

A Loss Severity Model for Residential Mortgages

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The secondary mortgage market has traditionally focused on prepayment risk. The growth in the nonagency market in recent years, especially the subprime sector, has led to increased interest in mortgage credit analysis, a trend accelerated by the recent turmoil in the subprime market. A key component of mortgage credit analysis is a *loss severity model*, which predicts the likely loss when a mortgage defaults. This article describes a loss severity model that we have developed, using loan level analysis of several hundred thousand defaulted loans combined with extensive research into state level costs and timelines associated with mortgage defaults.¹

The loss from a mortgage default can be simply stated as:

$$\text{Loss} = \text{Loan Balance} + \text{Costs} - \text{Property Sales Price} - \text{Mortgage Insurance Payment}$$

This simplicity is deceptive—the phrase “the devil is in the details” was never more applicable than here. Other than the loan balance, each of the terms depends on myriad factors, such as mortgage and property characteristics, state laws, local taxes and expenses, servicing contract details, and so on. In addition, the sale price of the property is subject to several levels of adverse selection.

THE PATH OF A DELINQUENT LOAN

A *mortgage servicer* handles the process of collecting and managing monthly payments and remitting them to mortgage investors.² If borrowers miss a payment, the servicer will contact them to determine the reasons for the missed payments and to decide on the best course of action. The goal is to try to *cure* the loan (that is, make it current again); the servicer will work with the homeowner to achieve this, and may even offer to recast or modify the loan.

Short sale. If efforts to cure the loan are not successful, and several payments are missed, the loan is termed to be seriously delinquent. Typically, delinquent borrowers that have positive equity in their home will either refinance or sell off their property to cover the outstanding balance. However, if they have little or no equity left in the property, those options are not available to them. In such a case, the servicer can encourage the homeowner to sell the property and may even agree to write off the remaining balance and late fees depending on the agreement between the lender and the borrower. This typically is referred to as a pre-foreclosure or short sale. The lender may set a timeframe for the borrower to sell his property that may put pressure on the borrower to sell at a below-market price. The motivation

here is obviously to avoid the substantial costs associated with formal foreclosure proceedings.

Foreclosure process. If attempts to cure the loan are not successful and a short sale does not occur, the servicer will typically start foreclosure proceedings. Foreclosure is a legal process that is governed by local laws. These laws determine the likely duration and hence the expense associated with a foreclosure.

Costs during foreclosure. Foreclosure typically involves significant costs that can be broadly divided into two categories: *transaction costs* and *carrying costs*. Transaction costs include those involved with foreclosure, such as attorneys' fees, trustees' fees, realtors' fees, closing costs, property title charges, and so forth. Carrying costs include those costs incurred by the servicer to carry the property until liquidation: property taxes, hazard insurance, maintenance costs, utilities, and interest advanced. Some of these costs (property taxes, attorneys' fees, and hazard insurance) are known with a reasonable degree of accuracy for a given region, while others (realtors' fees and miscellaneous costs) are empirically estimated. Note that the longer the foreclosure procedure takes, the greater the carrying costs, and therefore the higher the loss. We include a section devoted to a comprehensive discussion on foreclosure costs and timeline comparison across different geographical states and their effect on loss severities.

The foreclosure process may be lengthened and costs increased if the borrower declares bankruptcy. We include a brief discussion of how bankruptcy can affect loss severities.

Sale of the property. At the conclusion of the foreclosure process, the property is sold, typically through a public auction. If the servicer feels that the highest third-party bid at the auction is well below the market value of the property, he may buy the property; in this case, the property (and the mortgage status) is said to become *real estate owned* (REO). The property and mortgage may also become REO during the delinquency or foreclosure process if the owner transfers the deed to the servicer. This is labeled *deed in lieu of foreclosure*.

There are several sources of uncertainty about the selling price of a property sold through foreclosure. Even if there is good data on home prices for the region, zip codes with above-average default rates may have below-average home price appreciation rates; even within a zip code, some blocks may be affected worse than others.

In addition, once the homeowner becomes delinquent, he may not properly maintain the property, letting it depreciate. Finally, if the loan was originated as a refinancing mortgage, the initial loan-to-value ratio (LTV), often used as a base for estimating the current market value, may be unreliable because of the inflated appraisal values that became common during the refinancing boom of recent years. We use data on about 250,000 defaulted loans to develop models for estimating the likely selling price of distressed properties. We show that the discounts to be applied depend on numerous factors, including loan purpose and the delinquency status before the sale (short sale, foreclosure sale, or REO).

Private mortgage insurance (PMI). Most lenders require borrowers to purchase insurance (labeled PMI) on loans with an LTV higher than 80%. PMI reimburses the lender for losses up to an agreed-on proportion of the claim (also called the coverage ratio) in case of mortgage default. The PMI coverage ratio is an important factor in loss calculation, and a detailed description and analysis is given later in this article.

Second liens. To avoid expensive PMI insurance, many borrowers choose to take out a second loan. This provides additional tax breaks, and the PMI premium avoided can be contributed towards building equity in the property. However, such borrowers have little equity in their property, and the risk of a default is, therefore, higher. In addition, if the loan does default, the first lien holder has a higher priority to claim any recovery from the liquidation of the property. Therefore, loss severities are significantly higher on second lien loans. A slightly modified version of the loss model is used for second lien loans. We discuss the differences between the two algorithms and other model enhancements in a later section.

Early payment defaults (EPDs). A bane of the subprime market in recent years has been loans that default after making zero or just one or two payments. Labeled EPDs, these loans display default seasoning curves that are radically different from traditional ones, where defaults typically are low in the first year or two, and indicate the presence of very poor or even fraudulent underwriting standards. We will discuss some of the issues involved in estimating loss severities for EPDs.

Finally, we put everything together, and show that our model does an excellent job of predicting loss severities for mortgages across time, loan age, delinquency status, and other factors.

Accounting versus Statistical Models

A distinction is often made between "accounting" and "statistical" models; the former refers to models where costs and other factors (such as legal fees) are direct inputs (that is, they are thought to be known with a reasonable degree of accuracy); the latter refers to models where such factors are estimated from historical data. In our view, such distinctions are artificial—a good model needs to use both techniques. Thus, our model uses accounting techniques (in estimating costs such as legal fees and local taxes) and statistical ones—for example, in estimating the selling price of distressed properties.

STATE LAWS AND FORECLOSURE TIMELINES

Foreclosure is a legal process through which the property that serves as collateral on a delinquent loan is sold so that the proceeds can be used to pay the contractual obligations on the loan. The process is governed by the terms of the loan contract and by applicable state laws. State laws differ in three areas: *procedures*, *redemption rights*, and *deficiency judgments*.

Procedures

Two common methods by which the mortgaged property is sold are foreclosure by judicial procedure and foreclosure by power-of-sale. However, some states have other methods of foreclosure: strict foreclosure and entry and possession.

Judicial procedure. In a judicial foreclosure, the lender must proceed through the courts to get a judgment against the borrower and a court order authorizing the sale of the property by an officer of the court. The statutes of each state establish the requirements for advertising the sale and giving notice to the appropriate parties. After the sale, a confirmation report is sent to the court that ordered the sale. The officer delivers the deed to the new owner and the proceeds of the sale, less the court costs, are forwarded to the lender(s) in order of their priority. Second and successive lien holders are paid after each prior lien holder has been paid first. Note that a lien placed by local authorities (for example, unpaid property taxes) gets priority over lenders. Any excess, which is rarely the case, is given to the borrower. Because the foreclosure proceeds through the court, it generally results in a title that is highly marketable. On the flip side, such a procedure

is complicated, expensive, and usually time consuming. In many cases, it may take several months before the court hears the case.

Power-of-sale. In a state that allows foreclosure by power-of-sale, the sale of the property can take place without a court order if the terms of the mortgage confer on the lender such a right in case of default. In such a case, there is a deed-of-trust that is usually held by a trustee. It is the duty of the trustee to ensure that the rights of the borrower are protected and that a foreclosure sale does not occur without actual default. State laws also protect the borrower by requiring that the sale occur at a public auction and that ample prior notice of sale be given. Proceeds of the sale go first towards paying the cost of conducting the sale, followed by payments to lender(s), with any excess going to the borrower. The power-of-sale procedure is much quicker and less expensive and therefore is generally preferred over the judicial method.

Strict foreclosure. In Connecticut and Vermont, a foreclosure is initiated when a complaint for foreclosure is filed with the court. Judgment of strict foreclosure is typically entered (day 90 after complaint filing) by the court if there is no equity in the property above the debt being foreclosed. In such a case, there is no sale. The mortgagor is given a legal date by which he must pay off the debt or lose his property. Upon failure of payment, the title automatically vests in the foreclosing mortgagee on the "vesting date" (day 150). The period between judgment and the vesting date is the redemption period and is discretionary with the judge. Hardship cases may prolong the redemption period. In the case where the mortgagor has equity in his property above the debt, a judgment of foreclosure by sale is typically entered. The length of redemption period between judgment and sale date varies at the discretion of the judge. Confirmation of sale takes at least 30 days (day 180).

Entry and possession. When the foreclosure is by entry and possession (found in New England states, such as Maine, Massachusetts, New Hampshire, and Rhode Island), the mortgagee petitions the court for the right to take physical possession of the pledged collateral on the defaulted loan. The entry must be peaceable, made before witnesses, and attested to by filing a certificate with the court. The mortgagee obtains full legal ownership after a period of time during which the mortgagor may redeem the property by repaying the mortgage lien plus costs.

Exhibit 1 shows the type of foreclosure procedures commonly used in each state and estimated average times to complete a foreclosure, based on historical data. The average foreclosure time in states that allow power-of-sale procedure is approximately 11 months, while in states with judicial procedures it is about 14 months. Connecticut and Vermont allow only "strict foreclosure," and for these states the foreclosure time is 16 months, higher than most other states.

Note that Exhibit 1 shows the *average* foreclosure times; there is significant dispersion around this average. A difference in servicer practices is one reason for this

dispersion. However, liquidation time (calculated from when the borrower was last current on the loan) also has a pronounced dependence on loan age. As Exhibit 2 shows, the liquidation time has an almost linear relationship with loan age up to about 60 months. The liquidation time used in our model includes a static component (that is, the state average foreclosure time) and an age-dependent variable, reflecting the relationship shown in Exhibit 2. The liquidation time determines the number of months over which carrying costs are incurred and has a significant impact on total losses.

EXHIBIT 1

Foreclosure Procedure and Timeline by State

State	Method of Foreclosure	Months to Liquidation		Property Tax (%)	Typical Foreclose Costs (\$)
		Foreclosure	REO		
Alabama	Power-of-Sale	12	14	0.54	2,043
Alaska	Power-of-Sale	10	16	2.01	2,667
Arkansas	Power-of-Sale	11	15	0.54	3,015
Arizona	Power-of-Sale	9	14	0.54	1,778
California	Power-of-Sale	9	14	2.01	2,190
Colorado	Power-of-Sale	9	15	2.01	2,266
Connecticut	Strict Foreclosure	16	19	2.01	3,253
District of Columbia	Power-of-Sale	13	13	0.85	4,450
Delaware	Judicial	17	23	0.85	4,617
Florida	Judicial	12	16	1.45	3,099
Georgia	Power-of-Sale	12	14	1.05	1,772
Hawaii	Judicial	18	22	0.85	1,811
Iowa	Judicial	13	21	2.27	1,968
Idaho	Judicial	10	16	1.13	2,188
Illinois	Judicial	13	20	2.27	3,339
Indiana	Judicial	14	19	1.13	2,194
Kansas	Judicial	11	19	1.15	2,038
Kentucky	Judicial	15	22	1.15	4,024
Louisiana	Judicial	12	18	1.15	3,962
Massachusetts	Power-of-Sale	11	19	1.51	4,769
Maryland	Power-of-Sale	12	18	1.42	3,828
Maine	Entry and Possession	14	22	1.77	3,182
Michigan	Power-of-Sale	11	20	1.97	1,670
Minnesota	Power-of-Sale	10	18	1.97	2,651
Missouri	Power-of-Sale	12	13	1.97	1,913
Mississippi	Power-of-Sale	13	16	0.85	1,823
Montana	Power-of-Sale	11	18	1.97	2,131
North Carolina	Power-of-Sale	11	17	1.26	1,543
North Dakota	Judicial	11	17	1.26	1,762
Nebraska	Judicial	11	15	1.26	1,817
New Hampshire	Power-of-Sale	11	15	2.87	3,271
New Jersey	Judicial	17	23	3.02	4,317
New Mexico	Judicial	12	19	2.66	2,407
New York	Judicial	15	21	2.66	5,216
Nevada	Power-of-Sale	9	14	2.66	1,974

EXHIBIT 1 (continued)

State	Method of Foreclosure	Months to Liquidation		Property Tax (%)	Typical Foreclose Costs (\$)
		Foreclosure	REO		
Ohio	Judicial	16	23	1.72	3,077
Oklahoma	Judicial	13	18	1.72	2,732
Oregon	Power-of-Sale	10	16	1.72	2,546
Pennsylvania	Judicial	16	22	2.17	5,372
Rhode Island	Power-of-Sale	10	15	2.17	3,084
South Carolina	Judicial	15	21	0.86	2,799
South Dakota	Judicial	15	24	0.86	1,175
Tennessee	Power-of-Sale	11	13	1.53	2,109
Texas	Power-of-Sale	11	13	1.53	1,867
Utah	Power-of-Sale	9	14	0.85	1,784
Virginia	Power-of-Sale	11	14	1.15	1,880
Vermont	Strict Foreclosure	16	24	1.15	1,981
Washington	Power-of-Sale	9	15	1.15	2,183
Wisconsin	Power-of-Sale	14	20	1.15	2,721
West Virginia	Power-of-Sale	15	18	0.85	1,075
Wyoming	Power-of-Sale	9	16	1.15	1,817

Note that many states allow multiple foreclosure procedures. The exhibit above lists the most common form of foreclosure procedure practiced for each state. The "months to liquidation" column shows the average number of months from when the loan was last current.

