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PRICE DISPERSION IN MORTGAGE MARKETS*

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Using transaction-level data on Canadian mortgage contracts, we document an increase in the average discount negotiated off the posted price and in rate dispersion. Our aim is to identify the beneficiaries of discounting and to test whether dispersion is caused by price discrimination. The standard explanation for dispersion in credit markets is risk-based pricing. Our contracts are guaranteed by government-backed insurance, so risk cannot be the main factor. We find that lenders set prices that reflect consumer bargaining leverage, not just costs. The presence of dispersion implies a lack of competition, but our results show this to be consumer specific.

I. INTRODUCTION

In many markets prices are determined through a negotiation process between buyers and sellers. Sellers post a price, but consumers may be able to negotiate a discount. This type of pricing behavior can be found, for example, in the markets for automobiles, for houses and for banking products, including consumer loans, investment products, and insurance products. In these markets, because consumers differ in terms of their profitability with respect to sellers and their ability to negotiate sizeable discounts, bilateral negotiation leads to price dispersion.

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An extensive literature has arisen to try to identify the exact sources of price dispersion in these markets. In credit markets, most of the observed dispersion is attributed to the ability of lenders to sort borrowers according to their level of risk or to adverse selection (see for instance Edelberg [2006], Livshits, MacGee, and Tertilt [2009], Einav, Jenkins, and Levin [2013] and Adams, Einav, and Levin [2009]). We study a sample of newly issued mortgage contracts in Canada that are fully insured against default by government-guaranteed mortgage insurance providers, which allows us to disentangle risk from other reasons for price variation and show that risk-based pricing represents only one possible source of dispersion in credit markets. Since the contracts we study are insured, if risk-based pricing were the only factor, we should observe little dispersion in rates. However, despite the fact that we have restricted ourselves to a homogeneous set of mortgages, we document a substantial amount of rate dispersion. In our sample the coefficient of variation for discounts in 2004 was 74 per cent, leading to economically important differences in the costs of financing the purchase of a home. Given an average loan of $160,928 in 2004, the extra term interest cost of paying the rate associated with the 75th percentile discount rather than the 25th percentile discount is $6,968, or $116 per month.[1]

This paper has three objectives: (i) to document the importance of price dispersion in this market, (ii) to identify groups of consumers who benefit from banks' discounting policies, and (iii) to test whether or not part of the observed dispersion can be associated with price discrimination. By price discrimination here, we do not mean race or gender based discrimination as in Goldberg [1996], for instance. Rather we seek evidence that financial institutions set prices that reflect the relative bargaining leverage of consumers, rather than solely lending costs. When negotiating with a bank, the bargaining leverage of consumers depends on the value of the next best alternative, and on the cost of getting extra quotes. As in other retail markets, the costs and benefits of obtaining additional offers are affected by market concentration and differentiation between lenders, as well as the quality of consumers' information and search costs. In consumer finance markets these factors are compounded by the fact that shopping is infrequent, and that there are important deficiencies in financial literacy (documented for instance by Campbell [2013] and Campbell, Jackson, Madrian and Tufano [2011]).

We achieve the first objective by decomposing the variance of transaction rates between observed and unobserved borrower characteristics. We find that throughout the 1990s', the rise of discounting in the Canadian market was accompanied by an increase in 'consumer-based pricing' (i.e., pricing based on measurable characteristics of borrowers), as well as a 60%

[1] The full amortization interest cost (over 25 years) on this mortgage is $24,903.

increase in the importance of residual dispersion. At the same time, the fraction of consumers paying the posted rate plummeted, from 80% in 1992 to 24% after 1999.

In an effort to determine who receives discounts, we estimate the reduced-form relationship between rates and consumer, lender and market characteristics. We show that borrowers face higher rates in more concentrated markets, and that borrowers choosing large network banks pay higher rates. We also find evidence that rates vary with consumer characteristics. Consumers who switch financial institutions receive better rates than do borrowers who stay loyal to their main financial institution. New home buyers pay lower rates than do previous home owners. Financially constrained borrowers pay higher rates, as do consumers with high credit risk.

