The impact of Federal Reserve's policies on the residential mortgage markets

by

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of
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ABSTRACT

Post Global Financial Crisis (GFC), the Federal Reserve adopted a new tool for temporary quantitative easing (QE) by purchasing agency mortgage-backed securities and Treasury securities from the market in an attempt to resurrect the economy. This unconventional method of restoring the capital markets proved innovative and effective. During the COVID pandemic, the Federal Reserve continued to purchase more securities to stabilize the markets resulting in a vast expansion in its balance sheet.

In the current inflationary environment (2022), the Federal Reserve is running losses on the balance sheet as it increases the interest rates as part of its quantitative tightening policies; the Federal Reserve must consider whether to sell its current MBS holdings according to its plan or hold on to the portfolio. The residential mortgage market faces additional liquidity pressures and uncertainty with limited Federal Reserve support.

Inspecting the spread between the 10-year Treasury yield and fixed 30-year mortgage rates during times of crisis and stable markets, this thesis investigates current market uncertainty and the impact of shocks that increase the spread, which translates into higher mortgage rates and lower affordability for the borrower. This thesis concludes the asymmetry of Federal Reserve policies may never work but adds uncertainty to the residential mortgage markets.

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From Rahul Raipelly:

I dedicate this thesis to my wife, Vijaya, my parents, Sharad Raipelly & Ambika Raipelly, and my family whose unwavering encouragement, sacrifices, and support have enabled me to achieve my dream of graduating from MIT.

From Corazon Wamakima:

Without the love and support of my family, especially my parents, Moses Kinyanjui and Tabitha Wamakima, I would not be able to pursue my potential at MIT. To my daughter, Njeri, you are my deepest motivation and thank you for believing in me.

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1.1 Introduction

This paper examines the impact of the Federal Reserve's quantitative easing and tightening policies that were prompted by the Global Financial Crisis. Homeownership skyrocketed during the 1990s leading into the 2000s due to increased issuance of subprime mortgages and their securitization through non-agency residential mortgage-backed securities (RMBS). Supported by the deregulation of the banking industry and risky derivative investments leveraged by the overpriced and nonperforming subprime mortgages, the housing bubble dismantled liquidity within the global financial markets.

Guided by the dual mandate of maintaining price stability and maximum employment, the Federal Reserve used new monetary policy tools to stabilize the economy. As the lender of last resort and to create additional liquidity beyond the Zero Lower Bound (ZLB), the Federal Reserve conducted several Large Scale Asset Programs (LSAPs) to induce downward pressure on the interest rate for longer-term Treasuries and agency mortgage-back securities (MBS).

Over the last twelve years, the Federal Reserve balance sheet has grown from $0.87 trillion in September 2007 to over $8.91 trillion in February 2022. The agency mortgage-back securities holding on the balance sheet is $2.7 trillion as of February 2022, representing 32% of its total assets.

As part of its second quantitative tightening (QT), the Federal Reserve must reduce its balance sheet holdings of Treasuries and MBS and normalize the balance sheet to the goal of only Treasury holdings. This paper investigates the QT strategies that Federal Reserve has to consider to offload its bloated balance sheet during high inflationary market conditions with a forecasted economic slowdown. Whichever decision the Federal Reserve makes, it will impact the MBS markets with a potential ripple effect on the mortgage rates and potentially decrease the affordability for the potential homebuyer.

1.2 Thesis Flow

Chapter 2 looks into understanding the history of the mortgage markets since the 1930s and the evolution of the secondary markets for mortgages. Chapter 3 highlights the history of the Federal Reserve, its mandate of price stability and maximum employment, and the tools it uses to execute the monetary policy. Chapter 4 details the concept and background of quantitative easing (QE) and quantitative tightening (QT) policies as the Federal Reserve's open market operations tool to attain its goals. Chapter 5 dissects the spread, a benchmark of the 30-year mortgage rate against the 10-year Treasury yield, and how it has been impacted by QE and QT's policies. Chapter 6 explores the impact of the Federal Reserve’s QT strategy on housing affordability.

Chapter 2 - Mortgage

2.1 What is a mortgage?

Simply described, a mortgage is a loan secured by real property. The word "*mortgage*" has its roots in the French language; the literal meaning of the word is broken down, "*mort*" is dead (adjective), and "*gage"* is a pledge (noun). A mortgage can be further defined as a loan given to the owner (borrower) and secured by the underlying real property, including land, any structure, or improvements on the land. Many key attributes are part of a mortgage; loan term, lien status, credit classification, interest rate type, amortization type, credit guarantees, loan balances, prepayments, etc. For this paper, these topics will not be discussed in detail, and to further them, refer to (Fabozzi 2016) & (Hu 2001). In modern standard agreement, the borrower seeks the lender to purchase the real property (land or property), and the lender provides the funds to the seller and holds onto the deed of the property until the debt (principal and interest) is paid by the borrower according to the executed agreement. The encumbrance of this agreement is that the lender can take the property if the borrower fails to repay the monies borrowed, including the interest.
(Halls 1999)

2.2 History and Evolution of Mortgage Markets

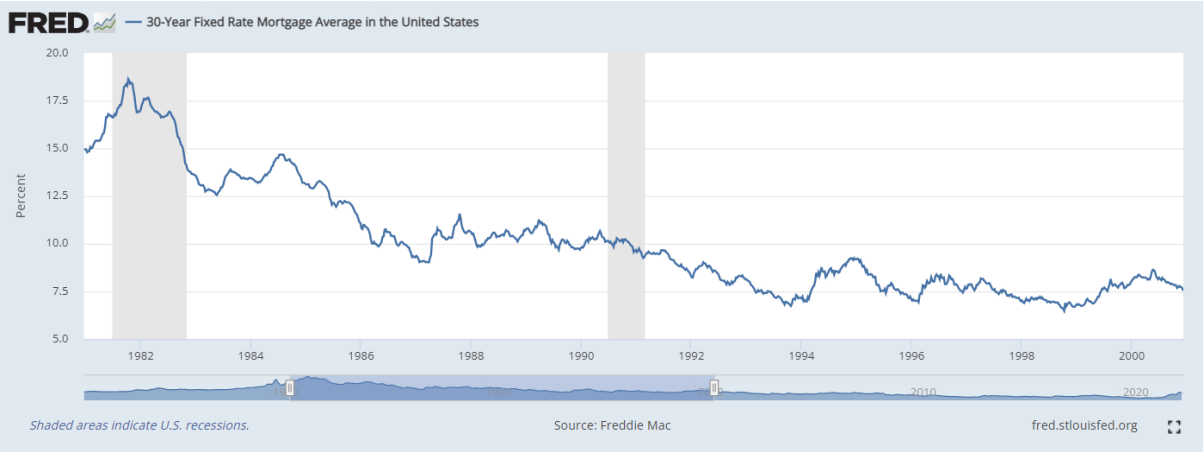
Before the 1930s, the US mortgage markets were dominated by primary markets whereby the key players were specialized depository institutions. Most of the specialized depository institutions were savings and loan associations [S&Ls] known as 'thrifts,' which held about 80% of their assets in mortgages. In 1930, Federal Home Loan Bank System (FHLB) and deposit insurance were established, giving thrifts access to a cheaper cost of funds which increased liquidity in the mortgage markets; therefore, they could extend additional funds for mortgages and increase homeownership across the United States.

The banking system expanded widely throughout the 1960s despite regulations that put ceilings on deposit rates and branch limits. Although the financial crisis of the 1980s saw the failure of many S&L institutions, the banking system managed to survive due to well-capitalized balance sheets. By this time, commercial banks owned about half of the mortgage market.

Standardization of mortgages also led to the growth of the secondary market for mortgages in the 1970s and 1980s; US Congress chartered three primary federally backed mortgage companies to provide liquidity, stability, and affordability to the mortgage market: the Federal National Mortgage Association (FNMA, also known as Fannie Mae), the Federal Home Loan Mortgage Corporation (FHLMC, now known as Freddie Mac) and the Government National Mortgage Association (GNMA, also known as Ginnie Mae). In the next two decades (from 1980 to 1999), there was a 10-fold increase in mortgages backed by these three institutions from $69 billion to $700 billion. (Van Order 2000)

These institutions contributed to continuous growth in the secondary US mortgage market through the 1990s, with an increased share in the total mortgage market. The decline in mortgage rates from the 1980s caused further household demand for homeownership which increased from 65.7% in 1997 to around 66.8% in 1999. Every percentage increase in homeownership leads to an additional 1.1 million homeowners. (Goodman and Thibodeau 2008)

Exhibit 2-1: 30-Year Fixed Rate Average Rate (1980-2000)



Source: St. Louis Federal Reserve & Freddie Mac

The second half of the 1990s was further driven by the growth in subprime mortgage loans, issued to higher-risk borrowers for higher interest compensation. This period also had an increased market size of mortgage-backed securities (discussed in subsequent parts of this paper), whereby non-agency MBS triumphed over agency MBS. From 2000 to 2007, the mortgage loans securitized by non-agencies grew from

$386 billion to $2.2 trillion because of a lower interest rate environment and dependency on risk-based pricing. (Barth et al. 2008)

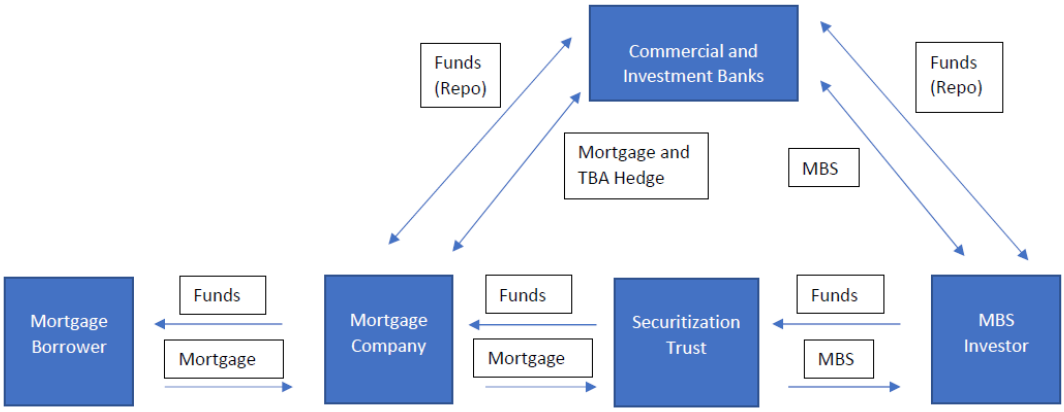
2.3 How are mortgage rates priced?

Although the Federal Reserve does not set mortgage rates, the central bank's monetary policy decisions directly influence mortgage rates. Mortgage rates are influenced by movements in long-term interest rates. Typically the market prices the mortgage rate above the 10-year US Treasury, which is considered a risk-free investment. The spread is the premium pricing of mortgage rates above the 10-year Treasury yield. This spread represents the risk the investors are willing to take to hold the mortgage bonds. Current and anticipated economic conditions and events also affect investor confidence in the market, affecting mortgage pricing.

