Theory and Empirical Evidence for Price-Driven Adverse Selection in Consumer Lending*

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Credit Scoring and Credit Control Conference XI
Edinburgh, Scotland
August, 2009

** Research sponsored in part by the US Federal Deposit Insurance Corporation Research Center.*

Agenda

- *Introduction: What is price-driven adverse selection and who cares?*
- Modeling price-driven adverse selection
- Estimation of price-driven adverse selection
- Empirical evidence
  - Example: US sub-prime auto lending
  - Example: Canadian personal lines of credit
- Research direction and summary

What is price-driven adverse selection?

- The loss behavior observed from loans funded in a population depends on the price of the product being offered:
  - Pricing a loan product higher will lead to higher losses.
  - Pricing a loan product lower will lead to lower losses.

- Manifestations:
  - The highest-priced lender in a market segment will experience higher losses than lower-priced competitors and vice-versa, assuming similar underwriting policies.
  - If underwriting policy is held constant and competitors do not respond, unilaterally raising the price of a credit product will lead to higher losses from new customers while lowering the price will lead to reduced losses.

- We call this phenomenon *price-driven adverse selection*. We are developing models of price-driven adverse selection in consumer lending markets and validating these models statistically using data from consumer lenders in the US, UK and Canada.

Price-driven adverse selection in consumer lending

- Widely recognized as a real and important phenomenon by many lenders (especially in sub-prime and near-prime markets).
- No systematic models or measures used across lenders.
- Limited research:
  - Edelberg (2004). Using data from the US Survey of Consumer Finance, found “strong evidence” for the existence of adverse selection in mortgages and automobile loans.
  - Ausubel (1999), Agarwal, et. al. (n.d.). US Customers choosing an inferior credit card product (including one with a higher APR) showed higher rates of default
  - Karlan and Zinman (2005). Randomized experiment in South Africa showed evidence of adverse selection.

Why does higher pricing lead to higher risk?

(At least) three reasons have been proposed:

1. **Capacity effects**: *As APR's rise, so does the difficulty of individuals to make higher payments – (*this is not considered adverse selection).

2. **Financial management skills**: *People who accept higher APR's tend to be those who are less sophisticated financially and thus more likely to default.*

3. **Private information**: *Those who accept higher APR's are those who have adverse private information – e.g. high likelihood of job loss, large private debts or other liabilities, etc.*

The focus of our research is primarily on developing and validating models of adverse selection, not determining its underlying cause(s).

Why does price-driven adverse selection matter?

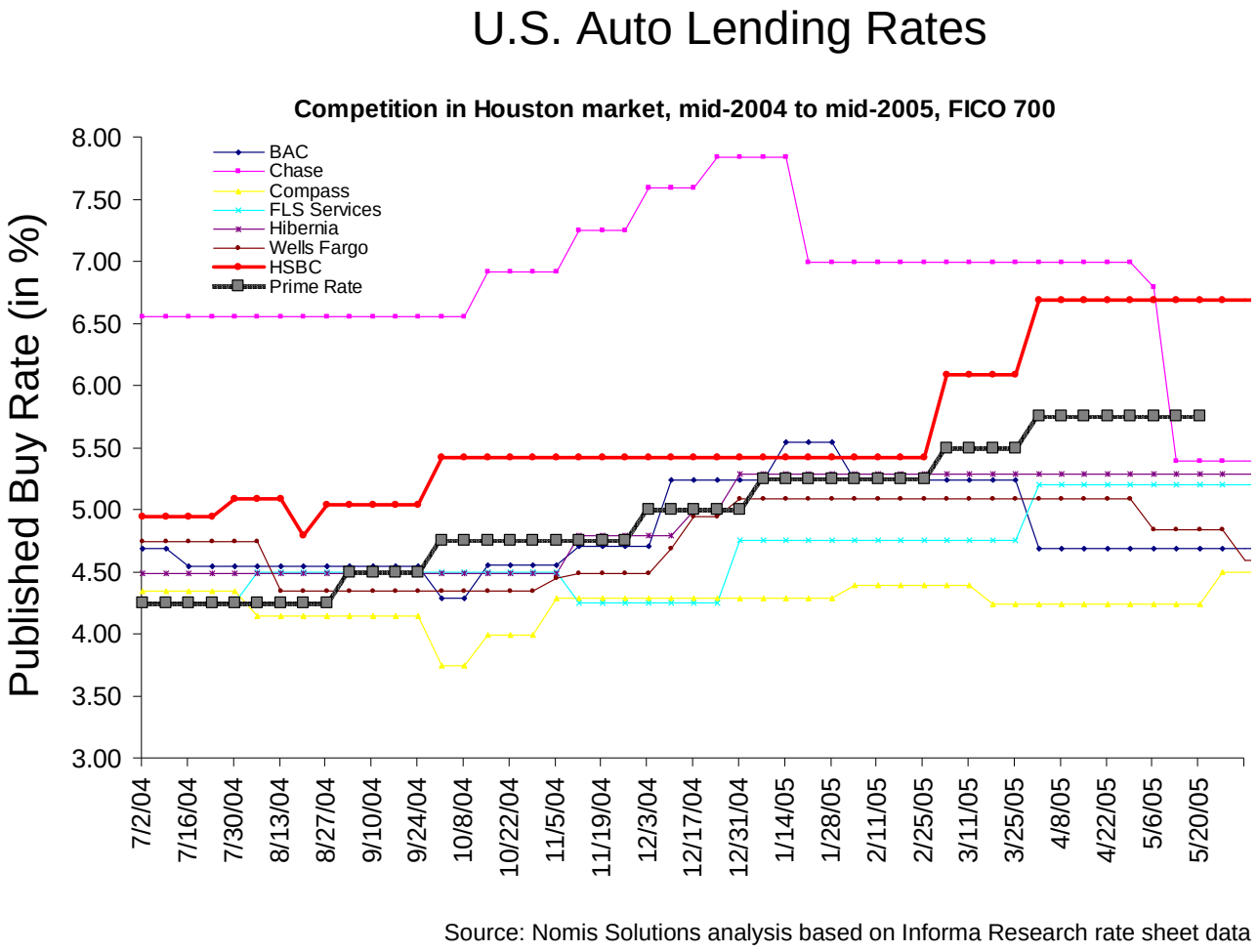
- At any one time, consumer lending markets typically support a wide variation in pricing. For any given lender, adverse selection can be substantial.

