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# **PROGRAM ON HOUSING AND URBAN POLICY**

## **CONFERENCE PAPER SERIES**

**C01-008**

### **AUTOMATED UNDERWRITING AND LENDING OUTCOMES: THE EFFECT OF IMPROVED MORTGAGE RISK ASSESSMENT ON UNDER-SERVED POPULATIONS**

By

Peter Zorn  
Susan Gates  
Vanessa Gail Perry

August 2001

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# Housing and the New Economy

May 31, 2001

## Session III:

### The New Economy and the Housing Industry

## Automated Underwriting and Lending Outcomes: The Effect of Improved Mortgage Risk Assessment on Under-served Populations

Peter Zorn, Susan Gates, and Vanessa Gail Perry

**Peter Zorn** received a BA in History from Marlboro College in 1975 and a Ph.D. in Economics from the University of California-Davis in 1982. He was an assistant professor in the Department of Consumer Economics and Housing at Cornell University from 1982 to 1988, and a tenured associate professor from 1988 through 1994. Since 1994 he has been Director of Financial Strategy and Policy Analysis at the Federal Home Loan Mortgage Corporation (Freddie Mac). His work at Freddie Mac focuses on mortgage prepayment and default modeling, fair lending, and equal access to mortgage credit with particular emphasis on the impacts of automated loan processing and risk-based pricing. He has recently conducted studies of barriers that minorities face in becoming homeowners, the factors driving borrowers to the sub-prime market and the difficulties consumers have in obtaining and maintaining good credit.

**Susan Gates** received a BA from the University of Delaware in 1981, a MA in public and international affairs from the University of Pittsburgh in 1982, and a Ph.D. in public administration and policy from Virginia Tech in 1998. She was a Presidential Management Intern at the Executive Office of the President Office of Management and Budget from 1983 to 1985, where she oversaw presidential budget and policy for State Department refugee and consular programs. From 1988 to 1990, she was responsible for presidential budget and policy for the Department of Veterans Affairs home loan mortgage program. Joining Freddie Mac in 1990, she was editor of *Secondary Mortgage Markets* and has written and edited numerous Freddie Mac public policy publications. She is currently Director of Public Policy.

**Vanessa Gail Perry** is a Senior Economist in Housing Economics at Freddie Mac, and Adjunct Professor at Georgetown University. Since 1991, her research at Freddie Mac has focused on affordable housing, fair lending, housing policy and credit access issues, such as the impact of automated loan processing and risk-based pricing. She received a BA in Philosophy from the American University in 1988, an MBA from Washington University in St. Louis, and a Ph.D. the University of North Carolina at Chapel Hill in 2000. Her research interests include consumer financial decisions, the effects of competition on consumers, and consumer information acquisition. She has recently conducted studies on consumer credit problems, financial literacy, and the sub-prime mortgage market.

## **Automated Underwriting and Lending Outcomes: The Effect of Improved Mortgage Risk Assessment on Underserved Populations**

Over the past six years, automated underwriting has become increasingly common in the nation's mortgage markets. Automated underwriting's risk-ranking systems particularly excel at assessing difficult loan cases that traditional underwriting can tend to dismiss out of hand as too risky. In this paper, using examples from Freddie Mac's Loan Prospector system, we examine the effects of automated underwriting systems on expanding the mortgage market for low-income and minority families.

### **Overview of AUS**

By weighing and balancing compensating factors with automated precision, these systems can identify borderline loan applications that fall within acceptable risk ranges. Furthermore, automated underwriting offers the promise of a loan-decision-making process that is totally impervious to racial and socioeconomic borrower differences. Qualified loan prospects previously excluded or unfairly penalized by the traditional underwriting system will get a better shake through fact-driven analysis of only those strengths and weaknesses that are relevant to mortgage repayment (Freddie Mac 1996).

Automated underwriting also reduces the costs of originating a mortgage. Lenders using Loan Prospector cite savings of up to \$650 in closing costs. Automation also is fostering greater competition among lenders by giving all mortgage lending players better tools with which to pursue their business. In the future, not only will borrowers save even more on their loan origination costs, but they will benefit from

lower mortgage interest rates and a greater choice of mortgage products and market niche that more intense competition will produce.