2.4 Mortgage back securities

Mortgage-backed securities (also known as mortgage pass-through securities) are security bonds backed by a pool of mortgages whose monthly payments are the source of cash flows for the security holder. These cash flows are passed by the mortgagor/issuer of the security to the investor/holder through the servicer company and/or securitization trust. In other words, mortgage-backed securities are bonds with cash flows tied to the principal and interest payments on a pool of underlying mortgages(Hu 2001) (Fuster, Lucca, and Vickery 2022).

Exhibit 2-2: Mortgage Securitization Pipeline

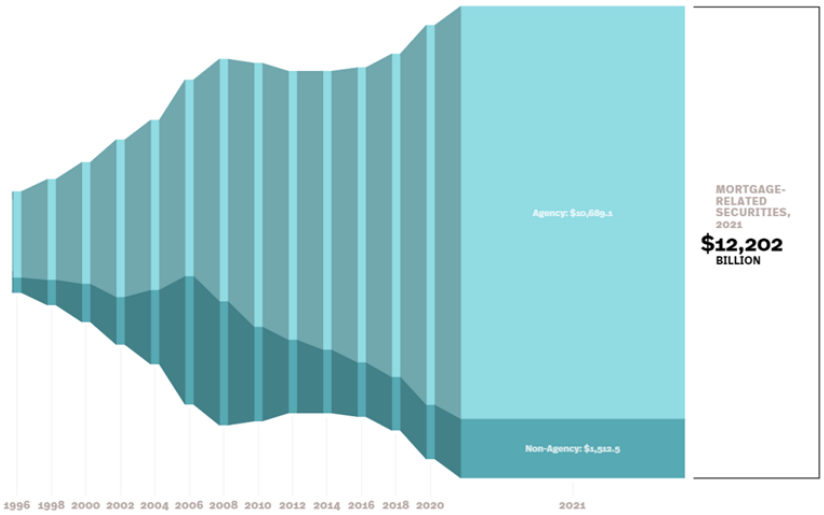


Source: Federal Reserve

2.5 Evolution of the mortgage-backed securities market

MBS was first offered as early as 1970 when GNMA (known as Ginnie Mae) offered it with a face value of $70 million (Torous, Fabozzi, and Modigliani 1993). Investors who bought a fraction of the security received prorated monthly payments collected by the issuer through a servicer (securitization trust). With variations, broadly, the stakeholders of the MBS market remain the same, including the originator, issuer, seller, servicer, and investor.

Exhibit 2-3: Mortgage Market Size As of December 31, 2021



Source: Securities Industry and Financial Markets Association (SIFMA)

Most of the mortgage market until the 1980s was where the mortgage lenders held the loans on their balance sheet. However, today's world allows pooled mortgages through mortgage-backed securities to be held by any investor around the globe. As of the year ending 2021, the mortgage-backed securities market has $12.2 trillion outstanding, as seen in Exhibit 2-2. The process of securitization and incentives for the participants in the MBS programs has been explained in the following papers (Rajapakse and Rajapakse, n.d.) and (Bhattacharya, Berliner, and Fabozzi 2008)

2.6 Broad Classification of mortgage-backed securities

a. Agency and non-agency: On the one hand, Agency mortgage-backed securities are backed by the government which is represented by either of the three agencies namely; Fannie Mae, Freddie Mac or Ginnie Mae. On the other hand, non-agency mortgage-backed securities are owned by issued by private

financial institutions and are catered to investors willing to take higher risks in investing.

b. Residential and Commercial: Most of the mortgage-backed securities market consists of Residential mortgage-backed securities, which are the pool of mortgages backed by residential assets (e.g., single-family housing). However, commercial mortgage-backed securities are spread across different asset classes within the real estate world (e.g., office, hotel, industrial, warehouse, etc.) and are much more complicated regarding investment structure and risks. The most common commercial mortgage-backed securities are in the office market.

2.7 Investors in the mortgage-backed securities market

As of 2021, depository institutions & banks are the largest holders of MBS (32%), federal reserve (23%), international investors (11%), mutual funds (7%), and money market mutual funds (5%) (Full tabulation shown below). Banks are one of the largest investors in MBS (specifically agency collateralized mortgage obligations (CMOs) but not in the RMBS. Federal Reserve has become the single largest owner of MBS at $2.7 trillion after the post covid purchase of agency MBS from the market. (Fuster, Lucca, and Vickery 2022)

Exhibit 2-4: Investors in agency and GSE-backed securities

	$bn	% of total
Depository institutions	3357	32%
Federal Reserve	2414	23%
Rest of the world	1145	11%
Mutual funds	713	7%
Money market funds	499	5%
State and local governments	428	4%
Life insurance companies	348	3%
Credit unions	297	3%
Pension funds	260	2%
Households and nonprofit organizations	247	2%
Government sponsored enterprises	219	2%
State and local government defined benefit pension funds	201	2%
Mortgage real estate investment trusts	188	2%
Property-casualty insurance companies	137	1%
Foreign banking offices	59	1%
Other	78	1%

Includes issues of federal budget agencies; issues of government sponsored enterprises such as Fannie Mae and FHLB; and agency- and GSE-backed mortgage pool securities issued by Ginnie Mae, Fannie Mae, Freddie Mac, and the Farmers Home Administration. Source: Financial Accounts of the United States, Table L.211, 2021:Q2.

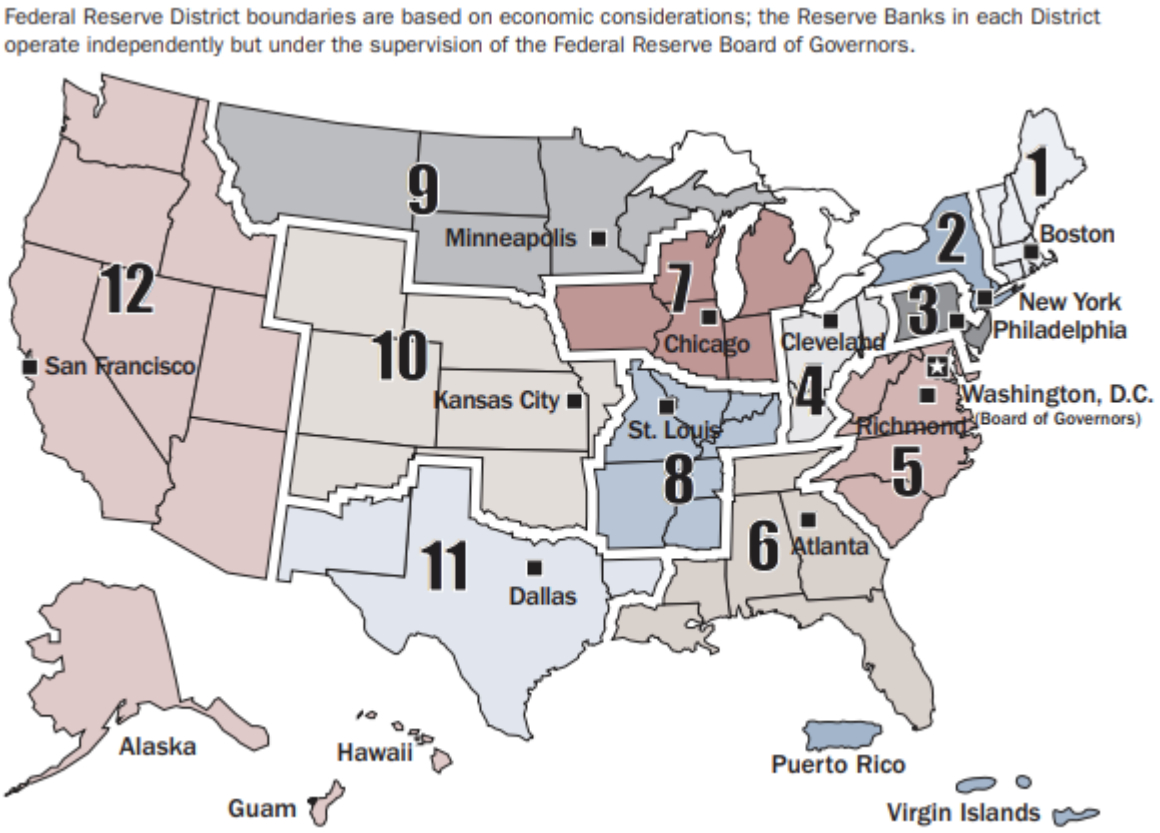
Source: Federal Reserve Bank

Chapter 3 – The Federal Reserve

3.1 History of the Federal Reserve & Structure

The Federal Reserve System, also known as the Federal Reserve, is the Central Bank of the United States, formed in 1913. Unbeknownst to many, the current structure is the third attempt to create one of the most powerful financial institutions in the world. The First Bank of the United States, the embryonic financial system, ran from 1791 – 1811; where it was the first national bank with nationwide branches championed by Alexander Hamilton, the first Secretary of the Treasury (Cowen n.d.). It expanded the federal fiscal and monetary power before the fateful Panic of 1792 and Congress's failure to renew the bank's charter. Shortly after Congress enacted the Second Bank of the United States, running from 1816 to 1836, it was championed by President James Madison, who opposed the first Bank of the United States. This new charter set a new precedence for monetary union, whereby its operations have touched the nation's economic life from being the largest issuer of bank notes to being the financial engine for interregional and international trade (Fraas 1974). Like its forerunner, its charter was not renewed by Congress, and it was privatized in 1836 and later liquidated. At the turn of the 20th Century, after several financial waves of panic over the century, Congress enacted the Federal Reserve Act on December 23, 1913. Its current decentralized structure, reflected in Exhibit 3-1, of 12 reserve banks, reflects the trade and political struggles that were prevalent during its formation. President Woodrow Wilson negotiated with proponents (e.g., bankers) and opposers (e.g., farmers) of a central bank that was independent of the political influence of Washington DC and Wall Street in the financial center of New York, NY and created a balance of power for all citizens (Meltzer 2010).

