

# MSCI Agency Fixed Rate Base Prepayment Model

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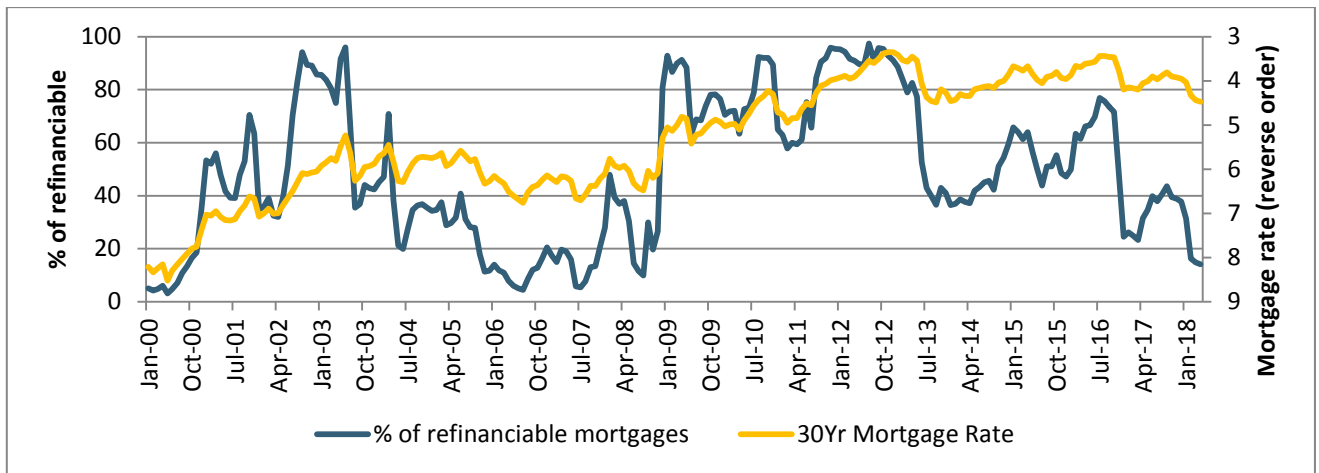
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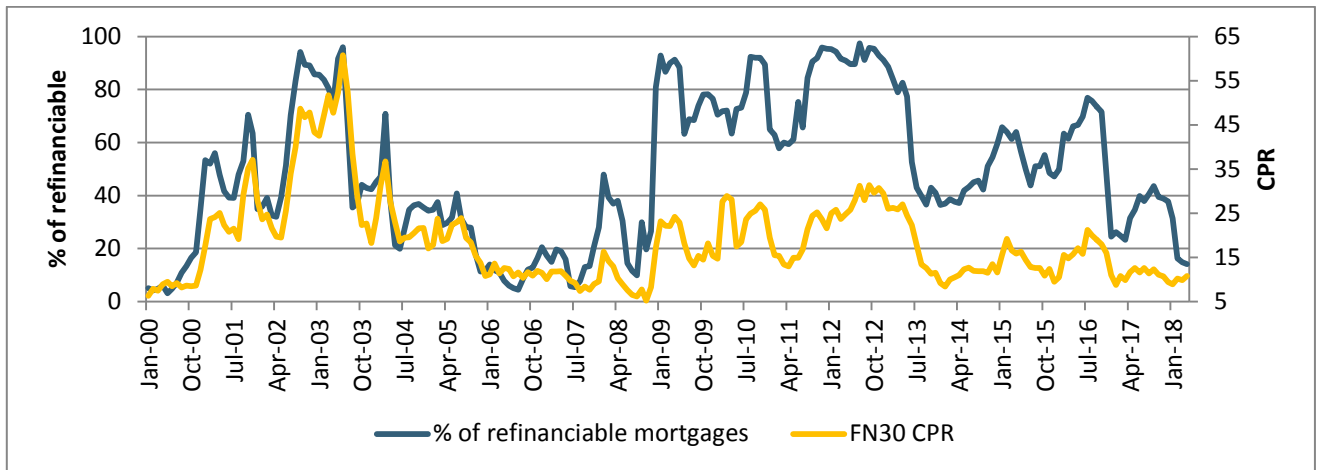
# 1 Summary

Two types of prepayment risk challenge the MBS investor: contraction and extension. Contraction risk arises as prepayment increases, and extension risk occurs when prepayment decreases. Contraction risk had been the dominating concern as the global fixed income market experienced a secular rally for 35 years.

Recently, after the financial crisis, mortgage rates had been dropping as the Federal Reserve acted to boost the economy and ease the financial burden on American households. As the economy and housing price rebound has been solidifying for the past several years, mortgage rates have risen to 4.6% recently from 3.5% in October. This quick rise in rates, combined with several post-2008 refinancing waves, has squeezed the refinancable (i.e., when the current mortgage rate is more than 40 bps higher than the prevailing rate) portion of the mortgage universe below 15%. Extension risk is now on the investor's radar, and this requires a solid understanding of base prepayment speeds. We present a detailed decomposition of base prepayment speed and specifications of our new MSCI agency fixed rate base prepayment model.



Source: Fannie Mae, Freddie Mac, MSCI



Source: Fannie Mae, Freddie Mac, MSCI

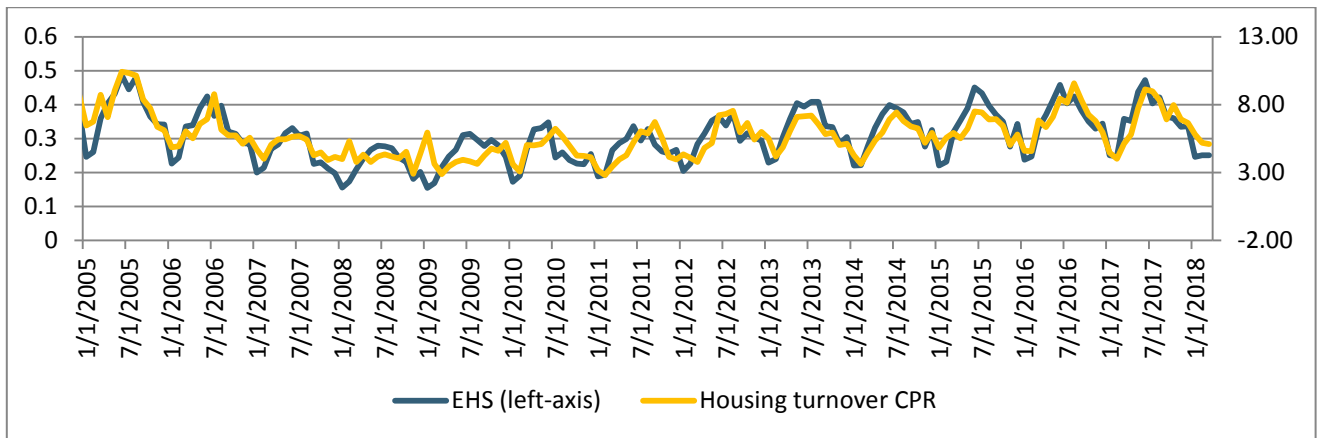


Base prepayment speed consists of **housing turnover**, **cashout**, and **curtailment**. (Rate/term refinance, albeit out-of-money, and WAC dispersion, curve refinance, etc., will be discussed in detail in upcoming articles). The biggest challenge for prepayment speed decomposition is that agencies do not disclose the reason behind the payoff. This poses a great challenge for agency MBS research, and it demands innovative modeling techniques.

