

MORTGAGE TERMINATION IN LOS ANGELES COUNTY

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Abstract: This paper investigates whether geographic location can affect the probability of mortgage termination either due to prepay or default. Probit model is used to examine the determinants of triggering loans to be prepaid, to default, or to remain active. In addition to five dummy variables representing five supervisory districts of Los Angeles County, variables such as loan to value ratio, home value, and mortgage interest rate are also included in our model. The results show that loan to value ratio, home value and mortgage interest rate have a consistently significant and positive impact on the probability of loans to be prepaid, to default, and to remain non-active. However, only the geographic locations of the First District and the Second District are significant factors affecting the probability of loans to be prepaid and to be non-active.

INTRODUCTION

Mortgages have a long duration, typically 15 or 30 years, and have a natural trend in the probability of termination at any particular time. Mortgages can be terminated prematurely in two different ways: (1) refinancing at a lower interest rate and selling of homes or (2) defaulting. Since there are two forms of termination, these terminations are studied using the so-called ‘competing risks’ models. Two most common such ‘survival’ or ‘duration’ models are the Cox Proportional Hazard Model adopted from the medical profession (Green and Shoven, 1986) and the multinomial logit model (Clapp, Goldberg, Harding and LaCour-Little, 2001). The idea is that there is a baseline trend in the probability of termination that varies over time, and that the basic trend is shifted by various covariates such as loan to value ratio, size of the loan, contract rate, FICO score, interest rates, and any characteristics of the borrower or the borrowers’ group. Survival models are usually used in measuring the impact of these covariates.

Cox, Ingersoll and Ross (1985), Kau and Keenan (1995), Hendershott and Van Order (1987) showed that mortgages provide the borrower a call option on the mortgage, with the unpaid mortgage balance being the strike price. This option pricing technique is used to value refinance/prepayment option (Kau and Kim, 1993) and to value default option (Kau and Kim, 1994). A rational borrower would prepay by taking the option to refinance when the market value of the mortgage exceeds the nominal balance plus any transaction costs, and would default when the value of the house falls below the value of the mortgage balance. Some suboptimal default behavior is observed in the market when default is associated with more than just the loss of the home. In addition borrowers at times do not seem to exercise their option to refinance even when the refinancing conditions are met (Deng, Quigley and Van Order, 2000) when there are significant transaction costs.

Some Empirical findings of the work cited above suggest that the probability of refinancing is an increasing function of the market value of the loan and the amount of loan balance and the borrower’s income. One expects that making the optimal refinancing decision requires the knowledge of market conditions and access to the loan market. Distinguishing itself from the literature, this paper intends to investigate whether any particular characteristics of borrower groups, specifically that of geographic location, play a differential and defining role in mortgage termination. Following the existing literature, we also examine the effect of loan to value ratio, home value, and mortgage interest rate.

The main focus of the paper is to examine the effect of geographic location of the loans in our sample on the probability that these loans are to be prepaid, to default, and to remain non-active. If geographic location that may very well serve as proxy for certain transaction costs results in significant differences in mortgage termination decision, it should be given serious consideration in modeling mortgage valuation and termination. Any modeling should allow and incorporate the effect of geographic location in attaining efficient parameter estimation. The results of our research may be of interest to lenders and borrowers alike in understanding the value and the risk of mortgages.

SAMPLE DESCRIPTION

Our data is comprised of 25,287 loans. All loans are originated between 1970 and 2002 in Los Angeles County with Bank of America as the lender. They are categorized as either active, prepaid, or defaulted during the observation period from 1986 to 2004. The prepay group includes loans that are refinanced due to lower mortgage rates and loans that are paid off due to sale of homes. Of the entire sample, 69% of the loans are prepaid, 29% remained active, and 2% defaulted. Table 1 shows the descriptive information of these loans. The average original loan to value ratio is 72% for the entire sample, 84% for the default group, 72% for the prepay group, and 70% for those remain active. The average home value is \$207,619 for the entire sample, the highest value \$216,139 for the prepay

group, \$189,978 for the active group, and the lowest value \$171,281 for the default group. All loans in the sample pay an average interest rate of 8.03%; the default group has the highest rate of 9.16%, the prepay group 8.20%, and the active group the lowest rate of 7.54%. The average amount borrowed is \$142,426 for the entire sample. The prepay group borrows the most \$149,191, the default group \$140,145 and the active group the least \$126,422.

