Credit Pricing, Rate Shocks, and Intermediary Discretion: An Auto Finance Field Study*

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ABSTRACT

We study how intermediaries transmit idiosyncratic funding cost shocks to consumers using a field experiment in the U.S. auto loan market. A subprime lender randomly varied the interest rate offered to dealers. Dealers could profit by marking up this rate to set the borrower's APR. A 1 ppt increase in the offered rate reduced loan take-up by 14%, and the pass-through ratio to the borrower's APR was 0.89. Dealers' proposed margins were largely insensitive to the offered rate, revealing that sophisticated intermediaries transfer cost shocks mechanically, not strategically, highlighting a key micro-level feature of the transmission of interest rate changes.

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1 Introduction

Interest rate shocks generated by central bank decisions or financial market gyrations reach borrowing consumers and firms through the conduit of intermediaries. These intermediaries may act to dampen, heighten, or redirect the effects of a shock. The influence of intermediaries can be observed in a variety of credit markets. The 30-year fixed mortgage rate, for example, is typically related to the Treasury yield, but the changing spread between them may reflect the state of bank balance sheets, originator capacity constraints, lender concentration, guarantee fees of government-sponsored enterprises, and the growing importance of shadow lenders (Scharfstein and Sunderam, 2013; Di Maggio et al., 2020; Kalda et al., 2023; Buchak et al., 2024). Credit card borrowers (Agarwal et al., 2018) and firms (Acharya et al., 2019; Grosse-Rueschkamp et al., 2019; Benetton and Fantino, 2021; Adelino et al., 2023) similarly experience macro rate-driven changes to their own cost of borrowing in a manner that depends on the market structure and heterogeneous capacities of their lending intermediaries.

The broad importance of intermediaries for the transmission of interest rate shocks is generally recognized, but less well understood are the specific strategies of individual lenders. In evaluating how to respond to an interest rate shock, some of the prominent considerations that a lender might be expected to take into account are the tolerance of borrowers for higher rates (i.e., their reservation values), the lender's bargaining power and the competitive dynamics of its market. Studies of pass-through typically analyze macro rate shifts. In this paper, by contrast, we study a transaction-specific shock to a lender's cost of funds. In doing so, we aim to illuminate the central micro-level dynamics that underlie observed macro interest rate pass-throughs.

Our setting is the U.S. car market, and we analyze a field experiment undertaken by a subprime auto lender (labeled Lender L) that provided financing for loans originated by dealers. In this market, dealers solicit financing offers from a variety of lenders. Each competing lender proposes a base interest rate for the auto loan, which is described as the buy rate. The dealer selects one lender offer and has discretion in marking up the loan rate before presenting the final terms to the borrower; dealers receive compensation that is increasing in the extent of their markup (Grunewald et al., 2024).

Lender L sought to evaluate two competing risk pricing models by randomly allocating appli-

cations across the models and observing the outcomes. The models differed in the proposed buy rates that they assigned to applicants with varying risk profiles. We use half the data (the training sample) to estimate the rates assigned by each model to different types of borrowers, and we show in the other half of the data (the testing sample) that our estimates are quite accurate. Given the random allocation of applications, we find, as expected, that borrowers assigned to the two models are very similar in ex ante characteristics. We then make use of the randomization and our estimated buy rates to analyze the impact on dealers and borrowers of being assigned a loan with an exogenously higher buy rate.

We find that higher buy rates strongly reduce the probability of loan take-up: A one percentage point increase in the buy rate offered to the dealer (which is 5.5% of the mean) reduces the probability that Lender L's bid will lead to a completed loan by 2.5 percentage points (a 14.1% reduction relative to the mean). This sensitivity of take-up to the buy rate could result from competition among lender bids or discouragement of the borrower.

Each shock to the buy rate that we study is idiosyncratic: it affects only a specific bid from Lender L to a particular dealer for a given applicant. Given the competitive lending setting, it might therefore be thought that the increased rate would have limited pass-through; if Lender L's bid increases, then perhaps the dealer will simply select financing from another source for this applicant. Further, there is competition not only among lenders but also among dealers. If a borrower receives a high rate proposal from a given dealer due to Lender L's bid, then the borrower could canvass car and loan offers from other dealers. Moreover, dealers might be sensitive to the payment capacities of their prospective borrowers, so they may reduce their markup when receiving a higher buy rate from Lender L, even if they prefer it to their other lender bids.

Using the randomized buy rates in our field study, however, we find a pass-through of 0.89: most, but not all, of the exogenous increase in the buy rate is borne by the ultimate borrower, and the pass-through is both significantly positive and less than one. Our estimate is consistent with average general macro pass-through coefficients that range from 0.8 to 0.89 (Gregor et al., 2021). Pass-throughs to consumer lending, however, tend to be substantially lower, with recent assessments in the range of 0.2 to 0.5 (Aristei and Gallo, 2014; De Jonghe et al., 2025). The high pass-through that we find may therefore be regarded as somewhat surprising, given the transaction-specific nature of our shock. It may perhaps be best understood as arising from the structure

of the negotiation between the dealer and the borrower; financing terms are set after the parties have agreed on a vehicle price and at a point at which it may be difficult for borrowers to solicit additional financing offers.

The interaction between dealers and borrowers that we observe may be viewed as a bargaining game with two-sided asymmetric information about reservation values. Models of this game are complex and may exhibit multiple potential equilibria (Myerson and Satterthwaite, 1983; Larsen, 2021). To develop an understanding of the key drivers of our empirical findings, we consider three simplified settings. The first is a Price Discrimination setting in which borrowers have a variety of known reservation values, and the dealer exercises full bargaining power. In light of the negotiation framework applying to our data in which borrowers have little recourse to outside credit, it may be argued that this setting is a natural fit for our empirical context; it also appears consistent with the high pass-through we document.

The second setting is a bargaining setup where borrowers share a known reservation value, and both this value and the buy rate are common knowledge.

The second setting we analyze is a Bargaining setting where borrowers share a known reservation value, and both this value and the buy rate are common knowledge. Dealers and borrowers engage in Nash bargaining over the loan price. The third setting is an Inflexible Margins setting in which the dealer's proposed margins are unaffected by the buy rate.

All three of these settings yield as implications our central results that higher buy rates lead to lower take-up and a pass-through below one. The settings differ, however, in their cross-sectional implications for the predicted pass-throughs to borrower types defined by the average loan margins (i.e., markups) paid. In the Price Discrimination setting, pass-throughs are increasing in the average loan margin paid by a group of borrowers. In the Bargaining setting, the pass-through is V-shaped in type: borrowers with both very weak and very strong bargaining power experience pass-throughs close to one, while borrowers with moderate bargaining power face lower pass-throughs. In the Inflexible Margins setting, offered loan margins are independent of the buy rate, but for high buy rates, borrowers will reject high loan margin proposals.

Testing these cross-sectional predictions requires a proxy for the predicted loan margin for a given borrower, and we consider two. Our first proxy is based on borrower-level characteristics and our second proxy is based on dealer-level average loan margins. We find that both variables are

predictive, although dealer-level averages are particularly informative for loan margins. Ultimately, margins are driven largely by the dealer, with borrower characteristics exerting a more modest influence. We find that both variables are predictive although dealer-level averages are particularly informative for loan margins. Ultimately, margins appear to mainly depend on the dealer with borrower characteristics exerting a more modest influence. Using both proxies, however, we find no evidence that the pass-through depends on the predicted loan margin. These findings do not offer support for the Price Discrimination setting. Despite a negotiation context in which borrowers might be argued to be bereft of competitive sources of financing, dealers do not extract all possible surplus. The lack of cross-sectional results is also inconsistent with the Bargaining setting.

We further find no evidence that the pass-through varies with the level of local competition, whether measured by the number of local dealers or their Herfindahl-Hirschman Index (HHI) by application count. This muted impact of competition is consistent with the relatively high pass-through that we find for the idiosyncratic buy rate shocks. We analyze the impact of uncertainty on the pass-through by considering the variation in loan margins received across both borrower zip codes and dealerships. We do not find that the pass-through differs with either measure of uncertainty.

The cross-sectional findings show that the pass-through does not appear to covary with dealer, borrower, or market characteristics. These results suggest that the third setting, in which dealers simply set inflexible margins and borrowers either accept or reject their offers, may offer a description of bargaining outcomes that is most consistent with the data. It is a direct implication of the Inflexible Margins setting that the distribution of observed loan margins when the interest rate shock is positive will be a truncation of the distribution of margins for negative interest rate shocks. This arises because the dealer-proposed margins are identical across the two cases, but when the buy rate is high, some borrowers reject the highest margin offers as the resulting loan rate exceeds their reservation values.

We test this prediction by comparing the distributions of loan margins for positive and negative interest rate shocks. We find that loan margins are higher when the interest rate shock is negative, which is consistent with our finding of a pass-through less than one. When we restrict the distribution of margins to those below the highest levels (i.e., below 1.5 percentage points), however, we find that the truncated loan margin densities under positive and negative interest rate

shocks are statistically indistinguishable. This finding clearly supports the empirical relevance of the Inflexible Margins setting: dealers appear to set margins in a manner that does not depend on their cost of funding. In the face of a complex bargaining game with borrowers that features two-sided asymmetric information about reservation values, dealers appear to adopt a simple strategy of maintaining a fixed distribution of loan margins that they add to the buy rate supplied by the lender.

Our analysis offers a clear description of how pass-through operates in the dealer segment of the U.S. auto loan market: dealers maintain inflexible loan margins and the pass-through is less than one due only to borrowers' rejection of high-margin offers when the underlying interest rate is elevated. We thus find evidence of a mechanical, rather than a strategic, response on the part of dealers to an increase in their funding costs. This inertia in loan margins may be considered unexpected in light of the fact that dealers are facing idiosyncratic transaction-specific shocks rather than aggregate shifts in financing terms such as those induced by monetary policy. One might have supposed dealer responses to be sensitive to competitive factors, even if they neglected borrower reservation values or bargaining power, but we find no evidence that dealers calibrate the pass-through to their loan terms in a manner that accounts for any of these considerations. This suggests that when facing a macro interest rate shock that also affects all their peers, dealers will likely exhibit the same inflexibility in setting their margins. Macro pass-throughs for this loan market would then fall below one due solely to the departure of some rate-sensitive borrowers from the market.

Another implication of our findings is that dealers, who likely have highly informed views of the financial capacities and preferences of borrowers, do not appear to exploit this information in determining their pass-through strategies. Banks and finance companies operating in the auto loan market may respond differently to changes in rates, but they likely possess less information than dealers about their prospective borrowers.

