Price negotiation in differentiated product markets: The case of insured mortgages in Canada.

Jason Allen
Bank of Canada

Robert Clark
HEC Montréal

Jean-François Houde
UW-Madison

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Correspondence to Jason Allen: Bank of Canada, Ottawa, Ontario, K1A 0G9; Phone: (613) 782-8712; Email: jallen@bankofcanada.ca, Robert Clark: HEC Montréal, CIRANO and CIRPÉE, Montreal, Quebec; Phone: (514) 340-7034; Email: robert.clark@hec.ca, Jean-François Houde: University of Wisconsin-Madison, Madison, Wisconsin and CIRANO; Phone: (608) 262-3805; Email: houdejf@ssc.wisc.edu. This research has benefited from the financial support of the NSF (SES-1024840).

1 Introduction

The goal of this paper is to document and evaluate market power in the Canadian mortgage market. We propose and estimate a model of mortgage-choice and measure the importance of search costs, switching costs and branch network size in generating market power.

A key feature of mortgages markets is that banks are able to price discriminate by setting different rates for different consumers. Like many markets (cars, insurance, etc),

mortgage payment, or approximately $56 per month. There is substantial dispersion in search costs, however, with roughly half the borrowers in the sample with search costs estimated below $38 per month. The home bank premium is slightly less than the search cost parameter, approximately $40 per month. That is, on average consumers are willing to pay $40 a month to stay with their home bank; in other words they are willing to forgo $40 a month to avoid switching banks. The final key parameter is the marginal utility of network size. In this case, the borrowers valuation is relatively small, approximately $3 per month. The results suggest the premium we observe for banks with large networks and the discounts received by switchers comes primarily from search and switching costs.

The paper is organized as follows. Section 2 presents a description of the household-level data, a discussion of the mortgage industry, and descriptive regressions analyzing interest rates. Section 3 presents the model. Section 4 discusses the estimation strategy and the empirical results. Section 5 concludes.

2 Data

This section describes the data as well as some key institutional features of the industry. Section 2.1 gives details on mortgage contracts, as well as the features of the Canadian mortgage market that are relevant for understanding the main results. Section 2.2 describes the structure of the industry. Section 2.3 presents descriptive regressions analyzing the extent of interest rate dispersion and shopping behavior. A detailed description of the data can be found in Allen, Clark, and Houde (2011).

2.1 Mortgage contracts and sample selection

Our main data-set is a sample of insured contracts from Canada Mortgage and Housing Corporation (CMHC) and Genworth Financial between 1999 and 2004. Over this period

mortgage insurance was required for households borrowing more than 75% of the cost of the home from a regulated financial institution.[1] Furthermore, mortgage insurance is for the life of the contract. The result is that about 73 per cent of all residential mortgages are insured. We obtained a 10% random sample of contracts of the 12 largest lenders from CMHC and the full set of contracts of the 12 largest lenders from Genworth Financial. We further sample from the Genworth contracts to match their annual market share, which by 2004 was approximately 30%.

In total we have access to 20 household / mortgage characteristics, including all of the financial characteristics of the contract (i.e. rate, loan size, house price, debt-ratio, risk-type), and some demographic characteristics (e.g. income, prior relationship with the bank, residential status, dwelling type). Table 10 in the Appendix lists all of the variables included in data-set. In addition, we observe the location of the purchased house up to the forward sortation area. While the average forward sortation area (FSA) has a radius of 7.6 kilometers, the median is much lower at 2.6 kilometers.[2]

With respect to the lender information, we signed confidentiality agreements with the 12 largest lenders in order to link each contract with a financial-institution. For the remaining contracts, we only know wether the lender is a bank, a credit-union, or a trust / insurance company. We come back to the description of the market structure in the next section.

We restrict our sample to contracts with homogenous terms. In particular, from the original sample we select contracts that have the following characteristics: (i) 25 years amortization period, (ii) 5 year fixed-rate term, (iii) newly issued mortgages (i.e. excluding refinancing and renewal), (iii) contracts that were negotiated individually (i.e. without a broker). A 5 year fixed-rate mortgage contract must be renegotiated every five

[1] Today mortgage insurance is required on all contracts where the amount borrowed is more than 80%.
[2] The FSA is the first half of a postal code. We observe nearly 1,300 FSA in the sample.