- Adverse selection influences the expected incremental profitability of a loan and thus should be incorporated in both underwriting and pricing decisions.

- Price-driven adverse selection (and retention) will also influence the losses experienced from an existing portfolio of loans.

- Ideally, risk scores should be “price-adjusted” to reflect the influence of price on default behavior.

Diversity of prices in consumer lending
Auto lending (US)



Source: Nomis Solutions analysis based on Informa Research rate sheet data

Diversity of prices in consumer lending
Unsecured Personal Loans (UK)

COMMENT

Britain's Best Personal Loans!

By **Cliff D'Arcy**
June 8, 2006

Today, I decided to do some research in order to find the best and worst unsecured loans in the UK. Hence, I turned to *Moneyfacts,* the holy book of financial writers, because the data it provides is accurate, comprehensive and timely, as well as being completely independent and unbiased. It covers 79 different loans and here's what I discovered (based on a loan of £5,000 over three years, without rip-off payment protection insurance):

Lender	*Typical APR (%)*	*TAR (£)*
Direct Line	5.6	5,428.08
Moneyback Bank Apply via the Fool	5.6	5,435.28
Masterloan	5.7	5,439.60
Lombard Direct	5.8	5,443.56
Northern Rock*	5.7	5,443.56
Cahoot Apply via the Fool	5.8	5,447.52
Alliance & Leicester	5.9	5,458.32
Masterloan (telephone) **	5.9	5,459.04

Best Buys: the eight cheapest loans
(ranked by total amount repayable, TAR)

Lender	*Typical APR(%)*	*TAR (£)*
Secure Trust Bank**	19.5	6,509.52
Barclays	14.9	6,160.68
Barclaycard	14.9	6,160.68
Bank of Scotland	9.2	6,149.16
Halifax	9.2	6,149.16

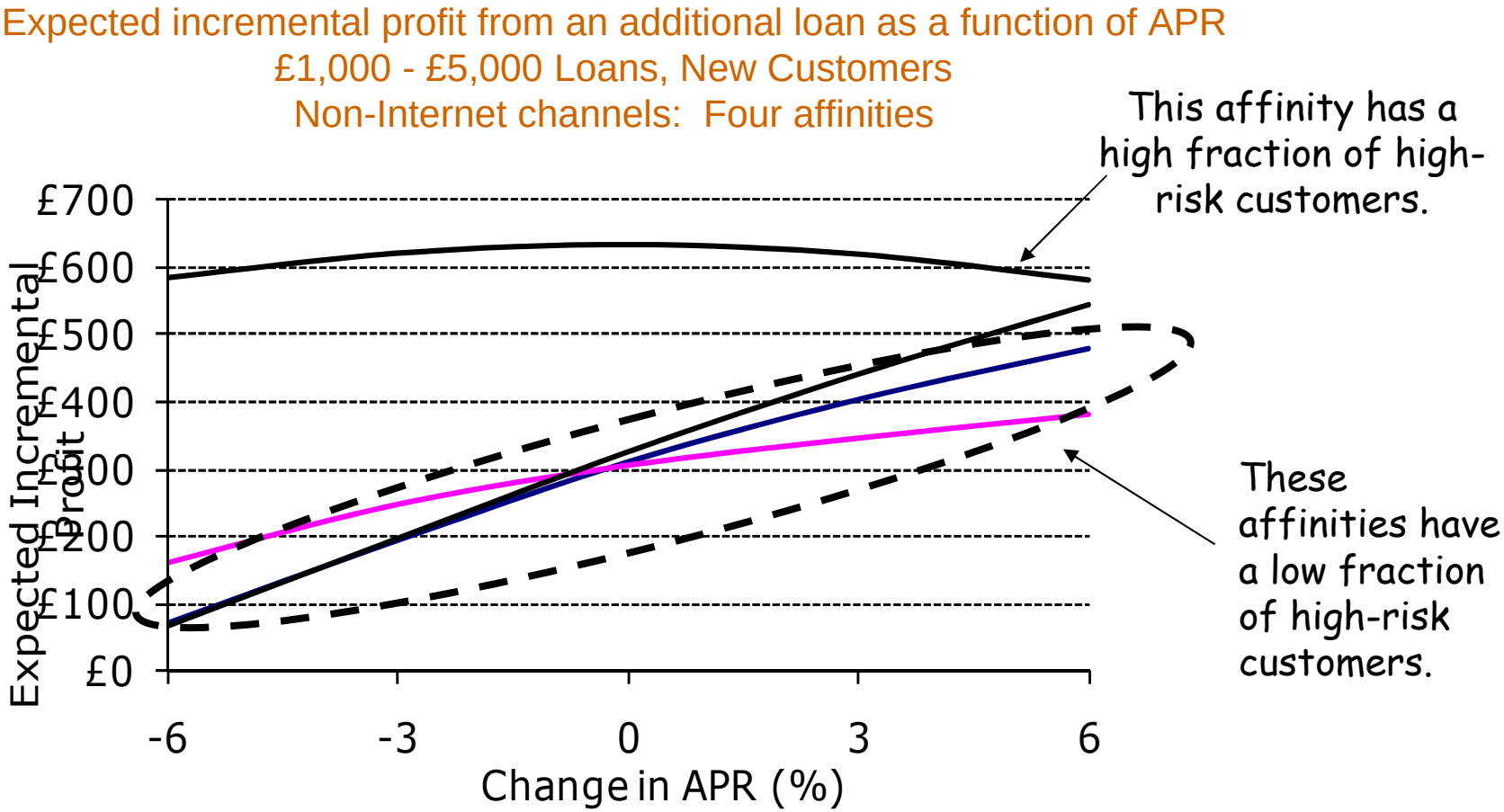
** no redemption penalty on early settlement*
*** same rate given to all customers*

