Mortgage Loss Given Default: Loss on Sale and Lost Time

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Abstract

From the lender or investor perspective, the expected losses on a loan reflect both the probability of the loan defaulting and the expected magnitude of the loss. This paper focuses on the magnitude of loss for mortgages that have defaulted. Those losses can be viewed as having two elements: the financial loss associated with the sale of the property, and the time it takes for the default to be processed before the lender or investor can take or sell the property. The results show that both the dollar loss on the sale and the opportunity cost of lost time have substantial variation both across space and over time. This variation can be, at least in part, attributed to borrower and loan characteristics and economic conditions. The legal environment (borrower and lender rights) can have dramatic effects on the default timeline, but there is no evidence that it has an impact on the dollar loss associated with the sale of the property.

Keywords: Mortgage Loss; Loss Given Default; Foreclosure; Foreclosure Laws

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Introduction

The fundamentals that drive the value of a mortgage are the expected cash flows the mortgage will generate over its life and the valuation of these cash flows in the financial market. If mortgages did not terminate early (default and prepayment) or if the losses on a default were zero, mortgage valuations would be much easier, if not trivial. Mortgages would behave very much like US Treasury Bills. However, mortgages do default at a non-trivial rate, and losses on mortgages can be large depending on idiosyncratic variation and macro-economic conditions. To create projected cash flows, lenders and investors must at a minimum model the probability that a loan will default and estimate the losses on loans given a default. This paper focuses on the loss on a mortgage in the event that it has defaulted. Two types of losses are considered. The first is the dollar loss associated with the sale of the property. The second is the time lost (opportunity cost) while a defaulted loan is being processed. This timeline spans from when the loan enters default to the end of the loan's life, when the lender or investor takes the property or sells the property.

This set of information, along with risk tolerances in the financial market (and other factors), can help to determine break-even interest rates on mortgages and the amount of capital a bank is required to hold. In fact, under the Basel II and III capital framework, banks use their own models of the probability of default and loss given default (LGD) to help determine their capital requirements. It is the job of the various regulatory agencies to determine the validity of these internally generated models and this paper can help on how to best design and evaluate internal LGD models.

This paper shows that the loss on the sale and the lost time should be estimated separately. Although both respond to economic stimulus, borrower characteristics, and the legal

environment (borrower and lender rights), they do so in different ways. For example, the low and negative equity almost by definition drives up dollar losses from the sale of the property but it also shortens the amount of time it takes to resolve the defaulted loan (opportunity cost). In fact many factors have this double edged sword impact. States where foreclosures are processed through the judicial system have much longer default timelines but we find no evidence that these types of foreclosures have any impact on the dollar losses from the sale of the property. In fact, the right to redeem the property by the borrower, the right of the lender to use recourse to recover losses outside of the property (using other borrower assets or wage garnishment) all have strong impacts on the default timeline but no measureable impact on dollar losses on the sale of the property.

Descriptive Information

Summary statistics from our dataset show substantial variation, across time and space, in both loss rates and the length of the default timeline.

Our data source is the Single Family Loan-Level Dataset from Freddie Mac (available at http://www.freddiemac.com/news/finance/sf_loanlevel_dataset.html, downloaded in February 2015). Only loans with reported losses (or gains) and default related sale prices are included in the sample. The sample starts in January 2000 and ends in December 2013. Repurchased and modified loans are not included in the sample. Loans with key missing information such as location, purchase prices, balance or other factors are also excluded. To calculate the loss on the sale (los_i) we use the sale price of the defaulted property (sp_i) at resolution (the end of the loan or zero balance date) and the unpaid balance (upb_i) on the loan at resolution. i indexes the loans.

$$los_i = (upb_i - sp_i) / upb_i \quad (1)$$

Figure 1 presents the distribution of the loss on sale. The mean loss is 38 percent with a standard deviation of 25 percent. The peak of the distribution is for losses of 40 to 50 percent. However, some loans show a gain (negative loss) on the sale because the sale price is above the unpaid balance. In short, there is a wide variety of losses on sales. Figure 2 shows box charts for the loss on sale for each year (the year in which the loan ends or is resolved, not the year in which the loan was originated). The figure indicates that within each year there is a very large variance in loss rates. The median loss rate increases steadily from 2000 until 2009 and begins to slowly decline thereafter. The distribution also tends to tighten up over the 2009 to 2013 time period. Figure 3 reports box charts by state. Again, within each state there is a very wide distribution of loss rates. Across states there are also substantial differences in both the median loss rate and the volatility around the median. Consistent with the magnitude of the house price cycles and overall severity of the Great Recession, states with especially low loss rates are Alaska, Montana, North Dakota, South Dakota, and Wyoming. States with especially high loss rates are Arizona, California, Florida, Indiana, Michigan, Nevada, and Ohio.

The last date the borrower makes a payment is used as the start date for the default timeline.[1] The loan is fully resolved when Freddie Mac has received proceeds from selling the property and any losses are written off (the zero balance date). Figure 4 shows the default timeline distribution. The mean default timeline is approximately 18 months, the peak of the distribution is 12 to 16 months and the shape of the distribution is approximately log-normal. Figure 5 box charts indicate that the default timeline was fairly steady from 2000 through 2007. In 2008 and 2009 both the variance and median of the timelines increased. After 2009 timelines

[1] Technically the loan is in default when it misses one payment. However, many of these loans cure so we mark the start of the timeline at the last payment date. The end of the default timeline is the end of the loan's life (the resolution date for the lender and investor).

have been declining considerable and are below the early 2000s speeds. Figure 6 shows the variation in the default timelines across states. Again, there is substantial variation across different states and substantial variation within states. States with large losses are not always states with long default timelines. For example, Arizona had very high loss rates but has the shortest default timeline and a low variance of timelines within the state. By way of contrast, Wisconsin has a long timeline as well as relatively high loss rates. This paper will try to disentangle the economic and legal reasons why losses and default timelines differ so dramatically.

There are multiple paths by which a loan can be resolved. In our data the most prevalent path is for Freddie Mac to become the owner of the property through a foreclosure sale. When this occurs, the property is referred to as "real estate owned," or reo property (approximately 65 percent of the data has an reo indicator). After Freddie Mac takes possession and ownership of the property, it contacts local representatives to sell the property in an attempt to recover losses. Loans with losses and a recorded sale that are not reo may be short sales (the borrower sells the property but does not cover all the losses), complete sales (the borrower sells the property and covers all the losses), or sales by or to third parties. There are a myriad of other avenues for resolving a loan in default, including refinancing or loan modification, but none of these other options include the sale of the property. For property that does become reo, we can measure the time from the last payment date to the reo begin date (pre-reo timeline) as well as the time from the beginning of reo status to the resolution date when the property is sold (reo timeline). Figures 7 and 8 provide the distributions of these parts of the default timeline. There is substantial variation. The peak of the distribution is 8 to 10 months for the pre-reo timeline and 4 to 5 months for the reo timeline.

In summary, losses and default timelines vary over time, across states, and within states. The remainder of this paper will discuss potential explanations for these findings and conduct empirical tests to support or refute these hypotheses.

Motivation and Literature

The loss given default (lgd) literature uses a variety of approaches to define losses and how these losses should be represented. The simplest approach, as discussed earlier, is to compare the outstanding balance on the loan at the end of a loan's life to the sale price of the defaulted property (los_{it}). The advantage of this approach is that it does not include any mechanical costs associated with holding the property or selling the property (Lekkas et al. 1993, Crawford and Rosenblatt 1995, and Pennington-Cross 2003). Therefore, economic and financial considerations should determine this loss rate, not servicer and lender operational efficacy. An alternative is to include the original balance of the loan in the denominator so the loss rate is a percentage of the origination loan amount instead of the amount of the loan still owed (Clauretie and Herzog 1990, and Zhang, Li, and Liu 2010). Other researchers include the costs of selling the property or the net sale proceeds (Park and Bang 2014) to calculate losses. Still others attempt to measure the lost interest payments, and proxies for insurance costs and real estate taxes (Calem and LaCour-Little 2004, Qi and Yang 2009 and Cordell, Geng, Goodman, and Yang 2013). This last approach comes closer to estimating the full costs associated with a default. However, the mixture of time-related costs with dollars lost due to property depreciation make interpretation of the results more difficult. For example, Qi and Yang (2009) include measures of the foreclosure processes used in each state. They find that loans in states with a judicial foreclosure process have higher loss rates. Cutts and Merrill (2008) document that for Freddie Mac loans originated before or at the beginning of the financial crisis, foreclosures

typically take longer in states with a judicial foreclosure process. The longer timeline of a judicial foreclosure process can increase losses due to time costs (lost interest) or due to depreciation of the property caused by poor maintenance.

