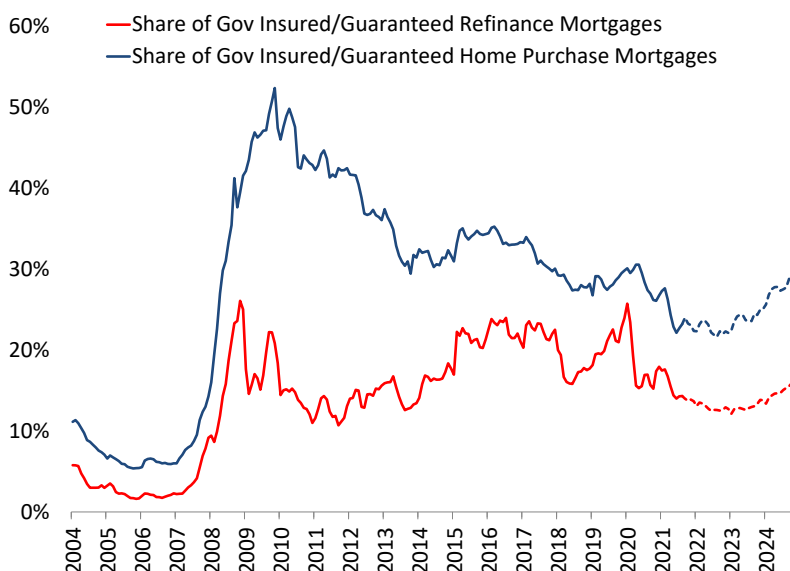
**Exhibit 6:** Historical and Projected Trends of Mortgage Underwriting Standards



### 3.2.6 Share of Government-Insured and Guaranteed Mortgages

Moody's does not publish forecasts for the government share of home purchase and refinance originations. The modeling team has developed basic forecast models to project these series for the 2022–2024. Government shares are modeled to be driven by trends in the unemployment rate, interest rates, the spread between FHA and conventional mortgage rates, existing home sales, relative underwriting tightness, and house prices. Exhibit 7 plots the historical and projected paths of the two series. Both series, especially the refinance share, declined noticeably during the pandemic in 2020 but they have since rebounded. It is expected that the government share of home purchases and refinances will reach 27.9 percent and 15.1 percent by 2024.

**Exhibit 7:** Historical and Projected Trends of Government Shares of Mortgages



## 4 Econometric Models Of The Single-Family Housing Goals

The purpose of the statistical models is to forecast the market share of the goal-qualifying mortgage originations in the mortgage market for the 2021–2024 period. The focus is on generating reliable model forecasts, rather than testing economic hypotheses or trying to explain the relationship between the variables. Moreover, the forecast equation itself is a reduced-form model for the affordable market. Separate models are developed and estimated for each of the four single-family housing goals. We use a type of time-series regression

models called Autoregressive Integrated Moving Average (ARIMA) models. Widely used in the field of economic forecasting, ARIMA models are known for their flexibility and ability to generate good fit to various historical series. FHFA has employed these ARIMA models in past rulemaking cycles to generate market forecasts. We have updated the model specification of the ARIMA models in this goal cycle from the models used in the 2018 rulemaking cycle as needed.

The outcome variable for each of the models is expressed in percentage share format. It is constructed as a monthly time-series using the 2004–2020 HMDA data, as described earlier. All outcome variables and driver variables were first-differenced to ensure that the data series have the statistical property that they are stationary. The augmented Dickey-Fuller tests (ADF) have been conducted on each of the first-differenced series to confirm that they are stationary.

Fitting an ARIMA model on first-differenced variables means that the reported regression coefficients can no longer be interpreted in the way the “beta” coefficients are interpreted in linear regression. Not only are the estimated equations non-linear (indicating the slope of the line is dependent on the specific point the reader is interested in), the coefficients themselves represent the change in the first difference of the dependent variable. Fortunately, since the goal of our models is to forecast rather than explain the reduced form equation of the various housing goal “markets,” we are able to rely on “hold-out” sample and out-of-sample forecasts to test the robustness of the model specifications as is common among forecasters.

In order to model the non-contemporaneous nature of the relationship between macroeconomic variables, both lag and lead versions of each driver variable were tested and the appropriate form of the variable chosen.<sup>17</sup> Moreover, to avoid multi-collinearity (or correlation among driver variables), the modeling team has examined the correlation between potential driver variables and ensured that the final model specification did not include driver variables that are highly correlated. Monthly indicator variables are included in the models to control for the seasonal/cyclic patterns of the mortgage activities. Finally, to allow for non-linearity between the outcome variable and driver variables, we tested and included some of the variables in natural logarithm scale. For example, the consumer confidence index variable is entered in logarithm scale in the model for the low-income home purchase market share because it provides a better fit to the data in that form.

During the model development process, we grouped the factors that are expected by housing market economists to have an impact on the market share of affordable housing into seven broad categories. They are:

---

<sup>17</sup>For example, lagged variables are reported with a subscript such as  $t - 1$  in the tables for the regression coefficients.

- Demand-side factors such as per capita income and household debt service indicators;
- Interest rate environment including the 30-year FRM mortgage rate;
- Expectation factors and indicators of the health of the economy such as the unemployment rate, labor force participation rate, the consumer confidence index and consumer confidence index;
- House price level including FHFA’s house price indices and the Housing Affordability Index;
- Supply-side factors including indicators of existing home sales;
- Underwriting standards including the Senior Loan Officer Opinion survey; and
- Other factors including the share of government insured or guaranteed mortgages.

For each category of variables, many variables were tested but only retained when they exhibited predictive power. For each model, we tested and succeeded in including at least one driver variable per category. We concentrated on the theoretical and behavioral implications when selecting the driver variables but since our goal was to develop robust forecasting models (rather than developing explanatory models), we retained driver variables depending on the strength of the explanatory power.

#### **4.1 Market Forecast For Low-Income Home Purchase Goal (LIP)**

Exhibit 8 reports the final set of model driver variables that we have selected for the low-income home purchase goal. It also reports the regression coefficients, their level of statistical significance, and model diagnostics.

The driver variables that were found to be statistically significant are:

- Unemployment rate
- Consumer confidence
- Housing affordability index
- FHFA’s purchase-only House Price Index
- Sale of existing homes
- Share of government insured or guaranteed mortgages

The Chi-square statistics and other model fit measures reported at the bottom of the table are reasonable for forecasting models for this kind of data. The  $\text{Pr}(\text{Chi-square})$  statistic, for instance, indicates the probability that, after including the relevant driver variables in the model, the regression residuals are following a white noise distribution (therefore random).