Sources: LoanPerformance and Citi.

Redemption Rights

A mortgagor who defaults on a loan may prevent a foreclosure sale by making all missed mortgage payments and paying all expenses (including interest) incurred by the lender. This is called the *equitable right of redemption* and can be exercised by the borrower until foreclosure sale.

The borrower can sell his equitable right of redemption, in which case the purchaser can cure the loan and assume the liability.

The *statutory right of redemption*, on the other hand, commences after the foreclosure sale (that is, when equitable right of redemption is terminated). This grants the borrower the right to regain property lost in a foreclosure

EXHIBIT 2

Plot of Liquidation Time with Loan Age



Sources: LoanPerformance and Citi.

sale by paying an amount equal to that paid at the sale plus back interest and expenses. Not all states have the statutory right to redemption, and in some states the right to redemption is available only if the foreclosure was by power-of-sale. If the lender takes possession of the property at the foreclosure sale, it may have to be held as REO during the period when the statutory right of redemption can be exercised; because the lender does not have a "clean" title the property may be difficult to market. This period varies between 1 and 12 months—the longer the period, the longer the time to liquidate. This is reflected in the REO timeline shown in Exhibit 1. States with lengthier redemption periods have a longer liquidation time. Exhibit 3 shows states with right of redemption and their timelines as of 2006.

Deficiency Judgment

This is a court-ordered judgment against the borrower for the difference between the value of the property at the foreclosure sale and the amount of indebtedness including back interest and foreclosure costs. Some states

disallow judgment against the borrower if the lender bids at the sale; in other states the court determines a fair market value of the property if the lender wins the bid. States that allow deficiency judgment against the borrowers are generally expected to have lower loss severities.

TRANSACTION AND CARRYING COSTS

The lender/servicer incurs significant costs while foreclosing on delinquent loans. There are two main types of costs: transaction costs and carrying costs.

Transaction Costs

These are one-time costs incurred during a foreclosure process and include the following:

Attorney fees. Legal fees incurred to complete a foreclosure vary by state and depend on the complexity of state laws governing the process.³ The average fee charged in each state is shown in Exhibit 1. In general, attorneys' fees are limited to 3% of the principal balance. This prevents

EXHIBIT 3

States with Redemption Rights and Timelines (Data as of 2006)

Colorado	2.5 months (or 5 months on security instruments executed before July 1, 1965)
Idaho	6 months (but 12 months for properties over 20 acres)
Illinois	6 months (or 12 months if purchase was before January 1, 1982)
Indiana	6 months before sale; time to complete sale is 10 months with a 12-month transfer time
Iowa	6 months (but if property was abandoned, it can be as low as 2 months)
Kansas	12 months (or 6 months if property was abandoned or if it was purchased with a mortgage with less than a third down)
Maine	12 months
Michigan	6 months (or 12 months if security dated prior to January 1, 1965)
Minnesota	6 months
New Mexico	1 month
North Dakota	6 months
South Dakota	6 months
Utah	3 months
Vermont	6 months
Wisconsin	12 months
Wyoming	3 months

Source: Citi.

attorneys from running up illegitimate legal expenses. Additional attorneys' fees are permitted in states that allow deficiency judgment, and the attorney is required to pursue it against the borrower.

Property title charges. These costs are incurred to check for liens on the property. These liens could be placed on the property as a result of a second mortgage on the property or by local authorities if the borrower fell behind on local property tax payments. Usually, properties without "clean" titles are difficult to sell and may require the purchaser to buy title insurance to safeguard against a loss due to a defect in the title.

Realtor fees. A realtor typically charges a percentage of the selling price of the house to list the home, market the property, and advise the seller during the sale and closing process. Although it is generally assumed that these fees range between 5% and 7%, data show that they are highly dependent on the selling price itself and can actually range from 5% for properties priced over \$100,000 to more than 40% for properties priced under \$6,000. Realtors' fees can therefore have a significant impact on loss severities, especially for loans with lower appraisal values, which partly explain the actual observances. Exhibit 4 shows the actual realtor's fee as a percentage of sales price and the estimated average used in our model.

Miscellaneous costs. In addition to realtors' fees, the servicer can incur various other costs in the process of selling the property. These costs can vary significantly and may include multiple broker price opinions (BPOs),

property inspection, travel charges to the property, and termite inspection, for example. In some cases, costs may also arise from having to evict the borrowers from the REO properties. Furthermore, the servicer (as a seller) may agree to bear some or all of the costs, such as escrow deposits, buyer and lenders' attorney fees, title insurance, underwriting fees, and recording fees, to make the purchase contract more attractive. We do not estimate each of these costs separately, partly because of the lack of data and dispersion in these costs. In our model, the miscellaneous cost is calculated as a percentage of the loan amount and is estimated from historical data. Exhibit 5 shows actual miscellaneous costs and the average value used in our loss model (shown as a dark solid line).

Carrying Costs

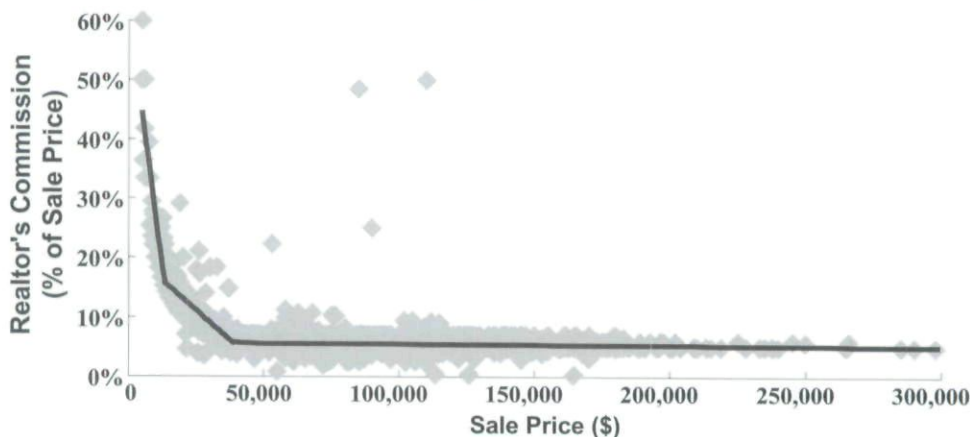
Carrying costs refer to recurring expenses borne by the servicer to carry the property from the initiation of foreclosure procedure until loan termination and include the following:

Property taxes. State average tax rates (see Exhibit 1) are used in the model. Paying property taxes that are owed would be among the highest priorities of the servicer, since local authorities can place a lien on the property if they are not paid.

Hazard insurance. This is a homeowner's insurance that covers property damage caused by fire, wind, storms, and other similar risks. If this insurance is terminated due

EXHIBIT 4

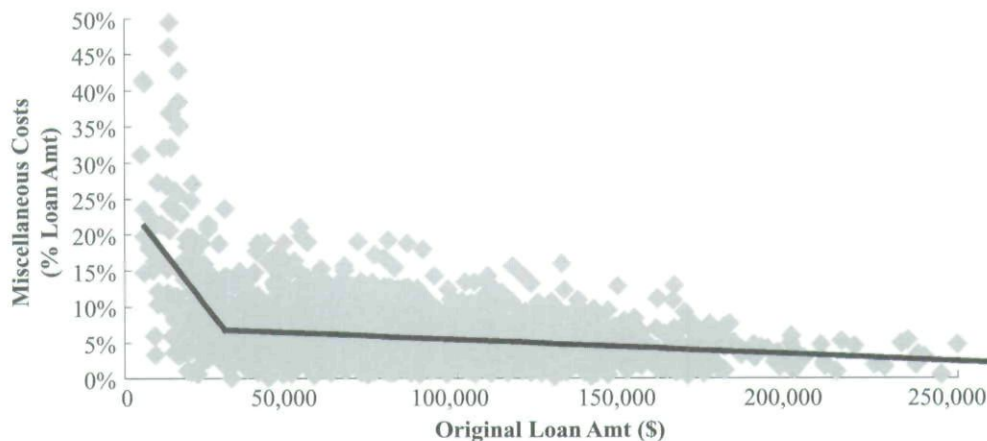
Actual Realtor's Commission and the Estimated Average Used in the Model



Source: Citi.

EXHIBIT 5

Actual Miscellaneous Costs and an Estimated Average Used in the Model



Source: Citi.

to missed payments (which is more likely to occur for delinquent loans) and the property is damaged, it is the lender who will end up with the loss, so the servicer generally makes these payments on behalf of delinquent/defaulted borrowers. The hazard insurance is estimated using a flat rate of 1.05% on the appraisal value.

Maintenance costs. These refer to expenditures required to maintain the property in good condition—for example, mowing the lawn. While the servicer will generally try to keep the home in good condition to recoup maximum value from selling the property, he may be contractually obligated to do so by the terms of the servicing agreement, or if the loan has PMI. Most PMI providers require that, before submitting any claims, the servicer ensure that the property is in similar condition to when the policy was taken out. This prevents the servicer from neglecting the property to the detriment of the insurer. Note that only normal maintenance expenses can be included in the claim; major repairs are disallowed. Maintenance costs range between 3% and 8% of the property value, with lower rates applied to expensive homes.

Interest advanced. The servicer is usually required to advance interest and, depending on the contract, even the principal to the investor. In our model, the servicing fee (typically 0.5%) is included in the interest. As pointed out previously, when there is a recovery from the sale of the property, the servicer is first allocated funds to cover his expenses. Obviously, this results in a larger severity on loans with a higher coupon.

THE IMPACT OF BANKRUPTCY

We first note, for linguistic clarity, that bankruptcy refers to the status of the borrower and not the loan status. For example, a borrower can be in bankruptcy while the loan could be 30-days delinquent, or in foreclosure, and so on. One of the reasons people file for bankruptcy is to get a “discharge,” which is a court order that states that the individual does not have to pay most of his debts. Some debts cannot be discharged and include, for example, mortgage debt on primary residence,⁴ most taxes, child support, alimony, most student loans, court fines and criminal restitution, and personal injury caused by drunk driving or being under the influence of drugs. Individuals can file for bankruptcy in a federal court under Chapter 7 (“straight bankruptcy” or liquidation) or Chapter 13 (a “reorganization” or debt adjustment case). Although individuals can technically file Chapter 11 bankruptcies, those filings are rare.

Chapter 7

A trustee is appointed to take over the bankrupt individual's property. Any property of value is sold to pay his creditors. He may be able to keep some personal items and possibly real estate depending on the law of the state where he resides and applicable federal laws. There is usually a deadline (termed the Bar Date) for filing claims to allow the trustee to determine the distribution of any funds obtained from the liquidation of the estate. Claims are paid out first to administrative

creditors, then to priority unsecured creditors according to their statutory priority, and finally to the nonpriority unsecured creditors, with all claims paid pro rata with other members of the class.