Table 1: Summary statistics on contractual characteristics in the full sample

	Distribution observations	
	Number	Fraction
New home purchase	139,488	0.866
25 Years amortization	143,193	0.889
Fixed-rate term	145,770	0.905
5 Years term	134,173	0.833
Big-12 Bank	133,045	0.826
Non-broker transaction	100,467	0.698
Missing values (broker, fico, residential status)	17,074	0.106
Total sample size	53,154	0.33

years, which in effect acts like an adjustable rate mortgage with a fixed time-frame to renegotiate. This contract type has traditionally been the most popular in Canada, although we do observe a slight shift in favor of short-term and variable-rate contracts over the last two years of our sample. In addition, we drop contracts that were initiated by smaller institutions that remained anonymous, as well as contracts with missing values for key attributes (e.g. credit score, broker and residential status). Table 1 illustrates the breakdown of the full sample according to those characteristics. The final sample includes slightly more than fifty thousand observations, or 33% of the initial sample. Most of this drop originates from omitting broker transactions, which represent more than 30% of newly issued mortgages.

Table 2 describes the main financial and demographic characteristics of the borrowers in our sample, where we trim the top and bottom 1% of observations in terms of income, loan-size, and interest-rate premium. The resulting sample corresponds to a fairly symmetric distribution of income and loan size. The average loan size is nearly $140,000 which is twice the average annual household income. The total debt service (or TDS) ratio is capped at 40%, but there are some consumers that are not constrained by this maximum. Figure 1b illustrates the distribution of TDS between 1999 and 2004. From

Table 2: Summary statistics on mortgage contracts

	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			

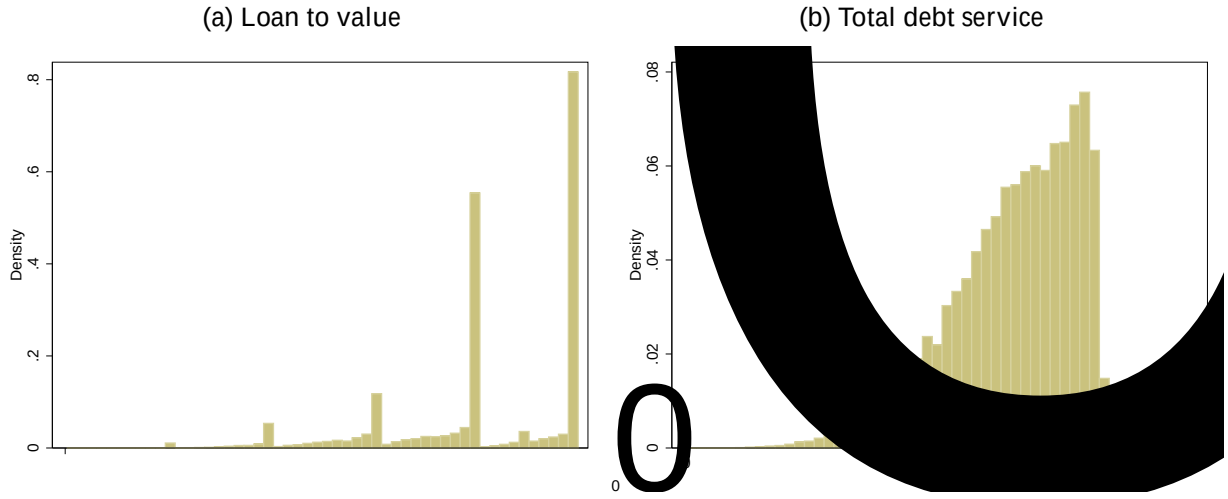
Sample5-year fixed-rate contracts issued by one of the Big-12 lenders between 1999 and 2004. Contracts negotiated through brokers are excluded. The sample also excludes top and bottom 1% of the loan size distribution.

this variable we construct a measure of the total other monthly debt payments subtracting the mortgage payments from the total debt services. On average households monthly debt payments other than the mortgage are $862

The loan-to-value (LTV) variable shows that many consumers are constrained by the minimum down-payment of 5% imposed by the government. Nearly 40%of households invest the minimum, and the average loan-to-value is 91% Figure 1a plots the distribution of the LTV ratio. LTV ratios are highly localized around 90 and 95, and to a lesser extent 75, 80, and 85. The clustering comes about because the insurance premium schedule is discrete, and there are only a small number of price-quantity pairs. Moreover, the vast majority of households in our data (i.e. 96%) roll-over the insurance premium into the initial mortgage loan. As a result, those households pay interests on the insurance premium, in addition to the premium itself.

