Price negotiation in differentiated product markets
The case of insured mortgages in Canada[1]

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[1]The views in this paper do not reflect those of the Bank of Canada.

Motivation

- In many concentrated markets, prices are **negotiated** and consumers incur **search costs** to choose among a set of differentiated products
  - Housing; consumer loans; personal insurance; new/used cars
- These markets do not fit the standard discrete-choice model used to evaluate market power
  - Consumers do not necessarily consider all available products
  - Missing counter-factual prices
    - Transaction prices $\neq$ Bertrand-Nash
- **Objective:** Develop and estimate a model of search and price negotiation
  - Case study: Canadian mortgage market

Five facts about the market

1. Highly concentrated
   - 8 national lenders issue 80% new mortgage contracts.
2. Transparent and common lending rules
   - Government backed insurance with common rules
   - Fully insure lenders against default risk
3. Decentralized market
   - Branch managers choose discounts
   - Within week standard-deviation $\approx$ 0.5 bp
4. Heterogenous search effort
   - Between 45% and 55% of consumers gather only one quote
5. Consumer loyalty
   - 80% of consumers get a quote from their home bank
   - Over 60% remain loyal to their main FIs (75% in our data).

Research question

- **Question:** How important is the market power of national banks in mortgage markets?

- Focus on two channels

  1. Incumbency advantage
     - Consumers differ in their ability to gather multiple quotes
     - Banks with large consumer base can discriminate between high/low search cost consumers
     - Retain a larger fraction of "non-shoppers"

  2. Differentiation
     - Quality of banking services raises the value of mortgage transactions
     - Extra willingness to pay for "home" bank
     - Sources: (i) complementarity, (ii) switching costs

Outline

1. Market and data
2. Model description
3. Estimation method
4. Preliminary estimation results

Market structure

- **Canadian banking industry**
  - 6 National banks: TD, Royal, Nationale, BMO,CIBC, Scotia
  - 3 large regional credit-unions: Desjardins (QC), ATB (AB), Vancity (BC)
  - Trust companies: Mainly in mortgage markets
  - The rest account for less than 10% of the market

- Merger/aquisition wave: "Big 8" now controls over 80% of the mortgage market.
  - **1992 Bank Act revisions:** Permitted banks to acquire trusts.
  - Chartered banks acquired the majority of trust companies during the following decade.

Mortgage pricing and negotiation

- Two market segments
  - **Insured**
    - Loans are insured for the full amortization period (i.e. 25 years)
    - Government sets rules:
      max 95% LTV + max 40% debt ratio + min FICO
    - **Assumption:** Common lending criteria across banks
  - **Uninsured**
    - Standard lending market
    - Heterogeneous risk evaluation
  - We focus on the first segment: $\approx$ 85% of new home-buyers

- National posted-prices / branch negotiation
  - Banks post **one** interest rate (per term) every week
  - Local branch managers are responsible for negotiating rate
  - No competition across branches of the same network

Data sources

- **Mortgage insurers:** CMHC (70% market share) and Genworth Financial (30% market share, since 1995)
  - Raw sample: 10% random sample from CMHC + 90% of Genworth Financial

