

US Agency mortgage-backed securities (MBS)

A foreign investor's perspective

Executive summary

The objective of this paper is to explore the US mortgage-backed securities market from the perspective of a foreign investor. We pay particular attention to the US Agency MBS segment, owing to its size, liquidity, return and risk characteristics.

First, we focus on the key defining feature of MBS, prepayment optionality, and what it means for investors. Second, we review other important characteristics of US Agency MBS, including their performance versus other asset classes, and the role MBS can play in the construction of fixed-income and multi-asset portfolios.

Third, we examine the ownership structure of US Agency MBS to assess the role of foreign investors in this market, its evolution and current trends. Finally, we seek to explain why foreign investors hold a relatively small share of the US Agency MBS market (15%) compared to domestic investors.

US Mortgage-backed securities market

Introduction and overview

Generally speaking, a **mortgage** is a loan made to a household or firm to finance the purchase of a home, land or any other real estate, and conceptually has existed for centuries. The process of transforming these individual loans into marketable securities is called **securitization** (also viewed by market participants as a form of transformation of illiquid assets into liquid securities) and involves a number of institutions.

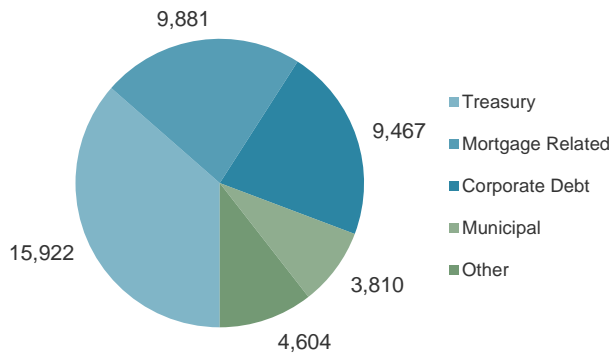
For example, Bank A originates mortgage loans to borrowers, including underwriting, funding and servicing. These US residential mortgages are then bought by Freddie Mac (Agency), which bundles them into a pool and sells them to a “bankruptcy-remote” special-purpose vehicle (SPV). The SPV issues MBS backed by this pool of loans and sells them to pension funds, asset managers and other investors.

A **mortgage-backed security** is an instrument that represents an ownership in a pool of mortgages and, more importantly, where cashflows depend on the underlying pool of mortgages.

Despite the first US MBS only being issued in 1968, the MBS market has grown to become the second largest segment of the US fixed-income market after US Treasuries, with a total outstanding volume of \$9.9 trillion as of June 2019 and a total issuance of \$1.9 trillion in 2018 (Figures 1 & 2).

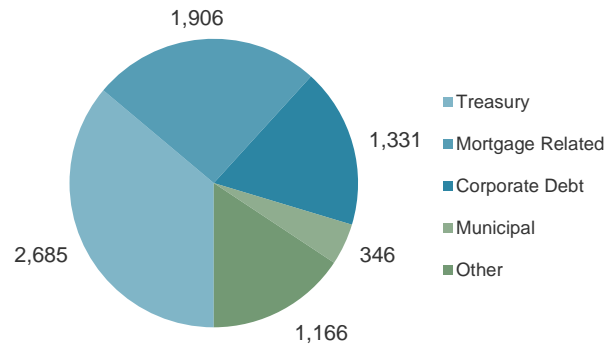
Looking at historical numbers, recent issuance is below the peak seen in the early 2000s, while outstanding volumes continue to rise (Figure 3).

Figure 1. Outstanding US bond market debt, \$bn



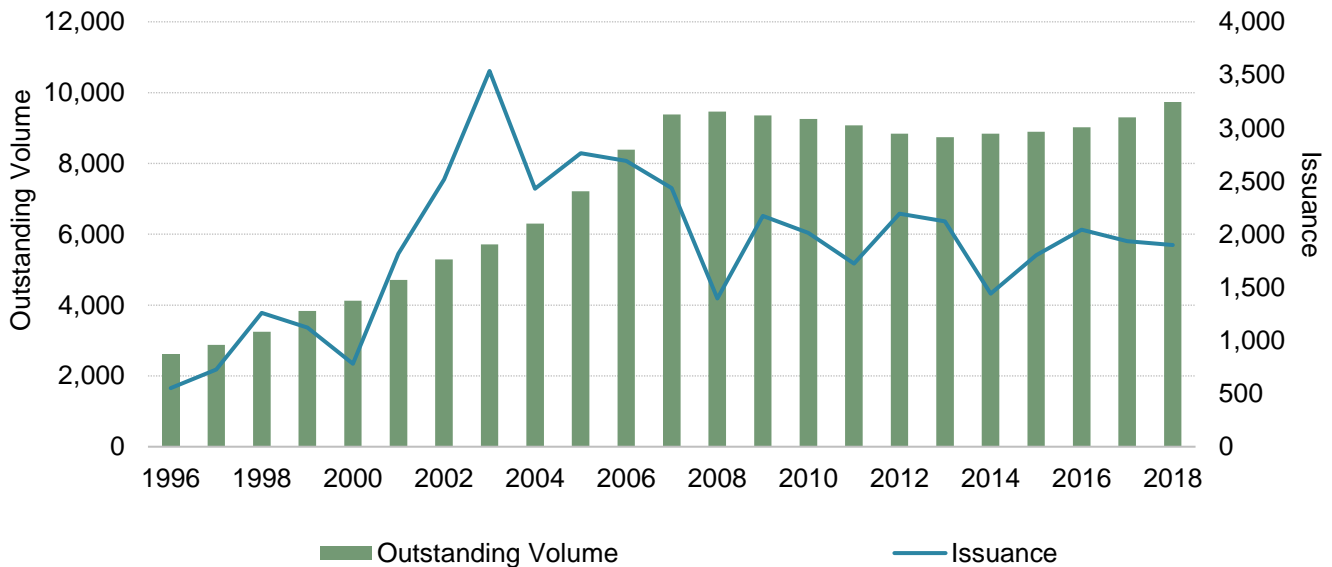
Source: SIFMA. Data as of June 2019.

Figure 2. 2018 Issuance in the US bond market, \$bn



Source: SIFMA. Data as of December 2018.

Figure 3. US MBS historical outstanding volume and issuance, \$bn



Source: SIFMA. Data as of December 2018.

Main types of US MBS

The majority of outstanding US mortgage-backed securities are **Agency MBS** (around 75%). These are guaranteed by the US government, either explicitly, issued by Ginnie Mae, or implicitly, issued by Government Sponsored Enterprises (GSE), like Fannie Mae and Freddie Mac. Therefore, Agency MBS are viewed as credit-risk free¹ by market participants (as long as Fannie Mae and Freddie Mac stay under conservatorship).

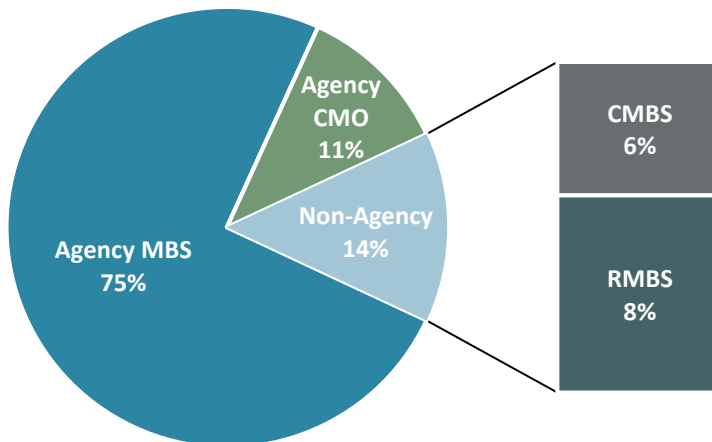
The most common Agency MBS structure is a pass-through, where investors are entitled to a pro-rata share of the cash flows from the underlying mortgages. Monthly interest and principal payments are then passed through from a pool of loans to security holders.

The rest of the Agency MBS market is made up of **collateralized mortgage obligations (CMOs)** – around 11% – that are issued against specific mortgage collateral and are divided into several bond classes, called tranches. This structure creates securities with a number of specific payment and maturity profiles, catering to different investor needs.

Non-Agency MBS, also referred to as private-label MBS, are issued by institutions that have lower credit-worthiness relative to government agencies, or GSE, and typically do not meet the loan size limits or underwriting standards required. Therefore, they offer a higher yield to investors to compensate for the higher level of risk.

The Non-Agency MBS market, represented by commercial and residential MBS, is significantly smaller (about 14% of US MBS), and less liquid compared to Agency MBS (Figure 4).

Figure 4. US MBS market breakdown by outstanding volume



Source: SIFMA. Data as of June 2019.