## 2 Base Prepayment Model

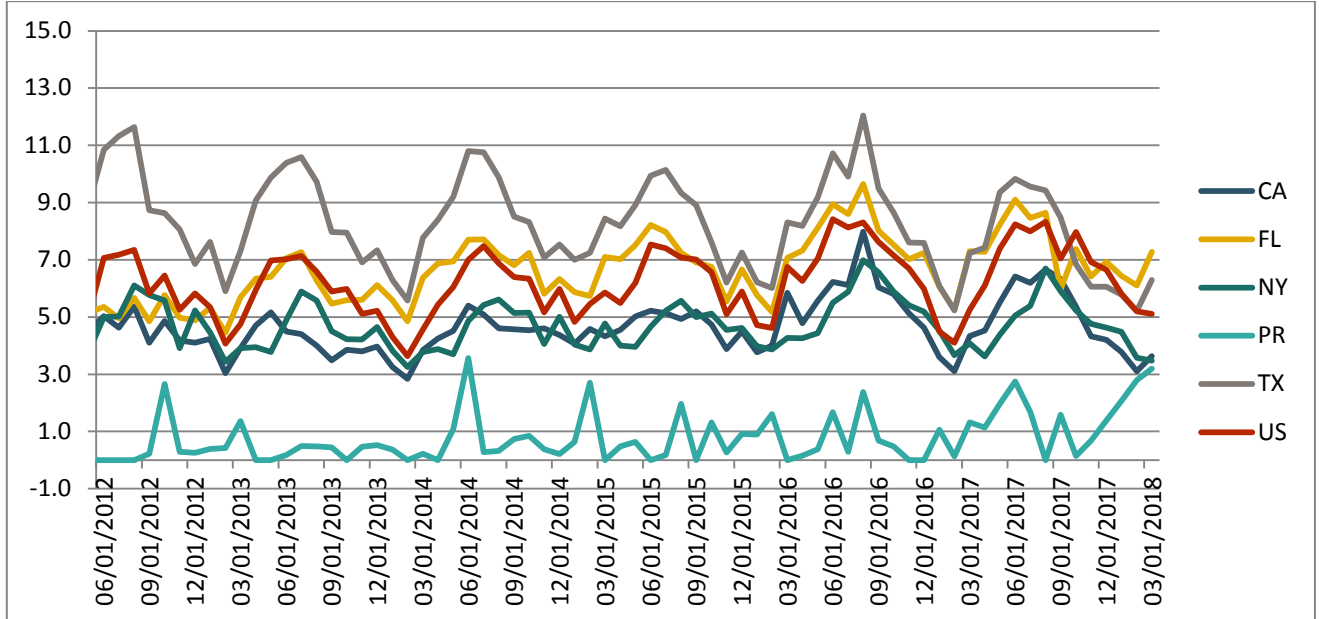
### 2.1 Housing Turnover

Housing turnover is the biggest component of base prepayment speed. When a home is sold, the underlying mortgage will be paid off. We created an algorithm to estimate housing turnover based on a newly originated purchase loan, as a purchase transaction prompts a housing sale. For each month, a total prepayment speed is reported, part of which is due to home sales. Meanwhile, agencies report the purchase percentage among the entire new issuance. With a proper lagging adjustment, we can calculate the amount of paydown based on total CPR, i.e., prepayment CPR due to housing turnover, and purchase percentage. The following exhibit shows the implied housing turnover speeds, overlaid with Existing Home Sales. The housing turnover speeds have been increasing steadily after the financial crisis, blessed by a strong housing price recovery and an economic rebound. We estimate that the current housing turnover speed is 7.5 CPR.



Source: Fannie Mae, Freddie Mac, NAR, MSCI

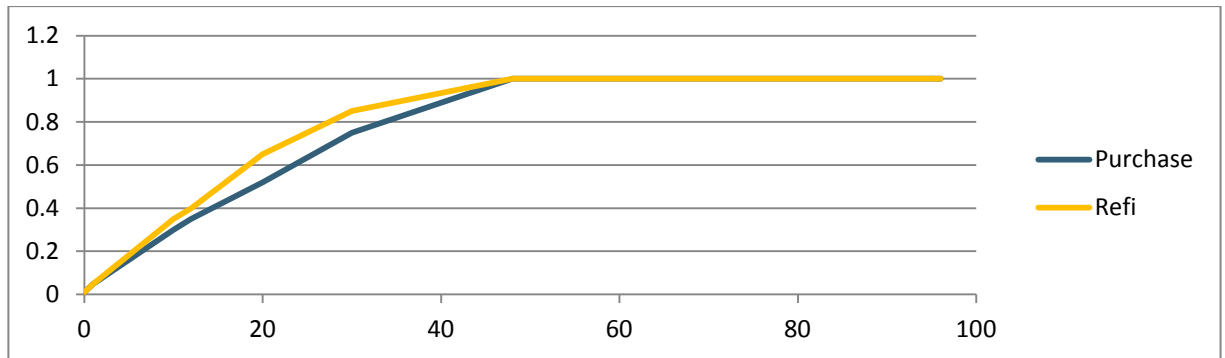
The same algorithm can be extended to build state-level housing turnover models. The exhibit below shows results for several states: TX and FL are traditionally fast states; CA, NY, and PR are on the slower side. This leads to higher values for TX and FL securities. PR pools usually trade at a high premium due to their robust convexity protection, but it is the opposite, due to their slow base speeds, under a discount environment.