The variable labeled “switchers” is a dummy variable equal to one if the duration of the prior relationship with the mortgage lender is zero. Slightly more than 80%of households choose a lender with which they already have a prior financial relationship. The fraction of switchers is significantly larger for new home-buyers (i.e. formerly renters or living with their parents). The mean borrower has been with his/her financial institution

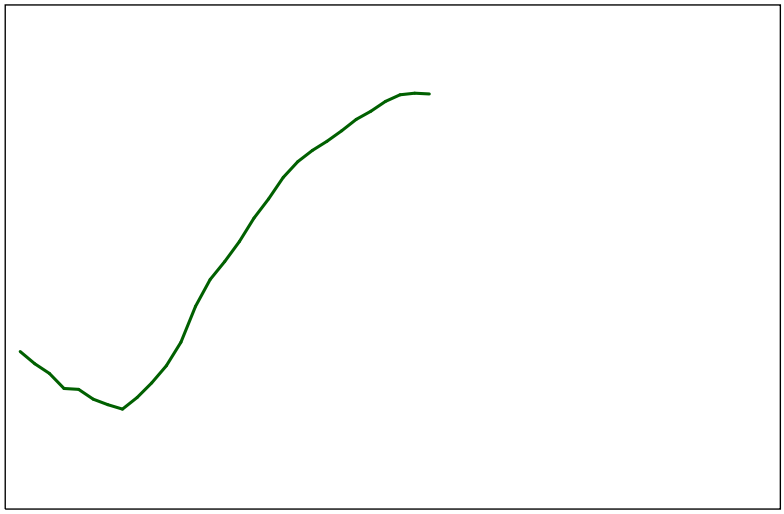
Figure 1: Loan to Value and Total Debt Service Ratios: 1999-2004



48 months before the contract is signed, about 6 months more than the mean for new home-owners and 20 months less than the mean for previous home-owners (unreported statistics).

2.2 Market Structure

Figure 2: Market shares of newly issued insured mortgages between 1992 and 2004

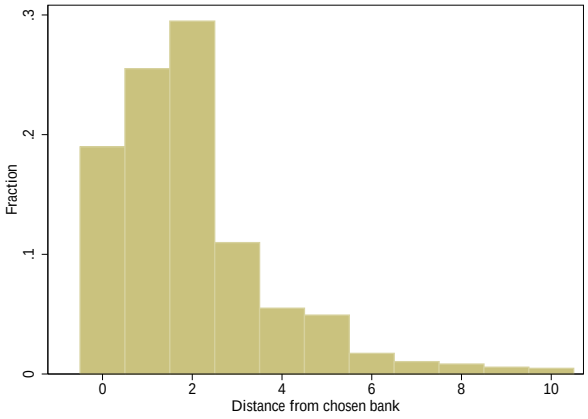


in the 1980s left the trust companies or their holding companies in financial distress. As a response to these troubles, and to the fact that trust companies had an unfair legislative advantage when it came to making loans (having to do with reserve requirements), legislative changes took place in 1992 to allow banks to enter the trust business. Figure 2 illustrates the changes in the distribution of new mortgages market shares following this reform. After the last merger in 2000, between Toronto-Dominion and Canada Trust, the market remained relatively stable. The 8 largest lenders jointly control 80% of the mortgage market. This statistics is higher when we excludes broker transactions, which predominantly deal with smaller financial institutions and trust companies (unreported). Allen, Clark, and Houde (2011) provide evidence on how the evolution of the Canadian banking sector led Canadians to treat their primary bank as a "one-stop shop" (universal bank) where they purchase the majority of their financial services.

We characterize the market structure facing each consumer by matching the house lo-

Figure 3: Distribution of minimum distances between banks and consumers

(a) Distance to chosen lender



(b) Distance to other lenders

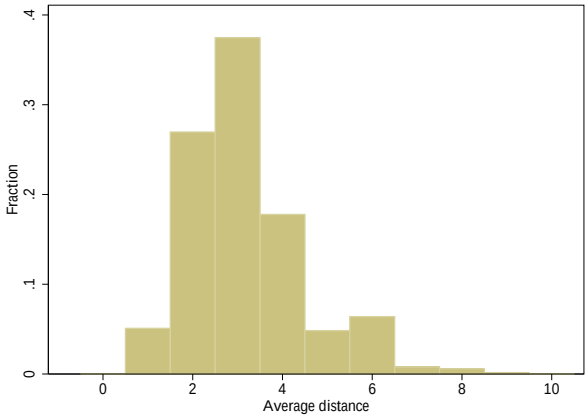


Table 3: Descriptive statistics on local market structure

	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.

region controls 41.4% of contracts. The HHI-contract variable suggests a somewhat lower level of concentration, although this variable is subject to measurement error due to the small sample in some region. This difference nonetheless suggests that, although the top lender in each region has a disproportionately large share, the remaining contracts are distributed more uniformly across other banks.

