Columbia Business School

The Effects of Field Price Discretion on Credit Pricing and Risk

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Agenda

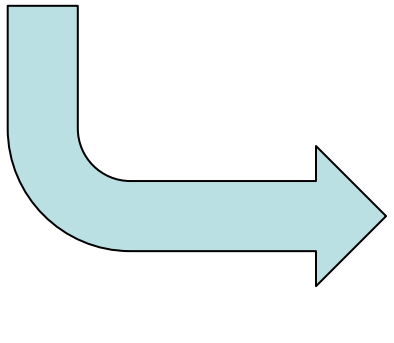
1. **Price Discretion in Consumer Lending**

2. What is the Effect of Discretion on Risk and Profit?

3. Conclusions

List Pricing with Discretion

Headquarters develops a rate sheet



…which is communicated to field sales.

Who then determine the actual rate for each customer within guidelines.

List Pricing with Discretion in Financial Services

List Pricing with Discretion is commonplace in Business-to-Business settings. It is also found in many consumer financial service markets:

- In unsecured personal loans in Canada, there is usually field sales discretion
- In indirect auto loans in the US, UK, Canada and elsewhere, the dealer has the ability to set the final rate within limits.
- About 50% of the secured loans and 70% of the unsecured loans offered in Europe involve some level of field pricing discretion (Oliver Wyman, 2010).

Why List Pricing with Discretion?

The existence of list pricing with discretion has not been fully explained. It relates to the tension between centralized versus decentralized pricing authority within many organizations.

Arguments for Pricing Centralization	Arguments for Pricing Decentralization
Data Pooling	Custom
Control	Perception of a Bargain
Consistency	Local Information
Sales Force Risk	Price Opacity

Typical situation: Sales argues for more pricing decentralization while Marketing and/or Finance argue for more centralization.

Headquarters' Role in Pricing with Discretion

What Headquarters Believes their Role is.

Their Actual Role

What Questions did we Research?

- How does price-discretion influence estimation of customer price-sensitivity? How can we account for this?
- Does field discretion improve or degrade profitability?
- What effect does it have on risk?

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Data From Three Different Lenders

We compare results from three North American lenders. Two of the lenders – US Indirect Auto and Canadian UPL – granted some level of decentralized discretion.

Lender	Field Price Discretion?	Period *	Approvals
US Indirect Auto	Y	Jan 2009 – June 2011 +	2,138,691
Canada UPL	Y	June 2010 – May 2011	51,799
US Internet Auto	N	Jan 2002 – Nov. 2004	152,963

* *Exact Period of US Indirect Auto suppressed to preserve anonymity.*

Data Characteristics

For each lender, we had information on all *approved* applications and their fate for some period of time.

Lender	Number of Approvals	Booked	Booking Rate	Discretion Percentage*
US Indirect Auto	2,138,691	1,473,786	69%	81%
Canada UPL	51,799	41,851	76%	54%
US Internet Auto	152,963	26,322	17%	0

* *Discretion Percentage* = Fraction of approvals whose final rate was different from the list rate.

Endogeneity and Discretion

Potential source of endogeneity: *Unrecorded variables* that are correlated both with both customer price-sensitivity and discretion.

These variables might include:

- Salesperson knowledge of local conditions
- Customer willingness to bargain
- Expressed eagerness to purchase
- Appearance, home address, …

Hypothesis: *Endogeneity will be present in the indirect lending data (in which pricing and sales occur face-to-face) but not in the on-line data.*

Instrumental Variables

We use as instruments the mean interest rates offered for similar loans in other regions during the same month. These instruments:

- Share the same marginal cost characteristics
- Are uncorrelated with unobserved characteristics of current customer.
- Average out national demand shocks.

Time of the loan offer:

- Captures possible seasonal effects on offered APR's
- *Plausibly* uncorrelated with unobserved customer type

Control Function Approach: Step I

We use the Control Function Approach (Rivers and Vuong, 1988)

Step I: For each observation *i,* compute:

$$\hat{r}_i = \left(\sum_{j \in S(i)} r_j \right) / n(i) + \varepsilon_i$$

Where:

r_i = Rate (including discretion) offered to loan *i*

$S(i)$ = Set of "similar loans",

$n(i)$= Cardinality of *S(i),*

ε_i = Error term

If the control function is valid, then $\hat{r}_i$ should be a good "unbiased" estimator of r_i , that is $E[\delta_i] = 0$ where $\delta_i = r_i - \hat{r}_i$.

Control Function Approach: Step 2

Step II: Regress take-up on offered rate, other variables and the residual from Step 1. That is, estimate the coefficients:

$$y_i = f(\alpha + \beta_0 r_i + \sum_{k=1\ldots n} \beta_k x_{i,k} + \beta_{n+1}\delta_i)$$

Where

y_i = Outcome (take or not take) for observation i

f = Logit or probit function

r_i = Rate (including discretion) offered in observation *i,*

$x_{i,k}$ = Characteristic *k* (e.g., loan size, FICO, …) for approval *i.*

$\alpha, \beta_0, \beta_1, \ldots, \beta_{n+1}$ = coefficients to be estimated.