Source: Fannie Mae, Freddie Mac, MSCI

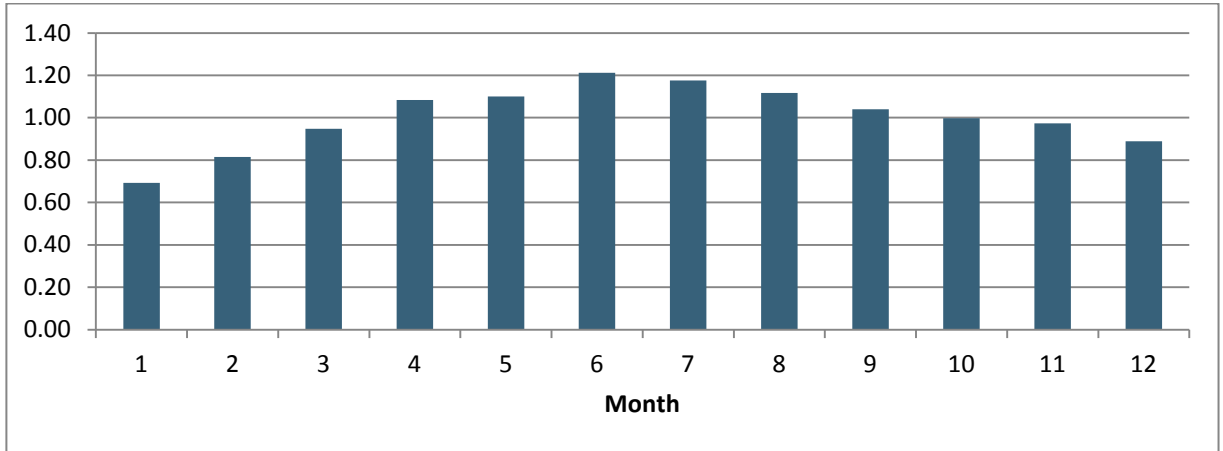
Housing turnover is driven by many factors:

- Age: It is unlikely that borrowers will move shortly after purchasing a new home. We differentiate the age ramp between purchase loans and refinance loans.



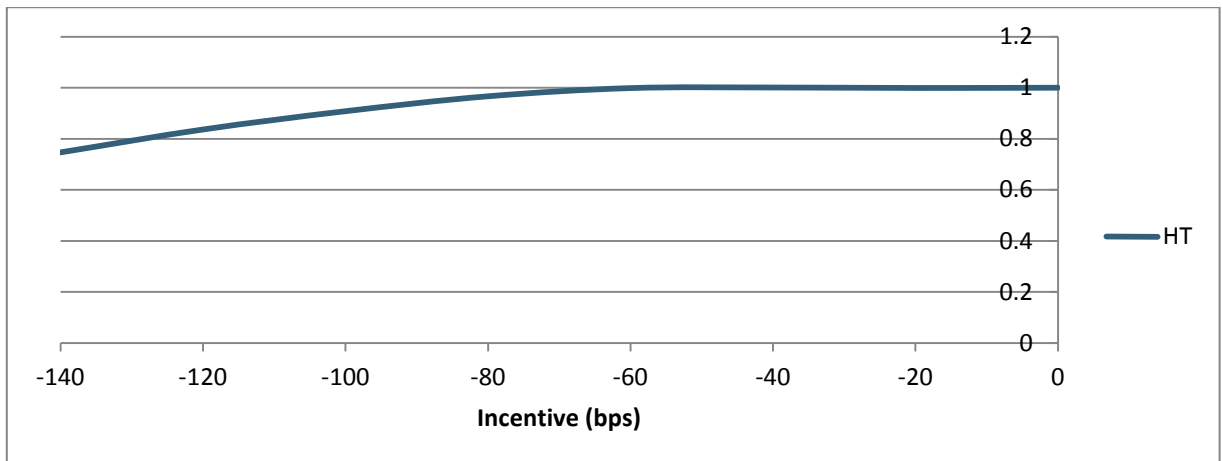
Source: Fannie Mae, Freddie Mac, MSCI

- Seasonality: Housing turnover shows strong seasonality, mostly due to the school calendar. The following exhibit shows the day-count-neutral seasonality for housing turnover.



Source: NAR, MSCI

- Lock-in: Significantly higher prevailing mortgage rates will deter borrowers from moving.



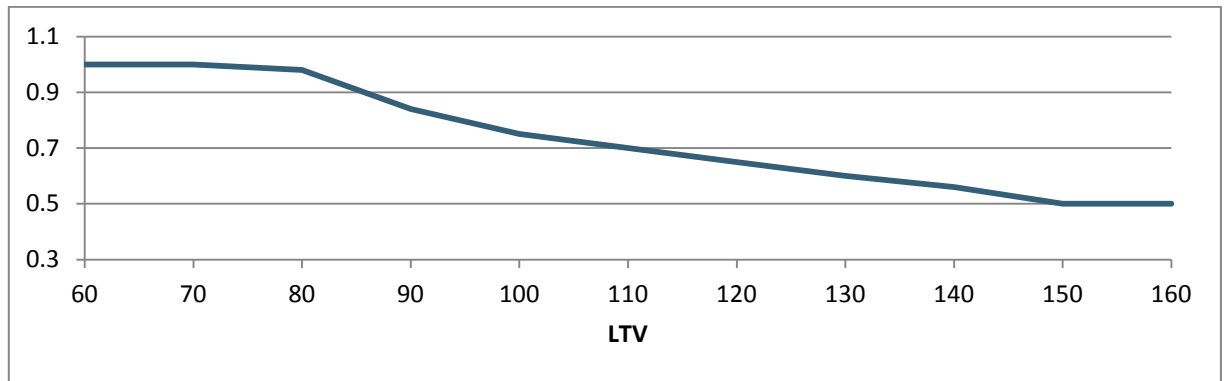
Source: Fannie Mae, Freddie Mac, MSCI

- Geo: Different states show very different housing turnover behaviors. TX and FL are traditionally faster states; CA, NY, and PR are on the slower side. The following table lists the housing turnover multipliers for different states.

State	Mult	State	Mult	State	Mult	State	Mult	State	Mult	State	Mult
AK	1.09	GA	0.93	MD	0.93	NH	0.65	SC	0.93	WV	0.93
AL	1.08	HI	1.09	ME	0.65	NJ	0.93	SD	1.04	WY	1.09
AR	1.08	IA	1.04	MI	1.04	NM	1.09	TN	1.08	GU	0.61
AZ	1.09	ID	1.09	MN	1.04	NV	1.09	TX	1.18	VI	0.61
CA	0.96	IL	1.04	MO	1.04	NY	0.93	US	1.02	PR	0.61
CO	1.09	IN	1.04	MS	1.08	OH	1.04	UT	1.09		
CT	0.65	KS	1.04	MT	1.09	OK	1.08	VA	0.93		
DC	0.93	KY	1.08	NC	0.93	OR	1.09	VT	0.65		
DE	0.93	LA	1.08	ND	1.04	PA	0.93	WA	1.09		
FL	1.12	MA	0.65	NE	1.04	RI	0.65	WI	1.04		