2.3 Descriptive evidence on discounting

Most Canadian banks operate nationally and post prices that are common across the country. Lenders typically post the mortgage rate for their different products on a weekly basis in both national and local newspapers, as well as online. Moreover, there is little dispersion in posted prices, especially among the Big six financial institutions. In fact, the coefficient of variation on posted rates for the Big six during the early part of our sample period is always around zero. Allen and McVanel (2009) provide a detailed analysis of movements in Canadian banks' posted rates. Allen, Clark, and Houde (2011) provide a detailed description of mortgage discounting in Canada. Here we focus on a substantially smaller set of contracts in than in Allen, Clark, and Houde (2011).

When shopping for a mortgage contract one option for consumers is to pay the posted price of their home bank or of some rival bank. However, in Canada this is not their only option. Local branch managers have the authority to offer borrowers discounts below the posted price under general guidelines from headquarters. Rather than settle for the posted price consumers can instead try to obtain mortgage contracts with lower rates. There are in general two ways for them to do this: (i) negotiating directly with branch managers by gathering, or threatening to gather, additional quotes, or (ii) hire a broker. In this paper we focus on the first option, and discard all contracts initiated by a broker.

Our data do not provide direct information on the number of quotes gathered by borrowers. However, survey evidence from CAAMP reveals that on average borrowers negotiate with between one and two financial institutions when searching for a rate, and between 46% and 61% of first-time home buyers gather multiple quotes. Table 4 reproduces these statistics from an annual survey conducted by CAAMP.

This survey also reaffirms the leading role played by the main institution of consumers; defined as the one with which borrowers conduct day-to-day banking activities. In 2004, 80% of new borrowers reveal that they contact their main financial institution

Table 4: Summary statistics on shopping habits

	1999	2000	2001	2002	2003	2004
Contact main FI						80%
Contact other FI						32%
Number of FI contacts						2-4
Number of quotes						1-2
Several rate offers	61%	56%	46%	57%	51%	
Arranged via Broker	18%	26%	38%	22%	30%	32%
Loyalty to main FI	57%	57%	48%	63%	63%	54%

Source: Canadian Association of Accredited Mortgage Professionals (CAAMP). Each entry estimates the average answer of new home-buyers.

when shopping for their mortgage. Moreover, depending on the year, nearly 60% of new home-buyers remained loyal to their main institution. This statistic is smaller than what is suggested by our sample, in which 19% of borrowers contracted with a financial institution with whom they have no prior experience. The two numbers are not directly comparable however, since the CAAMP survey focusses only on new-home buyers. In our sample, 44% of contracts originate from borrowers who already own a house, and first-time home buyers are more likely to switch institutions.

The fact that transaction interest rates are negotiated rather than posted induces a substantial amount of dispersion. Table 5 measures the dispersion in transaction interest rates (in logs). Between 1997 and 2004, which includes the sample that we study in this paper, the standard-deviation of log-rates was 0:0924 after removing the contribution of aggregate trends in the level of interest rates (see table footnote). The residual dispersion of log-rates, which conditions on observable financial attributes of the contract, is very similar (0:087), suggesting that most of the dispersion is idiosyncratic and driven by non-financial attributes.

The table also illustrates an increase in the amount of dispersion over time. This trend is mainly due to the fact that the fraction of consumers paying the posted-rate went from 40% in the first half of the 1990s, to 16% after 1997.

Table 5: Evolution of interest rate dispersion and variance decomposition

	1992-1996	1997-2004
Fraction paying posted rate	0.4019	0.1655
Std.-Deviation: log-rate	0.0616	0.0924
Std.-Deviation: residual log-rate	0.0610	0.0876
Variance decomposition (fraction between):		
Lender	0.0232	0.0289
Neighborhood (fsa)	0.0238	0.0702
Contractual characteristics (37)	0.0193	0.0588
HHI-Branch (10 km)	0.0037	0.0118
Number Lenders (10 km)	0.0025	0.0079

The log-rate is expressed in deviation from month/year fixed-effects in order to remove trends in the level of interest rates. The "residual log-rate" variable is obtained by projecting the natural log of transaction interest rate onto month/year fixed-effects, and financial characteristics of the contract (i.e. loan-size, income, fico score, ltv). The "contractual characteristics" is a set of 37 discrete categories of contracts based on the income, loan-size, and loan to value. The "fraction between" measures the ratio of the between group variance over the the total variance.