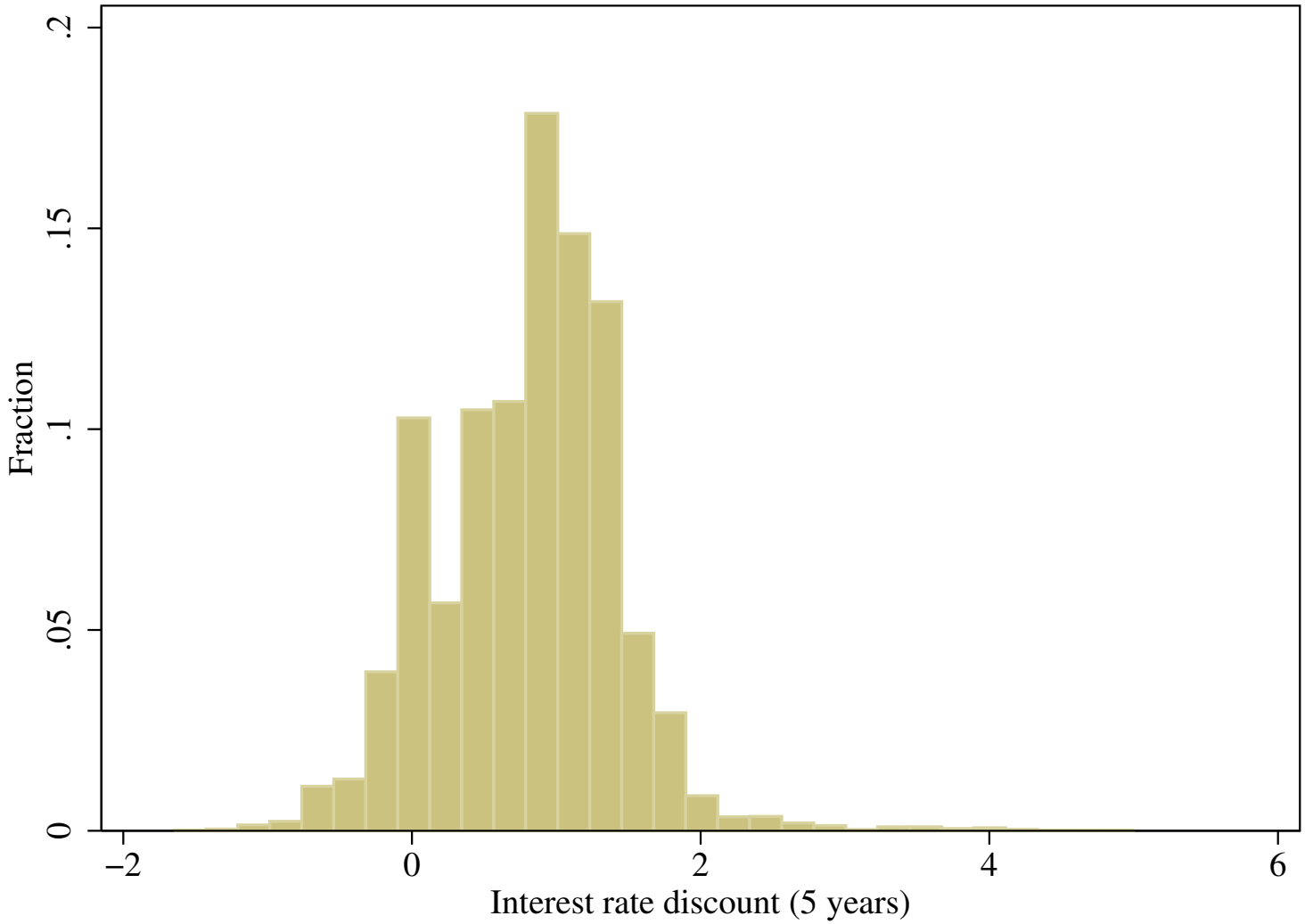
- **Key variables:** (i) contract terms, (ii) financial characteristics (income, fico, debt, etc), (iii) lender (confidential), (iv) house location, (v) prior relationship with lender.

- **Sample selection:**
  - Period: 1999-2004
  - Homogeneous contracts: 25 year amortization + 5 years fixed
  - New mortgages
  - Main FIs and individual contracts (i.e. drop brokers)

- **Branch location data:**
  - Proquest-Micromedia: Annual listing of branch addresses

Distribution of discounts from posted rates

5-year fixed-rates in 2000



Summary statistics

	N	Mean	SD	Min	Median	Max
Loan (X100K)	47,039	1.39	.548	.425	1.31	3.16
Income (X100K)	47,039	.681	.258	.161	.644	2
Other debt (X1000)	47,039	.862	.527	.00143	.761	5.04
LTV	47,039	.91	.0442	.75	.907	.95
FICO (mid-point)	47,039	.672	.0691	.5	.7	.75
Switchers	35,560	.187	.39			
Renters	47,039	.488	.5			
Living with parents	47,039	.0709	.257			

Sample: 5-year fixed-rate contracts issued by one of the Big-12 lenders between 1999 and 2004. Contracts negotiated through brokers are excluded. The sample also excludes top and bottom 1% of the loan size and discounts distribution.