Los Angeles County	At Origination			
	All Loans	Active	Prepay	Default
Number of Observations	25,287	7,296	17,443	548
(Number of Observations in %)	100.00%	28.85%	68.98%	2.17%
LTV (%)	72.28	70.37	72.71	83.77
(Standard error)	(0.11)	(0.23)	(0.13)	(0.51)
Loan Amount	142,426	126,422	149,191	140,145
(Standard error)	(469)	(715)	(598)	(2,440)
Home Value	207,619	189,978	216,139	171,281
(Standard error)	(760)	(1,204)	(967)	(3,359)
Original Rate (%)	8.03	7.54	8.20	9.16
(Standard error)	(0.01)	(0.01)	(0.01)	(0.05)

Table 1: Means and Standard Errors of LTV, Home Value, Original Rate for all loans in Los Angeles County financed by Bank of American from 1970 to 2004

In summary the default group has the highest loan to value ratio, has the lowest home value, and pays the highest interest rate. The active group, on the other hand, has the lowest loan to value ratio, has the lowest loan amount, and pays the lowest interest rate. The majority of the loans are prepaid; the prepay group borrows the most and also has the highest home value.

We further divide our sample into five supervisory districts of Los Angeles County. The intent is to examine if loans originated in certain districts are more likely to default, to be prepaid, or to remain active. The districts of the Los Angeles County are drawn in such a way that each district has roughly two million people. The First District and the Second District are in the heart of the Los Angeles County. The First District is known to be majority Latino area and the Second District has a plurality of African Americans. The Third District covers some of the coastal cities, the Fourth District consists of the southern most cities, and the Fifth District is comprised of the northern most cities of the Los Angeles County.

Table 2 reports that about 15% of the loans in the entire sample are from the First District. The First District has a higher default rate than the sample average, in fact the second highest among all districts. It has a lower than average prepay rate and a higher than average active rate. Its average loan amount is the lowest among all districts in addition to its lowest average home value. This district also has the highest average borrowing rate, and has the highest loan to value ratio. The Second District has about 14% of all loans. It has the highest default rate among five districts. It also has the highest active rate and the lowest prepay rate, followed by the First District. Both the loan amount and the home value are ranked second lowest among five districts, the First District being the lowest. It pays the second highest borrowing rate; only the First District has a higher rate.

Loans from the Third District account for 20% of all loans. This district has the highest prepay rate and the lowest active rate. It also has the highest loan amount and home value among all five districts. All loans pay an interest rate close to the entire sample average. The Fourth District has the highest percentage of loans, nearing 26%. Many of the characteristics of the Fourth District fall between those of the First/Second Districts and the Third District. The Fourth District is also noted for its lowest default rate, its lowest borrowing rate, and its lowest loan to value ratio.

The Fifth District encompasses the largest geographical area that includes cities not so densely populated. It has about 25% of all loans. The Fifth District is a true in-between district in terms of its characteristics. It has a lower than average default rate, higher than average prepay rate, and lower than average active rate. All of its loan amount, its home value, its loan to value ratio, and its borrowing rate are close to the respective sample average.

First District	All Loans	Active	Prepay	Default
Number of Observations	3759	1353	2309	97
Number of Observations in %	100%	35.99%	61.43%	2.58%
LTV (%)	74.20	72.73	74.55	86.23
(Standard error)	(0.29)	(0.51)	(0.35)	(1.15)
Loan Amount	123,334	115,287	127,670	132,373
(Standard error)	(926)	(1,281)	(1,279)	(5,178)
Home Value	170,386	161,828	176,021	155,597
(Standard error)	(1,251)	(1,622)	(1,772)	(6,331)

