The use of profit scoring as an alternative to credit scoring systems in peer-to-peer (P2P) lending

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ABSTRACT

This study goes beyond peer-to-peer (P2P) lending credit scoring systems by proposing a profit scoring. Credit scoring systems estimate loan default probability. Although failed borrowers do not reimburse the entire loan, certain amounts may be recovered. Moreover, the riskiest types of loans possess a high probability of default, but they also pay high interest rates that can compensate for delinquent loans. Unlike prior studies, which generally seek to determine the probability of default, we focus on predicting the expected profitability of investing in P2P loans, measured by the internal rate of return. Overall, 40,901 P2P loans are examined in this study. Factors that determine loan profitability are analyzed, finding that these factors differ from factors that determine the probability of default. The results show that P2P lending is not currently a fully efficient market. This means that data mining techniques are able to identify the most profitable loans, or in financial jargon, "beat the market." In the analyzed sample, it is found that a lender selecting loans by applying a profit scoring system using multivariate regression outperforms the results obtained by using a traditional credit scoring system, based on logistic regression.

1. Introduction

Credit scoring poses a classification problem in that the dependent variable is dichotomous and assigns "0" to failed loans and "1" to non-failed loans. Subsequently, techniques such as logistic regression or neural networks try to estimate the borrower's probability of default (PD). For lenders, not only does the PD matter but also the profit gain which the loan is likely to produce. This profit gain also depends on the loss given default (the share of a loan that is lost when a borrower defaults) and on the interest rate charged [1]. Factors explaining the PD may differ from those factors explaining profits. For example, the PD of startup business loans may be higher than the PD of wedding loans; however, if a startup business loan's interest rate is high enough, the profits from lending to entrepreneurs may be even greater than the profits from lending for weddings. Factors explaining the PD are well known: Abdou and Pointon [2] and Lessmann et al. [3] review recent studies. However, few studies analyze the factors explaining loan profitability. This is caused by the difficulty of calculating customer profitability and the lack of necessary data [4]. The goal of this study is to develop a profit scoring Decision Support System (DSS) for investing in P2P lending.

The P2P lending market is made up of individual lenders that provide loans to individual borrowers using an electronic platform. This platform puts lenders in contact with borrowers by charging a fee. Lenders bear the full risk of this operation. Recent studies develop P2P credit scoring [5,6,7], although none propose profit scoring. A profit scoring DSS allows for selection of the most profitable borrowers, which is related to customer lifetime value [8]. The calculation of customer profitability for a store selling products on credit requires data from the management accounting system, such as the margin of each product sold to each customer. For financial institutions, each customer may own different products, ranging from mortgages to credit cards, and may use different channels, ranging from bank branches to online banking. All of these combined factors make it difficult to obtain precise data on customer profitability, and researchers complain about the lack of enough data to investigate profit scoring [3]. However, P2P lending platforms provide sufficient data; this is because P2P lending suffers from a severe problem of information asymmetry—lenders know little of borrowers and normally would not lend to them [9], and P2P platforms try to cope with this lack of data by disclosing as much information on borrowers as they can provide, including loan payments. Furthermore, the P2P business model is considerably leaner than the bank business model. Hence, it is feasible to calculate relevant borrower profitability measures.

This study proposes utilizing the internal rate of return (IRR) of each loan as a profitability measure. IRR is a well-known financial formula

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that may be easily computed for investments that have an initial cash outflow (the loan amount) followed by several cash inflows (the payments), and may contain irregular repayment schedules [10]. In the loans market, the IRR is the lender's effective interest rate, which may differ from the borrower's effective interest rate, due to delinquent loans and fees. The use of IRR has two advantages. First, IRR is a continuous variable that allows more precise information when compared to a dichotomous variable. Take, for example, three borrowers obtaining a $100 loan at a 10% interest rate: the first borrower pays back $110, the second borrower pays $102, and the third borrower pays back $5. The first loan is fully paid, while the second and third loans are considered as charged off, although the second borrower has paid most of the payments. In fact, the first loan's IRR is 10%, the second loan's is 2%, and the third loan's is −95%. The second advantage is that IRR takes into account not only loan payments but also loan interest rates. The riskiest loans have a high PD but also offer lenders high interest rates to compensate them for this high PD. An example is microcredits, loans to financially excluded people, which may be risky but profitable, given their high interest rates [11].

The first research question addressed in this study is methodological and deals with the design of a profit scoring DSS for P2P lending, which is the main contribution of this study. Other studies develop profit scoring for credit cards and consumer credit [3,12–16]; however, the lack of data resulted in the use of customer profit proxies. To the best of our knowledge, there are no previous studies using the IRR as a dependent variable. The proposed methodology of this study combines exploratory analysis, multivariate regression, and CHAID, a decision tree technique [17].