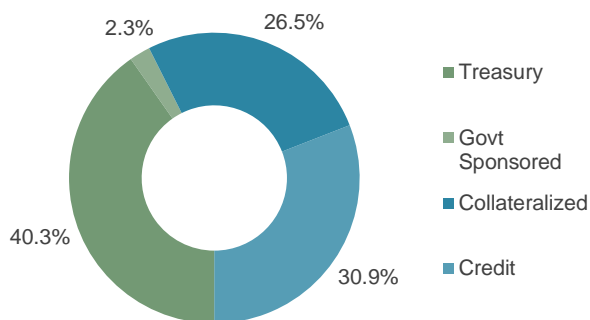
¹In 2008 both Fannie Mae and Freddie Mac were placed into conservatorship with the Federal Housing Finance Agency (FHFA) in response to their deteriorated financial condition caused by the financial crisis. In January 2019, the regulator announced its plans to take Fannie Mae and Freddie Mac out of conservatorship. This will mean the introduction of risk-based capital requirements and revision of minimum leverage capital requirements for GSEs, which have been suspended since 2008. Implications for market participants will become clearer once the details are published.

US MBS in fixed-income benchmarks

It is worth noting that mortgage-backed securities also comprise a significant part of US and global fixed-income benchmarks. Looking at the FTSE US Broad Investment-Grade Bond Index (USBIG®) breakdown as of June 2019, the collateralized sector makes up 26.5% (Figure 5).

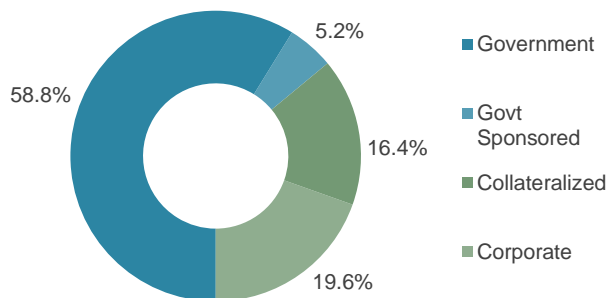
Furthermore, the collateralized sector has a weighting of 16.4% (Figure 6) in the FTSE World Broad Investment-Grade Bond Index (WorldBIG®).

Figure 5. FTSE USBIG



Source: FTSE Russell. Data as of June 2019.

Figure 6. FTSE WorldBIG



Source: FTSE Russell. Data as of June 2019.

What differentiates MBS from other fixed-income securities?

While being a key element of the fixed-income universe, mortgage-backed securities have a number of distinguishing characteristics, which we will investigate in more detail:

- Prepayments
- Negative convexity
- Pay-offs frequency

Prepayment optionality

The prepayment option is the main feature of MBS, which differentiates it from other types of fixed-income securities. MBS cashflows are not known with certainty as homeowners can fully or partially prepay their mortgages prior to maturity. This feature makes MBS more complex and challenging compared to traditional non-callable bonds or even standard callable corporate bonds.

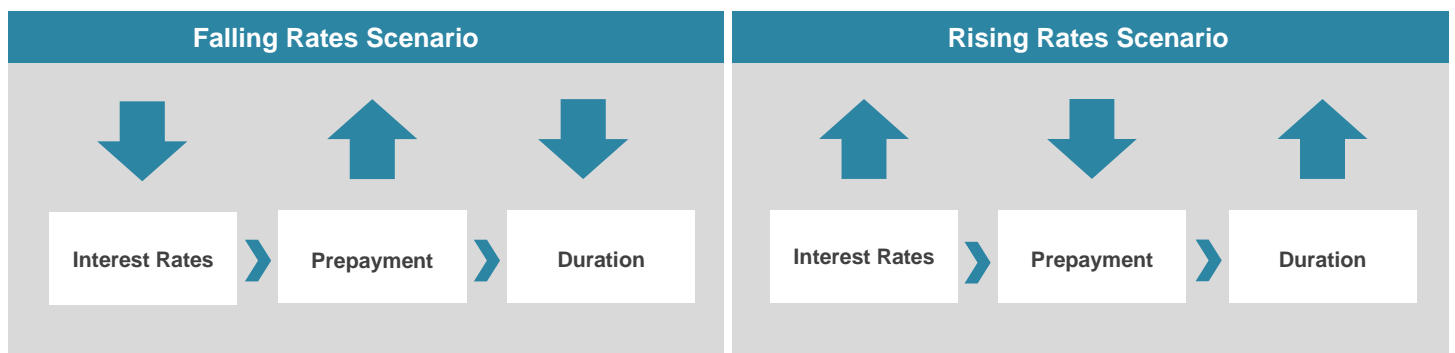
What drives prepayments?

Mortgage prepayments are mainly caused by either **home sales**, which happen due to life changing events of homeowners, or **refinancing**, which generally occur when mortgagors wish to take advantage of lower rates or access the increased equity in the house.

A smaller proportion of prepayments is driven by defaults, curtailments and full payoffs. **Defaults** occur when borrowers stop making payments on their mortgage obligations. As for **curtailments** and **full payoffs**, the former happens when homeowners pay more than scheduled monthly to build up equity faster, while the latter means they pay their mortgages off completely (this typically happens if loans have a small remaining balance)².

What does the prepayment option (or call option) mean for investors? For the majority of MBS securities, it is an extra risk dependent on interest rates shifts. Therefore, they have a more pronounced duration uncertainty as illustrated below:

Figure 7. How interest rates impact MBS duration



Source: FTSE Russell.

When interest rates fall, homeowners with fixed-rate mortgages are incentivized to refinance their loans at lower rates. This leads to an increase of principal prepayments and shorter duration (known as “contraction risk”). In this situation, MBS investors are paid off earlier than scheduled and face reinvestment at a lower interest rate.

On the other hand, rising interest rates slow down principal prepayments, as homeowners are already locked into a more preferable mortgage rate. This increases duration for the MBS investors (known as “extension risk”), who are unable to reinvest at a higher rate.

Negative convexity

Prepayment risk translates into a negative convexity feature. Conventional straight bonds, which are non-callable, have known interest and principal repayment dates, and positive convexity (duration sensitivity to interest rate changes). This means that a price increase, when interest rates decline, is greater than a price decrease, when interest rates rise by the same amount. However, it is not the case for MBS. Rising prepayments dampen price appreciation in a declining interest rate scenario and may result in an

² “Anatomy of Prepayments”, Hayre, Young, Teytel and Cheng (2004).

underperformance versus a non-callable fixed-income instrument, such as a comparable US Treasury (due to negative convexity).

The prepayment option introduces additional risk and adds complexity into the MBS analysis, as it requires both interest-rate and prepayment modelling. However, investors are compensated for taking on that extra risk. Diep, Eisfeldt & Richardson (2017) found in their study that MBS investments earn premia with respect to the prepayment risk factor³. This is typically captured in the Option-Adjusted Spread (OAS) (Figure 8).

Figure 8. US Agency MBS OAS



Source: FTSE Russell. Data from January 1989 to June 2019. Past performance is no guarantee of future results. Data for US Agency MBS based on USBIG Mortgage Sector. Please see the end for important legal disclosures.

Frequency of pay-offs

Monthly principal and interest pay-offs are another feature that distinguishes MBS from conventional fixed-income securities. Investors typically receive scheduled coupon payments (annually or semi-annually) and the principal at maturity. This feature is an advantage in a rising rates environment due to more frequent reinvestment opportunities. It also suits investors with monthly income requirements.

On the other hand, a falling interest rates environment is not as beneficial as MBS investors incur higher prepayments and expect reinvestment at a lower rate. However, as already mentioned, they are compensated for taking this risk. In addition, complex prepayment models can project future cashflows, while efficient risk management and scenario analysis can help investors prepare for various market conditions. See Appendix for more details on MBS analysis.

³ "Prepayment Risk and Expected MBS Returns", Diep, Eisfeldt and Richardson (2017). Their research also showed that prepayment risk premia is dependent on the current market composition. Discount securities benefit from prepayments, as they are traded below face value but are prepaid at face value, while premium securities suffer from prepayments, as they experience a decrease in their value. This also demonstrates that any interest rate scenario can result in very different performance profiles even within the same asset class.