We consider the broader borrower responses to the interest rate shocks that are passed through to their auto loan terms. In mortgage markets, consumers have been shown to alter their consumption and borrowing when rates change (Di Maggio et al., 2017; Cloyne et al., 2020). We do not find that loan-to-value (LTV) ratios shift in response to higher rates. The subprime borrowers do not appear to use more cash to purchase cars when their loan terms are less attractive, perhaps

because they are financially constrained. We also examine the response of the car price to the loan terms. Given that some borrowers may be forced to abandon the transaction if both the auto and the loan are expensive, one might expect car prices to decline when the loan rate increases. We do not find evidence of that, perhaps because the car price has already been determined before financing is negotiated or perhaps because different individuals at the dealership with separate incentive schemes negotiate the pricing of the auto and the loan. The structure of the negotiation game between dealers and consumers thus has an important influence on the outcomes in this segment of the auto market, as has also been documented in upstream components (Larsen and Zhang, 2021; Larsen et al., 2021).

We find that consumers who pay high prices for cars relative to their wholesale values are also likely to be charged high loan margins. This result is consistent with the literature on consumer credit that often finds that lenders and brokers steer susceptible borrowers to products that generate high fees for intermediaries (Woodward and Hall, 2010, 2012; Egan, 2019; Guiso et al., 2022; Egan et al., 2022; Bhattacharya et al., 2025). We do not, however, find that the interest rate pass-through is related to the premium that the borrower pays for a car.

Borrowers do not respond to higher interest rates by extending their loan terms or purchasing gap insurance less frequently.[1] We find that borrower payment-to-income (PTI) ratios are not significantly affected by higher rates, which may suggest a degree of selection in the types of borrowers who proceed with loans when offered expensive terms. This finding accords with the result in prior work that auto borrowers appear to target specific monthly payments (Argyle et al., 2021).

Higher interest rates might be predicted to increase borrower default risk for screening (lower quality borrowers may be more likely to accept higher rate loans), moral hazard (a higher rate loan leaves the borrower with less valuable equity) or affordability reasons. We find, however, no effect of a rate shock on default. The shock does reduce time to default and weakly increases the risk of early delinquency. When controlling for borrower characteristics, however, the impact on both these outcomes is rendered insignificant, which suggests that any causal impact of higher rates on time to default and delinquency arises through a selection channel. Research on mortgages has

[1] Gap insurance protects a borrower from personal liability in the event of an accident that leaves her with negative equity in her car.

shown that interest rate reductions on *existing* mortgages reduce default risk (Tracy and Wright, 2016; Fuster and Willen, 2017; Byrne et al., 2022). Our results, by contrast, suggest that a shift in the rate *offered* to applicants can induce a change in the pool of borrowers who accept the proffered credit. This change in borrower characteristics can generate quicker defaults and a weak increase in delinquency risk. Given, however, that borrowers take up loans in a manner that leaves their PTI ratios generally unaffected by the change in offered terms, when controlling for borrower income we find no residual impact of the rate on time to default or delinquency.

Our study is most closely related to earlier work on autos and auto loan pricing. Grunewald et al. (2024) share our focus on the role of dealers in the car loan market, and estimate an equilibrium model of auto and finance pricing. Jansen et al. (2025) examine finance margins for subprime borrowers. Adams et al. (2009), Einav et al. (2012), and Einav et al. (2013) assess the roles of liquidity constraints, down payments and credit scoring in the subprime auto market. Grieco et al. (2024) estimate markups on vehicles in the U.S. car market, Argyle et al. (2021) study the impact of changes in loan maturity, and Gavazza and Lanteri (2021) investigate the impact on the car market of changes in borrower credit limits. Busse et al. (2006) show that information asymmetries between dealers and consumers affect the pass-through of manufacturer promotions to retail prices. While their analysis focuses on how dealers allocate surplus created by upstream discounts, we study how dealers transmit upstream financing cost shocks. Our work is distinctive in both the specific question we study, the mechanics of interest rate pass-through in the auto loan market, and in our field study methodology.

Dealer loan margins may be viewed as a markup of a financing product. The size and trajectory of markups and their relationship to firm market power has been a topic of recent interest (De Loecker et al., 2020; Döpper et al., 2025). While average lender margins may be related to features of the local competitive environment, we show that changes in loan margins in response to interest rate variation are insensitive to measures of market power.

The transmission of interest rate shocks to consumers is a central issue in the study of monetary policy (Bernanke and Gertler, 1995; Kashyap and Stein, 2000; Auclert, 2019). The micro-level description we provide of how intermediaries respond to changes in their cost of funds can contribute to a more developed understanding of a critical link in that transmission, the interactions between borrowers and lenders.

2 Indirect Auto Financing

The lender in our field experiment operates in the indirect auto financing market, where loans are originated at dealerships and then sold to finance companies. This contrasts with direct financing, in which consumers secure loans from banks or credit unions before purchasing a vehicle.

In indirect financing, the dealer acts as the intermediary. When a buyer opts to finance a vehicle, the dealership submits the credit application to multiple lenders through standardized platforms such as *DealerTrack* or *RouteOne*.[2] Lenders evaluate applications using external data sources (e.g., credit bureaus) to assess borrower risk, then either decline the application or offer terms under which they are willing to purchase the loan.

Dealers typically select the loan offer that maximizes their profit, a function of several variables: (1) whether the borrower qualifies under lender-specific terms; (2) the advance rate or loan-to-value (LTV) ratio; (3) the loan discount; and (4) the dealership's ability to mark up the interest rate (APR) above the lender's offered buy rate. Lender L restricted dealers to markups of no more than 2 percentage points.[3]

The advance rate determines how much above wholesale value the loan is written. Higher LTVs effectively allow the dealer to charge a higher price for the vehicle and add-ons. Loan discounts, typically ranging from 2% to 12% of the vehicle's wholesale value, reflecting borrower credit quality; loans to riskier borrowers are purchased at a deeper discount, much like junk bonds.

Crucially for our analysis, dealers can also receive "reserve payments" or "dealer participation" which represents compensation based on the markup of the APR above the lender's buy rate. These reserves allow loans to trade at a premium and represent a key source of profit in indirect financing and are the focus of our investigation.[4]

3 Field Experiment

The lender conducted a randomized controlled trial (RCT) to assess how differences in loan pricing affect dealership behavior, consumer take-up, and loan performance. In the experiment,

[2] Our data come from one such lender.

[3] Fewer than 0.02% of the observed markups exceed 2 percentage points.

[4] See Jansen et al. (2024) for further discussion of dealership markups.

each consumer application was randomly assigned to one of two credit screening models. Both models used the same underlying characteristics of the borrower, vehicle, and dealer, but they differed in precisely how they priced those variables: the models thus offered identical borrowers different APRs.

The lender held the loan-to-value ratio (LTV) and discount fixed across risk models, isolating the variation in the buy rate (APR) as the treatment. This random assignment allows for clean causal inference on how lower buy rate APRs affect downstream loan outcomes.

The primary objective of the experiment was to determine the impact of loan pricing on the lender's market share and credit risk. Specifically, the lender wanted to assess: (1) how dealerships respond to lower buy rates, (2) whether lower rates lead to higher consumer take-up, (3) whether dealerships pass through or retain the benefit via markup behavior, and (4) whether any resulting loans differ in default or repayment performance.

From a dealership perspective, a lower buy rate creates two strategic options: pass the benefit through to consumer, which can raise the probability of closing the sale, or mark up the loan to increase their profit margins. Dealer compensation includes "reserve payments", which are based on the spread between the lender's buy rate and the final APR. These payments are front-loaded to the dealer, while the lender retains the repayment risk associated with the higher APR. As a result, a lower buy rate expands the scope for dealer markups and potentially higher profits, even if consumers see little benefit. However, higher markups also raise borrowers' monthly payments which can increase default risk.

If consumers are rate-sensitive, we would expect higher take-up when buy rate APRs are lower. If dealers simply increase markups when presented with a lower buy rate, however, then the benefit to consumers may be muted, even if lender market share increases.

The lender also evaluated whether the loan performance differs between models. A key concern is whether higher APRs lead to a "winner's curse" in which higher pricing attracts riskier borrowers, while safer borrowers reject the offer. Higher APRs may also lead to elevated default or delinquency rates due to moral hazard or affordability effects.

4 Data

Our data cover approximately 335,000 loan applications, 59,000 loan offers and 11,000 loans during the period from August 2020 to July 2021. The sample includes all loan applications received by the lender during the experiment, covering every U.S. state and spanning 2,437 dealerships across 1,417 ZIP codes. For each loan, we observe the full set of origination variables submitted to the lender at the time of application, along with performance updates through May 2024. Loan-level data include borrower attributes such as credit score, income, homeownership status, and bankruptcy history; vehicle characteristics including make, model, age, mileage, and book value; and complete loan contract terms such as principal, loan-to-value (LTV), duration, and interest rate. Summary statistics on borrower chacteristics and loan features are presented in Table 1.

Given that auto-loan terms often exceed six years, many loans in the dataset were still active at the end of the observation window. For terminated loans, we observe whether they were paid in full, prepaid, or defaulted. In the event of default, the data include both vehicle recovery values and any additional post-default collections. For ongoing loans, we observe the payment history up to the final sample date.

5 Hypotheses

We consider a setting in which a dealer solicits offers from various lenders to finance an auto that is being purchased by the borrower. Lender L offers to provide financing at a specified buy rate b, and the dealer selects the offer from Lender L with probability $p(b)$, where p is a decreasing function.[5] Conditional on the selection of Lender L's offer, the dealer and borrower then attempt to come to an agreement over the loan margin $m \leq 2\%$ that will be added to the buy rate to yield the overall rate $b+m$ that the borrower will pay. The dealer receives a payoff from the financing transaction that is increasing in m- for simplicity, we set the payoff equal to m.

We analyze the interaction between the dealer and the borrower in three simple settings. In the first, the dealer possesses all the bargaining power, but borrowers have varying reservation values.

[5]For example, the dealer may conduct a first-price auction over proposed buy rates bid by all lenders and select the lowest bid.

Information is presumed to be full. In the second, borrowers have a common reservation value but vary in their bargaining power. Information is full in this setting as well. In the third, the dealer's margins are inflexible and do not depend on the buy rate.

5.1 Setting A: Price Discrimination

In this setting we assume that dealers have full bargaining power and that borrowers have different reservation interest rates r. Under our presumption of full information, each borrower's reservation interest rate is observable to the dealer. Under these assumptions, variation in observed loan margins arises from differential borrower reservation values r: a higher value for r will result in a higher margin.

Our experimental context generates random variation in the buy rate b. We consider the implications in this setting for loan take-up, loan margin and borrower composition of an exogenous increase in the buy rate to $b' = b + 1\%$.

Given that the dealer has all the bargaining power, the dealer sets the loan margin $m(b) = min\{r - b, 2\}$. Lender L's bid will be accepted if the dealer selects it over all the other lender bids and if $b \leq r$. An increase in the buy rate reduces the probabilities of both of these events, which yields Implication A1:

Implication A1: An increase in the buy rate reduces the probability of take-up.

An increase in the buy rate reduces the loan margin that the dealer can charge borrowers with low reservation values, as the buy rate begins to approach the highest rate that they will pay. For borrowers with high reservation rates, the dealer can simply maintain the maximum $m = 2\%$, as even at this margin these borrowers will accept the loan.