Original Rate (%)	8.07	7.62	8.30	8.96
(Standard error)	(0.02)	(0.03)	(0.02)	(0.12)
Second District	All Loans	Active	Prepay	Default
Number of Observations	3609	1392	2120	97
Number of Observations in %	100.00%	38.57%	58.74%	2.69%
LTV (%)	74.04	74.67	73.12	85.04
(Standard error)	(0.31)	(0.51)	(0.39)	(1.25)
Loan Amount	131,021	120,426	138,024	130,015
(Standard error)	(1,099)	(1,458)	(1,575)	(4,735)
Home Value	183,958	167,702	195,908	156,075
(Standard error)	(1,612)	(2,195)	(2,280)	(6,736)
Original Rate (%)	8.05	7.61	8.31	8.80
(Standard error)	(0.02)	(0.03)	(0.02)	(0.12)
Third District	All Loans	Active	Prepay	Default
Number of Observations	5144	1237	3785	122
Number of Observations in %	100.00%	24.05%	73.58%	2.37%
LTV (%)	71.30	67.83	72.11	81.60
(Standard error)	(0.26)	(0.56)	(0.30)	(1.09)
Loan Amount	153,776	132,895	160,555	155,166
(Standard error)	(1,179)	(1,992)	(1,434)	(5,822)
Home Value	232,574	211,428	240,712	194,513
(Standard error)	(2,127)	(3,753)	(2,592)	(8,093)
Original Rate (%)	8.03	7.48	8.17	9.41
(Standard error)	(0.02)	(0.03)	(0.02)	(0.12)
Fourth District	All Loans	Active	Prepay	Default
Number of Observations	6490	1645	4737	108
Number of Observations in %	100.00%	25.35%	72.99%	1.66%
LTV (%)	70.85	67.49	71.77	81.71
(Standard error)	(0.23)	(0.48)	(0.26)	(1.14)
Loan Amount	150,354	135,863	155,513	144,780
(Standard error)	(954)	(1,604)	(1,167)	(5,731)
Home Value	223,015	213,073	227,430	180,771
(Standard error)	(1,538)	(2,744)	(1,865)	(8,094)
Original Rate (%)	8.01	7.50	8.16	9.19
(Standard error)	(0.01)	(0.02)	(0.02)	(0.11)
Fifth District	All Loans	Active	Prepay	Default
Number of Observations	6285	1669	4492	124
Number of Observations in %	100.00%	26.56%	71.47%	1.97%
LTV (%)	72.38	69.59	73.07	84.77
(Standard error)	(0.23)	(0.47)	(0.26)	(1.02)
Loan Amount	142,917	126,346	149,283	135,336
(Standard error)	(937)	(1,546)	(1,156)	(5,108)
Home Value	207,150	192,716	213,695	164,324
(Standard error)	(1,441)	(2,536)	(1,761)	(6,935)
Original Rate (%)	8.02	7.49	8.18	9.32
(Standard error)	(0.01)	(0.02)	(0.02)	(0.10)

Table 2: Means and Standard Errors of LTV, Home Value, Original Rate for five supervisory districts of Los Angeles County

METHODOLOGY AND EMPIRICAL RESULTS

This study applies Probit model to examine the determinants triggering the probability of loans being prepaid, default, and non-active. The factors of interest included in the analysis are: the five districts in L.A. County (D1, D2, D3, D4, and D5), original loan to value

ratio (LTV), home value (HV), and original mortgage rate (RATE). A loan is defined as prepaid if it is refinanced or terminated voluntarily due to sell of house. A default loan is a loan terminated involuntarily, which can be attributed to the failure of making scheduled mortgage payments. Taken together, a loan is categorized as non-active if it has the status of prepay or default.

The probit model can be described as equation (1):

$$p = \Pr(Y = 0|X) = \beta_0 + \beta_1 D_{1t} + \beta_2 D_{2t} + \beta_3 D_{3t} + \beta_4 D_{4t} + \beta_5 D_{5t} + \beta_6 LTV_{it} + \beta_7 HV_{it} + \beta_8 RATE_{it} + \varepsilon_{it}. \quad (1)$$

In equation (1), the dependent variable, p is the probability of an event defined as $Y = 0$, which includes the case (i) prepay, (ii) default, and (iii) non-active loans. β is a vector of parameter estimates; Pr is a cumulative distribution function, which is normal distribution for the probit model and logistic for the logit model; and X is a vector of explanatory variables, which include D1, D2, D3, D4, D5, LTV, HV, and RATE.