A recent survey found that in 1999, 60 percent of mortgages were underwritten using some sort of automated system.<sup>1</sup> Freddie Mac alone has processed more than 10 million conventional conforming mortgages using Loan Prospector, the statistically based automated underwriting service it introduced in 1996. Today two of every three loans Freddie Mac purchases is assessed by Loan Prospector prior to origination, and loans that are manually underwritten or seasoned in portfolios are run through Loan Prospector post-purchase to assess their level of risk. In 1999, Freddie Mac made an Internet version of Loan Prospector commercially available, putting the automated system in the hands of more than 11,000 mortgage brokers and 300 mortgage wholesalers. Other automated underwriting systems in use today include Fannie Mae's Desktop Underwriter, Wells Fargo's ECS service and Countrywide's CLUES.

Automated underwriting's entrée into the government mortgage market has kept pace with broader market acceptance. In 1996 the Federal Reserve examined the use of credit scores in the mortgage underwriting decision and concluded that they were statistically valid predictors of default (Avery, Bostic, Calem, and Canner 1996). The following year, the Department of Veterans Affairs approved the use of Loan Prospector for VA loans, followed by HUD's approval of a custom version for FHA loans. Usage quickly took

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<sup>1</sup> A recent survey, KPMG Consulting (2000), p. IV-4, found 60% of total loans underwritten by AU in 1999.

off. By August 1999, Loan Prospector had processed nearly 1.8 million government loan submissions.

The jumbo mortgage market also has been transformed by the rise of automated underwriting. Freddie Mac's Loan Prospector will assess the risk of loans that exceed the conforming loan limit and are thus ineligible for purchase by the secondary market company.

Industry participants have been quick to praise automated underwriting for reducing the time, documentation requirements and processing costs of mortgage originations.<sup>2</sup>

Borrowers appear to be the ultimate beneficiaries of the increased efficiencies; the average time from mortgage approval to closing has shrunk from xx to x days since 199x, largely due to automated underwriting. [anybody got a cite?] To the extent that these process efficiencies are not passed through to borrowers in the form of lower closing costs, they may allow lenders to "redirect underwriting resources from relatively low-risk cases" to marginal loans (Bunce et. al. 2000?).

Automated underwriting has also been touted for its improved accuracy over manual underwriting. This has increased the comfort of mortgage purchasers and guarantors who ultimately bear the brunt of poor underwriting decisions. As discussed in Straka (2001), automated underwriting has greatly reduced the extent of principal-agent based adverse selection, which has long plagued manual underwriting. By "screening-out" the highest-

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<sup>2</sup> Paul Peterson, "Keeping Promises," *Mortgage Banking*, May 2001.

risk tail of loans that would have “slipped in” under manual systems, automated underwriting has contributed to a reduction in industry credit losses.

To be sure, the industry’s rapid adoption of automated underwriting not occurred without “new needs, costs, issues, pitfalls and detractors.”<sup>3</sup> In the sphere of fair lending, concerns have been raised about the “black box” nature of automated underwriting systems and the widespread reliance on credit bureau scores.<sup>4</sup> As noted by Bunce (200?), there is the concern that the codification of certain underwriting guidelines that are not representative of the mortgage behavior of all groups could result in unintentional discrimination or disparate treatment across groups. To avoid this outcome, the specification of the mortgage scoring model must “correctly define objective equals with respect to risk.”<sup>5</sup>

Other concerns center on the strictly quantitative nature of automated underwriting systems. Automated underwriting’s heavy reliance on objective and electronically verifiable data such as credit scores, financial reserves and loan-to-value (LTV) ratios does contribute to a bias-free mortgage market. However, to the extent that wealth and credit variables are unevenly distributed, as well as the electronic verification thereof, underserved populations may remain underserved in a world of automated underwriting.

(Fannie Mae, Airlie Conference 2001)<sup>6</sup>

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<sup>3</sup> John W. Straka, “A Shift in the Mortgage Landscape: The 1990s Move to Automated Credit Evaluations,” *Journal of Housing Research*, forthcoming, p. 2.

