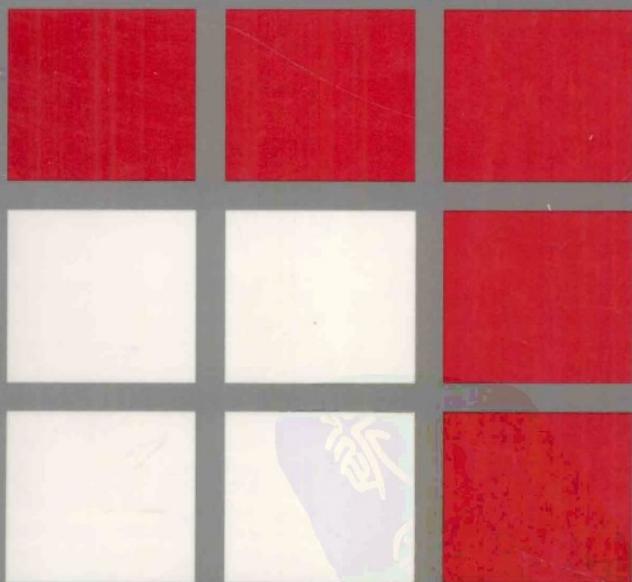


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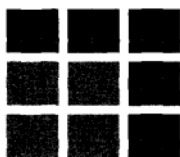
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Journal of the
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Articles

Editor's Introduction

Kerry D. Vandellpage 207

Handing Over the Keys:
A Perspective on Mortgage Default Research

Kerry D. Vandellpage 211

Transaction Costs, Suboptimal Termination
and Default Probabilities

James B. Kau, Donald C. Keenan and Taewon Kimpage 247

Commercial Mortgage Pricing with Unobservable
Borrower Default Costs

Timothy J. Riddiough and Howard E. Thompsonpage 265

Explaining Refinancing Decisions Using Microdata

Amy Dickinson and Andrea J. Heusonpage 293

Elective Mortgage Prepayment:
Termination and Curtailment

Peter Chinloypage 313

Why Do We Have ARMs?

Jan K. Bruecknerpage 333

Editor's Introduction

It is especially appropriate that the American Real Estate and Urban Economics Association is sponsoring a special issue of its journal devoted to "third generation" mortgage research on the eve of the 60th anniversary of the creation of the Federal Housing Administration in 1934. It was the establishment of the modern housing finance system which led to standardized loans and underwriting, mortgage insurance, the secondary market, securitization and in general, the world of real estate finance as we know it today.

The "first generation" of mortgage research began in the early 1960s with empirical studies of default and prepayment behavior such as those by Jung (1962) and Page (1964). These extended to the econometric models of Herzog and Earley (1970) and von Furstenberg (1969, 1970) and finally to those empirical models of the late 1970s through the early 1980s, such as Vandell (1978) and Campbell and Dietrich (1983), which incorporated evolving mortgage pricing theory and embraced alternative instrument types.

"Second generation" research was primarily theoretical and introduced formal pricing models of mortgages and their securities, especially those based upon options theory. Asay's (1978) dissertation began this stream of creative application of options theory; it reached full maturity in papers by Brennan and Schwartz (1985), Epperson et al. (1985) and Titman and Torous (1989). Empirical tests were undertaken but tended to be inexact, owing to data deficiencies.

"Third generation" mortgage research now promises the flowering of the efforts of the first two generations. Extensions include the explicit consideration of transaction costs, "suboptimal" payment behavior and a broader array of explanatory factors affecting default and prepayment behavior. Data availability, especially at the micro level, is beginning to permit useful empirical application of these models. Attention is moving beyond underwriting and pricing questions to those examining market efficiency and investment performance [see, for example, Green, Howe and Shilling (1992) and Ciocchetti et al. (1993)].

Our call for papers for this issue of the *Journal* provoked a considerable response. In fact, the magnitude and quality of the response was so overwhelming that we have decided to break the special issue into two editions, for Fall and Winter, 1993. The papers which have been selected to be included in the two editions are highly innovative and representative of the breadth of research which is needed today in order to broaden our understanding of the demand, supply and investment characteristics of the mortgage instrument and its associated securities.

We introduce this issue with my Presidential Address at the ASSA meetings in New Orleans in January, 1992. It serves as a useful survey of some of the current research issues which face the mortgage market, though primarily from the standpoint of default behavior.