Possible benefits from investing in MBS

Apart from these unique characteristics, US Agency MBS may be attractive for investors from a portfolio construction perspective due to the following features:

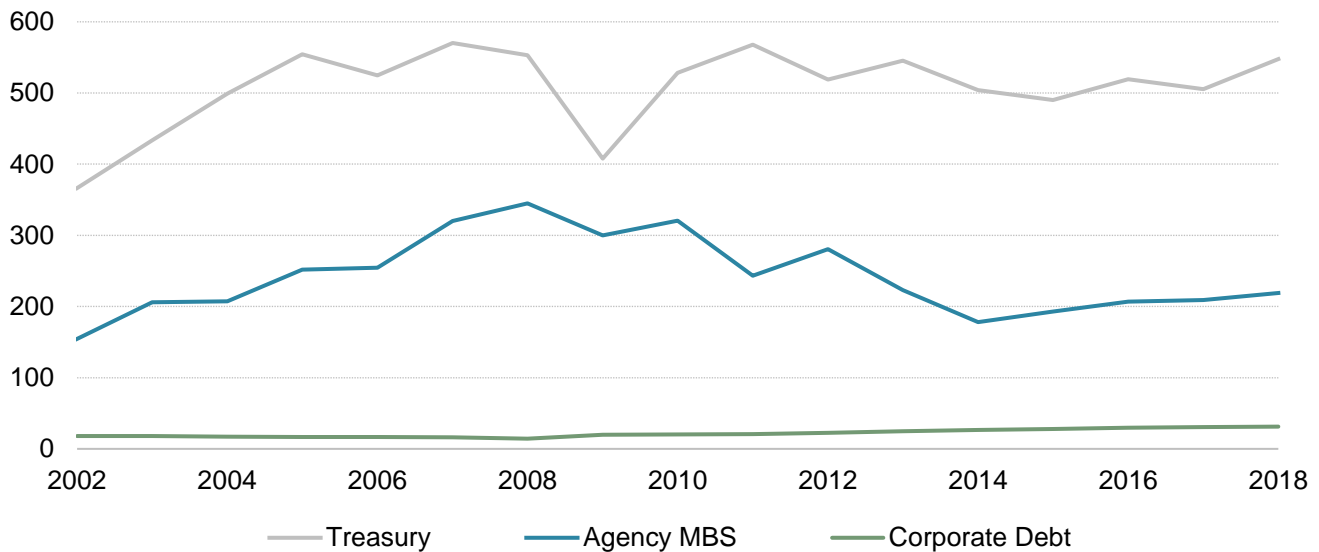
- Liquidity
- Yield
- Risk-adjusted performance
- Correlation
- Strong performance during the global financial crisis
- Behaviour in various interest-rate environments
- Security selection

Liquidity

US Agency MBS is a highly liquid segment of the total US fixed-income market, with an average daily trading volume of \$219 billion in 2018 (Figure 9), which significantly exceeds Corporates (\$31 billion), but is not as large as Treasuries (\$548 billion).

The current average daily trading volume remains well below its 2008 peak of nearly \$350 billion, although there has been an upward trend since 2014, when average daily volume fell below \$180 billion.

Figure 9. Average daily trading volume, \$bn



Source: SIFMA. Data as of December 2018.

Why does the Agency MBS market trade in such high volumes? The implied government guarantee is part of the answer. However, the way in which these instruments are traded may be another reason. The majority of pass-through Agency MBS (over 90%) are traded in the forward market – TBA (to-be-announced) market.

In a TBA market, the seller agrees to a sales price today and commits to the delivery of securities with predefined characteristics (issuer, maturity, coupon, par amount, settlement date) in a few months' time.

Trading is consolidated into a handful of TBA contracts, typically across 30yr, 20yr and 15yr maturities, and three or four coupons. This process makes the Agency MBS market more homogenous and liquid compared to Corporates, and results in large average trade sizes and narrow bid-ask spreads.

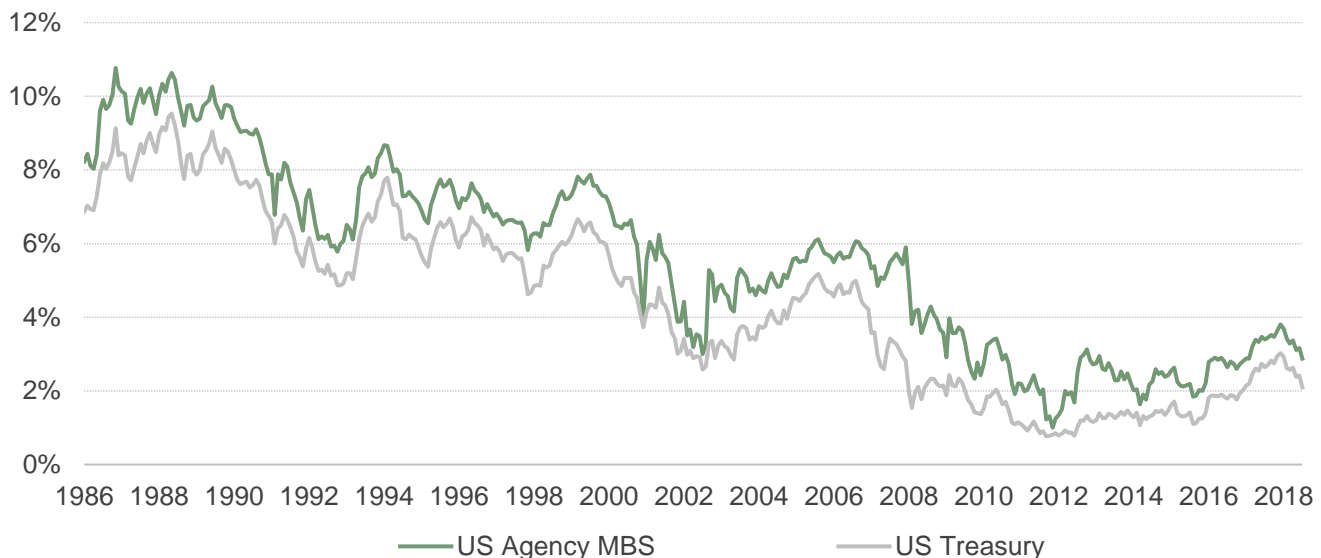
TBA trading helps investors in a few ways:

- It simplifies analytical and risk management challenges, as it is easier to analyse parameters of the TBA contract rather than value each individual security;
- The TBA market has evolved into a funding and hedging mechanism – the dollar roll – where TBAs are bought for a specific settlement date and simultaneously sold for a later settlement. This transaction provides financing, similar to a repo, or can be used for hedging the price risk.

Yield

Mortgage-backed securities typically offer a yield advantage over other fixed-income securities of similar maturity and credit quality, to compensate for prepayment risk (Figure 10). US Agency MBS are very liquid instruments with limited credit risk, which makes them comparable to US Treasury bonds.

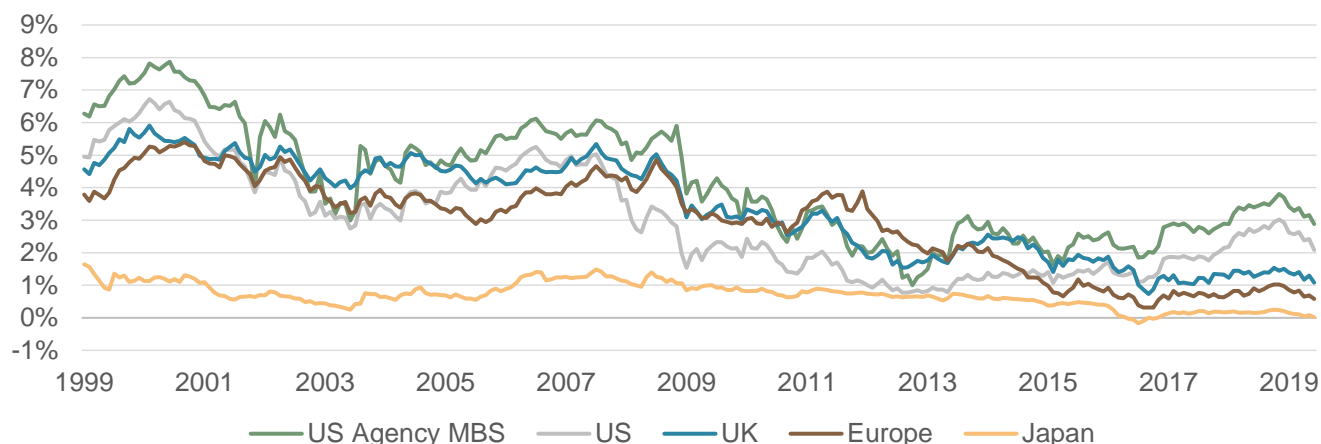
Figure 10. Yield comparison: US Agency MBS vs US Treasury



Source: FTSE Russell. Data from December 1986 to June 2019. Past performance is no guarantee of future results. Data for US Agency MBS, US Treasury based on USBIG Mortgage Sector, USBIG Treasury Sector. Please see the end for important legal disclosures.

Figure 11 also shows the yield comparison of US Agency MBS versus global government bonds. The average monthly yield of the US Agency MBS over the past 20 years was 4.14%, while government bonds in the US, UK, Europe and Japan yielded 3.01%, 3.37%, 2.95% and 0.71%, respectively. Hence, mortgage-backed securities offer some yield enhancement versus the major government bonds, especially in a low bond-yield environment.