We define the change in the loan margin, conditional on the selection of Lender L's offer when both b and b' are bid, to be

$$\Delta m = m(b') - m(b). \tag{1}$$

Implication A2:

i) An increase in the buy rate results in a decrease in the loan margin.

ii) Specifically,

$$\Delta m = \begin{cases} -1, & \text{if } r < b+2 \\ r-b-3, & \text{if } r \in [b+2, b+3] \\ 0, & \text{if } r > b+3 \end{cases} \tag{2}$$

In the Price Discrimination setting, as outlined in Implication A2 (ii), the change in the loan margin is increasing in r. We do not observe r in our data, but in Setting A borrower groups with high average margins correspond to those with high r. From an empirical perspective, Implication A2 (ii) therefore predicts that the relationship between the change in the loan margin and the average margin paid by a class of borrowers is increasing in the average margin.

We define the pass-through as the change in the total interest rate charged for a given increase in the buy rate expressed as a fraction of the change in the buy rate. That is, the pass-through is $\Delta(b+m)/\Delta b = 1 + \Delta m/\Delta b$. Thus, for a 1 percentage point increase in the buy rate, the pass-through to the borrower's APR is given by $1 + \Delta m$.

The change in the loan margin is evaluated conditional on the loan funding at both b and b', as margins are only realized when a loan is originated. This isolates the dealer's pricing response from changes in the composition of funded borrowers. We now consider selection effects (i.e., which borrowers drop out of the market as the buy rate rises).

In Setting A, an increase in the buy rate leads borrowers with lower reservation values to reject any offer from the dealer and to decline financing. At a buy rate of b, financing will be extended to all borrowers with $r \geq b$. At the higher buy rate of $b+1$, financing will be granted to all borrowers $r \geq b+1$. Thus, the distribution of borrower reservation values under the higher buy rate first-order stochastically dominates the distribution of borrower reservation values under the lower rate.[6] We therefore have

Implication A3: An increase in the buy rate increases the average borrower reservation value for those who receive financing.

[6]This follows from the fact that for a given cumulative distribution function (CDF) G over reservation values r, the CDF truncated from below at y is given by $\frac{G(r)-G(y)}{1-G(y)}$.

5.2 Setting B: Dealer-Borrower Bargaining

In this setting we presume that all borrowers have a shared reservation interest rate r such that $r \geq b + 2\%$.[7] Both the interest rate and the buy rate are common information. We assume that the dealer has bargaining power θ. Under a standard Nash bargaining solution, the two parties agree that $m(b) = min\{\theta(r-b), 2\}$. In this setting, variation in observed loan margins is driven by heterogeneity in bargaining strength θ between dealers and borrowers: a higher value for θ will yield a higher loan margin.

Implication B1: An increase in the buy rate reduces the probability of take-up.

Implication B1 follows directly from the assumption that the probability $p(b)$ that the dealer selects Lender L's offer is decreasing in b; higher buy rate bids are less likely to be accepted. Conditional on the dealer's accepting the bid, however, the borrower and the dealer always come to agreement.

Implication B2:

i) An increase in the buy rate results in a decrease in the loan margin.

ii) Specifically,

$$\Delta m = \begin{cases} -\theta, & \text{if } \theta < \frac{2}{r-b} \\ \theta(r-b') - 2, & \text{if } \theta \in \left[\frac{2}{r-b}, \frac{2}{r-b'}\right] \\ 0, & \text{if } \theta > \frac{2}{r-b'} \end{cases} \tag{3}$$

As described in Implication B2 (ii), in this Bargaining setting the change in the loan margin is V-shaped in θ: it is decreasing in θ for low values of θ, increasing in θ for moderate values of θ and then constant at zero for high values of θ. The θ parameter describes the margin generally paid by a given borrower. While we do not observe θ in our data, in Setting B borrower groups with high average loan margins correspond to those with high θ. From an empirical perspective, Implication B2 (ii) thus indicates that the relationship between the change in loan margin and the average margin paid by a class of borrowers is V-shaped in the average margin.

In the data, we do not directly measure either reservation values (from Setting A) or bargaining power (from Setting B). Instead, we proxy borrower 'type' by the average margin realized in that

[7] If $r < b + 2\%$ then no borrower will pay a 2% margin. In the data, approximately 40% of borrowers do pay a 2% margin.

borrower group. Groups with higher average realized margins are interpreted as having higher reservation value r (in Setting A) or higher bargaining type θ (in Setting B). These mappings underpin the predictions we test empirically.

An increase in the buy rate reduces the loan margin in both Settings A and B, as shown in Implications A2 i) and B2 i). The relative impact of an increase for different types of borrowers, however, differs between the two settings, as outlined in the contrasting Implications A2 (ii) and B2 (ii). The prediction from Setting A is that the change in loan margin will be increasing in the average loan margin within a group, while the prediction from Setting B is that the change in loan margin will be V-shaped in the average loan margin.

Implication A3 describes the change in borrower composition generated by an increase in the buy rate in Setting A. By contrast, in Setting B all borrowers receive financing, as the dealer and borrower are always able to negotiate terms, so the average borrower reservation value is unaffected by the buy rate.

5.3 Setting C: Inflexible Margins

Last, we consider a setting in which the dealer's margins are unaffected by the buy rate. Borrowers have a shared reservation interest rate r and dealers propose a margin m according to a CDF H that is independent of the buy rate. The dispersion in within-dealer margins may arise, for example, from heterogeneity in the financing staff at the dealership. The inflexibility of the offered margins may arise from limited attention or other information frictions that lead dealership staff to adopt rule-of-thumb policies.[8]

As in Setting A, an increase in the buy rate both reduces the probability that the dealer will accept Lender L's bid and the probability that $b+m$ will fall below the borrower's reservation value r. This generates Implication C1:

Implication C1: An increase in the buy rate reduces the probability of take-up.

Given the inflexibility of the dealer's margin policy, the distribution of *offered* loan margins is unaffected by the buy rate. As the buy rate increases, however, the borrower will reject high

[8]These may include considerations related to the complexity of equilibrium strategies in environments such as this one with two-sided asymmetric information.

loan margin proposals. Only margins such that $b+m \leq r$ will be accepted, so the distribution of *accepted* margins on completed loans is truncated from above at $r-b$. Therefore, an increase in the buy rate results in a distribution of accepted margins that declines in the sense of first-order stochastic dominance. Implication C2 follows from this argument.

Implication C2: An increase in the buy rate results in a decrease in the average loan margin on completed loans.

Setting C offers a clear prediction about the effect of a buy rate increase on the distribution of observed loan margins.

Implication C3: An increase in the buy rate leads to a truncation from above in the distribution of the loan margin on completed loans.

In this setting, there is a fixed reservation value, so a shift in the buy rate has no impact on the average borrower reservation interest rate.

6 Empirical Method

As described in Section 3, the lender used two pricing models during the experimental period, which we label Models I and II. Twenty percent of the applications were randomly assigned to Model I and the remaining applications were assigned to Model II. The assigned model determined whether a financing offer would be extended and at what price. Each model evaluated applicants and assigned a continuous score from zero to 1. The lender provided us with the assignment of each application and with the Model I and II scores for 82% and 73%, respectively, of the applications in the sample period. Out of our total sample of 335,000 applications, there are 31,539 observations for which we have only Model I scores and only 4 observations for which we have only Model II scores. Scores for both models line in the range $[0,1]$. The means (standard deviations) of Model I and II scores, respectively, are 0.36 (0.15) and 0.56 (0.14).

Each application is assigned to a homogeneous comparison group. Comparison groups are defined by a 5-tuple comprising a 5 percentage point bucket of Model I scores, a 5 percentage point bucket of Model II scores, an indicator for a prior Chapter 7 bankruptcy, an indicator for a prior Chapter 13 bankruptcy, and an indicator above-mean credit score. Separate comparison

groups are defined for applications with missing Model II, income, or credit score data.

The data are split into training and testing samples. The training sample data are used to calculate the average offered buy rate APR for each comparison group separately for Models I and II. Specifically, for each comparison group cg we calculate in the training sample $\overline{APR(I)}_{cg}$ and $\overline{APR(II)}_{cg}$, where $\overline{APR(K)}_{cg}$ is the mean APR in the training sample for Model K for each cg. These average APRs describe how the two models assign potentially different APRs to very similar applications.

These comparison group-model APRs are then attributed to the testing sample. For each application i in the testing sample that belongs to comparison group cg_i, we calculate

$$Interest\,Rate\,Shock_i = \begin{cases} 0.5 * (\overline{APR(I)}_{cg_i} - \overline{APR(II)}_{cg_i}), & \text{if } i \text{ is assigned to Model I} \\ 0.5 * (\overline{APR(II)}_{cg_i} - \overline{APR(I)}_{cg_i}), & \text{if } i \text{ is assigned to Model II,} \end{cases} \tag{4}$$

The difference in *Interest Rate Shock* between two testing sample applications in the same comparison group that are assigned to different models is thus equal to the difference in average APRs across models for the observations in the same comparison group in the training sample.

All of the tests in our study are conducted on the testing sample. Our first test verifies that *Interest Rate Shock* is indeed a valid measure of the impact of random assignment on the offered buy rate APR. We estimate

$$Buy\,Rate\,Offered\,to\,Dealer_i = \beta Interest\,Rate\,Shock_i + cg_i + \varepsilon_1, \tag{5}$$

where cg_i is a comparison group indicator and ε_1 is an error term. If the training sample provides a noise-free estimate of the true impact of random model assignment on the offered buy rate, then we would expect $\beta = 1$. While the assessment from the training sample of the rate impact of model assignment may not be perfectly precise, as long as the training sample provides meaningful information about interest rates, we should observe $\beta > 0$.

In our main tests, we explore the impact of the interest rate shock on various outcomes and application and loan characteristics:

$$Outcome_i = \gamma Interest\,Rate\,Shock_i + cg_i + \varepsilon_2. \tag{6}$$

We test the distinct predictions across settings by interacting the buy-rate shock with ex-ante margin bins (e.g., terciles of average margin). setting B predicts a V-shape across bins, setting A predicts monotonic increases, and Setting C predicts downward shifts with truncation in the upper tail.

In some specifications, we consider Two-Stage Least Squares (2SLS) analyses, in which the first-stage is described by Equation (5) and the second-stage is given by:

$$Outcome_i = \delta Buy\,Rate\,Offered\,to\,Dealer_i + \varepsilon_3. \tag{7}$$

We cluster all our regressions at the level of the comparison group. In some specifications, we cluster as well at an additional level such as the dealership.

7 Results

7.1 First Stage

We begin by assessing whether the randomized field experiment was indeed implemented in a manner consistent with the description in Section 3. The empirical method outlined in Section 6 relies on the argument that different APRs observed in the training sample across Models I and II for a given comparison group should reflect the true impact of model assignment for observations in the test sample for the same comparison group. To evaluate this claim, in the test sample we regress the buy rate offered to the dealer on the interest rate shock, as described in Equation (5).

