

Multifamily Mortgage Credit Risk: Lessons From Recent History

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Abstract

This article uses an innovative default model to explain increases in conventional multifamily mortgage default rates in the 1980s. Factors behind these changes are well known, but quantification of relative influences has not yet been performed. Our theoretical model has investors or borrowers defaulting if the underlying project has both negative equity and negative cash flows, a “double trigger.” This leads to modeling default probabilities as a function of primary underwriting ratios, rental market conditions after loan origination, and institutional factors. A binary logit model is estimated with data on over 7,500 conventional multifamily mortgages purchased by Fannie Mae and Freddie Mac from 1983 to 1995. The results are used in simulations to explain why default rates increased in the 1980s and 1990s. We find that the increase was due to lax underwriting, declines in the tax benefits of owning real estate, and declines in rental market conditions. Default rates would have been worse had it not been for declines in interest rates.

Multifamily housing projects are considered very sound investments today, and they generally rate as a lower risk than other commercial property types. Good market fundamentals have led to increased funds for multifamily mortgages from commercial banks, insurance companies, State housing finance agencies, and general capital markets by way of the secondary mortgage market. This is a substantial change from just 6 years ago, when traditional lenders and investors were removing multifamily projects from their portfolios.

This study looks at the fundamental problems of the 1980s that led to the great real estate selloff of the early 1990s. There was poor underwriting, a decline in depreciation writeoffs for commercial property investments, and a decline in rental market conditions. This study shows how these problems led to sharp increases in multifamily mortgage default rates. Default rates on loans in our sample steadily increased from just 0.14 percent

in 1986 to 3.05 percent in 1993; they declined in 1994 to 2.22 percent and again in 1995 to 1.34 percent. The dramatic initial rise in default rates would have been even worse had it not been for the beneficial effects of a downturn in interest rates. Falling interest rates increased property sales prices and improved the cash-flow position of adjustable-rate and balloon mortgages.

The remainder of this article is as follows: In the next section we review the nature of multifamily mortgage lending in general. The following section highlights the problems that developed in the 1980s. We then discuss multifamily credit-risk models and present statistical model estimations. Finally, simulations of the 1984–93 experience and conclusions concerning lessons learned are presented.

Multifamily Lending and Credit Risk

Any residential building with five or more rental units is considered a multifamily property. Typical multifamily loans are in the \$1 million to \$10 million range, representing projects of between 25 and 200 housing units. The most common loan is a 7–10 year balloon with a 30-year amortization term. For all fixed-rate mortgages, prepayments are costly or prohibited during the initial years of the loan. Adjustable rate mortgages (ARMs) have become more popular since 1988. They generally do not have the same onerous prepayment restrictions as do fixed-rate loans.¹

Multifamily mortgages are more risky than single-family loans for a variety of reasons. First, they are commercial, nonrecourse loans made for investment purposes; borrowers are more likely to be ruthless about exercising the implicit default option than are owner-occupants who have moving costs and who could face post-foreclosure deficiency judgments and difficulty obtaining new credit. Second, both property cash flows and equity are important to investors, and cash flows can be very volatile because of changes in vacancy rates. Fundamentally, the cash-flow volatility problem arises from a mismatch between long-term debt financing and short-term renter horizons. Renters have very high mobility rates, when compared with owner-occupants. Owner mobility rates are in the 3- to 5-percent per year range, whereas renter mobility is in the 20- to 55-percent range. The 1989 American Housing Survey shows an average multifamily unit turnover rate of 41 percent per year.² Investors thus face the continual risk of attracting sufficient numbers of new renters.

A third factor leading to high risk from multifamily mortgages is the sensitivity of project profitability to changes in tax laws. Whereas owner-occupants are only affected by income tax changes, investors are affected by income tax rates, capital gains tax rates, and depreciation allowances. All three of these changed in dramatic ways in the 1980s, leading to equally dramatic changes in the profitability of commercial real estate investments. A fourth factor is that commercial mortgages are predominately balloons or ARMs, compared with the 30-year fixed rate mortgages that dominate single-family mortgage originations. So project viability is more sensitive to interest rate changes over time, as they cause changes in the monthly payments due on the mortgage. Interest rates have an additional effect on fixed-rate multifamily loans through yield-maintenance terms that make it costly to refinance a mortgage in the early years. Projects having financial difficulties cannot easily take advantage of the same cost-saving refinancings as can single-family homeowners when interest rates decline.³

Historically, higher risk of loan default has been offset by higher interest rates than are generally charged on single-family loans. In addition, multifamily loans rarely have less than 20-percent equity at origination. The typical loan has initial equity of 30 percent and

borrowers may have to pay for the cost of added credit support even at that level.⁴ Yet even with these safeguards, multifamily loan portfolios produced serious losses in the late 1980s and early 1990s. These losses led to a tightening of underwriting standards and a “credit crunch” during the 1991–92 national recession.

Roots of the Problem

Multifamily developers take calculated business risks that there will be a sufficient pool of renters to support their projects over time. The relative ease of entry into the industry makes boom-and-bust cycles common. When returns are high, the supply of new apartments can increase, leading to high vacancy rates and fall out. This situation occurred in the 1980s: A boom period in 1981–86 encouraged overexpansion and led to a severe downturn in 1987–93. The cycle was fueled by changes in tax laws and lenient underwriting practices in the early and middle 1980s.