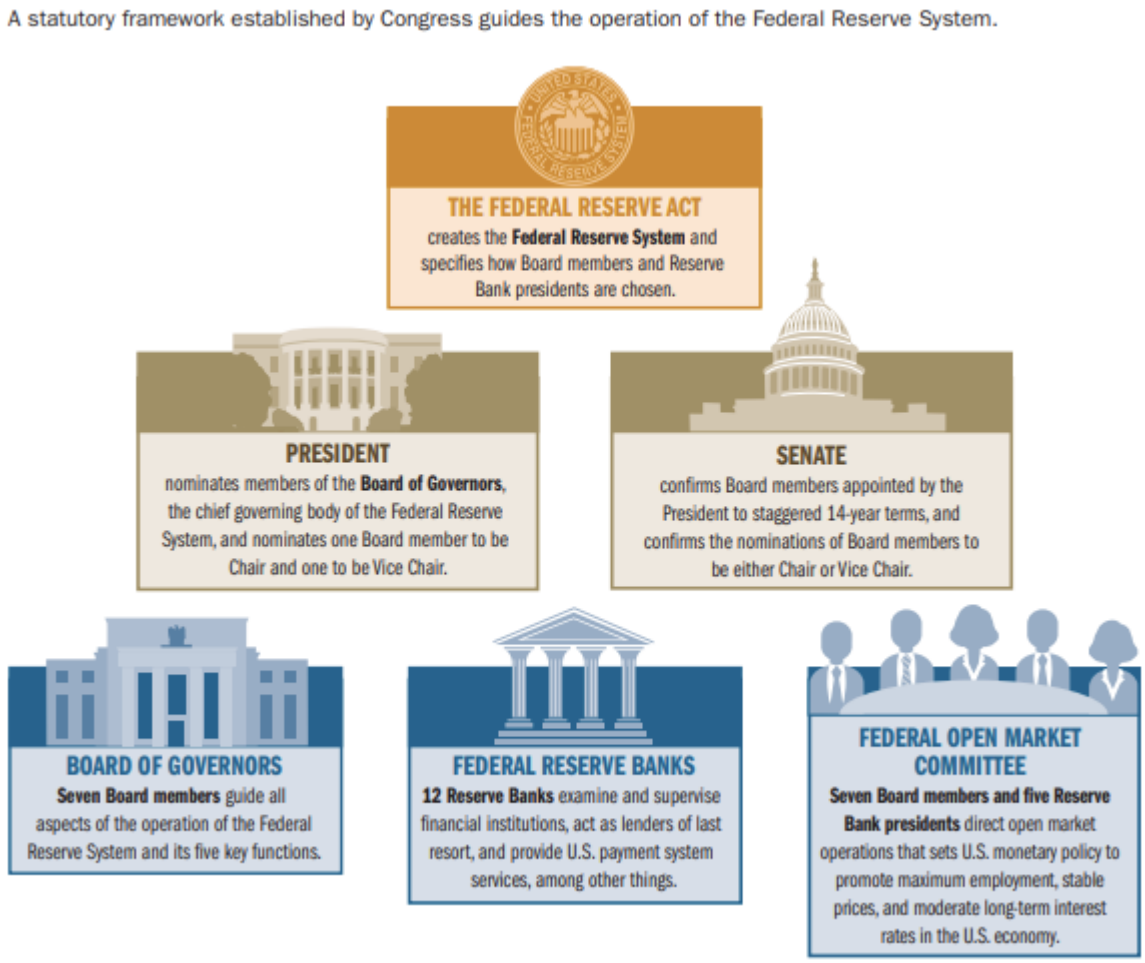
Exhibit 3-1: Twelve Federal Districts operate independently but with supervision



Source: Federal Reserve System

Each regional reserve bank representing a designated district operates independently under the supervision of the Board of Governors. Each regional reserve bank has a single governing body composed of seven people appointed by the President and confirmed by the Senate. To limit the President's power, he or she can only appoint one governor every two years with a 14-year term, as seen in Exhibit 3-2.

Exhibit 3-2: How the Federal Reserve operates within the US government framework



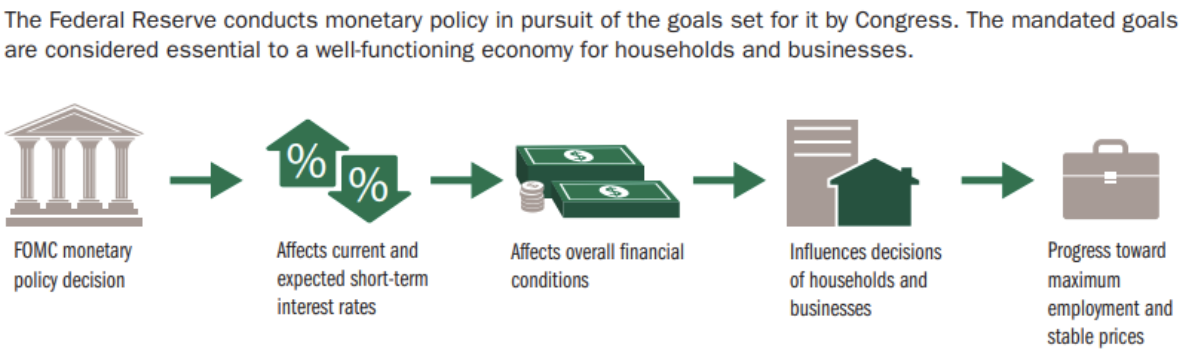
Source: Federal Reserve Bank System

Each regional bank functions as a private corporation that issues its own stock. Each bank in the United States is mandated by the law to reserve 6% of its capital in its regional reserve bank. In return, the private banking institution receives an equivalent share in the reserve bank. The price per share is fixed at $100 per share, and they cannot be exchanged (i.e., sold or traded). The shares carry voting rights to about two-thirds of the Board of Governors for that regional reserve bank. It is essential to note the President appointed the Board of Governors. The shares have dividend rights, although it does not receive any dividends. Any profit that the Federal Reserve makes over the 6% payout goes to the Treasury. With the USD as the dominant currency in many central banks across the globe, the Federal Reserve Bank is the most influential financial institution as the markets depend on its communications and activities for market efficiency and operations.

3.2 How the Federal Reserve Works

At its formation, the objective of the Federal Reserve was to provide an elastic currency by affording means of rediscounting commercial paper and overseeing more effective banking supervision in the United States (Federal Reserve Reform Act of 1977). In 1971, in response to the inflation and volatility of the US dollar valuation, President Nixon removed the gold standard as an index to the US dollar. Shortly after, in 1977, the Federal Reserve refocused its mandate for the monetary policy "**To promote effectively the goals of maximum employment, stable prices, and moderate longer interest rates.**" (Reserve 2021) Over time, the dual mandate has successfully communicated two goals: 1) price stability and 2) maximum sustainable employment (The Federal Reserve's Dual Mandate). Refer to the Exhibit for a fuller description of the mandate and the numerical value of the dual mandate over time. As of December 31st, 2022, the Federal Reserve no longer holds numerical values as benchmarks for price stability and maximum sustainable employment but rather qualitative descriptions of their standards or measures. (Statement on Longer-Run Goals and Monetary Policy Strategy)

Exhibit 3-3: The Federal Reserve's statutory mandate: maximum employment and stable prices



Source: Federal Reserve Bank System

To execute its responsibilities over monetary policy, the Federal Reserve has a few primary tools: federal funds rate, reserve requirements, the discount rate, interest on reserve balances, and open market operations.

Federal Funds Rate (FFR)

The interest rate at which banks borrow and lend reserve balances to each other overnight. The target range is directly influenced by the Federal Reserve through various tools. Many tools have changed recently in the last two decades. This target range for interest rates is known to influence short-term interest rates and is the critical measure of liquidity in worldwide money markets.

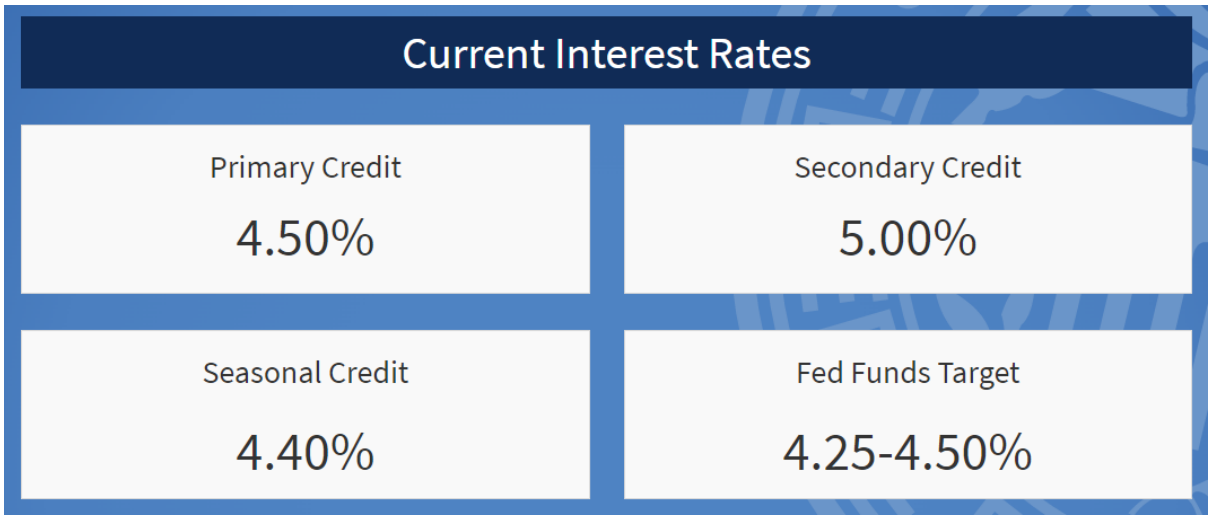
Reserve Requirements

Forming the current structure of the Federal Reserve, the reserve requirements were a primary tool to monitor the monetary policy. Whereby previously stated, each participating bank had to reserve a specified amount with the regional reserve bank. In response to the CoVid19 financial panic, the Board of Governors announced in March 2020, the mandated reserve requirement was reduced to zero, obliterating this tool ("Federal Reserve Issues FOMC Statement" n.d.). One of the deciding factors for this crucial decision was today's banking system, "with a much larger level of reserves …, reserve requirements are not a key factor influencing reserve demand for many banks."

Discount Rate Window Lending

Another primary tool that the Federal Reserve uses and is an alternative to the federal funds rate is the discount rate, a short-term loan at a fixed discount rate that is charged to lenders: primary credit, secondary credit institutions (usually 50 basis points higher than primary credit) and seasonal credit institutions (varies but usually an average of selected market rates) as seen in Exhibit 3-4. Usually, the discount is set every 14 days, and it is a last resort for banks as it is usually higher than the federal funds rate, which is the primary tool for liquidity. As of December 31, 2022, the primary credit rate is 4.50, the secondary credit rate is 5.00%, the seasonal credit is 4.40%, and the federal funds target rate is 4.25% - 4.50%.

Exhibit 3-4: Discount Rate Window as of December 31, 2022



Source: Federal Reserve

The Federal Reserve leverages the discount rate to control the supply of available funds as a ceiling on the federal funds rate, which impacts inflation and overall interest rates.

Interest on Reserve Balances (IORB)

On the required reserve balances in the respective regional reserve banks, banks earn interest on the reserve balance. This interest was paid on required reserve balances and any excessive balances beyond the requirement. Since the reserve requirements were eliminated, the interest rates have been referenced as the interest on reserve balances (IORB) since July 2021. By lowering or raising this rate, the Federal Reserve sets a floor on the rates at which lenders are willing to pay interest on excess cash sitting with the Federal Reserve rather than in the market. IORB guides the FFR to become the benchmark of interest rate to lend since many parties will not take less than what they can receive from the Fed Reserve.