<sup>4</sup> See, for example, Lawrence Richter Quinn, “Credit Score Scrutiny,” *Mortgage Banking*, September 2000, p. 50.

<sup>5</sup> Bunce, et. al., p. x.

<sup>6</sup> Ironically, it is as a result of automated underwriting and the resulting availability of statistical data about rejection rates that we know that problems still exist. Thus, it is convenient to blame automated underwriting for observed disparities in the distribution of mortgage credit.

Finally, some might argue that the objective, sterile and quantitative nature of automated underwriting has created a mortgage “meritocracy” that disadvantages underserved populations. That is, just as gains have been made in expanding access to mortgage markets, automated underwriting represents a new set of immutable “rules.” As noted by Bunce (200?), those “marginal” borrowers who have been most helped in recent years by the rise of affordable lending programs would be disproportionately represented among borrowers rejected under strict statistically-based underwriting systems. Further, although rejected loans are “referred” to manual underwriters, this stigmatizes a loan and reduces the likelihood that it will be approved.<sup>7</sup>

Perhaps the core of many of these concerns is the suspicion that the increased accuracy of automated underwriting somehow works against the consumer—particularly the low- and moderate-income or minority borrower. Put starkly, the concern is that the mortgage guarantor’s interest in increased accuracy conflicts with the consumer’s interest in obtaining a loan.

Contrary to this argument, we believe that while automated underwriting may represent a change in the rules of mortgage allocation decisions, quantitatively based mortgage decisions work to the benefit of underserved populations—not against. We attempt to demonstrate this first theoretically and then empirically based on an examination of

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<sup>7</sup> Chris De Reza, “Automated Underwriting: The Jury Is Still Out,” *Real Estate Finance Today*, Electronic Edition, Mortgage Bankers Association of America, April 30, 2001.

“accept rates” by Freddie Mac’s Loan Prospector automated writing system.

### Theoretical Argument

We begin by assuming an average default rate for conforming fixed-rate mortgages of about 5 percent. If automated underwriting systems could perfectly predict which loans would default, then for every 100 loans scored, 95 loans would be approved. Just five would be rejected—and these five would be ones actually to default.

This level of accuracy has yet to be achieved by existing automated underwriting systems. In reality, across all underwriting systems in use today, roughly 15 out of every 100 loans are rejected.<sup>8</sup> Of the 15 rejected loans, x percent have an expected default rate of 10 percent, while the rest have a 1 percent default rate (verify)—for an average default rate of 5 percent.

As automated underwriting systems become increasingly accurate, the number of loans rejected by automated underwriting should move closer and closer to five. As shown below, ...

[picture showing default curve becoming more concave]

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<sup>8</sup> Cite Freddie and/or Mercer?



There is also a cost dimension to predicting mortgage defaults. The mortgage default function is very asymmetric; although default is a rare occurrence, it is costly. Roughly speaking, to cover the costs on every one loan that defaults, 99 performing loans are needed.<sup>9</sup> Given this slim margin, it is not surprising that underwriting is, by nature, conservative. However, in studiously avoiding Type I error, lenders accept large amounts of Type II error. In the example above, 10 performing loans are “needlessly” rejected in order to “capture” the five that will go on to default.

Improving the surgical skill of automated systems to distinguish between ever-finer gradations of risk not only reduces Type I error, it also reduces Type II error. The determination of an acceptable credit risk is a function of both the expected mean default rate and the variance. For credit risk managers, this means determining the expected level of risk presented by a pool of loans and ascribing a certain level of confidence to the estimate. All things equal, the higher the confidence in the estimate, the lower the risk premium for “model error” and the more overall risk can be taken on.

Manual underwriting and early forms of automated underwriting have been characterized by a high degree of uncertainty. This arises, in part, from the greater amount of subjectivity involved in the credit allocation decision and the inability to quantify risk factors and their offsets. The high variance has necessitated tighter underwriting standards, and, subsequently, higher rejection rates, in order to keep overall risk within

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<sup>9</sup> Verify and document.

bounds.