Changes in Tax Laws

The Accelerated Depreciation Rate Schedule (ACRS) introduced in 1981 and 1984 provided large and fast writeoffs (15–18 years) for real estate projects put into service starting in those years. A return to straight-line depreciation over a longer period (27 years) was imposed by the Tax Reform Act of 1986, which reduced writeoffs for *new* investors in 1987. Existing investors were grandfathered and did not have to change their depreciation schedules. However, the resale value of properties was reduced because the value of tax writeoffs was reduced for new investors. The Tax Reform Act also brought declines in tax rates on ordinary income and increases in rates on capital gains, virtually eliminating the difference between these rates from 1987 to 1993. On balance, we believe that the dominant effect of the Tax Reform Act on multifamily mortgage defaults was through the decline in the value of depreciation writeoffs.⁵

Underwriting Deficiencies

ACRS increased potential profit margins and, together with rental inflation, helped to fuel an overbuilding boom in the United States from 1981 to 1986. This boom encouraged underwriting practices that overstated actual property value in a number of ways. First, rather than using actual rents, appraisers would factor in rental inflation when estimating revenues for the initial year of the loan. To compound this, expense ratios and vacancy rates were assumed to equal market averages rather than what could be higher actual values on a specific project. These practices, when combined, resulted in an overstatement of net operating income (NOI) by 10 to 20 percent.⁶ Therefore, projects supporting mortgage loans were not as financially sound as they appeared in the underwriting documents. A second factor leading to the overstatement of property value was that multipliers used to capitalizing NOI into property value were often taken from grade-A properties, without any property-specific compensating adjustments. This situation tended to overstate property value by 5 to 10 percent.⁷ In addition to these direct factors, there was a lack of appreciation for the subtleties of multifamily underwriting by new market players. Such things as engineering reviews, capital replacement reserves, and site inspections for environmental hazards were overlooked or simply neglected.

Freddie Mac and Fannie Mae entered the market to purchase conventional multifamily loans in 1983. Their lack of due diligence and other controls resulted in the purchase of poorly underwritten loans with overstated underwriting ratios. Fannie Mae recognized the problem first and tightened its underwriting in 1988. Freddie Mac, in contrast, continued to purchase noninvestment-quality loans through 1990. The resulting damage-control effort kept Freddie Mac out of the purchase market for 3 years.⁸

Exhibit 1

Multifamily Loans and Credit Loss Chargeoffs. Dollar Volumes and Percentage of Combined Single-Family and Multifamily Totals

Loan Volumes and Chargeoffs	1991		1995	
	Fannie Mae	Freddie Mac	Fannie Mae	Freddie Mac
Multifamily loans (billions)	\$281	\$10	\$32	\$6.6
Percentage of all loans	5.7	2.6	4.1	1.2
Multifamily chargeoffs (millions)	\$62	\$162	\$26	\$20
Percentage of all chargeoffs	30.2	51.4	15.1	6.5
Ratio of multifamily chargeoff percentage to loan percentage	5.3	19.8	3.7	5.4

Source: Fannie Mae and Freddie Mac, Investor Analyst Reports, 1991 and 1995

The Relative Magnitude of Multifamily Credit Risk

Exhibit 1 illustrates 1991 and 1995 data from *Investor Analyst Reports*. In what is considered the worst year for industry credit costs, 1991, Fannie Mae's multifamily bad-loan chargeoffs as a percentage of all chargeoffs (single- and multifamily) were more than five times as large as the relative size of its multifamily portfolio in the total mortgage portfolio.⁹ For Freddie Mac the situation was much worse: the relative magnitude of multifamily chargeoffs to total credit loss chargeoffs was nearly 20 times the size of the multifamily loan share in its portfolio. Dividing Freddie Mac's 1991 chargeoff by its multifamily loan balance yields a 162-basis-point loss per loan in the portfolio. That amount is much higher than multifamily guarantee fee income for the year. This high level of credit loss existed for the 1990–92 period. If it were not for a favorable interest-rate environment, in which the company could cover these losses through interest earnings on retained portfolios, Freddie Mac could have experienced serious financial difficulties before the end of 1992. In 1995, which was considered a good year of credit-loss experience, multifamily credit costs remained relatively large for both Fannie Mae and Freddie Mac.

Modelling Credit Risk

To model the risk of mortgage default, we focus on the two primary commercial lending underwriting ratios: debt service coverage ratio (DCR) and loan-to-value (LTV) ratio. DCR is measured as the annual NOI of a project divided by the annual mortgage payment.¹⁰ It indicates the size of cash cushions above operating expenses for loan repayment or, conversely, to what extent the property can absorb income shocks and still service the debt. LTV is the ratio of loan amount to the value of the property. It measures borrower equity.¹¹

A third factor of importance is the depreciation rate available to the investor. With ACRS, the tax benefits of depreciation writeoffs during the early years of an investment were of sufficient size that investors would not default on a mortgage until there was substantial negative cash flows. It was worth the "investment" of allowing negative cash flows on any one project to obtain the tax benefits from income on other investments. The Tax Reform Act of 1996 removed both accelerated depreciation and the use of tax losses on

real estate to offset taxable income on non-real estate investments. This was a “double whammy” to current investors and guarantors of multifamily mortgages.

To model mortgage borrower behavior we must then capture the underlying factors influencing three variables: DCR_t , LTV_t , and depreciation (DEP_t). The first two variables are measured as:

$$DCR_t = NOI_t / PMT_t \tag{1}$$

and

$$LTV_t = L_t / V_t \tag{2}$$

where

PMT_t = periodic mortgage payment (principal plus interest), in time t,

L_t = contemporary loan balance, in time t, and

V_t = property value, in time t.

Previously published research on multifamily mortgage default risk has not fully captured the dynamics of changes in DCR_t , LTV_t , and DEP_t over time. The most complete attempts were made by Kerry Vandell et al (1983) and Walter C. Barnes and S. Michael Gilberto (1994), who each attempted to update LTV_t through a national property-value index. Vandell et al (1983) added DCR_0 as a “transaction cost” of default, but did not attempt to update it over time. In addition, each study used broader samples of commercial (nonresidential) mortgages in their estimation to build sufficient databases.¹²

The primary underwriting ratios, DCR_0 and LTV_0 , do form the starting point for default risk analysis. Commercial loans are underwritten with values of DCR_0 and LTV_0 that provide financial cushions to protect against degradations of property cash flows; a typical configuration would be $LTV_0 = 0.70$ and $DCR_0 = 1.30$. Other factors known at origination are loan type, amortization period, and mortgage coupon rate (r_0). As discussed below, changing interest rates under ARM and balloon mortgages creates increased risk of default because of the direct implications for DCR_t .