We find a coefficient of 0.87 (t-statistic=37.76) on the interest rate shock, as displayed in the first column of Table 2. This is strong evidence that we are indeed measuring interest rate shocks generated by the mechanism described in Section 3. If the treatment and control assignments were made in some unrelated manner, then the estimated APR differences from the training sample would represent pure noise when applied to the testing sample, and we would expect a coefficient of zero. If we had a perfect measure of the treatment effects, then we would expect a coefficient of

one. We are, however, estimating the APRs in each comparison group in the training sample, so our treatment effects are not completely accurate; the coefficient of 0.87 that we find suggests that we have a clean, though imperfect, measure of the treatment effects.

In the second column of Table 2 we show that including year-month fixed effects has little influence on the estimated impact of the interest rate shock (coefficient=0.87 and t-statistic=37.62).

7.2 Balance Tests

The field experiment randomly assigned applications to Models I and II. We therefore would not expect to observe differences in characteristics across the applications assigned to the two models. To confirm this, we run balance tests by regressing various application characteristics on the interest rate shock, as outlined in Equation (6).

We consider the following set of application characteristics: the log of the number of years the applicant has spent at his/her residence, the log of the number of years the applicant has worked for his/her current employer, the log of the applicant's income, the applicant's credit score and an indicator for homeowner status. As shown in Table 3, the interest rate shock is not significantly related to any of these variables. The comparison groups are constructed to be homogeneous in Chapter 7 and 13 bankruptcy status, so the interest rate shock is also unrelated to these variables. Overall, the randomization of model assignments results in applicant pools that have characteristics that appear to be unrelated to interest rate shocks.

7.3 Loan Take-Up

It is a uniform prediction across all three theoretical settings that an exogenous increase in the buy rate will reduce loan take-up. This arises from a lower probability that the dealer will accept Lender L's bid in Bargaining setting B (Implication B1). In addition to this effect, in Price Discrimination setting A (Implication A1) and Inflexible Margins setting C (Implication C1) a higher buy rate also increases the probability that borrowers with lower reservation values will reject the dealer's offered terms. We test this prediction by regressing an indicator for loan take-up on the interest rate shock, as outlined in Equation (6). We find a negative and significant effect of an increase in the buy rate on the probability of loan take-up (coefficient=-0.022 and t-statistic=-

5.10), as detailed in the first column of Table 4. This is consistent with the predictions in each of the theoretical settings.

To assess the magnitude of the effect, we conduct a 2SLS regression of loan take-up on the buy rate offered to the dealer, in which we instrument the buy rate with the interest rate shock, as described in Equation (7). We find a coefficient of -2.5% and a t-statistic of -5.17, as shown in the second column of Table 4.[9] A one percentage point increase in the buy rate offered to the dealer reduces the probability that Lender L's bid will lead to a completed financing by 2.5 percentage points. The average take-up for bids that Lender L makes is 17.7%, so a one percentage point increase in the buy rate reduces the probability of loan take-up by 14.1%. As a point of context, the average buy rate offered to dealers is 18.1%, so a one percentage point increase is 5.5% of the mean. This suggests that loan take-up is quite sensitive to the offered buy rate.

7.4 Pass-Through

The pass-through is the change in the interest rate charged relative to the change in the buy rate. In all three theoretical settings, an increase in the buy rate results in a weakly lower loan margin and therefore generates a pass-through that is weakly less than one. This arises from reduced surplus between the dealer and borrower that can be seized by the dealer in the Price Discrimination setting (Implication A2) and split between the two parties in the Bargaining setting (Implication B2). In the Inflexible Margins setting, the dealer charges the same margins irrespective of the buy rate, but high margins are not accepted by borrowers as the buy rate increases, leading to lower average margins on completed loans (Implication C2).

We analyze the impact of the buy rate on the overall rate charged by regressing the completed loan APR on the interest rate shock. We find a positive and significant effect (coefficient=0.68 and t-statistic=7.04), as displayed in the first column of Table 5.[10] When the buy rate increases, borrowers secure financing at higher rates.

We test the shared prediction that emerges from all three settings of a pass-through weakly less one by regressing via 2SLS the loan APR on the buy rate, where the latter variable is instrumented

[9] Consistent with the strong significance of the first-stage coefficient on the interest rate shock shown in Table 2, we find a Kleibergen-Paap Wald F statistic in excess of 1400 in the 2SLS specification.

[10] This estimation is performed in the sample of completed loans, as loan APRs are only available if the financing is provided.

with the interest rate shock. We find a coefficient of 0.89 (t-statistic=19.49), as shown in the second column of Table 5.[11] This is consistent with Implications A2, B2 and C2.

Our estimate is consistent with average general macro pass-through coefficients that range from 0.8 to 0.89 (Gregor et al., 2021). Pass-throughs to consumer lending, however, tend to be substantially lower (recent assessments are in the range of 0.2 to 0.5), though within this category auto loans appear to be relatively more sensitive to rate changes; there is substantial variation in pass-throughs across different geographical markets and lending segments (Aristei and Gallo, 2014; De Jonghe et al., 2025). The high pass-through that we find may be regarded as somewhat surprising, though, given the transaction-specific nature of the shock that we study. This financing offer is supplied in a market with both competing lenders and dealers, none of which is affected by the shock. It may have been thought, therefore, that dealers would be able to pass along to borrowers relatively little of this random variation in their buy rates. It is also the case that even absent competitive considerations, dealers receiving a high buy rate might have been expected to scale back their margins to accommodate the limited tolerance of borrowers for high APRs. Despite all these considerations, we find a pass-through that is close to one. This may perhaps be best understood in the context of the negotiation between the borrower and the dealer. Bargaining over financing terms takes place after the two sides have agreed on a vehicle price and at a point at which it would be difficult for the borrower to seek outside financing offers. Given these circumstances, the dealers are able to pass through to borrowers the large majority of the buy rate shock.

In a complementary test, we regress the loan margin on the interest rate shock. We find, as detailed in the third column of Table 5, a coefficient of -0.088 (t-statistic=-2.48). We show in the fourth column of Table 5 that the impact of the buy rate on the margin is negative (coefficient=-0.11 and t-statistic=-2.53). That is, the estimated pass-through, although high, is strictly less than one.

7.5 Bargaining and Price Discrimination – Consumer Characteristics

The Price Discrimination and Bargaining settings described in Section 5 yield predictions relating the change in loan margin to the interest rate shock for different types of borrowers. Specifically, in the Price Discrimination setting, the impact of the buy rate on the loan margin is increasing in the average margin paid by a class of borrowers (Implication A2 (ii)). In the Bargaining setting,

[11] The Kleibergen-Paap Wald F statistic is 61.4.

the impact of the buy rate on the loan margin is V-shaped in the average margin paid by a class of borrowers (Implication B2 (ii)).

To test these competing predictions, we first construct an estimate of the average margin for different borrowers. For observations that preceded the sample period, we regress the loan margin on the following consumer characteristics: log of applicant income, applicant credit score, indicators for prior Chapter 7 and 13 bankruptcies, and applicant zip code fixed effects. The estimated coefficients on these characteristics are then applied to the observations in the sample period to generate a predicted loan margin. We label this consumer-based estimated variable $Predicted\,Loan\,Margin(C)$.

All of our tests are then conducted during the sample period. We regress the loan margin on the predicted loan margin and the interest rate shock. We find a coefficient of 0.27 (t-statistic=7.55) on the predicted loan margin, as displayed in the first column of Table 6. If the predicted loan margin were a perfect estimate of the loan margin, we would expect a coefficient of one. The estimate coefficient of 0.27 is significant, suggesting that it contains meaningful information, but it is clearly imperfect.

The Price Discrimination Implication A2 (ii) is that the impact of the buy rate on the loan margin is increasing in the predicted loan margin. We test this prediction by regressing the loan margin on the interaction between the interest rate shock and the predicted loan margin and the levels of these two variables. As shown in the second column of Table 6, the interaction is insignificant (coefficient=-0.046 and t-statistic=-0.69). This finding does not support Price Discrimination Implication A2 (ii)).

For borrowers with relatively low average margins, Bargaining Implication B2 (ii) and Price Discrimination Implication A2 (ii) yield directly contrasting predictions. In the Bargaining setting, for these borrowers, an increase in the buy rate should have a smaller effect as the average margin increases. In the Price Discrimination setting, an increase in the buy rate should have a larger effect as the average margin increase.

We restrict the sample to borrowers with low predicted margins of 0.5 and below and again regress the loan margin on the interaction between the interest rate shock and the predicted loan margin and the levels of these two variables. We find an insignificant coefficient of 0.11 (t-statistic=0.26) on the interaction, as displayed in the third column of Table 6, which offers support

for neither the Price Discrimination nor the Bargaining predictions.

This null finding may perhaps be explained as arising from a mixture in the data between the Price Discrimination and Bargaining settings. In other words, perhaps some negotiations resemble price discrimination and others have bargaining features, so the net effect of the interaction for low predicted margin borrowers is null. Both settings, however, share the prediction that for borrowers with relatively high predicted loan margins, an increase in the buy rate should have a larger impact on the loan margin as the predicted loan margin rises. We test this shared predicted by regressing the loan margin on the interaction between the interest rate shock and the predicted loan margin and the levels of these two variables in a sample restricted to borrowers with relatively high predicted loan margins of 1.5 and above. In this sample, we also find an insignificant effect of the interaction (coefficient=-0.05 and t-statistic=-0.11), as shown in the fourth column of Table 6, which does not support the shared prediction arising from both settings.

The Price Discrimination setting offers an additional prediction Implication A3 that as the buy rate increases, the average borrower reservation value for borrowers who receive financing should rise. In the Price Discrimination setting, the loan margin is increasing in the reservation value, so from an empirical perspective this suggests that the predicted loan margin for all borrowers who complete transactions should be increasing in the buy rate. We test this prediction by regressing a borrower's predicted loan margin on the interest rate shock. We find, as detailed in the fifth column of Table 6, an insignificant effect (coefficient=0.03 and t-statistic=1.60). This finding does not offer support for Price Discrimination Implication A3.

Taken together, there is no evidence in Table 6 in support of the various predictions arising from the Price Discrimination and Bargaining settings. In general, the impact of the interest rate shock on the loan margin appears to be quite homogeneous across various types of borrowers, which is consistent with the Inflexible Margins setting. Alternatively, it may be that consumer characteristics cannot be used to generate a sufficiently accurate estimate of predicted loan margins.

7.6 Bargaining and Price Discrimination – Dealer Characteristics

As an alternative to the consumer-based predictor of loan margins discussed above, we consider dealer-specific estimates of the interest margin paid. The rationale for this approach is that dealers

may use firm- or employee-specific margins with little reference to the specific characteristics of any given borrower. We calculate the average loan margin per dealer for observations that precede the sample period. We then attribute this estimated margin to the dealer's transactions during the sample period. We refer to this dealer-based estimated variable as $Predicted\,Loan\,Margin(D)$. In the context of Section 5, in Price Discrimination Setting A, a high value of $Predicted\,Loan\,Margin(D)$ reflects a dealer whose borrowers generally have high interest rate reservation values. In Bargaining setting B, a high value of $Predicted\,Loan\,Margin(D)$ serves a proxy for a dealer with strong bargaining power.