If δ_i enters the regression as significant, it is strong evidence that endogeneity is present.

Model Results: Indirect Lender

Variable Class	Variable	Estimate	
		Uncorrected	Corrected
Term	48	-0.33***	-0.20***
	60	-0.55***	-0.35***
	≥ 66	-0.68***	-0.30***
Tier	2	-0.09***	0.05***
	3	0.03***	0.35***
	4	0.24***	0.90***
	5	0.20***	1.25***
Vehicle Type	Used	1.37***	1.67***
Subvention?	No	-1.55***	-0.73***
Prime Rate		5.98***	-13.94***
Log(Amount)		0.16***	- 0.12***
Customer Cash ($1,000)		1.12***	1.24***
Normalized FICO		-0.17***	-0.26***
Δ Rate	Tier 1	-7.83***	-23.18***
	Tier 2	-5.40***	-21.38***
	Tier 3	-4.88*	-21.32*
	Tier 4	-8.10***	-24.60***
	Tier 5	-6.40***	-23.09***
Rate Residual		N/A	9.03***

Significant with p < .001

Estimated Price Elasticities

Estimated Elasticities by Risk Tier

Tier	On-line Lender (Uncorrected)	Indirect Lender	
		Uncorrected	Corrected
1	2.77	.35	.97
2	1.87	.24	.86
3	1.38	.21	.77
4	1.17	.34	.77
5	**NA**	.27	.58

Correcting for endogeneity increases estimated elasticities for on-line lending by a factor of two or more. On-line lender elasticities are shown for comparison.

Note that, even after correction, the on-line channel is substantially more price elastic than the indirect channel.

Auto-Lending Results

- Endogeneity is present and highly significant for the indirect channel but not the internet channel.
- Correcting for endogeneity leads to significant changes in the rate coefficient in the models – the uncorrected model was systematically and significantly *underestimating* price sensitivity for the direct channel.
- Local rate discretion was adding value to the process as dealers offered rates that were closer to customer willingness-to-pay on average than list prices.
- We estimate that dealer price discretion increased profit by 10.6% over pricing based on current dimensions without discretion (using control-function prices).

Interesting, but …

…isn't that what we would expect? After all, aren't sales-people paid to capture the highest price possible in each transaction?

Canadian Unsecured Lending

List rate was based on *size_of_loan* and *risk_band* alone.

The Control Function Test showed significant endogeneity *in the opposite direction* from indirect auto lending – that is, lower-price sensitivity customers were offered lower prices and higher-price sensitivity customers were offered higher prices – resulting in lost profit to the bank.

Why would this be?

Clearing the Endogeneity

Adding two observable variables -- *region* and *loyalty_index* – cleared the endogeneity. *Loyalty_index* was based on customer tenure and number of products held with the bank. There was no additional evidence of *systematic* bias in pricing.

On the average, Field Sales Staff were offering higher discounts to customers with higher *loyalty_index*. These customers, however, had *lower* price sensitivity. Therefore, local discretion ended up destroying profitability on the average.

The loss in profitability from local price discretion in this case was about 1.4%.

Since both *region* and *loyalty_index* are observable at the time of application, they could be incorporated into list pricing.

What's Different Between the Two Markets?

Auto Lending: Dealers get to keep loan profits from higher rates

Canadian UPL: Field Sales incentivized primarily on volume and on promoter score.

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Effect on Profitability and Risk

	US Auto Lending		Canadian UPL	
	Profit ($M)	Loss Rate %	Profit ($M)	Loss Rate %
No Discretion	$2,639	2.31%	$16.6	.18%
Actual	$2,920	2.23%	$16.4	.18%
Difference	$281	(.08)	(.2)	-
% Change	10.6%	-3.5%	-1.4%	0%

Field pricing discretion increased profitability by 10.6% for the auto lender, but reduced profitability by 1.4% for the UPL lender.

Discretion reduced risk by 8 basis points for the auto lender. For the UPL lender, risk was unchanged.

Conclusions

Lessons:

1. Understanding the pricing process is critical when estimating price sensitivity.

2. Depending upon the situation, price-estimation without endogeneity correction can lead to under-estimation or over-estimation of price-sensitivity.

3. Local price-adjustments can either increase or reduce profitability, depending upon the context and the incentives given to sales.

4. Follow the money.

Questions and Discussion

Control Function Approach

We use a two-step approach to endogeneity correction (Rivers and Vuong, 1988)

1. Regress key variable (APR) on
   - Exogenous variables (customer, loan, and market characteristics),
   - Additional instruments (relevant to APR, exogenous) to obtain the residuals.
2. Regress outcome variable (take/not take) on:
   - Exogenous variables
   - Endogenous variable (APR),
   - Residuals

Significance of the residuals in Step 2 is a test for endogeneity.

