Mortgage Prepayment Analysis - HELOC Retention Marketing Application

Issue:
A large bank is trying to better manage their cash-flows from their mortgage portfolio by trying to identify segments or tranches within their portfolio of consumer loans that have a high probability of closing their loans or using market parlance 'prepay' their loans. They especially wanted to focus on Home Equity Line of Credit or HELOC loans.

Prepayment Analysis
Prepayment analysis is a big part of mortgage analytics, be it pricing, risk or marketing. Mortgage Prepayment Analysis from the Capital Markets perspective is driven by pricing considerations. Whole Loan assets and Mortgage Backed Securities are priced according to the prepayment rate expectations of the underlying individual mortgages. An asset that will prepay faster will be less attractive than one that will prepay slower because prepayment forces the investor to reinvest the principal at a lower rate of return. This is because individual borrowers have a stronger incentive to refinance when interest rates fall. Prepayments can also be due to default in the case of Mortgage Backed Securities, because although the borrower defaults, the security is guaranteed by a Government Agency (Fannie Mae, Freddie Mac or Ginnie Mae) or a non-government Guaranty company. For the purposes of this paper, we will focus on prepayments due to refinance.

From a marketing perspective prepayment analysis is from a customer retention goal. It is important to correctly identify loans that are a refinance risk and try to retain them accordingly. If you do not identify the loans that are at risk of prepayment, these loans will refinance and the lender will lose income. On the other hand if the loan is incorrectly identified as a prepayment risk, then there will be loss due to inefficiency, as the retention offer is usually a lower rate of interest, which will lower income even though the loan was not really a prepayment risk. In both cases Marketing Return on Investment will be lower as direct marketing efforts will be inefficient. This study focuses on a marketing application of mortgage prepayment analysis.

Fig.1 Mortgage Market Process- Investment Perspective

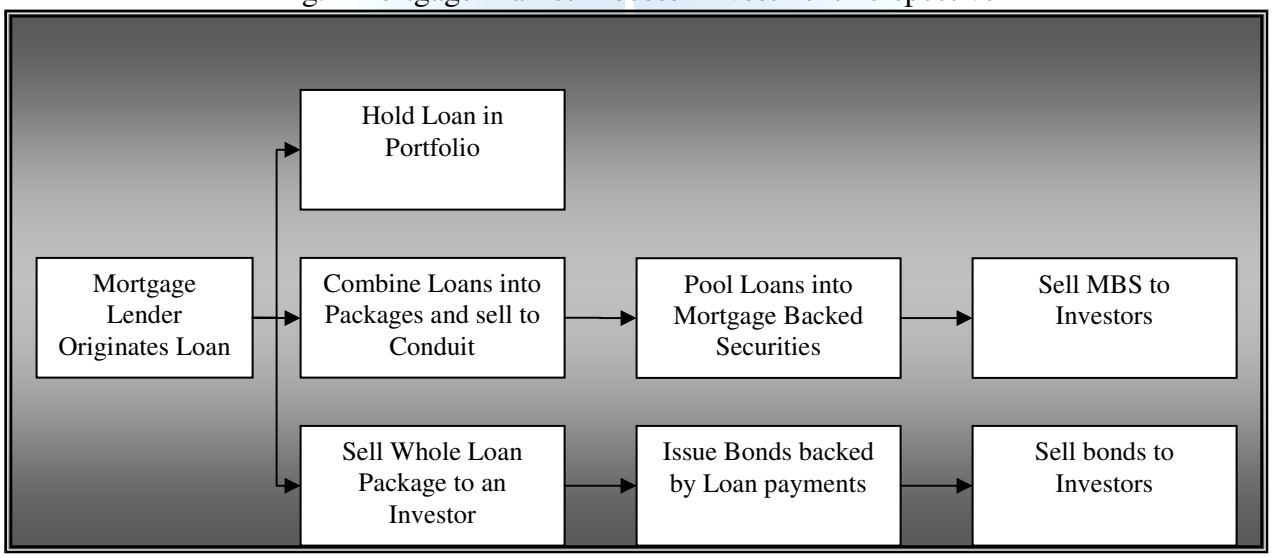
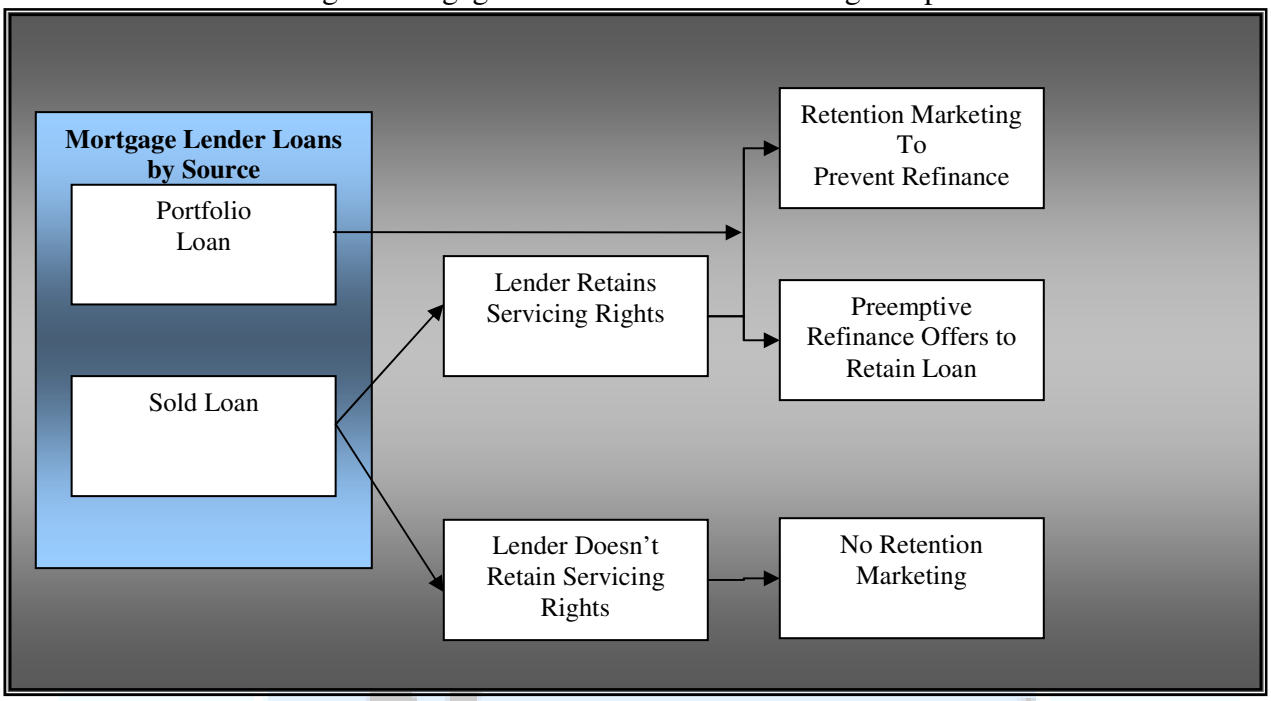