Don't Buys: the five most expensive loans

Source: *www.motleyfool.com*

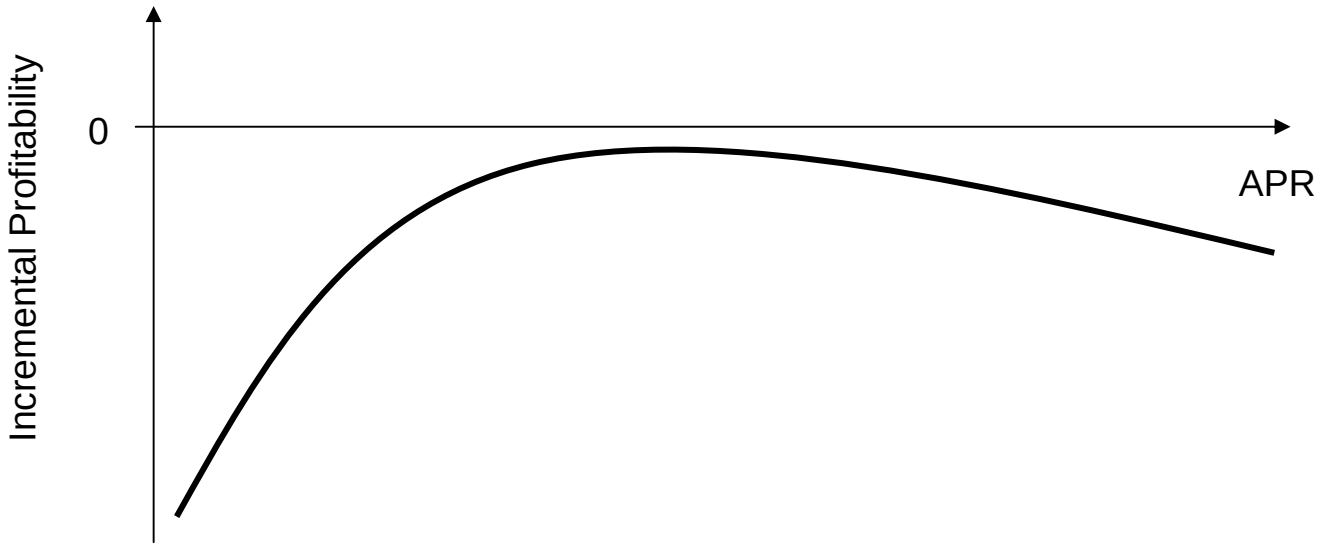
Adverse selection and incremental profit

If adverse selection is severe, the *expected incremental profitability* of a loan can actually decrease with increasing APR. This can be a particularly strong effect with sub-prime customers.



The extreme case

- In highly sub-prime populations, the magnitude of adverse selection can be so great that the incremental profitability of loans is less than zero at all APR's.
- In other segments, the only APR's that generate incrementally profitable loans are above the legal usury limit.
- The optimal policy for a lender in this case is to exclude these loan/customer combinations through its underwriting policies – e.g. to ration credit (Stiglitz and Weiss [1981]).



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A simple model

- Two types of customers:
  - "Bads" who default with certainty (PD = 1)
  - "Goods" who don't ever default (PD = 0)

- Both populations have exponential price responses:

  $d_g(p) = d_g(0) \exp(-\lambda_g p)$

  $d_b(p) = d_b(0) \exp(-\lambda_b p)$

- $\lambda_g > \lambda_b$ → "Goods" are more elastic than "bads" at any price p.

- The loss rate at price p is $LR(p) = d_b(p)/(d_g(p) + d_b(p))$.