Analogous to our approach for the consumer-based predictor, we begin by regressing the loan margin on $Predicted\,Loan\,Margin(D)$ and the interest rate shock. This regression yields a coefficient of 0.78 (t-statistic=17.64) on the dealer-based predicted loan margin, as shown in the first column of Table 7. This coefficient is approximately three times as large as the estimated coefficient in the consumer-based predictor displayed in the first column of Table 6, suggesting that dealer characteristics have a significantly stronger impact on loan margin than consumer characteristics.

Price Discrimination Implication A2 (ii) suggests that the impact of the buy rate on the loan margin should increase in the predicted loan margin. We test this prediction by regressing the loan margin on the interaction between the interest rate shock and $Predicted\,Loan\,Margin(D)$ and the levels of these two variables. The interaction is insignificant (coefficient=-0.023 and t-statistic=-0.30), as detailed in the second column of Table 7.

In the Bargaining setting, the model predicts that when the average margin is relatively low (i.e., when dealer bargaining power is limited), an increase in the buy rate has a smaller effect on the dealer margin because the dealer captures only a small share of the surplus. In contrast, in the Price Discrimination setting, the model predicts that when the average margin is relatively low (i.e., when borrowers have low reservation rates), an increase in the buy rate has a larger effect on the dealer margin because the dealer must reduce markups more sharply to keep the loan acceptable to the borrower. In the sample of dealers with low predicted margins of 0.5 and below, we find an insignificant impact of the interaction between the interest rate shock and $Predicted\,Loan\,Margin(D)$ (coefficient=-0.13 and t-statistic=-0.23). This result is displayed in the third column of Table 7, and offers support for neither prediction.

In both settings, if dealers charge relatively high average margins, then an increase in the average margin should lead to a greater impact of the interest rate shock. In the sample of dealers with high predicted margins of 1.5 and above, we find an insignificant impact of the interaction between the interest rate shock and $Predicted\,Loan\,Margin(D)$ (coefficient=0.54 and t-statistic=0.98), as described in the fourth of Table 7. This result does not support the shared prediction arising from the two settings.

In the Price Discrimination setting, Implication A3 (ii) is that as the buy rate increases, dealers who face borrowers with generally lower reservation values cannot make loan offers that will be accepted. As a consequence, the market will become dominated by dealers whose borrowers have interest rate reservations values, i.e., higher values of $Predicted\,Loan\,Margin(D)$. We regress the predicted loan margin on the interest rate shock and find, as shown in the fifth column of Table 7, an insignificant effect (coefficient=0.02 and t-statistic=1.16).

The dealer-based estimate of average loan margins is an effective predictor of realized margins in the sample period. Despite this fact, when utilizing this predictor, we do not find support for many of the predictions arising from either the Price Discrimination or Bargaining settings.

The fact that loan margins are substantially more dependent on dealer characteristics than consumer characteristics is, however, consistent with the mechanism outlined in the Inflexible Margins setting. In that setting, dealership employees propose unchanging margins that do not depend on the type of consumer.

7.7 Inflexible Margins- Distributions of Loan Margins

The results described in Tables 6 and 7 are broadly not consistent with the Bargaining or Price Discrimination settings. The influence of the interest rate shock on loan margins does not appear to vary with the characteristics of either borrowers or dealers, as suggested by those settings. In the Inflexible Margins setting, by contrast, proposed dealer margins are insensitive to changes in the buy rate. Margins on completed loan contracts, however, do decline as buy rates increase because borrowers with lower reservation values reject the offered debt. This leads to Inflexible Margins Implication C3 (ii) that an increase in the buy rate will truncate from above the loan margin on observed loan contracts.

We test this prediction by contrasting the distributions of loan margins on completed loan contracts for borrowers who receive positive and negative (or zero) interest rate shocks. We first consider the two full loan distributions that are displayed in Figure 1. As the figure shows, margins are generally higher for negative interest rate shocks. Indeed, an unreported regression of loan margins on an indicator for a positive interest rate shock and comparison group fixed effects yields a negative and significant coefficient of -0.10 (t-statistic=-3.38). This is consistent with the finding described in the third column of Table 5 that the interest rate shock reduces the loan margin. A permutation-based Kolmogorov–Smirnov (K-S) test yields a p-value of 0.001.[12] The distributions of the loan margin are clearly distinct for positive and negative interest rate shocks.

Implication C3 (ii) suggests that the loan margin distribution under a positive shock is simply a truncation from above of the loan margin distribution under a negative shock. In other words, for the set of low-to-moderately high loan margins, the distributions of the loan margins should be identical under the positive and negative shocks. Figure 2 displays the two distributions both truncated above at 1.5%, and, as the figure makes clear, the truncated distributions are very similar.[13] A permutation-based K-S test yields a p-value of 0.38. This is clear evidence in favor of Implication C3 (ii): Once the highest loan margin observations are excluded, the distributions of loan margins under positive and negative shocks are not statistically distinguishable.

In the Inflexible Margins setting, dealership employees propose the same distribution of loan margins to all customers in a manner that does not depend on the underlying buy rate. If, however, both the buy rate and the proposed margin are relatively high, then some borrowers will reject the financing offer. As a consequence, observed margins on completed loan contracts are lower when the buy rate is high. Excluding the highest margins, however, the distribution of loan margins should not differ under positive and negative interest rate shocks, and that is what we observe.

7.8 Dealer Competition

The dealer margin-determination strategy described in the Inflexible Margins setting suggests that the interest rate pass-through will also be independent of the competitive environment. In this setting, even if a dealer operates in a highly contested market, it will not reduce the margin it

[12] The permutation-based test accounts for the atoms in the distribution of the loan margin.

[13] Figures 3 and 4 display, for ease of presentation, the full and truncated distributions on the range above -2.5%.

charges when it receives a higher buy rate offer from Lender L.

We examine this hypothesis by regressing the loan margin on the count of dealers active in the dealer's zip code prior to the sample period, the interest rate shock, the interaction between these two variables and the comparison group fixed effects. We do not find a significant direct effect (coefficient=0.006 and t-statistic=1.64) of the number of active dealers in the zip code on the loan margin, as shown in the first column of Table 8. The interaction between the number of local active dealers and the interest rate shock is also insignificant (coefficient=-0.003 and t-statistic=-0.43), as described in the second column of Table 8.

When using as our measure of competition the log of the number of dealers in the zip code or the Herfindahl-Hirschman Index (HHI) by application count, we similarly find that competition has an insignificant effect on the loan margin both directly and when interacted with the interest rate shock. These results are displayed in the third through sixth columns of Table 8. There is no evidence that the local competitive environment has an influence on margins or the pass-through of the buy rate.

The results in Tables 6, 7 and 8 uniformly show that the interest pass-through is independent of borrower, dealer and local competition characteristics. As described in the Inflexible Margins setting, dealers appear to set loan margins in a consistent way over time with little reference to changes in their own cost of financing.

7.9 Margin Uncertainty

The analyses in Section 5 focused on settings in which information was presumed to be either full (Price Discrimination and Bargaining) or irrelevant to the dealer's action (Inflexible Margins). In the actual interaction between the borrower and the dealer, there is uncertainty on both sides about the reservation values of the other. In this section, we consider how this uncertainty affects the average margin observed.

For observations prior to the sample period, we regress the loan margin on the log of the borrower's income, the borrower's credit score, indicators for prior Chapter 7 and 13 bankruptcies, and applicant zip code and dealer fixed effects. We calculate the standard deviations of these residuals within each applicant zip code and label this measure as the zip code-level variation. We

regress the loan margin on the variation, the interest rate shock and the comparison group fixed effects. We find, as shown in the first column of Table 9, a negative and significant coefficient of -0.14 (t-statistic=-2.36) on zip code-level variation. This suggests that applicants from zip codes with greater variation in their loan margins tend to receive lower margins on average. This might arise from a more conservative negotiating strategy adopted by dealers in the face of heightened uncertainty, or it may be driven by various unobserved borrower characteristics.

If uncertainty has a causal effect on loan margins, one might expect the impact of an interest rate shock to differ with the degree of uncertainty; for example, perhaps dealers are more hesitant to pass interest rate shocks through to borrowers when there is greater uncertainty about borrower reservation values. We test this claim by regressing the loan margin on the interaction between the zip-code level variation and the interest rate shock, the levels of these two variables and comparison group fixed effects. We find that the interaction variable is not significant (coefficient=-0.17 and t-statistic=-1.41), as detailed in the second column of Table 9.

In the third and fourth columns of Table 9 we show that zip-code level variation in margins does not have a significant effect on loan take-up either directly or in interaction with the interest rate shock. Taken together, there is little evidence that zip-code-level variation in average margin paid by borrowers has a causal influence on the margin paid by any given borrower.

To assess the impact of uncertainty about dealer margins, we calculate the standard deviations of the loan margin residuals for each dealer and label them as our measure of dealer-level variation. Dealer-level variation is correlated in a negative and significant manner (coefficient=-0.64 and t-statistic=-6.35) with margins, as displayed in the fifth column of Table 9. In the sixth column of Table 9, however, we show that the interaction between dealer-level variation and interest rate shock is insignificant (coefficient=0.11 and t-statistic=0.82). Dealer-level variation is positively correlated with loan take-up, but the interaction of dealer-level variation with the interest rate shock is not significantly related to take-up, as displayed in the seventh and eighth columns of Table 9.

While there is evidence that borrower- and, especially, dealer-level variation is directly correlated with loan margins, and that dealer-level variation is also directly correlated with loan take-up, neither of these measures of variation mediate the impact of the interest rate shock on either margins or take-up. There is thus no evidence in Table 9 that margin uncertainty plays an important

role in determining the interest rate pass-through for these auto loans.

7.10 Debt Supply and Bundling

Our focus to this point has been on the effect of an increase in the buy rate on loan take-up and the ultimate cost of financing to the borrower. The interest rate shock causes a reduction in take-up (Table 4) and an increase in the borrower's APR (Table 5). We now examine the implications of the shock on other loan outcomes. In this section, we analyze the extent to which borrowers reduce their debt demand in the face of higher loan prices. We also consider whether the final price of the vehicle reflects variation in the cost of financing; that is, we examine whether in this respect dealers bundle the vehicle and the auto loan.

A natural hypothesis is that a higher interest cost on the debt will lead borrowers to reduce the size of their loans. We test this prediction by regressing the loan-to-wholesale value (LTV) ratio of the debt on the interest rate shock. We find, as described in the first column of Table 10 an insignificant effect (coefficient=-0.001 and t-statistic=-0.15). A regression of the cash-to-wholesale value ratio on the interest rate shock also yields an insignificant result, as shown in the second column of Table 10 (coefficient=0.002 and t-statistic=1.23). These results show, perhaps somewhat surprisingly, that the loan size sought by borrowers is insensitive to the price of the debt. This finding is consistent with the argument that these borrowers are highly financially constrained and simply do not have enough cash on hand to increase their equity investments even if the loan rate is high.