Figure 11. Yield comparison: US Agency MBS vs Global Government Bonds



Source: FTSE Russell. Data from January 1999 to June 2019. Past performance is no guarantee of future results. Data for US Agency MBS, US, UK, Europe and Japan based on USBIG Mortgage Sector, WGBI US Sector, WGBI UK Sector, WGBI Europe Sector and WGBI Japan Sector. Please see the end for important legal disclosures.

Risk-adjusted performance

Historical analysis across a few main asset classes (Table 1) shows that US Agency MBS have offered favorable risk-adjusted returns, helped by relatively low volatility over the analyzed period (June 2000 - June 2019).

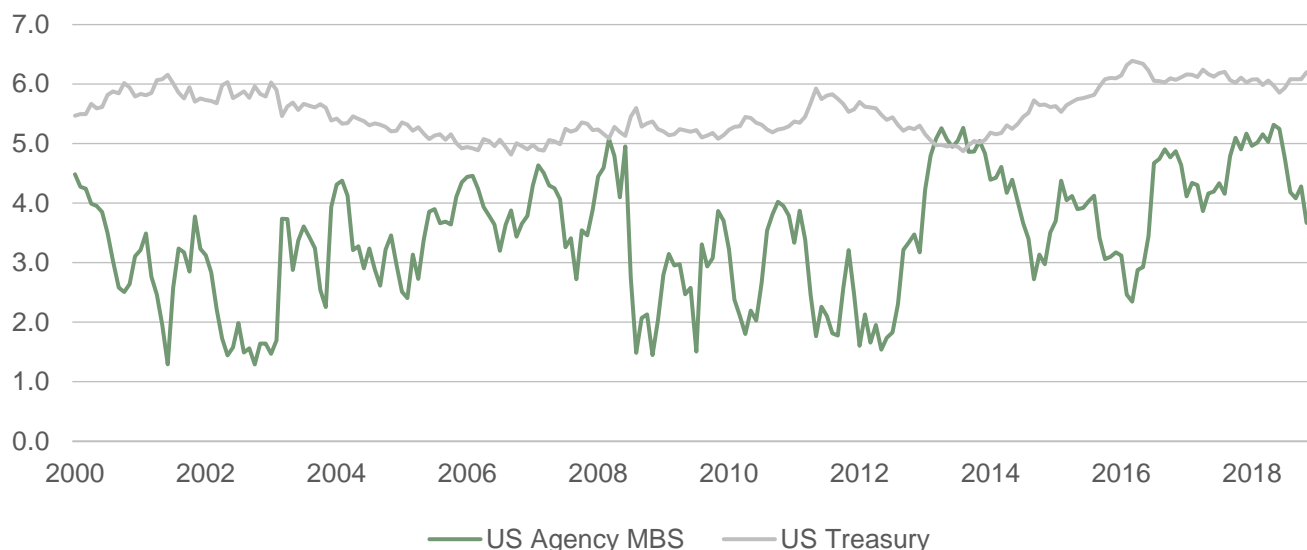
Table 1. Risk-adjusted performance comparison across asset classes

	Monthly			Annualized		
	Return (%)	Standard Deviation (%)	Risk-Adjusted Return	Return (%)	Standard Deviation (%)	Risk-Adjusted Return
US Agency MBS	0.40	0.77	0.52	4.90	2.68	1.83
US Treasury	0.38	1.26	0.30	4.65	4.36	1.07
US IG Corporate	0.52	1.53	0.34	6.42	5.32	1.21
Global Govt	0.33	0.84	0.40	4.08	2.91	1.40
Euro Govt	0.41	1.11	0.37	5.00	3.84	1.30
EM Govt	0.74	2.49	0.30	9.27	8.61	1.08
US Equity	0.58	4.21	0.14	7.17	14.59	0.49
DM Equity	0.48	3.99	0.12	5.93	13.83	0.43
EM Equity	0.90	4.91	0.18	11.29	17.02	0.66

Source: FTSE Russell. Data from June 2000 to June 2019. Return and risk in local currency terms, unhedged. Risk-Adjusted Return calculated as Return over Standard Deviation. Past performance is no guarantee of future results. Data for US Agency MBS, US Treasury, US IG Corporate, Global Government, Euro Government, EM Government, US Equity, DM Equity, EM Equity based on USBIG Mortgage Sector, USBIG Treasury Sector, USBIG Corporate Sector, WGBI, EMU Government Bond Index, Emerging Markets USD Government Bond Index, FTSE USA, FTSE Developed, FTSE Emerging Indexes. Please see the end for important legal disclosures.

One of the reasons why US Agency MBS have demonstrated lower volatility compared to US Treasury is their lower duration profile. The average monthly option-adjusted duration of the US Agency MBS over the analyzed period is around two years lower compared to US Treasury (3.44 vs 5.53 respectively), as Figure 12 shows. Although MBS duration profile is shorter, it exhibits profound fluctuations, mainly driven by the prepayment optionality.

Figure 12. Option-adjusted duration: US Agency MBS vs US Treasuries



Source: FTSE Russell. Data from June 2000 to June 2019. Past performance is no guarantee of future results. Data for US Agency MBS, US Treasury based on USBIG Mortgage Sector, USBIG Treasury Sector. Please see the end for important legal disclosures.

Foreign investors are exposed to foreign exchange risk which they can either hedge (with additional cost) or take on if they have specific currency views. The latter will translate into significantly higher volatility, however, with an opportunity to earn higher returns (Table 2).

Table 2. Performance of the US Agency MBS in various currencies

	LC		Hedged		Unhedged		
	USD	EUR	GBP	JPY	EUR	GBP	JPY
Monthly Performance Measures							
Return	0.40	0.36	0.44	0.23	0.35	0.50	0.43
Standard Deviation	0.77	0.79	0.80	0.76	2.86	2.67	2.56

Source: FTSE Russell. Data from June 2000 to June 2019. Past performance is no guarantee of future results. Data for US Agency MBS based on USBIG Mortgage Sector. Please see the end for important legal disclosures.

Correlation

Due to their unique primary risk factor (prepayment risk) mortgage-backed securities exhibit relatively low correlation to risky assets. As we can see from Table 3, correlation versus emerging and developed equity markets is in fact negative: -0.08 and -0.21 respectively (using monthly data). As a result, the inclusion of MBS into fixed-income and multi-asset portfolios may have a significant diversification benefit for investors.

Table 3. US Agency MBS correlation analysis

	US Agency MBS	US Treasury	US IG Corp	Global Govt	Euro Govt	EM Govt	US Equity	DM Equity	EM Equity
US Agcy MBS	1.00								
US Treasury	0.84	1.00							
US IG Corp	0.64	0.61	1.00						
Global Govt	0.75	0.89	0.60	1.00					
Euro Govt	0.58	0.65	0.49	0.88	1.00				
EM Govt	0.40	0.23	0.67	0.24	0.22	1.00			
US Equity	-0.19	-0.35	0.18	-0.30	-0.19	0.49	1.00		
DM Equity	-0.21	-0.39	0.19	-0.32	-0.19	0.50	0.98	1.00	
EM Equity	-0.08	-0.26	0.28	-0.22	-0.13	0.60	0.76	0.80	1.00

Source: FTSE Russell. Data from June 2000 to June 2019. Past performance is no guarantee of future results. Data for US Agency MBS, US Treasury, US IG Corporate, Global Government, Euro Government, EM Government, US Equity, DM Equity, EM Equity based on USBIG Mortgage Sector, USBIG Treasury Sector, USBIG Corporate Sector, WGBI, EMU Government Bond Index, Emerging Markets USD Government Bond Index, FTSE USA, FTSE Developed, FTSE Emerging Indexes. Please see the end for important legal disclosures.

Attractive risk-adjusted performance and correlation characteristics are paramount from a portfolio construction perspective. Bernhardt, Kolbe and Zagst (2013) studied optimal asset-allocation strategies during March 2001 to March 2003 and found that an inclusion of US MBS in portfolio optimization increased the expected utility of the optimal portfolio for the same level of risk⁴.