Descriptive regressions

VARIABLES	(1) Margin	(2) Switching
Loan/Income	-0.18^a	0.043^a
	(0.012)	(0.0087)
Renter	-0.031^a	0.087^a
	(0.0075)	(0.0044)
Living w/ parents	-0.071^a	0.053^a
	(0.012)	(0.0064)
Switcher	-0.076^a	
	(0.0093)	
Relative network	0.040^a	-0.022^a
	(0.0053)	(0.0035)
Nb. FIs in $[1, 7)$		-0.018^a
		(0.0057)
Nb. FIs=7	-0.037^b	
	(0.014)	
Nb. FIs=8	-0.081^a	
	(0.021)	
Nb. FIs=9	-0.080^a	
	(0.030)	
Nb. FIs>9	-0.11^a	
	(0.057)	

Description of the model

- **Assumptions**
  1. Consumers are affiliated with a "home" bank - h_i
  2. Maximum choice-set $\mathcal{N}_i = 10$ KM radius around house
  3. Consumers receive a "free" initial offer:
     - From h_i if $h_i \in \mathcal{N}_i$
     - Randomly matched with $j \in \mathcal{N}_i$ otherwise
  4. Obtaining additional offers is costly:

$$\kappa_i = \bar{\kappa} + \varepsilon_i, \quad \varepsilon_i \sim \text{Exp}(\sigma_\kappa)$$

     and ε_i is privately observed.

- **Timing**
  1. Qualifying buyers identify a house price and commit to a downpayment: Loan size is fixed (L)
  2. Buyers get an initial quote p^0
  3. If p^0 is rejected, buyers run an ascending auction among all banks in $\mathcal{N}_i$

Preferences

- Consumers' indirect utility (net of search cost):

$$U_{ij} = \theta_{ij} - p_{ij},$$

where θ_{ij} is the willingness to pay for bank j, $p_{ij} = L_i r_{ij}$.

- Banks' profits:

$$\pi_{ij} = p_{ij} - c_{ij} + u_{ij},$$

where c_{ij} is the lending cost (reduced-form), and u_{ij} is a private-value profit shock.

- Total surplus from transaction (i, j):

$$V_{ij} = \theta_{ij} - c_{ij} + u_{ij}$$

Auction stage

- Ascending auction with differentiation:
  - Demand:
    - **One** if $\theta_{ij} - p_j > \theta_{ik} - p_k$ for all $k \neq j$.
    - **Zero** if $\theta_{ij} - p_j < \theta_{ik} - p_k$ for all $k \neq j$.
  - Nash equilibrium:
    - Firms bid at most $p_{ij} = c_{ij} - u_{ij}$ (i.e. $\pi_{ij} = 0$)
    - Efficient allocation: Highest total surplus option wins

$$V_{(1)} = \max_{k \in \mathcal{N}} V_{ik}$$

- Winning bank pays the equivalent utility of the **second highest** surplus bank:

$$\theta_{ij} - Lr_{ij}^* = \max_{k \neq j} V_{ik} = V_{(2)}$$

- Transaction price:

$$p_{ij}^* = r_{ij}^* L_i = \theta_{ij} - V_{(2)}$$

Initial quote

- Home bank = Monopolist with random demand
- Initial quote p^0 maximizes expected profit:

$$\max_{p^0} \quad (p^0 - c_{ih} + u_{ih})\left(1 - H(p^0|V_{ih})\right) + H(p^0|V_{ih})\Pr(V_{ih} > V_{(2)})\left[E\left(p^*_{ih}|V_{ih} > V_{(2)}\right) - c_{ih} + u_{ih}\right],$$

  where $H(p^0|V_{ih})$ is the search probability.
- **Special case:** Full information about $\{u_{ij}\}$

$$p^0_{ih} = \begin{cases} c_{ih} - u_{ih} + \sigma_\kappa & \text{If } V_{ih} \leq V_{(2)} \\ \theta_{ih} - V_{(2)} + \sigma_\kappa & \text{Otherwise.} \end{cases}$$

- **General case:** (i) $p^0(u_{ih})$ is decreasing in u_{ih}, (ii) $p^0(u_{ih})\lim_{u_{ih}\to\infty} \bar{p}^0_i$

Functional form and distribution assumptions

- Willingness to pay and cost functions
  - θ_{ij} is function of local network size (Q_{ij}), and prior experience (E_{ij}):
$$\theta_{ij} = \alpha Q_{ij} + \lambda 1(E_{ij} > 0)$$
  - c_{ij} is function of lender/borrower characteristics (Z_{ij}), 5-year bond rate (b_i), and unobserved borrower attribute (ϵ_i):
$$c_{ij} = \beta L_i b_i + \gamma' Z_{ij} + \epsilon_i, \quad \epsilon_i \sim N(0, \sigma_\epsilon^2)$$
- Distribution assumption for match values (Brannman and Froeb [2000]):
$$u_{ij} \sim \mathrm{EV}(0, \sigma_u)$$
- Additional unobservable: Home bank identity (for switchers)
  - Estimate distribution of main FIs separately using survey data
  - Conditioning: province, year, income group.