Over the past five years, automated underwriting systems have become increasingly accurate in their assessment of default risk. This has both improved the estimation of the mean and reduced the variance. The increased confidence in our ability to assess default risk has resulted in an ability to take on more risk on the margin.

As shown below, there are two primary effects of improved risk assessments. First, there is what can be inelegantly called the “swap out.” Improved risk assessments will identify a handful of loans that would have “slipped through” less accurate measurement systems—but which actually have a high probability of default. Rejection of these few loans reduces costly Type I error. At the same time that a few low-quality loans are “swapped out,” a greater number of acceptable quality loans are being “swapped in.” This is because the increased accuracy of automated systems is able to identify more borrowers with default probabilities that may be higher than average, but nevertheless are acceptable. This reduces Type II error.

[insert picture showing two effects]

On net, highly accurate automated systems produce far more winners than losers. For every one loan swapped out, x loans are swapped in, and the overall increase in risk is marginal. Improved accuracy means that underwriting standards can be broadened,

which has the effect of expanding homeownership opportunities, particularly for underserved populations.<sup>10</sup>

### **Empirical Analysis**

An examination of Loan Prospector “accept rates” supports our view that increased accuracy expands homeownership opportunities. Automated underwriting is shown to be highly accurate for all borrower groups. Further, automated underwriting approves more borrowers than manual underwriting.

Freddie Mac’s Loan Prospector predicts a mortgage applicant’s likelihood of default based on the three “Cs” of manual underwriting: the creditworthiness of the borrower, the borrower’s financial capacity to repay the loan, and the underlying value of the collateral. That’s where the similarities with manual underwriting end. Loan

Prospector includes a statistical model that predicts mortgage default based on the actual performance of millions of mortgages purchased by Freddie Mac over many years. By using Loan Prospector, individual mortgage originators effectively incorporate the experience of thousands of loan originators and millions of borrowers into their own lending decisions.

Loans that receive an ‘accept’ or ‘accept plus’ designation by Loan Prospector are immediately approved for sale to Freddie Mac. The remaining loans receive a ‘caution’ designation as well as specific feedback about why the loan is considered higher risk.

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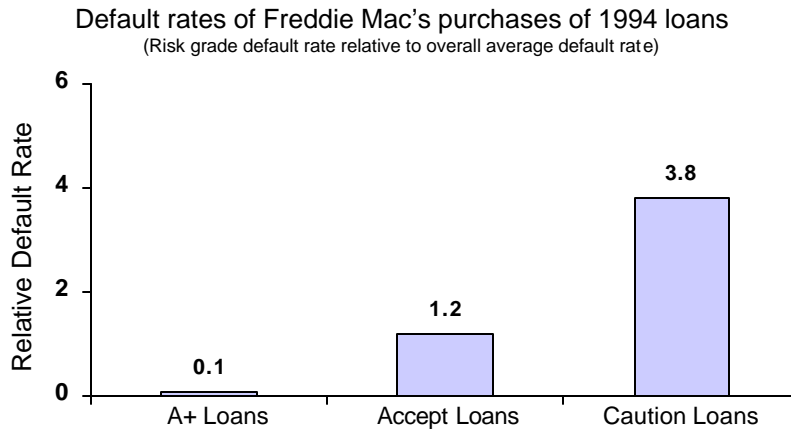
<sup>10</sup> A recent study by the Research Institute for Housing America found that borrowing constraints, such as embodied in underwriting guidelines, restrict access to homeownership disproportionately across racial and ethnic groups. In the case of whites and Hispanics, borrowing constraints serve to delay home purchase, while primarily excluding African Americans. The study estimates that the removal of borrowing constraints would increase the level of homeownership rate by 4 percentage points, *ceteris paribus*. Stuart

Caution loans are not barred from Freddie Mac purchase, however. Lenders may sell them to Freddie Mac if they believe there are factors that offset the risks identified by Loan Prospector.