Source: Fannie Mae, Freddie Mac, MSCI

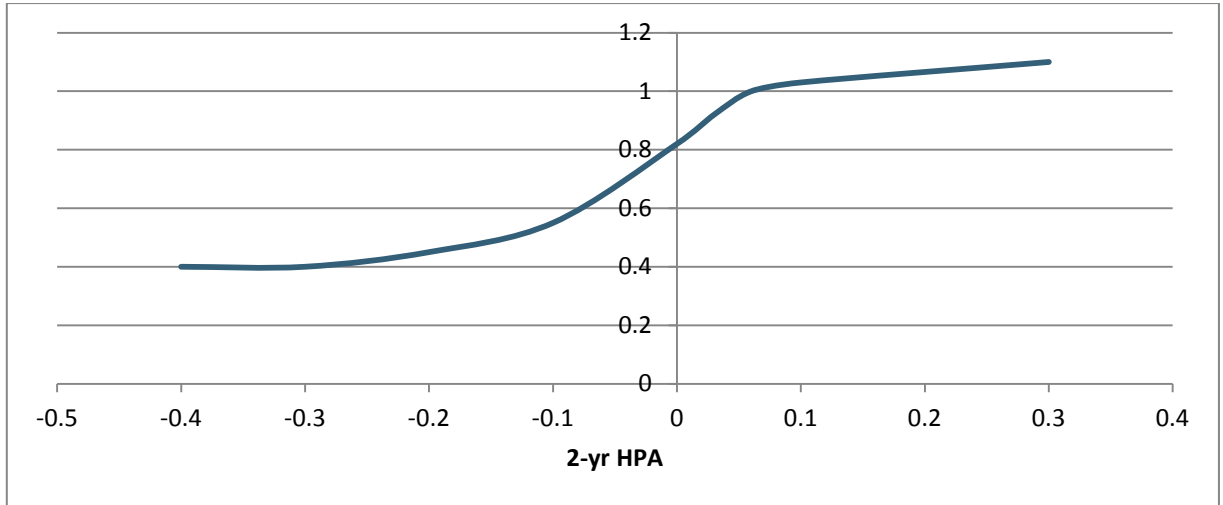
- LTV: Higher mark-to-market LTV hinders the ability of borrowers to move, especially when their loans are under water. We use the FHFA purchase-only housing price index for this purpose.



Source: Fannie Mae, Freddie Mac, MSCI

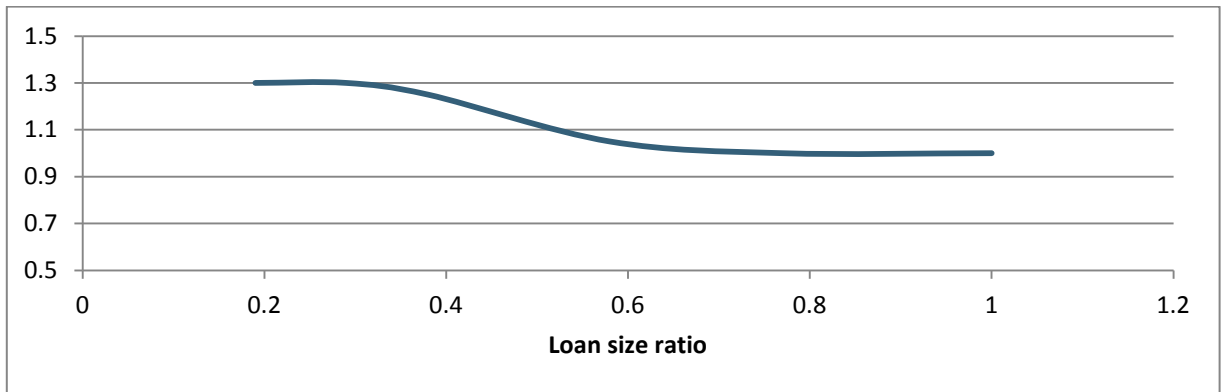


- HPA: There is a strong correlation between HPA and housing sales activity. When the housing market is strong, home sales will be very active, with higher trade-up transactions. When the housing crisis hits Main Street, turnover activity will suffer.



Source: Fannie Mae, Freddie Mac, MSCI

- Loan size: Lower loan size displays faster turnover, as lower loan size has a higher share of first-time buyers, who are more likely to move again to a bigger house. We compute the loan size ratio with respect to each geographic state’s average loan size to account for the housing price difference across different states.

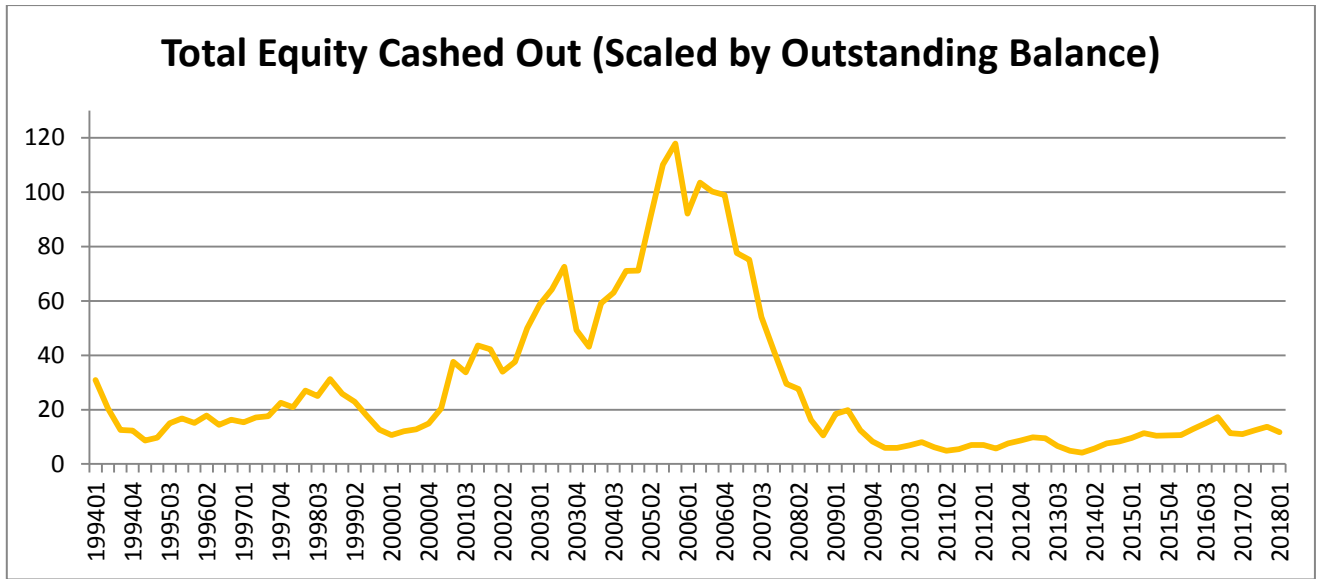


Source: Fannie Mae, Freddie Mac, MSCI

- Occupancy and property types: Second home and investor loans display slightly slower turnover than owner-occupied loans. Borrowers in multi-unit housing tend to stay in the same home a bit longer than those in single-unit housing.