Open Market Operations (OMO)

The Federal Reserve adopted a new tool over the last 15 years since the Global Financial Crisis to regulate and monitor the monetary policy whereby the Desk (New York Federal Reserve) purchases and sells securities in the open market. Acquiring the securities (treasuries and mortgage-backed securities) temporarily or permanently increases the reserves for the bankers.

The Desk (on behalf of the Federal Reserve) increases or reduces liquidity through 3 primary transactions:

Repurchase agreement (Repos)

A short-term loan agreement of money that is collateralized by securities whereby the Desk (or counterparty in the lending ecosystem) agrees to sell back the collateral security at a specified price at a specific time in the future. The terms vary from 1 to 14 days or even 1-2 months.

Overnight reverse repurchase facility (ON RRP)

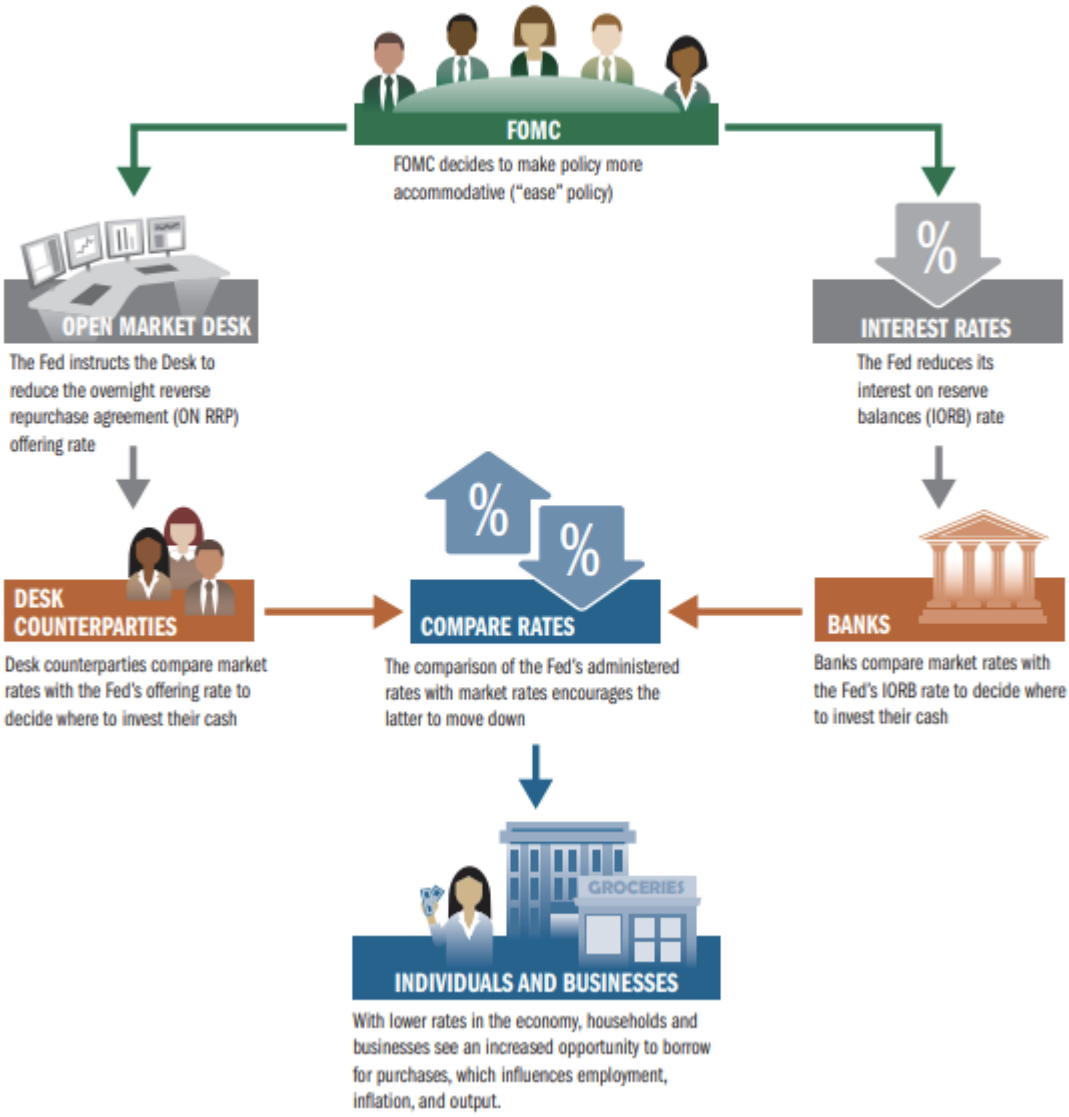
A short-term loan agreement of securities collateralized by money. The Desk sets an overnight rate, which is the maximum price, in the form of an interest rate, that the Federal Reserve is willing to pay to have lenders' deposits in their reserves overnight (IORB). The next day, the transaction is reversed, the Federal Reserve repurchases the security, and the lender earns interest for the cash deposited with the Federal Reserve overnight. The amount charged on the ON RRP is limited by the number of Treasuries owned by the Federal Reserve. This is a risk-free investment because it is overnight and hedged against the short-term Treasury security (high liquidity); this is the lowest price any lender will lend their reserves or securities, therefore, acting as a floor for the federal funds rate. As of December 31, 2022, the target rate is between 4.25% and 5.00%.

Purchases and sales of securities

During the last two financial panic situations of the Global Financial Crisis (2007 - 2008) and CoVID-19 (Spring – Summer 2020), the Federal Reserve permanently purchases Treasuries and mortgage-backed securities in 4 separate tranches. During these two crisis periods, when the federal funds rate was zero lower bound (ZLB) or near zero, resulting in a liquidity trap and limiting the central bank's ability to stimulate economic growth. The Federal Bank needed to purchase the longer-term securities to put downward pressure on the Treasuries and MBS yields, making them attractive to the market for continuous purchasing and more importantly, increasing liquidity in the open market.

Exhibit 3-5: How the Federal Reserve implements monetary policy

When the Federal Open Market Committee (FOMC) sets monetary policy that, for example, requires lowering the policy interest rate, the Federal Reserve also lowers its administered interest rates. Fed counterparties then make investment decisions by comparing the Fed's administered rates and market interest rates. This comparison causes market rates to decline, which increases borrowing opportunities for households and businesses. These actions allow the FOMC to make progress toward its dual mandate of maximum employment and price stability.



Source: Federal Reserve Bank System

Chapter 4 - Quantitative Easing and Tightening

4.1 Quantitative Easing (QE)

Quantitative easing (QE) is considered an unconventional monetary policy, according to which a national central bank (Federal Reserve) tries to improve national economic performance by purchasing a large number of long-term securities in the open market.

QE was first introduced after the Global Financial Crisis in 2007-2008 when the Federal Reserve had to expand the money supply when inflation was below normal levels, and the ordinary monetary tools were ineffective. During this time, the Federal Reserve lowered the federal funds rate to zero lower bound (ZLB) to induce liquidity in the money markets. When they needed additional liquidity measures, the Federal Reserve underwent large-scale asset purchases (LSAPs). These LSAPs, through the Federal Reserve tools discussed earlier, infuse additional liquidity in money markets and credit for businesses and households to borrow. The below graph depicts the three QE phases when the target funds rate was around zero.

Exhibit 4-1: Federal Reserve's Balance Sheet during QE1 - QE3

Source: FRED, Federal Reserve Bank of St. Louis

Since the Global Financial Crisis up until 2019, the Federal Reserve has done a total of three LSAPs, listed below. These purchases were intended to apply downward interest rate pressure on longer-term securities that dampen the money markets. This unconventional monetary policy introduced a method for the Federal Reserve to

become a semi-permanent holder or indirectly a portfolio investor for the 10-year yield Treasury securities and mortgage-backed securities.

Exhibit 4-2: Break-up of Treasury Securities, Agency MBS/Debt across QE

(all figures indicated are $ billions)

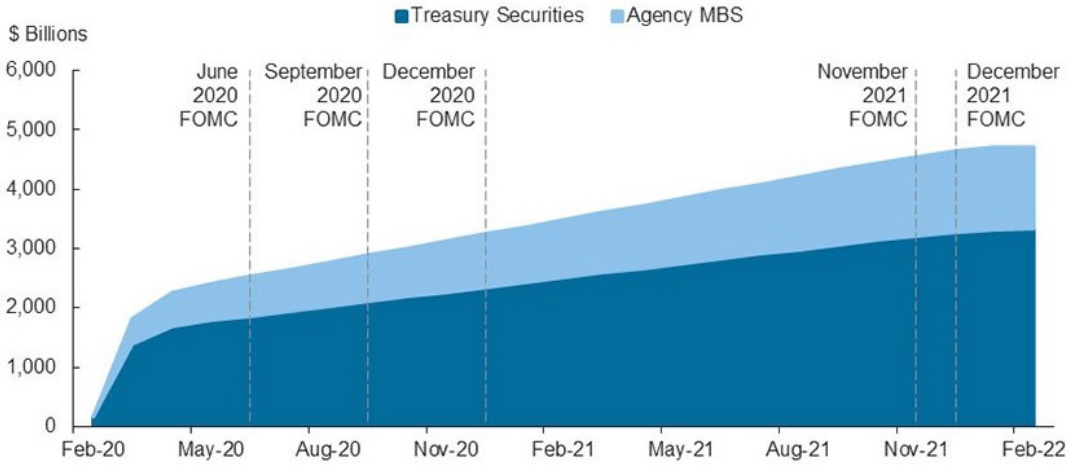
Time Period	Treasury Securities	Agency MBS	Agency Debt	Total
QE1 (08 - 10)	300	1250	175	1725
QE2 (10 - 11)	600	-	-	600
Maturity Extension Program (11 -12)	667	-	-	667
QE3 (12 – 14)	790	823	-	1613

Source: Federal Bank of New York

In March 2020, when Covid triggered market wide disruption of the economy, and the financial markets threatened to make the situation worse, The Federal Reserve stepped in with multiple actions to maintain liquidity and limit the damage from the pandemic. The effective federal funds rate (EFFR) was reduced to a range of 0-0.25%, a move that encouraged spending by lowering the borrowing cost for businesses and households.

In addition, the Federal Reserve reverted to the old policy tool (LSAPs or Quantitative easing) used after GFC to infuse more liquidity in the market. From March 2020, the Federal Reserve started buying Treasuries and MBS and continued the aggressive purchases until December 2020. The next year was focused on tapering the asset purchase, and by the time the end of QE4 was announced in December 2021, the Federal Reserve had accumulated an additional $4.6 trillion of Treasury securities and MBS.