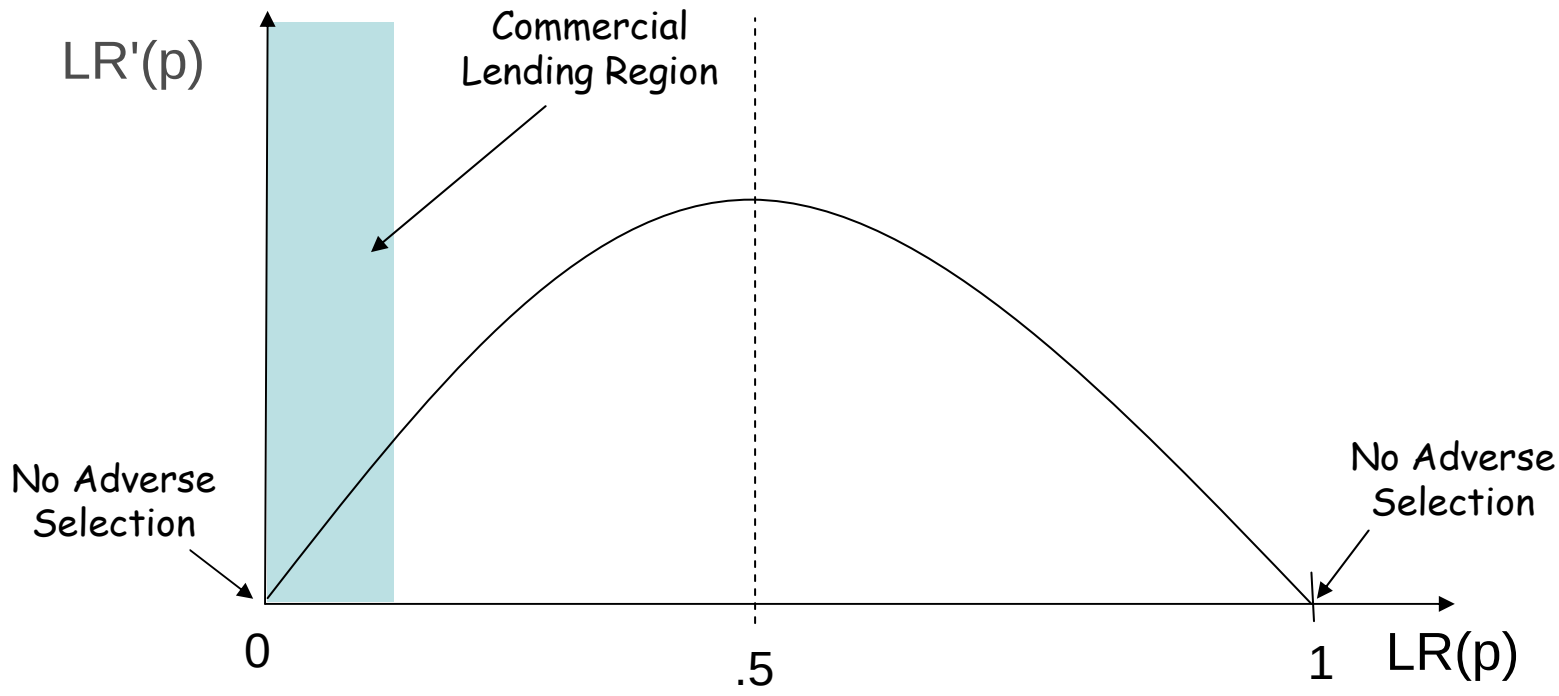
Measures of adverse selection

- We will consider two measures of adverse selection:
  - The *Adverse Selection Rate* is defined as LR'(p). The existence of adverse selection implies LR'(p) > 0. High values of LR'(p) mean that loss-rate is very sensitive to price.
  - *Adverse Selection Elasticity* is defined as $\varepsilon(p) = LR'(p)p/LR(p)$. Adverse selection elasticity is the percentage change in loss rate associated with a 1% change in price. High elasticity means that the loss-rate is sensitive to price.

Adverse selection and loss rate

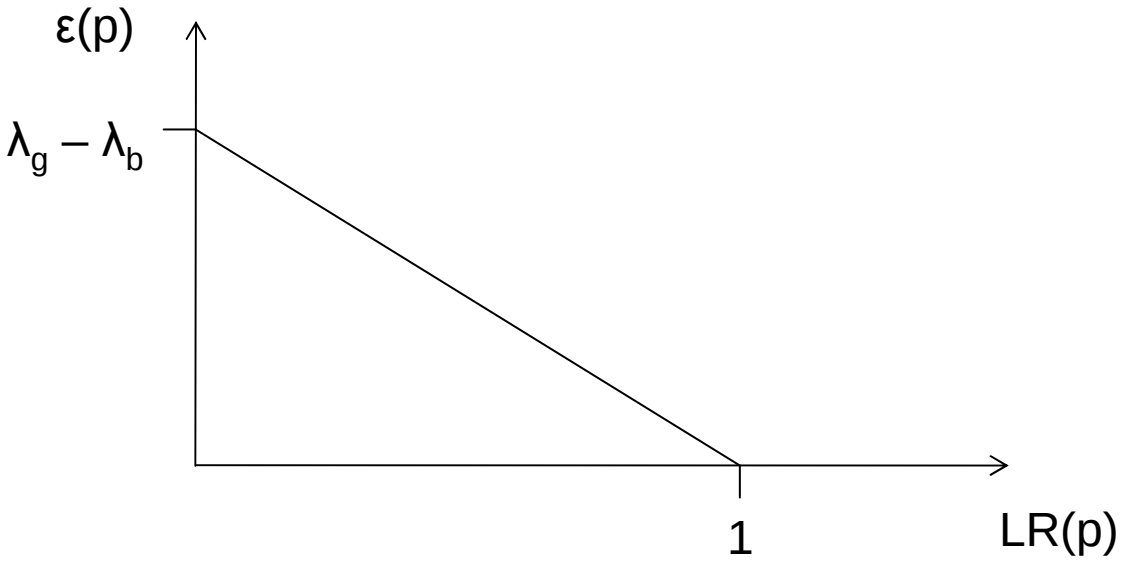
- For the simple model:

$$LR'(p) = (\lambda_g - \lambda_b)\, LR(p)(1 - LR(p))/p$$



Adverse selection elasticity and loss rate

- For the simple model, $\varepsilon(p) = (\lambda_g - \lambda_b)\,(1 - LR(p))$.
- This implies that adverse selection elasticity is a decreasing function of the loss rate.
- It also implies that $\lambda_g - \lambda_b = \lim_{LR(p)\to 0} \varepsilon(p)$



Simple model implications

- The simple model of price-driven adverse selection has testable implications:

  1. The adverse selection rate should be an increasing function of risk in the commercial lending region. We have confirmed that this is true in all four data sets that we have examined.

  2. If “goods” and “bads” follow exponential price-response functions, then adverse selection elasticity will be a linear decreasing function of loss-rate and $\varepsilon(0) = (\lambda_g - \lambda_b)$.

- More generally, the form and parameters of the price-response functions for “goods” and “bads” can be estimated from the change in loss-rate as a function of price.

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Two manifestations of adverse selection

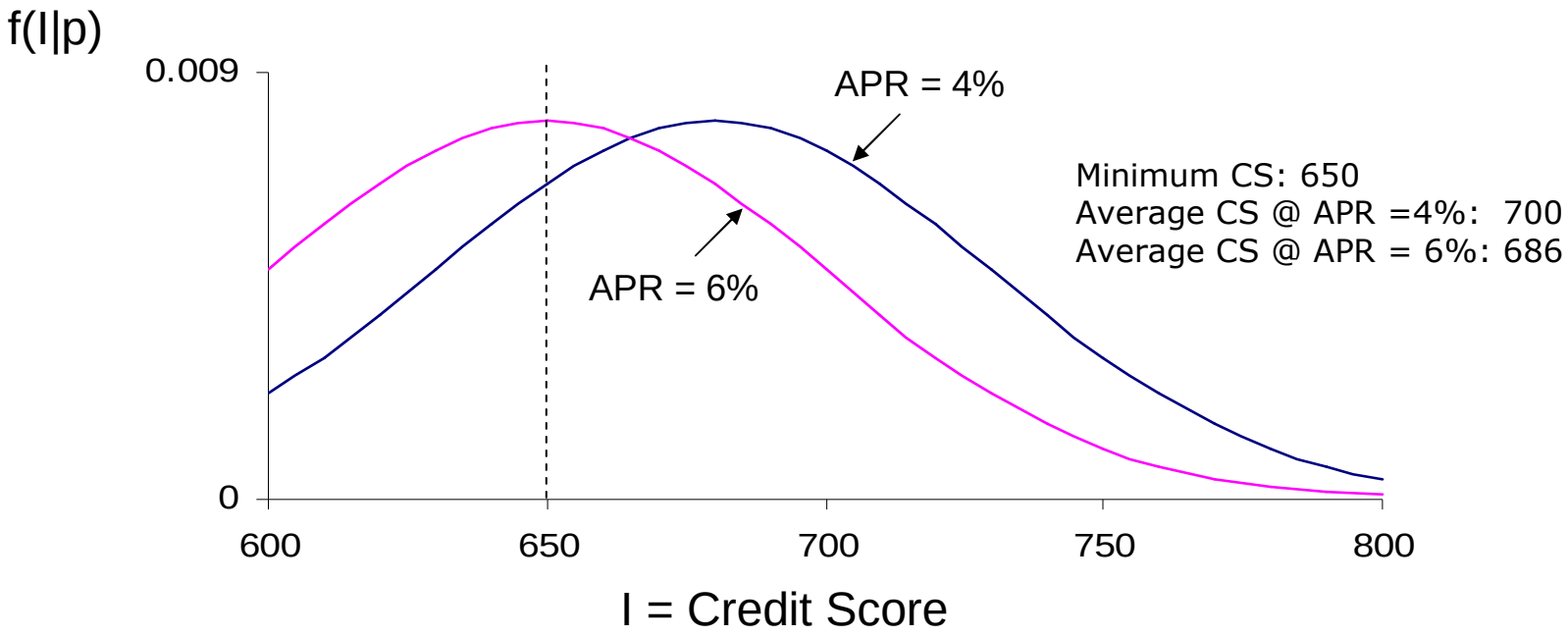
Direct Adverse Selection: Change in the distribution of risk score among funded loans as price is changed.

Indirect Adverse Selection: Change in the loss behavior of borrowers with the same credit score as price is changed.

Combined (or Total) Adverse Selection: The total effect of price on risk including both direct and indirect adverse selection effects.

Direct adverse selection

- Direct adverse selection manifests itself as a price-driven shift in the distribution of credit scores of customers who accept a loan.



Levels of adverse selection

- No accounting for adverse selection:

$$LR = \int LR(I)\ f(I)\ dI$$ (No effect of price on Loss Rate.)