Strong risk-adjusted performance during the global financial crisis

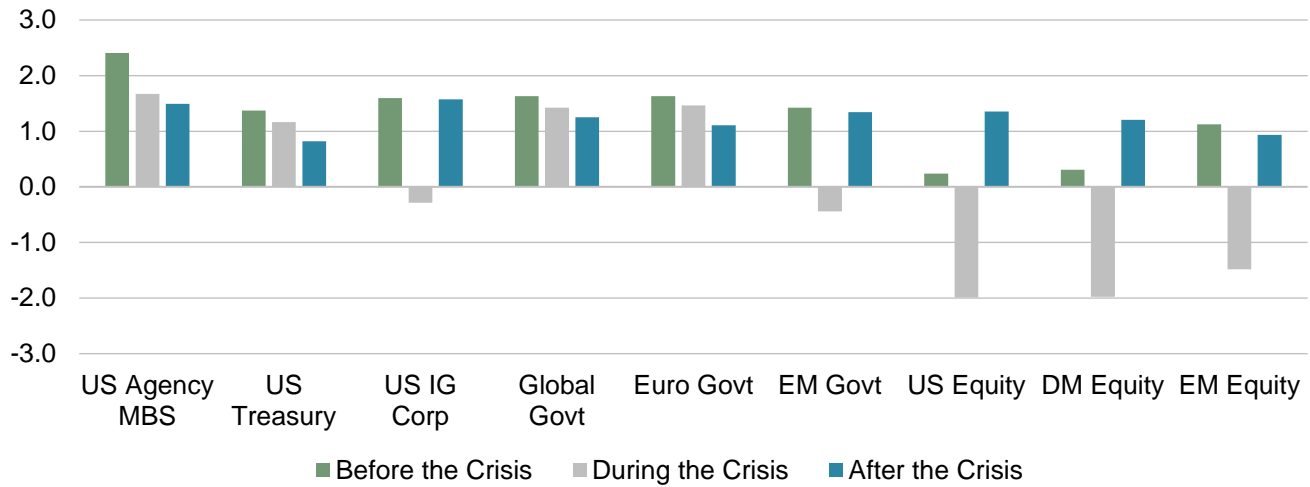
It is interesting to compare the performance of the US Agency MBS to other asset classes during the financial crisis of 2008/09, especially since US Non-Agency MBS were at the center of this event.

- US Agency MBS delivered annualized risk-adjusted performance ratio of 1.67 during the crisis (January 2008 – February 2009), followed by the European government bonds (1.47), global government bonds (1.42) and US Treasuries (1.17), while other analyzed asset classes delivered negative returns (Figure 13).

⁴ “Optimal Portfolios with Mortgage-Backed Securities”, Bernhardt, Kolbe and Zagst (2013)

- Performance of the US Agency MBS was also the strongest before the crisis (June 2000 – December 2007) and marginally outperformed by US IG Corporate after the crisis (March 2009 - May 2019).

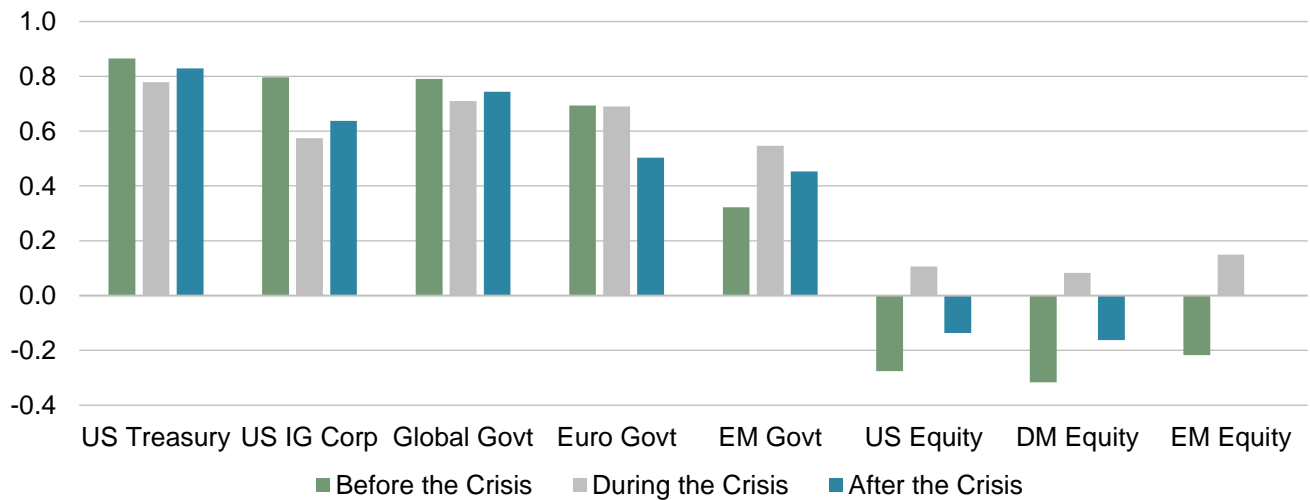
Figure 13. Risk-adjusted performance ratio: before, during and after the 2008 crisis



Source: FTSE Russell. Data from June 2000 to June 2019. Past performance is no guarantee of future results. Data for US Agency MBS, US Treasury, US IG Corporate, Global Government, Euro Government, EM Government, US Equity, DM Equity, EM Equity based on USBIG Mortgage Sector, USBIG Treasury Sector, USBIG Corporate Sector, WGBI, EMU Government Bond Index, Emerging Markets USD Government Bond Index, FTSE USA, FTSE Developed, FTSE Emerging Indexes. Please see the end for important legal disclosures.

In terms of correlation with major asset classes, Figure 14 shows that during the crisis MBS correlation versus equities turned marginally positive before becoming negative again (zero vs EM equity). Correlation versus the European and EM government bonds decreased substantially after the crisis: From 0.69 to 0.50 and 0.55 to 0.45, respectively.

Figure 14. US Agency MBS correlation: before, during and after the 2008 crisis

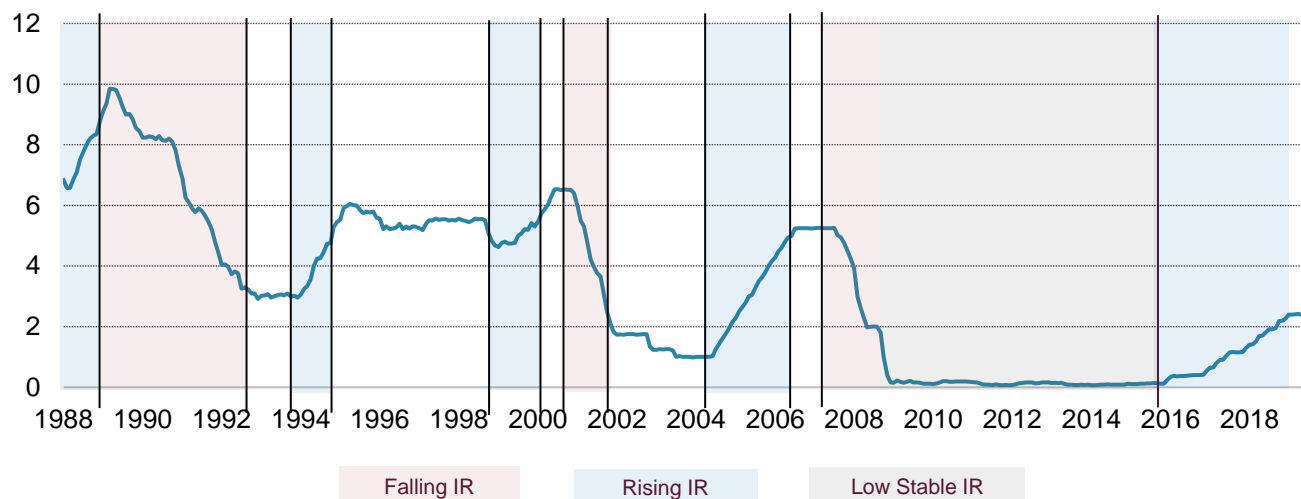


Source: FTSE Russell. Data from June 2000 to June 2019. Past performance is no guarantee of future results. Data for US Agency MBS, US Treasury, US IG Corporate, Global Government, Euro Government, EM Government, US Equity, DM Equity, EM Equity based on USBIG Mortgage Sector, USBIG Treasury Sector, USBIG Corporate Sector, WGBI, EMU Government Bond Index, Emerging Markets USD Government Bond Index, FTSE USA, FTSE Developed, FTSE Emerging Indexes. Please see the end for important legal disclosures.

Behavior in various interest rate environments

Given the substantial change in the interest rate and economic regime since 2008/09 and the accompanying quantitative easing programs, it is also important to assess the performance of mortgage-backed securities in different interest rate environments, not least because of the sensitivity of prepayments to the interest rate levels. Figure 15 shows the evolution of the federal funds rate (the interest rate at which depository institutions trade federal funds with each other overnight⁵) over the past 30 years, broken down into periods of rising and falling rates.

Figure 15. Effective federal funds rate evolution



Source: Board of Governors of the Federal Reserve System (US), Effective Federal Funds Rate [FEDFUNDS], retrieved from FRED, Federal Reserve Bank of St. Louis. Data as of June 2019.

And Table 4 demonstrates the risk-adjusted performance of the US Agency MBS relative to US Treasuries during rising and falling rates, including a prolonged period of low rates. It is worth noting that the last two periods (Jan 09 - Nov 15 and Dec 15 - Apr 19) fall under the new monetary policy regime (QE program).