Chapter 13

The advantages of Chapter 13 over Chapter 7 include the ability to stop foreclosures and to have a mortgage declared reinstated upon bankruptcy plan completion. Under Chapter 13, the debtor proposes a plan to pay his creditors over a three- to five-year period. During this period, his creditors cannot attempt to collect on the individual's previously incurred debt except through the bankruptcy court. In general, the individual gets to keep his property, and his creditors end up with less money than they are owed. The court must approve the debtor's repayment plan and his budget. A court-appointed trustee collects the payments, pays the creditors, and ensures that the debtor lives up to the terms of his repayment plan.

Generally, bankruptcy protection makes it difficult for the lender to foreclose on the borrower and take possession of his property as it is under the control of a court-appointed trustee. Therefore, the loan may be delinquent for several months, sometimes years, before any recoveries. All accrued interest is lost. The higher losses are mostly due to a longer foreclosure period over which interest accrues (Exhibits 6 and 7 show average severities for loans in bankruptcy against those not in bankruptcy), as well as higher legal fees. The average foreclosure and REO timeline is shown in Exhibit 8. Note that borrowers can also file for multiple bankruptcies, which could extend the timeline several months beyond those shown in Exhibit 8. We do not discuss the various costs involved and the options available to borrowers that file for multiple bankruptcies (for example, loans in short sale/foreclosure/REO with multiple bankruptcy filing).

ESTIMATING THE VALUE OF FORECLOSED PROPERTIES

Historical studies have shown that foreclosed properties sell at a discount from "market value." Exhibit 9 provides further confirmation. This shows actual and projected loss severity assuming the property was sold at its market value, where we define market value to be the original sales price or appraisal (if the loan was a refinancing), multiplied by the cumulative home price appreciation from

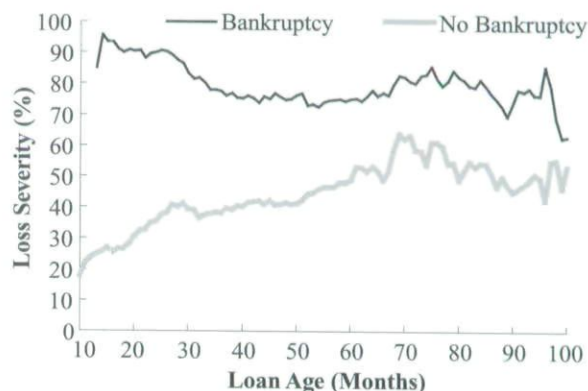
the loan origination date. There is obviously a large gap between the actual and projected loss severities, indicating that the properties sold for well below their market value.

Why do foreclosed properties sell at a discount to market value? There are several reasons, including several types of adverse selection:

- The particular neighborhood will likely experience lower rates of home price appreciation than the average for the MSA or state if there have been a significant number of foreclosures in the area—many

EXHIBIT 6

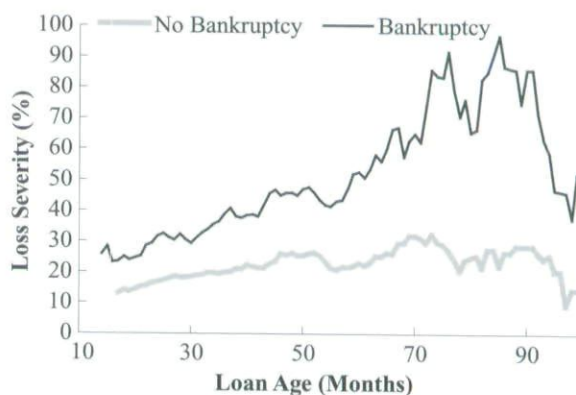
Loss Severities on Fixed-Rate Loans (including Second Liens) Liquidated in Pre-Foreclosure Sale for Bankrupt and Nonbankrupt Borrowers



Source: LoanPerformance.

EXHIBIT 7

Loss Severities on Adjustable-Rate Loans Liquidated in Pre-Foreclosure Sale for Bankrupt and Nonbankrupt Borrowers



Source: LoanPerformance.

potential buyers will want to avoid buying in such a neighborhood.

- The house may not have been well maintained, since homeowners facing foreclosure tend to become unmotivated.
- Potential buyers expect to pay below market value if a house is sold at a foreclosure auction or is REO. On the other side, the institution holding the property tends to be motivated to get rid of the property and prevent further maintenance and other costs.
- Some states allow borrowers the right of redemption under which they can acquire their property by

paying off the amount owed within a specified period of time after it is REO. As a result, these properties do not have a "clean" title in that period and are difficult to market.

- If the loan was a refinancing loan, the original appraisal may have been inflated (for purchase loans, however, the actual purchase price is provided at loan origination).

The discount to market value depends on a number of loan and property factors and can be as high as 60%. In this section, we identify the factors that determine the discount. These factors are used in our model to estimate

EXHIBIT 8

Average Time to Liquidate for Borrowers in, and not in, Bankruptcy (in months)

State	In Bankruptcy			Not in Bankruptcy	
	90 + days	FC	REO	FC	REO
Alaska	19	21	26	10	16
Alabama	21	19	23	12	14
Arkansas	18	19	21	11	15
Arizona	14	14	19	9	14
California	15	14	17	9	14
Colorado	13	13	19	9	15
Connecticut	18	19	22	16	19
Dist. Of Columbia	21	19	22	13	13
Delaware	29	24	26	17	23
Florida	17	19	22	12	16
Georgia	19	16	19	12	14
Hawaii	17	22	24	18	22
Iowa	23	18	22	13	21
Idaho	15	15	21	10	16
Illinois	21	20	24	13	20
Indiana	20	19	21	14	19
Kansas	17	18	21	11	19
Kentucky	20	20	24	15	22
Louisiana	21	21	23	12	18
Massachusetts	20	18	21	11	19
Maryland	20	19	23	12	18
Maine	13	21	27	14	22
Michigan	18	18	24	11	20
Minnesota	17	17	22	10	18
Missouri	18	15	18	12	13
Mississippi	25	20	24	13	16
Montana	17	16	24	11	18
North Carolina	23	20	25	11	17
North Dakota	—	—	22	11	17

EXHIBIT 8 (continued)

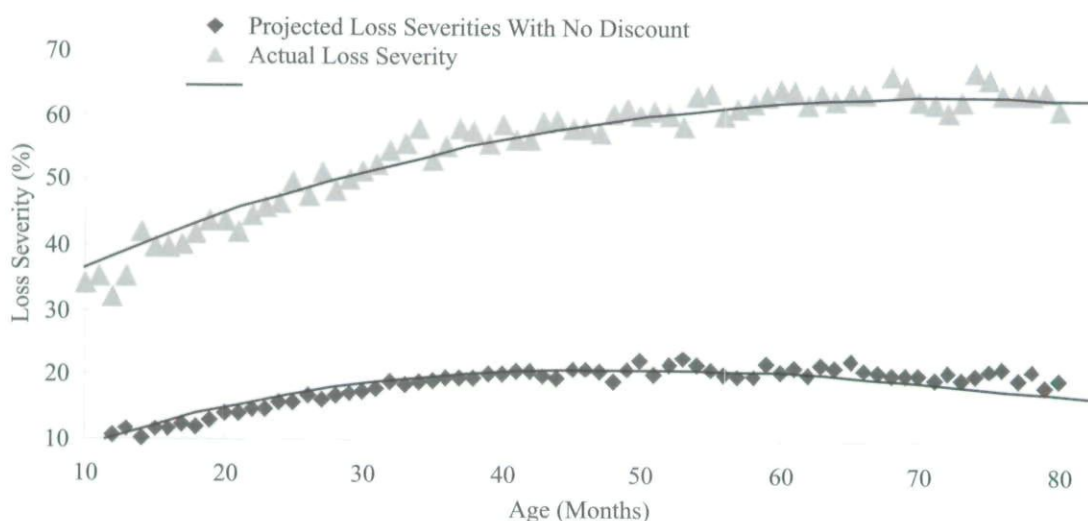
State	In Bankruptcy			Not in Bankruptcy	
	90 + days	FC	REO	FC	REO
Nebraska	16	18	20	11	15
New Hampshire	18	15	18	11	15
New Jersey	19	24	27	17	23
New Mexico	16	17	22	12	19
New York	20	23	26	15	21
Nevada	14	16	19	9	14
Ohio	22	23	26	16	23
Oklahoma	17	17	22	13	18
Oregon	16	16	21	10	16
Pennsylvania	22	24	27	16	22
Rhode Island	17	16	17	10	15
South Carolina	25	24	28	15	21
South Dakota	12	—	25	15	24
Tennessee	17	17	19	11	13
Texas	21	20	22	11	13
Utah	16	15	19	9	14
Virginia	19	19	21	11	14
Vermont	4	17	26	15	24
Washington	17	16	20	9	15
Wisconsin	20	20	24	14	20
West Virginia	25	25	23	15	18
Wyoming	9	10	20	9	16

Notes: The liquidation months represent the average number of months from the last date when the loan was current on its payment.

Sources: LoanPerformance and Citi.

EXHIBIT 9

Projected Severity with No Discount Against Historical Loss Rates



Sources: LoanPerformance and Citi.

realistic property liquidation values. Our analysis is based on a dataset of 90,000 first-lien liquidated loans. For many of the loans, the final sale price was available; for others, it was backed out using the net reported loss (see Appendix A).

Determinants of Discount to Market Value

A number of factors affect the likely discount.

Property value. The lower the property value, the larger the discount (see Exhibit 10). Realtors' fees and the repair costs required to bring foreclosed properties to near-market value tend to be larger in percentage terms for lower priced properties. In addition, because of their likely low returns, they receive the least priority of liquidation from the servicer. Hence, they are typically sold in their current condition and, therefore, are less marketable compared to more expensive properties.

Because property value is such an important determinant of the foreclosure discount, we will include it as one of the variables when displaying the dependence of the discount on other factors in the following graphs.

Property type. Townhouses (TH), multifamily homes (MF), and manufactured homes (MH) are found to have the largest discount to foreclosure sale. Following these are single-family homes (SF) and planned unit developments (PUDs) (see Exhibit 10). Foreclosed condos (CO) experienced the least discount relative to other property types (exceptions include certain regions like Florida).

Although there is no clear explanation for this observation, we believe the cause may be that townhouses and multifamily homes are less desirable (and therefore less marketable) than single-family homes for most families. In addition, these properties are less "liquid" than single-family detached homes and condos and thus experience a more severe price adjustment.

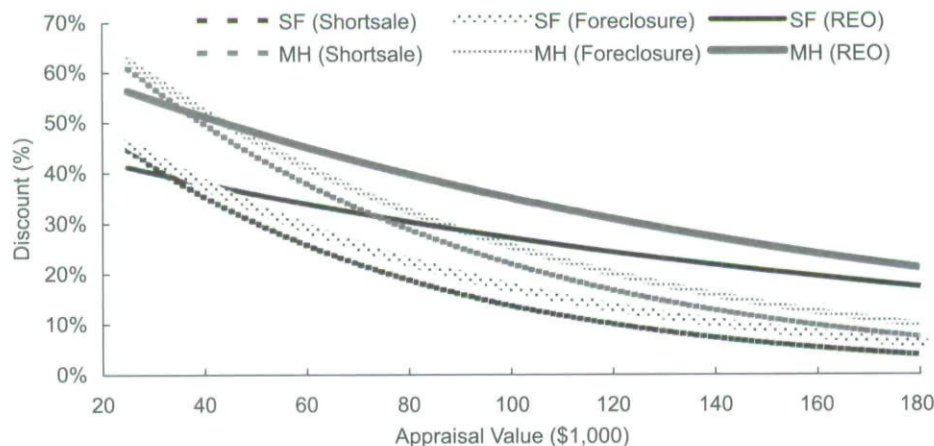
Exhibit 10 shows estimated discounts for manufactured housing and single-family homes by loan size and delinquency status.

Occupancy. We have observed that loss severities are significantly higher on investor properties than on owner-occupied (primary residence) or second homes. This would lead one to believe that investor properties experience a significantly higher discount because they are more likely to be neglected than primary residences. However, this is not always the case and does not explain the higher severities. In addition, borrowers (in this case, the investor) have little influence on severities (unless they choose to file for bankruptcy or do not agree to a short sale), and it is the servicer who decides the loss mitigation strategy. In general, loss severities depend primarily on the property value and the outstanding balance at the time of default. Exhibit 11 shows the general characteristics of defaulted loans that have primary, secondary, or investor property as collateral.