- Direct adverse selection only:

$$LR(p) = \int LR(I)\, f(I|p)\, dI$$ (Price effects LR only through score distribution shifts.)

- Both direct and indirect adverse selection:

$$LR(p) = \int LR(I,p)\, f(I|p)\, dI$$ (Price effects LR both through score distribution shift and changed relation between scores and LR.)

Estimating adverse selection

- Direct Adverse Selection:
  - For all approved applications estimate the difference in credit scores between funded loans and customer-declined loans as a function of rate.
  - Requires a database of the fate of all approved applications with rates and credit scores including both funded loans and customer-declined loans.

- Indirect Adverse Selection:
  - For all funded loans estimate the difference in default rate (or other loss measure) as a function of rate.
  - Requires a database with rates and loan performance for some minimum period of time (at least 24 months)

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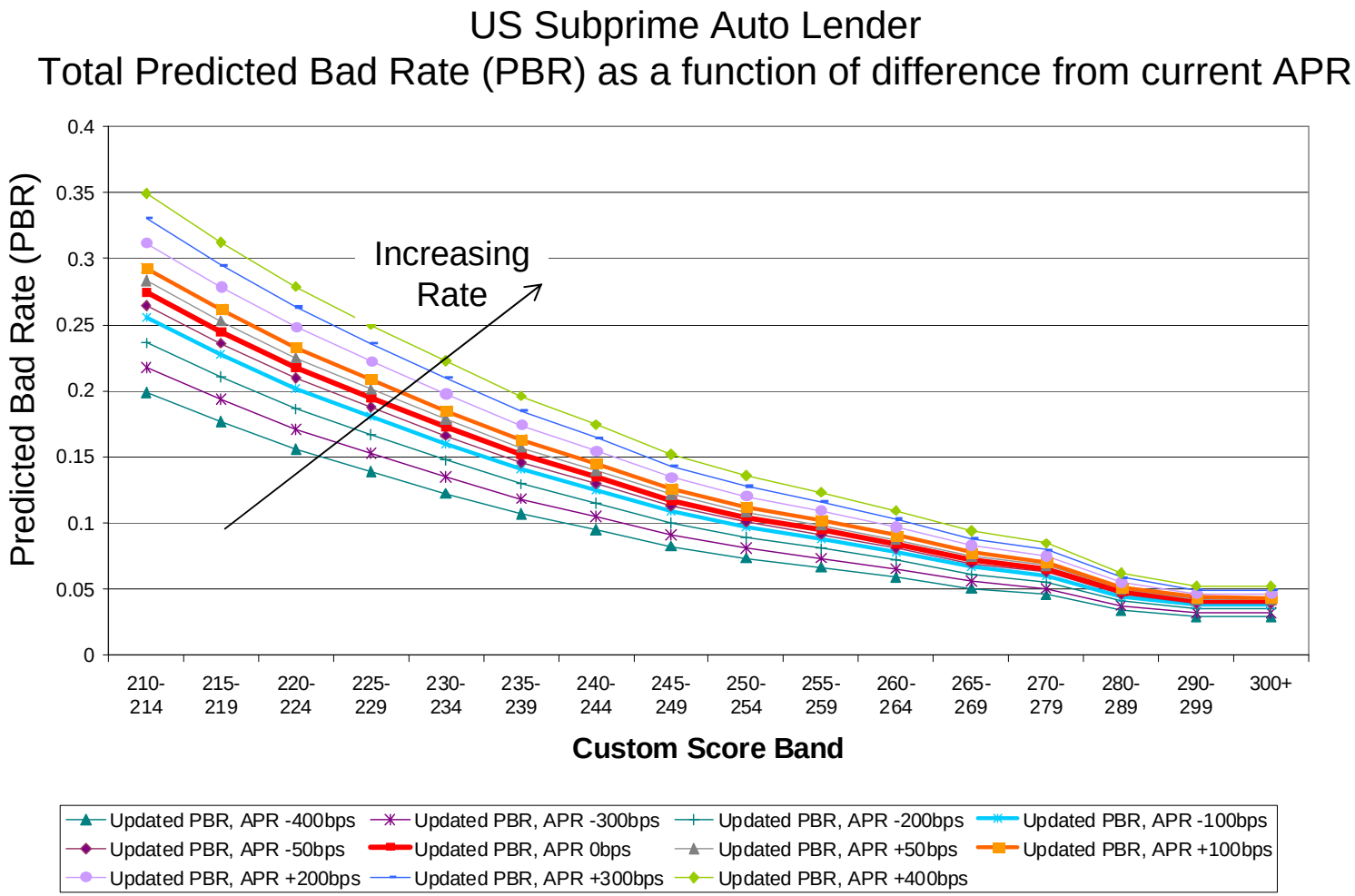
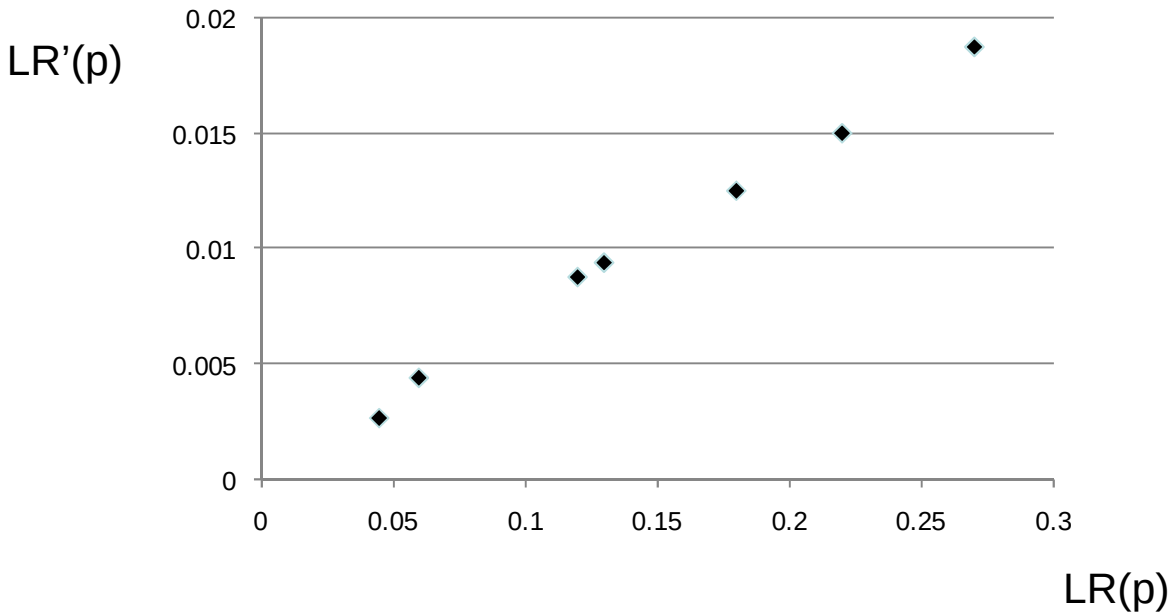
Total Adverse Selection
US Subprime auto lending