Updating DCR_t : Vacancies and Rental Prices

Over time, default probabilities are greatly affected by changes in NOI_t , which affects both DCR_t and LTV_t . NOI_t , in turn, is affected by rates of apartment vacancies and changes in rental prices. We measure vacancy rates ($VAC_{m,t}$) and rental price indices ($RPI_{m,t}$) at the metropolitan statistical area (MSA) level, m , to capture changes in market conditions that either strengthen or weaken mortgages over time, t . Dropping the MSA subscript for clarity of exposition, we specify DCR_t as a function of NOI_t , vacancies (VAC_t), and rental growth (RPI_t):

$$NOI_t = (1 - 2.15 (VAC_t - VAC_0)) RPI_t NOI \tag{3}$$

where

2.15 = estimate of the elasticity of NOI with respect to vacancies (explained below).

NOI_t is then a direct function of changes in vacancy rates ($VAC_t - VAC_0$) and growth of rents (RPI_t). The adjustment factor of 2.15 results from two simplifying assumptions. The first assumption is that expenses (excluding vacancies and collection losses) are a constant ratio of gross rents. The second is that the origination vacancy rate equals the

long-term national trend rate, 0.0623. Data from annual surveys of apartments indicate that (for the entire United States) the expense ratio (k) averages about 47 percent and that it is relatively constant in the long run.¹³ Likewise, using the long-run trend vacancy rate for loan origination is supported by underwriting requirements that new projects must be rented-up before permanent financing is finalized.

To see how these two assumptions yield the 2.15 factor, we first rewrite NOI_t as:

$$NOI_t = RENT_t(1 - k - v) \tag{4}$$

where

$RENT_t$ = Rental income per unit, if at full occupancy,

k = dollar expenses as a percent of $RENT_t$ and

v = vacancy losses as a percent of $RENT_t$

Taking the derivative of equation (5) with respect to v yields:

$$\frac{\partial NOI_t}{\partial v} = -RENT_t \tag{4a}$$

which is the effective change in NOI if vacancies go from 0 to 100 percent (one “unit” change). So, effectively,

$$dNOI_t = \frac{\partial NOI_t}{\partial v} dv \tag{5}$$

or

$$dNOI_t = -RENT_t dv \tag{6}$$

where dv is $(VAC_t - VAC_0)$ from equation (3). Rearranging equation (4), the multiplicative factor, $-RENT_t$ can be computed as:

$$-RENT_t = \left(\frac{-NOI_t}{(1 - k - v)} \right) \tag{7}$$

Since we are measuring changes against time 0, we substitute in $v=VAC_0$ along with the long-term national trend, $k=0.47$. We then have the effect of a vacancy change on NOI :

$$dNOI_t = \frac{-NOI_t}{(1 - 0.47 - 0.0623)} \equiv -NOI_0 \cdot RPI_t \cdot 2.15 \cdot (VAC_t - VAC_0) \tag{8}$$

The final right-hand side of equation (8) is then equation (3). This formula is used to update DCRs over time through:

$$DCR_t = DCR_0 * RPI_t * (1 - 2.15(VAC_t - VAC_0)) \tag{9}$$

Updating DCR_t : Interest Rates and Payment Shocks

Sampled loans used in this study have fixed interest rates, and the majority have balloon terms. Typical balloon maturities are 5, 7, 10, or 15 years, each with a 30-year amortization period. Projects with weaker financials will be unable to qualify for a new loan in the balloon year, especially if there is an increase in interest rates. One would then expect a higher incidence of default at that point. However, few loans in our sample actually arrive at the balloon point, so this factor was not included in the statistical model.¹⁴

Depreciation

We only know when sampled loans were originated: we do not know when investors actually purchased the properties. Therefore, we do not know their tax-basis years. However, we can infer that changes in tax laws would affect writeoffs for new investors, changing property value and LTV_t . To capture this, we construct an index variable, $PVTAX_t$, that measures the present value of depreciation writeoffs to a new investor:

$$PVTX_t = \sum_{s=1}^{20} \left[\frac{\theta DEP_s}{(1+r_t)^s} \right] - \phi \left[\frac{\sum_{s=1}^{20} DEP_s}{(1+r_t)^{20}} \right] \quad (10)$$

where

θ = marginal tax rate, earned income,

DEP_s = dollar value of depreciation allowance in year s of investor holding period, per \$100 of property value,

ϕ = marginal tax rate on capital gains, and

r_t = weighted average cost of capital, proxied by the aftertax cost of debt.

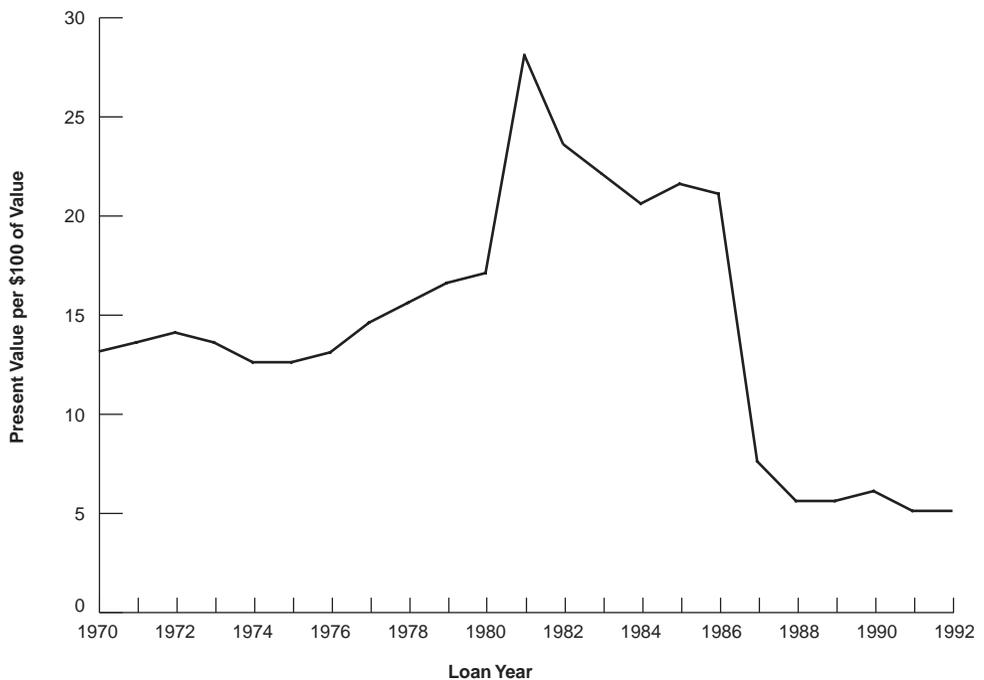
In constructing $PVTAX_t$ we assume a 20-year holding period in which the investor obtains the benefits of the writeoffs and depreciation recapture in the final year. The index has a value of 20.7 in 1986 and then falls dramatically to about 7.2 after the 1986 tax law changes (see Exhibit 2).¹⁵ $PVTAX_t$ is included to adjust for changes in property value not captured by the primary value variable, LTV_t .