Two articles follow that characterize the debate going on today with respect to the degree of "ruthlessness" with which default is exercised in mortgage contracts, hence the relative importance of transaction costs in hindering default and foreclosure. Kau, Keenan and Kim use option-based methodologies to extract implicit probabilities of default and introduce both transaction costs and suboptimal termination behavior as explanatory factors for default underexercise. They find that transaction costs are by far the more powerful of the two but contend that neither greatly affects qualitative default behavior. Thompson and Riddiough introduce an option-based pricing model that postulates the existence of transaction costs which are unobservable to the lender/investor at origination and are heterogeneous across borrowers. These create "fuzzy" default boundaries, which account for investor uncertainty with respect to evaluating the borrower's default decisions and which under certain circumstances, could be important in pricing.

The next two papers turn to prepayment behavior. Heuson and Dickinson examine why borrowers with similar loans will behave differently with respect to their refinancing decisions. Their model moves beyond interest-rate differentials to explain how desired changes in capital structure in the face of changing incomes and housing wealth can be important precipitators of prepayment. Chinloy takes a first look at "curtailment," or partial prepayment. The curtailment option is added to traditional pricing models of default and prepayment. Although considered "second order" under most conditions, under certain circumstances, such as steep term structures or higher marginal tax rates, curtailment behavior could become common, resulting in major pricing modifications.

Finally, Brueckner turns from pricing questions to ask a more basic question about mortgage demand, namely "why do we have ARM's?", when

lenders typically can be assumed to be risk-neutral, or nearly so, while borrowers are risk-averse and ARM's saddle the borrower with interest-rate risk. He finds that because borrowers are typically liquidity constrained and may not find the level payment constraint of the FRM optimal, especially if they face a rising time trend for the cost of funds, they may accept exposure to interest-rate risk in order to gain a more favorable time path of payments. Incorporating Brueckner's model into empirical estimates can help us do a better job in predicting instrument choice.

We trust that you will find these papers useful and provocative in extending your own efforts in this most fruitful area of innovative research.

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Handing Over the Keys: A Perspective on Mortgage Default Research

Kerry D. Vandell*

This paper is the text of the 1992 Presidential Address for the American Real Estate and Urban Economics Association. A comparative evaluation of mortgage default research finds that both the residential and commercial markets evolved from informal underwriting rules, to formalized (though unvalidated) ratios and rules of thumb, to early risk ratings based upon empirical evidence, to generalizable econometric models of default, to option-based pricing models. The commercial market lagged the residential market by about 10 to 20 years at first but is now only about five years behind. The survey finds that research and progress in understanding mortgage credit risk has been precipitated by a public policy need or mandate, data availability, and adequate technology. The absence of any one of these factors has hindered progress in the past. Finally, six emerging issues in default research are identified and discussed: (1) the degree of "ruthlessness" with which default is exercised, (2) loan recourse, (3) the magnitude and timing of revenues and losses associated with default, (4) loan modification, (5) default in a portfolio context, and (6) leasehold default. Progress in these areas will enhance the efficiency of both the residential and commercial markets.

Today I am going to speak with you about a topic that over the years has become near and dear to my heart: mortgage default risk and our understanding of what drives it and how it can be tamed. I decided to select this topic for four reasons:

- (1) I know something about it. It all started with my dissertation back in 1976, when as a by-product of an analysis of demand for alternative mortgage instruments, I fell into an examination of credit rationing and differential default risk among such instruments.
- (2) It now has become a major public policy issue. The current crisis within the banking, savings and loan (S&L) and life insurance industries has been precipitated largely by credit-risk related fac-

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tors. The credit crunch, risk-based capital requirements, the growth of commercial mortgage securitization and community-based lending requirements all have their roots among credit risk issues.

- (3) The story of the evolution of research on mortgage default behavior is a major part of—and is reflective of—the story of the evolution of real estate research in general. It is a reflection of the migration of mortgage finance academics and practitioners into the field.
- (4) And finally, its boundaries extend and generalize to broader areas of research in the mortgage market and the debt markets in general—first to embrace commercial as well as residential lending, then to borrower/lender relationships and finally to non-asset-based lending.

My discourse today begins with the historical evolution of what we know about credit risk in the residential and commercial markets. This historical perspective will act as a window to the future which provides insights as to where we are heading and where the gaps are. Note as we embark on our odyssey that there have always been three ongoing themes which have precipitated research efforts: (1) a public policy need or mandate, (2) data availability, and (3) adequate technology. The absence of any one of these has more than once stalled progress.