An examination of Freddie Mac Loan Prospector “accept rates” supports our view that increased accuracy expands homeownership opportunities. Loan Prospector has been shown to be highly accurate for all borrower groups. Further, automated underwriting approves more borrowers than manual underwriting. Underserved populations have been the chief beneficiaries of this increased accuracy.

In a 1996 report entitled *Automated Underwriting: Making Mortgage Lending Simpler and Fairer for America’s Families*, Freddie Mac showed that Loan Prospector accurately predicted defaults on its 1994 book of business. That is, loans determined to present a low level of risk by Loan Prospector actually did perform much better than loans rated caution. We recently updated that analysis using the same set of loans, which have now reached their peak default years. The updated analysis shows a similar pattern of defaults. As shown in Exhibit 1, loans rated caution experienced default at 3.8 times the average rate of all loans. In contrast, accept plus loans experienced default at just one-tenth of the average default rate.

### Exhibit 1: Loan Prospector Accurately Predicts Default

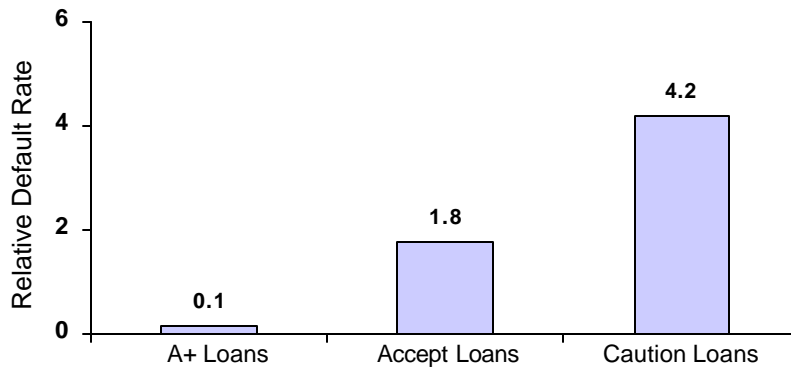


Loan Prospector's high degree of predictive power is evident for all borrower groups.

Exhibit 2 shows the relative default rates of loans purchased in 1994 for minority borrowers. Caution loans experienced default at more than double the rate of loans rated accept. Loans rated accept plus performed exceptionally well; minority borrowers experienced a combined default rate of just one-tenth of the average default rate for all loans.

## Exhibit 2: Loan Prospector Accurately Predicts Default For Minority Borrowers

Default rates of Freddie Mac's purchases of 1994 minority loans  
(Risk grade default rate relative to overall average default rate)



### Higher Approval Rates

As Loan Prospector has been enhanced over the years, Freddie Mac's confidence in the system's predictive power has increased. Accurate risk assessments have enabled us to focus on the few factors that have been found to be highly predictive of default—while minimizing the importance of less significant factors. In addition, Freddie Mac is able to determine how various risk factors compound—or offset each other. The ability to account for the ways in which risk factors influence each other is one of the major advantages of automated underwriting over manual underwriting.

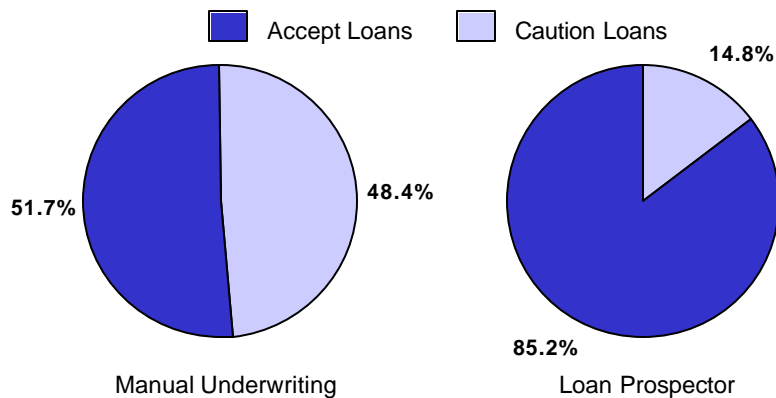
Loan Prospector's improved accuracy shows up in higher borrower accept rates. Freddie Mac recently analyzed the performance of nearly 1,000 loans originated in 1993 and 1994 and purchased by Freddie Mac as part of an affordable housing initiative. Using