Updating LTV_t

LTV_t will decline over time as a loan amortizes (L_t declines), but it will also fluctuate as rental market conditions change the property value, V_t . The value of the underlying properties, V_t , is a multiple of the net cash flow, the NOI_t . We update NOI_t according to equation (3), and then apply an estimated cap-rate multiplier (CRM_t) to derive current value. The cap rate is an appraisal device that reflects what investors are willing to pay for an annual cash flow stream on a given property, given property and market conditions and current mortgage interest rates, as discussed earlier in this paper. We first derive the

Exhibit 2

Present Value of Depreciation Tax Benefits to a New Investor (dollars of benefit per \$100 of property value)



Source: Office of Federal Housing Enterprise Oversight calculations of equation (10)

cap-rate multiplier implied by the original property value (V_0/NOI_0), and then update it according to market interest rates for fixed rate loans through the following log-linear relationship:

$$\ln CRM_t = 3.01 - 0.27 * \ln r_t \quad (11)$$

(t=13.3)

$$n = 8535$$

$$R^2 = 0.0525$$

Average $CRM = 10.7$.

Equation (11) is estimated from the sample used in this study and is used to update LTV through:

$$LTV_t = \frac{LTV_o \cdot (L_t/L_o)}{(CAP_t/CAP_o) \cdot NOI_t/NOI_o} \quad (12)$$

which reduces to

$$LTV_t = \frac{L_t}{CAP_t \bullet NOI_t} \quad (13)$$

While the overall goodness-of-fit of equation (11) is very low, our interest is only in the marginal influence of interest rate changes, as reflected by the coefficient on $\ln r_t$.

Time Dimension

Individual projects are most vulnerable to economic shocks in the early years after loan origination because DCR_t is typically at its lowest level and LTV_t is relatively high. However, a troubled project may not default immediately for a number of reasons. First, there may be large and valuable depreciation writeoffs that we are not capturing in $PVTAX_t$. Also, working-capital cushions required at loan origination provide a shield from default if there are temporary dips in occupancy rates. Furthermore, it may be optimal to “bleed the project” through deferred maintenance and other expenditures for a few years prior to default (Quercia, 1995). Such bleeding can be extended through nonpayment of the mortgage for between 12 and 24 months, the time it takes to foreclose on a defaulted property (Riddiough and Thompson, 1993). For all of these reasons, we expect default rates to rise slowly at first and then peak after a sizable period of time. Preliminary data analysis suggests that the peak default period is between 6 and 7 years from loan origination on new properties. To model this relationship, we use a quadratic function of time since origination.

Underwriting Changes

DCR_0 and LTV_0 are adjusted for loans underwritten in earlier time periods to make them consistent with current practice, which uses actual values of project rents and expenses, and a conservative (high) vacancy factor. Our approach is first to reduce NOI_0 on early originations by 15 percent and then to add a shift variable ($OLDRITE$) to capture the lower level of due diligence at loan origination. The 15-percent adjustment factor is the midpoint of the range mentioned earlier. It captures a combination of historical rent trending (adding 1 year of inflation to rental income), assumptions of immediate and continued full occupancy, and the disregard for capital replacement reserves when computing expense ratios.

Data Sources

The mortgage sample for this study includes multifamily cash purchases acquired by Fannie Mae and Freddie Mac between 1983 and 1995. The original sample includes 14,211 loans. However, after deletion of observations with missing variable values and restricting loans to cities for which rental market data are available, the final estimation sample includes 7,564 loans, representing 52,222 loan-years.¹⁶ Default in this study refers to a forfeiture of property rights, so it includes foreclosure, third-party sale, note sale, and short sale events.

Data on apartment vacancy rates (from Bureau of the Census, Housing Vacancy Surveys) and rent growth (from the consumer price index (CPI) residential rent series) are for 28 MSAs for which government data are available back to 1983. The CPI residential rent series is used to compute the RPI_t indices for each loan.¹⁷

The distribution of the sample (loan-years) by MSA is presented in exhibit 3, which also gives the average annual growth rate of rents and average annual vacancy rates throughout the observation period, 1983–95. Annual growth rates of rents over the entire period ranged from a low of 2.1 percent in Houston to a high of 4.6 percent in New York City. These cities were also the polar extremes in terms of average vacancy rates throughout this time period: 13.41 percent for Houston and 3.78 percent for New York.

Exhibit 3**Rental Market Conditions for 28 MSAs in Data Sample, 1983–95 (in percent)**

MSA	Average Annual Rental Growth	Average Annual Vacancy Rates
Atlanta, GA	3.801	8.88
Baltimore, MD	3.738	6.60
Boston, MA	4.066	5.25
Buffalo, NY	4.269	5.75
Chicago, IL	4.456	6.85
Cincinnati, OH	3.625	6.33
Cleveland, OH	3.533	6.78
Dallas, TX	2.402	11.92
Denver, CO	2.562	7.71
Detroit, MI	3.267	7.40
Honolulu, HI	5.216	4.50
Houston, TX	2.141	13.41
Kansas City, KS/MO	2.957	11.30
Los Angeles, CA	3.690	6.04
Miami, FL	2.869	6.98
Milwaukee, WI	3.984	4.25
Minneapolis-St. Paul, MN	2.992	5.04
New Orleans ^a , LA	1.539	10.71
New York, NY	4.587	3.78
Philadelphia, PA	4.333	7.83
Pittsburgh, PA	3.205	7.32
Portland, OR	4.133	4.58
San Diego, CA	3.593	6.43
San Francisco, CA	4.422	4.19
Seattle, WA	3.843	5.10
St. Louis, MO	2.851	7.56
Tampa-St. Petersburg ^a , FL	2.909	9.90
Washington, D.C.	4.183	5.92

^a Data available for 1987–95.