We explore the issue of vehicle and financing bundling by regressing the total vehicle price-to-wholesale value on the interest rate shock. If dealers treat the vehicle and its supporting debt as a joint package, they could reduce the vehicle price to encourage the borrower to complete the transaction when the financing turns out to be expensive. We show in Table 4 that the loan take-up is lower when the interest rate shock is high, suggesting that if dealers were to offset high financing costs, they would do so by lowering vehicle prices. We find, however, that the interest rate shock has an insignificant impact on the price-to-wholesale value ratio (coefficient=0.001 and t-statistic=0.20), as displayed in the third column of Table 10. This result is consistent with the insignificant effects of the interest rate shock on both the LTV and the cash-to-wholesale value.

There are two rationales that may explain the lack of a vehicle price response to an interest

rate increase. The first is temporal: typically buyers first negotiate the price of the vehicle and subsequently discuss the terms of financing. Even if financing turns out to be expensive, dealers may be reluctant to reopen already concluded vehicle price negotiations. The second explanation focuses on personnel. At most dealerships, the salesperson and the finance manager are separate roles with distinct compensation structures. Because their incentives are not fully aligned, it can be difficult for them to coordinate and offset unexpectedly high financing costs by lowering the vehicle's selling price.

Our field experiment allows us to explore one specific element of bundling: Does the later revelation of high financing costs cause dealers and buyers to reduce vehicle prices? We find that the answer to this question is no. Bundling, however, may arise through several distinct mechanisms. For example, if dealers generally expect higher financing costs, based on borrower characteristics or broader credit conditions, they may incorporate these expectations into the vehicle price negotiation. In such cases, we would not observe a subsequent adjustment in the vehicle price when the realized financing cost is high. Importantly, in our experimental setting, the buy-rate shocks are randomized and unanticipated. Dealers may form priors about typical financing costs, but cannot anticipate the idiosyncratic cost changes induced by the experiment.

We do find, however, that loan margins are correlated with vehicle price-wholesale value ratios. In the fourth column of Table 10 we detail the results from regressing the loan margin on the interest rate shock and the price-to-wholesale value ratio paid by the consumer. We find that borrowers who pay higher prices tend to pay higher loan margins as well (coefficient=0.73 and t-statistic=10.21). The price paid by the consumer, though, is clearly endogenous, so this coefficient does not offer a causal interpretation. For example, borrowers in certain regions or who purchase certain types of vehicles may, for reasons driven by various unobserved characteristics, pay higher prices both for vehicles and financing.

With this caveat in mind, we regress the loan margin on the interaction of the interest rate shock and the price-to-wholesale ratio, as well as the levels of these variables, and display the result in the fifth column of Table 10. The coefficient on the interaction is insignificant (coefficient=0.11 and t-statistic=0.92). If dealers tend to shade upward the cost of debt for buyers who have paid high vehicle prices (perhaps reflecting their enhanced financial capacity), one would expect to see a positive interaction. If dealers tend to reduce the cost of debt for buyers who pay high vehicle

prices (out of bundling considerations), one would expect a negative interaction. The insignificant result we find, however, suggests that there is no evidence in support of either of these arguments; borrowers who pay high vehicle prices do not appear to be differentially affected by the interest rate shock.

7.11 Non-price Loan Outcomes

An exogenous increase in the interest may affect outcomes other than debt supply and vehicle price. For example, when responding to a positive interest rate shock, one might expect that dealers and borrowers would extend the term of the loan, perhaps to maintain a given level of monthly payment (Argyle et al., 2020). We do not find evidence for this hypothesis. As described in the first column of Table 11 Panel A, the impact of the interest rate shock on the loan term is insignificant (coefficient=-0.06 and t-statistic=-0.39). We show in the second column of Table 11 Panel A that the interest rate shock does not significantly increase the payment-to-income (PTI) ratio (coefficient=0.0007 and t-statistic=0.80), despite the higher rate paid by the borrower, perhaps due to a degree of income selection in the set of borrowers who take-up the loans.

If financing and insurance were bundled, an interest rate shock should reduce the frequency of GAP insurance, but as detailed in the third column of Table 11 Panel A, we do not find that to be the case. This is consistent with the lack of evidence for bundling we describe in Table 10.

An increased loan rate might be thought to elevate borrower default risk for three reasons. First, borrowers may simply be unable to make the higher payments. Second, from a selection perspective, better borrowers may forego these unattractive loan offers and seek credit elsewhere, leaving only weaker borrowers to accept the financing. Third, a higher interest can increase the moral hazard rationale for a borrower to choose to engage in strategic default. We find, however, as shown in the first column of Table 11 Panel B, that the interest rate shock does not increase the risk of default.

We do find, as detailed in the second column of Table 11 Panel B, that the interest rate shock reduces the time to default for loans that do enter default (coefficient=-0.06 and t-statistic=-2.07). When including log of borrower income and applicant credit score as additional controls, however, the coefficient on the interest rate shock is rendered insignificant, as outlined in the third column of

Table 11 Panel B. This suggests that a higher rate may lead to quicker time to default due primarily to selection effects. A similar pattern is displayed for early 15 day-delinquency within the first 60 days of loan origination: the interest rate shock increases the probability of early delinquency, but the effect is driven by selection in those who accept the loan, as shown in the fourth and fifth columns of Table 11 Panel B.[14]

Taken together, the results in Tables 4, 5 and 11 indicate that an interest rate shock reduces loan take-up and increases the borrower's APR but has little influence on other loan terms. There is weak evidence that, due to selection effects, higher rates lead to quicker time to default and greater 15-day delinquency risk.

7.12 Robustness

7.12.1 Approval Shocks

The two credit screening models across which the lender randomized generated different APRs that were offered to borrowers, as described in the results above. The models also yielded differential loan approval rates. We have interpreted our take-up and pass-through findings as describing the responses of dealers and borrowers to interest rate shocks. If the varying approval rates of the two models, however, altered the composition of the borrowers who received offers, then the take-up and pass-through results might instead reflect differences in borrower pools rather than responses to shifts in the offered APR.

This concern is not warranted. The approval rate shocks, like the interest rate shocks, were applied randomly to borrowers within a given homogeneous comparison group. As a result, while a positive approval shock would increase the fraction of borrowers within that group that received an offer, it would not do so in a selective manner. It would simply result in the random approval of a greater number of borrowers who could still be appropriately compared to the smaller number of randomly approved borrowers who received a negative approval shock. In other words, the approval shock would not be expected to affect the composition of the borrowers who received offers. As shown in Table A.2 in the Appendix this is indeed the case; the approval shock is uncorrelated with borrower characteristics.

[14]The positive coefficient on log of income in the early delinquency regression in the fifth column may be explained by negative selection in the types of relatively higher income borrowers who seek this subprime financing.

As a consequence, conditional on the interest rate shock, the approval rate shock should not influence the take-up rate or loan margin. Further, the approval rate shock should not affect the direct impact of the interest rate shock. In Table A.3 in the Appendix we show that both these expectations are correct. It is therefore appropriate to focus solely on the interest rate shock, as we do in our analyses above.

8 Conclusion

In this paper, we study a field experiment in the U.S. auto loan market in which a lender randomly varied the interest rate it offered to dealers (i.e., the buy rate). Dealers had discretion in marking up the rate on the loan presented to car buyers above the buy rate, and dealer compensation was increasing in the markup. Higher buy rates substantially reduce borrower loan take-up. We find that the pass-through of the buy rate to the ultimate borrower rate is 0.89, despite the fact that the buy rate shock was idiosyncratic to the particular transaction. The pass-through is unrelated to measures of local market power. Proposed dealer loan margins are inflexible and do not depend on the buy rate; the pass-through is less than one because loans with high rates are declined by borrowers. Our finding documenting dealers' inflexibility in setting margins in the face of transaction-specific shocks to their cost of funding suggests that loan margin inertia on the part of intermediaries may be a central driver of the pass-through of macro-level interest rate shifts.

Loan-to-value and other non-price loan terms are unaffected by exogenous changes in the buy rate. Higher buy rates reduce time to default and weakly increase delinquency, and these effects are driven completely by induced selection in the types of borrowers who accept the loans.

Auto dealers are sophisticated negotiators who can read their customers well. In the field experiment we study, we find that the buy rate pass-through is insensitive to observable borrower characteristics, and we see no evidence that financing terms influence the price or leverage of the car. These results suggest that organizational structures may be, to some degree, inhibiting the ability of dealers to use bargaining strategies to achieve full transactional efficiency. Our findings imply that the consumer-level transmission of funding-cost shocks is shaped less by dealer strategic adjustment and more by borrower selection, highlighting limits to intermediary flexibility in retail credit markets. An analysis of these frictions, which are likely at play in a variety of other contexts,

may enhance our understanding of intermediary-borrower interactions in other segments of the consumer finance market.

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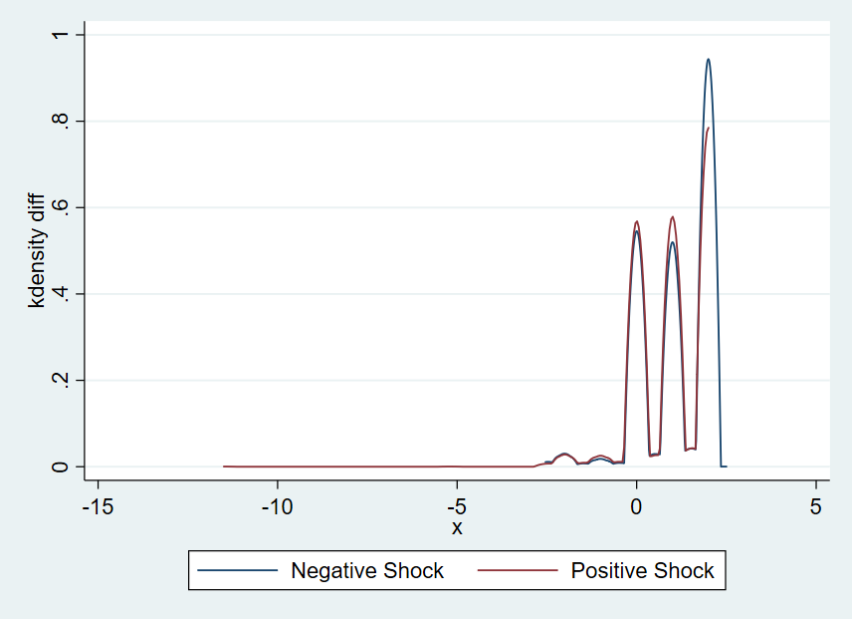


Figure 1: **Loan Margin Full Densities** This figure presents the densities of loan margins contrasting cases in which the interest rate shock is positive and negative.