To test for reliability and accuracy of the model’s forecasts, we have conducted an out-of-sample test where we withhold the last 12 months (2020) of the HMDA series and estimated

**Exhibit 8: Regression Coefficients of Market Forecast Model for the Low-Income Home Purchase Goal**

<b>Outcome Variable (First Difference)</b>	
Share of Borrowers with Low Income	
<b>Driver Variable (First Difference)</b>	<i>Coefficient Estimate</i>
Unemployment Rate	0.0019 * (0.0010)
Ln(Consumer Confidence)	0.0172 * (0.0089)
Consumer Price Index (CPI) <sub>t-1</sub>	-0.0014 (0.0008)
Housing Affordability Index	0.0004 * (0.0002)
FHFA House Price Index (HPI) - Purchase Only	0.0009 ** (0.0004)
Sale of Existing Homes	0.0092 ** (0.0041)
Senior Loan Officer Opinion Survey: Percent of lenders reported tightening of underwriting	-0.0079 (0.0080)
Share of Government-Insured or Guaranteed Mortgages	0.2078 *** (0.0421)
AR(1)	-0.0280 (0.0748)
AR(2)	0.0611 (0.0752)
<i>Model Diagnostics</i>	
$\chi^2$	5.03
Prob(> $\chi^2$ )	0.28
AIC	-1506.44
SBC	-1436.87

Notes:

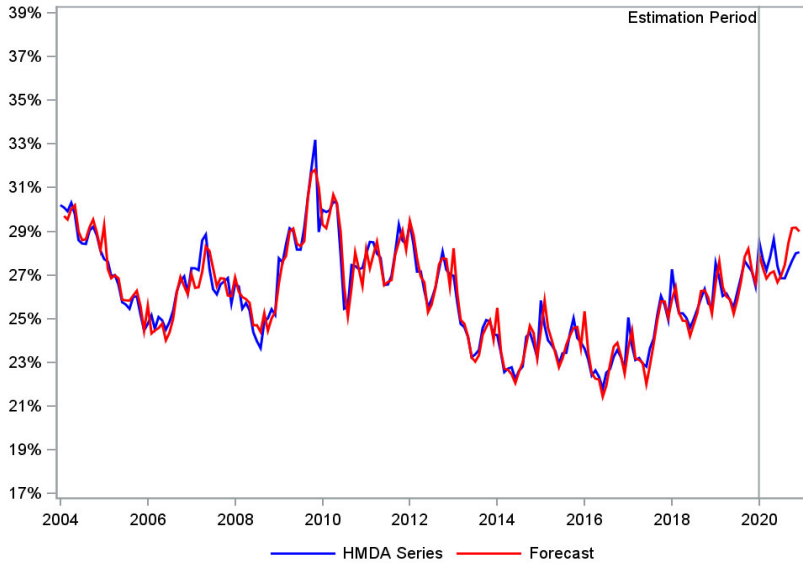
All variables are in first-difference format. Model includes monthly dummy variables that control for seasonal variations. Standard Errors are reported in parentheses. Significance levels: \* p<0.1, \*\* p<0.05, \*\*\* p<0.01.

the model using the remaining data series (that is, 2004–2019). We then compared the model forecasts in the “hold-out” period (2020) to the actual values in the same period (2020). Results of this analysis are presented in Exhibit 9. The blue line represents the historical HMDA series, while the red line represents the model forecasts. Focusing on the out-of-sample forecast period (2020), while the two lines do not track each other perfectly, the forecast model is able to capture the downturns and upturns in the actual data (blue line), albeit with a lag. This is an indication of the robustness of the model specification.

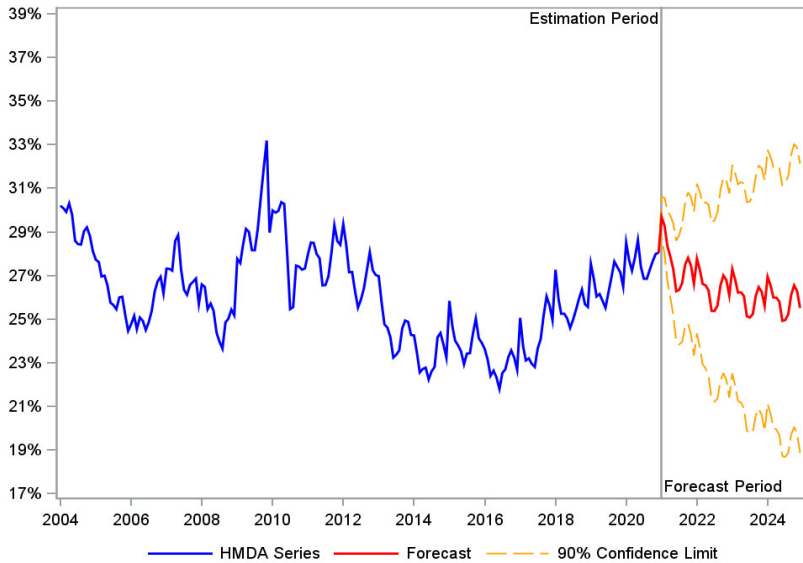
Exhibit 10 plots the monthly forecasts generated by the model for 2021–2024 period. The red line represents the forecast, while the yellow lines are the corresponding confidence intervals. The LIP market share is shown to rise gradually in 2020 and 2021 before leveling out for the 2022–2024 period.

Exhibit 11 presents a summary of the annual forecasts (and their confidence intervals), together with the historical market shares (HMDA) and the benchmark levels that FHFA

**Exhibit 9:** Robustness Test of Market Forecast Model for the Low-Income Home Purchase Goal



**Exhibit 10:** Model Forecast for the Low-Income Home Purchase Goal



set for the Enterprises in the past couple rulemaking cycles. As a reference, it also shows the model forecasts for the 2017–2020 period that FHFA published in the Federal Register for the 2018 Final Rule. Forecasts from the new model are shown in the last row: 26.6 percent for 2022, 25.7 percent for 2023, and 25.5 percent for 2024. The average annual forecast across the 2022–2024 period is 26.0 percent.

**Exhibit 11: Historical Performance and Model Forecast for the Low-Income Home Purchase Goal**

	Historical Performance						Projected Performance			
	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
<b>Actual Market</b>	23.6	22.9	24.3	25.5	27.0	27.6				
<b>Benchmark</b>	24	24	24	24	24	24	24			
<b>2018 Final Rule</b>			21.9	22.7	24.4	24.3				
<b>Market Forecast</b>			+/-	+/-	+/-	+/-				
			2.5	4.3	5.5	6.5				
<b>Current Market</b>							27.5	26.6	25.7	25.5
<b>Forecast</b>							+/-	+/-	+/-	+/-
							2.3	3.9	5.0	5.9

## 4.2 Market Forecast For Very Low-Income Home Purchase Goal (VLIP)

The market model for the very low-income home purchase goal includes the same set of driver variables that are included in the model for the low-income home purchase goal. The coefficient estimates and their level of significance are, of course, different from those for the model of the low-income home purchase goal. Exhibit 12 presents the model driver variables and the corresponding coefficient estimates as well as the model fit diagnostic measures.