The bottom half of Table 5 presents the contribution to the variance of systematic differences across borrowers and local markets. The results suggest again that most of the observed dispersion is idiosyncratic. The ratio of the variance between groups over the total variance ranges from 1% to 7%. The location of houses is the most disaggregate category and explains only 7% of the variance. It captures systematic regional differences across market structure and consumers. Over time however, the contribution of all categories increased significantly, suggesting that negotiated rates reflect more closely the characteristics of consumers.

Next we analyze the relationship between transaction rates and observed consumer and market attributes. To remove aggregate trends in interest rates, we measure the margin of lenders by the 5 year bond rate from the transaction interest rate. The average margin in the data is 1:20 percentage point (standard-deviation of 0:67), which is slightly higher than the average discount based on the posted price (i.e. mean and standard de-

level, and even further when we add location fixed-effects. The relationship between the number of lenders and rates, however, remain statistically significant in most cases.

In Table 7 we study the relationship between borrower characteristics and the probability of switching institutions. As we alluded to earlier new home buyers are more likely to switch, especially consumers formerly renting an apartment. Moreover, consumers who transact with larger network institutions are less likely to switch, suggesting as before that consumers matched with dominant banks are more likely to be loyal. The number of available options also influences the decision to switch. Consumers located in less competitive markets (i.e. fewer than seven lenders) are less likely to switch.

Finally, the loan to income ratio indicates that consumers shopping for a larger loan are less likely to remain loyal to their home institutions, while richer household are more likely. This relationship remains significant when we include loan and income as linear terms as well. It is consistent with the previous results relating income and loan size with transaction rates. Since switching in our context proxies for the search effort of consumers, this result importantly suggests that high income consumers are less likely to gather multiple quotes, while the opposite is true for consumers with larger loans.

3 Model

We propose a sequential search model in which consumers with heterogeneous search costs are initially matched with their “home” bank to obtain an initial quote, and then

base are more likely to be initially matched with potential clients, and therefore more likely to transact with consumers with low outside option.

Large network banks benefit from a second advantage because of differentiation. All else being equal, the model allows consumer to value their home bank more, and/or lenders with a large network of retail branches. Quality differentiation in this market arises because banks are multi-product firms, and a large fraction of consumers combine their day-to-day banking and lending transactions with the same institution. Moreover, to the extent that consumers face a switching cost to transact with a different bank than their home bank, the average willingness to pay for the home will be higher.

We describe the model in details in the next three subsections. First, we describe additional notation, and formally define the timing of the model. Then we solve the

results.

We assume the following payoff functional forms:

$$\text{Consumers:} \quad U_{ij} = \quad _{ij} \quad p_{ij} \tag{1}$$

$$\text{Firms:} \quad _{ij} = \quad \underbrace{\quad _i (r_j \quad c_i)}_{\text{Profits from lending}} + \underbrace{! _{ij} + u_{ij}}_{\text{complementary services}} \tag{2}$$

where $p_{ij} = L_i \quad r_j$ is the cost of the contract for consumers, and L_i is the fixed loan size.

The cost of the contract p_{ij} measures the monthly payment made by household i. We assume that households borrow the amount of the insurance premium at the same interest rate. Therefore L_i incorporates the lump-sum insurance premium paid by the banks to the insurance company. This insurance premium is an increasing function of the loan-to-value ratio.

The marginal cost of lending c_i is common across banks and is equal to the 5 years bond rate at the starting date of the contract. The scale of r_j and c_i measure the monthly payment that consumers and banks have to incur on a loan of size 1 over a common amortization period of 25 years.

The lender's profits include an additional component measuring the indirect profit earned through complementary services offered by the bank. It is further decomposed into a function of consumers and bank characteristics $! _{ij} = Z_{ij} + _i$, and a random variable u_{ij} unobserved to the econometrician. The random variable $_i$ is an unobserved attribute of consumer i that affects banks' profits symmetrically.

The value of banking with bank j for consumer i is a function of the "quality" of bank j's services in the neighborhood of consumer i, and a premium earned by consumers to accept a contract from a bank with which they have prior experience. We measure the quality of banks services by the density of their branch network, denoted by q_j. Fur-earnm95522 1

consumers have positive months of experienced with at most one bank. The willingness to pay function is expressed as:

$$_{ij} = q_{j} + 1(E_{ij} > 0) \quad (3)$$

This willingness to pay function implies that firms are vertically differentiated. While we assume that the marginal utility for quality is common across consumers, the size of the loan affects the ranking of offers. This is because the scale of p_i in function of L_i, while $_{ij}$ is common across consumers facing the same choice-set and having the same home bank. As a result, everything else being equal, consumers with larger loans are more likely to search and choose the lowest rate (as opposed to the highest quality option).