Note that the average original loan size (and therefore the value of the property) of defaulted loans with investor property is significantly lower than those of

EXHIBIT 10

Estimated Foreclosure Discounts by Property Type, Loan Size, and Delinquency Status



Source: Citi.

EXHIBIT 11

Characteristics of Defaulted Loans by Occupancy

Orig. Year	Occupancy	Avg. Orig. Loan Size	OLTV	Delinquency Status at Default			Property Type			
				% Short Sale	% Foreclosure	% REO	SF	CO	PD	TH/MF/MH
2005	Investor	114,939	87.25	7.60	14.49	77.91	68.52	4.25	6.70	20.54
	Primary	187,982	84.35	7.50	18.67	73.83	76.09	5.98	12.99	4.93
	Secondary	158,541	86.56	8.32	15.68	76.00	59.46	11.56	20.20	8.77
2006	Investor	140,569	87.79	15.80	25.60	58.60	71.90	5.01	7.21	15.88
	Primary	245,251	83.69	14.33	26.00	59.67	73.94	6.33	15.78	3.95
	Secondary	270,186	85.39	14.61	21.36	64.03	56.72	17.53	24.94	0.82

Sources: LoanPerformance and Citi.

owner occupied and second homes. Therefore, they experience a steeper discount, as described earlier. In addition to lower property value, investor properties include a significantly higher fraction of townhouses, multifamily homes, manufactured housing, and mobile homes that experience higher discount at foreclosure (see Exhibit 10). These factors, including higher LTVs, account for the higher severities on investor properties.

Delinquency status. One of the most important factors affecting the discount is the delinquency status at liquidation. A *pre-foreclosure* or *short sale* looks like any typical sale to potential buyers, and the discount may be much less than that of similar foreclosed or REO properties (see Exhibit 10).

A foreclosed property can be sold in a variety of ways, depending on the foreclosure procedure and laws for the state (see Exhibit 1). For example, the property could be auctioned at a "Sheriff's Sale" or sold at a public auction at an advertised place and location (note that the cost incurred is deducted from the proceeds of the sale). Other possibilities include an attorney's sale or a court-appointed referee's sale. In all cases, potential buyers will expect a significant discount from market value, especially in a weak housing market.

As discussed earlier, a lender may end up purchasing the property (for example, if he believes that the property is worth more than any of the bids received), in which case it is termed *REO*. REO properties are often in bad condition or in an undesirable location (probably the main reasons why there was not a good offer at the time of foreclosure auction), and the time between delinquency and final property sale can be long. These reasons explain why discounts tend to be highest on REO properties, as shown in Exhibits 10 and 12.

Geographical state. As discussed previously, foreclosure laws and procedures differ from state to state, and these can affect the foreclosure property discount. In states that allow a deficiency judgment, for example, we would expect the borrower to better maintain the property, implying a lower discount. In states that allow the right of redemption to the borrower, the property may not have a "clean" title, and this could negatively affect the sale price.

Exhibit 12 shows historical *average* foreclosure discounts by state, initial property value, and delinquency status. We note, however, that these discounts can be heavily influenced by the strength of the housing markets and the local economy at the time of the sale, making it difficult to discern average discounts by state that are stable over time.

Loan purpose and appraisal inflation. For loans originated as refinancings or cash-outs, we rely on the appraisal value to estimate the current property value. There is much anecdotal evidence that appraisal values were often inflated during the housing boom of recent years. Hence, use of the given appraisal value may mean overestimating current property values, thus underestimating loss severities. This is evident from Exhibit 13, which shows loss severities by loan purpose and loan age for foreclosure sales (top panel) and REO properties (lower panel).

Loss severities are generally lowest for purchase loans (for which, barring fraud, there is no uncertainty about the initial property value) and highest for cash-out loans, with refinance loans somewhere in the middle—assuming similar initial sale price (purchase loan) and appraisal value (refinance and cash-out). This is consistent with anecdotal evidence, which suggests that appraisal inflation tends to be most severe for cash-out

EXHIBIT 12

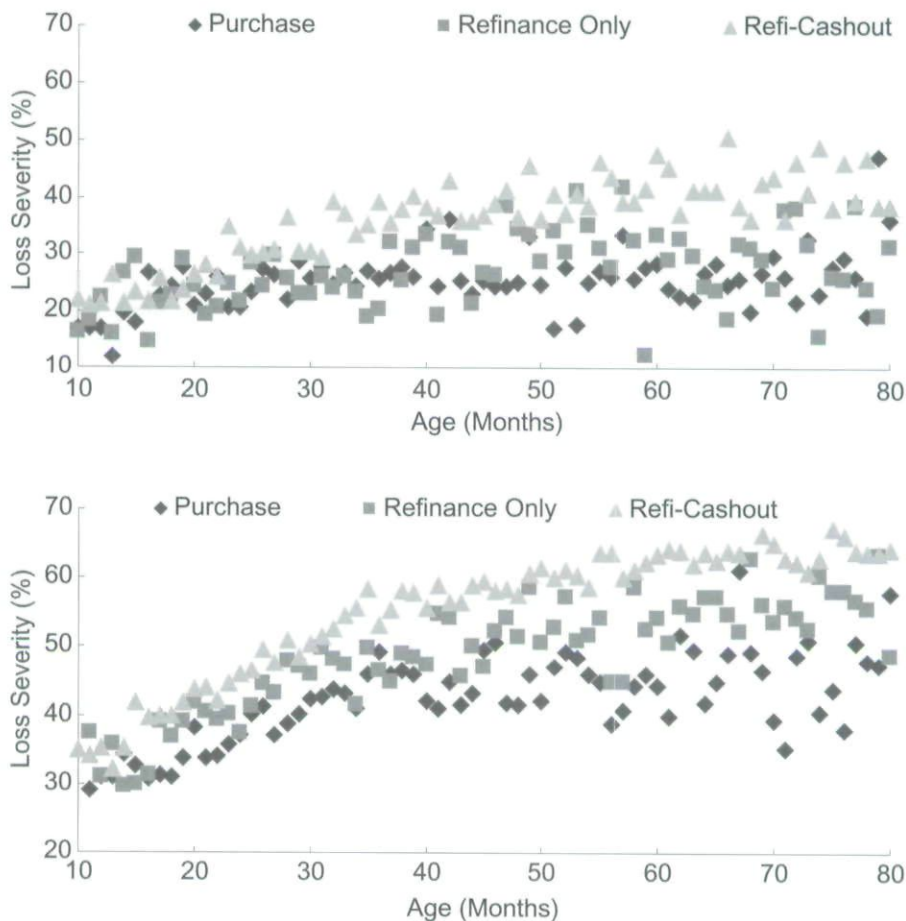
Historical Average Discounts Estimated on Sale of Distressed Properties by Initial Property Value, State, and Delinquency Status (in percent)

State	Discount on Foreclosed Properties (Dollars in 000s)					Discount on REO Properties (Dollars in 000s)				
	< \$25	\$25-\$50	\$50-75	\$75-100	\$100-250	< \$25	\$25-50	\$50-75	\$75-100	\$100-250
Alaska	41.01	35.48	30.76	14.18	7.51	43.33	44.10	35.57	28.09	14.52
Alabama	37.64	39.51	32.02	20.19	12.41	50.40	42.59	37.36	30.51	27.74
Arkansas	38.57	37.90	32.94	27.46	19.82	51.80	44.07	36.95	32.50	28.57
Arizona	29.14	24.43	17.62	10.81	2.85	40.14	24.76	20.98	17.21	14.98
California	30.71	29.54	21.90	13.95	6.05	32.05	31.70	31.35	24.21	17.62
Colorado	57.89	46.40	23.23	13.36	5.40	60.39	47.55	25.37	25.22	11.17
Connecticut	55.10	38.72	31.67	24.61	16.72	70.40	60.88	52.66	51.26	31.56
District of Columbia	38.53	35.48	30.76	24.98	17.29	45.31	44.10	33.57	32.58	30.63
Delaware	57.67	45.09	33.11	13.09	7.79	64.81	52.92	45.55	38.18	20.65
Florida	25.01	21.11	19.76	13.46	7.17	32.72	30.61	28.99	23.42	17.84
Georgia	32.70	31.27	23.69	21.48	13.73	34.83	34.84	33.15	22.95	20.79
Hawaii	38.53	34.75	32.69	13.15	5.23	40.25	36.99	33.57	23.79	14.01
Iowa	32.72	30.58	21.27	15.45	7.58	35.24	33.91	27.63	23.37	19.10
Idaho	47.24	37.34	30.40	23.47	12.48	56.21	41.17	37.25	33.33	25.50
Illinois	42.54	40.75	31.73	19.71	6.71	44.68	44.31	37.30	30.41	20.04
Indiana	44.61	48.16	43.13	26.45	18.79	52.80	51.70	47.37	38.85	32.20
Kansas	35.32	33.91	28.31	4.66	1.83	41.33	39.85	32.75	29.68	21.06
Kentucky	36.13	27.13	22.78	14.36	10.38	47.31	47.06	36.26	27.55	26.87
Louisiana	31.86	28.05	19.74	17.36	9.55	36.01	38.85	28.69	20.87	23.83
Massachusetts	35.44	33.77	30.91	10.72	2.75	45.15	44.10	33.73	22.58	11.43
Maryland	54.95	42.68	35.05	22.18	14.44	60.67	45.26	42.86	40.46	24.46
Maine	57.32	49.54	30.23	16.70	11.81	60.70	57.01	33.01	25.95	31.66
Michigan	29.12	28.44	27.77	23.12	15.40	37.99	36.42	32.30	27.72	21.15
Minnesota	34.21	31.05	22.44	13.83	6.01	39.11	31.52	23.65	19.24	14.83
Missouri	22.58	27.99	27.40	17.53	9.70	37.12	39.87	32.65	27.81	22.97
Mississippi	35.03	31.29	29.13	27.28	19.64	39.64	38.21	29.53	30.04	24.94
Montana	36.05	35.86	29.13	17.11	8.91	38.99	37.09	30.78	21.79	12.81
North Carolina	34.67	29.11	27.86	20.98	13.17	40.42	39.21	34.76	29.38	23.75
North Dakota	34.13	29.05	23.98	16.18	8.47	47.00	32.63	26.66	20.69	11.88
Nebraska	22.68	20.61	15.54	13.59	5.68	37.87	32.96	27.13	15.59	11.38
New Hampshire	37.69	32.22	12.62	9.85	1.96	47.61	40.10	36.64	34.44	15.24
New Jersey	22.39	16.62	12.28	7.94	2.09	24.52	24.13	23.74	18.76	13.77
New Mexico	35.05	33.75	30.65	21.01	13.24	41.77	40.04	32.37	29.39	19.25
New York	54.28	53.22	35.85	18.47	9.26	63.08	62.87	56.47	54.24	33.24
Nevada	43.32	35.48	18.45	11.04	3.07	58.12	44.10	20.63	11.86	8.85
Ohio	43.83	40.84	37.85	23.25	15.51	48.83	48.61	39.83	34.30	31.67
Oklahoma	30.21	27.35	19.76	18.54	10.77	37.53	35.16	25.72	20.79	18.69
Oregon	29.30	25.28	16.72	13.73	10.74	30.70	26.70	23.78	20.86	17.51
Pennsylvania	35.33	33.60	32.46	19.56	11.76	49.01	47.30	45.59	35.89	32.05
Rhode Island	62.99	51.56	40.79	30.02	16.08	64.01	51.94	45.31	38.68	22.07
South Carolina	36.83	35.45	33.30	17.26	9.42	39.05	38.22	37.39	33.29	29.70
South Dakota	44.41	35.71	24.26	15.00	9.16	50.40	36.11	28.09	20.07	14.77
Tennessee	37.57	33.59	23.07	21.06	13.29	39.01	36.51	34.01	25.77	22.88
Texas	33.18	32.62	25.95	20.98	13.21	34.16	33.50	32.16	30.49	23.48
Utah	30.05	24.09	21.68	17.96	12.18	34.00	31.67	24.03	18.54	18.51
Virginia	19.41	24.34	22.99	11.52	3.64	60.73	45.12	34.67	25.91	23.19
Vermont	35.09	30.06	20.49	11.92	3.86	40.33	36.55	20.87	12.51	9.74
Washington	37.96	34.86	26.31	14.52	6.65	40.95	39.01	35.81	32.59	21.05
Wisconsin	27.92	27.91	26.72	18.08	10.26	28.27	28.29	27.53	21.45	19.85
West Virginia	40.78	39.39	31.25	23.11	15.39	44.81	44.53	44.24	35.64	33.22
Wyoming	30.82	27.24	21.92	16.60	8.75	34.25	27.33	26.57	20.02	14.36

Source: Citi.