The driver variables that were found to be statistically significant are:

- Housing affordability index
- Sale of existing homes
- Share of government insured or guaranteed mortgages

Exhibit 13 presents the out-of-sample robustness test with the red line representing the model estimated on 2004–2019 data and the blue line representing the actual HMDA estimates for the entire period. As can be seen in the graph, for the out-of-sample period (2020), the model forecast (red line) does a good job capturing the turns in the actual data for 2020 (blue line), indicating the robustness of the model specification.

Exhibit 14 plots the monthly forecasts generated by the model for 2021–2024 period. The red line represents the forecast, while the yellow lines are the corresponding confidence intervals. It shows that similar to the LIP market, the VLIP market share is predicted to rise in 2020 and 2021, reaching a peak in early 2021. From there, it eventually returns to the 2018/2019 level in 2024.

**Exhibit 12: Regression Coefficients of Market Forecast Model for the Very Low-Income Home Purchase Goal**

<b>Outcome Variable (First Difference)</b>	
Share of Borrowers with Very Low Income	
<b>Driver Variable (First Difference)</b>	<i>Coefficient Estimate</i>
Unemployment Rate	0.0002 (0.0004)
Ln(Consumer Confidence)	0.0055 (0.0034)
Consumer Price Index (CPI) <sub>t-1</sub>	-0.0004 (0.0003)
Housing Affordability Index	0.0002 ** (0.0001)
FHFA House Price Index (HPI) - Purchase Only	0.0001 (0.0002)
Sale of Existing Homes	0.0035 ** (0.0016)
Senior Loan Officer Opinion Survey: Percent of lenders reported tightening of underwriting	-0.0018 (0.0031)
Share of Government-Insured or Guaranteed Mortgages	0.0535 *** (0.0156)
AR(1)	-0.7603 *** (0.2865)
AR(2)	-0.6698 ** (0.3254)
<i>Model Diagnostics</i>	
$\chi^2$	4.98
Prob(> $\chi^2$ )	0.29
AIC	-1910.03
SBC	-1840.45

Notes:

All variables are in first-difference format. Model includes monthly dummy variables that control for seasonal variations. Standard Errors are reported in parentheses. Significance levels: \* p<0.1, \*\* p<0.05, \*\*\* p<0.01.

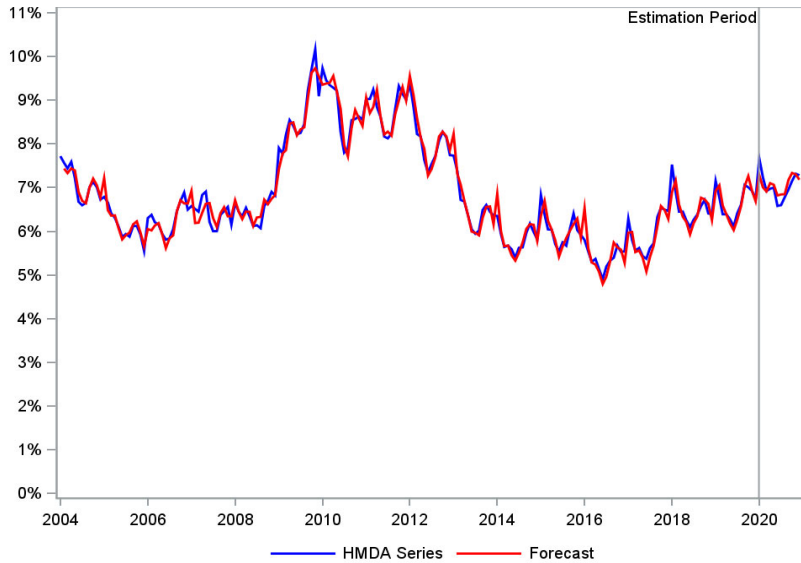
Exhibit 15 presents a summary of the annual forecasts (and their confidence intervals), together with the historical market shares (HMDA) and the benchmark levels that FHFA set for the Enterprises in the past. As a reference, the graph also shows the model forecasts for the 2017–2020 period that FHFA published in the Federal Register for the 2018 Final Rule. Forecasts from the new model are shown in the last row: 6.2 percent for 2022, 6.1 percent for 2023, and 6.2 percent for 2024. The average annual forecast across the 2022–2024 period is 6.2 percent.

### 4.3 Market Forecast for Minority Census Tracts and Low-Income Census Tracts Home Purchase Subgoals

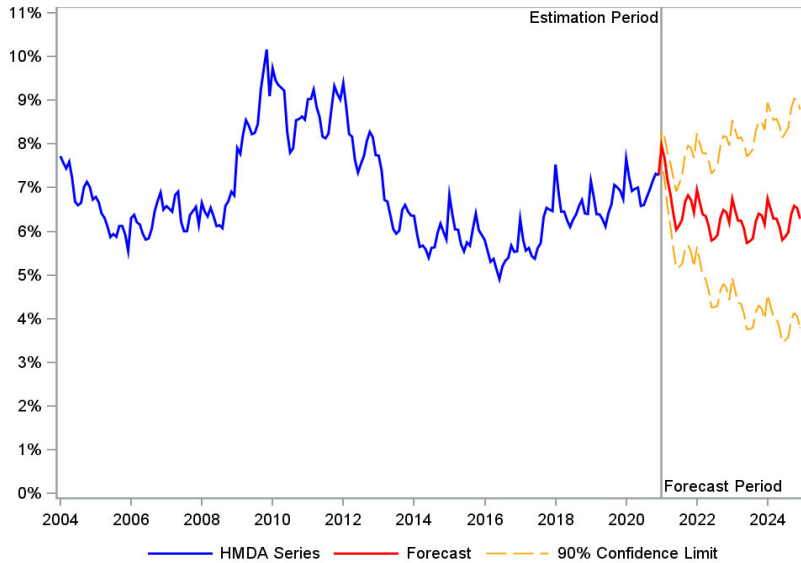
FHFA’s Proposed Rule for 2022–2024 proposes two new area-based subgoals, each with its own benchmark level: the minority census tracts subgoal and the low-income census tracts



**Exhibit 13:** Robustness Test of Market Forecast Model for the Very Low-Income Home Purchase Goal



**Exhibit 14:** Model Forecast for the Very Low-Income Home Purchase Goal



subgoal. Since then, the modeling team has developed market forecast models for them.