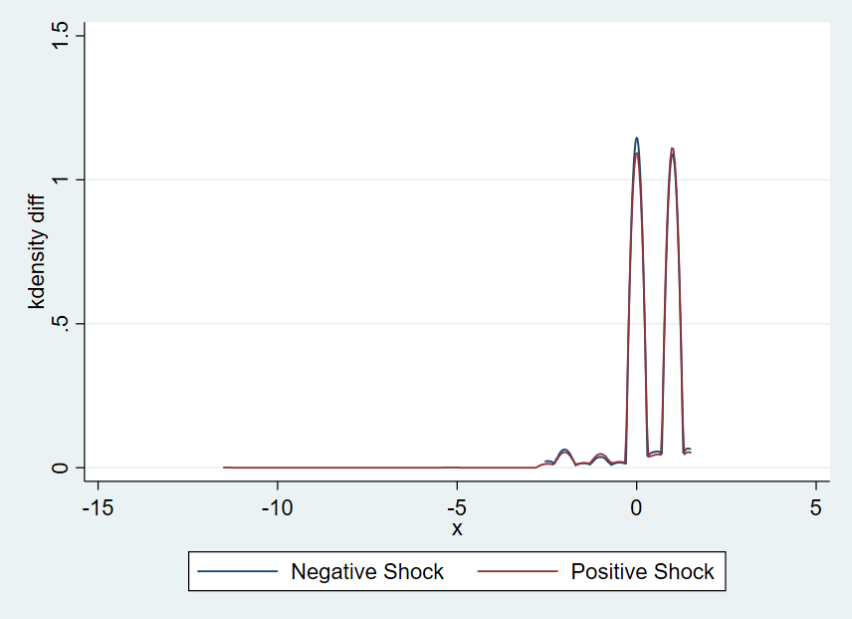


Figure 2: **Loan Margin Truncated Densities** This figure presents the densities truncated at 1.5 percentage points of loan margins contrasting cases in which the interest rate shock is positive and negative.

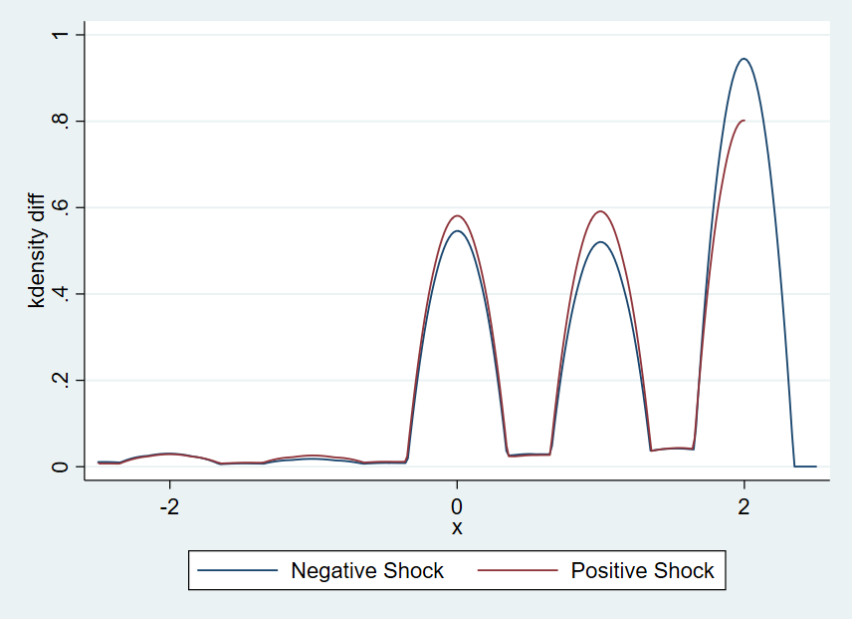


Figure 3: **Loan Margin Full Densities- Display Range Above -2.5%** This figure presents the densities of loan margins contrasting cases in which the interest rate shock is positive and negative. The range of margins above -2.5% is displayed.

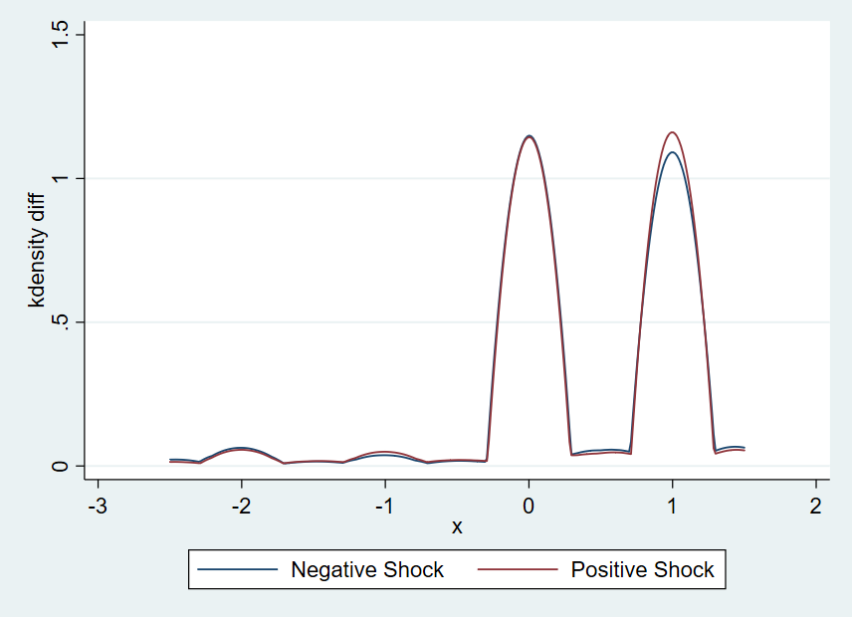


Figure 4: **Loan Margin Truncated Densities- Display Range above -2.5%** This figure presents the densities truncated at 1.5 percentage points of loan margins contrasting cases in which the interest rate shock is positive and negative. The range of margins above -2.5% is displayed.

Table 1: Summary Statistics

	Mean	Std. Dev.	P25	Median	P75	N
Borrower Characteristics						
Years in Residence	7.295	7.684	2.417	4.083	9.250	250,960
Years Employed	4.280	5.472	0.750	2.167	5.000	310,587
Income (annual)	43430.595	19968.648	30780.000	38400.000	51012.000	316,005
Credit Score	547.105	58.599	507.000	546.000	585.000	243,301
Homeowner (ind)	0.000	0.005				335,469
Chapter 7 bankruptcy (ind)	0.068	0.253				335,470
Chapter 13 bankruptcy (ind)	0.043	0.203				335,470
Loan Features						
APR offered to dealer	18.145	2.584	15.990	18.490	19.990	59,447
Interest Rate shock	0.009	0.712	-0.379	0.002	0.414	92,441
Take-up (ind)	0.031	0.174				335,470
APR	18.472	2.641	15.990	18.490	20.490	10,536
Margin	1.054	0.974	0.000	1.000	2.000	10,536
LTV	1.279	0.179	1.167	1.278	1.404	10,536
Cash-to-Value	0.055	0.069	0.000	0.035	0.082	10,536
Price-to-Value	1.333	0.180	1.217	1.328	1.455	10,536
Term	70.441	5.128	72.000	72.000	72.000	10,536
GAP (ind)	0.590	0.492				10,536
PTI	0.112	0.028	0.094	0.116	0.134	10,536
Default (ind)	0.172	0.378				10,536
Early Dlq. 30 (ind)	0.124	0.470				10,540
Early Dlq. 15 (ind)	0.296	0.701				10,540
Dealer Characteristics						
No. of dealers	3.595	4.278	1.000	2.000	5.000	335,468
Dealer HHI	0.686	0.281	0.452	0.727	1.000	335,470

Table 2: First Stage. This table reports the first-stage relationship between the randomized interest rate shock and the APR rate offered to the dealer. Columns 1 and 2 show OLS regressions with and without year-month (YM) fixed effects. All regressions include comparison-group (CG) fixed effects. Standard errors are clustered by comparison group (CG), with t-statistics in parentheses (* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$).

	(1)	(2)
	APR offered to dealer	APR offered to dealer
Interest Rate Shock	0.871^{***}	0.871^{***}
	(37.76)	(37.62)
Observations	28074	28074
R^2	0.688	0.690
Fixed effects	CG	CG, YM
Clusters	CG	CG

Table 3: Balance Tests. This table reports balance tests of application characteristics across experimental assignments. We regress each borrower or application characteristic on the randomized interest rate shock. Dependent variables include log years at residence, log years employed, log income, credit score, and homeownership indicator. All regressions include comparison-group (CG) fixed effects. Standard errors are clustered by comparison group (CG), with t-statistics in parentheses (* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$).

	(1)	(2)	(3)	(4)	(5)
	Residence	Employed	Income	Credit Score	Homeowner
Interest Rate Shock	0.0117	0.0153	0.000622	-0.0392	-0.0000302
	(1.14)	(0.89)	(0.15)	(-0.10)	(-0.63)
Observations	19971	24236	25773	26698	28074
R^2	0.063	0.052	0.059	0.655	0.003
Fixed effects	CG	CG	CG	CG	CG
Clusters	CG	CG	CG	CG	CG

Table 4: Take-up. This table reports regressions of loan take-up on the interest rate shock. Column 1 presents the reduced-form estimate of the shock's effect on an indicator for loan take-up which equals to one if the consumer consummates the loan. Column 2 reports 2SLS estimates instrumenting the buy rate with the interest rate shock. All regressions include comparison-group (CG) fixed effects. Standard errors are clustered by comparison group (CG), with t-statistics in parentheses (* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$).

	(1)	(2)
	Takeup	Takeup
Interest Rate Shock	-0.0218***	
	(-5.10)	
APR offered to dealer		-0.0250***
		(-5.17)
Observations	28074	28074
R^2	0.271	-0.017
Method	OLS	2SLS
Fixed effects	CG	CG
Clusters	CG	CG

Table 5: Pass-Through. This table estimates the pass-through of randomized buy rate shocks to final loan APRs and dealer margin on the loan. Dependent variables are the APR charged to the borrower (Columns 1–2) and the dealer loan margin (Columns 3–4). Columns 1 and 3 report reduced-form estimates; Columns 2 and 4 report 2SLS specifications. All regressions include comparison-group (CG) fixed effects. Standard errors are clustered by comparison group (CG), with t-statistics in parentheses (* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$).

	(1) APR	(2) APR	(3) Margin	(4) Margin
Interest Rate Shock	0.676***		-0.0878**	
	(7.04)		(-2.48)	
APR offered to dealer		0.885***		-0.115**
		(19.49)		(-2.53)
Observations	4989	4989	4989	4989
R^2	0.527	0.774	0.128	0.046
Method	OLS	2SLS	OLS	2SLS
Fixed effects	CG	CG	CG	CG
Clusters	CG	CG	CG	CG

Table 6: Bargaining and Price Discrimination–Consumer Characteristics. This table examines heterogeneity in pass-through by predicted loan margins based on consumer characteristics. Columns split the sample by predicted margins and compare loan margins across treatments. Columns 3 and 4 restrict the sample to dealers with low predicted margins (≤ 0.5) and dealers with high predicted margins (≥ 1.5). All regressions include comparison-group (CG) fixed effects. Standard errors are clustered by comparison group (CG), with t-statistics in parentheses (* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$).