Likelihood function

- Endogenous outcomes: $\{p_i, b_i, M_i\}$, where M_i is a latent state
- Under the timing assumption
  - Conditional LLF for loyal consumers:

$$L(p_i, b_i|\mathcal{I}_i) = L(p_i, b_i, M_i = a|\mathcal{I}_i) + L(p_i, b_i, M_i = n|\mathcal{I}_i)$$

  - Conditional LLF for switchers:

$$L(p_i, b_i|\mathcal{I}_i) = L(p_i, b_i, M_i = a|\mathcal{I}_i)$$

  where $\mathcal{I}_i = (X_i, \epsilon, h, E_h)$.
- Unconditional likelihood integrates unobservables:

$$L(p_i, b_i|X_i, \theta) = \int \sum_{h \in \mathcal{N}_i, E \in \{0,1\}} L(p_i, b_i|X_i, \epsilon, h, E) \Pr(h, E|X_i) \psi(\epsilon; \sigma_\epsilon) d\epsilon$$

- **Extra component:** Match aggregate probability of getting more than one quote (from annual survey).

Conditional likelihood functions

- **Switcher** prices $p_i = \theta_{i,b_i} - V_{(2)}$ identify $f_{(2)}(\cdot)$:

$$\begin{aligned} L(p_i, b_i, M_i = a|\mathcal{I}_i) &= \Pr(p_i, b_i|M_i = a, \mathcal{I}_i) \Pr(M_i = a|\mathcal{I}_i) \\ &= f_{(2)}(\theta_{i,b_i} - p_i) \int_{V_h \leq \theta_{i,b_i} - p_i} H(V_h) dF_h(V_h) \end{aligned}$$

Note: Equilibrium search probability adjusts for selection.

- Both mechanisms are feasible for **loyal** consumers:
  - Negotiation price density obtained by inverting $p_h^0(V_{ih})$:

$$L(p_i, b_i, M_i = n|\mathcal{I}_i, \theta) = f_h\left(p_h^{0\,-1}(p_i); \sigma_u\right)\left(1 - H\left(p_h^{0\,-1}(p_i)\right)\right)\frac{1}{|p_h^{0\prime}|}$$

  - Loyal consumers opting for the auction:

$$L(p_i, b_i, M_i = a|\mathcal{I}_i, \theta) = f_{(2)}(\theta_{ih} - p_i) \int_{V_{ih} > \theta_{ih} - p_i} H(V_h) f_h(V_h) dV_h$$

Parameter estimates (preliminary)

Variables	**Parameters**	
	Full Info.	Incomplete Info.
Negotiation cost		
Intercept $\bar{\kappa}$	0.233	0.175
	(0.008)	
Mean private-value (σ_κ)	0.328	0.312
	(0.007)	
Differentiation		
Quality (α)	0.030	0.048
	(0.012)	
Home bank premium (λ)	0.429	0.249
	(0.007)	
Cost function (controls omitted)		
Idiosyncratic profit shock (σ_u)	0.101	0.204
	(0.001)	
Residual (σ_ϵ)	0.564	0.59
	(0.003)	

Asymptotic standard-errors in parenthesis. Control variables in the profit function: Loan size, income, FICO score, previous owner. The utility and profit functions are expressed in 100 dollars units. Sample size: $5,000$.