Indirect Lender Data Elements

Element Name	Comment
Term	Term of the loan (months)
Type	New or Used
Prime Rate	Rate at time of approval.
Amount	Size of loan ($)
Δ Rate	APR – Prime Rate
Tier	Risk-based classification of borrowers. 4 tiers for on-line, 6 tiers for off-line
Normalized FICO	Credit (FICO) Score normalized by average for tier.
Customer Cash	Cash incentive provided by supplier via indirect channel
Subvention	Was the rate offered a promotion? (Y/N)

Model Estimate Result – Online Channel

Variable Class	Variable	Estimate	
		Uncorrected	Corrected
Term	48	0.24***	0.27***
	60	0.66***	0.60***
	≥ 66	1.43***	1.50***
Credit Tier	2	-0.50***	-0.51***
	3	-0.82***	-0.84***
	4	-0.64***	-0.66***
Partner	Partner A	-0.40***	-0.41***
	All Other	-0.24***	-0.24***
Vehicle Type	Used	1.30***	1.42***
Prime Rate		-1.39***	-1.39***
Normalized FICO		-0.27***	- 0.30***
Log(Amount)		8.02***	8.02***
Δ Rate	Tier 1	-76.02***	-79.86***
	Tier 2	-54.34***	-58.02***
	Tier 3	-41.55***	-45.23***
	Tier 4	-38.08***	-41.76***
Rate Residual		N/A	- 0.52

Not Significant at 90%

Online Results

For the on-line data:

- All variables in both the uncorrected and corrected models enter with high confidence ($p < .001$).
- The rate residual does not enter with high confidence ($p > .1$).
- Adjusting the coefficients for endogeneity does not change their values significantly.

Endogeneity does not appear to significantly effect the estimation of price-sensitivity for the on-line data.

Data Sources

Online Lender: ~ 150,000 observations over 30 months (2002-2004).

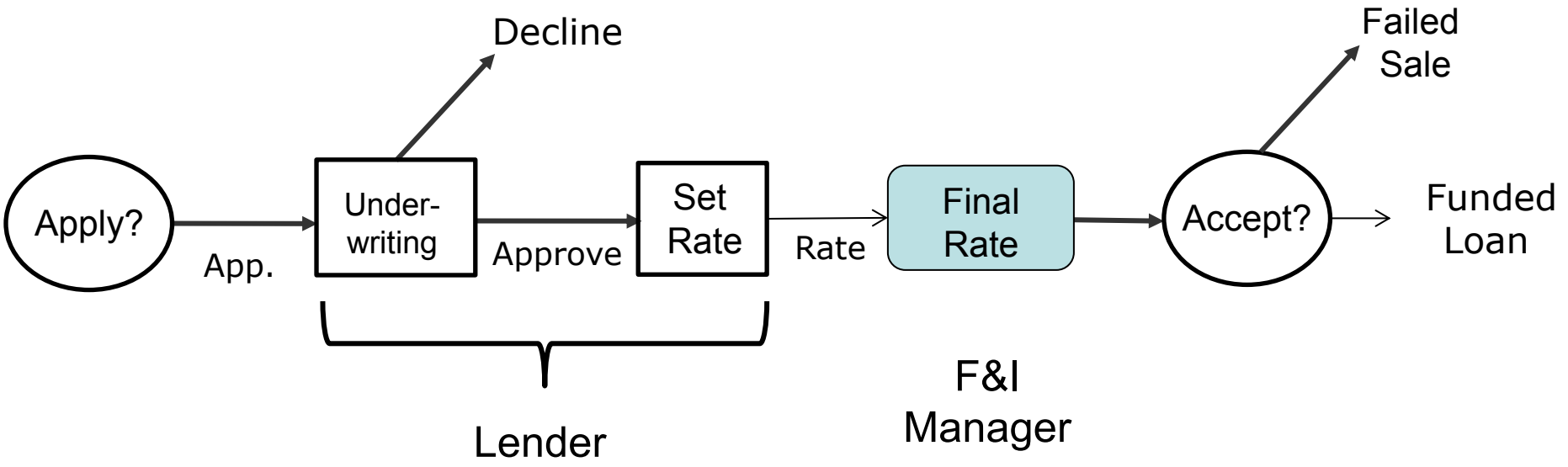
Indirect Lender: ~2,300,000 observations over 38 months (2009 – 2011).

Data was from all approved loan offers for each lender over the period.

Both data sets included:

- Customer characteristics (risk, region)
- Loan characteristics (term, amount, size-of-loan)
- Outcome (Customer Take/Not Take)
- Market information (Prime Rate)

Indirect Auto Lending Process



In the indirect channel, the final rate is determined by the F&I Manager after discussion with the customer. This introduces the possibility of unrecorded variables being used in setting the rate.