As a result of these complications, our empirical approach is to conduct two separate model specifications. The first is a simple loss on the sale (los_{it}) specification. The second estimates the time it takes for a loan to transition from the beginning of the default to resolution of the loan. This default timeline includes time when the borrower is still living in the property (pre-reo time) and the period of time after the lender takes over the property (reo time). Since ownership has changed, these two time periods (pre-reo and reo) should be treated separately. The incentives for the original homeowner and the foreclosing investor are likely quite different, and the quality of the ownership (quality of the title) may have also changed.

Data and Model Specification

The loss on sale (los_{it}) should be strongly related to the amount of equity in the property. Figure 1 and table 1 highlight that the average loss is very high in the data (38 percent) but there are some property that have 100 percent losses and a non-trivial number that have gains on the sale (negative losses). A gain on the sale can only occur when the value of the property is greater than the outstanding balance on the loan. In short, and consistent with the literature, property with lower current loan to value (ltv) ratios should have low losses and even potentially gains, whereas property with high ltvs should have higher losses. Loans with larger unpaid balances also have lower losses. This may be due to fixed costs, the amount of effort made in the sale of lower cost defaulted homes, the quality or "sellability" of the home, or other hidden factors that may be reflected in the outstanding loan balance (Clauretie and Herzog 1990, Zhang, Li, and Liu 2010, Park and Bang 2014, Calem and LaCour-Little 2004, Qi and Yang 2009).

Borrower characteristics may also affect the loss. For example, homeowners who are having financial difficulty may react differently if this is their first home or if they had been very careful with their finances. Therefore, a first time homebuyer indicator is included, as well as the credit score of the borrower at origination. To proxy for overall deterioration of the labor market, the change in the county level unemployment rate from origination to the end of the loan is also included. Locations with overall worsening employment conditions are likely to have weak demand for housing, leading to larger price declines and losses on default-related sales.

The type of loan may also matter, at least indirectly. For example, the channel (retail, broker, or wholesale) through which the loan is originated may reflect unobserved differences in loan quality (Jaing, Nelson and Vytlacil 2014). In addition, borrowers who extract equity through a cash-out refinance may be more likely to default (Pennington-Cross and Chomsisengphet 2007). Single family homes technically can include up to 4 units. If the borrower lives in one of the units and rents out the remaining units, she is likely relying on the income from the rentals to help pay the mortgage. This arrangement can increase the risk of the loan and may lead to more property value volatility and sensitivity to local economic conditions.

The mortgage market experienced a series of interventions as the mortgage crisis unfolded that are likely to affect default timelines and realized losses. For example, in October of 2008 Fannie Mae and Freddie Mac announced that they suspended foreclosures of occupied homes (Reuters.com, 2008) and the largest servicers announced a similar moratorium in February of 2009 (Wall Street Journal, 2009). In addition, different states (for example, California in June of 2009) and even municipalities instituted moratoriums. In September of 2010 some larger servicers announced that they were suspending foreclosures after the "robo-signing" of legal documents (in which servicers were approving foreclosures in large quantities

without having or even reviewing appropriate documentation) was publicly revealed (Inside Mortgage Finance, 2010). Any empirical model of foreclosures, refinances, or losses must try to account for these changes in the mortgage market. In this paper we include state and time fixed effects to control for the events.

There is evidence that the way foreclosures are processed and the rights of the lender and borrower can affect mortgage outcomes. For example, there is evidence that, in states with judicial foreclosure proceedings (as opposed to power of sale proceedings which do not involve the judicial process), the foreclosure process takes longer, and defaulted loans may modify a little more and cure less or more (in other words, empirical results are mixed). However, ultimately the use of judicial foreclosure proceedings has little impact on the outcome for the borrower. The impact of the right to redeem the property is even less clear in terms of default rates but again is associated with longer foreclosure timelines (Collins, Lam and Gerardi 2011, Demiroglu, Dudley and James 2014, Lambie-Hanson and Willen 2013, Cordell, Geng, Goodman and Yang 2013, and Clauretie and Herzog 1990). The ability of the lender or investor to attempt to recover losses from the borrower beyond taking the home has also been shown to decrease foreclosure rates and this is especially true when a home is in negative equity, ltv>100 percent (Ghent and Kudlyak 2011, Cha, Haughwout, Hayashi and Klaauw 2015). Our measures of states with judicial foreclosures, statutory rights of redemption, and recourse are taken from Cutts and Merrill (2008) and Ghent and Kudlyak (2011). How these results translate to losses is an empirical question but it would be reasonable to assume that factors that drive up foreclosures and defaults may also drive up losses. Our focus is on separating the costs into time costs and dollars costs on the sale.

Table 1 provides the summary statistics for the estimation data set. The average loss on sale is 38 percent and the average time to resolve a default is 18 months (defaults that end in the sale of the property only). Compared to all loans, the loss rate on loans that become reo is almost identical but the default timeline is a few months longer, almost 21 months. The majority of the default timeline is spent before the property becomes reo (pre-reo). Consistent with the incentives to default, by the time a defaulted loan (reo or not) is resolved the ltv is almost 100 percent for the average loan. Credit scores are less than 700 on average and unemployment rates have risen by almost 4 percentage points since origination. The majority of the loans were refinances at origination and about one third originated through a retail (non-broker or wholesale) channel. The legal variables show that there is substantial variation in space in the legal rights of the borrower and lender.

The loss on sale specification is as follows:

$$los_i = bal_i + bor_i + loan_i + legal_i + fe_i + \varepsilon_i \quad (2)$$

los_i is the loss on the sale; bal_i is a vector of balance related variables such as the unpaid balance (upb_i) and the current loan to value ratio (ltv_i); bor_i is a vector of borrower related variables such as credit score ($fico_i$), a first time homeowner indicator ($first_i$) and the change in the county unemployment rate ($\Delta urate_i$); $loan_i$ is a vector of loan attributes at origination such as an indicator that the loan was originated through a retail channel ($retail_i$), a cash out refinance indicator ($cashrefi_i$), a refinance indicator when no cash is extracted ($nocashrefi_i$) and units an indicator that there is only one unit in the property ($units_i$); $legal_i$ is a vector of variables that describe the legal processes and rights of the borrower and lender such as an indicator that the foreclosure process follows a judicial procedure ($judicial_i$), an indicator that the borrower has the statutory right to redeem the property after the initial transfer of property ownership from the

borrower to another entity (srr_i), and an indicator that the lender has the ability recover any losses from non-housing related sources, income or other borrower assets ($recourse_i$); fe_i is a matrix of fixed effects including fixed effects for the year the loan is resolved ($year_i$), servicer fixed effects representing the entity that collects the checks and processes defaults ($serv_i$) (which may differ from the originator, lender, and investor), and a vector of state fixed effects ($state_i$) which can only be included when the legal variables are not included; ε_i is a random and identically distributed error term. The specification is estimated in ordinary least squares and allows the errors to correlate within each 3-digit zip code.

The default timeline specification is very similar to the loss on sale specification and is as follows:

$$months_i = bal_i + bor_i + loan_i + legal_i + fe_i + \varepsilon_i \quad (2)$$

Months represents the number of months from the last payment to the loan resolution ($month\_ltz_i$), which is the end of the loan or zero balance. Various specifications will look only at loans that become reo and break the time line into the pre-reo timeline ($month\_ltr_i$) and the reo timeline ($month\_rtz_i$). Each grouping of explanatory variables is the same as for the loss on sale regression except that all time-varying variables are observed at the last payment date (the beginning of the default time line). This is done so the explanatory variables represent starting conditions of the default timeline instead of contemporaneous conditions.