Exhibit 4-3: Cumulative net purchases from March 2020 to February 2022



Source: Federal Bank of New York

Exhibit 4-4: Comparison of Federal Reserve's SOMA portfolio Pre-Covid & Post-Covid:

($ Trillions)	End of LSAP 3 Nov 2014	Current Feb 2022
Total Balance Sheet	$4.5	$8.9
SOMA Portfolio	$4.2	$8.5
Percent Nominal GDP	24%	35%
SOMA Treasury	$2.5	$5.7
Percent of SOMA Holdings	58%	68%
Percent <3 years to Maturity	16%	45%
Weighted Average Maturity (in years)	9.7	7.6
SOMA Agency MBS*	$1.7	$2.7
Percent of SOMA Holdings	41%	32%

Note: *Excluding CMBS.
Source: Federal Reserve Bank of New York

Source: Federal Bank of New York

4.2 Quantitative Tightening (QT)

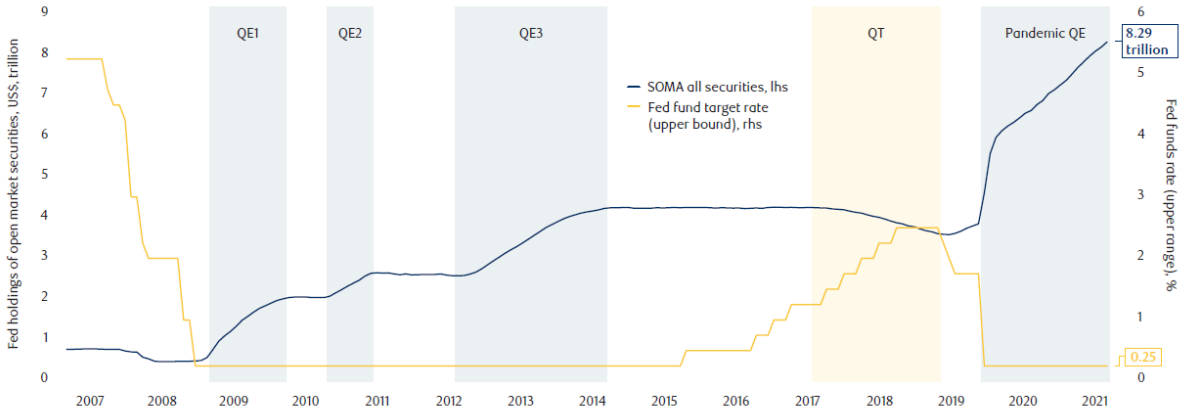
4.2.1 QT1 (October 2017 - September 2019)

Intuitively, quantitative tightening is the opposite of quantitative easing when the Federal Reserve has to contract the money supply to stabilize prices and unemployment. Post GFC, the initial effort of the Federal Reserve (QE1) was to

stabilize the upward pressure on the interest rates on long-term securities (MBS markets), resulted in the Fed owning almost 20% of the MBS market.

During 2010-2014, the Federal Reserve continued to balance its portfolio by extending the maturity profile through re-investing longer maturity MBS from the market utilizing the proceeds of the matured MBS from the existing portfolio, which resulted in maintaining the Fed's then balance sheet size. Starting in December 2015, the Federal Reserve began a series of interest rate hikes impacting the federal funds rates (FFR), which was 0% since Dec 2008.

Exhibit 4-5: Fed securities holdings and Fed funds rate



Note: grey shaded columns denote balance sheet expansion due to quantitative easing (QE) and the yellow denotes column balance sheet reduction or quantitative tightening between October 2017 and July 2019.

Source: US Federal Reserve and US Treasury Department; latest data at 13 January 2022

To kick start its quantitative tightening (through open market operations), the Central Bank coupled the interest rate hikes with the normalization of the balance sheet (QT1) or its strategic balance sheet reduction. On September 30, 2017, the FFR was 1.00% - 1.25%, and the Federal Reserve's total assets were $4.45 trillion before the announcement of the normalization of the balance sheet that would gradually reduce its securities holdings.

The QT1 plan of the Federal Reserve was set at a total of $10 billion per month ($6 billion for Treasury securities and $4 billion for agency debt and MBS). The plan was to increase it in tranches of $10 billion per month to a cap of $30 billion per month for Treasury securities and $20 billion per month for agency debt and MBS. Once the monthly cap was reached, the plan was to continue the normalization until the Federal

Reserve's MBS on the balance sheet was zeroed out to effectively and efficiently carry out its monetary policy. Given the total balance sheet size after QE3, it would have taken 6.5 years for the Federal Reserve to sell off the Treasuries at the maximum monthly cap of $30 billion. With the agency debt and MBS, it would have taken 9.4 years at the maximum monthly cap of $20 billion.

During QT1, the highest reported FFR was 2.25% - 2.50% for the eight months from December 2018 to July 2019. During QT1, the Federal Reserve managed to decrease its SOMA holdings by $650 billion (14%) from $4.6 trillion to $3.8 trillion. The FOMC balance sheet run-off through maturing securities each month had a modest tightening effect on the markets. The effects and challenges of QT1 on the markets have been explained in (Lee Smith and Valcarcel 2022).

4.2.2 QT2 (March 2020 - June 2022)

During the Covid-19 financial panic in 2020, the Federal Reserve again resorted to buying additional MBS holdings and Treasuries (QE4) to combat the liquidity crisis. By March 2022, its total MBS holdings were at $2.7 Trillion. QE4 was in addition to the continued easing by setting FFR at around 0% - 0.25%. By April 2022, with surging inflation and a continued tight labor market, FOMC decided to withdraw from the easing and set a plan to reduce the balance sheet. However, the process of quantitative tightening was likely to be more challenging with the limited experience of the Federal Reserve with their only previous attempt at QT during 2017 - 2019.

On May 4, 2022, the FOMC increased the FFR from 0.25% - 0.50% to 0.75% to 1% and communicated more ongoing increases in the future; on the same day, the FOMC released a tactical plan to reduce the Federal Reserve's balance sheet from $8.48 trillion.

Similar to QT1, but on a much larger scale for QT2, the Federal Reserve set a total cap of $47.5 billion per month ($30 billion for Treasury securities and $17.5 billion for agency debt and MBS). The proposed cap was to increase in three months (by September 2022) to $95 billion per month ($60 billion for Treasury securities and $35 billion for agency debt and MBS).

Given the total balance sheet size of $8.48 trillion after QE4, the Federal Reserve would take eight years to sell off the Treasuries at the maximum monthly cap of $60 billion. With the agency debt and MBS, it would take six years at the maximum monthly cap of $35 billion.

Compared to QT1, the timeline is more aggressive, given the total balance sheet size, high inflation, and rising interest rate environment. As of December 31, 2022, the FFR was 4.25% - 4.50%, and the Federal Reserve has decreased its SOMA holdings by 4% from $8.48 trillion to $8.15 trillion.

4.3 Contrasting Market conditions: QT1 vs. QT2

During QT1, inflation and employment gains were low. Hence, the run-off had a modest tightening effect on the markets. The effects and challenges of the run-off on the markets have been explained in (Lee Smith and Valcarcel 2022). In stark contrast, the 2022 QT2 announcement was made when inflation was at a multi-decade high, and the labor market was historically tight; the FOMC had planned for a much more aggressive (almost double the volumes achieved in 2017-19 QT) balance sheet run-off.

The FOMC waited for three years after the last QE in 2014 to pursue the first QT in 2017 but announced the last QT in June 2022, within three months after the Covid-led QE4 ended in March 2022. However, the QT2 plan uses the same strategy as QT1, where FOMC planned to reduce the balance sheet by no longer reinvesting the proceeds from the maturing securities. FOMC also indicated that it would consider MBS sales along the way. (Gulati 2022)

The Federal Reserve's QT1 attempt to cap the balance sheet run-off allowed no more than $30 billion in Treasury securities and $20 billion in MBS resulting in par value balance sheet offload of $650 billion compared to $4.6 trillion purchased from across all previous QE (1 to 3) periods. This strategy resulted in lesser than expected MBS holdings run-off as mortgages in the US are 15 to 30-year mortgages, and the ones purchased in 2008 needed to mature during the 2017 to 2019 period. Further, the high-interest rates led to lesser pre-payments.

Over the last six months (from June 2022), the Federal Reserve has removed more than $330 billion from the financial system and plans another $1.1 trillion by the end of 2023. In the current high-interest rate environment, a similar strategy will not help the MBS run-off and the Federal Reserve attain its Treasury-only portfolio goal. Considering the current strategy, the estimated goal of reducing the MBS portfolio of $2.5 trillion by the end of 2025 will be challenging, and the Federal Reserve may not achieve its objective of market stabilization.

However, the current run-off strategy has been less impactful in reducing Fed's MBS portfolio due to lower prepayments or refinancing events, considering the rising mortgage rate environment at the current interest rates of around 6%.

The Fed's (Quantitative tightening) Options - MBS Portfolio

1. Sell more aggressively: This option could disrupt the MBS market and shoot up yield expectations from MBS investors. The market may be unable to absorb the excessive MBS portfolio sale shock, and the Federal Reserve with its already bloated balance sheet, will not be able to do another QE to act as a buyer of the last resort.
2. Planned portfolio run-off and additional sale: The Federal Reserve may be unable to achieve its planned run-off goal in the current high-interest environment due to limited mortgage refinancing or mortgage prepayment opportunities. This strategy might result in a larger share of MBS in the Fed's portfolio while limiting its target to build a Treasury-heavy portfolio in the long term. The additional sale will have a similar impact as the aggressive sale strategy.

Chapter 5 - Mortgage Spread

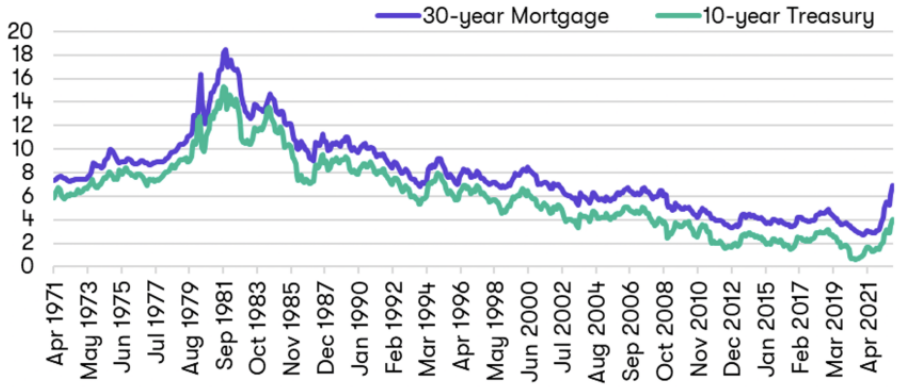
5.1 Mortgage Rates

Mortgage rates are influenced by various factors, including short-term interest rates by the Federal Reserve, the bond market, the secured overnight finance rate, the constant maturity Treasury rate, the state of the economy, and inflation. Statisticians and economists would define the mortgage rate as a funding cost for the “marginal mortgage”. During the Global Financial Crisis (GFC), when the GSEs securitized all mortgages that were originated, the mortgage [was] a fairly straightforward “mark-up” over the MBS yield for all mortgage market participants.” (Hancock and Passmore 2011) In simpler terms, the mortgage rate reflects the supply of money from MBS investors and demand from mortgage borrowers. In fixed-income terms, a mortgage is structured like a bond whereby the monthly payments are made over the life of the mortgage contract, and the mortgage rate is the internal rate of return of the bond (Veronesi 2010).