Freddie Mac's Gold Measure Worksheet, the loans were manually re-underwritten after Freddie Mac's purchase and categorized similarly to Loan Prospector's accept/caution designations. The Gold Measure Worksheet is a statistically based manual mortgage scoring worksheet for noncredit and credit risk factors (with a FICO bureau score, or MDS bankruptcy score, or detailed credit alternative), designed to assist underwriters in evaluating risk layering, especially on affordable loans that were stretching the limits of traditional underwriting (Avery, et al. 1996). Next, the loans were underwritten using the Loan Prospector system and today's underwriting standards.

Exhibit 3 compares the original risk assessments produced by the manual re-underwriting to the reassessments produced using Loan Prospector. Manual underwriters rated 52 percent of the loans as accept, compared to the 85 percent rated accept by Loan Prospector. Borrowers are far more likely to obtain a mortgage under automated underwriting than under traditional methods.

### Exhibit 3: Loan Prospector Scores Far More Affordable Loans as Accepts

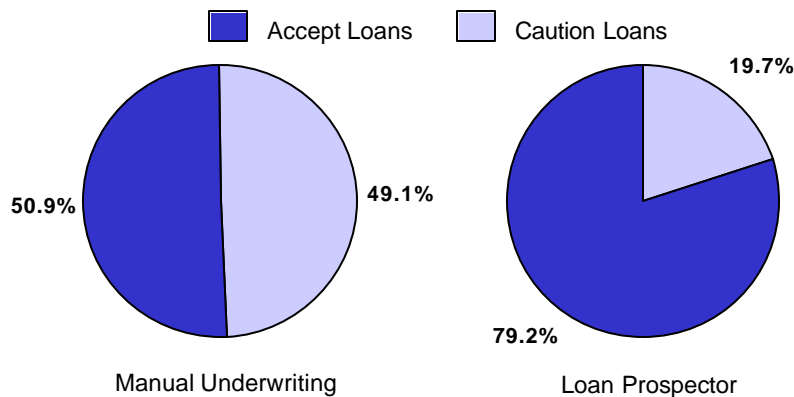
Risk assessments of affordable loans by manual underwriters and LP  
(Shown for about 1,000 affordable loans originated in 1993-94 and purchased by Freddie Mac)



Stronger predictive power is having a pronounced effect on minority approval rates. In 1994, manual underwriters rated 51 percent of minority borrowers in this sample as accept. Today's Loan Prospector, however, would rate 79 percent of these minority borrowers as accept, as shown in Exhibit 4.

### Exhibit 4: Loan Prospector Scores Far More Minority Borrower Affordable Loans as Accepts

Risk assessments of affordable loans by manual underwriters and LP  
(Shown for 350 affordable loans to minority borrowers originated in 1993-94 and purchased by Freddie Mac)



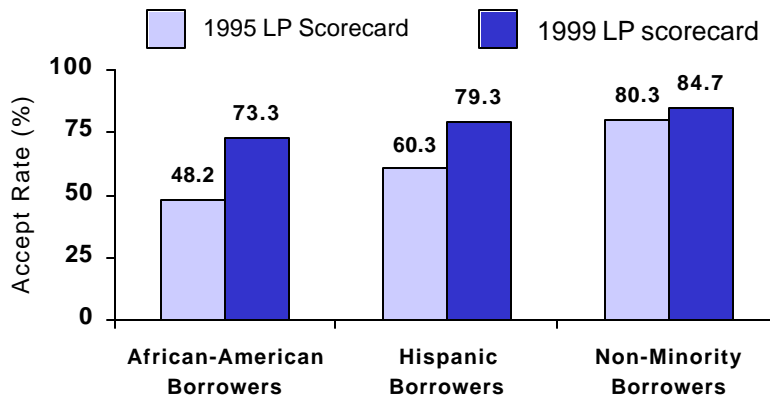
Representing a vast improvement over manual underwriting, Loan Prospector itself undergoes continual refinement. By analyzing the actual performance of millions of mortgage loans over time, Freddie Mac is able to enhance and fine-tune the statistical engine behind Loan Prospector. In 1998, Freddie Mac released its Outlook version of Loan Prospector, which incorporated new loan products and enhanced the risk assessments still further. The net result of the changes was to broaden the definition of an accept loan, as shown in Exhibit 5. Underwriting Freddie Mac's 1995 purchases using