Results

Loss on Sale Results

Table 2 provides the loss on sale results for various specifications. Consistent with the prior findings, specification I shows that the ltv and unpaid balance on the loan have the

expected signs and provide reasonable explanatory power (R^2 over 0.25). Loans with higher current ltvs have higher losses; loans with larger unpaid balances have lower losses. Non-linear and more flexible specifications of these two variables showed no unusual patterns and provided little or no more explanatory power, so we report the linear specification only. Specification II indicates that borrower characteristics can also impact losses. For all specifications in the table, first-time homebuyers, borrowers with higher credit scores at origination, and declining unemployment rates are associated with lower loss rates on the sale. However, compared to the balance variables (unpaid balance and ltv) the borrower characteristics provide little additional explanatory power. Specification II indicates that the characteristics of the loan at origination can also have meaningful impacts on expected losses on the sale. Loans originated through the retail channel and properties with one unit have lower losses. Refinance loans tend to have higher losses and cash out refinances have the highest. In summary, purchase loans that are retail originated and have one unit are expected to have much lower losses on sale (more than 35 percent lower than other loans).

The time period of this study covers the housing boom, housing bust and recovery. Since there have been many interventions in the market, resolution-year fixed effects are included in specification IV. This has little impact on the point estimates or their precision for all variables except the change in the unemployment rate. Specification V includes state fixed effects to control for the legal environment (borrower and lender rights) and servicer fixed effects to control for unobserved differences in how servicers process defaulted loans. These extra control variables add little to the explanatory power of the regression and do not materially change the results.

Loss on Sale Results: Borrower and Lender Rights

Table 3 presents specification tests that examine borrower and lender rights. Specification I includes the typical approach to examining these issues. Dummy variables are included to indicate whether the defaulted loan is in a judicial foreclosure state, a statutory right of redemption state, or a recourse state. In general we should expect that judicial foreclosure processes and rights of redemption increase losses on the sale: they increase the time it takes to recover the property, and they reduce the quality of the title (ownership) during the right of redemption time period. This logic may be correct when time costs are included in the loss estimate, but the impact on loss on sale is less direct. For example, consider a homeowner who is not making any payments on his mortgage. The owner expects to be eventually removed from the property but does not know exactly when (see the next section for the large variance on the default timeline). Under these circumstances, the homeowner has no incentive to maintain the property with a view to the long run. The primary objective is to maintain habitability (for example, keep the heat or air conditioning on), not to invest in needed capital expenses to stop property depreciation and maintain full functionality (such as replacing the roof, repaving the driveway, or repainting the exterior). From this perspective it is not a surprise that specification I finds that losses on sale are 3 percentage points higher in judicial foreclosure states.

Specification II improves identification by reducing the sample to metropolitan areas whose regions include at least one state with a judicial foreclosure process and another state with a power of sale foreclosure process. The specification also includes metropolitan area fixed effects. This empirical approach uses the variation within a single metropolitan area, not across different metropolitan areas, to investigate the impact of different legal regimes. In contrast to the prior literature, the point estimate is statistically insignificant and the opposite sign. The same

approach is used to create unique metropolitan area samples where there is variation in rights of redemption and recourse. Again, the results find no statistically significant impact on the loss on sale.

In short, while there is evidence that borrower rights and foreclosure processes have impacts on many mortgage outcomes, there is no evidence that they have an impact on the loss associated with the sale. The next section will examine whether these factors have an impact on losses associated with time or the default timeline.

Lost Time or the Default Timeline Results

Tables 4 and 5 present the default timeline results. Since the number of months in the default timeline has a log-normal distribution, the log of the number of months from the beginning of default to resolution is used as the left hand side variable. Year, state, and servicer fixed effects are included in most specifications. In table 4, specifications I and II use the full length of the default timeline (from the last payment date to loan resolution or zero balance). Specification I includes loans where the property never becomes reo; specifications II through IV include loans that do enter the reo state at some point during the default timeline. The average timeline is much longer for loans that enter reo (on average 35 months versus 18 months); however, the coefficient estimates are similar.

Loans with higher ltvs have shorter timelines, in contrast to our finding that loans with higher ltvs result in higher losses upon sale. There are intuitive reasons why this might be the case. Less equity, almost by definition, increases losses on a sale. However, a higher ltv makes it harder to cure or modify the loan. As a result, less effort is likely spent on finding an alternative to foreclosure and more effort is spent processing the foreclosure and getting the home sold, thus shortening the timeline.

Loans with larger outstanding amounts (unpaid balances) usually are associated with a longer default timeline. This is in contrast to losses on sale, where larger loans are associated with smaller losses. These contrasting findings likely relate to the amount of effort made by servicers for larger loans and the thickness of the market for selling property. On the one hand, a large loan may get more attention and effort from the servicer because it is a bigger percentage of servicing rights compensation, resulting in smaller losses. On the other hand, the larger homes associated with larger loans can be more unique and more difficult to sell. Moreover, the potential buyer pool is often smaller -- there are only so many executives to buy expensive homes in most cities -- and that means it can take longer to sell a property, extending the default timeline.

The remaining results for foreclosure timelines are largely consistent with the loss on sale results. The default timeline is shorter for borrowers with higher credit scores and in locations with declining unemployment rates. Refinanced loans tend to take longer to sell, and the impact of being a single-unit property is inconsistent.

There are differences in the results across the different timelines. For example, using specifications I and II, the non-reo defaults are almost 3 times more sensitive to borrower credit score. There are large differences between the pre-reo timeline and the reo timeline results (specifications III and IV). In general, once the loan has become reo the timeline is more strongly affected by the key loan characteristics (ltv, upb, and fico) and not materially impacted by loan origination information, labor market conditions or other borrower characteristics. This result makes good sense. During the pre-reo timeline the original owner is still in the house; during the reo timeline the lender/investor owns and controls the property and is attempting to sell it to recover any losses. So, once the lender/investor owns the property factors that affect borrower

behavior (job status, first time homebuyer, the type of loan, etc.) have no consideration anymore. The process has no negations left between the borrower and the lender/investor. Lastly, credit scores are likely proxying for the reliability of the borrower and may reflect the inclination of the borrower to maintain the property.

Lost Time or the Default Timeline Results: Borrower and Lender Rights

Tables 5 and 6 examine the impact of the legal processes used to govern a foreclosure and the rights of the lender to recover losses from other assets and income sources beyond just the property. In table 5 the same specifications are used as in table 4 but dummy variables for judicial, statutory right of redemption and recourse are included. The results for the default timelines are much stronger and more consistent than for loss on sale results. In general, judicial foreclosures increase the length of the default timeline. The impact is the strongest in the pre-reo timeline. This makes sense because once a loan becomes reo it has completed the judicial portion of the foreclosure process. In the post judicial time period (reo timeline), the impact of a judicial foreclosures should be zero unless there is some unobserved post treatment or residual effect on the ability to sell for judicially foreclosed property. The results indicate some of this impact and the estimated coefficient is about one-sixth the size as comparted to the pre-reo coefficient.

The right to redeem the property tends to speed up non-reo sales and the pre-reo timeline, while extending out the reo timeline. The right to redeem occurs after the first transfer of ownership. If the property is sold before the redemption period ends, the new owner will not have a clean title or the usual property rights, which should suppress the value of the property. Therefore, a lender/investor will most likely wait for the redemption time period to pass before selling the property on the open market. The results confirm this notion and also find that the processing before reo is speeded up, likely to compensate for the longer reo timeline.

The lender/investor's right to seek recourse also speeds up the default timeline. Lenders who may use recourse may spend less time looking for alternative ways to recover losses and therefore can get through the default timeline more quickly. This is true for both reo and non-reo default timelines.

Table 6 takes the same geographic based sampling approach as was used for the loss on sale legal tests. Each coefficient reported is estimated in a separate regression. All regressions include the basic specifications reported in table 5 and add metropolitan area fixed effects. The results are reported for four different samples that are designed to improve identification. For example, the judicial sample only includes metropolitan areas that have judicial and power of sale states. The srr sample only includes metropolitan areas that include states both with right of redemption and without. The recourse sample includes metropolitan areas that includes states with and without the right of recourse for the lender. With these additional controls, the results are largely unchanged. Judicial foreclosures slow the default timeline, recourse speeds it up before reo and statutory right of redemption slows the timeline once the reo process has started.