Parameter	Estimate	Chi-Square	p-value
D1	-0.2563	6.63	0.01
D2	-0.3365	11.42	0.0007
D3	-0.0284	0.08	0.7751
D4	-0.0083	0.01	0.9328
D5	-0.0377	0.15	0.7028
LTV	0.005	114.32	<.0001
HV	0.0002	511.45	<.0001
RATE	0.2372	958.46	<.0001

Table 3: Effects of LTV, Home Value (HV), Original Rate (RATE) and five districts of Los Angeles County (D1, D2, D3, D4, and D5) on determining the probability of prepaid loans.

A loan is categorized as a prepaid loan if the loan was refinanced due to the change of mortgage rate or prepaid due to the sell of the house. As shown in Table 3, results are consistent with expectation that higher ratio of loan to house value, higher house value, and higher mortgage rate are more likely to trigger the event of prepay. In terms of the impact of the districts in L.A. County, the First District and the Second District are the two districts that present significant effects on the probability of prepay. Specifically, these two districts show lower probability in the event of prepay.

Parameter	Estimate	Chi-Square	p-value
D1	-0.1041	0.0393	0.8429
D2	-0.1146	0.0475	0.8274
D3	-0.0617	0.0139	0.9061
D4	-0.3736	0.5089	0.4756
D5	-0.2627	0.2527	0.6152
LTV	0.0621	233.9304	<.0001
HV	0.000194	16.7011	<.0001
RATE	0.6593	475.9654	<.0001

Table 4: Effects of LTV, Home Value (HV), Original Rate (RATE) and five districts of Los Angeles County (D1, D2, D3, D4, and D5) on determining the probability of default loans.

Table 4 demonstrates the results of the analysis on the probability of default. The results provide no evidence supporting that different district in L.A. County plays a role on triggering the event of default. Nevertheless, consistent with the findings in the extant literature, higher probability of default is positively correlated with the ratio of loan to value, house value, and original mortgage rate.

Parameter	Estimate	Chi-Square	p-value
D1	-0.5443	8.8979	0.0029
D2	-0.7082	15.0436	0.0001
D3	-0.0666	0.1338	0.7145
D4	-0.1041	0.3295	0.566
D5	-0.1416	0.6101	0.4347
LTV	0.0187	476.9282	<.0001
HV	0.000441	708.5602	<.0001
RATE	0.8502	2212.817	<.0001

Table 5: Effects of LTV, Home Value (HV), Original Rate (RATE) and five districts of Los Angeles County (D1, D2, D3, D4, and D5) on determining the probability of non-active loans.

We further conduct an analysis based on the loan status, which is categorized as active or non-active. A non-active loan is triggered by the event of either prepay or default. The results are presented in Table 5. Compared to the results shown in Table 3, the results shown in Table 5 further confirm that First and Second Districts are the two major districts that have an impact on the probability of loan termination, which can be due to the event of prepay or default. Among the loan characteristics, the ratio of loan to value, house value, and original mortgage rates consistently show their positive effects on probability of loan termination.

CONCLUSION

In conclusion a sample of 25,287 loans originated between 1970 and 2002 in Los Angeles County with Bank of America being the lender is examined for the effect of geographic location on the probability of whether these loans are more likely to be prepaid, to default, and to remain non-active during the observation period from 1986 to 2004. The geographic location of each loan is defined as one of the five supervisory districts of the Los Angeles County. Probit model is used with five dummy variables representing five supervisory districts in addition to loan to value ratio, home value and mortgage interest rate. The results show that higher loan to value ratio, higher home value, and higher mortgage interest rate are more likely to trigger the event of loans being prepaid, default, and non-active. The effect of geographic location is only significant for the First District and the Second District and only in the event of loans being prepaid and being non-active. In order words the probabilities of loans being prepaid and non-active are lower for loans in the First and the Second Districts. We conjecture that the geographic location may serve as proxy for transaction costs that may have prevented loans to be prepaid in these two districts.

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