EXHIBIT 13

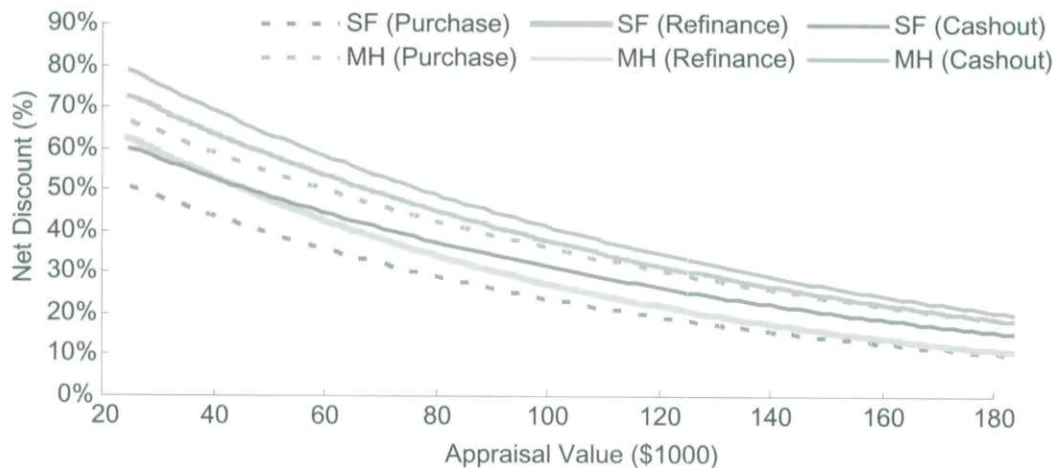
Loss Severities on Purchase, Refi, and Cash-Out Loans for Loans in Foreclosure (top panel) and REO (lower panel)



Sources: LoanPerformance and Citi.

EXHIBIT 14

Estimated Net Discount to Foreclosure Sale by Property Type, Loan Size, and Loan Purpose



Source: Citi.

loans. The data summarized in Exhibit 13 are used to estimate discounts to be applied to refinance and cash-out loans to correct for inflated appraisals. Exhibit 14 shows net discounts on foreclosed properties by loan size and loan purpose for single-family homes and manufactured housing.

Loan age. Loss severities tend to increase with loan age. This is apparent from Exhibits 9 and 13. One reason for this is that, for the first several years, liquidation time tends to increase with loan age (see Exhibit 2). Longer liquidation times imply greater neglect of the property, as well as higher maintenance and carrying costs. In addition, older loans imply older properties, and older properties may suffer more from neglect, depreciation, and lack of maintenance than newer properties. An age-dependant depreciation factor is included in the model.

Appendix A describes how the discount to appraisal and foreclosure sale are estimated from available data.

PRIVATE MORTGAGE INSURANCE

Private mortgage insurance (PMI) covers the lender against a portion of the losses caused by borrower default. Lenders typically require borrowers to purchase PMI if they obtain a loan with an LTV above 80%. As would be expected, loss severities on loans with PMI coverage are on average lower than on loans without PMI. Exhibit 15 compares average loss severities for loans with and without

PMI for adjustable rate loans with a current LTV greater than 80%.

PMI Overview and Effects on Loss Severity

In general, PMI covers the top portion of the loan. The lender usually sets the coverage requirement based on the percent of down payment (or LTV) and the borrower's credit score (FICO) (see Exhibit 18). The lower the down payment, the greater the amount of coverage required. Lenders may require more extensive coverage for certain loan products and in certain geographical regions. The coverage is typically expressed in terms of the *coverage ratio*. For example, assuming that the lender desires coverage for the amount of the loan in excess of 75% of the value of the property, the coverage ratio that accomplishes this is as follows:

$$\text{Coverage Ratio} = \frac{\text{Original Balance} - (0.75 \times \text{property value})}{\text{Original Balance}}$$

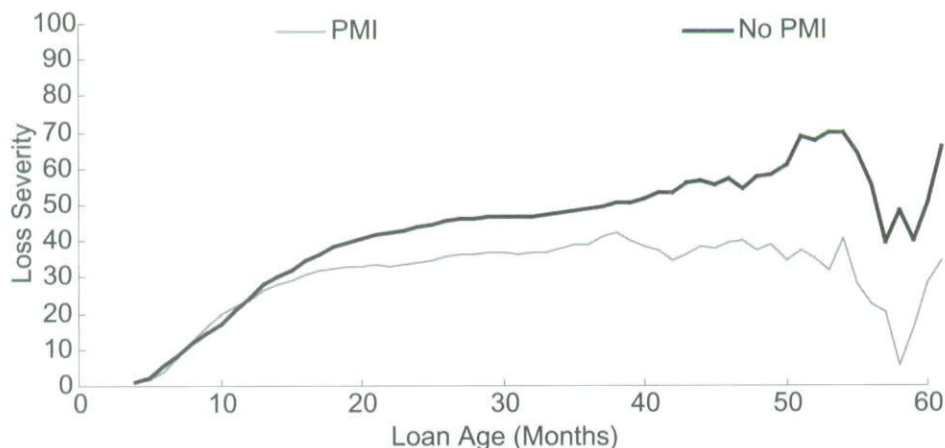
In the case of a 10% down payment, the coverage ratio would be:

$$\text{Coverage Ratio} = \frac{90 - (0.75 \times 100)}{90} \approx 17\%$$

If this loan defaults, the claim can include the principal balance outstanding, transaction costs, and carrying

EXHIBIT 15

Loss Rates on ARMs with and without PMI (LTV Greater than 80%)



Sources: LoanPerformance and Citi.

EXHIBIT 16

Typical Mortgage Insurance Claim Example

Principal balance due	\$90,000
Accumulated interest	8,000
Attorneys' fees	2,500
Property taxes	1,500
Hazard insurance	650
Maintenance expenses	1,500
Other foreclosure costs	2,500
Subtotal	\$106,650
Less rent received	1,200
Total Claim	\$105,450

Notes: With a 17% coverage ratio, the PMI provider is responsible for $\$105,450 \times 0.17 = \$17,927$. Source: Citi.

costs. Only normal maintenance expenses can be included in the claim, as major repairs are disallowed. In addition, legal fees are limited to 3% of the principal balance. An example of a typical insurance claim is shown in Exhibit 16.

Upon submission of the claim, the mortgage insurer pays the lower of (1) the coverage percent of the total claim (17% in this example) or (2) the actual net loss. The PMI policy generally gives the insurer the right, but not the obligation, to pay 100% of the claim and take title of the property itself, if he wishes to handle the actual liquidation. He might want to do that if he believes he can recover more than the mortgage servicer, which might well be the case with a small servicer that does not have expertise in handling loans in REO. Exhibit 17 shows a flowchart of the procedures for filing and resolution of a claim with the mortgage insurer. Note that it is in the interest of the servicer/lender to forward PMI premiums when the borrower does not make those payments. These payments are not included in the claims and are directly passed on to the lenders/investors as losses.

Exhibit 18 shows typical PMI premiums for different coverage ratios. The model estimates the coverage ratio and PMI premium based on loan and borrower characteristics in estimating loss severity.

Note that PMI can be as much as 4.7 percentage points in addition to the coupon on the loan and can significantly increase monthly payments. However, PMI payments do not increase the borrower's equity in his home. Piggyback loans (or second lien loans) provide a way for the borrower to avoid paying PMI and further benefit from the interest on the second mortgage being tax deductible.

However, these loans result in a combined LTV of 100% in many cases and significantly enhance the risk of default. The second lien lender is the one to take the first loss (remember there is no PMI) and severities of over 100% are common for these loans. In the next section we describe how losses on second lien loans are estimated.

PMI Coverage Termination

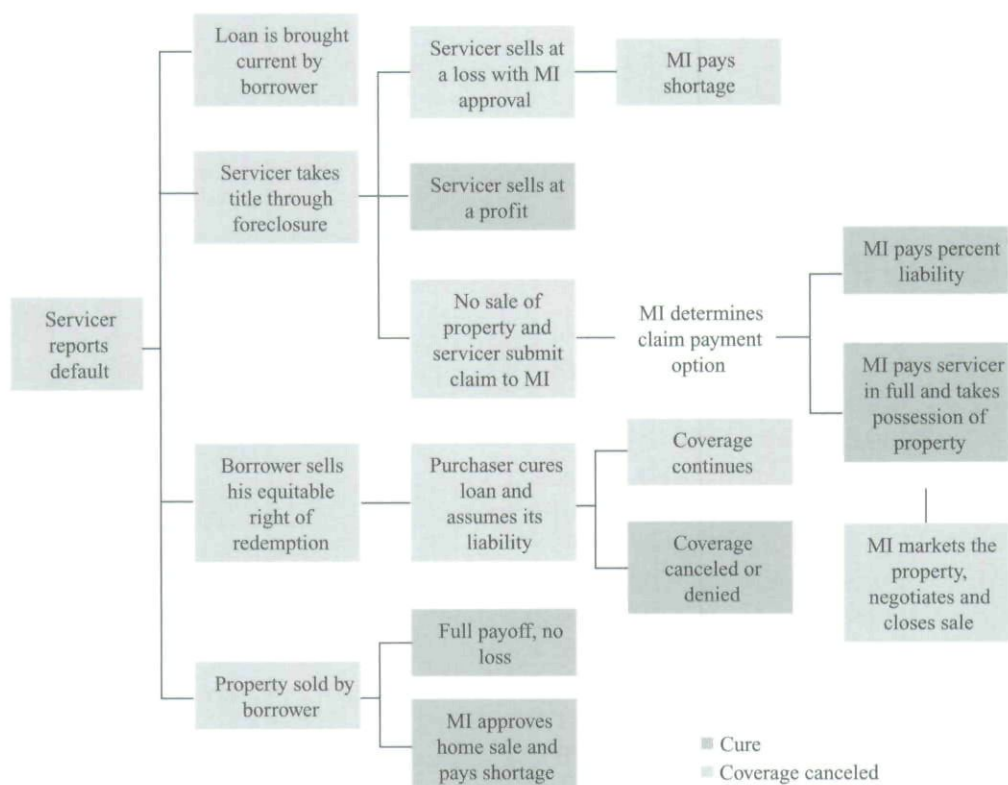
PMI can be terminated either at the request of the borrower or automatically. The Homeowners Protection Act of 1998 established rules for automatic termination and borrower cancellation of PMI on home mortgages. These protections apply to certain home mortgages signed on or after July 29, 1999, for the purchase, initial construction, or refinance of a single-family home. These protections do not apply to government-insured FHA or VA loans or to loans with lender-paid PMI. Under these terms, the borrower can ask to have the PMI canceled once he reaches more than 20% equity in his home based on the original appraisal value or a new appraisal that he pays for. If the borrower does not ask for the cancellation of the PMI, the lender is required to automatically cancel it once the borrower reaches 78% equity in his house based on amortization and initial appraisal. For most borrowers the PMI premiums are included in escrow accounts and often overlooked, and many are not savvy enough to know these clauses. Within the model, we automatically shut off PMI when the LTV (based on original appraisal) reaches 78% rather than 80%.

LOSS SEVERITIES ON SECOND LIENS AND EARLY PAYMENT DEFAULTS

Towards the latter stages of the recent housing boom, there was a significant increase in second lien originations. This period also saw a loosening of underwriting standards, with many of the second liens resulting in combined LTVs that were 100% or even higher. Not surprisingly, the current housing downturn has led to a surge in defaults on these second lien loans. Loss severities on second liens tend to be high, since the first lien holder has a prior claim on any recovery from a default. Making matters worse, many second liens were taken out as a means of avoiding the PMI premium; the lack of insurance coverage means that loss severities are often over 100%.

EXHIBIT 17

Procedures for Filing and Resolution of a PMI Claim



Source: Citi.