Conclusion

This paper examines losses on defaulted mortgages. Information in this paper can help lenders and their regulators design more effective loss given default models that are crucial for estimating needed economics and regulatory capital requirements. Descriptive statistics show that the loss on the sale and the amount of time that a loan is in default before resolution have substantial variation across space (state and metropolitan areas) and over time (during the housing run-up, collapse and recovery). While loss rates on sales have been declining after the recession, the default timeline (the time from the last payment to loan resolution through sale)

has been declining much more rapidly. In fact, the default timeline is shorter in 2012 and 2013 than it was in any time during the 2000s.

When considering losses given default it is important to treat the loss on the sale separately from the lost time (the time it takes the loan to work its way through the default, foreclosure, and recovery processes). For example, less equity and smaller loan amounts increase losses on the sale but shorten the default timeline.

After improving the identification strategy by limiting the sample to loans in metropolitan areas with a spatial variation in the legal rights (proxied by the type of foreclosure proceeding, rights of redemption and the lender's ability to recover losses from more than the property sale or recourse), there is no evidence that borrower and lender rights have an impact on the loss on the sale. However, these legal rights do have non-trivial impacts on the default timeline (lost time or the opportunity cost). For example, in states with judicial foreclosure proceedings, the default timeline takes from 19 to 32 percent longer. In addition, the judicial effect is largest before the loan becomes owned by the lender/investor (more than 40 percent longer). Defaulted loans in states that allow recourse in general have shorter default timelines (10 to 20 percent). As anticipated, the right of the borrower to redeem the property after default slows the sale of the property once it becomes owned by the investor/lender (12 percent longer) but has no measureable impact before the reo time line begins.

Before a property becomes reo (pre-reo timeline), almost all potentially relevant information has a nontrivial impact, including the equity position, loan type, borrower and local labor market conditions. This may reflect the fact that the pre-reo time period is when the borrower and lender/investor are still negotiating (or at least interacting) and both parties have specific rights. Once the lender takes possession of the property, only three factors drive the reo

timeline – the equity in the home, the size of the outstanding loan, and the borrower's credit score. The type of loan, labor market conditions and most of the information about the borrower are no longer relevant. This is because the lender owns the property during the reo timeline and no longer needs to interact with the borrower and so the maintenance and the sale of the property is done at its own discretion.

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Table 1: Summary Statistics and Description of Variables

Variable Name	Description	Mean	Standard Deviation
los_i	Loss on sale = 100*(unpaid balance - default sale price) / unpaid balance at loan resolution date.	38.36	25.07
$month\_ltz_i$	The timeline: Months from last payment date to loan resolution (end of loan and zero balance date).	18.10	9.60
ltv_i	100*(loan amount /house value) at loan resolution date. House value is estimated by updating the value from the origination date to the resolution date using the 3-digit zip code repeat price index reported by the Federal Housing Finance Agency.	99.81	30.25
upb_i	Unpaid balance in $1,000 at the loan resolution date.	165.37	85.36
$fico_i$	Fico score at origination.	692.95	54.00
$first_i$	First time homebuyer indicator at origination.	0.10	0.31
$\Delta urate_i$	Change in county unemployment rate from origination to loan resolution as reported by the Bureau of Labor and Statistics. Positive values indicate an increase in the rate.	3.90	2.73
$retail_i$	Loan originated through a retail channel indicator.	0.34	0.47
$cashrefi_i$	An indicator that the loan was originated as a refinance that extracted equity and took cash out.	0.35	0.47
$nocashrefi_i$	An indicator that the loan was originated as a refinance that did not take any cash out.	0.25	0.43
$units_i$	One housing unit indicator.	0.99	0.11
$judicial_i$	Judicial foreclose process indicator.	0.35	0.48
srr_i	Statutory right of redemption indicator.	0.45	0.50
$recourse_i$	Recourse indicator.	0.65	0.48
Loans that are real estate owned (reo) at some point during the default timeline			
los_i	Loss on sale = 100*(unpaid balance - default sale price) / unpaid balance.	38.05	27.44
$month\_ltz_i$	The timeline: Months from last payment date to loan resolution (end of loan and zero balance date).	20.60	9.04
$month\_ltr_i$	The pre-reo timeline: Months from last payment date to the beginning of the property becoming reo.	14.16	8.25
$month\_rtz_t$	The reo timeline: Months from beginning of reo to loan resolution (end of loan and zero balance date).	6.43	3.92

218,128 loan are included in the sample. 141,489 loans become real estate owned (reo) at some point during the default timeline. Source: All variable are collected from the Freddie Mac Single Family Loan Level Dataset except $\Delta urate_{it}$ is collected from the Bureau of Labor and Statistics and judicial, srr, recourse are collected from Cutts and Merrill (2008) and Ghent and Kudlyak (2011).

Table 2: Loss on Sale (los_{it}) Results

	I: Balance		II: Borrower		III: Loan		IV: Year		V: Servicer & State	
Variable	Coeff.	SE	Coeff.	SE	Coeff.	SE	Coeff.	SE	Coeff.	SE
ltv_{it}	0.48***	0.03	0.43***	0.03	0.45***	0.03	0.47***	0.03	0.51***	0.01
upb_{it}	-0.12***	0.01	-0.12***	0.01	-0.12***	0.01	-0.12***	0.01	-0.11***	0.00
$fico_i$			-0.02***	0.00	-0.01***	0.00	-0.02***	0.00	-0.01***	0.00
$first_i$			-6.16***	0.38	-1.11***	0.24	-1.29***	0.24	-1.15***	0.21
$\Delta urate_{it}$			1.06***	0.11	1.00***	0.11	0.25*	0.13	0.60***	0.10
$retail_i$					-2.82***	0.23	-2.98***	0.23	-3.05***	0.22
$cashrefi_i$					7.81***	0.43	7.82***	0.42	8.00***	0.34
$nocashrefi_i$					6.51***	0.44	6.63***	0.44	6.22***	0.30
$units_i$					-20.31***	0.95	-19.84***	0.90	-19.00***	0.68
fixed effects:										
year							x		x	
servicer									x	
state									x	
constant	9.84***	2.18	23.84***	2.46	34.77***	2.96	25.21***	9.04	11.83	8.97
R^2	0.28		0.29		0.32		0.34		0.38	
N	218,128		218,128		218,128		218,128		218,128	

*, **, and *** indicate that the coefficient is significant at the 10, 5, or 1 percent level. Ordinal Least Squares results allowing the errors to correlate within 3-digit zip codes.

Table 3: Loss on Sale (los_{it}) Results – Borrower and Lender Rights (Legal)

	I. Whole Sample		II. Yes/No Judicial Metro Areas		III. Yes/No SRR Metro Areas		IV. Yes/No Recourse Metro Areas	
Variable	Coeff.	SE	Coeff.	SE	Coeff.	SE	Coeff.	SE
ltv_{it}	0.47***	0.02	0.76***	0.04	0.77***	0.04	0.66***	0.04
upb_{it}	-0.12***	0.00	-0.16***	0.02	-0.14***	0.02	-0.12***	0.01
$fico_i$	-0.01***	0.00	-0.02***	0.01	-0.01**	0.01	-0.01**	0.01
$first_i$	-1.01***	0.23	-2.01**	0.87	-0.75	0.81	-1.91*	0.98
$\Delta urate_{it}$	0.34***	0.12	0.73***	0.16	0.91***	0.17	0.28	0.21
$retail_i$	-3.00***	0.23	-3.32***	0.53	-3.75***	0.62	-2.90***	0.65
$cashrefi_i$	7.78***	0.45	10.75***	0.47	11.28***	0.91	8.51***	1.33
$nocashrefi_i$	6.62***	0.43	6.80***	0.62	8.15***	0.66	5.62***	0.86
$units_i$	-19.43***	0.86	-21.82***	2.16	-22.90***	1.36	-21.38***	2.30
$judicial_i$	3.05**	1.47	-3.20	3.69	0.44	3.13	-3.44	3.38
srr_i	1.69	1.28	-4.05	4.04	0.65	2.10	10.19***	3.52
$recourse_i$	1.05	1.15	3.90	3.70	-5.84**	2.36	3.99	3.36
fixed effects:								
year	x		x		x		x	
servicer	x		x		x		x	
metro area			x		x		x	
constant	19.53**	8.83	9.23	7.30	11.14	8.52	6.65	5.06
R^2	0.35		0.34		0.34		0.27	
N Metro	341		19		19		6	
N	218,128		19,760		19,554		5,096	

*, **, and *** indicate that the coefficient is significant at the 10, 5, or 1 percent level. Ordinal Least Squares results while allowing the errors to correlate within 3-digit zip codes. The impact of judicial foreclosure is also insignificant when the metropolitan area fixed effects are not included in the specification.