5.2 The Spread

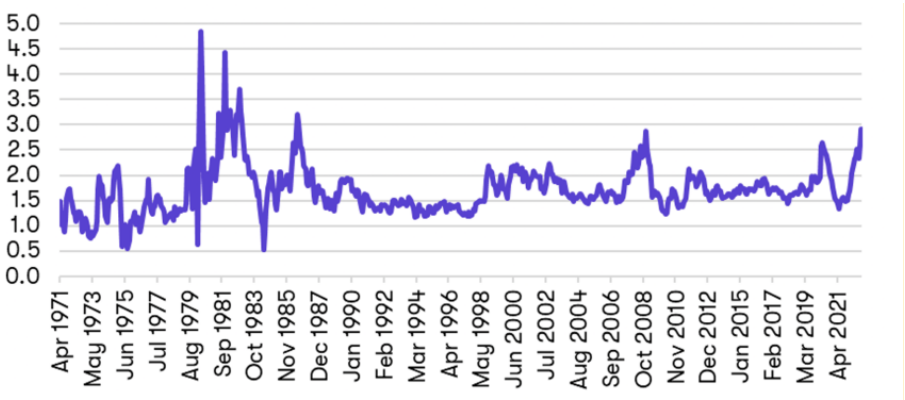
The spread between the 10-year Treasury securities and the 30-year mortgage rate is a standard metric to assess the market’s judgment of these long-term and relatively safe investments. The investments move in the same direction for various reasons.

Exhibit 5-1: 30-year Mortgage and 10-year Treasury Rates (%)



Source: FRED, Federal Reserve Bank of St. Louis / Zonda Research

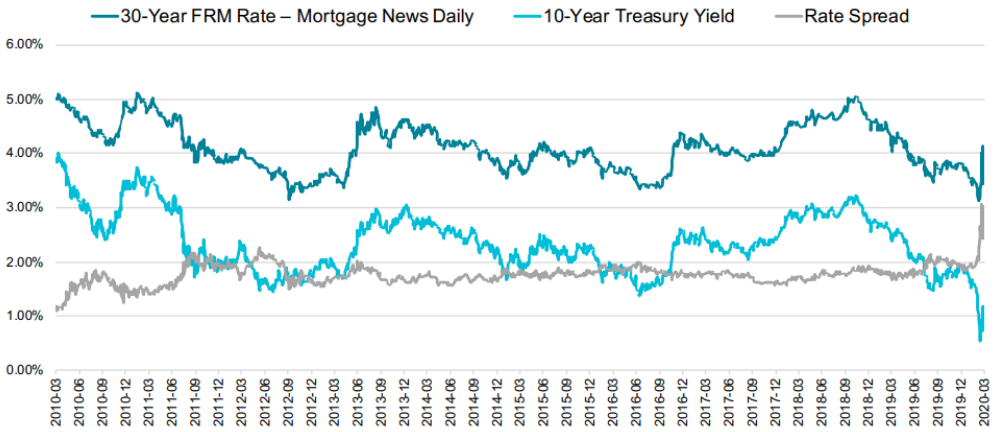
Exhibit 5-2: 30-year Mortgage and 10-year Treasury Spread (%)



Source: FRED, Federal Reserve Bank of St. Louis / Zonda Research

Historically, in normal market conditions, the spread between 10-year Treasury and mortgage rates is around 170 basis points or 1.7% in the graphs above. But, in times of uncertainty or economic instability, the spread widens. As seen in the charts above, the spread was as high as 450 basis points or 4.5% during the recession of the 1980s with high inflation after aggressive Federal Reserve actions and similarly, in the GFC (2007-08), where the spread widened at 300 basis points (3%). In January 2023, the spread reflected financial distress similar to the spread during GFC. The wider spread reflects continued uncertainty and possible challenges to be faced by the economy in the near future.

Exhibit 5-3: 30-year Mortgage rate and 10-year Treasury Spread (10-year history 2010 to 2020)



Source:Board of Governors of the Federal Reserve System (US) & FRED, Federal Reserve Bank of St. Louis

There are multiple macroeconomic variables to consider in understanding the spread, such as the Federal Reserve monetary policies that impact the mortgage spread. Several studies have presented the potential integration of the mortgage market into the capital markets. This has been further explained to reflect that the 10-year LIBOR (London interbank overnight rate) swap rate is better at reflecting the mortgage rates instead of the 10-year Treasury rate. The literature demonstrates that the Swap rate is superior and delivers a strong relationship between mortgage rates and capital market rates (Sirmans, Smith, and Sirmans 2015).

Research dissects the impact of unanticipated macroeconomic announcements on interest rates and residential mortgages. The paper (Ramchander, Simpson, and Webb 2003) uses examples like, home mortgages that are priced based on borrower debt servicing capacity, and any adverse effect on the labor market would impact borrowers servicing ability and, thereby, housing demand affecting mortgage rates. The study also attempts to highlight the influence of macroeconomic surprises on mortgage yields through co-integration procedure analysis, which is evident through various credit instruments and their linkages to interest rate movement.

To better understand the spread, it is essential to understand the 10-year Treasury security and 30-year mortgage rate separately;

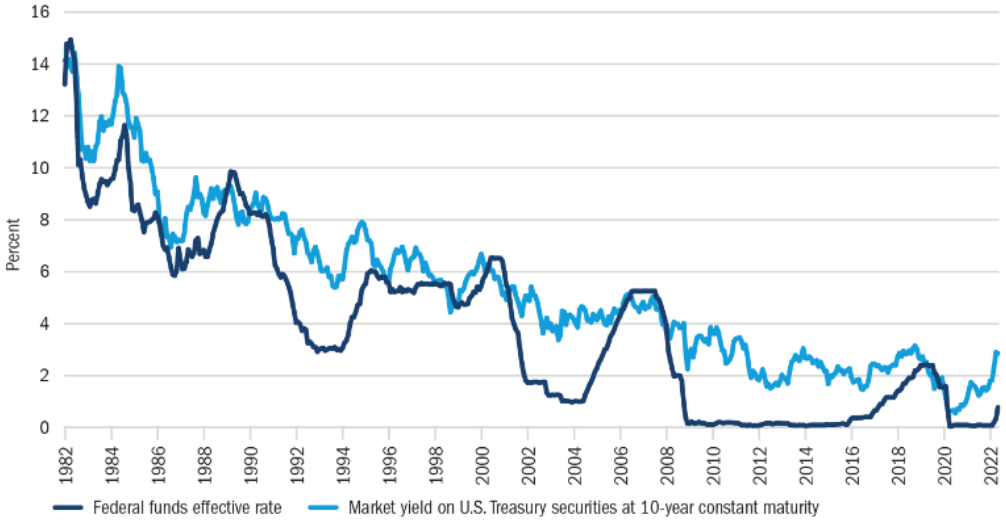
5.3 10-Year Treasury Yield

Treasuries are bonds issued by the government to support its spending and obligations; in other words, investors who buy Treasury securities lend the government money at a fixed interest rate. Bonds issued by the government are considered extremely safe because they are full faith and credit of the US Government. The interest earned on these bonds is used to calculate bond yields. Yields on Treasuries are determined by various factors, including demand and supply, inflation, and Federal Reserve policy changes and their impact on the economy. The yields are inversely related to their price.

The 10-year Treasury yield is an economic indicator as it is part of the yield curve showing the investor’s confidence in the economy. When investors are confident about

the economy, they participate more in riskier alternatives and less in the bond market, therefore, reflecting in the reduced pricing of the bonds. Lower-priced bonds have higher yields to attract investors to the bond market. The yield curve is expected to slope in an upward direction as it reflects higher yields for longer maturities.

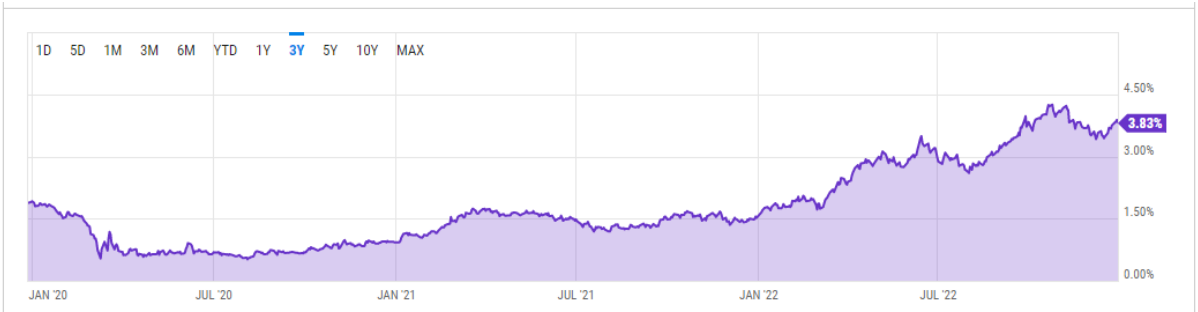
Exhibit 5-4: 10-year Treasury yields with changes in Fed funds rate



Source: FRED, Federal Reserve Bank of St. Louis

It is important to note that the 10-year yield does not closely follow the federal funds rate. Federal funds rate (FFR) directly impacts short-term interest rates. However, the FOMC announcements shift the market's expectations for investors to adjust the pricing of their short-term and long-term investments considering other factors, including inflation, growth, and geopolitical risk.

Exhibit 5-5: 10-year Treasury Rate - 3.83% as of December 29th, 2022



Source: YCharts

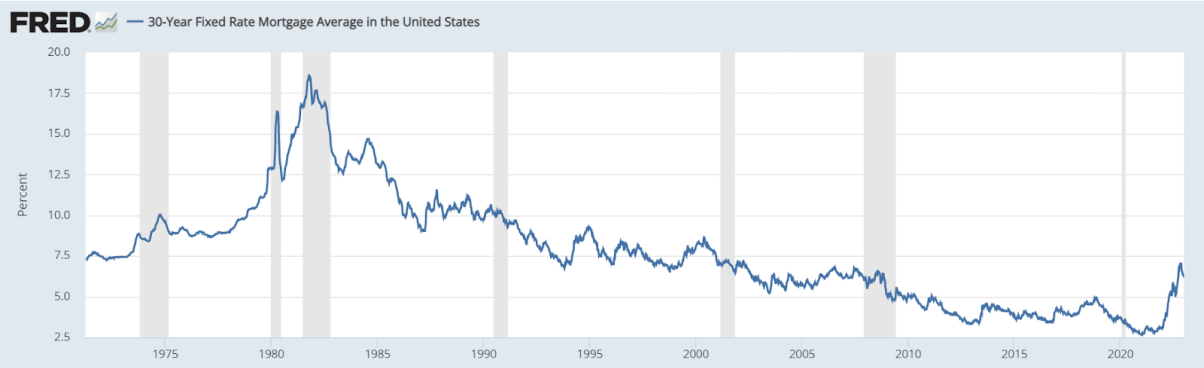
The 10-year Treasury Note measures other riskier investments and assesses whether the additional returns justify the risk. Additionally, the 10-year yield has been used to assess the mortgage rates, as rising yields signal higher mortgage rates reducing

dually home sales and prices, and inversely lower yields can indicate the time for home sales and refinance.