While the definition of goal-qualifying mortgages for the low-income and very low-income goals involves the borrower’s income affordability level alone, the definition of goal-qualifying mortgages for the two new subgoals involves both the borrower’s income affordability level and the (census tract) location of the borrower’s residence. Specifically, the two subgoal definitions are:

**Exhibit 15: Historical Performance and Model Forecast for the Very Low-Income Home Purchase Goal**

	Historical Performance						Projected Performance			
	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
<b>Actual Market</b>	5.8	5.4	5.9	6.5	6.7	7				
<b>Benchmark</b>	6	6	6	6	6	6	6			
<b>2018 Final Rule</b>			5.1	5.3	5.9	5.9				
<b>Market Forecast</b>			+/-	+/-	+/-	+/-				
			0.9	1.5	1.9	2.2				
<b>Current Market</b>							6.7	6.2	6.1	6.2
<b>Forecast</b>							+/-	+/-	+/-	+/-
							0.8	1.4	1.8	2.1

- **Minority Census Tracts Purchase Subgoal:** This goal measures the share of each Enterprise’s goal-qualifying purchase loans made to borrowers with incomes no greater than 100 percent of AMI in minority census tracts.<sup>18</sup>
- **Low-Income Census Tracts Purchase Subgoal:** This goal measures the share of each Enterprise’s goal-qualifying purchase loans made to two subgroups: (1) borrowers (regardless of income) in low-income census tracts<sup>19</sup> that are not minority census tracts, and (2) borrowers with incomes greater than 100 percent of AMI in low-income census tracts that are also minority census tracts.

By design, these two subgoals are mutually exclusive—there is no overlap between the populations of borrowers qualifying for the two subgoals. Thus, the modeling team has constructed forecast models separately for them.

The driver variables and regression coefficient estimates for the minority census tracts subgoal are shown in Exhibit 16. The driver variables that were found to be statistically significant are:

- Labor force participation rate (working age)
- Consumer price index

The variables and coefficient estimates for the low-income census tracts subgoal are reported in Exhibit 17.

The driver variables that were found to be statistically significant are:

- Per capita income

<sup>18</sup>Census tracts that have a minority population of at least 30 percent and a median income of less than 100 percent of AMI.

<sup>19</sup>Census tracts where the median income is no greater than 80 percent of AMI.

**Exhibit 16: Regression Coefficients of Market Forecast Model for Minority Census Tracts  
Purchase Subgoal**

<b>Outcome Variable (First Difference)</b>	
Share of Borrowers Residing in Minority Census Tracts	
<b>Driver Variable (First Difference)</b>	<i>Coefficient Estimate</i>
Yield Curve $t-1$	0.0016 (0.0012)
Unemployment Rate	-0.0010 (0.0006)
Labor Force Participation Rate (Working Age)	-0.0040 ** (0.0020)
Consumer Confidence $t-1$	0.0001 (0.0000)
Consumer Price Index (CPI)	-0.0005 * (0.0003)
Housing Affordability Index $t-2$	-0.0001 (0.0001)
FHFA House Price Index (HPI) - Purchase Only	0.0000 (0.0001)
Sale of Existing Homes	-0.0016 (0.0014)
Senior Loan Officer Opinion Survey: Percent of lenders reported tightening of underwriting	0.0009 (0.0030)
Share of Government-Insured or Guaranteed Mortgages	0.0126 (0.0166)
AR(1)	-0.2302 *** (0.0763)
AR(2)	-0.1333 * (0.0767)
<i>Model Diagnostics</i>	
$\chi^2$	6.47
Prob(> $\chi^2$ )	0.17
AIC	-1877.99
SBC	-1801.78

Notes:  
All variables are in first-difference format. Model includes monthly dummy variables that control for seasonal variations.  
Standard Errors are reported in parentheses. Significance levels: \* p<0.1, \*\* p<0.05, \*\*\* p<0.01.

- Consumer confidence
- Housing affordability index
- FHFA’s purchase-only House Price Index

The Chi-square statistics reported at the bottom of both tables indicate that, after including the relevant driver variables in the model, the regression residuals are distributed randomly (following a white noise distribution).

Results of the out-of-sample forecast robustness tests are reported in Exhibit 18, separately for the two models. Once again, the blue line represents the historical HMDA series, while the red line represents the model forecast. In both cases, the red line tracks the blue line closely for the 2020 out-of-sample period, showing the robustness of the model estimates.

## Exhibit 17: Regression Coefficients of Market Forecast Model for Low-Income Census Tracts Purchase Subgoal

<b>Outcome Variable (First Difference)</b>	
Share of Borrowers Residing in Low-Income Census Tracts	
<b>Driver Variable (First Difference)</b>	<i>Coefficient Estimate</i>
Per Capita Income $t_{-1}$	0.0007 ** (0.0003)
Yield Curve	0.0001 (0.0008)
Consumer Confidence $t_{-2}$	0.0001 *** (0.0000)
Housing Affordability Index	-0.0002 *** (0.0000)
FHFA House Price Index (HPI) - Purchase Only	0.0002 * (0.0001)
Sale of Existing Homes	-0.0011 (0.0008)
Senior Loan Officer Opinion Survey: Percent of lenders reported tightening of underwriting $t_{-4}$	-0.0016 (0.0023)
Share of Government-Insured or Guaranteed Mortgages	0.0051 (0.0113)
AR(1)	-0.2477 *** (0.0765)
AR(2)	-0.1217 (0.0757)
<i>Model Diagnostics</i>	
$\chi^2$	3.93
Prob(> $\chi^2$ )	0.42
AIC	-2033.24
SBC	-1963.67

**Notes:**

All variables are in first-difference format. Model includes monthly dummy variables that control for seasonal variations.

Standard Errors are reported in parentheses. Significance levels: \*  $p < 0.1$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$ .

## Exhibit 18: Robustness Test of Market Forecast Model for Minority Census Tracts and Low-Income Census Tracts Subgoals

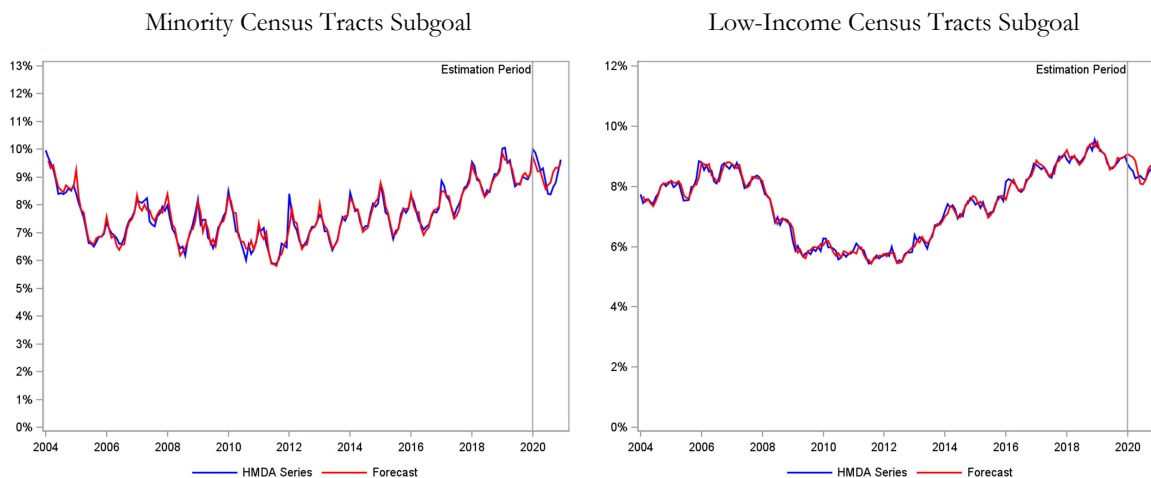


Exhibit 19 plots the monthly forecasts. This is done separately for the two models. The red lines represent the forecasts, while the yellow lines are the corresponding confidence intervals. The forecasts exhibit noticeably seasonal and cyclical patterns. Over the 2022–2024 period, the market share of borrowers qualifying for the minority census tracts subgoal is forecast to decline slightly, while the share of borrowers qualifying for the low-income census tracts subgoal is expected to return to the long-term trend after its dip in 2019 and 2020, notwithstanding the strong seasonal and cyclical patterns.