Table 4. Performance of the US Agency MBS in various interest rate environments

	Rising	Falling	Rising	Rising	Falling	Rising	Falling	Low Stable	Rising
	Mar 88 Mar 89	Apr 89 Dec 92	Jan 94 Apr 95	Jan 99 Jul 00	Nov 00 Jan 02	Jun 04 Aug 06	Jul 07 Dec 08	Jan 09 Nov 15	Dec 15 Apr 19
Monthly Risk-Adjusted Return									
US Agcy MBS	0.26	0.93	0.24	0.41	1.00	0.55	0.63	0.49	0.27
US Treasury	0.23	0.71	0.12	0.20	0.53	0.31	0.70	0.18	0.15
Relative	0.03	0.22	0.13	0.21	0.48	0.24	-0.06	0.30	0.12

⁵ <https://fred.stlouisfed.org/series/FEDFUNDS>

Source: FTSE Russell. Data from March 1988 to June 2019. Return and risk in local currency terms, unhedged. Risk-Adjusted Return calculated as Return over Standard Deviation. Past performance is no guarantee of future results. Data for US Agency MBS, US Treasury based on USBIG Mortgage Sector, USBIG Treasury Sector. Please see the end for important legal disclosures.

- US Agency MBS outperformed Treasuries in most regimes.
- The strongest performance was from November 2000 to January 2002, when the federal funds rate fell sharply from over 6% to under 2% and the US Agency MBS delivering relative monthly risk-adjusted performance of 0.48.
- The second strongest period was during very low but stable interest rate environment from January 2009 to November 2015, with relative risk-adjusted performance of 0.30.
- And the only period of underperformance versus US Treasuries was July 2007 – December 2008, when the federal funds rate fell from over 5% down to just above 0%, resulting in -0.06 relative risk-adjusted performance.

Security selection

Another feature of the mortgage-backed securities market is its depth and breadth, which makes it attractive for active managers from a security selection point of view. Various types of MBS instruments (like CMOs and CRTs), as well as market dislocation and arbitrage opportunities, give active managers the flexibility to express their views and exploit opportunities.

The CMO market developed in the 1980s brought a whole new range of instruments to investors – fixed and floating-rate CMO bonds, various maturity and prepayment profiles, planned amortization class (PAC) bonds, which essentially remove prepayment risk and provide stable cash flows, targeted amortization class (TAC) bonds, which offer one-sided protection (either against contraction or extension risk), principal only (PO) and interest only (IO) tranches.

For example, sequential-pay structure gives investors an opportunity to buy the short, intermediate or long-term cashflows of the underlying collateral. Investors with a greater appetite for yields can purchase support tranches, while those averse to prepayment risk can buy targeted amortization classes or planned amortization classes, which reduce call risk or protect from call and extension respectively.

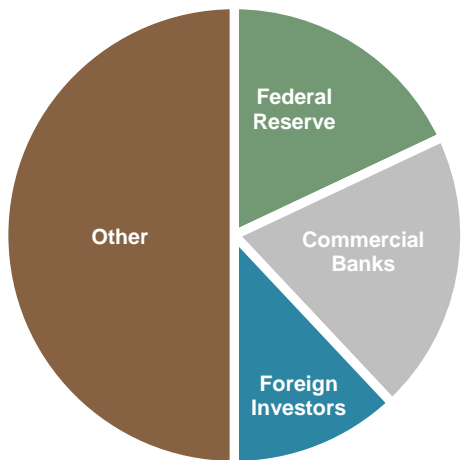
More recently (in 2013), Credit Risk Transfer (CRT) securities have been introduced, which shift a portion of the credit risk away from the GSEs (Fannie Mae and Freddie Mac) to private investors. These securities involve senior/subordinate structure and offer exposure to various tranches with very distinct risk and return profiles. The CRT program has become very popular, as it gives investors an opportunity to gain exposure to residential mortgage credit risk. Moreover, it created a market for pricing and trading this risk.

US Agency MBS ownership: domestic versus foreign investors

Overall foreign ownership

Domestic investors dominate the US agency debt market, with the Federal Reserve and commercial banks being the largest players – around 40% combined (Figure 16). Other category includes mutual funds, money market and pension funds, broker/dealers etc.

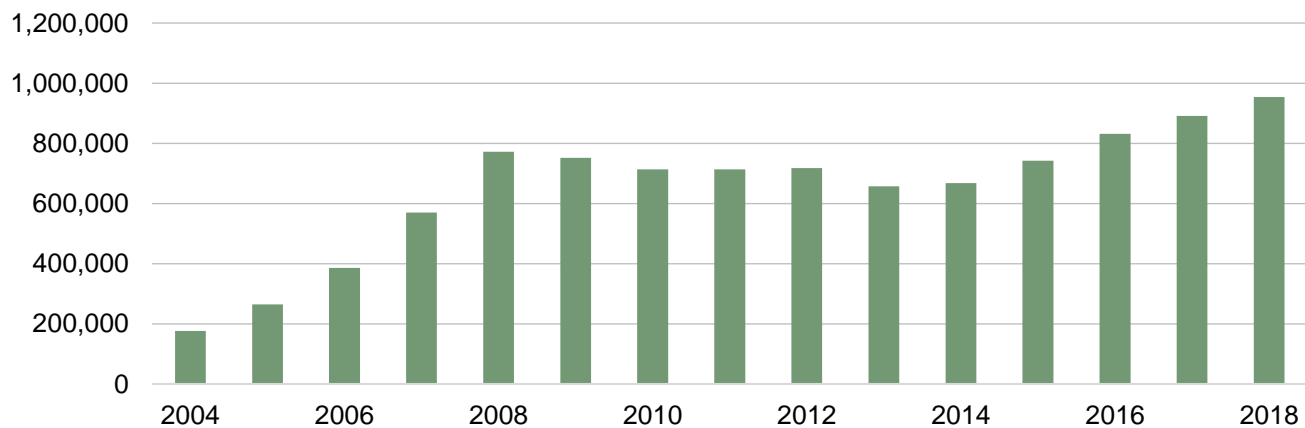
Figure 16. US Agency debt ownership breakdown



Source: Global Markets Analysis Report: A Monthly Publication of Ginnie Mae’s Office of Capital Markets. Data as of March 2019.

Foreign demand has grown substantially over the past decade – from \$176 billion in 2004 to \$953 billion in 2018 (Figure 17). However, foreign investors own only 15.4% of the total US Agency MBS outstanding amount as of Q1 2019 (up from 5.4% in 2004)⁶.

Figure 17. Volume of US Agency MBS owned by foreign entities



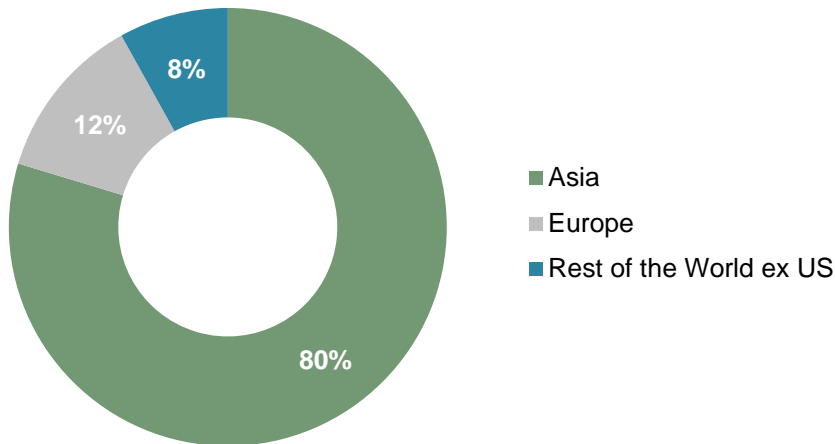
Source: US Treasury International Capital data. Data as of June 2018.

⁶Source: Global Markets Analysis Report: A Monthly Publication of Ginnie Mae’s Office of Capital Markets. Data as of March 2019.

Foreign ownership by region

Looking at foreign ownership on a regional basis, Asian countries have collective exposure of 80% to US Agency MBS, while Europe and the Rest of the World ex US own only 12% and 8% respectively (Figure 18).

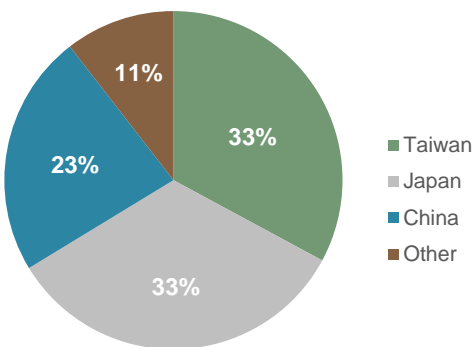
Figure 18. Regional breakdown of foreign US Agency MBS investors



Source: US Treasury International Capital data. Data as of June 2018.