## 2.2 Cashout

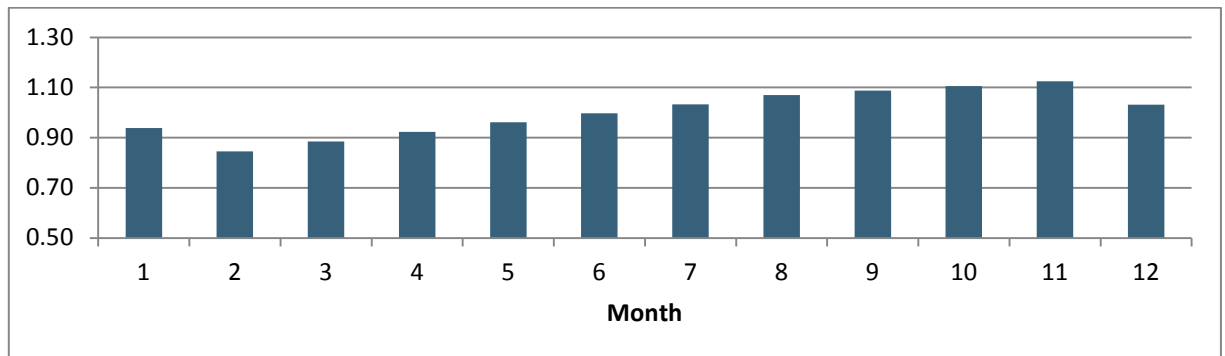
Cashout activity has also been recovering toward the historical average level. The following exhibit shows the total equity cashed out divided by the outstanding balance. We estimate that the cashout contributes about 2 CPR to the current total base speed. Cashout activity is very sensitive to rising mortgage rates. As rates rise, borrowers will choose to utilize other vehicles (HELOC or other closed-end home equity loans), rather than refinance the entire primary mortgage. This creates extension risk on the cashout component.



Source: Fannie Mae, Freddie Mac, MSCI

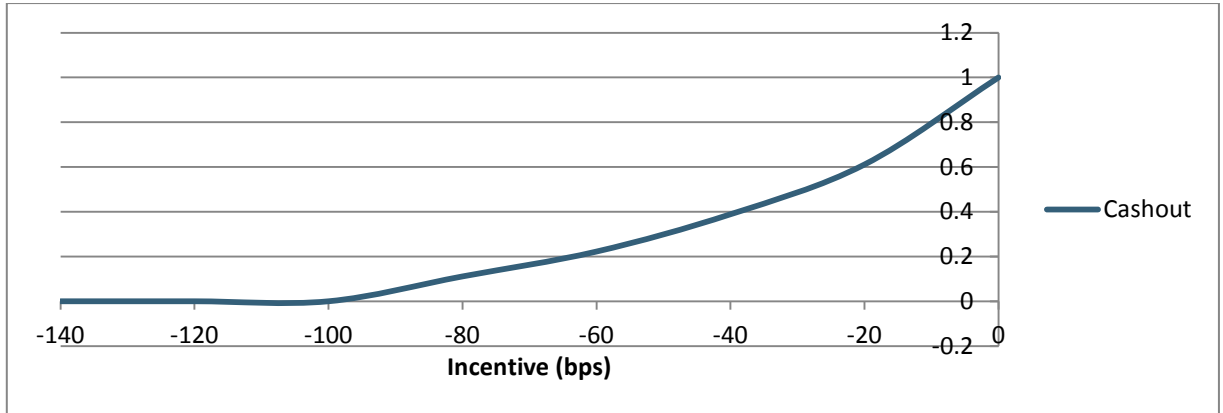
Cashout is driven by many factors:

- Age: Cashout ramps up very fast with controlled LTV, and it then tapers off in the back end, as the cashout propensity burns out over time.
- Seasonality: Cashout activity tends to be higher during the holiday season and lower in the first quarter of the year.



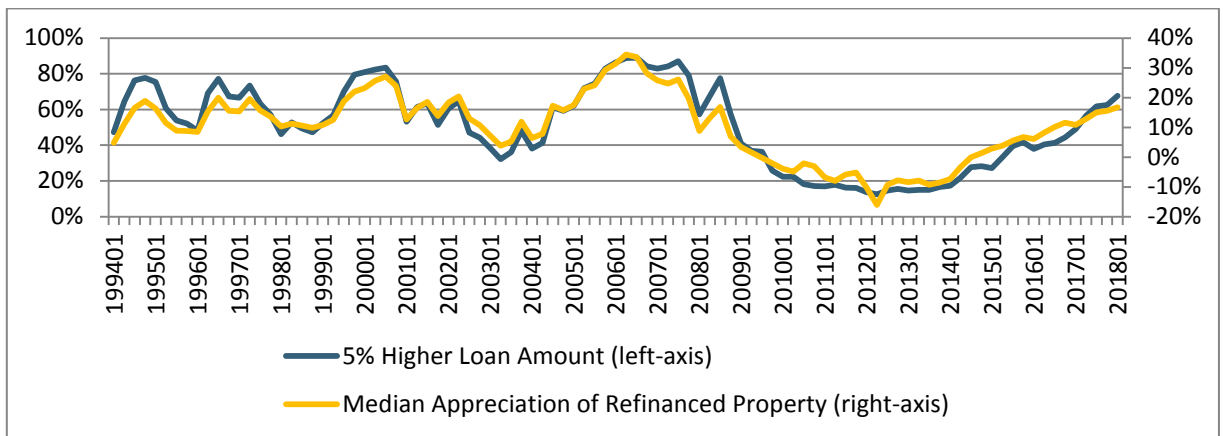
Source: Freddie Mac, MSCI

- Lock-in: Cashout has a strong lock-in effect, as borrowers can choose other borrowing options to tap into their home equity more economically, rather than refinancing the entire mortgage to a higher prevailing rate.



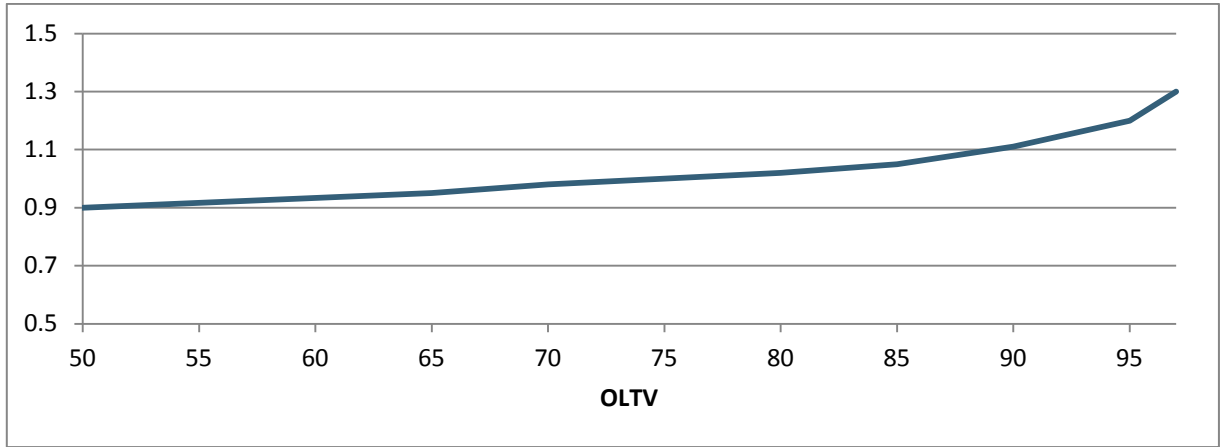
Source: Fannie Mae, Freddie Mac, MSCI

- HPA: Over time, strong HPA builds up home equity for the borrowers to extract. The following exhibit shows a strong correlation between cashout activity and housing price appreciation.