**Exhibit 19: Model Forecast for Minority Census Tracts and Low-Income Census Tracts Subgoals**

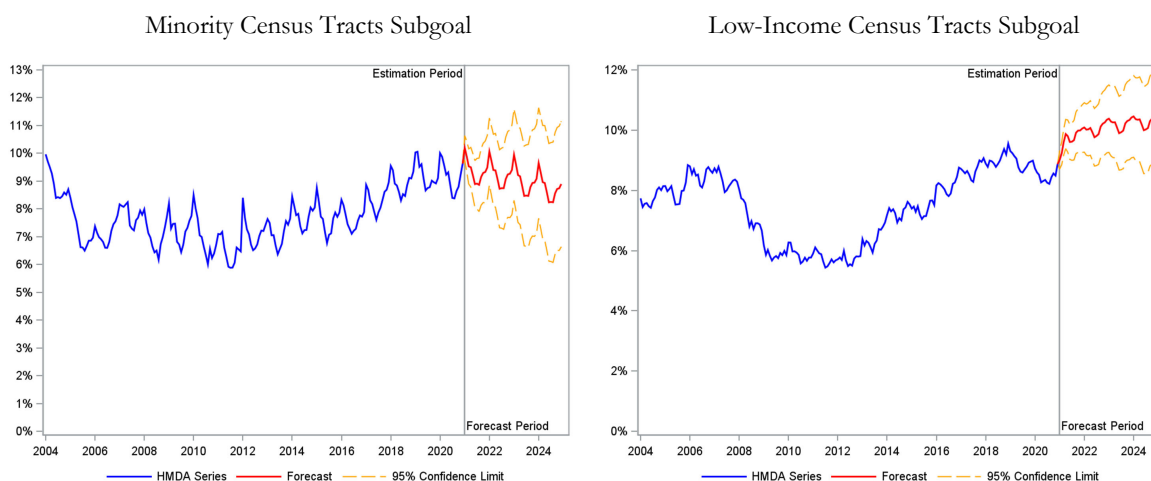


Exhibit 20 summarizes the annual forecasts (and their confidence intervals), together with the historical market shares (HMDA) of borrowers qualifying for the two subgoals since 2015. Forecasts from the new models are shown in the last row of the two panels of the Exhibits. For the minority census tracts subgoal, the forecasts are 9.2 percent for 2022, 8.9 percent for 2023, and 8.7 percent for 2024. The average annual forecast across the 2022–2024 period is 8.9 percent. For the low-income census tracts subgoal, the forecasts are 10 percent for 2022, 10.2 percent for 2023, and 10.3 percent for 2024. The average annual forecast across the 2022–2024 period is 10.1 percent.

#### 4.4 Market Forecast For Low-Income Refinance Goal (LIR)

The model for forecasting the share of low-income refinances is shown in Exhibit 21. As expected, the driver variables are quite different from those for the home purchase goal models because different factors determine a borrower’s refinance decisions.

The driver variables that were found to be statistically significant are:

**Exhibit 20:** Historical Performance and Model Forecast for Minority Census Tracts and Low-Income Census Tracts Subgoals

Minority Census Tracts Subgoal											
	Historical Performance						Projected Performance				
	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	
<b>Actual Market</b>	7.6	7.8	8.5	9.0	9.2	9.2					
<b>Current Market</b>							9.3	9.2	8.9	8.7	
<b>Forecast</b>							+/-	+/-	+/-	+/-	
							0.9	1.4	1.8	2.1	

Low-Income Census Tracts Subgoal											
	Historical Performance						Projected Performance				
	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	
<b>Actual Market</b>	7.4	8.1	8.6	9.1	8.9	8.5					
<b>Current Market</b>							9.7	10.0	10.2	10.3	
<b>Forecast</b>							+/-	+/-	+/-	+/-	
							0.6	1.0	1.2	1.5	

- Refinance incentive, measured as a spread between the prevailing 30-year fixed rate and the moving average of the monthly 30-year fixed rates from previous 3 years
- Refinance share of the mortgage applications (MBA’s refinance index)
- Refinance share of the mortgage originations

The Chi-square statistics reported at the bottom of the table indicate that, after including the relevant driver variables in the model, the regression residuals are distributed randomly (following a white noise distribution).

Results of the out-of-sample forecast robustness test are presented in Exhibit 22. The blue line represents the historical HMDA series, while the red line represents the model forecast. Focusing on the out-of-sample forecast period (2020), the forecast does a reasonably good job at tracking the actual HMDA observations. In particular, the model is capable of correctly predicting the downturn of the low-income refinance share since the beginning of 2020. This indicates robustness of the model specification.

Exhibit 23 plots the monthly forecasts generated by the model for 2021–2024 period. To account for the volatile and uncertain nature of future interest rate path, the modeling team has generated forecasts based on driver inputs from two of Moody’s scenarios: (1) Scenario #1: Consensus Forecast scenario; and (2) Scenario #2: Baseline Forecast scenario. Both scenarios are equally valid. Additional information about the Baseline scenario is included in Appendix A. In Exhibit 23, the red line represents the scenario #1 forecast, while the purple line denotes the scenario #2 forecast. The yellow lines are the confidence intervals. The

## Exhibit 21: Regression Coefficients of Market Forecast Model for the Low-Income Refinance Goal

**Outcome Variable (First Difference)**

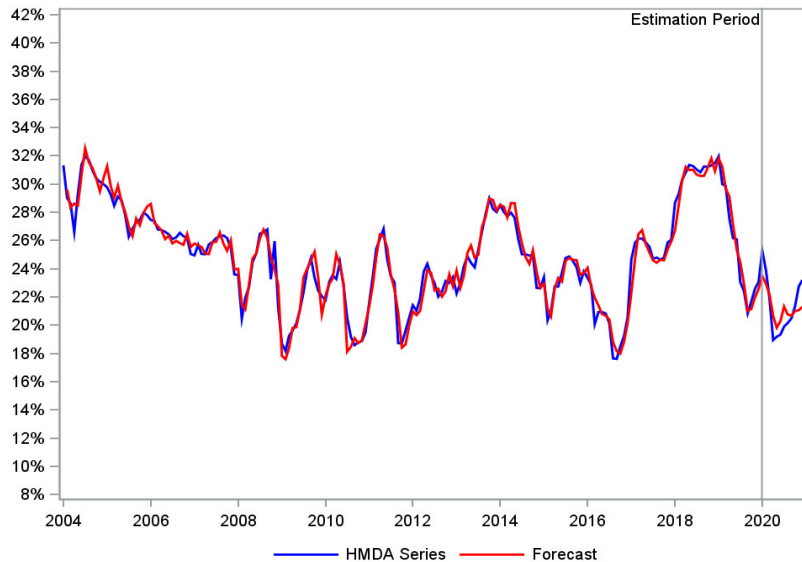
Share of Refinance Borrowers with Low Income