EXHIBIT 18

Standard PMI Coverage Requirements and Premium

LTV	FICO	CR	Maturity > 25 Years Premium (%)			Maturity < 25 Years Premium (%)		
			FRM	ARM		CR	FRM	ARM
>95	620	35	0.96	1.17		35	0.85	1.06
>95	600-619	35	1.88	2.11		35	1.77	2.00
>95	575-599	35	2.57	2.89		35	2.46	2.78
>95	574	35	4.18	4.70		35	4.07	4.59
90-95	620	30	0.78	0.88		25	0.56	0.62
90-95	600-619	30	1.32	1.48		25	1.07	1.22
90-95	575-599	30	1.80	2.00		25	1.50	1.70
90-95	574	30	2.92	3.28		25	2.50	2.82
85-90	620	25	0.52	0.61		12	0.23	0.24
85-90	600-619	25	0.90	1.00		12	0.46	0.53
85-90	575-599	25	1.22	1.37		12	0.66	0.76
85-90	574	25	1.97	2.21		12	1.13	1.28
<85	620	12	0.32	0.33		6	0.18	0.19
<85	600-619	12	0.53	0.60		6	0.34	0.40
<85	575-599	12	0.72	0.80		6	0.50	0.57
<85	574	12	1.15	1.29		6	0.86	0.98

Sources: MGIC and PMI.

To determine loss severities on second lien loans, it is necessary to first estimate the total recovery and subtract from it the total claim filed by the first lien holder. The second lien holder receives the excess if it is positive (which is rarely the case). Therefore the net loss for a second lien holder is given by the following:

$$\begin{aligned} \text{Second Lien Loss} = & \text{Outstanding Balance} \\ & + \text{Accumulated Interest} \\ & - \text{Max } \{0, (\text{Net Recovery} \\ & - \text{First Lien Claim})\} \end{aligned}$$

To estimate the net recovery and the first-lien lender claim, we use the loss severity model for the first lien that has been outlined in previous sections. Specifically, we can estimate the accrued interest and various costs incurred by the primary lender. However, some of the first lien information needed for calculating losses (such as outstanding loan balance and coupon) may not be available. In this case, we estimate it from the information available on the corresponding second lien. The procedure for estimating losses on second liens is illustrated in Exhibit 19.

Early Payment Defaults

Although early payment defaults (EPDs) have been a hot topic recently, there is no standard market definition for an EPD. The most common definition is that any loan that goes into delinquency or liquidation within 90–120 days of origination is an EPD. EPDs generally result in severities that are high, even on the first lien (sometimes 100%). EPD rates more than doubled between the first quarter of 2003 and the fourth quarter of 2006, reflecting a mix of shoddy underwriting and outright fraud. This has made EPDs an important component of credit modeling.

Generally, the purchase of loans from originators involves contracts that have covenants that require the loan originator to take back an EPD loan (EPD is usually defined in the contract). Although such buybacks reduce the impact of EPDs on the pricing of mortgage-backed securities, defaults on loans that are relatively unseasoned remain a major problem. We have also noted significantly higher severities on loans that default between 120 and 240 days.

We have found it difficult to explain such high severities based on the loan data provided at origination, such as LTV and appraisal value. (We note that second lien

loans increase the likelihood of EPD as they tend to default fairly early and also have severities over 100%.) A telling statistic is that about 70% of EPD loans have low or no documentation. This indicates the presence of poor and fraudulent underwriting that involves misrepresentation of appraisal values and borrower and collateral characteristics. Because it is fairly difficult to estimate actual LTVs or appraisal values for these loans, we model the effects of EPDs empirically, by estimating a function of age that multiplies the loss severity estimated from the original loan information. This methodology leads to loss severity estimates that fit well across different cohorts and seems to capture the aggregated misrepresentation in collateral characteristics of EPD loans.

MODEL PERFORMANCE AND VALIDATION

We have back-tested our model using groups of loans with varying characteristics and found that it does an excellent job in predicting loss severities. Exhibits 20 through 31 show actual and predicted loss severities, along with prediction errors, for 2/28 ARM and fixed-rate first-lien subprime mortgages by loan age, loan purpose (cash-out, refinance, or purchase), and delinquency status prior to liquidation (foreclosure or REO). The prediction errors are also shown and are generally small. The model uses historical state-level HPA, but it is fairly straightforward to incorporate MSA-level or even zip-code-level HPA if the corresponding data are available.

As described earlier, loss severities are highest for loans liquidated from REO, followed by foreclosures, and short sales. This pattern is clear in the plots shown in Exhibits 20 to 31, and the projected severities also pick up these differences. In addition, the model also captures differences by loan purpose.

Exhibits 32 to 39 compare actual and projected loss severities on first lien loans by loan sizes and LTV. Loan size (and therefore appraisal value) is an important determinant of loss severity, with lower balance loans having much higher severities, and the model captures these differences.

Aggregated Vintage Loss Severity Fits for First Liens

Our loss model is integrated with the default model.⁵ A vintage or deal is broken up into loan buckets with similar loan and borrower characteristics, and then the default model generates default rates for these buckets.

EXHIBIT 19

Illustrative Example for Estimating Second Lien Loss Severity

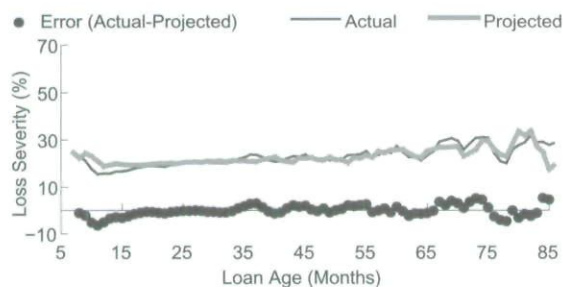
At Origination		At Default	
CLTV	100%	Age	22
LTV	20%	Delinquency status	Foreclosure
Original balance	\$20,000	Outstanding balance	\$18,000
WAC	11%		
Lien	second		
Property type	Single-Family		
Loan purpose	Purchase		
State	CA		
Calculation:	1st Lien (Estimated)	Second Lien	Recovery
Case 1: HPA = 10%			
Coupon (estimated for 1st lien)	7.5%	11%	
Orig balance	\$80,000	\$20,000	
Current balance (maturity = 360 (1st lien), 180 (second lien))	\$78,604	\$18,933	
Interest advanced (liquidation time = 12 months)	\$5,895	\$2,083	
Closing costs (2% of balance)	\$1,572	\$379	
Attorneys' fees	\$2,500		
Property taxes	\$1,500		
Hazard insurance	\$650		
Maintenance expenses	\$1,500		
Other foreclosure costs			-\$2,500
Sale price (net foreclosure discount = 27%, HPA=10%)			\$80,300
Realtors' fees (5% of sale price)			-\$4,015
Claim/recovery	\$92,222	\$21,395	\$73,785
Excess (Max {0, (1st lien claim - Recovery)})			\$0
Loss Severity	23.5%	113.0%	
Case 2: HPA = 40%			
Other foreclosure costs			-\$2,500
Sale price (net foreclosure discount = 27%, HPA=10%)			\$102,200
Realtors' fees (5% of sale price)			-\$5,293
Claim/recovery	\$92,222	\$21,395	\$98,058
Excess (Max {0, (1st lien claim- Recovery)})			\$5,836
Loss Severity	0.0%	82.2%	

Note: For the purpose of illustration some costs are assumed not to change with HPA (e.g., maintenance costs, property tax, etc.).

Source: Citi.

EXHIBIT 20

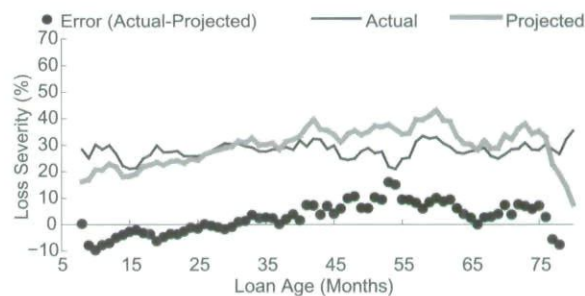
Loss Severities on Foreclosed Purchase ARMs



Sources: LoanPerformance and Citi.

EXHIBIT 21

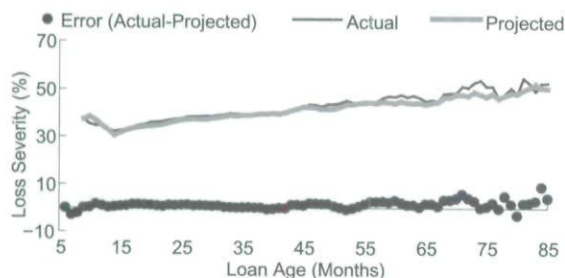
Loss Severities on Foreclosed Purchase FRMs



Sources: LoanPerformance and Citi.

EXHIBIT 22

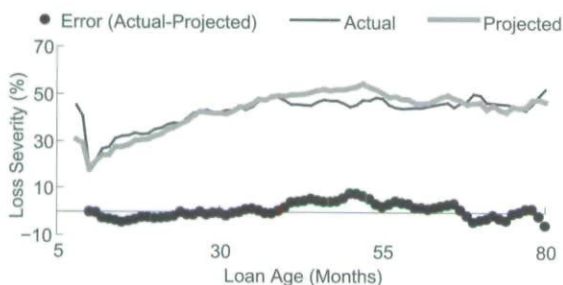
Loss Severities on REO Purchase ARMs



Sources: LoanPerformance and Citi.

EXHIBIT 23

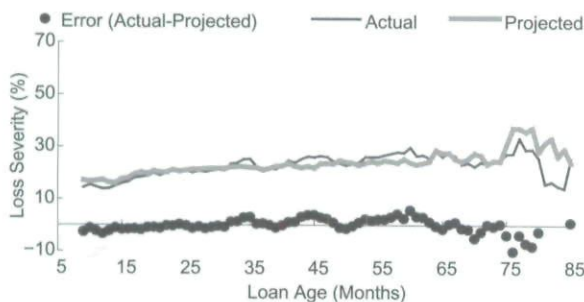
Loss Severities on REO Purchase FRMs



Sources: LoanPerformance and Citi.

EXHIBIT 24

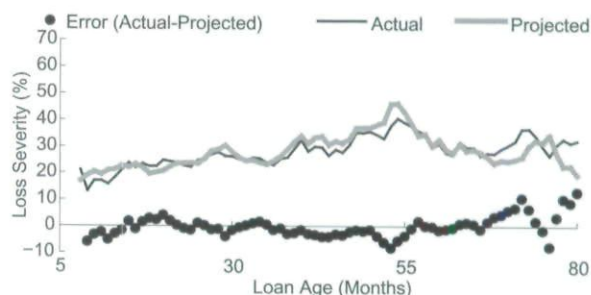
Loss Severities on Foreclosed Refinance ARMs



Sources: LoanPerformance and Citi.

EXHIBIT 25

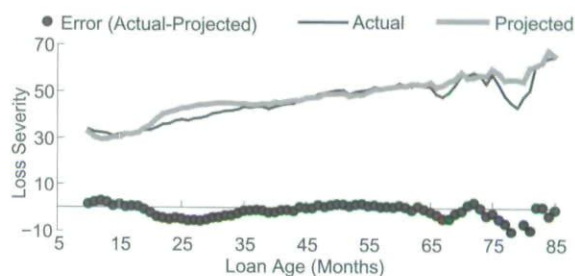
Loss Severities on Foreclosed Refinance FRMs



Sources: LoanPerformance and Citi.

EXHIBIT 26

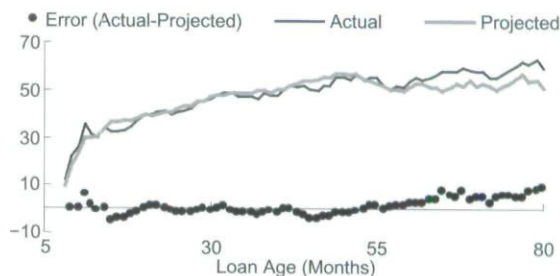
Loss Severities on REO Refinance ARMs



Sources: LoanPerformance and Citi.

EXHIBIT 27

Loss Severities on REO Refinance FRMs



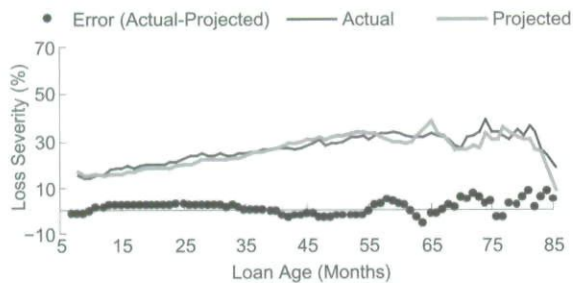
Sources: LoanPerformance and Citi.