Sources: Rental growth rates are from the Bureau of Labor Statistics CPI index, rental cost component. Vacancy rates are from the Bureau of the Census, H-111 series.

Exhibit 4

Trends in Default Rates and Risk Factors for Data Sample

Variable	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
Default rate (%)	0.00	0.00	0.00	0.14	0.21	0.75	0.84	1.05	1.70	2.57	3.05	2.22	1.34
Vacancy rate (%)	4.68	4.23	4.48	4.66	4.59	5.06	5.28	5.98	6.56	6.88	6.94	6.68	6.89
DCR	1.14	1.15	1.14	1.12	1.13	1.13	1.13	1.14	1.14	1.14	1.16	1.18	1.20
LTV (%)	76.0	81.1	84.9	86.7	86.5	86.6	86.0	85.0	84.7	84.2	83.7	83.1	82.1
Age	1.0	1.7	1.5	1.7	2.2	2.9	3.4	4.1	4.9	5.7	6.3	6.8	7.1
PVTAX	22.3	20.6	21.3	20.7	7.6	6.0	5.9	6.2	5.4	5.3	6.9	6.9	6.9
OLDRITE	1,000	1,000	1,000	1,000	1,000	0.988	0.961	0.927	0.916	0.884	0.831	0.774	0.689
Number of loans	92	283	975	2780	4352	5081	5845	6264	6105	5866	5441	4809	4329

Source: Data used in this study. Average values of all loans active in each calendar year.

Annual averages for default rates and key variables by calendar (exposure) year are given in exhibit 4. As mentioned earlier, the default rate rises from 1983 to 1993, and then declines from 1993 to 1995. During this period, there are increases in vacancies and the average age of the portfolio increases from 1 to 7 years. There is also a sharp decline in depreciation writeoffs in 1987. Until 1988, the portfolio consists entirely of *OLDRITE* loans; then the mix starts improving and, by 1995, better underwritten loans account for about one-third of the portfolio. The regression analysis will measure the effects of risk factors and provide a framework for explaining the contribution of various factors to the trend in default rates.

Statistical Model Specification

Investor wealth maximizing choices can be modelled in a logistic regression. The logistic model estimates choice probabilities based on a linear wealth (indirect utility) function, which in our case is:

$$W_{i,m,y,t} = \beta_0 + \beta_1 (1/DCR_{i,m,y,t}) + \beta_2 LTV_{i,m,y,t} + \beta_3 PVTAX_{i,y,t} \quad (14)$$

$$+ \beta_4 OLDRITE_y + \beta_5 t + \beta_6 t^2 + \mu_{i,m,y,t}$$

where

i = borrower,

m = MSA,

y = origination year of mortgage, and

t = age of the property.¹⁸

This equation is estimated with maximum likelihood techniques on a cumulative logistic probability function:

$$\text{Probability (default)} = \frac{e^{W_{i,m,y,t}}}{1 + e^{W_{i,m,y,t}}} \quad (15)$$

The one change made here for purposes of the statistical model is to use the inverse of *DCR*, as the parameter of interest. The reason for this is to provide a similar scale and interpretation of coefficients on *DCR* and *LTV* at the trigger points: probabilities of default increase as both *1/DCR* and *LTV* increase.¹⁹

We assume that the relevant choice here is binary: to default or not to default. Because of the prevalence of yield maintenance clauses, or outright prepayment lockouts on sampled loans, we do not attempt to estimate a joint decision function for defaults and prepayments. The model can be thought of as a discrete hazard function, in which loans are tracked from acquisition to default or to a censoring point defined by payoff or the end of the sample period, 1995.

Estimation Results

All coefficient signs are correct and indicate statistically significant effects (see exhibit 5). The effects of *DCR* and *LTV* are additive, indicating that default risk increases sharply for loans with deteriorating underwriting ratios.²⁰ Exhibit 5 also provides mean values and marginal probability estimates for each variable (evaluated at sample means). These show the slightly stronger effect of *LTV* over *DCR*. The baseline hazard curve (constants plus

Exhibit 5

Binomial Logistic Regression Coefficient Estimates^a

Variables	Coefficient Estimates	t-statistics	Mean Variable Values	Marginal Probabilities ^b
1/DCR	3.568	10.603	0.775	0.0294
LTV	4.598	12.251	0.692	0.0379
OLDRITE	0.365	1.756	0.899	0.0030
PVTAX	-0.0464	1.729	7.425	-0.0004
LOANYR	1.532	14.553	4.558	0.0126
LNYSQ	-0.0953	10.966	—	-0.0008

Summary Statistics

Observations	52,222 loan-years
Model Chi-squared	1013.0
Default Probability at Mean Values of Variables	0.83%

^a The constant term is deleted.

^b Effect of a one-unit change in an explanatory variable on probability of default. Computed at mean values of all variables.

time and time-squared) is also strong, verifying the underlying time dimension of credit risk discussed above.

The 1987 tax-change shock to *PVTAX* implies a roughly 50-basis-point increase in annual default rates on multifamily mortgages (0.0004 marginal probability times the 13-point drop). *OLDRITE* measures changes in underwriting practices not captured by adjustments to DCR_0 and LTV_0 . The mean-values marginal probability of 30 basis points suggests that improvements in due diligence at loan underwriting have had a substantial effect on default risk. The effects of changes in tax laws and underwriting are fully discussed in the next section, where we simulate default risk under different scenarios.