Fig. 2 Mortgage Market Process- Marketing Perspective



Econometric Approaches to Prepayment Modeling

From an econometric viewpoint, Mortgage Prepayment Analysis can be approached either as a survival problem, using a proportional hazards model or as a discrete event, using a logistic regression model. For a complete perspective, including defaults, the discrete logit approach should be Multinomial, to account for 'competing risks', where really there are three options, to not refinance, refinance or default. From a marketing perspective, the problem is binomial- refinance or not refinance.

Unique Characteristics of HELOC Prepayments

Typical mortgage loans are 'first mortgages' because the purpose of the loan is to pay for the purchase of a home. Loans can be for other purposes too, for example to make modifications to an already purchased house with an existing first mortgage or education or other purposes. These loans are called second mortgages (higher degree mortgages are also possible but not common due to the risk associated). Most of these loans are also called Home Equity Loans because the borrower typically uses the paid-off principal or owned 'equity' from the first mortgage as a collateral to secure an additional loan. The equity increases as the borrower pays off greater amounts of the first mortgage off or as the house price appreciates. Basically as the 'Loan-to-value ratio' decreases, equity increases and greater the equity, more that can be borrowed on the second mortgage. Second mortgages can be revolving or non-revolving. Non-revolving loans (Home equity Loans or HEL) are regular loans with a fixed payment amount every month that has a fixed tenure (e.g. 15 years). Revolving loans, also known as a Home Equity Line of Credit or HELOC, are like credit card loans. They have a fixed credit limit that is determined based on amount of built equity and borrower credit history and the borrower can use the account to make periodic withdrawals up to the maximum credit limit or pay off the balance periodically. HELOC prepayments are more difficult to predict because of the open-ended nature of the loan and the flexibility of payments.

The Model:
From a retention and prediction point of view, our client was only interested on whether the loans would be closed early or not. From an econometric perspective, there is a third option of defaulting, but we were not interested in that. We therefore structured it as a binary problem, to prepay or not and estimated binary logistic regression model. The econometric approach we use involves estimating conditional probabilities of mortgage prepayment or termination within specified time intervals. As opposed to the continuous time hazard function given by the instantaneous rate of failure conditional on survival to a given point, the discrete time hazard function is the probability that an event occurs in the interval *t* to *t+1,* given that the event has not already occurred prior to *t* (Calhoun & Deng, 2002).

Monthly loan-level pay-off data was split into Quarterly aggregations with a binary variable that indicated whether a loan paid off in that quarter or not. Only the loans that survived in that quarter were rolled forward to the next quarter, where they again got a value of 1 or 0 depending on whether they paid off in that quarter or not. For the purposes of this paper we treated all pay-offs, both defaults and refinances as prepayment and hence the binary approach. If the goal was to differentiate between defaults and refinances, then a competing risks approach using a multinomial model would be more appropriate. We used custom transformations for several key variables including a proprietary negative exponential transformation to capture the impact of Loan Age on payoff probability.

Below is a description of all the variables that were significant predictors, along with their relationship to prepayment probability:

FACTOR	RELATIONSHIP TO PREPAYMENT PROBABLITIY
% QUARTER OVER QUARTER BALANCE REDUCTION	+
LINE SIZE	-
LOAN AGE (NEGATIVE EXPONENTIAL TRANSFORMATION)	+
HIGH CREDIT LIMIT INDICATOR	+
SEASONALITY INDEX	+
CURRENT FICO	-
LOWER RATE CAP INDICATOR	+
HOUSE PRICE APPRECIATION AT STATE-LEVEL SINCE ORIGINATIC	+
PRODUCT TYPE INDICATOR	+
LOAN PURPOSE INDICATOR 1	+
LOAN PURPOSE INDICATOR 2	-
GEOGRAPHIC CLUSTER 1	-
GEOGRAPHIC CLUSTER 2	+
COMBINED LOAN TO VALUE INDICATOR	+
CURRENT COUPON- 30 YR FRM RATE	+
FRLO INDICATOR	+
PROPERTY TYPE INDICATOR	-
QUARTERLY INCREASE IN PRIME RATE	-

This is just one of several ways we can help you leverage your in-house data.

For further information email us at info@enumerys.com.

References

A Dynamic Analysis of Fixed and Adjustable Mortgage Terminations, Charles A. Calhoun and Yongheng Deng, Journal of Real Estate Finance and Economics 24:1/2, 9-33, 2002