Title: The Impact of Varying Consumer Credit Pricing by Consumer Risk: An Empirical Investigation using Indirect Lending **(Submitted to the PhD Track)**

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Consumer credit, which "refers to loans and lines extended to individual consumers as opposed to those extended to businesses or governments" (Phillips 2013), is an important part of the U.S. economy, amounting to $4 trillion in the U.S. (Board of Governors of the Federal Reserve System 2019). This form of credit is unique in that pricing is often disperse (Phillips 2013), enabling lenders to customize pricing by consumer, which is advantageous since there is strong evidence that suggests that consumers differ in their willingness to pay (Besanko, Dubé, and Gupta 2003). One of the pricing strategies that has emerged within consumer credit is risk-based pricing, which involves the classification of borrowers into consumer risk segments that are each priced differently (Magri 2015) for two reasons. First, individuals that are more likely to default on loans pose greater costs to lenders, which can be offset by higher premiums (Edelberg 2006). Second, riskier customers are less price-sensitive than low-risk customers (Phillips 2013), providing lenders the ability to increase rates for high-risk customers without concern that they will reject loan offers. Lenders implement risk-based pricing either directly or through an agent (i.e. indirect lending). The latter scenario often involves use of rate sheets, which is a menu of prices and agent incentives that are provided to agents by lenders.

In this paper, we investigate the profit implications of risk-based pricing in the context of indirect consumer loans. Using individual-level loan data from a North American financial institution, we build a three-stage model of choice with the following structure: First, we model the lender's decision to approve a loan application based on customer, product, and loan characteristics. Second, we model the agent's decision to select a loan rate to offer the customer from the combinations of rates and agent incentives that are available on the rate sheet. Third, we model the customer's decision to accept a loan offer. Finally, given the estimation results, we run two optimizations to assess: (1) the impact of *directly* implementing risk-based pricing by optimizing the loan rate and agent incentive for each risk segment and (2) the impact of implementing risk-based pricing *indirectly* by optimizing agent incentives given the predetermined set of price points on the rate sheet. The results suggest that *direct* implementation of risk-based pricing is expected to lead to double-digit increases in the financial institution's profits. Moreover, lenders can also increase profits through *indirect* implementation of risk-based pricing, albeit to a lesser extent.

Although consumer credit pricing seems like a promising area of research, the subject has not received much attention in the academic literature (Phillips 2013), especially with respect to the examination of the potential for prices to vary by borrower (Edelberg 2006), primarily because the data required for empirical investigations on the subject are proprietary (Getter 2006). While a few studies explore the effects of varying price by borrower (e.g. Einav, Jenkins, and Levin (2013) and Phillips, Şimşek, and Van Ryzin (2015)), to the best of our knowledge, our study is the first to simultaneously account for the three key stakeholders in the process.

Keywords: Price Optimization, Risk-Based Pricing, Price Discrimination, Financial Services, Consumer Credit

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