Table 4: Default Timeline Results (log of months)

	I. No reo defaults: Full timeline		II. Reo defaults: Full timeline		III. Reo defaults: Pre-reo timeline		IV. Reo-defaults: Reo timeline	
Variable	Coeff.	SE	Coeff.	SE	Coeff.	SE	Coeff.	SE
$lnltv_{it}$	-0.168***	0.024	-0.124***	0.011	-0.079***	0.014	-0.206***	0.015
$lnupb_{it}$	0.008	0.006	0.090***	0.004	0.068***	0.004	0.146***	0.007
$lnfico_i$	-0.969***	0.037	-0.332***	0.015	-0.308***	0.017	-0.352***	0.020
$first_i$	-0.003	0.008	0.012***	0.003	0.013***	0.004	0.007	0.006
$\Delta urate_{it}$	0.008***	0.002	0.008***	0.002	0.012***	0.002	-0.002	0.002
$retail_i$	-0.040***	0.005	-0.018***	0.002	-0.023***	0.003	-0.010***	0.003
$cashrefi_i$	0.051***	0.005	0.017***	0.003	0.024***	0.004	-0.004	0.005
$nocashrefi_i$	0.019***	0.005	0.016***	0.003	0.023***	0.004	-0.001	0.004
$units_i$	-0.027	0.024	0.030***	0.008	0.043***	0.011	0.005	0.012
fixed effects:								
year	x		x		x		x	
servicer	x		x		x		x	
state	x		x		x		x	
constant	9.627***	0.349	9.627***	0.349	3.678***	0.168	3.372***	0.230
R^2	0.26		0.33		0.42		0.18	
N	76,693		141,489		141,489		141,489	

Left hand side the log of months. *, **, and *** indicate that the coefficient is significant at the 10, 5, or 1 percent level. Ordinal Least Squares results allowing the errors to correlate within 3-digit zip codes.

Table 5: Default Timeline Results (log of months) – Borrower and Lender Rights (Legal) – Whole Sample

	I. No reo defaults: complete timeline		II. Reo defaults: complete timeline		III. Reo defaults: pre-reo timeline		IV. Reo-defaults: Reo timeline	
Variable	Coeff.	SE	Coeff.	SE	Coeff.	SE	Coeff.	SE
$judicial_i$	0.173***	0.030	0.348***	0.016	0.485***	0.020	0.077***	0.022
srr_i	-0.125***	0.022	-0.004	0.015	-0.114***	0.016	0.184***	0.030
$recourse_i$	-0.063***	0.024	-0.042**	0.020	-0.112***	0.015	0.042	0.045
$lnltv_{it}$	-0.145***	0.032	-0.121***	0.021	-0.056**	0.023	-0.255***	0.032
$lnupb_{it}$	0.037***	0.008	0.102***	0.006	0.087***	0.006	0.140***	0.012
$lnfico_i$	-0.919***	0.036	-0.307***	0.019	-0.261***	0.021	-0.391***	0.026
$first_i$	0.000	0.008	0.014***	0.004	0.007*	0.004	0.023***	0.007
$\Delta urate_{it}$	0.029***	0.002	0.011***	0.003	0.027***	0.003	-0.029***	0.005
$retail_i$	-0.037***	0.005	-0.008***	0.003	-0.023***	0.004	0.015**	0.006
$cashrefi_i$	0.061***	0.005	0.028***	0.004	0.032***	0.005	0.013**	0.007
$nocashrefi_i$	0.025***	0.006	0.019***	0.004	0.014***	0.005	0.032***	0.007
$units_i$	-0.024	0.024	0.019	0.013	0.058***	0.015	-0.064***	0.022
fixed effects:								
year	x		x		x		x	
servicer	x		x		x		x	
constant	8.970***	0.358	4.036***	0.186	3.040***	0.226	3.839***	0.308
R^2	0.24		0.34		0.37		0.06	
N	76,693		141,489		141,489		141,489	

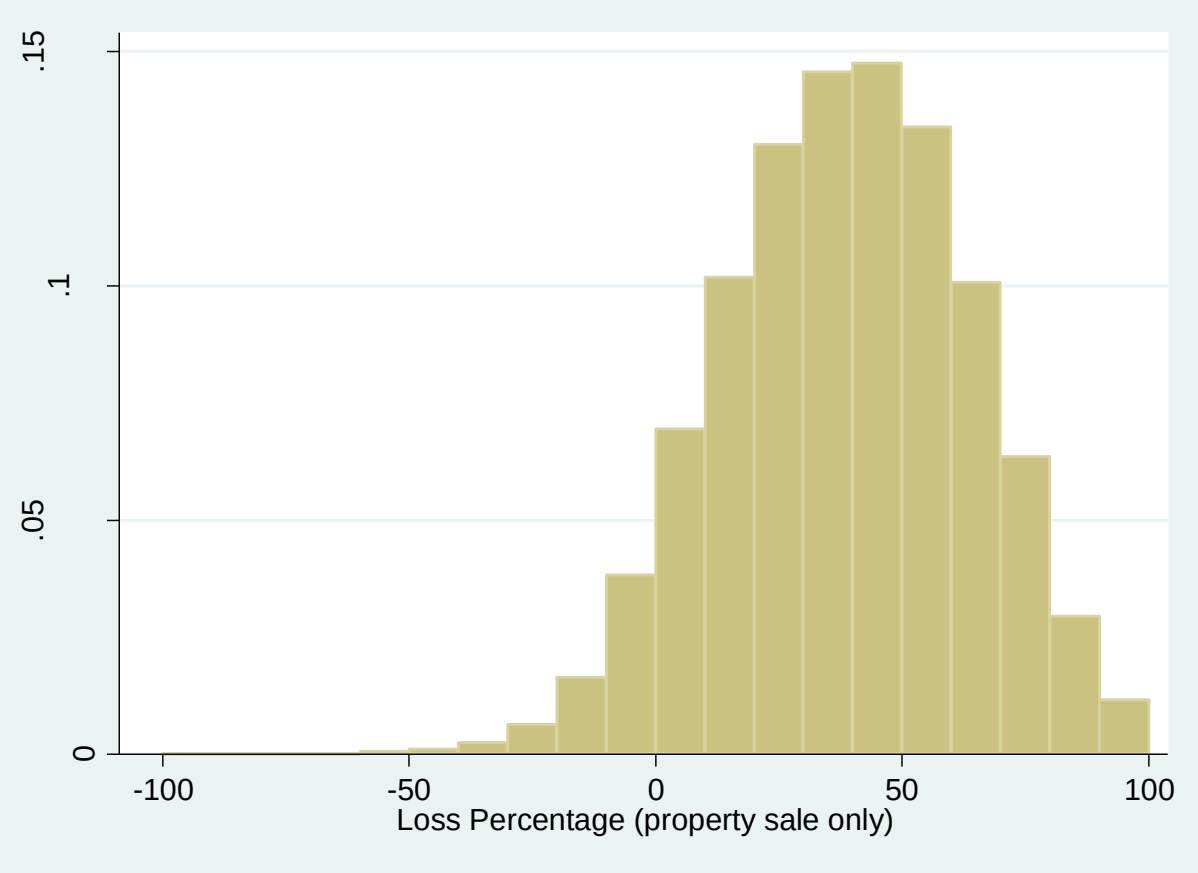
Left hand side the log of months. *, **, and *** indicate that the coefficient is significant at the 10, 5, or 1 percent level. Ordinal Least Squares results allowing the errors to correlate within 3-digit zip codes.

