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The failure of models that predict failure: Distance, incentives, and defaults ☆

Uday Rajan [a], Amit Seru [b,*], Vikrant Vig [c]

[a] *Ross School of Business, University of Michigan, Ann Arbor, USA*
[b] *Booth School of Business, University of Chicago, Chicago, USA*
[c] *London Business School, London, UK*

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ABSTRACT

Statistical default models, widely used to assess default risk, fail to account for a change in the relations between different variables resulting from an underlying change in agent behavior. We demonstrate this phenomenon using data on securitized subprime mortgages issued in the period 1997–2006. As the level of securitization increases, lenders have an incentive to originate loans that rate high based on characteristics that are reported to investors, even if other unreported variables imply a lower borrower quality. Consistent with this behavior, we find that over time lenders set interest rates only on the basis of variables that are reported to investors, ignoring other credit-relevant information. As a result, among borrowers with similar reported characteristics, over time the set that receives loans becomes worse along the unreported information dimension. This change in lender behavior alters the data generating process by transforming the mapping from observables to loan defaults. To illustrate this effect, we show that the interest rate on a loan becomes a worse predictor of default as securitization increases. Moreover, a statistical default model estimated in a low securitization period breaks down in a high securitization period in a systematic manner: it underpredicts defaults among borrowers for whom soft information is more valuable. Regulations that rely on such models to assess default risk could, therefore, be undermined by the actions of market participants.

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1. Introduction

Statistical predictive models are extensively used in the marketplace by policy makers, regulators, and practitioners to infer the true quality of a loan. Such models are used by regulators to determine capital requirements for banks based on the riskiness of loans issued, rating agencies to predict default rates on underlying collateral, and banks

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* Corresponding author at: University of Chicago, 5807 S. Woodlawn Avenue, Chicago, IL 60637, USA.
E-mail addresses: urajan@umich.edu (U. Rajan), amit.seru@chicagobooth.edu (A. Seru), vvig@london.edu (V. Vig).

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to decide what information they should collect to assess the creditworthiness of borrowers. In each case, the true quality of the loan might not be known for years, so participants in current transactions must rely on some observable features about the loan to assess the quality. For example, a bank regulator could consider the credit scores of borrowers and a collateralized debt obligation (CDO) investor could consider the interest rates on the underlying loans.

These statistical models have come under much scrutiny in the context of the subprime mortgage market, where they were extensively used to forecast the default likelihood of borrowers and of collateral. There has been a public outcry over the failure of rating agency models that estimate the quality of CDO tranches (see Faltin-Traeger, Johnson, and Mayer, 2010, and Griffin and Tang, 2012). In addition, statistical scoring models such as FICO credit scores that assess a subprime borrower's default probability and guide lender screening have come under scrutiny.[1] Why did statistical default models fare so poorly in the build-up to the subprime crisis? A common answer to this question is that they were undermined by unanticipated movements in the house prices (see, e.g., Brunnermeier, 2009). We argue that this is far from the complete story. Our central thesis is that a primary reason for the poor performance of these predictive models is that they are subject to the classic Lucas critique (Lucas, 1976): They fail to account for a change in the relations between variables when the behavior of agents that influence these relations changes.

We analyze this phenomenon in the context of subprime mortgage loans issued in the US over the period 1997–2006. A notable feature of this period is a progressive increase in the proportion of loans that are securitized. Securitization changes the nature of lending from “originate and hold” to “originate and distribute,” and it increases the distance between a homeowner and the ultimate investor. A loan sale to an investor results in information loss: some characteristics of the borrower that are potentially observable by the originating lender are not transmitted to the final investor.[2] Because the price paid by the investors depends only on verifiable information transmitted by the lender, this introduces a moral hazard problem: The lender originates loans that rate high based on the characteristics that affect its compensation, even if the unreported information implies a lower quality. The same tension exists in the multitasking framework of Holmström and Milgrom (1990): An agent compensated for specific tasks ignores other tasks that also affect the payoff of the principal.

In general, the quality of a mortgage loan is a function of both hard and soft information that the lender can obtain about the borrower (see Stein, 2002). Hard information, such as a borrower's FICO credit score, is easy to verify; conversely, soft information, such as the borrower's future job prospects, is costly to verify (see, e.g., Agarwal and Hauswald, 2010; Liberti and Mian, 2009 on the role of soft information in the context of business lending). In the absence of securitization, a lender internalizes the benefits and costs of acquiring both kinds of information and adequately invests in both tasks. With securitization, hard information is reported to investors; soft information, which is difficult to verify and transmit, remains unreported. Investors, therefore, rely only on hard information to judge the quality of loans. This eliminates the lender's incentives to produce soft information.[3] Consequently, after a securitization boom, among borrowers with similar hard information characteristics, over time the set that receives loans becomes worse along the soft information dimension. That is, securitization changes the incentives of lenders, and hence their behavior. The result is a change in the relation between the hard information variables (such as the FICO score) and the quality of the loan (such as the likelihood of default). This implies a breakdown in the quality of predictions from default models that use parameters estimated using data from the pre-boom period.

We provide evidence for our thesis by demonstrating three main effects of increasing securitization over time. First, due to the greater distance between originators and investors, the interest rate on new loans depends increasingly on hard information reported to the investor. Second, due to the loss of soft information, the interest rate on a loan becomes an increasingly poor predictor of the likelihood of default on a loan. Third, because the change in lender behavior modifies the relation between observed characteristics of loans and their quality, a statistical model fitted on past data underestimates defaults in a predictable manner—precisely for those borrowers on whom soft information not reported to investors is likely to be important.

Our first result is that the mapping between borrower and loan characteristics and the interest rate on a loan changes with the degree of securitization. In setting the interest rate on a loan, the lender ceases to use information that is not reported to the final investor. Using a large database on securitized subprime loans across different US lenders, we find that over time the interest rate on new loans relies increasingly on a small set of variables. Specifically, the R^2 of a regression of interest rates on borrower FICO credit scores and loan-to-value (LTV) ratios increases from 9% for loans issued in the period 1997–2000 to 46% for 2006 loans. Further confirmation comes from the dispersion of interest rates: Conditioning on the FICO score, the standard deviation of interest rates on new loans shrinks over time. Finally, using data from a single large subprime lender, we demonstrate the converse: As securitization increases, interest rates depend less on information observed by the lender but unreported to investors.

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[1] Calomiris (2009), Mayer (2010), and Pagano and Volpin (2010) discuss various issues and remedies related to the rating process.

[2] Bolton and Faure-Grimaud (2010) and Tirole (2009) argue that contracts will be endogenously incomplete when there are costs involved in verifying or processing information. Along similar lines, Stein (2002) draws a distinction between hard (verifiable) and soft (unverifiable) information. One can think of the latter as being verifiable only at an infinite cost; it cannot be communicated to a third party, and so cannot be contracted on.

[3] In the context of jumbo mortgage loans, Loutskina and Strahan (2011) suggest that geographic diversification adversely affects the ability to collect information about borrowers.

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