^{i} $_{ij}$

profit offer from the second-highest surplus bank:

$$_{ij} \quad L_i r_j = V_{i;(2)} = \max_{k \neq j} V_{ik} \quad , \quad r_j = \frac{1}{L_i} \quad _{ij} \quad V_{i;(2)} \tag{5}$$

Where Pr $_{ih}$ $p^0 < V_{i;(2)}$ $= H_{ih}$.

3.3 Distribution assumptions

The model has three sources of randomness: (i) identity of banks with prior experience, (ii) common unobserved profit shock $_i$, and (iii) idiosyncratic match values u_{ij}.

The identity of home banks is partially observed when consumers transact with a bank which they have at least one month of experience. We assume that $1(E_{ij} > 0)$ is a binomial random variable with probability distribution $_{ij}$ that is function of the location of consumers (i.e. region), and income group. This probability distribution is estimated separately using data on bank affiliation. We come back to the estimation of this distribution below.

The common unobserved lending cost $_i$ is normally distributed with mean zero and variance ^{2}.

The bank-specific idiosyncratic match values $f u_{ij}\ g_{j=1:::N}$ are independently distributed according to a type-1 extreme-value (EV) distribution with location and scale parameters $(0;\ _u$

j offers the highest surplus:

$$_{ij} = \Pr\quad V_{ij} = \max_{k2N_i} fV_{i;k}g \quad = \frac{\exp(\ _u\ _{ij})}{\sum_{k2N_i}\exp(\ _u\ _{ik})} = \frac{@_{i;max}}{@_{ij}}: \tag{9}$$

The second-order statistics of the V's distribution can also be derived analytically:

$$\Pr(V_{i;(2)} < v\, jV_{ij} = V_{i;(1)}) = G_{ij}(v jN_i) = \frac{1}{_{ij}} F(v;\ _{i;}\ _{j};\ _v) + (\ _{ij} \quad 1)F(v;\ _{i;max};\ _u) \tag{10}$$

$$\Pr(V_{i;(2)} < v) = G_i(v jN_i) = \sum_{j2N_i} F(v;\ _{i;}\ _{j};\ _u) + F(u;\ _{i;max};\ _u) \sum_{j2N_i} (\ _{ij} \quad 1)$$

$$= \sum_{j2N_i} F(v;\ _{i;}\ _{j};\ _u) + (1 \quad N_i)F(u;\ _{i;max};\ _u) \tag{11}$$

where $N_i = jN_i j$, and $_{i;}\ _{j} = \ _u \log \sum_{k\in j} \exp(\ _{ik} = \ _u \quad _{i;}$

Case 1: $b_i = h_i$

With probability $_{i;b_i}$ the initial quote is drawn from the highest-surplus bank. If that is the case, the transaction price is equal to $p_i =$

Joining these two events, the likelihood contribution of individual i's outcomes when $h_i = b_i$ is:

$$L(b_i = h_i; p_i | Z_i; \quad) = \quad _{i;b_i} L(b_i = h_i; p_i | Z_i; V_{ih} = V_{i;(1)}) + (1 \quad _{i;b_i}) L(b_i = h_i; p_i | Z_i; V_{ih} < V_{i;(1)}) \tag{12}$$

Case 2: $b_i \neq h_i$

In this case, lender b_i is automatically the highest surplus option in consumer i's choice-set. The transaction price is therefore equal to $p_i = \quad _{i;b_i} \quad V_{i;(2)}$ and $V_{i;(2)} = \quad _{i;b_i} \quad p_i$. Moreover, before choosing b_i the initial quote must have been rejected with probability $H_{i;h_i}$, which is function of the unobserved value of the home bank, V_h. This random variable must thus be integrated-out to calculate the choice-probability. In that case the distribution of transaction price is given by the conditional distribution of second-order statistics $g_{i;b_i}$, conditional on option b_i offering the highest surplus. The likelihood contribution integrates out the value of the initial option taking into accounts this fact.

$$L(b_i \neq h_i; p_i | Z_i; \quad) = \quad _{i;b_i} \int_1^{V_{i;(2)}} 1 \quad \exp \quad \frac{1}{_i} \max \quad V_{i;(2)} \quad V_h + \quad _i \quad ; 0 \quad P(p_i | V_h) \frac{f(V_h; \quad _{i;h_i}; \quad _u)}{F(V_{i;(2)}; \quad _{i;h_i}; \quad _u)} dV_h$$

$$= \quad _{i;b_i} g_{i;b_i}(V_{i;(2)} | N_i) \int_1^{V_{i;(2)}} 1 \quad \exp \quad \frac{1}{_i} \max \quad V_{i;(2)} \quad v_h + \quad _i \quad ; 0 \quad \frac{f(v_h; \quad _{i;h_i}; \quad _u)}{F(V_{i;(2)}; \quad _{i;h_i}; \quad _u)} dv_h$$

where $V_{i;(2)} = \quad _{i;b_i} \quad p_i$ and $H_{i;h_i} = 1 \quad \exp \quad \frac{1}{_i}(\quad _i \quad)$.