Table 6: Default Timeline Results (log of months) – Borrower and Lender Rights (Legal) – Subsamples

	I. No reo defaults: complete timeline		**II. Reo defaults: complete timeline**		**III. Reo defaults: pre-reo timeline**		**IV. Reo-defaults: Reo timeline**	
Variable	Coeff.	SE	Coeff.	SE	Coeff.	SE	Coeff.	SE
Judicial sample								
$judicial_i$	0.191***	0.029	0.316***	0.020	0.403***	0.027	0.219***	0.052
ssr sample								
ssr_i	-0.027	0.019	0.020	0.018	-0.027	0.020	0.120**	0.059
recourse sample								
$recourse_i$	-0.187**	0.087	-0.107**	0.049	-0.203***	0.033	0.173	0.110

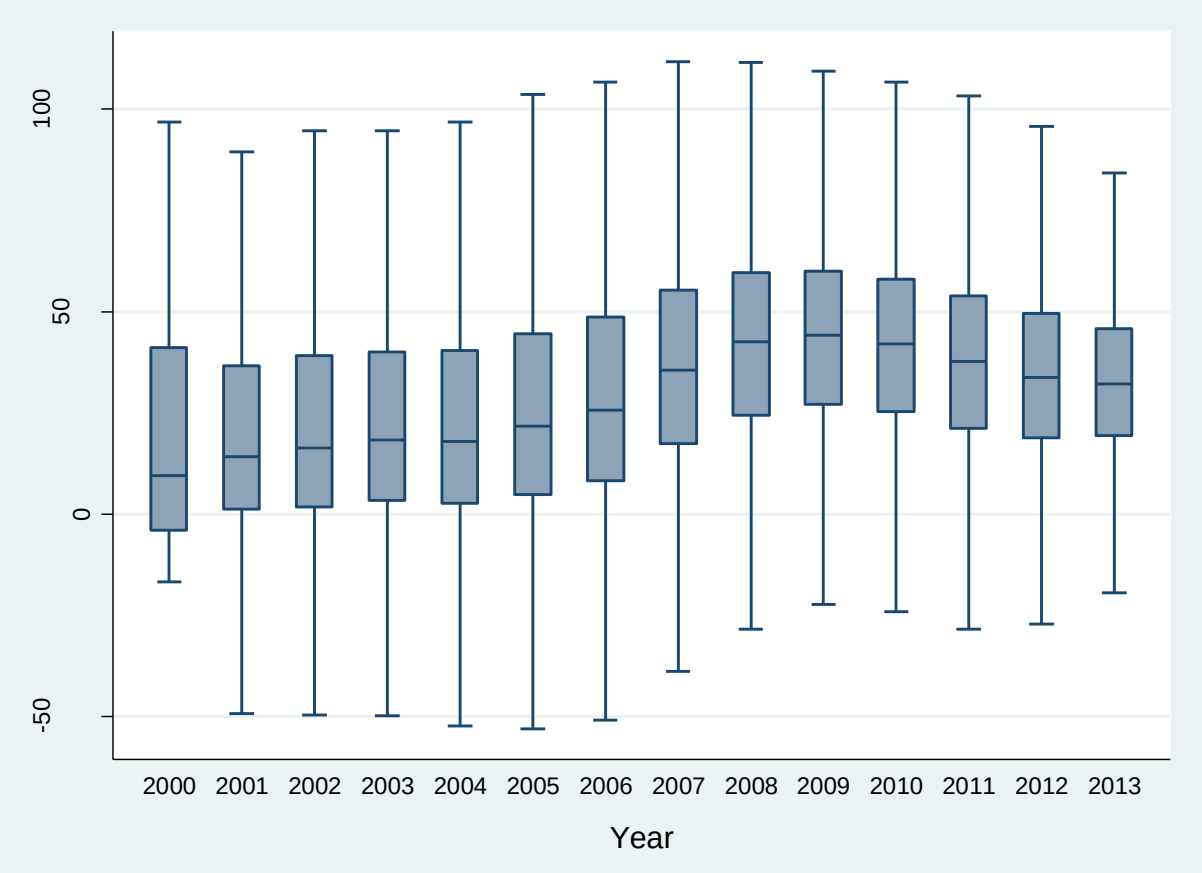
Left hand side the log of months. *, **, and *** indicate that the coefficient is significant at the 10, 5, or 1 percent level. Ordinal Least Squares results while allowing the errors to correlate within 3-digit zip codes. Each reported coefficient is estimated in a different regression. The judicial sample includes all loans in metropolitan areas with a spatial variation in judicial foreclosure proceedings. The ssr and recourse samples also only include metropolitan areas with spatial variation in ssr or recourse. In addition to metropolitan area fixed effects the specifications include all the control variables in Table 5.

Figure 1: Loss on sale distribution



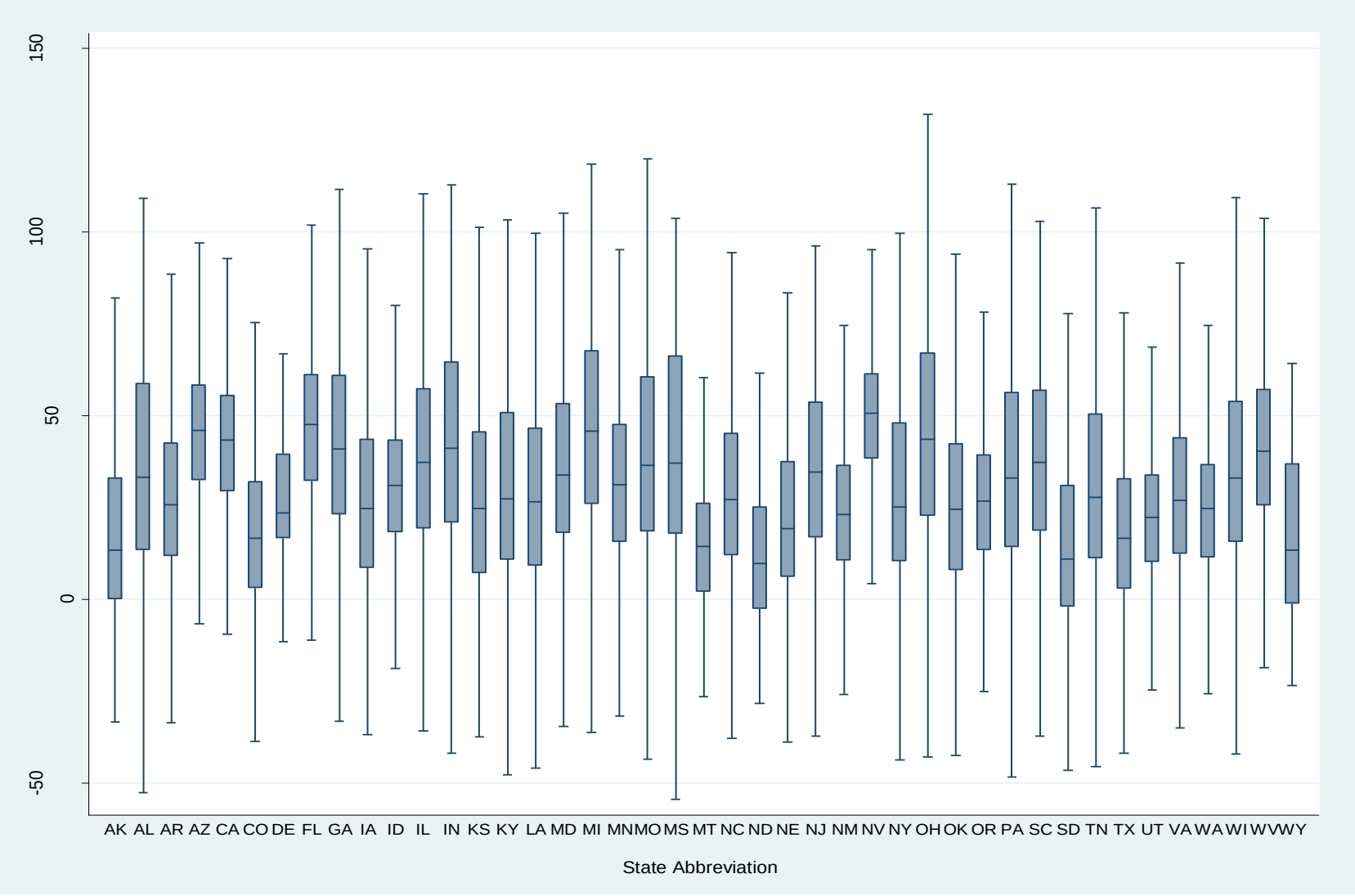
Loss Percentage equals unpaid balance at the end of the loan's life less the sale price divided by unpaid balance at the end of the loan's life. Each column represents the fraction of all loans in the bucket. The bucket is 10 percentage points wide. For example, the column just to the right of 0 on the x-axis indicates that approximately 7.5 percent of the loans had a loss percentage >= 0 and < 10.