<b>Driver Variable (First Difference)</b>	<i>Coefficient Estimate</i>
Refinance Rate	-0.2622 *** (0.0204)
Refinance Incentive $t-6$	-0.0150 *** (0.0047)
Unemployment Rate	-0.0011 (0.0011)
Housing Affordability Index	0.0000 (0.0003)
Senior Loan Officer Opinion Survey: Percent of lenders reported tightening of underwriting	-0.0147 (0.0099)
Share of Government-Insured or Guaranteed Refinance Mortgages	-0.0617 (0.0510)
Refinance Application Volume Index $t+2$	-0.0487 *** (0.0181)
AR(1)	-0.1781 ** (0.0746)
<i>Model Diagnostics</i>	
$\chi^2$	2.53
Prob(> $\chi^2$ )	0.77
AIC	-1376.14
SBC	-1313.19

**Notes:**

All variables are in first-difference format. Model includes monthly dummy variables that control for seasonal variations. Standard Errors are reported in parentheses. Significance levels: \*  $p < 0.1$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$ .

## Exhibit 22: Robustness Test of Market Forecast Model for the Low-Income Refinance Goal



plot shows that, for both scenarios, although the affordable share in the refinance market declined substantially in 2020, it is expected that it will recover sharply in 2021 and then gradually rise during the 2022–2024 period.

**Exhibit 23:** Model Forecast for the Low-Income Refinance Goal

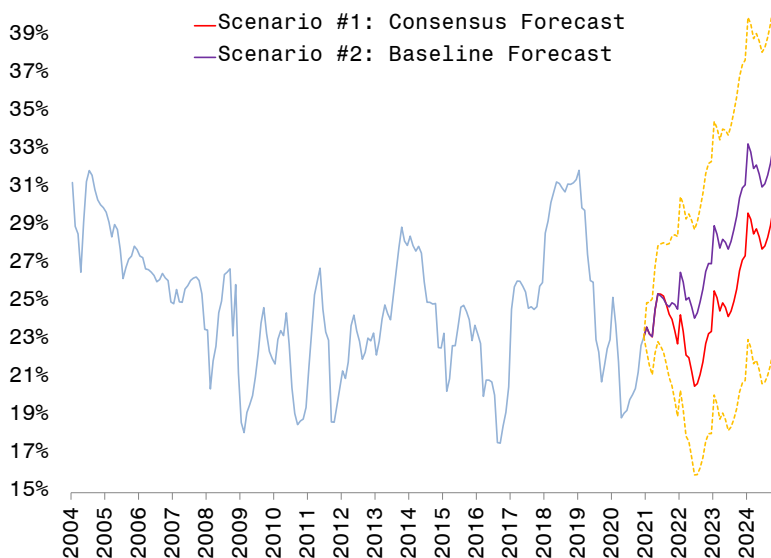


Exhibit 24 presents a summary of the annual forecasts (and their confidence intervals), together with the historical market shares (HMDA) and the benchmark levels that FHFA set for the Enterprises in the past. As a reference, it also shows the model forecasts for the 2017–2020 period that FHFA published in the Federal Register for the 2018 Final Rule. Forecasts from the model are shown in the last two rows, separately for two forecast scenarios. For the scenario #1, the forecasts are 22.3 percent for 2022, 25.5 percent for 2023, and 29.1 percent for 2024. The average annual forecast across the 2022–2024 period is 25.7 percent. For the scenario #2, the forecasts are 25.7 percent for 2022, 29.1 percent for 2023, and 32.5 percent for 2024. The average annual forecast across the 2022–2024 period is 29.1 percent.

## 5 Sensitivity of Model Estimates

The modeling team has also investigated the sensitivity of the model forecasts with respect to our assumption of future macroeconomic scenarios. Results are summarized in Appendix A. Overall, we find that the forecasts are rather insensitive to the use of alternative scenarios. Forecast for the low-income refinance goal is an exception: it is sensitive to the scenario assumptions used for the model driver variables.



**Exhibit 24: Historical Performance and Model Forecast for the Low-Income Refinance Goal**

	Historical Performance						Projected Performance			
	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
<b>Actual Market</b>	22.5	19.8	25.4	30.7	24.3	21				
<b>Benchmark</b>	21	21	21	21	21	21	21			
<b>2018 Final Rule Market Forecast</b>			23.4	23.4	20.6	18.0				
			+/-	+/-	+/-	+/-				
			3.0	5.1	6.5	7.7				
<b>Current Market Forecast</b>							24.2	22.3	25.5	29.1
<b>Scenario #1</b>							+/-	+/-	+/-	+/-
							2.9	5.0	6.4	7.4
<b>Scenario #2</b>							24.6	25.7	29.1	32.5
							+/-	+/-	+/-	+/-
							2.9	5.0	6.4	7.4

## 6 Concluding Remarks

This report provides the technical details of the econometric models that we have developed to forecast the market share of the goal-qualifying mortgage originations in the mortgage market for each of the single-family housing goals and subgoals. Forecasts for the 2022–2024 period are presented. Model diagnostics and reliability of the forecasts have also been discussed. To examine the sensitivity of the model forecasts, we have also provided model forecasts using driver variables embedded in a number of alternative scenarios published by Moody’s.

# Appendix A: Sensitivity Of Model Estimates To Alternative Macroeconomic Forecast Scenarios

This section analyzes the extent to which our market share estimates are sensitive to the macroeconomic environments that we have assumed. With the exception of low-income refinance goal, the market share estimates we have reported so far are based on forecast values of the driver variables from Moody's Consensus Forecast scenario. This scenario incorporates the central tendency of baseline forecasts from a broad range of reputable institutions and professional economists, including the Congressional Budget Office, Office of Management and Budget, and the Federal Reserve Board.