A History of Mortgage Credit Risk Evaluation

The Early Days

The chart in Figure 1 summarizes the historical evolution of credit-risk rating systems as a component of the underwriting of residential and commercial mortgages. In the residential market prior to 1934, credit-risk evaluation perhaps could be described best as informal but primarily asset-based; i.e., looking primarily to the housing unit itself both as the security for the indebtedness and as the major indicator of potential default problems.

In 1934, with the creation of the Federal Housing Administration (FHA), came the first standardized underwriting criteria. [See Dennis (1989) for a summary of the development of the FHA.] These criteria dealt both with the creditworthiness of the borrower and the asset itself, as well as with neighborhood characteristics. By the late 1930s, they had been formalized by the FHA into a series of ratios, namely:

- the ratio of monthly payment (including taxes and insurance) to gross income—set at a maximum of 25%,

Figure 1 ■ Stages in Residential and Commercial Mortgage Underwriting Development

| | Residential Underwriting | Commercial Underwriting |
|------|--|--|
| 1920 | Informal—Primarily Asset Based | Informal—Primarily Credit Based (Commercial Banks) |
| 1930 | FHA Initiates Standardized Underwriting-1934 | |
| 1940 | Formalized via FHA--Emphasis on Borrower Creditworthiness. Risk Rating | |
| 1950 | Formalized Ratios—Rules of Thumb | Informal Rules of Thumb and Ratio Analysis |
| 1960 | Early Risk Ratings Based Upon Empirical Evidence | |
| 1970 | Beginnings of Econometric/Discriminant Models | |
| 1980 | Beginnings of Models Generalizable to AMI's | |
| | Beginnings of Option Pricing Models | First Risk Ratings Based Upon Empirical Evidence (S&P's) |
| | | Beginnings of Econometric Models/Generalizable Models |
| 1990 | | Beginnings of Option Pricing Models |

- the ratio of total monthly payment plus other installment debt obligations to gross income—set at a maximum of 33%,
- the loan-to-value ratio, set initially at a maximum of 80% and later increased to 95% or even higher,
- and sometimes the ratio of house value to gross household income, typically limited to a maximum of 2.5 times.

In addition, ratings were made of neighborhood quality (which led to explicit redlining of specific neighborhoods—the term was originally an

FHA term). Figure 2 is a summary of the credit-risk rating system in use by the FHA in 1938.

These ratios served as the basis for residential underwriting and credit-risk analysis until the 1970s. They seemed to work perfectly well during the 1940s, 1950s and 1960s, as long as the unanticipated inflation during this time period tended to bail out even the most mis-underwritten loans and as long as those borrowers who were excluded systematically by the process, such as those in older, inner-city, racially transitional areas, did not complain. These were the "good old days" of residential underwriting, in which such rules apparently worked well—with low, stable inflation and interest rates, an all-fixed-rate mortgage (all-FRM) world and localized markets for lending with no secondary market to speak of.

However, as we look back upon these criteria, we realize they were inadequate in many respects; they were completely ad hoc and based only upon impressions and prejudices. There was no formal validation based upon actual default experience in the market. They also focused only on the potential existence of delinquency or foreclosure. They said nothing about its timing, loss severity in the event of default or the effects on pricing and yields. Nonetheless, their use persisted, and they remained essentially unchanged (with some minor changes in the cut-off points) for almost 40 years. Furthermore, they were extended in modified form to the conventional loan market when that market began after World War II and also extended to the secondary market with the expansion of Federal National Mortgage Association (FNMA) and the Federal Home Loan Mortgage Corporation (FHLMC) activities in the 1970s.

The 1960s and Early 1970s: Problems Created by Swings in the Macroeconomy

However, the good old days were not to last. Beginning in the 1960s, the economy began to experience large swings in inflation and interest rates, with a concomitant rise in defaults in 1966 and 1970. This also was the period of development of Government National Mortgage Association (GNMA) securities, the beginnings of the secondary market and the expansion of private mortgage insurance. The public policy mandate for greater understanding of credit risk and underwriting criteria was clearly present: losses were being incurred as a result of defaults, which reached their highest levels since the Depression, and true liquidity could not be achieved unless we had a better understanding of default risk to allow proper pricing of mortgages and mortgage insurance.

The response by the industry was the creation of the first risk-rating criteria which had been validated through discriminant analysis or similar techniques against past default experience. The U.S. League of Savings Associations developed such a model, although it was not widely adopted by its members (the unvalidated FHA criteria, remember, remained static). However, several mortgage insurers adopted such criteria to aid them in underwriting their policies. Figure 3 is a copy of the risk rating criteria adopted by Foremost Guaranty based upon a discriminant analysis. Again, these criteria dealt with the likelihood of default only, not its timing or loss severity. But these criteria were, for the first time, an attempt to validate explicitly the factors being used as indicators of default risk.