The likelihood function is evaluated by integrated out two other unobservables: h_i and $_i$. The common lending profit shock $_i$ is distributed according to a normal distribution with common variance . We integrate it out using quadrature methods.

In the first case, the observed loyalty of consumers fully identifies the identity of the initial offer. For the contracts that are switching institutions, the likelihood must integrate

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the $N_i \quad 1$ lenders excluding bank j.

the identify of the bank with prior experience. Moreover, this variable is absent for the contracts insured by Genworth. We get around this problem by separately estimating the distribution of the main financial institution from a survey of consumer finances performed by Epsos-Reid. This data-set surveys nearly 12; 000 households per year in all the regions of the country. We group the data into six years, ten regions, and four income categories. Within these subsamples we estimate the probability of choosing one of the twelve largest lender as their main financial institution. We denote this estimated probability by $\hat{}_{ij}$, where i indexes the contract identifier. This probability corresponds to the density of positive experience level $1(E_{ij} > 0)$ given the income and location of borrower i.

In addition, consumers go first shop at their home bank if it is present in their neighborhood, which is non-zero for some consumers. For instance, a bank might not be present in the new residential neighborhood of consumers, or they might be affiliated with one of the smaller institution outside of the Big-12. As a result, the identity of the first offer (i.e. h_i) is not always equal to the "home" bank, which means that we must integrate out two possibilities when evaluating the likelihood contribution of an individual: (i) receiving an initial quote from the home bank (i.e. $E_{ih} > 0$), and (ii) receiving an initial quote from a bank with no prior experience (i.e. $E_{ih} = 0$). In the latter case, we assume that consumers affiliated with a bank that is not in their choice-set are matched with banks randomly as function of the branch network size, denoted by s_i. Formally the probability of pairs $(h_i; E_{ij})$ is:

$$\Pr(h_i = j; E_{ij}) = \begin{cases} 1(j \in N_i)\hat{}_{ij} & \text{If } E_{ij} > 0 \\ \sum_{k \in N_i} \hat{}_{ik} s_{ij} & \text{If } E_{ij} = 0 \end{cases} \tag{13}$$

In words, the initial comes from the home bank of consumer i if possible, and is randomly

sampled from the set of available options otherwise.

The likelihood contribution of a contract i therefore can be written as:

$$L(b_i; p_i | X_i; \quad) = \int \left(\sum_{j \in N_i; E \in \{0;1\}} \Pr(h_i = j; E_{ij}) \, L(b_i; p_i | X_i; h_i; \ _i; \ ) \right) f(\ _i; \quad) d\ _i; \qquad (14)$$

where X_i is a vector of exogenous covariates characterizing the payoff functions.

4.2 Results

Table 8 presents the maximum likelihood estimates for the key model parameters. The price coefficient is normalized to one and monthly payments are measured in hundreds of dollars. The scale of the parameters translates into $100 of monthly expenses for the life of the contract (i.e. 5 years).

The two parameters entering the search cost distribution suggest that search frictions are economically important, and heterogeneous in the population. The baseline cost is equal to $23 while the average is $56 per month; roughly 5% of the average monthly payment. Under the exponential distribution assumption, half of the population of mortgage clients face a search cost lower than $38 per month, implying substantial dispersion. According to the model, the marginal consumer accepting the initial quote from a winning bank is indifferent between searching and reducing his monthly payment by $56, or accepting p^0.

The home bank premium is equal to $40, while the marginal utility of network size is equal to $3. Therefore, on average consumers are willing to pay $40 every month to stay with the bank with which they have prior experience. Assuming that this utility gain originates from avoid the cost of switching bank affiliation, our result suggests that

in the willingness to pay for a lender with a branch network that is half the size of the average network, and a lender with a branch network that is twice the size of the average network is slightly more than $5 per month; significantly smaller than the cost of

tionship between retail margins and switching probability, and the characteristics of consumers. For this we simulated 500realizations of the market outcomes for each consumer, and compare the average regression coefficients with the observed ones. This comparison confirms that the model replicates most of the observed correlations. The model fits well the observed relationships between consumers financial characteristics and transaction rates, as well as the relationship between the number of lenders and rates. However, the model tends to under-estimate the magnitude of the discount that switchers receive, while over-estimating the premium paid by consumers dealing with large network institutions.