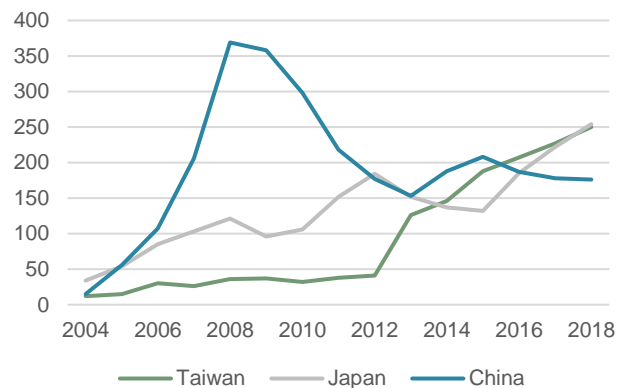
Further country level analysis of foreign investors reveals a high ownership concentration: only three countries in Asia (Taiwan, China and Japan) account for 89% of the region's total US Agency MBS ownership (Figure 19), with Taiwan and Japan rapidly increasing their share in recent years (Figure 20).

Figure 19. US Agency MBS ownership by Asia: country breakdown, %



Source: US Treasury International Capital data. Data as of June 2018.

Figure 20. US Agency MBS ownership by Asia: top 3 countries, \$mil



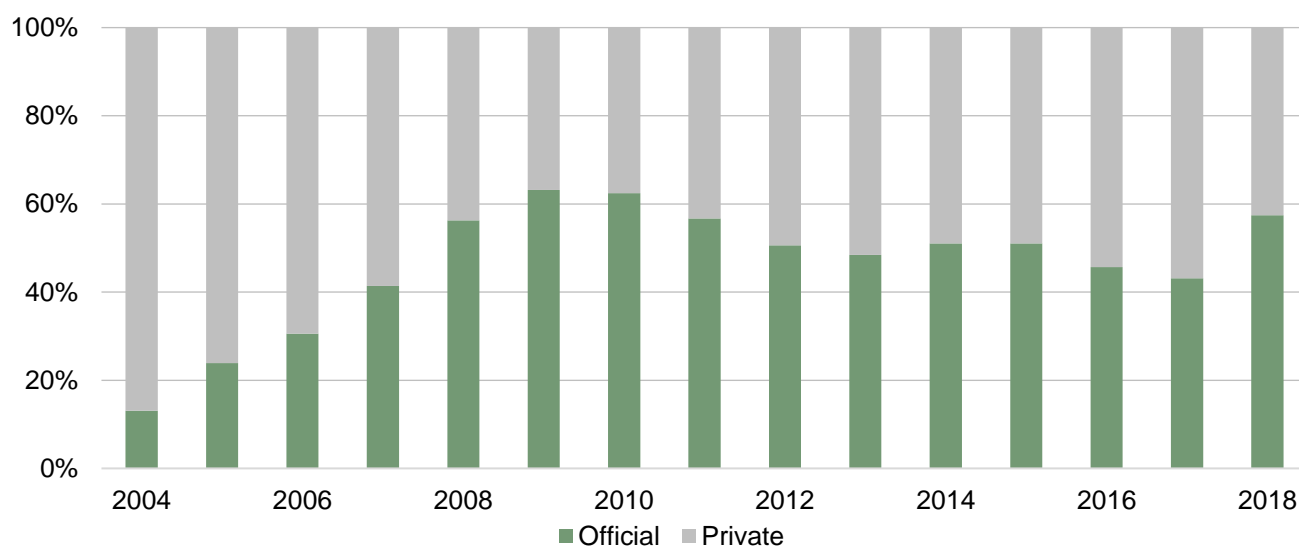
As for the US Agency MBS ownership in Europe, around 70% is concentrated in the major banking and financial centres – Luxembourg, Ireland and Switzerland – where many funds are domiciled.

Dominance of Asian investors has not always been the case. In 2003, Europe accounted for 46% of the overall foreign ownership, followed by the Rest of the World ex US (29%) and then Asia (25%). However, over the past decade, Asian economies have significantly increased their demand for foreign assets (including US Agency MBS), helped by rising current account balances and growing foreign-exchange reserves.

Foreign ownership by type

Finally, we look at the evolution of owner type. In the early 2000s, private entities were the main investors, owning around 87%, while official institutions only held 13% (Figure 21). The picture changed by 2009 with official institutions owning over 60%, mainly driven by the growth in China's official holdings. This number has gradually declined to about 45% in 2016-2017, however has picked up to 57% in 2018⁷.

Figure 21. US Agency MBS ownership: official versus private investors



Source: US Treasury International Capital data. Data as of June 2018.

Challenges for foreign investors

Despite the potential diversification benefits and attractive yields, many foreign investors do not have exposure to US Agency MBS in their fixed-income portfolios. We try to understand the reasons from the perspective of foreign investors.

A number of explanations are offered, with the following commonly cited by market participants:

- Perceived complexity of the asset class and computational burden associated with its analysis;
- The role of US MBS in the 2008 financial crisis;
- The US Federal Reserve's influence on the market.

⁷Source: US Treasury International Capital data. Data as of June 2018.

Perceived complexity and computational burden

In an early study of the MBS market in 1987, Christiansen and Elebash assessed investors' attitude towards mortgage-backed securities, mainly focusing on pension funds. According to this survey, the majority of investors chose not to invest in MBS instruments due to their perceived complexity, in particular because of their indefinite maturities and lack of call protection⁸.

The MBS market has become a very large segment of the fixed-income universe. However, there is a low uptake by international investors for exactly the same reasons. The lack of familiarity with the asset class and its unique characteristics add to the problem.

The computational burden associated with the inclusion of mortgage-backed securities into portfolio optimization processes, their valuation and risk management, all introduce extra challenges. This requires wide security coverage; complex interest-rate and prepayment models, accounting for interest-rate evolution and cash-flow uncertainty embedded into MBS; and a powerful calculation engine that will produce meaningful analytics on large portfolios.

Firms with a global presence tend to manage their US Agency MBS exposure in the US-based offices, due to easier access to the local market's expertise and information.

Often, US Agency MBS exposure is implemented via TBAs, which substantially reduces computational burden and in-depth analytical needs.

Yield Book, a well-known and widely used analytical platform backed by decades of experience and expertise in the mortgage-backed securities space, offers a solution to this problem. The option-adjusted model provides investors with an in-depth analysis across various types of MBS, based on robust term structure and prepayment models, which will consider all possible interest rates scenarios and their implications.

A comprehensive set of analytics, produced by Yield Book models, can then be applied to inform the investment decision making process and efficient risk management.

The role of US MBS in the global financial crisis

More recently, the role of mortgage-backed securities in the financial crisis of 2008 appears to have created a negative perception of the asset class as a whole. This is despite the fact that the primary catalyst was actually the Non-Agency Residential Mortgage-Backed Securities (RMBS) segment, backed by lower credit-quality mortgages, that collapsed with deteriorating economy and housing market conditions. Spreads widened alike for both Agency MBS and Non-Agency RMBS, but the effect on the former was much more modest. As a result, investment returns of Agency MBS continued to grow from 2008, while the Non-Agency RMBS segment suffered until late 2009⁹.

⁸ "A Note On the Attitude of Pension Fund Investment Managers towards Mortgage-Backed Securities," Christiansen and Elebash (1987)

⁹ "The Handbook of Mortgage-Backed Securities," Fabozzi (2016)

Notwithstanding this, significant effort has been put into reshaping the US securitized market over the past 10 years. Post-crisis investigation revealed a number of areas, which require improvements and tighter regulations, including greater insight into the process of securitization of loan pools, alignment of incentives among various parties involved, MBS valuation challenges in stressed market conditions and the role of credit rating agencies.

The Dodd-Frank Act was passed by the US Congress in 2010 to improve market transparency and due diligence analysis, and limit potential conflict of interests by putting restrictions on participants of the securitization process.

In 2014, the SEC published Regulation AB-II and introduced greater disclosure requirements into the private-label market, aimed at providing more transparency to investors.

Moreover, the Single Security initiative went live in June 2019, aimed at introducing a Universal Mortgage-Backed Security (UMBS) and combining the TBA markets of the GSEs. It is an important change, which is establishing a single and even more liquid market for Fannie Mae and Freddie Mac securities, with standardized disclosures and structures.

The Fed's influence on the market

In addition, some investors are concerned about the US Federal Reserve's influence on the MBS market over the past decade, as a result of the US Fed's quantitative easing (QE) program put in place after the crisis to stimulate economic activity.