To assess the sensitivity of our market share estimates, we use forecast values of the driver variable from three alternative macroeconomic scenarios from Moody's. They are:

- **Baseline scenario.** This scenario is the baseline forecast of Moody's Analytics. Since it is a baseline, by construction, the probability that the economy will perform better than this projection is equal to 50 percent, the same as the probability that it will perform worse. This scenario assumes that GDP growth will be very strong in 2021 and 2022 as the pandemic eases and fiscal spending increases. The Federal Reserve is expected to keep Federal Funds Rate in the 0–0.25 percent range until early 2023. The 10-year U.S. Treasury yield is expected to increase steadily over the next few years. In addition, strong demographic tailwind is expected for the housing market as more millennials enter their prime first-time homebuying years.
- **Stronger Near-Term Growth (S1) scenario.** This scenario assumes that the US economy will demonstrate more robust economic growth in the near term as compared to the Baseline scenario. It assumes that the pandemic eases earlier than assumed in the Baseline scenario and fiscal spending is even higher, increasing business and travel activity and leading to lower unemployment and an even stronger economy in 2021. Consumer confidence increases, accelerating spending and lifting nonresidential investment which adds to growth in real GDP. Wage rates rise, lifting household incomes and spending. House prices rise by 12.4 percent over the course of 2021, compared to 11.3 percent in the Baseline scenario.
- **Protracted Slump (S4) scenario.** This scenario assumes that pandemic persists or worsens, causing business closures and lower consumer confidence and spending. Unemployment rates rise and recession begins. GDP declines through 2022, unemployment rate exceeds 10 percent in 2023. House price growth will be negative in

2022. The recession will be less severe than the 2008–2009 downturn. However, the trough is well above that of the 2011 trough following the Great Recession. The recovery is assumed to begin in the third quarter of 2022. Based on historical experience, we assume that the maximum share of the government mortgages (FHA, VA, and RHS) cannot exceed 55 percent of the overall mortgage market. As this share approaches its maximum, we expect that there would be other policy intervention to address the growing share of government financed mortgages.

The comparison of the driver variables for all scenarios is presented in Exhibit 1 and, as shown, the differences in many of the variables themselves are more subtle than stark.

**Exhibit 1: Comparison of Forecast Scenarios**

		2021	2022	2023	2024
<b>GDP Growth Rate</b>	Baseline	6.0	4.3	2.3	2.8
	Consensus	6.0	4.6	2.5	1.9
	Stronger Near-Term Growth	6.2	6.2	1.8	2.0
	Protracted Slump	5.2	-1.8	-0.3	3.4
<b>Unemployment Rate</b>	Baseline	5.5	3.6	3.5	3.7
	Consensus	5.5	4.2	4.0	3.9
	Stronger Near-Term Growth	5.4	3.1	2.9	3.1
	Protracted Slump	6.0	8.8	10.3	9.1
<b>30-Yr Fixed Rate</b>	Baseline	3.0	3.5	3.9	4.4
	Consensus	2.9	3.1	3.4	3.7
	Stronger Near-Term Growth	3.0	3.7	4.2	4.5
	Protracted Slump	2.9	2.7	2.6	2.8
<b>FHFA Purchase-Only HPI Growth Rate</b>	Baseline	11.3	1.4	0.8	0.8
	Consensus	11.8	4.0	1.2	0.2
	Stronger Near-Term Growth	12.4	4.3	1.2	0.9
	Protracted Slump	3.5	-5.5	0.3	1.2
<b>Housing Affordability Index</b>	Baseline	155.2	152.3	150.3	150.1
	Consensus	156.4	151.2	150.0	151.6
	Stronger Near-Term Growth	154.0	146.8	143.6	144.6
	Protracted Slump	162.3	171.1	171.7	174.8
<b>Refinance Share Mortgage Applications</b>	Baseline	59.9	58.7	45.9	33.9
	Consensus	60.6	67.1	55.7	44.0
	Stronger Near-Term Growth	59.3	56.0	42.6	29.6
	Protracted Slump	60.6	68.7	61.8	49.8

To generate the alternative market share forecasts, we input the forecast values of the driver variables from each of the alternative scenarios into the regression equations. Monthly forecast results are then aggregated into yearly forecasts. We compare these to the market share forecasts based on the Consensus Forecast scenario. Exhibit 2 provides a summary of the results by year, while Exhibit 3 presents the monthly forecast results. Results for

the low-income purchase share are shown in the first panel of Exhibit 2. The first row of each panel highlights the results based on the Consensus Forecast scenario, while the other rows show results from using the alternative scenarios. Average annual market performances over the 2022-2024 period are presented in the last column. The results show that the share forecasts for the low-income home purchase goal change slightly in response to alternative macroeconomic environments. The scenarios themselves are close in terms of assumptions (despite the names assigned by Moody's) and this closeness translates into the closeness of the results across different scenarios. For example, average forecast for the low-income purchase (LIP) share in the 2022-2024 period is identical for the Stronger Near-Term Growth scenario and the Consensus Forecast scenario. If the Protracted Slump scenario is assumed, the differential is 1.5 percentage point only. These are small differences. The same is true for the share forecasts for the very low-income home purchase goal as well as the minority census tracts and low-income census tracts home purchase subgoals. The only exception is that, for the low-income refinance goal, substantial differentials are observed for the average share forecasts across the four scenarios. This is likely a reflection of the uncertainty of future mortgage interest rate path and the corresponding refinance mortgage origination volumes.

Comparisons for the low-income refinance goal are presented in the bottom panel of Exhibit 2. Under the Stronger Near-Term Growth scenario, market share is forecast to be 30.4 percent for the 2022-2024 period, as compared to 25.7 percent under the Consensus Forecast scenario. This represents an increase of 4.7 percentage points. If the Protracted Slump scenario is assumed, the market share is forecast to be 22.8 percent, representing a decrease of 2.9 percentage points. The differential of average forecast between the Baseline and Consensus Forecast scenarios is 3.4 percentage points.

**Exhibit 2: Summary of Market Model Forecasts Based on Different Scenarios**

		2022	2023	2024	2022-2024 Average
<b>LIP</b>	Consensus Forecast	26.3%	25.9%	25.8%	26.0%
	Baseline Forecast	25.9%	25.4%	25.3%	25.5%
	Stronger Near-Term Growth	26.5%	26.0%	25.5%	26.0%
	Protracted Slump	23.5%	24.4%	25.5%	24.5%
<b>VLIP</b>	Consensus Forecast	6.2%	6.1%	6.2%	6.2%
	Baseline Forecast	6.2%	6.2%	6.3%	6.2%
	Stronger Near-Term Growth	6.2%	6.1%	6.1%	6.2%
	Protracted Slump	5.9%	6.3%	6.9%	6.4%
<b>MCT</b>	Consensus Forecast	9.2%	8.9%	8.7%	8.9%
	Baseline Forecast	9.1%	8.8%	8.6%	8.8%
	Stronger Near-Term Growth	9.2%	8.9%	8.5%	8.9%
	Protracted Slump	9.0%	9.1%	9.2%	9.1%
<b>LICT</b>	Consensus Forecast	10.0%	10.2%	10.3%	10.1%
	Baseline Forecast	10.0%	10.0%	10.2%	10.1%
	Stronger Near-Term Growth	10.4%	10.7%	10.8%	10.6%
	Protracted Slump	8.4%	8.2%	8.3%	8.3%
<b>LIR</b>	Consensus Forecast	22.3%	25.5%	29.1%	25.7%
	Baseline Forecast	25.7%	29.1%	32.5%	29.1%
	Stronger Near-Term Growth	26.8%	30.3%	34.1%	30.4%
	Protracted Slump	20.3%	22.1%	26.0%	22.8%