5 Conclusion

References

Adams, W., L. Einav, and J. Levin (2009). Liquidity constraints and imperfect information in subprime lending.

Table 6: Margin regression results

VARIABLES	(1) Margin	(2) Margin	(3) Margin	(4) Margin	(5) Margin
Annual income (X 100K)	-0.14[a]	-0.076[a]	0.15[a]	-0.22[a]	-0.19[a]
	(0.011)	(0.011)	(0.014)	(0.036)	(0.036)
Loan size (X 100K)				0.035[b]	0.050[a]
				(0.017)	(0.018)
Loan / Income				-0.20[a]	-0.18[a]
				(0.012)	(0.013)
Other debt (X 100K)				-0.086[a]	-0.085[a]
				(0.0076)	(0.0076)
0:85 LTV < 90				0.065[a]	0.061[a]
				(0.0088)	(0.0089)
0:90 LTV < 0:95				0.10[a]	0.097[a]
				(0.011)	(0.011)
LTV = 0:95				0.19[a]	0.18[a]
				(0.0092)	(0.0093)
FICO (mid-point)				-0.75[a]	-0.76[a]
				(0.038)	(0.038)
Renter	0.00022	0.0023	-0.00077	-0.035[a]	-0.029[a]
	(0.0071)	(0.0071)	(0.0070)	(0.0071)	(0.0072)
Living w / parents	-0.058[a]	-0.054[a]	-0.066[a]	-0.078[a]	-0.069[a]
	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)
Switcher	-0.080[a]	-0.077[a]	-0.072[a]	-0.075[a]	-0.069[a]
	(0.0089)	(0.0089)	(0.0088)	(0.0087)	(0.0088)
Relative network size	0.057[a]	0.055[a]	0.053[a]	0.053[a]	0.048[a]
	(0.0044)	(0.0044)	(0.0043)	(0.0043)	(0.0049)
Nb. FIs=7	-0.094[a]	-0.072[a]	-0.050[a]	-0.046[a]	-0.020
	(0.0080)	(0.0080)	(0.0080)	(0.0079)	(0.014)
Nb. FIs=8	-0.16[a]	-0.13[a]	-0.11[a]	-0.097[a]	-0.068[a]
	(0.0088)	(0.0091)	(0.0091)	(0.0090)	(0.020)
Nb. FIs=9	-0.22[a]	-0.17[a]	-0.14[a]	-0.13[a]	-0.073[b]
	(0.014)	(0.015)	(0.015)	(0.015)	(0.029)
Nb. FIs> 9	-0.27[a]	-0.21[a]	-0.15[a]	-0.15[a]	-0.079
	(0.037)	(0.037)	(0.037)	(0.037)	(0.054)
Constant	1.30[a]	1.43[a]	1.46[a]	2.26[a]	2.28[a]
	(0.040)	(0.046)	(0.045)	(0.059)	(0.16)
Observations	47,039	47,039	47,039	47,039	47,039
R-squared	0.263	0.272	0.284	0.305	0.333
Census variables	N	Y	Y	Y	Y
FSA FE	N	N	N	N	Y

Robust standard errors in parenthesis. [a] p< 0.01, [b] p< 0.05, [a] p< 0.1 Controls variables: Bank+Prov. FE, Year+Prov. FE, Month dummies.

Table 7: Switching probability linear regression

VARIABLES	(1) Switching	(2) Switching
Loan / Income	0.051[a]	0.043[a]
	(0.0086)	(0.0087)
Renter	0.091[a]	0.087[a]
	(0.0043)	(0.0044)
Living w / parents	0.056[a]	0.053[a]
	(0.0063)	(0.0064)
Relative network	-0.021[a]	-0.022[a]
	(0.0034)	(0.0035)
Nb. FIs in [1; 7)	-0.028[a]	-0.018[a]
	(0.0049)	(0.0057)
Constant	0.55[a]	0.71[a]
	(0.042)	(0.094)
Observations	35,560	35,560
R-squared	0.252	0.257
City FE	N	Y

Robust standard errors in parentheses. [a] $p < 0.01$, [b] $p < 0.05$, [a] $p < 0.1$ Control variables: Bank+Prov. FE, Year+Prov. FE, Month dummies.

Table 8: Maximum likelihood estimation results

Table 10: Definition of Household / Mortgage Characteristics