	(1)	(2)	(3)	(4)	(5)
	Margin	Margin	Margin	Margin	Pred Margin
Predicted Loan Margin	0.268***	0.262***	0.0364	0.0633	
	(7.55)	(7.48)	(0.23)	(0.31)	
Interest Rate Shock	-0.108**	-0.0594	-0.320*	0.250	0.0271
	(-2.53)	(-0.76)	(-1.81)	(0.32)	(1.60)
IR Shock * Pred Loan Mgn		-0.0459	0.114	-0.0478	
		(-0.69)	(0.26)	(-0.11)	
Observations	3231	3231	365	390	3231
R^2	0.152	0.152	0.176	0.193	0.127
Sample	All Loans	All Loans	Low Margin	High Margin	All Loans
Fixed effects	CG	CG	CG	CG	CG
Clusters	CG	CG	CG	CG	CG

Table 7: Bargaining and Price Discrimination- Dealer Characteristics. This table examines heterogeneity in pass-through by dealer characteristics. Columns split the sample into dealers with low versus high average loan margins. Dependent variables include dealer loan margins and loan terms. Columns 3 and 4 restrict the sample to dealers with low predicted margins (≤ 0.5) and dealers with high predicted margins (≥ 1.5). All regressions include comparison-group (CG) fixed effects and, where indicated, dealer fixed effects. Standard errors are clustered by comparison group (CG) and, where indicated, dealer, with t-statistics in parentheses (* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$).

	(1)	(2)	(3)	(4)	(5)	(6)
	Margin	Margin	Margin	Margin	Pred Margin	Term
Predicted Loan Margin	0.780***					
	(17.64)					
IR Shock	-0.0980***	-0.0490	-0.0558	-0.923	0.0213	0.237
	(-3.07)	(-0.55)	(-0.39)	(-1.00)	(1.16)	(0.88)
IR Shock * Pred Loan Mgn		-0.0226	-0.129	0.537		-0.210
		(-0.30)	(-0.23)	(0.98)		(-0.96)
Observations	4782	4501	525	377	4782	4501
R^2	0.232	0.384	0.343	0.576	0.076	0.273
Sample	All Loans	All Loans	Low Margin	High Margin	All Loans	All Loans
Fixed effects	CG	CG, Dealer	CG, Dealer	CG, Dealer	CG	CG, Dealer
Clusters	CG	CG	CG, Dealer	CG, Dealer	CG	CG, Dealer

Table 8: Impact of Dealer Competition. This table estimates whether dealer competition moderates pass-through of buy rate shocks. The key independent variables are (1) the number of dealers in the local market (measured at the county level) and (2) the Herfindahl–Hirschman Index (HHI) for dealerships. These variables are interacted with the interest rate shock. Dependent variables are loan margins. The HHI is constructed from the distribution of loan applications across dealers in the same county/zip code market. All regressions include comparison-group (CG) fixed effects. Standard errors are double-clustered by comparison group (CG) and dealer zip code, with t-statistics in parentheses (* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$).

	(1)	(2)	(3)	(4)	(5)	(6)
	Margin	Margin	Margin	Margin	Margin	Margin
# of Dealers	0.00649	0.00636				
	(1.64)	(1.65)				
Interest Rate Shock	-0.0878**	-0.0748	-0.0884**	-0.0626	-0.0880**	-0.127**
	(-2.50)	(-1.53)	(-2.51)	(-1.21)	(-2.50)	(-2.14)
IR Shock * # of Dealers		-0.00305				
		(-0.43)				
Ln(# of Dealers)			0.0411	0.0389		
			(1.06)	(1.02)		
IR Shock * Ln(# of Dealers)				-0.0225		
				(-0.73)		
Dealer HHI					-0.0492	-0.0420
					(-0.42)	(-0.36)
IR Shock * Dealer HHI						0.0620
						(0.72)
Observations	4989	4989	4989	4989	4989	4989
R^2	0.129	0.129	0.129	0.129	0.128	0.128
Fixed effects	CG	CG	CG	CG	CG	CG
Clusters	CG, Zip	CG, Zip	CG, Zip	CG, Zip	CG, Zip	CG, Zip

Table 9: Impact of Margin Variation. This table reports OLS regressions of loan margins and take-up on the experimental interest rate (IR) shock, a measure of variation in margins, and their interaction. Columns 1–4 use variation measured at the ZIP code level, while Columns 5–8 use variation measured at the dealer level. Dependent variables are loan margin (Columns 1, 2, 5, 6) and loan take-up (Columns 3, 4, 7, 8). All regressions include comparison-group (CG) fixed effects. Standard errors are double-clustered by comparison group (CG, with t-statistics in parentheses (* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$).

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Margin	Margin	Takeup	Takeup	Margin	Margin	Takeup	Takeup
Variation	-0.137**	-0.159***	0.0125	0.0125*	-0.643***	-0.634***	0.0431***	0.0422***
	(-2.36)	(-2.63)	(1.63)	(1.65)	(-6.35)	(-6.38)	(4.63)	(4.57)
Interest Rate Shock	-0.0779**	0.0538	-0.0204***	-0.0203**	-0.0810**	-0.159*	-0.0223***	-0.00965
	(-2.14)	(0.59)	(-4.49)	(-2.28)	(-2.20)	(-1.70)	(-4.97)	(-1.07)
IR Shock * Variation		-0.167		-0.000127		0.107		-0.0179
		(-1.41)		(-0.01)		(0.82)		(-1.48)
Observations	4237	4237	23108	23108	4675	4675	25475	25475
R^2	0.127	0.128	0.276	0.276	0.146	0.146	0.273	0.273
Variation across	Zip	Zip	Zip	Zip	Dealer	Dealer	Dealer	Dealer
Fixed effects	CG	CG	CG	CG	CG	CG	CG	CG
Clusters	CG	CG	CG	CG	CG	CG	CG	CG

Table 10: Debt Supply and Bundling. This table examines how the interest rate shock affects loan terms and bundling. Dependent variables include the loan-to-value ratio, cash-to-value, price-to-value, and dealer loan margins. Interaction terms test whether effects vary with the price-to-value ratio. All regressions include comparison-group (CG) fixed effects. Standard errors are clustered by comparison group (CG), with t-statistics in parentheses (* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$).

	(1)	(2)	(3)	(4)	(5)
	LTV	Cash-to-Value	Price-to-Value	Margin	Margin
Interest Rate Shock	-0.00103	0.00239	0.00136	-0.0887**	-0.229
	(-0.15)	(1.23)	(0.20)	(-2.51)	(-1.46)
Price-to-Value				0.728***	0.731***
				(10.21)	(10.13)
IR Shock * Price-to-Value					0.106
					(0.92)
Observations	4989	4989	4989	4989	4989
R^2	0.108	0.202	0.105	0.144	0.145
Fixed effects	CG	CG	CG	CG	CG
Clusters	CG	CG	CG	CG	CG

Table 11: Non-price Loan Outcomes. This table reports regressions of non-price loan outcomes on the experimental interest rate shock. Dependent variables in Panel A are loan term, payment-to-income (PTI) ratio, and GAP insurance purchase indicator. Dependent variables in Panel B are loan default, time to default in months, and early delinquency (15-day). All regressions include comparison-group (CG) fixed effects. Regressions are estimated via OLS except for the time to default regressions which are estimated via Poisson. Standard errors are double-clustered by comparison group CG, with t-statistics in parentheses (* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$).

Panel A: Loan Terms at Origination

	(1)	(2)	(3)
	(1) Loan Maturity	(2) PTI	(3) GAP Indic.
Interest Rate Shock	-0.0587	0.000684	-0.0147
	(-0.39)	(0.80)	(-0.93)
Observations	4989	4989	4989
R^2	0.067	0.170	0.075
Fixed effects	CG	CG	CG
Cluster	CG	CG	CG

Panel B: Loan Performance

	(1)	(2)	(3)	(4)	(5)
	Default	Time to Default	Time to Default	Early Dlq. 15	Early Dlq. 15
Interest Rate Shock	-0.0185	-0.0645**	-0.00281	0.0145*	0.00571
	(-1.27)	(-2.07)	(-0.06)	(1.93)	(0.72)
Income			0.0208		0.0162**
			(0.59)		(2.37)
Credit Score			0.000971		-0.000129
			(1.37)		(-1.17)
Observations	4989	1272	714	4989	3491
R^2	0.120			0.072	0.082
Fixed effects	CG	CG	CG	CG	CG
Cluster	CG	CG	CG	CG	CG

Internet Appendix for "Credit Pricing, Rate Shocks, and Intermediary Discretion: An Auto Finance Field Study"

Table A.1: Bargaining and Price Discrimination- Credit Score Interactions. This table examines heterogeneity in pass-through and takeup by consumer credit score. All regressions include comparison-group (CG) fixed effects. Standard errors are clustered by comparison group (CG), with t-statistics in parentheses (* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$).

	(1)	(2)	(3)
	Loan Margin	Loan Margin	Takeup
Credit Score	0.000445	0.000452	-0.000593***
	(1.04)	(1.03)	(-4.95)
Interest Rate Shock	-0.0963**	-0.120	-0.0450
	(-2.57)	(-0.39)	(-1.36)
IR Shock * Credit Score		0.0000450	0.0000410
		(0.08)	(0.72)
Observations	4676	4676	26698
R^2	0.125	0.125	0.265
Sample	All Loans	All Loans	All Applications
Fixed effects	CG	CG	CG
Clusters	CG	CG	CG

t statistics in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A.2: Balance Tests- Approval Shock. This table reports balance tests of application characteristics across experimental assignments. We regress each borrower or application characteristic on the randomized approval rate shock. Dependent variables include log years at residence, log years employed, log income, credit score, and homeownership indicator. All regressions include comparison-group (CG) fixed effects. Standard errors are clustered by comparison group (CG), with t-statistics in parentheses (* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$).

	(1)	(2)	(3)	(4)	(5)
	Residence	Employed	Income	Credit score	Homeowner
Approval Shock	-0.0309	-0.00708	-0.0118	-0.989	-0.0000137
	(-1.15)	(-0.20)	(-1.45)	(-1.22)	(-0.91)
Observations	102256	129489	131997	121278	137023
R^2	0.040	0.052	0.038	0.666	0.002
Fixed effects	CG	CG	CG	CG	CG
Clusters	CG	CG	CG	CG	CG

t statistics in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A.3: Take-up and Pass-Through: Approval Shocks. This table reports regressions of loan take-up and interest rate pass-through on the interest rate shock and approval shock.

	(1)	(2)	(3)	(4)
	Take-up	Take-up	Loan Margin	Loan Margin
Interest Rate Shock	-0.0218***	-0.0223***	0.871***	0.870***
	(-5.10)	(-5.15)	(37.76)	(37.73)
Approval Shock		-0.0200		-0.0487
		(-0.91)		(-0.42)
Observations	28074	28074	28074	28074
R^2	0.271	0.271	0.688	0.688
Fixed effects	CG	CG	CG	CG
Clusters	CG	CG	CG	CG

t statistics in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$