Figure 2: Loss on sale over time – box charts



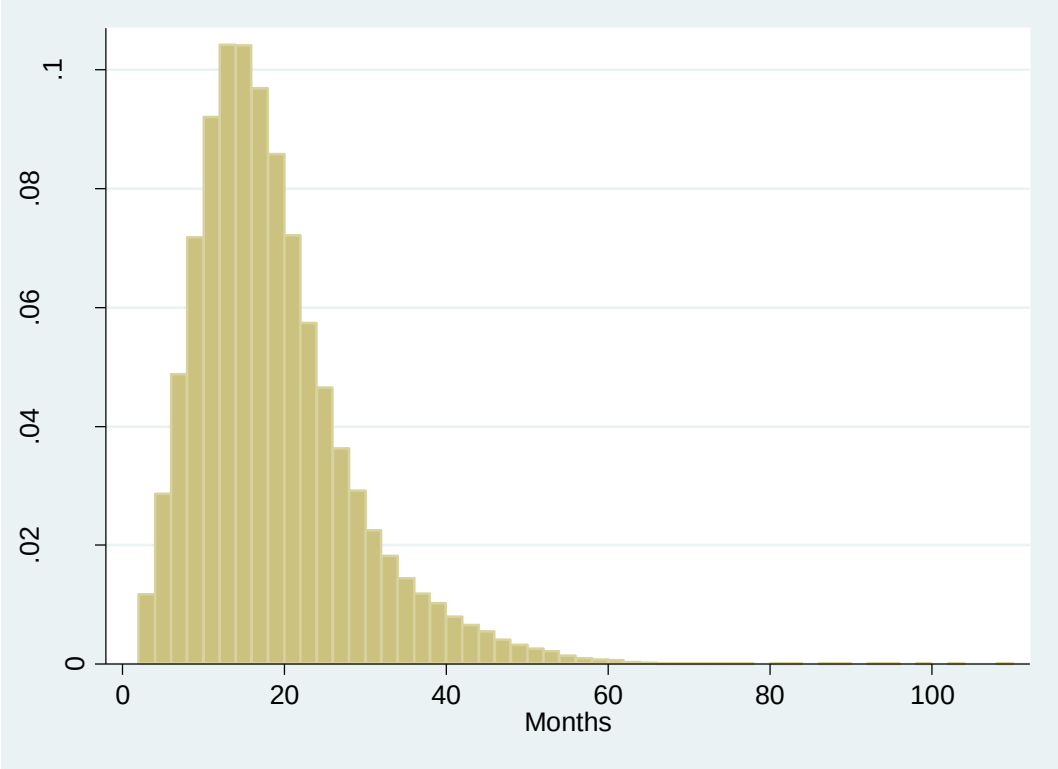
The box includes the 25th to 75th percentile of the distribution and the line in the box is the median. The whiskers or lines leading out of the box extend to the last adjacent value (next value is more than one unit away). Year is the year the resolution (zero balance or end of the loan's life) year.

Figure 3: Loss on sale by state – box charts



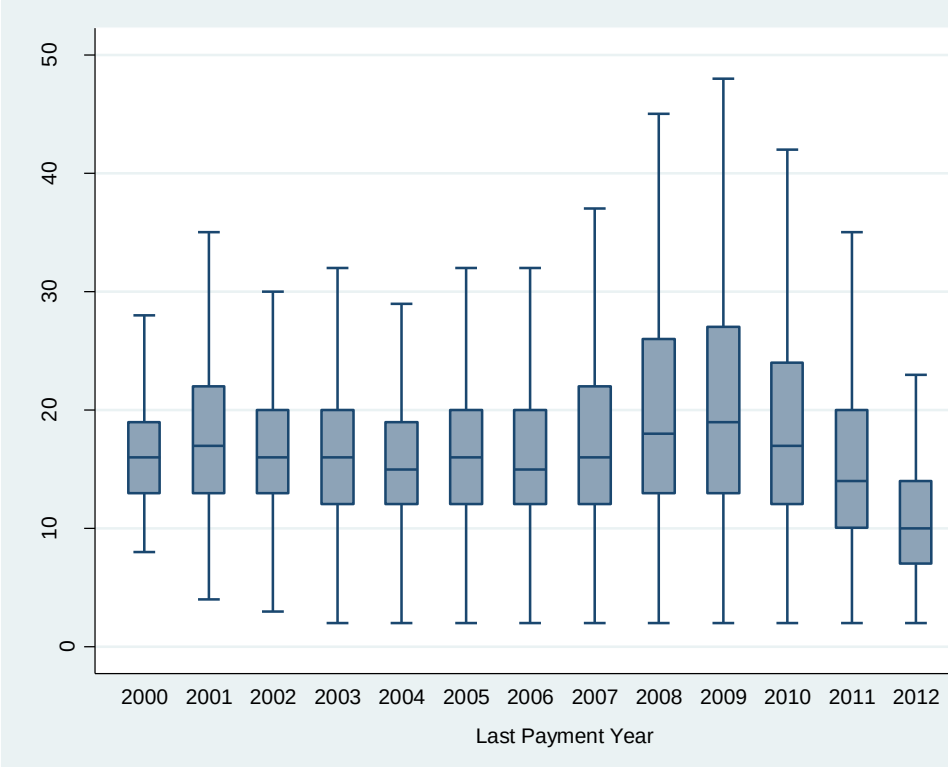
The box includes the 25th to 75th percentile of the distribution and the line in the box is the median. The whiskers or lines leading out of the box extend to the last adjacent value (next value is more than one unit away).

Figure 4: Default timeline distribution – last payment date to resolution date



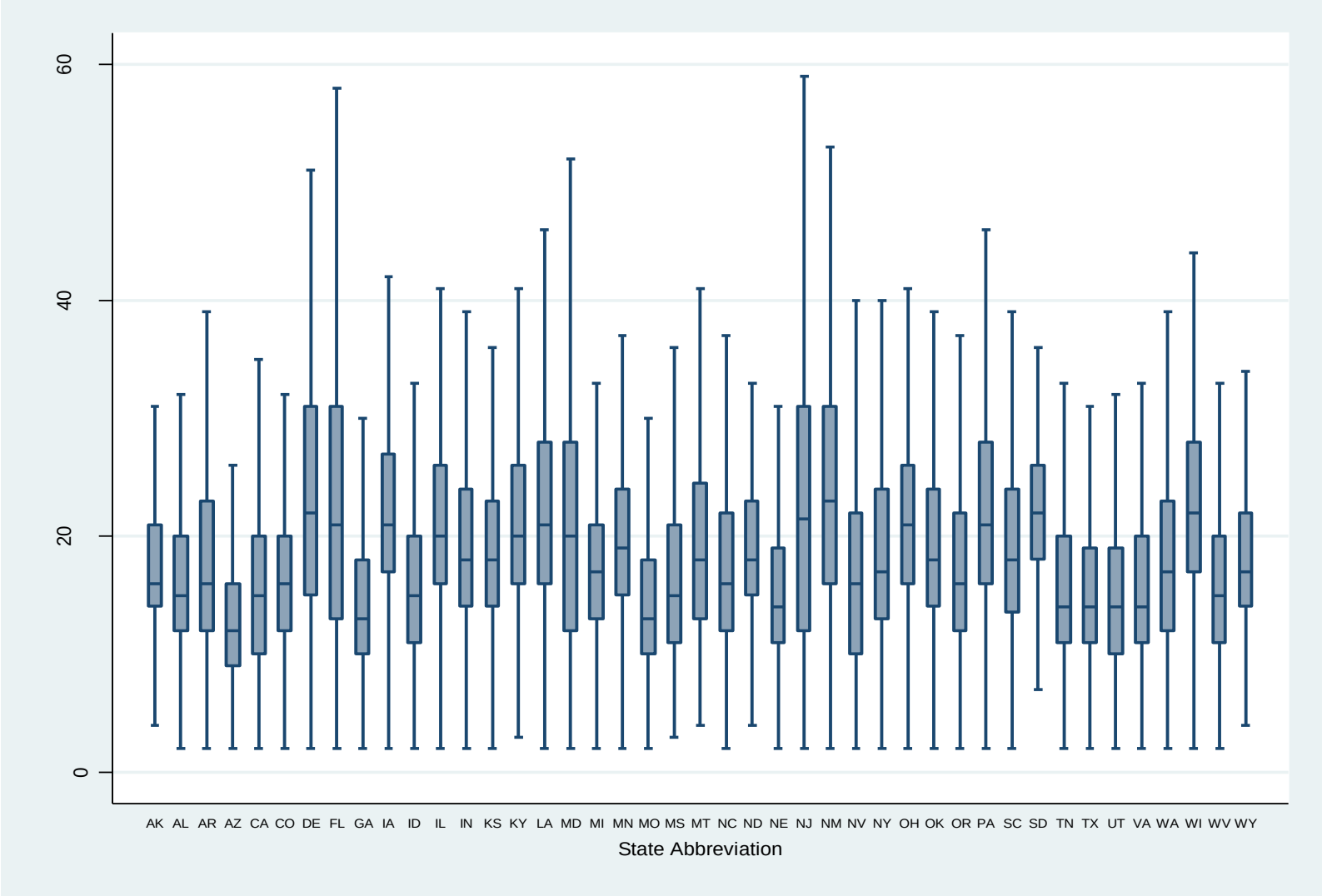
Months equals the number of months from when the last payment was made by the borrower until the loan is fully resolved by Freddie Mac. The bucket is 2 months wide. For example, the column just to the right of 0 on the x-axis indicates that 0 percent of the loans were in default for months >= 0 and < 2.