both versions of Loan Prospector shows far higher accept rates using the 1999 version, particularly for minority borrowers. The 1995 version approved 48 percent of African-American borrowers, compared to 73 percent under the 1999 version—an increase of 52 percent. The accept rate for Hispanic and non-minority applicants grew by 32 and 5 percent, respectively.

### Exhibit 5: Loan Prospector Enhancements Help Close the Gap for Minority Borrowers

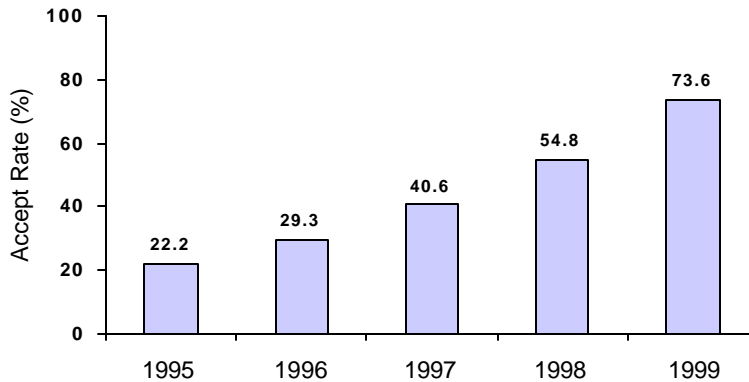
Accept rates of Loan Prospector's 1995 and 1999 scorecards  
(Applied to all of Freddie Mac's 1995 loan purchases)



Steady expansion of the share of loans rated accept attests to Loan Prospector's positive influence on homeownership. From 1995 to 1999, the share of all loan applications rated accept or better by Loan Prospector rose 66 percent. The trend is even more pronounced for minority borrowers. Exhibit 6 shows that the accept rate for African-American and Hispanic applicants more than tripled in just four years, rising from 22 to 74 percent.

## Exhibit 6: The LP Accept Rate for Minority Applicants Has More Than Tripled Since 1995

Percent of minority applicants rated accept by Loan Prospector  
(1995 through 1999 LP loan applications)



### Conclusion and Challenges

Improved risk assessments reduce the variance of the default equation, which allows risk managers to accept an overall higher level of risk. Examination of Freddie Mac's Loan Prospector "accept" rates demonstrates that improved accuracy is good for both mortgage investors and mortgage borrowers. Underserved populations, in particular, have benefited from Loan Prospector's increased ability to distinguish between a wide range of credit risks. Increased confidence has led to a liberalization of mortgage underwriting criteria, which has helped eliminate barriers to homeownership.<sup>11</sup>

<sup>11</sup> According to the Joint Center for Housing Studies, the number of new homeowners grew by 4 million between 1994 and 1997. Unlike previous surges in homebuyer growth, however, an influx of low-income

Increased accuracy has led to the development of new mortgage products that would have been deemed too risky even just a few years ago. Freddie Mac now uses Loan Prospector to approve higher-risk mortgages, such as zero-money-down loans, Alt A loans, which tend to have nontraditional documentation, and A-minus loans, which pose a significantly higher risk of default. Accurate risk measurement is working in borrowers' favor—not against.<sup>12</sup> In its 1998 *State of the Nation's Housing* report, Harvard's Joint Center for Housing Studies concluded that the advent of new loan products, such as low down payment loans and ARMs, have enabled "more income-constrained and cash-strapped borrowers at the margin to qualify for mortgage loans."<sup>13</sup>

Despite these impressive gains, however, minority borrowers are still less likely to be approved for a loan.<sup>14</sup> The differential between minority and non-minority accept rates

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and minority households into the housing market was the driving force behind the recent increase. Joint Center for Housing Studies of Harvard University, *State of the Nation's Housing 1998*, p. 13.