5.4 30-year Mortgage Rate

Investors looking to invest in the fixed-income markets look at opportunities of comparing investing in bonds to similar options like MBS. The MBS market demand determines how mortgage rates will be priced based on investors' perceptions of market volatility and uncertainty. If the possibility of default is high, the investors will ask for more interest on the MBS securities, driving up the mortgage rates.

Exhibit 5-6: 30-year Fixed Rate Mortgage (1971 - 2022)



Source: FRED, Federal Reserve Bank of St. Louis

The recent interest hike to the federal funds rate has put substantial pressure on mortgage rates reaching the highest level of 7% since the 1980s. Other Federal Reserve monetary policies, such as Quantitative Tightening and Quantitative Easing, have impacted mortgage rates too.

5.5 Quantitative Easing's Impact on the Spread

After the GFC, the Federal Reserve purchased MBS as part of its Large Scale Asset Purchases (LSAP) to boost the economy, reduce the mortgage interest rates and add liquidity to the market. The program started in 2008 and 2009 with Fannie and Freddie guaranteed MBS intending to reduce the mortgage interest rate (as announced by the Fed), initially starting with $500 billion but later increasing to $1.25 trillion in 2010. The Federal Reserve directly influences the primary mortgage rates by purchasing MBS in the secondary market and reducing their supply, thereby having the MBS investors aggressively bid for the remaining MBS owned by the originator. This effectively

results in the secondary market making funding available to the originator and reducing the primary mortgage rates.

The paper by (Stroebel and Taylor 2009) estimates the extent of the Fed's purchase program on declining the mortgage spreads in 2009 and determines the Fed's ability to affect the pricing of MBS for extended periods and whether it will work in the future.

Exhibit 5-7: Impact of LSAP on the 10-Year Treasury Yield

LSAP Policies	Estimated Decline in 10-Year Treasury Yield (basis points) at onset of the program	Other Studies
LSAP 1	34	91 - (Event Studies); 36 to 82 (Regressions) - Gagnon et al. (2011) 100 - Krishnamurthy and Vissing-Jørgensen (2011) 20 to 30 - (Treasury security purchases only) - D'Amico and King (2013) 35 - (Treasury security purchases only) - D'Amico et al. (2012)
LSAP 2	12	25 - Krishnamurthy and Vissing-Jørgensen (2011) 55 – D'Amico et al. (2012) 21 – Meaning and Zhu (2011) 15 – Swanson (2011)
MEP	28	22 - Hamilton and Wu (2012) 17 – Meaning and Zhu (2012)
LSAP 3	31	60 - Engen, Laubach, and Reifschneider (2015)[1]

Source: Federal Reserve

The table summarizes researchers' calculations of the decrease in 10-year Treasury yields from the various LSAP or QE programs. Subsequent studies have tried to showcase the effect of the Fed's portfolio reserves of MBS holdings (essentially QE2 in 2011) on MBS yields and mortgage rates, whether it will work and how it was different from QE1, which was specifically targeted for reduction in mortgage rates. The paper argues that QE2, even without targeting a reduction in mortgage rates in a better market condition compared to 2008 had an impact on reducing mortgage rates. (Hancock and Passmore 2012).

In their subsequent paper, (Hancock and Passmore 2015) focus on establishing the impact of portfolio rebalancing and continued large-scale asset purchases with Fed holding its asset purchase in MBS and Treasuries to maintain lower MBS yields and significantly lower mortgage rates. However, the effect of the Fed's asset purchase on liquidity needs to be clarified and may increase investors' confidence in selling their securities to Fed as a last resort buyer. Also, the Fed continuing to expand its holding of the total MBS market will lead to a shallow market with limited private MBS investors to purchase the securities held by the Federal Reserve.

Research (Walentin 2014) shows that "*a mortgage shock of 100 basis points (bps) yields a decrease of 1.6 percent in consumption, 6.2 percent in residential investment,*

and 1.9 percent in GDP. These responses are gradual and reach a trough after more than one year. House prices respond faster and decline by 2.6 percent. A 100 bps mortgage spread shock yields a fast and strong 184 bps offsetting response of the policy rate."

5.6 Quantitative Tightening's Impact on the Spread

Large Scale Asset Purchases (LSAP) of MBS result in increasing demand in the market and thereby reducing mortgage yields. (Hancock and Passmore 2012)
Similarly, the decline in the Fed's portfolio, i.e., offloading of the MBS portfolio in the market, might result in higher MBS yields, thereby increasing the spread between a 10-year Treasury and a 30-year fixed-rate mortgage.

The current high-interest rate environment has resulted in high Treasury yields and mortgage spreads. The mortgage spread has been at elevated levels of 300 bps (similar to what was seen during the GFC) above the 10-year Treasury, which determines the mortgage rates. The Fed's 2022 QT or run-off strategy has been less impactful in reducing Fed's MBS portfolio due to lower prepayment or refinancing events considering the rising mortgage rate environment with interest rates around 6-6.5%. This paper focuses on the MBS portfolio run-off and its impact on the MBS markets and mortgage rates for the primary borrower.

In the graphs below, the economists at the Federal Reserve calculated the interest rate pressure through scenario analysis (sell-off timelines for 3, 5, and 7 years) in normal versus crisis market conditions. Both graphs depict the severity of asset sales and their impact on the Treasuries rates.

Exhibit 5-8: QT-equivalent rate hikes under passive Roll-off

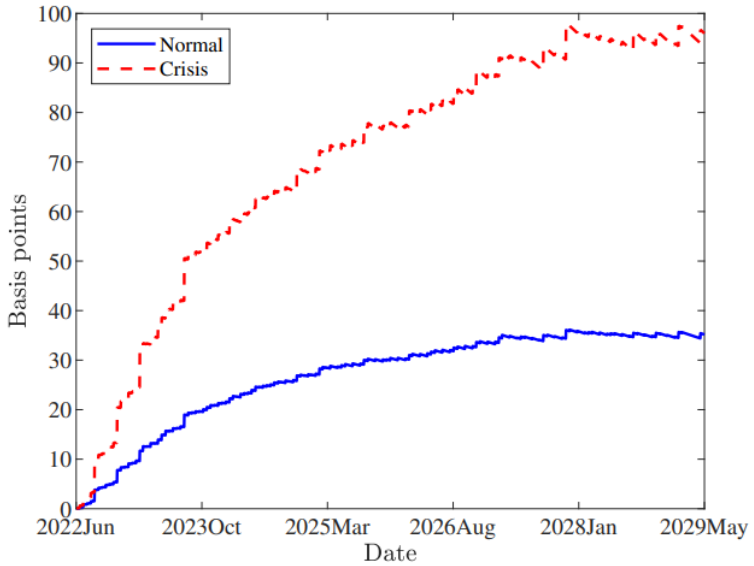
(Normal versus Crisis Market Conditions)

	Scenario 1		Scenario 2		Scenario 3	
Equiv. Impact	normal	crisis	normal	crisis	normal	crisis
10-year yield (basis points)	6.0	9.1	7.2	11.3	7.3	12.0
Current FF rate (basis points)	29.2	74.2	34.7	92.2	35.2	97.6
FF rate path (basis points)	75.0	211.6	63.2	178.0	53.5	153.2
QT size (trillion)	2.2		2.8		3.3	
QT duration (years)	3		5		7	

NOTE: This table reports our estimates of QT-equivalent rate hikes for both passive roll-off (Column "passive") and active sales (Column "active") during crisis periods. We consider three scenarios: QT—beginning on June 1, 2022—lasts for 3 years in Scenario 1, 5 years in Scenario 2, and 7 years in Scenario 3. We report the equivalent effects of QT in basis points on the 10-year yield (Row "10-year yield"), the current federal funds rate (Row "Current FF rate"), and the path of future federal funds rate (Row "FF rate path").

Source: Federal Reserve

Exhibit 5-9: QT Impact on Treasuries



NOTE: This figure plots the real-time estimates of QT-equivalent rate hikes in the current federal funds rate under normal market conditions (blue solid line) or during crisis periods (red dashed line). Specifically, we consider passive roll-off that begins on June 1, 2022, but can end on any day before June 1, 2029.

Source: Federal Reserve

Chapter 6 - Mortgage & Affordability

6.1 History of US mortgage rates

The history of mortgage rates dates back to the 1970s when the Federal Home Loan Mortgage Corporation (known as Freddie Mac) started to track the annual mortgage rates. In the 1970s, the mortgage rates were in the 7-8% range, eventually reaching double digits for the first time.

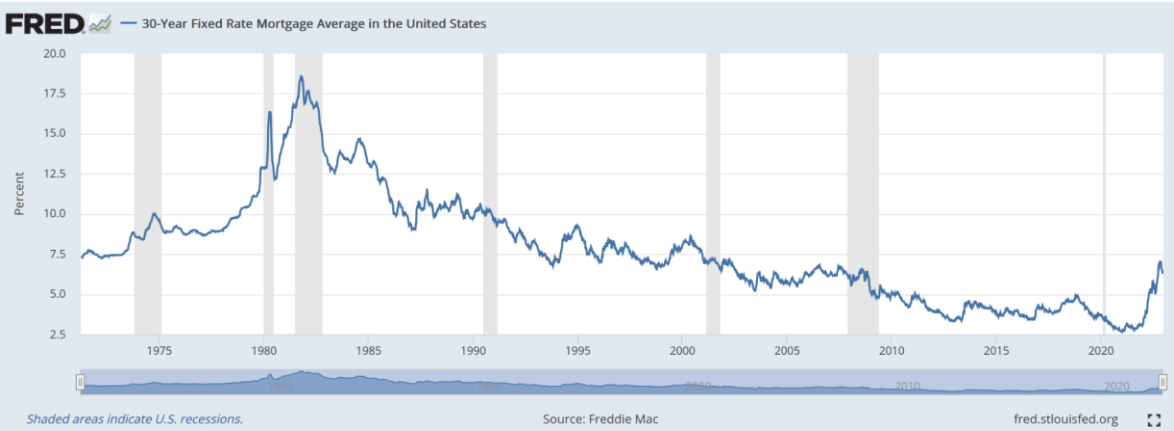
During the 1970s and 1980s, the US experienced high inflation caused by the oil crisis, which translated into the high cost of goods, including mortgage rates. To stabilize the economy and curb inflation, the Federal Reserve increased short-term rates while the decade saw some of the highest mortgage interest rates at 18.63% in 1981.

