Rate Lock Model

Rate lock is a derivative on fixed rate and adjustable rate mortgages. Fallout functions are specified for various types of rate locks, and depend on several factors including source of rate lock and mortgage type. Like the prepayment models, these fallout functions are based on analysis of historical data and these have a significant impact on the risk measures of these rate locks.

Rate locks are specified using various categories upon origination. Additionally, there is a current status that may change daily during the course of the rate lock. Depending on the category and status of the rate lock, a fallout function is applied. This fallout function is supposed to be a measure of how many of these loans will close at expiry. Like the prepayment functions, these are based on historical observations.

In theory, one could specify a different fallout function based on the many combination of category and status. In practice, a smaller number of fallout functions is actually specified.

In order to understand the risk profile of a rate lock, we need to determine a valuation model for them. A rate lock can be viewed as a put option on a mortgage. This is because the borrower has the right but not an obligation to sell the mortgage, and whether or not the mortgagee chooses to sell the loan depends somewhat on mortgage price movements.

There are two reasons not to evaluate these options using a traditional Black-Scholes formula:

• The returns of mortgage prices are not normally distributed. Mortgage price movements experience compression (lower volatility) as prices rise and decompression (higher volatility) as prices fall.

• The exercise of the options by the borrower is not efficient. It is in fact given by the fallout functions discussed earlier. If the exercise was efficient, then all locks would close if the market price decreased (higher rates) and none would close if the market price increased.

Conceptually, the valuation of a rate lock is straightforward. For each rate lock (depending on its status and category), we have a specified fallout function as a function of price changes of the mortgage. The value of the rate lock is given by

$$V = E\left[(P - S)f(P - S)\right],$$

where P is the forward price, S is the strike price and $f(P - S)$ is the fallout function. The strike price is as par (100) plus discount points. Note that for perfectly efficient exercise, this looks like a European option.

A model for the forward price distribution of the mortgages is needed in order to compute this expectation. In order to do this, we will need to evaluate the mortgage forward prices together with their volatilities.

Market prices for the various mortgage drivers are used for different coupons and settlement dates. For example, in the setup used, for a Premier Fixed 30yr mortgage type we had market prices for the current date (9/2/2003) at various settlement dates (9/17/2003, 10/2/2003, 10/17/2003 and 11/1/2003).

There are forward program related to these mortgage driver types, and specific loans are mapped to these forward programs. This allows flexibility to the user as to how specific loans will be sold in the market. This would mean a specific loan can mapped to more than one forward program, and it also allows the user to specify how these decisions are made.

In order to do so, one needs to decide what the appropriate settlement date would be for a loan (or a rate lock closing on certain date). At the forward program level, the user specifies the time lag (in days) for closed to ready, ready to pooled and pooled to delivered. The total time lag from closed to delivered is then used, and the next available settlement date is used.

In some cases, the first available date for the delivery of a closed rate lock will be past the last provided settlement date (i.e. in the current example, this would be later than 11/2/2003). In this case, we need to extrapolate the forward prices at the later settlement dates. The settlement dates beyond the dates listed in the market data input section are again user defined, and in the case we examined appeared to be set in monthly interval past the last listed settlement date. The price drop for these settlement dates is given by

$$D = (W * 100 - rP)\frac{n}{360}$$

where W is the net WAC, P is the market price, r is the appropriate risk-free rate and n is the number of days between settlement dates. For example, for 12/2/2003 settlement this drop should equal a 0.47 from the 11/2/2003 market price, or a market price of 100.8.

A further complication arises if interest carry is included in the mark to market (and therefore price) of the loan. In this case, one must add the accrued interest on the loan to get the appropriate forward price. A user defined warehousing rate is supplied, and the cost of carry is given by

$$C = (W * 100 - r_w P)\frac{n}{360}$$

where W is the net WAC, rw is the warehousing rate, P is the (forward) price of the mortgage and n is the number of days between rate lock expiry and settlement (delivery of loan). In the setup we looked at, rw = 0.33%, although this was being changed to 1.5%.

Finally, the forward price is then

$$F = \frac{1}{D(n)}(P + C)$$

where D(n) is the appropriate discount factor between the current date and rate lock expiry and P is the settlement price.

Reference:
https://finpricing.com/lib/EqBarrier.html