Simulations and Issues for Today

We have built a statistical model that allow us to decompose economic and tax-law effects on the default risk of multifamily mortgage loans. This double-trigger model of multifamily loan default allows for updating of DCR and LTV over time and for measuring default rates directly from these variables. In the 1983–92 period, market default rates steadily increased. In our simulations, we track how these movements can be attributed to declines in tax benefits and rental market conditions and to the aging of poorly underwritten loans made in the mid-1980s. We show that defaults would have been greater had it not been for declines in interest rates that increased the value of project cash flows.

Exhibit 6**Simulation Parameter Values^a**

Variables	Scenarios				
	Baseline Scenario (1)	(1) + tax change (2)	(2) + economic stress (3)	(3) + decline in interest rates (4)	New origination (5)
DCR ₀	1.30 x 0.85 = 1.10				1.3
LTV ₀	0.70/0.80 = 0.85				0.70
OLDRITE	on				off
PVTAX	27	drops to 6.9 in year 4			6.9
Initial mortgage interest rate	.13				0.09
Change in interest rates each year	0			-0.04	0
RPI growth rate (annual)	0.05		0.037		0.03
Change in vacancy rate from origination	0		0.02		0
Prepayment rate path (conditional rates, in %)	p = {0.25, 0.25, 0.25, 0.25, 0.25, 0.91, 2.49, 4.54, 8.27, 15.06} ^b			p = {0.25, 0.25, 0.25, 0.46, 2.91, 5.29, 9.65, 17.57, 32.02, 58.35} ^c	p=rates from scenario (1)

^a Parameter values continue across each scenario until changed.

^b The simulated prepayment path given here mimics historical experience from our data sample for 10-year balloons with a 7-year yield maintenance period, holding interest rates constant. Payoff rates are constant and very small in the first years of the mortgage. We then derive the path starting in year 6 from an exponential function: $p_t = (p_5 \times \exp\{0.60 \times (t-5)\}) \times 3$, for $t = \{6, \dots, 10\}$. The multiple of 3 is used to create the jump in prepayment rates that occurs just prior to the end of the yield maintenance period, as the cost of refinancing diminishes. Final payoffs at the balloon point are not shown here.

^c The prepayment function in scenario (4) reflects a declining interest-rate environment, and is simulated from: $p_t = (p_3 \times \exp\{.60 \times (t-3)\}) \times 3.5$, $t = \{4, \dots, 10\}$

Exhibit 7

Conditional Default Rates for 1983 Multifamily Mortgage Originations (simulation parameters are in exhibit 6)

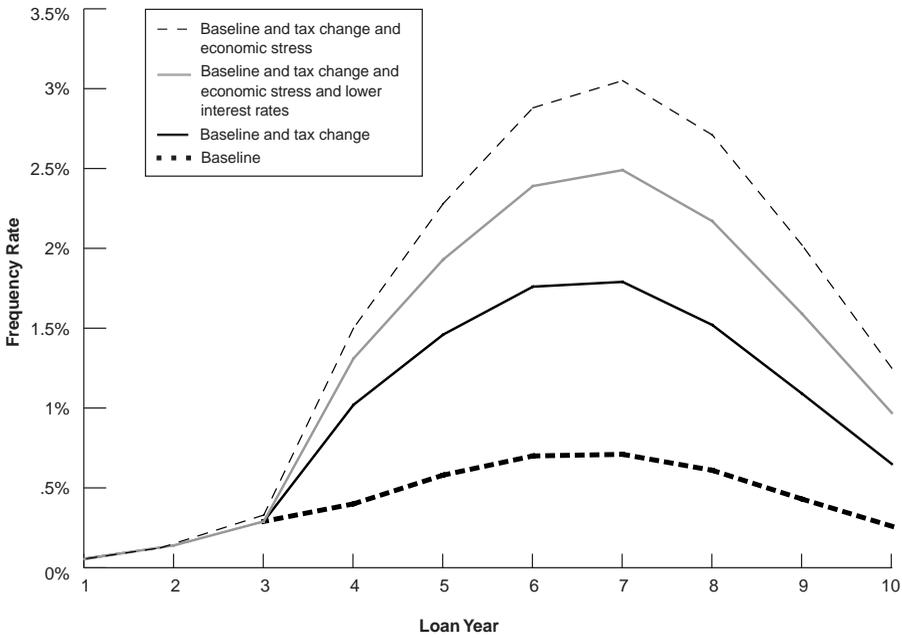


Exhibit 8

Cumulative Default Rates for 1983 Multifamily Mortgage Originations (simulation parameters are in exhibit 6)