Note:

LIP = Low-Income Purchase Goal

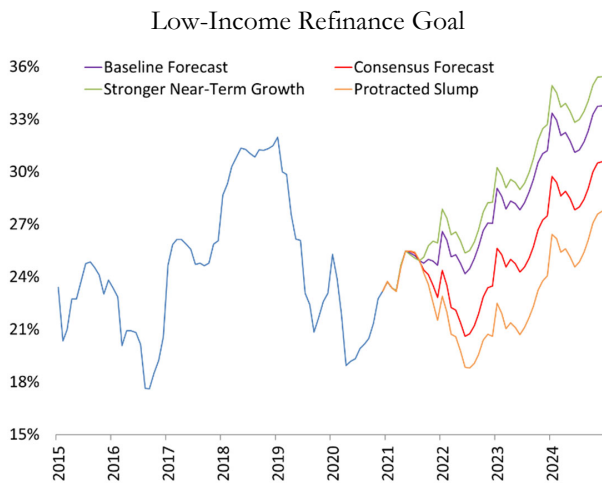
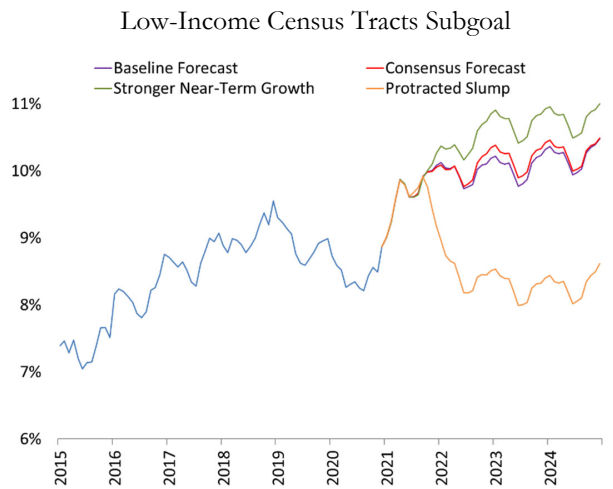
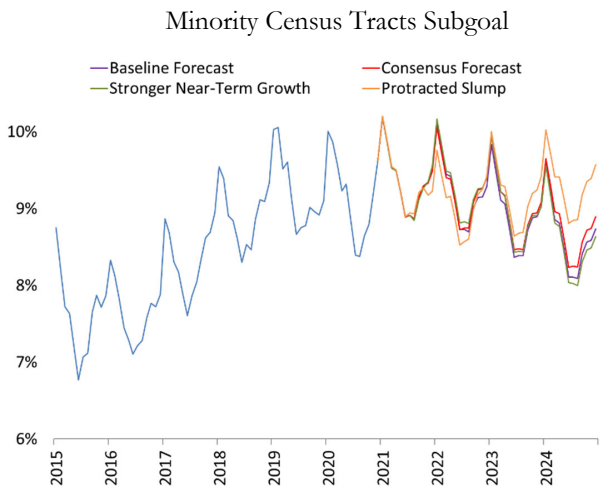
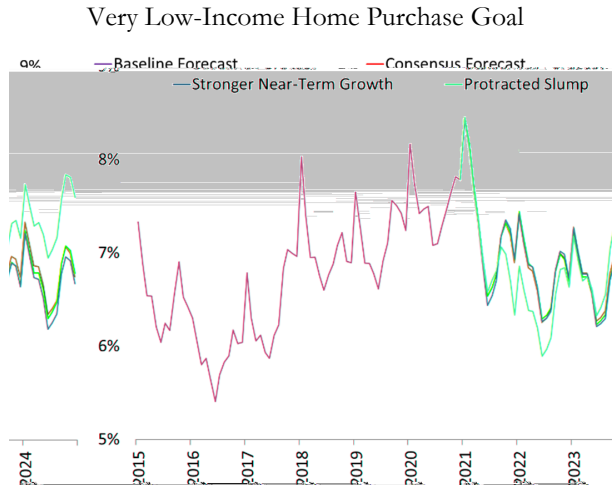
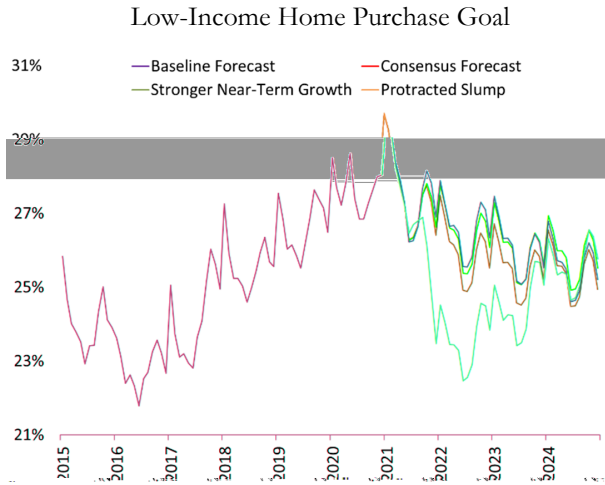
VLIP = Very Low-Income Purchase Goal

MCT = Minority Census Tracts Subgoal

LICT = Low-Income Census Tracts Subgoal

LIR = Low-Income Refinance Goal

### Exhibit 3: Market Model Forecasts Based on Alternative Scenarios



# Appendix B: List Of Data Sources

**Moody's Analytics**

<https://www.economy.com/products/tools/data-buffet>

**Federal Housing Finance Agency: House Price Index**

<http://www.fhfa.gov/DataTools/Downloads/Pages/House-Price-Index.aspx>

**Mortgage Bankers Association**

<http://www.mortgagebankers.org/ResearchAndForecasts/ForecastsAndCommentary>

**Freddie Mac**

<http://www.freddiemac.com/finance/ehforecast.html>

**Fannie Mae**

<http://www.fanniemae.com/portal/research-and-analysis/emma.html>

**Wells Fargo**

<https://www.wellsfargo.com/com/insights/economics/monthly-outlook>

**PNC Financial**

<https://www.pnc.com/webapp/unsec/NCAboutMicrositeNav.do?siteArea=/pnccorp/PNC/Home/About+PNC/Media+Room/Economic+Reports>

**National Association of Home Builders**

[http://www.nahb.org/reference\\_list.aspx?sectionID=138](http://www.nahb.org/reference_list.aspx?sectionID=138)

**Wall Street Journal Survey**

<http://projects.wsj.com/econforecast>