Interpretation of the parameters

- Search cost is important and heterogeneous:
  - Common component (i.e. lower bound): \$23.3
  - Distribution of total search cost:

Mean	Q_{25}	Q_{50}	Q_{75}
\$54.5	\$38.7	\$61.01	\$98.55

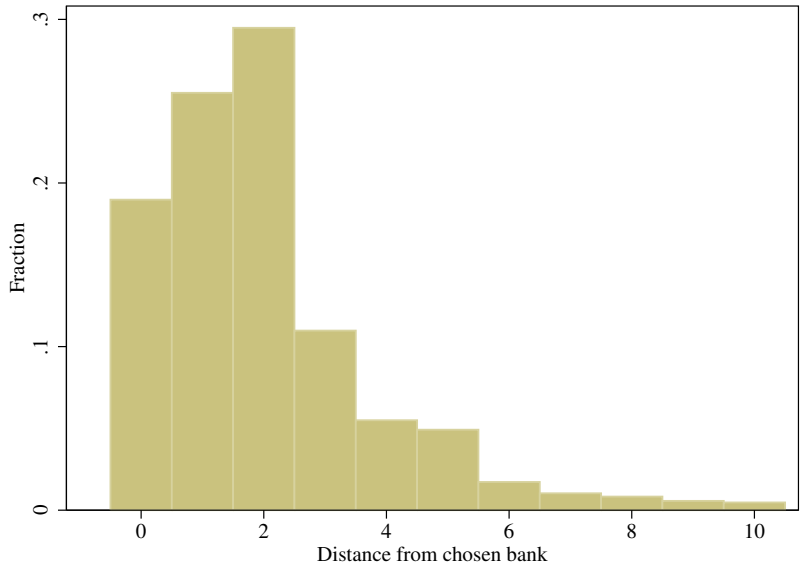
  - The average monthly payment is \$960.
- Home-bank premium translates into a switching cost of \$44 (full info) or \$24.9 (incomplete info)
- Marginal utility of network size (i.e. quality) is relatively small
- There is relatively little dispersion in the unobserved match values to banks
  - Most of the dispersion is coming from the common lending profit shock: $\mathrm{sd}(\epsilon_i) = \$56.5$
  - Differences in idiosyncratic profits across lenders is much smaller: $\mathrm{sd}(u_{ij}) = \$7.09$ or \$20.

Conclusion

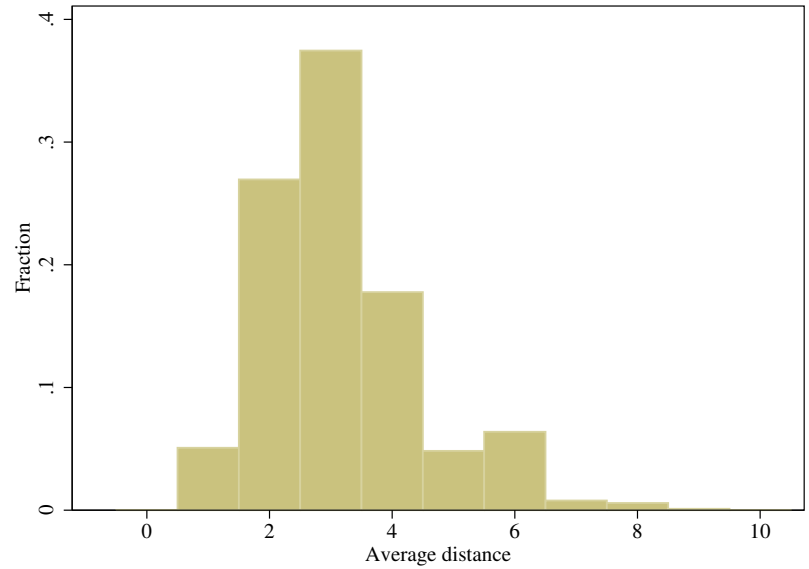
A lot of things to do...

- Model improvements: Heterogeneous choice-set and richer controls.
- Financial intermediaries: Brokers and mortgage-specialists.

Distribution of distances from home to closest branch



(a) Distance from chosen FI



(b) Distance from competing FIs

Description of local markets

	Mean	Min	P25	P50	P75	Max
Nb. contracts	455	11	29	169	410	4288
Nb. FIs (in 10 KM)	6.09	2	5.18	6.12	7.03	8.12
HHI-Branch (in 10 KM)	2240	1527	1874	2089	2325	5370
C1-Contract	41.4	21.6	29.2	36.8	48.5	90
HHI-Contract	1304	338	517	762	1424	7300
Relative network size	1.58	.831	1.11	1.28	1.52	10.6

Markets are defined as census-divisions (130 obs.). Sample excludes market with less than 10 contracts between 1999 and 2004, and only includes contracts with Big-12 lenders.