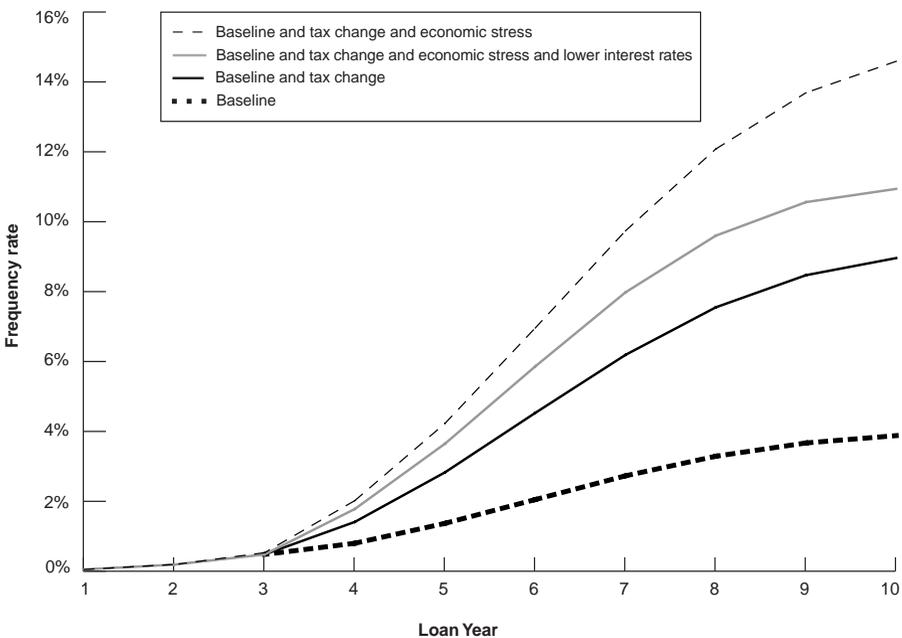
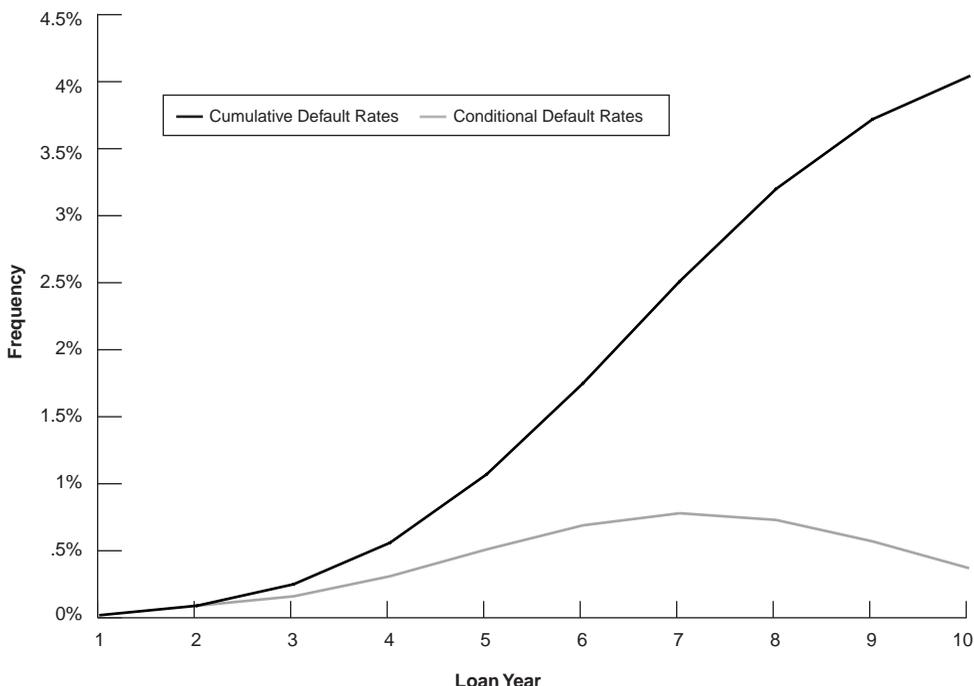


Exhibit 9

Expected Conditional and Cumulative Default Rates on New Multifamily Mortgage Loans Under Current Economic Conditions and Tax Laws (simulation parameters are in exhibit 6)



Simulations

We undertake a simulation exercise to decompose effects of the compound risk factors that caused the high default experience of multifamily mortgage loans in the late 1980s and early 1990s. We perform the decomposition through a simulation of a new loan originated in 1983, following the loan through 1992. While this is ostensibly just one loan, the probabilistic nature of the statistical model infers a loan-pool interpretation. The results of the simulation are pertinent to a portfolio of loans with average characteristics as defined here.

The representative loan is assumed to be a 10-year balloon loan with a 30-year amortization schedule. Any surviving loans at the end of 1992 time are assumed to payoff and refinance, but this is not shown in our simulations. Parameter values for running the simulations are provided in exhibit 6. The conditional and cumulative default rates generated in our simulations are shown in exhibits 7, 8, and 9.

The baseline case takes a new, but poorly underwritten loan, and computes effective DCR_0 and LTV_0 values in accordance with current practice. These underwriting ratios then change from recorded values of $DCR_0=1.30$ and $LTV_0=0.70$, to effective values of $DCR_0=1.105$ and $LTV_0=0.867$. Economic conditions for the 10-year period are assumed to be average national experience during 1983–92, but with steady interest rates and

the ACRS depreciation schedule. This initial simulation yields a 10-year cumulative, expected default rate of slightly less than 4 percent.

The Tax Reform Act of 1986 deeply reduced the value of depreciation writeoffs and property values. The baseline + tax change scenario 2 shows how this alone would cause conditional default rates to more than double during the 1987–92 period and increase the cumulative default rate from the base of 4 percent to more than 9 percent.

Adding a deterioration of economic conditions to the mix yields the highest curves shown in exhibits 7 and 8. The marginal effect of lower rental price growth and higher vacancy rates is slightly more than that of the tax law change, raising cumulative defaults another 6 percentage points to 15 percent.

One factor working in the favor of real estate investors was a continual drop in interest rates during the 10-year period. Multifamily mortgage contract rates went from more than 13 percent in 1983 to roughly 9 percent in 1992. This helped shore up property values because cap-rates fell (multipliers rose). Property owners having difficulty making mortgage payments at 13 percent could refinance or sell to someone who could borrow at lower rates, thus improving the value of the property *NOI* stream to investors. This was especially important at the critical 7-year mark, when properties are most vulnerable to default. In scenario 4, we allow the cap-rate multiplier to increase from 10.18 to 11.25 over the 10-year period. This corresponds with an underlying decline in interest rates from 13 to 9 percent over the same time interval. This reduces conditional default rates by 4 percent in the first year and as much as 22 percent in the 10th year.²¹ The 10-year cumulative default rate is also affected by faster prepayment speeds (see exhibit 6) and drops from 15 percent to 11 percent.

Simulating these four scenarios on a 1983 multifamily mortgage helps to explain the impact of events affecting credit risk in the 1980s. Lax underwriting led to weak portfolios that were vulnerable to changes in tax laws and rental market deterioration. An expected cumulative default rate of 4 percent turned into an actual rate of more than 11 percent, and could have been even higher had it not been for declines in interest rates.

Issues for Today

Exhibit 9 shows simulations of conditional and cumulative default rates for a loan that might be underwritten in 1998. In comparison with the 1980s, underwriting today is better (greater due-diligence and valuation controls), and coupon interest rates are lower. However, this loan is likely to experience lower rental price growth and lower depreciation allowances than were available in the early 1980s (see exhibit 6). On net, the expected default rate is in line with what our simulations showed could have been expected on 1983 originations, at the time of loan underwriting (exhibits 7 and 8). This is a cumulative default rate of approximately 4 percent.