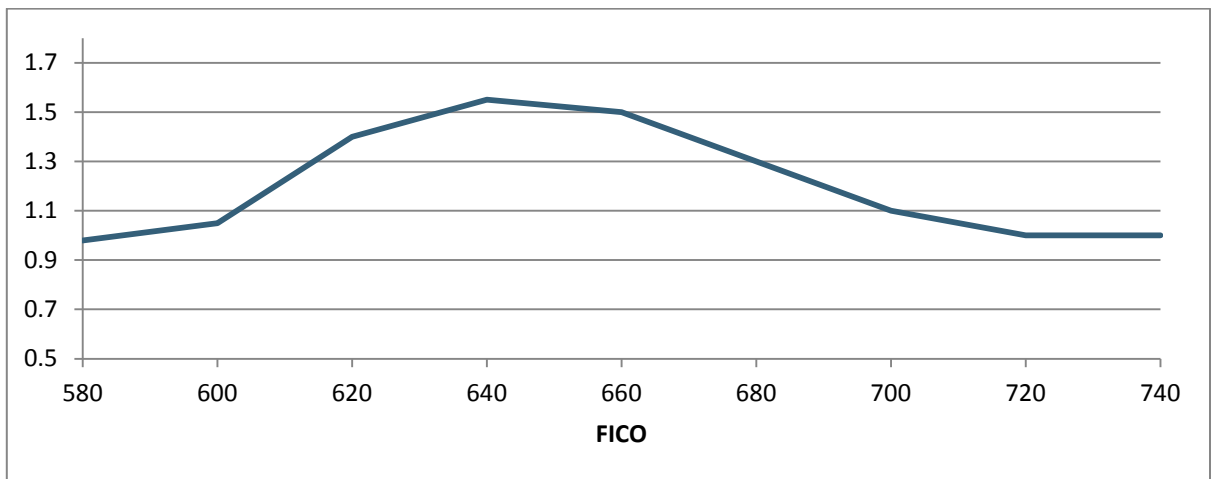
Source: Freddie Mac, MSCI

- **OLTV:** Higher OLTV borrowers are more likely to extract home equity.



Source: Fannie Mae, Freddie Mac, MSCI

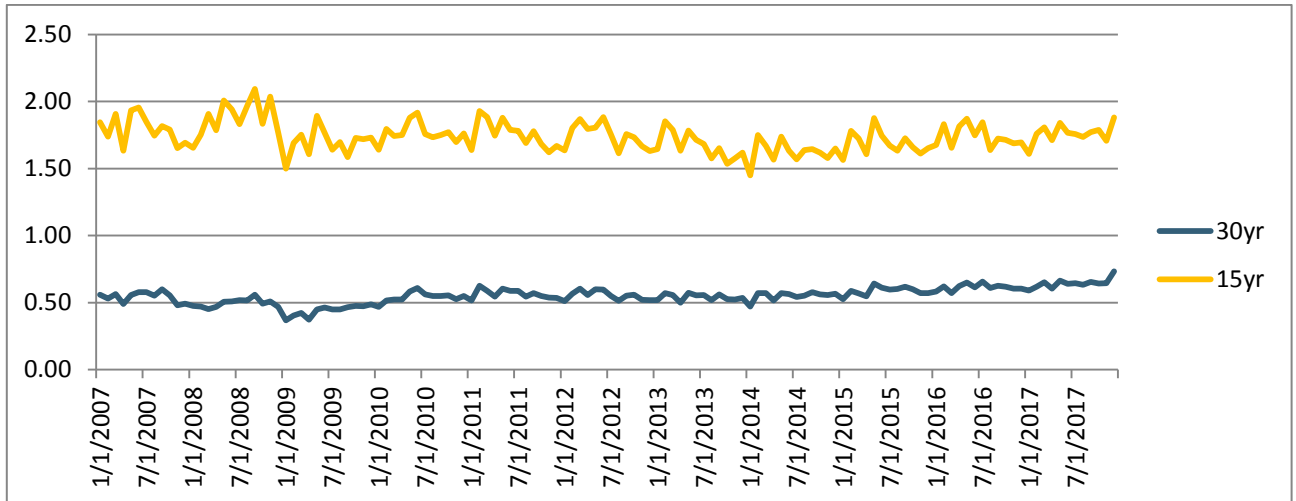
- **FICO:** Mid-range FICO borrowers are more likely to tap into their home equity.



Source: Fannie Mae, Freddie Mac, MSCI

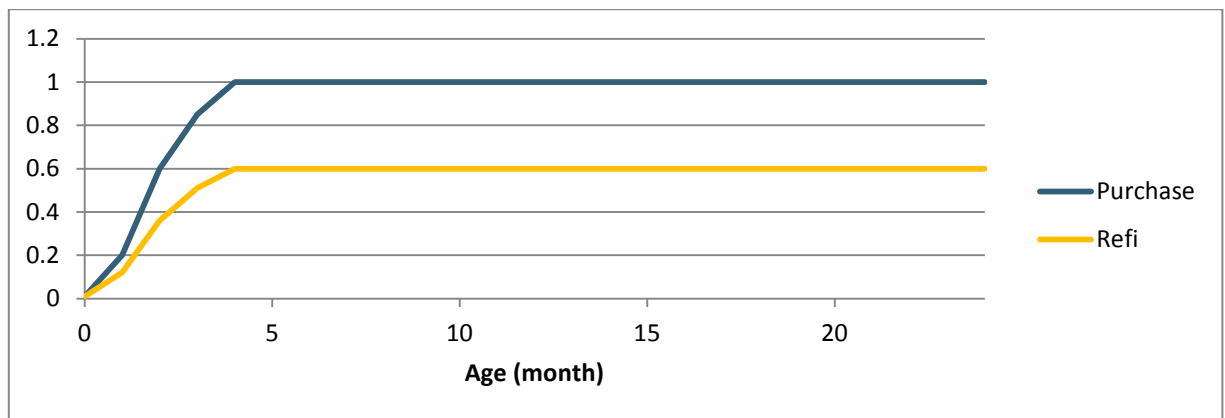
### 2.3 Curtailment

Curtailment occurs when the borrower, motivated by faster equity building, makes a partial payment to bring down the outstanding loan balance. Curtailment is a relatively stable and smaller component of the base prepayment speed. Based on FH loan level data, we can compute roughly 0.5 CPR for 30yr and 1.7 CPR for 15yr.