Subsequently, the next two decades saw the mortgage rates cool down to the 7-8% range. Economists attributed the decrease in mortgage rates to the internet boom, informed population, and fast-paced technological advancement, which helped economic recovery. Financial engineering in the subprime mortgages brought about the Global Financial Crisis (GFC) of 2007-08. To reinstate the economy, the Federal Reserve reduced interest rates to zero lower bound (ZLB) and conducted three large-scale asset purchases (LSAPs) of long-term Treasuries and agency MBS. Mortgage rates dropped, infusing confidence amongst the borrowing American population. Recovering from the GFC, the mortgage rates hovered around 3-4%, eventually settling at around 4% during 2019.

In response to the Covid-19 pandemic, the Federal Reserve infused trillions of dollars through another LSAP long-term Treasuries and MBS and the interest rates once again to ZLB (0% - 0.25%), incentivizing borrowing. These were some of the lowest mortgage rates in US history, with 30-year fixed-rate mortgages as low as 2.5%. However, the continued indirect impact of supply chain issues, geopolitical instability, and rising inflation led to a sharp increase in mortgage rates. This increase in rates was responding to overheating housing markets with low supply, record-high increasing prices, and inflation (9% reported in June 2022). In the second half of 2022, Federal Reserve intervened to calm down inflation through continued multiple 75 bps

rate increases taking the mortgage rates to around 7% and making mortgage payments increase at 2x during the last 7-8 months.

Exhibit 6-1: 30-year Fixed Rate Mortgage (1971-2022)



Source: FRED, Federal Reserve Bank of St. Louis

6.2 Affordability

Housing affordability has been defined across multiple platforms, but an accurate definition is still to be established. The US public policy has established an indicator of affordability based on the percentage of income spent on housing (Herbert, Hermann, and McCue, n.d.). More than 30% of household expenditure allocated towards housing has been considered an affordability issue. Historically, housing affordability in the US focussed on low-income families or the median. The challenges in measuring affordability through conventional measures and possible solutions are discussed in (Linneman and Megbolugbe 1992).

Attempts have been made to standardize the concept of affordability with banks, real estate agencies, and government agencies focused on median-based fixed-rate mortgages. Therefore, it was essential to have affordability measures as reliable indicators for the long-term burden on home buyers while fixed rates increased lenders' risk. The three main affordability indexes in the US are the National Association of Realtors (NAR), the US Department of Housing and Urban Development (HUD), and the National Association of Home Builders (NAHB); their strengths and weaknesses have been described in (Hill and Gan, n.d.) and (Jewkes and Delgadillo 2013)

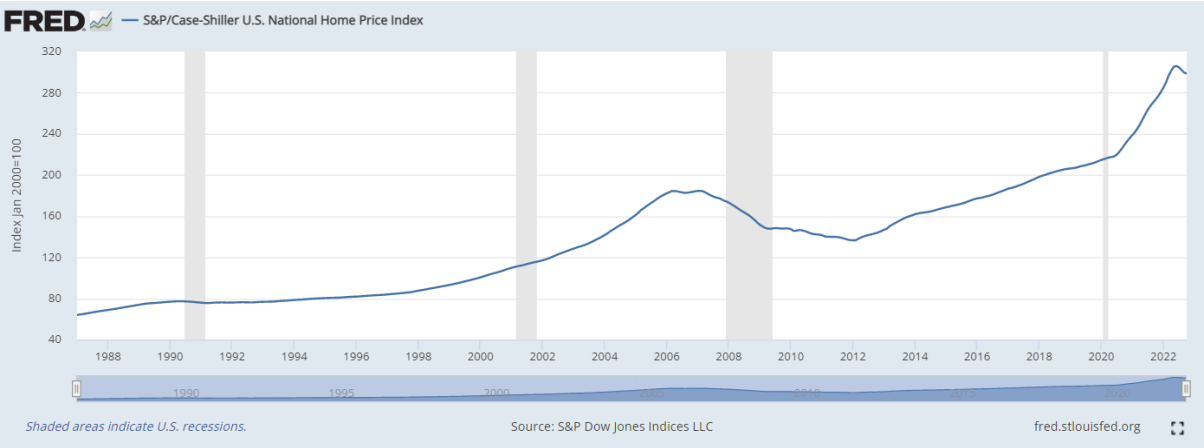
The various concepts and interpretations of housing affordability have been discussed in the research paper (Galster and Lee 2021). Housing affordability could be focussed on three dimensions; home prices, household incomes, and mortgage interest rates instead of policies to increase demand by bringing households into buying homes and putting pressure on prices. However, focusing on supply drivers like increased new development would balance the price increase. The paper emphasizes that all three dimensions have to move at a stable pace and similar direction to avoid disrupting housing affordability in the US (Trimbath and Montoya 2002).

In the current environment, with the increased gap in the home median income to median home prices and with increased mortgage rates, the higher mortgage-to-income ratio would not qualify households for Fannie and Freddie criteria-issued mortgages.

As housing prices and household income move in tandem over the long term, mortgage rates are a critical determinant of affordability in the long term. Therefore, high mortgage rates are a deterrent to potential home buyers. The house price increase during 1982-1988 had a lesser impact on affordability because of the reduced interest rate environment over the same period. However, the rise in mortgage rates after 1989 had a much greater loss of affordability during the same period (Linneman and Megbolugbe 1992). Similarly, we estimate that the current high mortgage rate environment will affect affordability more than the increased housing prices and household income.

In anticipation of a cooling market, homebuyers are waiting for prices to cool down and mortgage rates to come back to some median range other than 5% -7%. Mortgage rates were last in this range back in 2000 - 2007. As seen in Case Shiller Housing Index, the drop in house prices in 2022 has responded slowly to the increased pace of mortgage rates.

Exhibit 6-2: S&P/Case-Shiller US National Home Price Index

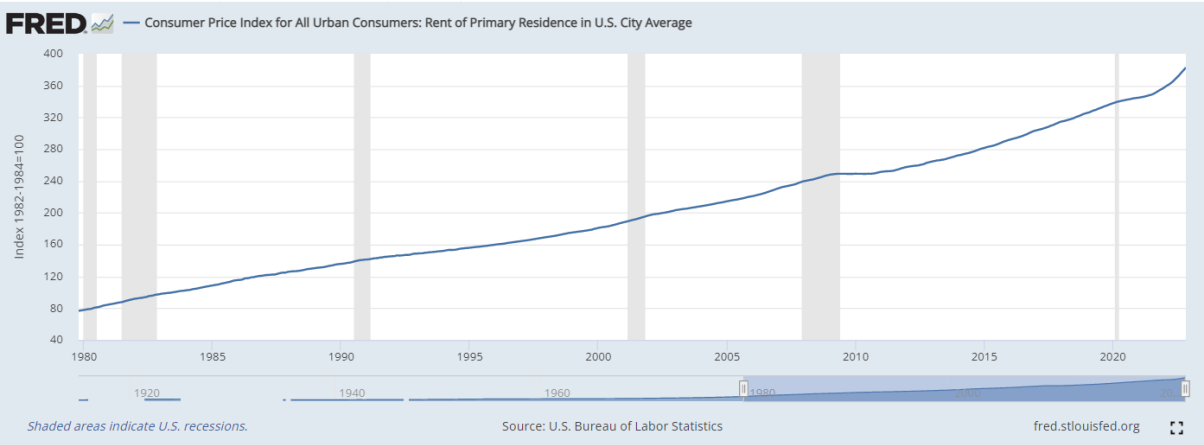


Source: FRED, Federal Reserve Bank of St. Louis

Potential homebuyers will resort to renting; high demand and low rental housing supply will keep rents elevated despite the Fed's effort to cool inflation, anticipating a softer rental market in 2023.

Rents will continue to be higher due to the following reasons: the expired forbearances in 2022, elevated mortgage rates that will make homeownership unaffordable, and the increased cost of construction and development.

Exhibit 6-3: CPI Rents Index - US Average



Source: FRED, Federal Reserve Bank of St. Louis

One of the big assumptions made by indexes that track affordability is that mortgage finance is available only to qualified borrowers. This assumption has been possible because of the development of the secondary mortgage market (through Ginnie Mae and Fannie Mae), which balances the asset-liability mismatch (short-term deposit

liability and 30-year fixed mortgages) and gives the mortgage originator ability to liquidate its position for the need of cash to repay the deposit holders request (Linneman and Megbolugbe 1992).

Many economists anticipate a market correction in rents, home prices, mortgage rates, and relative affordability. However, highlighting the Fed's massive participation through LSAPs has absorbed previous market disruptions or crisis situations (GFC and Covid). In this new decade, there will be limited choices for the Federal Reserve to sustain the housing market, creating room for innovations in the housing finance sector.

Chapter 7 - Conclusion

As the lender of last resort and to prevent financial panic, the Federal Reserve provides available means of borrowing and intervenes to circumvent any failure to obtain credit. The housing market, which represents 15-18% of the GDP, was in financial distress, and to save it, the Federal Reserve conducted LSAPs of MBS, some of the less risky mortgage instruments as the GSEs back them.

If the Fed, which currently owns 38% of the total MBS market, decides to offload the MBS as planned, the sale will have additional pressure on the MBS market, creating further uncertainty. The mortgage spread, which indicates the perception of the MBS market, is currently at elevated levels in the range of 300 bps above the 10-year Treasury yield, similar to the past housing crisis, i.e., the 1980s, GFC, and Covid-19.

The Federal Reserve increased the federal funds rate to curb the record-high inflation of 9% in June 2022. With the option of QE unavailable to the Federal Reserve, any additional QT measures will put additional pressure on the spread, which translates into higher borrower mortgage rates. The recent aggressive rate hikes were intended to increase unemployment and reduce high consumer spending, which might eventually reduce home sales and possibly trigger delinquencies and foreclosures in the foreseeable future. High borrowing costs will further affect affordability which has already been impacted by the increased housing prices and lower growth in household income, making home ownership much more difficult.

In the last quarter of 2022, the rental market showed signs of cooling off as FFR increased and mortgage rates peaked at 7%. Potential homebuyers are still renting at historically high rents as they wait for home prices to return to the mean and possibly a Federal Reserve's intervention as they did in the past.

Held by its mandate, the Federal Reserve used its balance sheet to restore the economy and inherently became a participant in the MBS market. The MBS market does not know how to function without its LSAPs during a liquidity crisis. With the focus on QT, the Federal Reserve has limited options to restore price stability and maximum

employment. As a participant in the MBS market, more research is needed on how the Federal Reserve should strategize against a potential housing and mortgage crisis.

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