What risk factors does a new loan face today? A building boom would lead to higher vacancy rates and further reduce rental price growth from today's low levels. Likewise, deflation would prevent project financials from improving as new loans approach the critical period in years 5 through 9. Should interest rates rise, they would depress property values and cause payment shock for ARM and balloon loans. But a repeat of the 1983 experience would require a significant deterioration of underwriting quality and adverse tax law changes. One such adverse tax law change would be movement to a flat tax plan that would affect the value of depreciation writeoffs.

Our simulations show that it is unlikely that 10-year cumulative default rates on a new portfolio of loans, with $DCR_0=1.30$ and $LTV=0.70$, could rise above 8 percent, even if rental market conditions were to deteriorate. These loans start with solid financial cushions to help sustain them through a market downturn. However, some loan programs today allow for DCRs as low as 1.20, or even 1.10 on special affordable housing loans, and allow LTVs as high as 80, with 90 percent on affordable housing loans. For such loans, the default experience of 1983 originations could be replicated with economic deterioration similar to that of the 1980s.

We conclude that an important source of risk today is the competitive pressure to relax DCR_0 and LTV_0 requirements for new loans. Use of adjustable-rate mortgage products to lower initial loan payments and increase DCR_0 also adds to default risk. By risk, we mean the sensitivity of default rates to an increase in interest rates or a deterioration in rental markets. President Clinton's first Comptroller of the Currency, Eugene Ludwig, expressed concern that commercial lending underwriting may be too comfortable under the current good economic conditions, and may be slipping into old habits. At an American Bankers Association convention in late 1997, Ludwig said, "We have learned before that imprudent loans made in the heady atmosphere of good times come back to haunt you when the good times fade." He directed the Office of the Comptroller of the Currency to increase scrutiny of bank underwriting practices and abilities of banks to deal with problem loans.²² We would only add that when the "good times fade," the Federal Government must be careful not to make matters worse by changing tax laws in drastic ways.

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Notes

1. ARM loans may be either fully-amortizing, or have balloon terms.
2. See Belsky (1992) for numerical tables and discussion of rental turnover rates derived from Bureau of the Census sources.
3. Some of the multifamily loans in our data sample had actual prepayment lockouts in the early years of the mortgage terms. Such contractual prohibitions against prepayment were more prevalent in the early 1980s than they are today.
4. Credit support may involve loss reserve accounts, letters of credit, co-insurance between lender and guarantor, bond insurance (State mortgage revenue bonds), pool insurance, or retained cash-flow tranches (for securitized pools).
5. See DiPasquale and Cummings (1992) for an overview of the general effects of tax code changes in the 1980s on commercial real estate.

6. For example, given an expense-to-rents ratio of 47 percent and a vacancy rate of 6.5 percent (both sample averages), NOI would be 46.5 percent of gross rents. If actual expenses were 49 percent and vacancies were 8.5 percent, NOI would actually be 42.5 percent. Dividing 46.5 by 42.5 (and subtracting 1) yields an estimate of the overstatement of NOI, 9.41 percent. If in addition rents are overstated by 4 percent, the bias is 18.8 percent.
7. A “cap” rate is the ratio of (annual) rental income to property value. The inverse of this is the cap-rate multiplier (CRM). Property appraisers multiply current NOI by the CRM to approximate property value. It is shorthand for the net present value of the future income stream from the property.
8. The significant credit-losses at Freddie Mac which led to a multifamily mortgage purchase moratorium in 1991 have been widely discussed. See DiPasquale and Cummings (1992) for details.
9. The Fitch Rating Agency views 1991 as the worst year for multifamily losses in recent history and has dubbed 1991 an “A” level multifamily mortgage recession year for the nation.
10. NOI is a measure of rental income less expenses. For underwriting purposes, it is typically measured as full potential rent at market prices, less all expenses other than debt repayment, and less a vacancy factor which includes uncollected rents. It provides an indication of the level of debt the property can support.
11. Commercial loan underwriting also includes examinations of borrower credit, servicer capabilities, site and engineering reviews, and cost certifications for new construction. Market condition reports are part of the appraisal process that feeds into DCR and LTV calculations.
12. Abraham (1993a, 1993a) and Goldberg (1994) obtained large databases to estimate default models exclusively for multifamily mortgages. While each author recognizes the need for updating LTV and DCR over time, neither has been successful in doing so.
13. This comes from survey data collected by the Institute for Real Estate Management, or IREM, a subsidiary of the National Association of Realtors.
14. In the future, we expect to expand the data sample in an attempt to measure the effect of any balloon-year payment shocks.
15. For more details on the PVTAX variable see Goldberg (1994).
16. Observations were deleted chiefly because of missing data on rents, vacancies, DCR, and LTV.
17. Government data at the MSA level does not differentiate multifamily from single-family rental properties. Resulting biases are more of a problem for vacancy rates, where multifamily rates are higher and more volatile than are single-family rental vacancies. We will continue to work on improving data sources in future research.
18. Many loans purchased by the secondary market are already seasoned. Our analysis observes only their conditional default rates after purchase.

19. The logistic functional form is optimized in practice when variables are in deviation form because the coefficients are utility weights from choosing one option over another. As the financial balances implied by LTV and 1/DCR move away from 1.00, so the probabilities of stability or instability of the mortgage also change. Another benefit of the logistic model, when variables are properly specified in deviation form—here implied by the ratios—is that marginal probabilities from equal changes in exogenous variables decline as those variables move further and further from the threshold levels.
20. This important finding differs from the typical default risk exhibit for multifamily loans, which assumes only small reductions in risk as LTV and DCR improve, e.g., see Standard & Poors (1993) for severe-case foreclosure rates assumed for various combinations of LTV and DCR.
21. These are percent reductions in rates, not percentage point changes.
22. Quotation and comments taken from, “Regulators Say Banks Have Eased Standards for Making Loans,” *The Wall Street Journal*, Monday, October 6, 1997. Mr. Ludwig’s speech was given on Sunday, October 5, 1997.

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