This was also the period of the first academic default-model building, since the econometric and computing technology was now far enough advanced to permit models to be built based upon large data sets of loan payment experience. There were two studies which were particularly influential during this period. Both were based upon FHA data, which was the only large-scale data base readily available:

- Herzog and Earley (1970) estimated a series of econometric models relating the occurrence of default to numerous characteristics of the borrower (e.g., occupation, number of dependents, marital status, age of head and payment-to-income ratio), the loan (e.g., whether for refinancing or purchase, whether a second mortgage existed, the loan-to-value ratio and the term to maturity) and economic conditions (e.g., region of country). Strangely, Herzog and Earley included no property-specific variables. However, their efforts were among the first to validate the dominance of the initial loan-to-value ratio in influencing default. Evidence of the role of payment-to-income ratio was mixed, in most cases either proving insignificant or negative in influence, the opposite of what would be expected.
- von Furstenberg (1969, 1970), in a series of papers, was the first to look at the timing of default. He related the occurrence of default over time to a variety of conditions at the time of underwriting, including borrower characteristics (e.g., age of head and income), loan characteristics (e.g., initial loan-to-value ratio) and property characteristics (e.g., new/existing unit and initial sales price or value). His only time-dependent variable was a variable he called "seasoning," the time since origination. This was supposed to proxy for growing attachment to the property and experience in successfully making the payments. His model was the

Figure 2 ■ FHA Risk Rating—1938

Rating of Property

| PHYSICAL SECURITY FEATURES | | REJECT | 1 | 2 | 3 | 4 | 5 | RATING |
|-----------------------------------|--------------------------------------|--------|----|----|----|----|----|--------|
| Durability | Structural Soundness | | 5 | 10 | 15 | 20 | 25 | |
| | Resistance to Elements | | 2 | 4 | 6 | 8 | 10 | |
| | Resistance to Use | | 1 | 2 | 3 | 4 | 5 | |
| Function | Livability and Functional Plan | | 4 | 8 | 12 | 16 | 20 | |
| | Mechanical and Convenience Equipment | | 2 | 4 | 6 | 8 | 10 | |
| | Natural Light and Ventilation | | 2 | 4 | 6 | 8 | 10 | |
| Architectural Attractiveness | | | 4 | 8 | 12 | 16 | 20 | |
| Total Rating of Physical Security | | | | | | | | |
| Adjustment for Nonconformity | | | 12 | 9 | 6 | 3 | 0 | |
| TOTAL RATING OF PROPERTY | | | | | | | | |

Rating of Borrower

| FEATURE | | REJECT | 1 | 2 | 3 | 4 | 5 | RATING |
|--------------------------|--|--------|---|----|----|----|----|--------|
| Attitudes | Social and Economic Characteristics | | 3 | 6 | 9 | 12 | 15 | |
| | Motivation in Relation to Transaction | | 5 | 10 | 15 | 20 | 25 | |
| Ability to Pay | Employability and Earning Stability | | 4 | 8 | 12 | 16 | 20 | |
| | Relation of Obligations to Transaction | | 3 | 6 | 9 | 12 | 15 | |
| | Relation of Income to Transaction | | 5 | 10 | 15 | 20 | 25 | |
| TOTAL RATING OF BORROWER | | | | | | | | |

Figure 2 ■ continued

Rating of Location

| FEATURE | REJECT | 1 | 2 | 3 | 4 | 5 | RATING |
|---|--------|---|---|----|----|----|--------|
| Relative Economic Stability | | | | | | | |
| Protection from Adverse Influences | | 4 | 8 | 12 | 16 | 20 | |
| Freedom from Special Hazards | | 1 | 2 | 3 | 4 | 5 | |
| Adequacy of Civic, Social, and Commercial Centers | | 1 | 2 | 3 | 4 | 5 | |
| Adequacy of Transportation | | 2 | 4 | 6 | 8 | 10 | |
| Sufficiency of Utilities and Conveniences | | 1 | 2 | 3 | 4 | 5 | |
| Level of Taxes and Special Assessments | | 1 | 2 | 3 | 4 | 5 | |
| Appeal | | 2 | 4 | 6 | 8 | 10 | |
| TOTAL RATING OF LOCATION | | | | | | | |