<sup>12</sup> As noted in Bunce (200x), "Fannie Mae and Freddie Mac, for example, seem to be more confident and willing to purchase low-income loans in they are processed through their mortgage-scoring models. Both government-sponsored enterprises have recently introduced new 3- percent down payment programs, based on their confidence in their automated underwriting systems."

<sup>13</sup> Joint Center for Housing Studies of Harvard University, *State of the Nation's Housing 1998*, p. 4. Automated underwriting's track record in expanding the availability of mortgage credit parallels the experience of credit scoring in other markets. Padhi et. al. (1999) found that credit scoring has had a positive effect on small business lending in low-income communities. According to the authors, "[W]e find that credit scoring has a significantly positive effect on the amount of small business credit extended in low-income communities and a mixed effect in moderate-income communities. Our findings do not support an argument that automated procedures in the small business lending process restricts the amount of credit extended to small businesses located in low- and moderate-income communities." Padhi, Woosley & Srinivasan, "Credit Scoring and Small Business Lending in Low- and Moderate-Income Communities," [get rest of cite from Frank] Paper presented at the Federal Reserve's Business Access to Capital and Credit Conference of March 1999.

<sup>14</sup> Minority borrowers remain relatively underrepresented among homeowners, accounting for 17 percent of homeowners compared to 24 percent of households. Joint Center for Housing Studies of Harvard University, *State of the Nation's Housing 1998*, p. 8.

mirrors broader societal inequities in financial capacity and credit, which are key variables in any underwriting equation—whether manual or automated.

In the future, developers of automated underwriting models will have to continue to work on making the models more predictive while reducing disparate impact on low-income and minority borrowers.

The mortgage industry faces two additional challenges in expanding homeownership opportunities for low-income and minority families. The first is posed by the so-called “digital divide”, and the second is posed by the growing complexity of financial services in the U.S. The growing use of the Internet presents an unparalleled opportunity to expand markets—as well as a looming challenge. In one example, in an initiative with the National Association of Hispanic Real Estate Professionals, Freddie Mac will make *Loan Prospector on the Internet* available on NAHREP’s bilingual Internet website, RealEstateEspañol.com. The initiative seeks to expand homeownership rates among Hispanic families by simplifying the mortgage process; 80 percent of Hispanic borrowers are first-time homebuyers. Increasingly, homebuyers use the internet to gather information about homes for sale, to obtain credit and homeownership counseling, to shop for as well as to apply for mortgages, and to communicate with agents and lenders. However, there are substantial differences in internet access and usage across income, racial and ethnic groups. This disparity in internet usage is referred to as the “digital divide”, and could potentially result in informational disadvantages for lower-income and less educated consumers. While about 46 percent of the U.S. Caucasian population has

the Internet at home, only 23 percent of Hispanics and African-Americans have home access.

A Vanderbilt University study reports that Caucasians use the Web more than African-Americans and are significantly more likely to do so because they have a computer at home<sup>15</sup>. Even more important, says the Department of Commerce, 73 percent of Caucasian students own a home computer, while only 33 percent of African-American students own one. A recent study by the Children's Partnership found that much of the information on the Internet is not useful for low-income people and people with limited reading skills. Clearly, this vehicle cannot be relied upon solely as a distribution channel for mortgage credit.

A second issue relates to lack of financial literacy in the U.S. Due to increasing consumer debt burdens, the prevalence of credit problems, and predatory lending concerns, government regulators, policy makers, and consumer advocates worry that many consumers lack the knowledge necessary to successfully navigate the complex financial marketplace. The mortgage industry, according to Alan Greenspan: "...should work to educate consumers on evaluating the broad array of products offered by financial service providers and to empower them to make the choices that contribute to their overall economic well-being."<sup>16</sup>

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<sup>15</sup> Bridging the digital divide  
Journal of Housing and Community Development; Washington; Mar/Apr 2001; Ben Hecht;

<sup>16</sup> Remarks by Chairman Alan Greenspan  
The importance of education in today's economy  
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