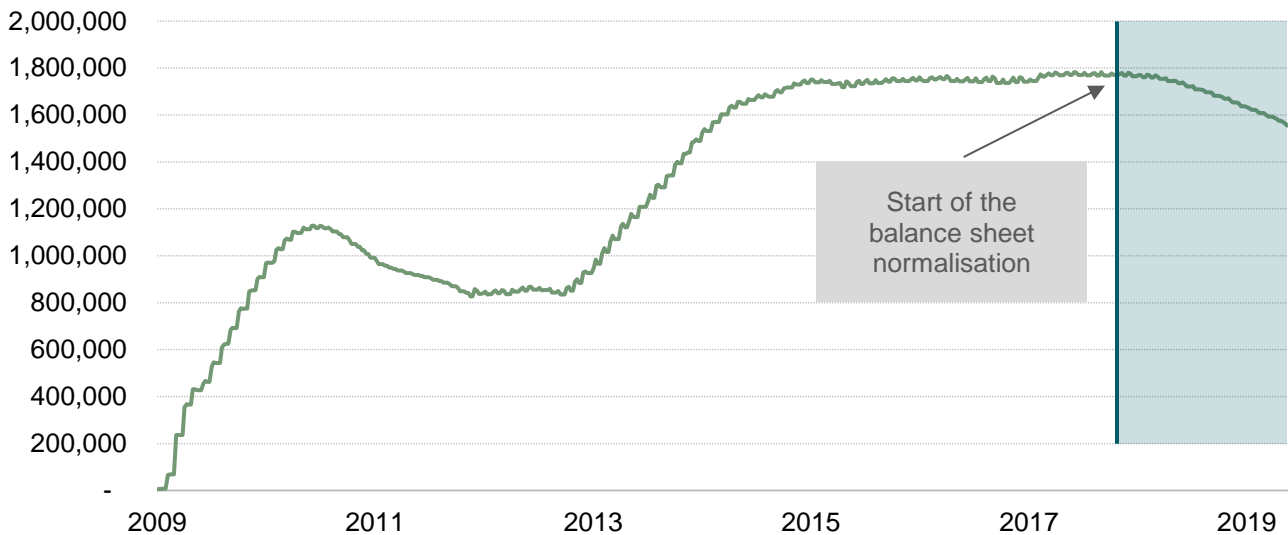
The Fed purchased \$1.25 trillion worth of Agency MBS between January 2009 and March 2010, which grew to nearly \$1.8 trillion in the following years, making the Fed one of the main players in the market.

In October 2017, the Fed began the process of balance-sheet normalization program by reducing its monthly reinvestment into Agency MBS, with the final goal of refraining from any reinvestment activity. This program, expected to result in increased market supply, posed a number question: "How will the market respond to this action?" and "How will the asset class perform in this situation?"

- Since the beginning of this program, the Federal Reserve has been implementing the balance-sheet normalization in a gradual way, with Figure 22 demonstrating a smooth decrease of the Fed's Agency MBS holdings since October 2017¹⁰.

¹⁰ At the conclusion of its July 2019 meeting, the FOMC noted that it would conclude the reduction of its aggregate securities holdings in the System Open Market Account in August, two months earlier than previously indicated.

Figure 22. Agency MBS held by the Fed, \$mil



Source: Board of Governors of the Federal Reserve System (US), Assets: Securities Held Outright: Mortgage-Backed Securities [WSHOMCB], retrieved from FRED, Federal Reserve Bank of St. Louis. Data as of June 2019.

- So far, the Fed's balance-sheet reduction has been absorbed by market participants due to attractive yields on US Agency MBS (Figure 23). Strong US housing market fundamentals and attractive relative valuation (Figure 24) should provide even more comfort to investors.

Figure 23. Yield: US Agency MBS vs Treasury

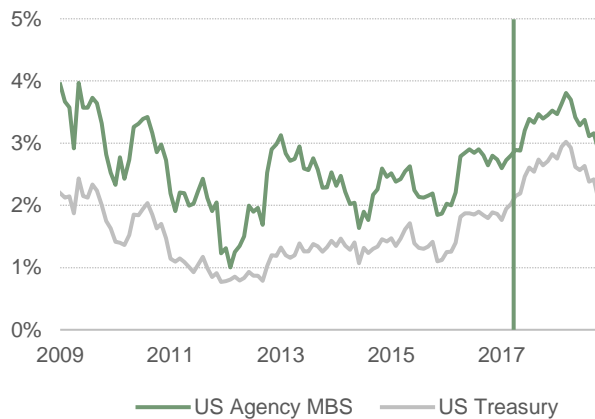
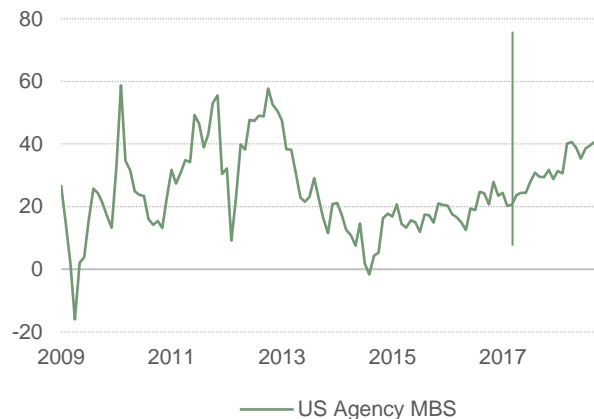


Figure 24. US Agency MBS OAS



Source: FTSE Russell. Data from September 2009 to June 2019. Past performance is no guarantee of future results. Data for US Agency MBS, US Treasury based on USBIG Mortgage Sector, USBIG Treasury Sector. Please see the end for important legal disclosures.

- And Table 5 addresses some potential performance concerns. Since the beginning of the balance-sheet normalization program (Oct 2017), US Agency MBS delivered marginally lower return with significantly lower volatility versus US Treasuries, resulting in a superior monthly risk-adjusted performance (0.33 vs 0.28).

Table 5. Performance of the US Agency MBS during the balance sheet normalization

	Monthly		
	Return (%)	Standard Deviation (%)	Risk-Adjusted Return
US Agency MBS	0.26	0.77	0.33
US Treasury	0.29	1.01	0.28

Source: FTSE Russell. Data from October 2017 to June 2019. Return and risk in local currency terms, unhedged. Risk-Adjusted Return calculated as Return over Standard Deviation. Past performance is no guarantee of future results. Data for US Agency MBS, US Treasury based on USBIG Mortgage Sector, USBIG Treasury Sector. Please see the end for important legal disclosures.

Conclusion

In this paper, we have shown that the US Agency MBS market is a very large and liquid segment of the US fixed-income market. It has a unique feature in prepayment optionality, and negative convexity, but this has not prevented US Agency MBS from showing favorable risk-adjusted performance throughout the global financial crisis and in various interest rate regimes. In addition, low correlation with risky assets may offer diversification benefits from a portfolio construction point of view.

The ownership analysis shows that a strong majority of US Agency MBS are held by domestic entities, as foreign investors only account for 15% of the total outstanding amount. One of the main reasons for the low share of holdings by foreign investors appear to be the perceived complexity of mortgage-backed securities in terms of modelling, valuation analysis and risk management. Yield Book, a trusted and authoritative source for fixed income analytics, enables investors to perform complex analysis of their portfolios, benchmarks, trading decisions, historical performance, and risk.

Appendix

MBS analysis

The prepayment optionality of mortgage-backed securities requires a modelling approach, capable of capturing the dynamic nature of all inputs and their behavior in various environments.

Option-Adjusted Analysis, pioneered by Salomon Brothers in 1989, has become an essential risk-analytic tool for MBS investors. OAS is similar to that commonly applied to corporate bonds, but also accounts for the variability and optionality of prepayments.

To understand the OAS of an MBS security, there are three essential steps:

1. A term-structure model is chosen to describe the evolution of interest rates over time and simulate hundreds of hypothetical interest-rate paths, including short-term and long-term rates. Short-term rates are important for discounting, while long-term rates are important for prepayment analysis.
2. A prepayment model is applied to every interest-rate path to project prepayments and aggregated to describe the cash flows of the mortgage-backed security.
3. The present values of the cash flows are calculated for each interest rate path, using short-term forward rates plus an option-adjusted spread. This option-adjusted spread is calculated through a number of iterations, as a value which solves for the average of all present values of the MBS equally to its market price.

Prepayment projections are extremely important for mortgage-backed security valuation and analysis. These also depend on a number of factors, such as interest-rate and macroeconomic environments, borrowers' characteristics (demographics, credit scores) and mortgage-specific features (coupon, loan type and age, etc). With so many input variables, the prepayment model needs to be flexible to capture the time-varying nature of key inputs and, at the same time, be based on consistent fundamental assumptions, which can be applied across mortgage types and borrower demographics.

A comprehensive prepayment model should be able to recognize various sources of prepayments and their contributions to the overall prepayment rate. This leads to a modelling framework where each prepayment type is modelled separately and subsequently aggregated into the total projected prepayment rate. This approach is beneficial, as it can be applied to all mortgage types across different regions and countries, and it accounts for the dynamic nature of key input parameters.

The prepayment model, developed by Salomon Brothers in the 1980s, was the first prepayment model in the industry, and has since become the market-wide standard in MBS valuation. This type of models is used by the major US Broker Dealers to support their mortgage trading, daily risk management and regulatory reporting.

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