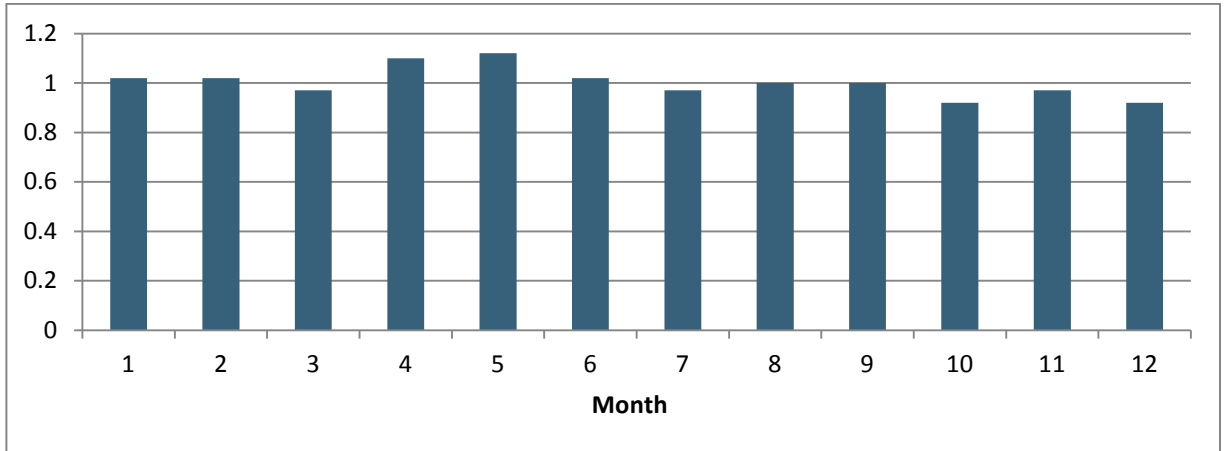
Source: Fannie Mae, Freddie Mac, MSCI

- Age: Curtailment ramps up very quickly, as a large portion of the partial payment is due to biweekly payments from the beginning, instead of monthly payments.



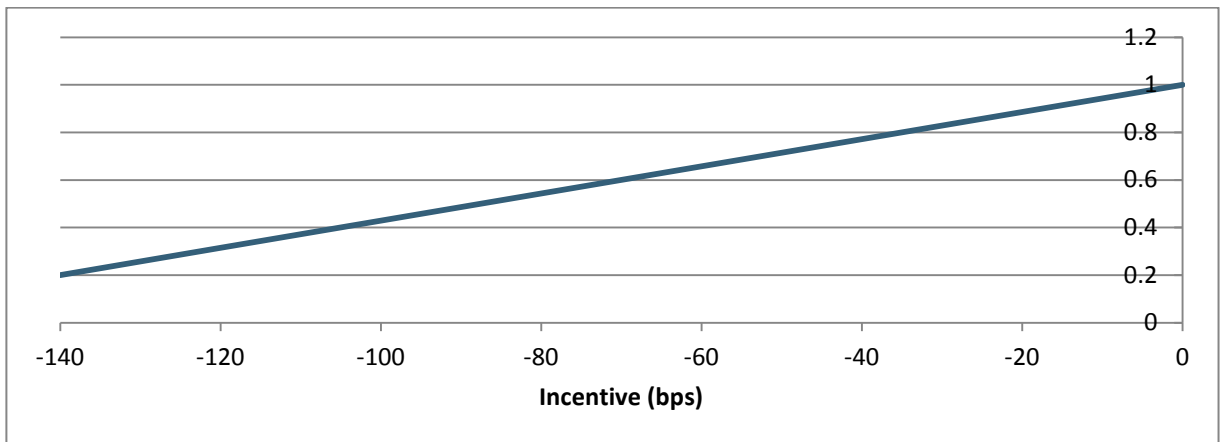
Source: Fannie Mae, Freddie Mac, MSCI

- **Seasonality:** Curtailment shows higher activity around the tax refunds received in the spring.



Source: Fannie Mae, Freddie Mac, MSCI

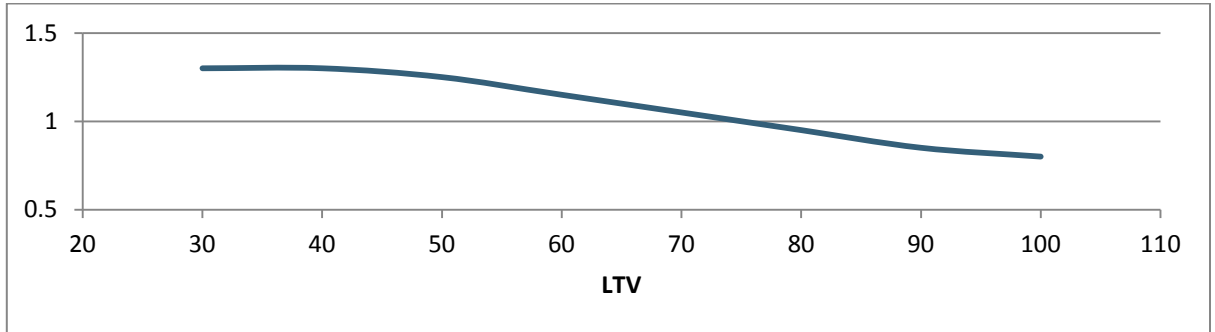
- **Lock-in:** Curtailment generally slows down when rates rise and the opportunity cost becomes high.



Source: Fannie Mae, Freddie Mac, MSCI

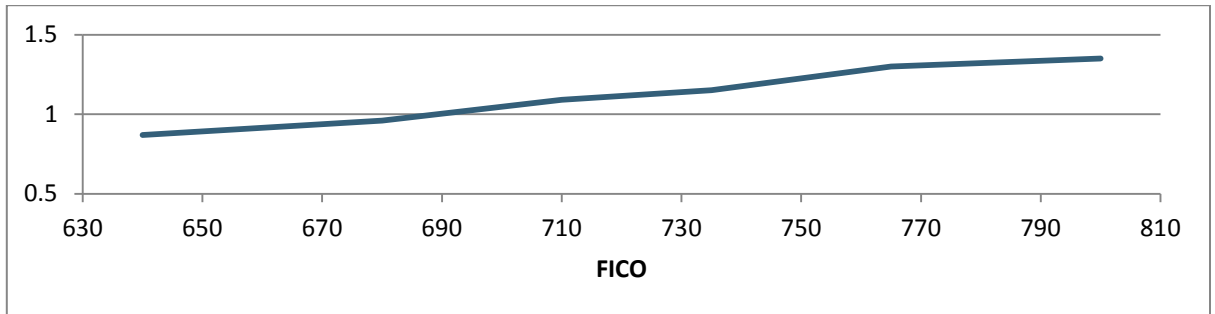
- **Purpose:** Purchase loans are 3 times more likely to curtail than refinance loans.