Loss severity is then estimated for each of these buckets and aggregated weighted by the defaulted balance to obtain average severities. In Exhibits 40–45, we compare actual and projected average loss severities for fixed rate and 2/28 adjustable rate mortgages with origination periods between the first quarter of 2005 and the third

quarter of 2006. A 12-month forecast is also provided. This assumes that the home prices will decline 2.5% over this period. Overall, the projected severities capture the actual observed severity trends.

EXHIBIT 28

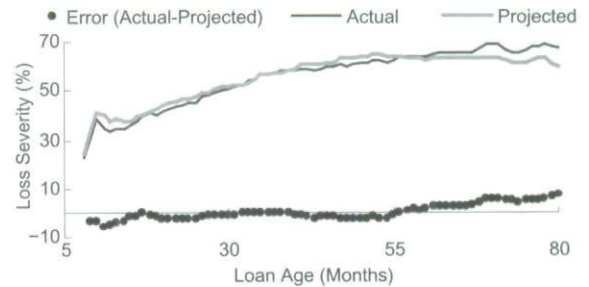
Loss Severities on Foreclosed Cash-Out ARMs



Sources: LoanPerformance and Citi.

EXHIBIT 31

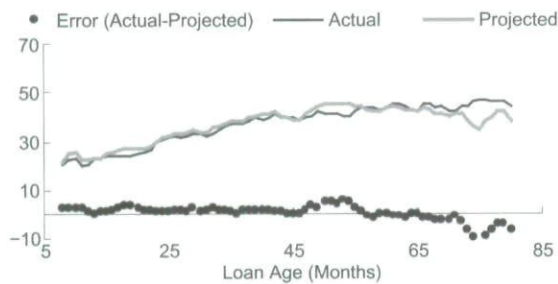
Loss Severities on REO Cash-Out FRMs



Sources: LoanPerformance and Citi.

EXHIBIT 29

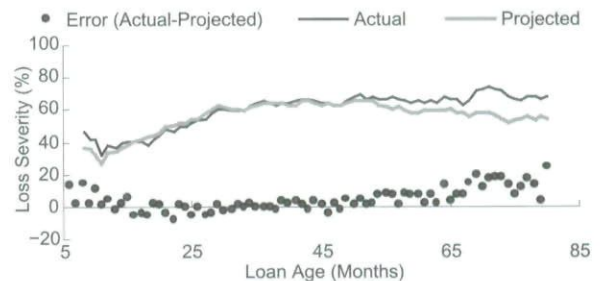
Loss Severities on Foreclosed Cash-Out FRMs



Sources: LoanPerformance and Citi.

EXHIBIT 32

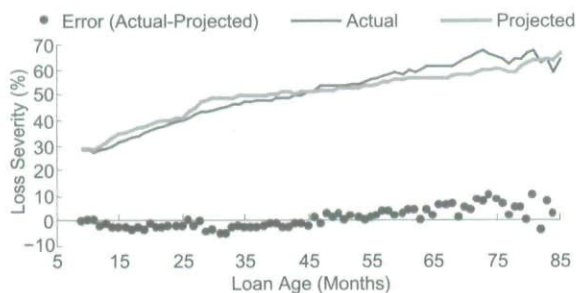
Severities on FRMs with LTV < 75 and Loan Size < \$75,000



Sources: LoanPerformance and Citi.

EXHIBIT 30

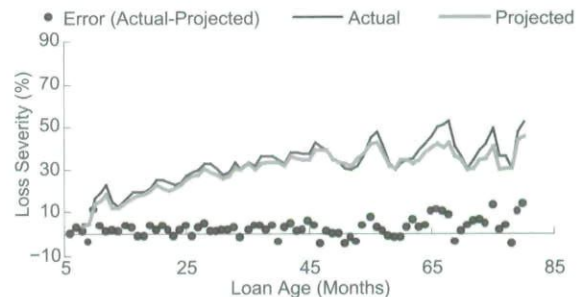
Loss Severities on REO Cash-Out ARMs



Sources: LoanPerformance and Citi.

EXHIBIT 33

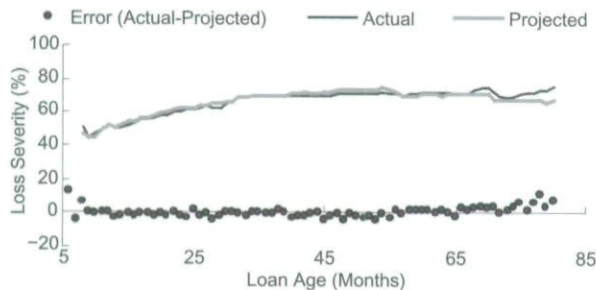
Severities on FRMs with LTV < 75 and Loan Size > \$75,000



Sources: LoanPerformance and Citi.

EXHIBIT 34

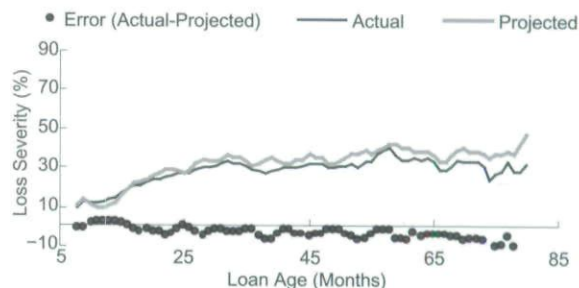
Severities on FRMs with LTV > 75 and Loan Size < \$75,000



Sources: LoanPerformance and Citi.

EXHIBIT 37

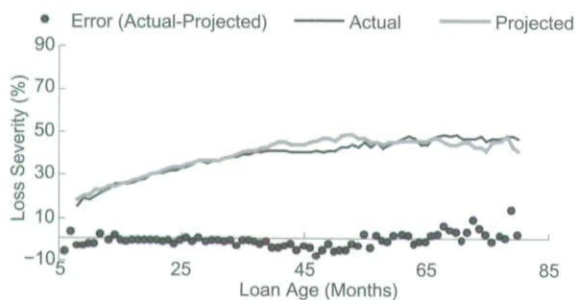
Severities on ARMs with LTV < 75 and Loan Size > \$75,000



Sources: LoanPerformance and Citi.

EXHIBIT 35

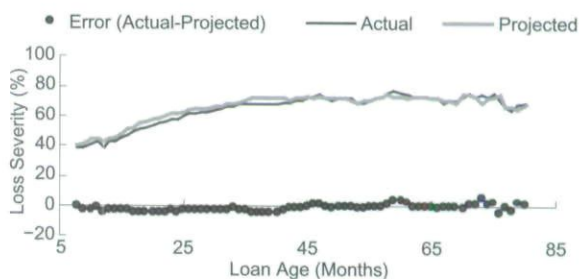
Severities on FRMs with LTV > 75 and Loan Size > \$75,000



Sources: LoanPerformance and Citi.

EXHIBIT 38

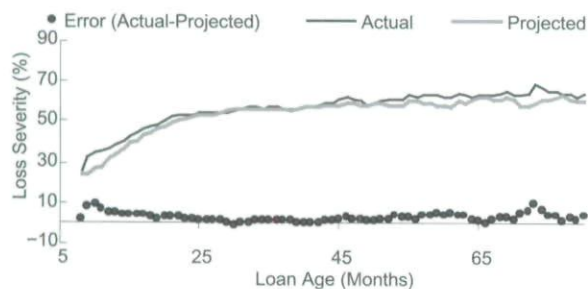
Severities on ARMs with LTV > 75 and Loan Size < \$75,000



Sources: LoanPerformance and Citi.

EXHIBIT 36

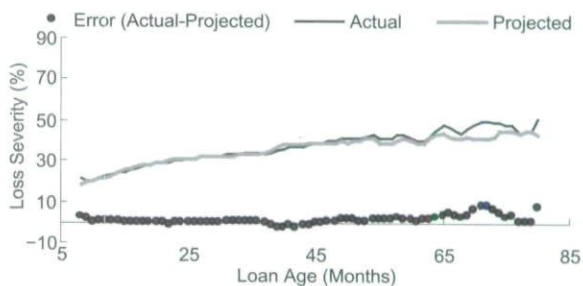
Severities on ARMs with LTV < 75 and Loan Size < \$75,000



Sources: LoanPerformance and Citi.

EXHIBIT 39

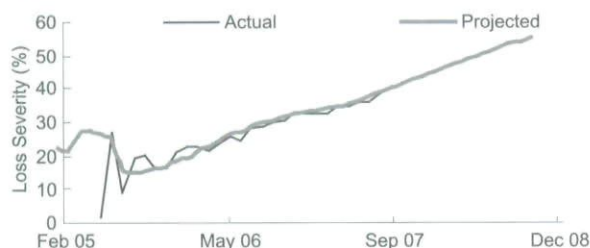
Severities on ARMs with LTV > 75 and Loan Size > \$75,000



Sources: LoanPerformance and Citi.

EXHIBIT 40

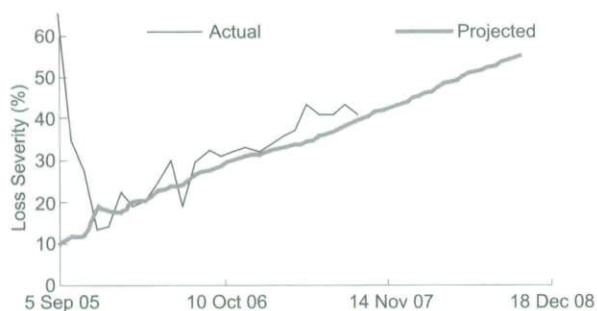
Actual and Projected Loss Severities for 2/28 ARMs Originated in 1Q 05 and 2Q 05



Sources: LoanPerformance and Citi.

EXHIBIT 41

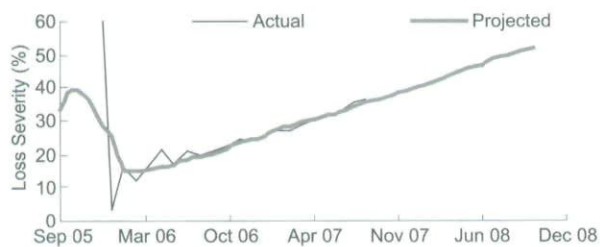
Actual and Projected Loss Severities for FRMs Originated in 1Q 05 and 2Q 05



Sources: LoanPerformance and Citi.

EXHIBIT 42

Actual and Projected Loss Severities for 2/28 ARMs Originated in 3Q 05 and 4Q 05



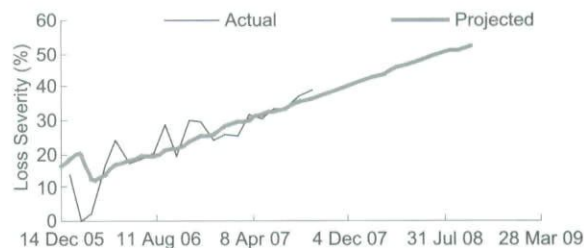
Sources: LoanPerformance and Citi.

Second Lien Loss Severity Fits

Second and higher liens recover only if the recovery from the sale of the property is in excess of the claim filed by the first lien holder. This generally results in significantly higher severities—that are almost always over

EXHIBIT 43

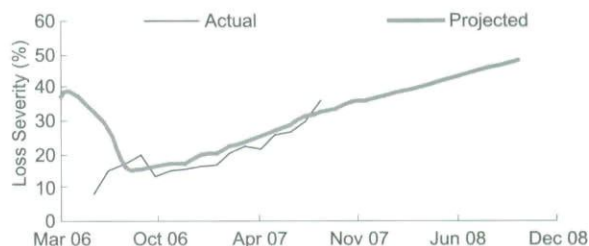
Actual and Projected Loss Severities for FRMs Originated in 3Q 05 and 4Q 05



Sources: LoanPerformance and Citi.

EXHIBIT 44

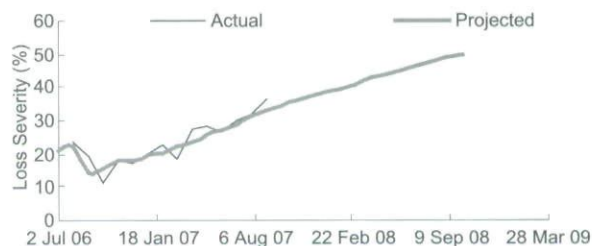
Actual and Projected Loss Severities for 2/28 ARMs Originated in 1Q 06 and 2Q 06



Sources: LoanPerformance and Citi.