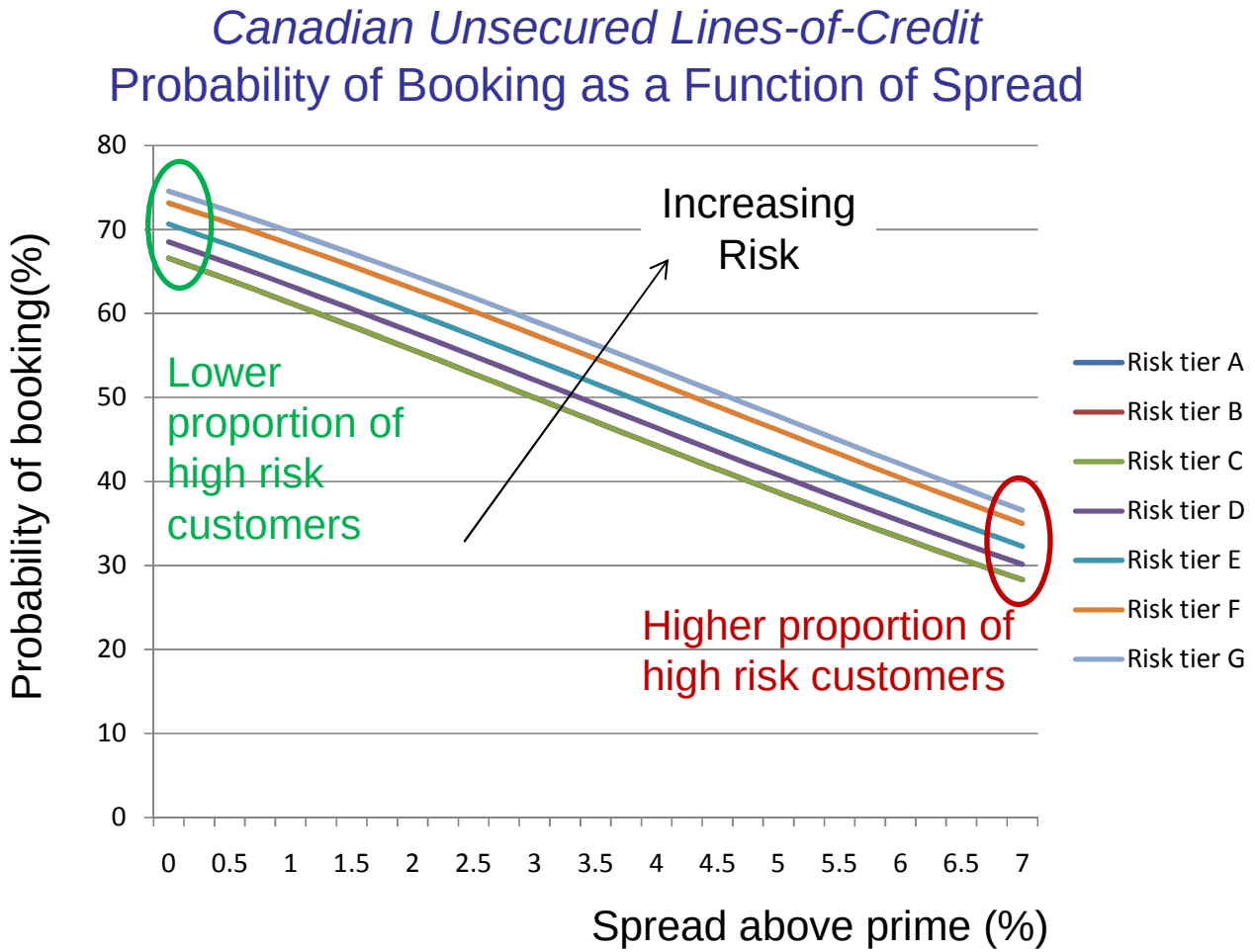
Adverse selection rate and loss rate
US Subprime auto lending