Figure 5: Default timelines over time (last payment year) – box charts



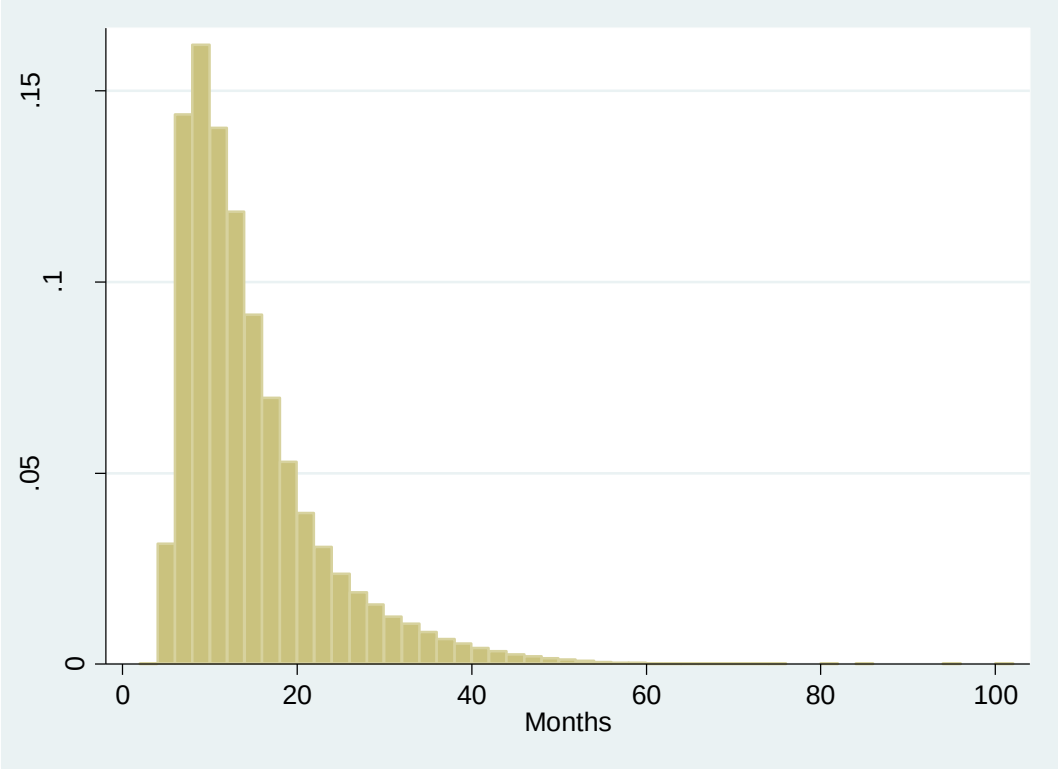
The box includes the 25th to 75th percentile of the distribution and the line in the box is the median. The whiskers or lines leading out of the box extend to the last adjacent value (next value is more than one unit away).

Figure 6: Default timelines by state – box charts



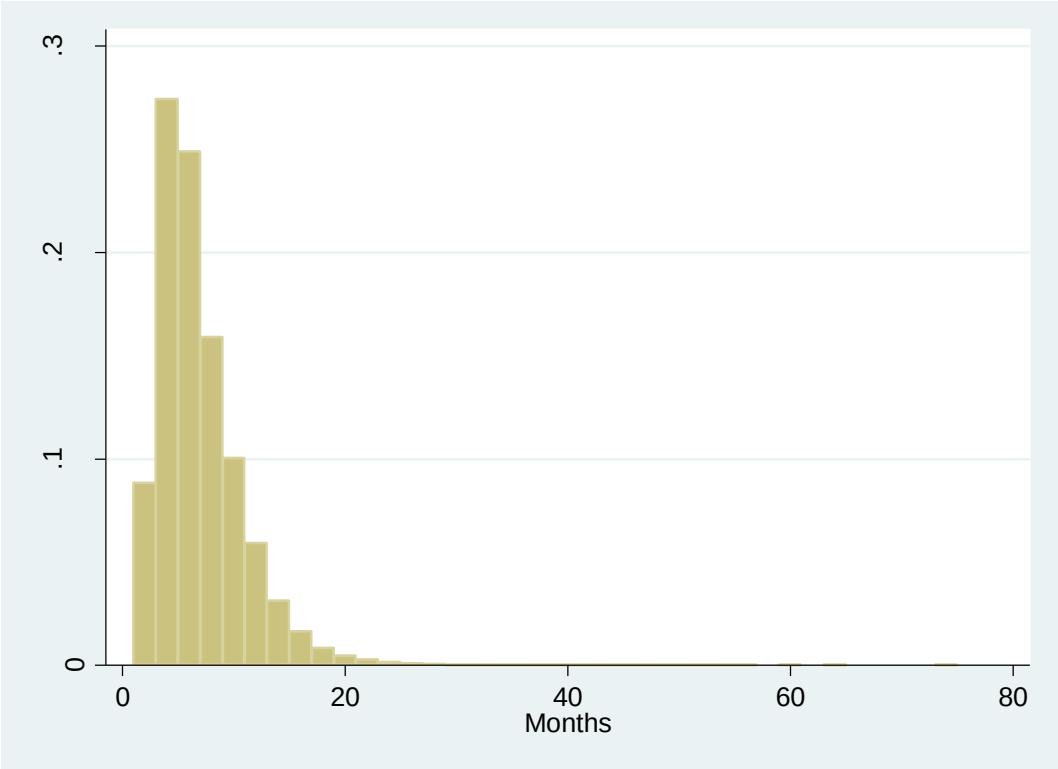
The box includes the 25th to 75th percentile of the distribution and the line in the box is the median. The whiskers or lines leading out of the box extend to the last adjacent value (next value is more than one unit away).

Figure 7: Real estate owned (reo) timeline distribution – last payment date to reo date



Months equals the number of months from when the last payment was made by the borrower until the loan is fully resolved by Freddie Mac. The bucket is 2 months wide. For example, the column just to the right of 0 on the x-axis indicates that 0 percent of the loans were in default for months >= 0 and < 2.

Figure 8: Real estate owned (reo) timeline distribution – reo date to resolution date



Months equals the number of months from when the last payment was made by the borrower until the loan is fully resolved by Freddie Mac. The bucket is 2 months wide. For example, the column just to the right of 0 on the x-axis indicates that 0 percent of the loans were in default for months >= 0 and < 2.