Conventional credit scoring models seek to determine factors explaining loan reimbursement, although these factors may differ from factors explaining loan profitability. It is acknowledged in prior studies that business loans are riskier than car loans [7]; the effect of borrower's annual income on the PD is well-known [18], as is the relationship between credit history and PD [19]. However, the determinants of profitability have yet to be systematically studied. The second research question investigates the factors explaining profitability in P2P lending.

P2P lending is an electronic marketplace where borrowers request money and lenders select appropriate borrowers. A market in which prices always fully reflect available information is called efficient [20]. If the P2P loan market is efficient, its prices (loan interest rates) will reflect all available information. Hence, a particular lender will be unable to obtain positive abnormal returns by selecting borrowers because this information is already contained in the prices. The efficient-market hypothesis states that it is impossible to "beat the market" [21]. Although this concept originally applied to stock markets, it may adapt to other markets, such as the labor market [22] or the credit market [23]. The third research question tests the efficiency of the P2P loan market. If this market is efficient, the strategy followed by a particular lender is irrelevant because profitability will be identical.

This empirical study utilizes data from the Lending Club, the largest U.S. P2P lending platform. The sample contains 40,901 loans, of which 4800 are failed. Intertemporal cross-validation is utilized as a validation method: the train sample contains all available loans up to a given date, while the test sample contains all available loans after this given date. Our study shows that the borrower's rate of interest, borrower's indebtedness, and loan purpose are all factors explaining the IRR, although the relationship is not linear. The use of decision trees allows detecting useful rules for investors. Beyond credit scoring, this study encourages the use of IRR as a dependent variable and further research into new approaches to develop profit scoring systems. Therefore, efficiency of this market will be further improved.

The remainder of the paper is organized as follows: Section 2 summarizes the relevant previous studies on profit scoring and on P2P lending. Section 3 presents the empirical results of the analyses. Section 4 discusses the results from the previous section, offering practical implications, scholarly contributions, limitations of the study, and future directions. Section 5 concludes with a summary.

2. Literature review

Credit scoring systems seek to estimate the PD based on statistical models, such as logistic regression [24], neural networks [25], or support vector machines [26]. Statistical scoring models have focused primarily on the minimization of default rates, which is only one of the dimensions of the more general problem of granting credit, as warned by Eisenbeis [27]. Credit lenders seek to change the focus from minimizing the risk of a borrower defaulting to maximizing the profit a borrower provides [19]. This author presents four approaches to develop a profit scoring system. The first approach is to build on the existing credit scorecards and attempt to define profit for groups of the population segmented according to their scores. Another approach is to build on the Markov chain approaches to develop more precise models. The third approach utilizes survival analysis to estimate profit obtained from a borrower. The final approach mimics the regression approach of credit scoring by attempting to define profit as a linear function of the independent variables. This is the most frequently used approach and is the approach utilized in this study, but using non-linear multivariate regression and by means of the CHAID algorithm. Decision makers need tools that are able to accurately predict loan defaults; however, they also seek to model loan default symptoms by identifying relevant variables. Multivariate regression is the standard tool that is widely used as a benchmark, while decision trees, such as CHAID, produce rules easy to interpret and implement, which is why they were selected for this analysis.

Table 1 indicates a revision in prior studies regarding profit scoring. To the best of our knowledge, there is no previous research using IRR as a dependent variable in the P2P context. Lessmann et al. [3] benchmark state-of-the-art algorithms for both credit and profit scoring. These scholars claim that profit scoring development is difficult because data sets lack specific information related to time and data regarding the loss given default. These scholars employ a simpler approach to estimate scorecard profitability by examining classification errors costs, as suggested by Eisenbeis [27]. This is the most frequent procedure; at least, it provides a rough estimate of the financial rewards. Finlay [28] and Finlay [12] develop credit scoring for profitability objectives. These scholars apply credit scoring to a large UK catalogue retailer that provides revolving credit. Credit is provided interest free and the profit from each account was calculated as net revenue minus bad debt. This measure is a proxy for customer value and is also used by Andreeva et al. [29]. Barrios et al. [14] utilized the cumulative profit relative to the outstanding debt for scoring purposes. They recognize the limitations of using this proxy because a standard accounting return requires a more detailed allocation of the total assets used by each customer. They apply their model to the case of consumer revolving credit and identify specific segments of customers that are profitable in relative terms.

Verbraken et al. [15] develop a profit-based classification performance measure for credit scoring. This measure accounts for profits generated by solvent loans and expenses created by failed loans. They report that using this measure for model selection leads to more profitable credit scoring models. Stewart [13] proposes another profit-based scoring system for credit cards and reports that borrowers most likely to charge-off are also more likely to spend on their cards, pay finance charges, and pay fees. So et al. [16] develop a profitability scoring model for credit card users including revolver assessments. The approach is similar to the standard method in predicting default but it is more accurate in estimating the profitability of potential applicants.

Bachmann et al. [30] and Bouncken et al. [31] review recent studies on P2P lending. One of the first empirical studies on P2P lending is Berger and Gleisner [32] who analyze the role of intermediaries in electronic markets using data of 14,000 loans from a P2P lending platform.