US Subprime Auto Lender
Estimated Adverse Selection Rate LR'(p) as a function of Loss Rate LR(p)



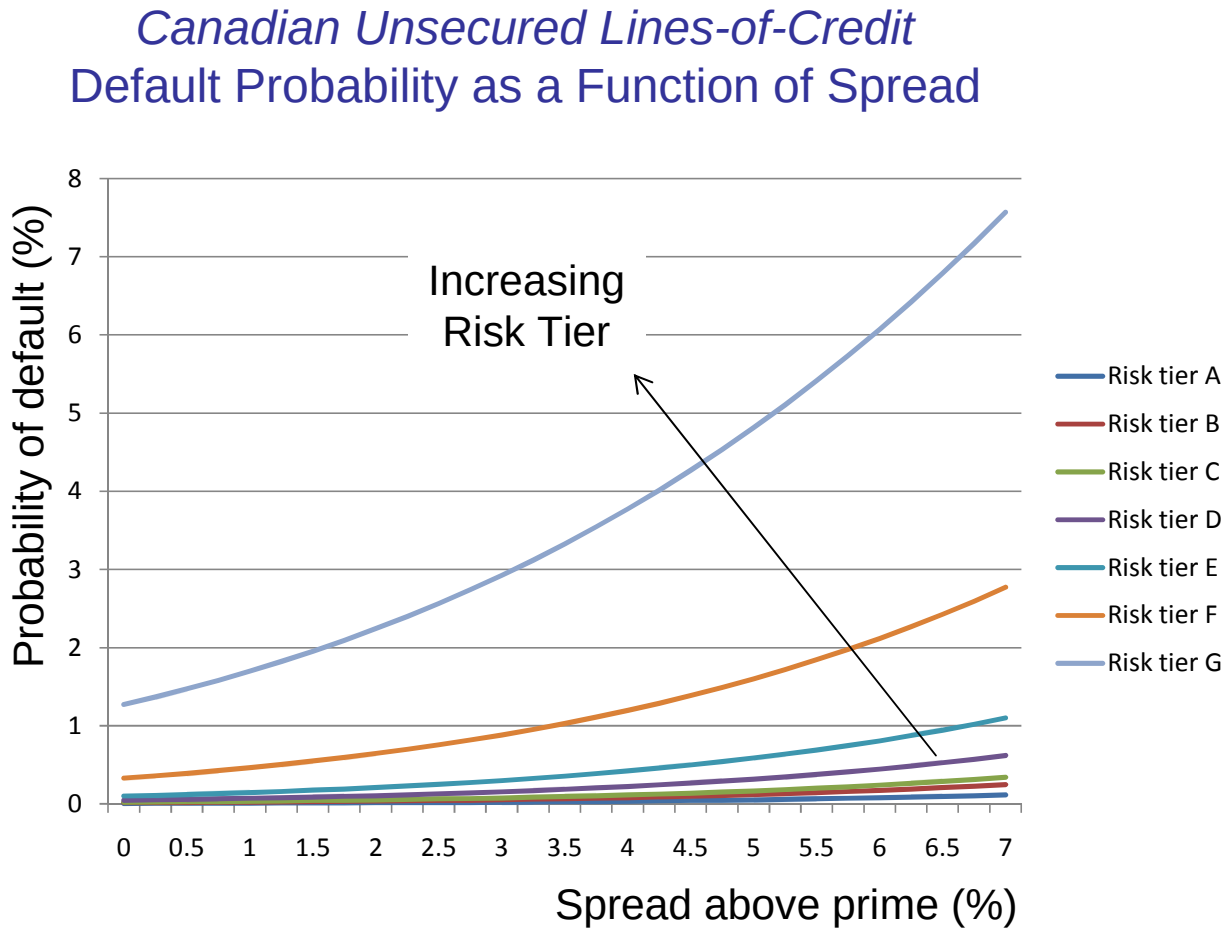
As predicted, the adverse selection rate rises as a function of the loss rate.

Direct adverse selection
Canadian unsecured lines-of-credit



At each price, low-risk customers are more price-elastic than high-risk customers. This is evidence for direct adverse selection.

Indirect adverse selection
Canadian unsecured lines-of-credit



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Next steps

- We have assembled 10 data sets from commercial lenders in the US, Canada, and UK
  - 5 for estimation of indirect adverse selection
  - 5 for estimation of direct adverse selection

- These datasets have been validated and cleansed and we are beginning the process of statistical analysis of adverse selection.

- The goal is to develop consistent models of both direct and indirect adverse selection that can
  - Explain the behavior seen in the data
  - Be used to improve loss estimation and pricing and underwriting decisions for consumer lenders.

Summary

- Price-driven adverse selection is a pervasive phenomenon in consumer lending.

- Despite its pervasiveness, there is no broadly accepted method for modeling price-driven adverse selection. Furthermore, there has been no broad-based study of its magnitude in different markets.

- Price-driven adverse selection as a manifestation of the differential price sensitivity of “good” and “bad” lenders. We have developed structural models that make testable predictions of these models such as an increase in adverse selection rate with loss rate.

- Our models will be tested using ten large data bases incorporating lending, rate, and loan performance data from consumer lenders in the US, UK and Canada.