EXHIBIT 45

Actual and Projected Loss Severities for FRMs Originated in 1Q 06 and 2Q 06



Sources: LoanPerformance and Citi.

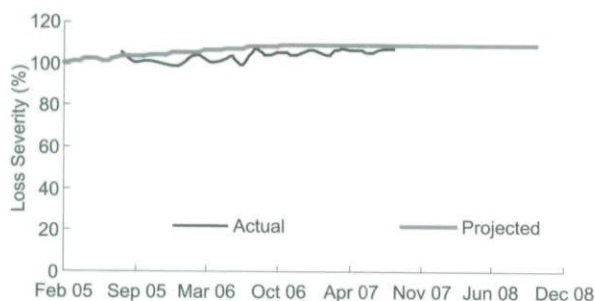
100%—as shown in Exhibits 46 through 49. Projected severities match actual severities fairly well.

Alt-A Loss Severity Fits

So far, we have only discussed and applied our model for projecting loss severities to subprime loans. However, these costs, timelines, etc., are applicable to

EXHIBIT 46

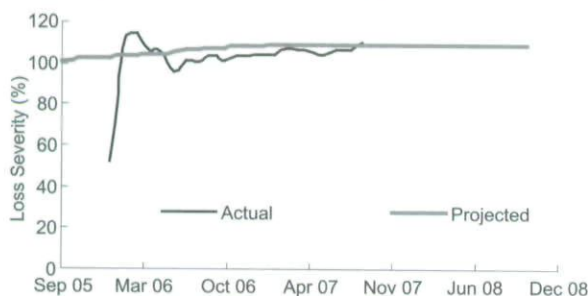
Actual and Projected Loss Severities for Second Liens Originated in 1Q 05 and 2Q 05



Sources: LoanPerformance and Citi.

EXHIBIT 47

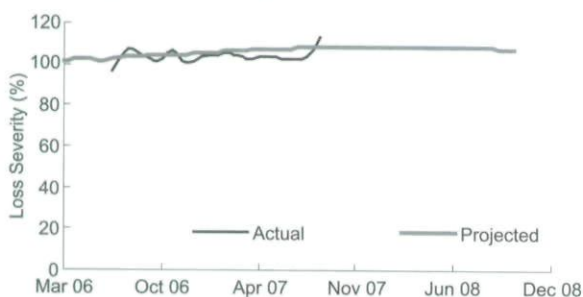
Actual and Projected Loss Severities for Second Liens Originated in 3Q 05 and 4Q 05



Sources: LoanPerformance and Citi.

EXHIBIT 48

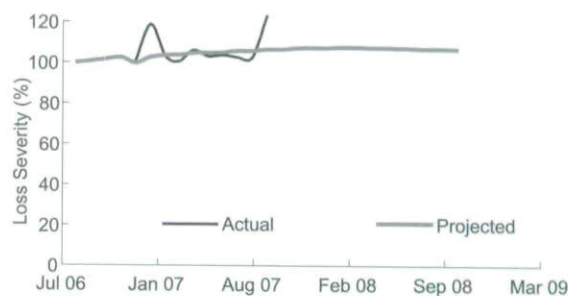
Actual and Projected Loss Severities for Second Liens Originated in 1Q 06 and 2Q 06



Sources: LoanPerformance and Citi.

EXHIBIT 49

Actual and Projected Loss Severities for Second Liens Originated in 3Q 06 and 4Q 06



Sources: LoanPerformance and Citi.

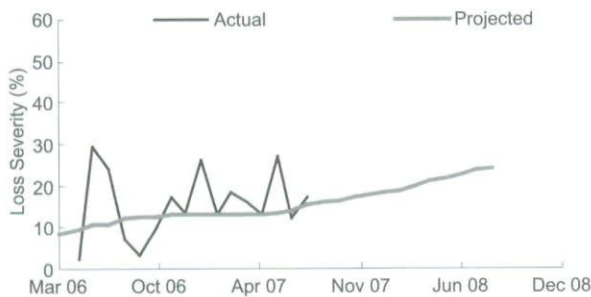
mortgage loans in general, and therefore the same model can be applied to predict losses on Alt-A loans. However, Alt-A loans generally involve significantly higher loan balances and, therefore, more expensive properties that are not subjected to such severe foreclosure discounts as subprimes. This results in a much lower loss severity. Exhibits 50 to 55 provide a comparison between actual and model projected loss severities on Alt-A loans.

Closing Comment: LTV-Based Loss Severity Models

Many loss severity models rely heavily, or even exclusively, on LTV to predict loss severities. Such models will generate similar loss severities on loans with similar LTVs, even though there may be significant differences in other loan and borrower characteristics. As we have discussed, these other characteristics can lead to significant differences in loss severities even when LTVs may be similar. This is further illustrated in Exhibits 32–39, which show the average severities on adjustable and fixed-rate mortgages originated between 2000 and 2006 with different initial property values but similar LTVs. Despite their LTVs being similar, the severities are significantly different, with an inverse relationship to property values. This emphasizes our point that over-reliance on LTV will produce unreliable loss severity predictions. Loan balance and appraisal value should be analyzed separately to estimate loss severities rather than being analyzed as a single entity in the form of LTV.

EXHIBIT 50

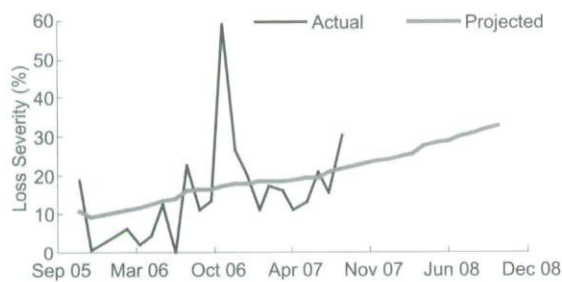
Actual and Projected Loss Severities for 5X1 Alt-A ARMs Originated in 1Q 05 and 2Q 05



Sources: LoanPerformance and Citi.

EXHIBIT 51

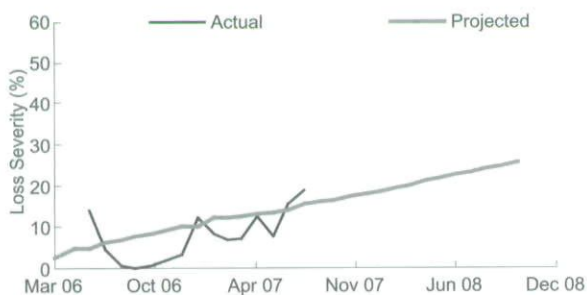
Actual and Projected Loss Severities for Alt-A FRMs Originated in 1Q 05 and 2Q 05



Sources: LoanPerformance and Citi.

EXHIBIT 52

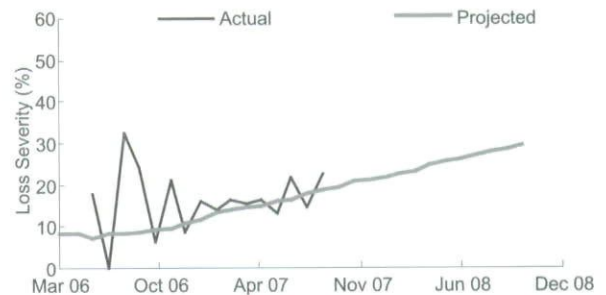
Actual and Projected Loss Severities for 5X1 Alt-A ARMs Originated in 3Q 05 and 4Q 05



Sources: LoanPerformance and Citi.

EXHIBIT 53

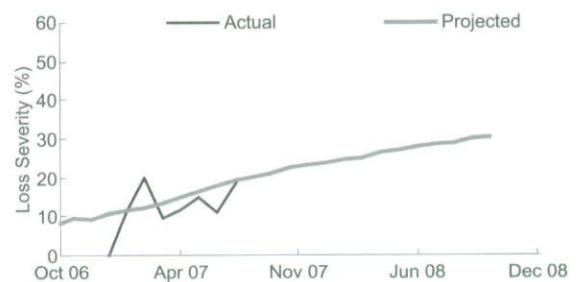
Actual and Projected Loss Severities for Alt-A FRMs Originated in 3Q 05 and 4Q 05



Sources: LoanPerformance and Citi.

EXHIBIT 54

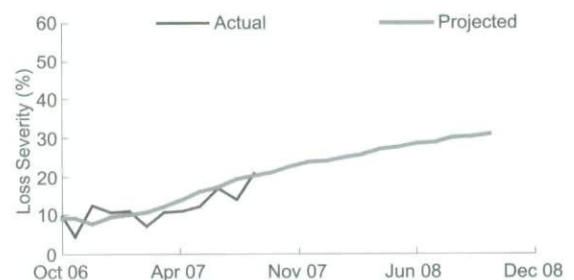
Actual and Projected Loss Severities for 5X1 Alt-A ARMs Originated in 1Q 06 and 2Q 06



Sources: LoanPerformance and Citi.

EXHIBIT 55

Actual and Projected Loss Severities for Alt-A FRMs Originated in 1Q 06 and 2Q 06



Sources: LoanPerformance and Citi.

APPENDIX A

Statistical Approach to Estimating Discounted Value of Distressed Properties

Let $AV(t_0)$ be the appraisal value provided at mortgage origination at time t_0 . The value of the property at any time t can be obtained using the corresponding home price appreciation, $HPA(t - t_0)$, between origination and time t :

$$AV(t) = AV(t_0) \times HPA(t - t_0) \quad (1)$$

Let $\delta(t - t_0)$ be the total discount a distressed property experiences in the market. The market value of the property at any time t is, therefore, estimated as:

$$MV(t) = \{1 - \delta(t - t_0)\} \times AV(t_0) \times HPA(t - t_0) \quad (2)$$

The discount experienced by distressed properties includes two separate discount factors: 1) inflation in the appraisal values above the market price (δ^A) and 2) atypical motivation that distressed properties are subjected to sell below market value. Generally, the inflation in appraisal value is dependent on the original appraisal value of the property and the property type. On the other hand, the second discount factor, $\delta^F(t - t_0)$, accounts for the condition of the property itself. Properties in REO are found to be in worse condition, the primary reason why they are not sold at the foreclosure sale. Hence, the biggest discount is applied to REO properties, followed by foreclosed properties, and then properties sold through short sale. This factor also involves a time-varying component to account for depreciation. The total discount is given by:

$$1 - \delta(t - t_0) = (1 - \delta^A) \times (1 - \delta^F(t - t_0)) \quad (3)$$

Note that the discount factor $\delta^F(t - t_0)$ should be zero at loan origination or at t_0 and, therefore, the total discount should only be due to inflation in appraisal value.

Given the appraisal value at $t = t_0$ and the sale price (or market value), it is fairly straightforward to estimate the discount to appraisal value:

$$\delta^A = 1 - \left(\frac{MV(t \approx t_0)}{AV(t \approx t_0)} \right) = 1 - \left(\frac{MV(t \approx t_0)}{AV(t_0)} \right) \quad (4)$$

Once δ^A is estimated, $\delta^F(t - t_0)$ is back-calculated using Equations (2) and (3). Note that for this calculation, market value at time t is needed, which we obtained from Mortgage Data Resources. Alternatively, an estimate of $MV(t)$ can be obtained using Equation (5):

$$MV(t) = B(t) + TC + CC - NLR \quad (5)$$

where $B(t)$ is the unpaid balance at loan termination, TC and CC are the transaction and carrying costs, and NLR is the net loss reported.

ENDNOTES

The authors wish to thank Robert Young for his many insightful comments, Janice London for her careful preparation of the manuscript, and Cecilia Sarmas, Judith Antelman, and Norma Lana for their fine editorial assistance.

¹Our default model is described in the companion paper, "Modeling of Mortgage Defaults," Lakhbir Hayre, et al., January 22, 2008.

²The servicer may be the original lender or a separate company that has purchased the servicing rights from the securitization trust and has agreed to service mortgage loans on behalf of the trust. Sometimes special servicers may be assigned the task of handling a trust's foreclosed loans and REO properties. We will use the terms lender and servicer interchangeably in this article.

³Note that this cost is not incurred for pre-foreclosure/short sale, where the borrower sells his property before going into foreclosure.

⁴The U.S. Congress may soon vote on the "Emergency Ownership and Mortgage Equity Protection Act." This bill proposes giving bankruptcy judges the authority to modify mortgages on primary residences for debtors in Chapter 13 bankruptcy.

⁵Our default model is described in the companion paper, "Modeling of Mortgage Defaults," Lakhbir Hayre, et al., January 22, 2008.

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