Rating of Mortgage Pattern

| FEATURE | REJECT | 1 | 2 | 3 | 4 | 5 | RATING |
|---|--------|---|----|----|----|----|--------|
| Ratio of Loan to Value ___% | | 6 | 9 | 12 | 16 | 20 | |
| Ratio of Total Payment to Rental Value ___% | | 2 | 4 | 6 | 8 | 10 | |
| Ratio of Life of Mortgage to Economic Life of Building ___% | | 1 | 2 | 3 | 4 | 5 | |
| Lowest Category Rating (_____) ___pts. | | 7 | 12 | 17 | 22 | 27 | |
| Intermediate Category Rating (_____) ___pts. | | 6 | 10 | 14 | 18 | 22 | |
| Highest Category Rating (_____) ___pts. | | 4 | 7 | 10 | 13 | 16 | |
| TOTAL RATING OF MORTGAGE PATTERN | | | | | | | |

Figure 3 ■ Foremost Guaranty Underwriting Guidelines

| ELEMENTS | 1 - 4 | 5 - 9 | 10 - 14 | 15 - 19 | 20 - 24 | 25 - 29 | 30 | POINTS | |
|-----------------------------|---|--|---|--|--------------------------|----------------------------------|---|---------------|-----|
| | | | | | | | | ACT. | MAX |
| Credit History | recent bankruptcy, repossession | judgments, tax liens, bad debts or rejected for credit | all accounts very slow; repeated judgments on small accounts | evidence of slowness on major accounts | major accounts favorable | generally good credit references | excellent references with fair amount of experience in credit | | 30 |
| Mortgage Payment to Income | more than 28% | 25%-28% | 20%-24% | less than 20% | | | | | 15 |
| Total Obligations to Income | 36%-39% | 31%-35% | 30% and under | | | | | | 10 |
| Potential | short period of employment; few liquid assets | good job tenure and liquid assets | | | | | | | 5 |
| Loan to Value Ratio | 91%-95% | 81%-90% | 80% or less | | | | | | 10 |
| Purpose of Loan | refinance, investment, 2nd home, etc. | purchase to occupy as primary residence | | | | | | | 5 |
| Type of Property | condominium, mobile home, duplex, etc. | conventionally built single family | | | | | | | 5 |
| Marketability | mixed ages and uses, few owner properties | some variation in ages and uses, fluctuation in value ranges | evidence of consistent uses, mostly owner occupied properties | | | | | | 10 |
| Condition | many costly repairs necessary | needs some minor repairs | well maintained property, pride of ownership highly evident | | | | | | 10 |
| | | | | | | | | TOTAL POINTS: | 100 |

This matrix illustrates the importance of each element of a mortgage loan. Each element may be evaluated by selection of the appropriate number of points and the total points are then compared to the following range of acceptability:

- 90 - 100 preferred loan
- 80 - 90 above average
- 70 - 80 average
- 60 - 70 marginal (grey area)
- 0 - 60 reject

These guidelines will be used to underwrite each application. However, Foremost is aware that there will be some deviation from the above range and each application will also be evaluated on its individual merits.

Figure 3 ■ continued

| Mortgage Payment to Income | | Total Obligations to Income | | Loan to Value | | Purpose of Loan | | Points |
|----------------------------|--------|-----------------------------|--------|---------------|--------|---|--|--------|
| % | Points | % | Points | % | Points | | | |
| 19 & less | 15 | 30 & less | 10 | 80 & under | 10 | Refinance for debt consolidation. | | 0 |
| 20 | 14 | 31 | 9 | 81-84 | 9 | Refinance for working capital or for investment. | | 1 |
| 21 | 13 | 32 | 8 | 85 | 8 | Refinance to pay land contract or improve property. | | 2 |
| 22 | 12 | 33 | 7 | 86 | 7 | Purchase for investment. | | 3 |
| 23 | 11 | 34 | 6 | 87 | 6 | Purchase for second home. | | 4 |
| 24 | 10 | 35 | 5 | 88-90 | 5 | Purchase to occupy as primary residence. | | 5 |
| 25 | 9 | 36 | 4 | 91 | 4 | | | |
| 26 | 8 | 37 | 3 | 92 | 3 | | | |
| 27 | 7 | 38 | 2 | 93 | 2 | | | |
| 28 | 5 | 39 | 1 | 94 | 1 | | | |
| 29 | 3 | 40 & over | 0 | 95 | 0 | | | |
| 30 | 1 | | | | | | | |
| over 30 | 0 | | | | | | | |

| Property Types | Points |
|----------------------------|--------|
| Condo | 0 |
| Mobile, modular | 1 |
| Townhouse | 2 |
| 3 or 4 unit | 3 |
| 2 unit | 4 |
| Conventional single family | 5 |