- **OLTV:** Lower OLTV loans make more partial payments than higher OLTV, as lower OLTV borrowers generally have a stronger desire to build home equity.



Source: Fannie Mae, Freddie Mac, MSCI

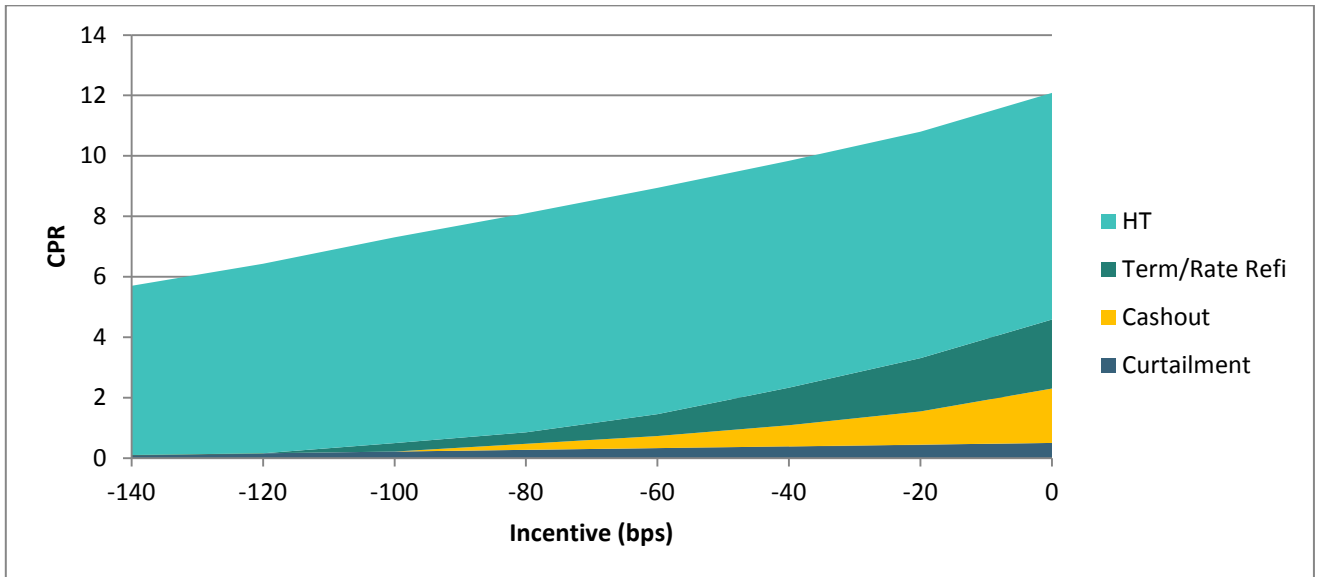
- **FICO:** Higher FICO loans are more likely to curtail.



Source: Fannie Mae, Freddie Mac, MSCI

### 3 Base Prepayment Speed Decomposition

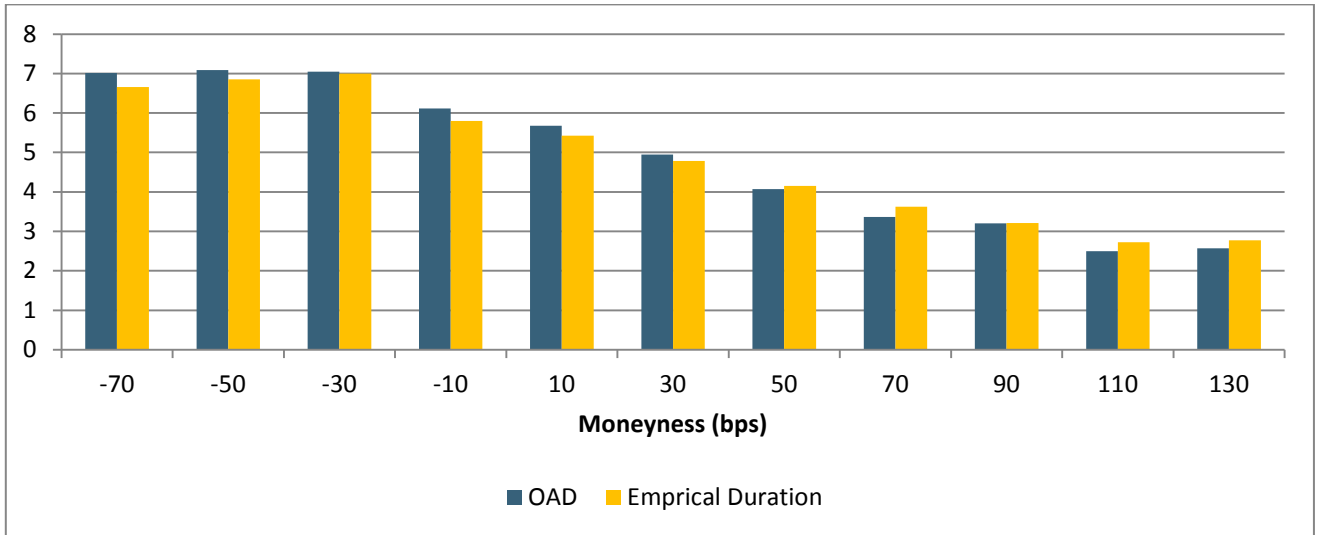
Putting all of the pieces together, the following graph shows the decomposition of the base prepayment speed across different rate incentives. Overall, the total base prepayment speed drops to 6.4 CPR (120 bps out-of-the-money) from 12 CPR (at-the-money). Cashout and rate/term refinance should be dampened quickly as rates rise, while HT stays relatively stable for a mild rise in rates and starts to slow down when the disincentive becomes significant. Curtailment is a relatively small and stable component, showing a moderate lock-in effect. The MSCI Agency Prepayment Model captures these components separately. As the drivers for each component are very different, it is critical to calibrate each component individually and accurately, so the model forecasts can navigate through the ever-changing, multi-dimensional economic sphere.



Source: MSCI



As 85% of mortgages are now in the discount space, and with the expectation of rising rates, extension risk has been a major concern for investors. With our carefully calibrated prepayment model, we can ask how much duration will extend when rates sell off. The following exhibit shows a comparison of empirical duration and MSCI model duration across different moneyness (net coupon – current coupon), based on historical FNCL data since 2012. MSCI model duration tracks the empirical duration very closely. This market-implied information is a strong testimony for our new agency prepayment model.



Source: MSCI

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