A limitation of this reduced-form analysis is that it does not tell us *why* different characteristics lead to different rates. It is unclear whether the observed dispersion in rates merely reflects cost-based pricing, or consumer-specific markups consistent with price discrimination. The standard approach to testing for price discrimination has been to find controls for costs or competition, and then to test for dispersion or nonlinearities in prices (c.f. Borenstein and Rose [1994], Busse and Rysman [2005], Dafny [2010]). This is because in more competitive markets, dispersion is attributed to heterogeneous costs (or profits) of serving consumers, whereas in less competitive markets, dispersion may be the result of rent extraction by the firm.

In this paper we propose two related tests for price discrimination. Both rely on the fact that in negotiated-price markets, competition is transaction-specific and consumers differ in their observable and unobservable ability to generate price competition. Specifically, we test for discrimination based on observed characteristics of borrowers and mortgage contracts. Our objective is to identify variables that affect the relative bargaining leverage of consumers. If there is price discrimination, prices will vary across groups of consumers who have heterogeneous incentives to engage in search (e.g., high vs low income consumers). This observed price difference, which is associated with markup differences, depends on consumers' unobserved ability to generate competition. It should disappear for those able to generate competition, but not for those unable to do so. We implement our tests by comparing the marginal effects of observed characteristics across groups of consumers with different unobserved abilities to generate competition (i.e., negotiation ability).

Our first test is based on quantile regressions. Since we control for a rich set of characteristics that affect the profitability of the transaction, what remains reflects heterogeneity in unobserved negotiation ability. We test the stability of the marginal effect on rates of observed characteristics, across the different percentiles of the conditional rate distribution. If price

discrimination is present, the marginal effect should be closer to zero at the bottom quantiles (good unobserved negotiation ability), than at the middle (weaker negotiation ability). Our findings are consistent with this form of price discrimination—market structure variables have zero effect at the bottom and other financial variables have smaller effects at lower quantiles than at higher ones.

Our second test is similar. We compare pricing patterns across broker and non-broker transactions to test whether the marginal effects of characteristics are constant across them. Brokers have better unobserved negotiation ability than the average consumer, because they are known to get more quotes and therefore face a more competitive environment. Controlling for the endogenous selection of brokers by consumers, we test the stability of the marginal effect on rates of observed characteristics, across broker and non-broker transactions. Again, our results are consistent with discrimination. We find evidence of significant differences in marginal effects in the two groups, suggesting that borrowers shopping alone are discriminated against relative to borrowers contracting through brokers.

Alternatively, if there is price discrimination, prices can differ across brokers and non-brokers if brokers employ a different negotiating strategy than individual borrowers, for instance, by collecting the same number of quotes across different groups of consumers (i.e., blind search). Under this interpretation, our test is in the same spirit as the price discrimination test proposed by Scott Morton *et al*. [2001, 2003], which consists of comparing prices for cars bought online and offline. In this context, some characteristics are muted when consumers buy online, and therefore any conditional price differences based on these characteristics should not exist online if they are associated with price discrimination (rather than unobserved car characteristics for instance). Our setting differs from the car market, since we cannot *ex ante* identify borrower characteristics that do not affect the profitability of the transaction absent price discrimination.

Our findings have important implications given the significance of mortgage markets in the economy, and especially in light of the financial crisis and the focus global regulators have put on mortgage design. The presence of price discrimination implies that the market is something less than competitive. However, our findings show that this lack of competition is consumer specific. Consumers with the knowledge and ability to generate competition amongst lenders pay rates that reflect their effective marginal cost, while those who are unable to do so pay rates above this.

The consequences of price dispersion in mortgage markets are of first order importance, since it can lead to excessive debt levels and the possibility of default (Geraldi, Goette and Meier [2010]). From a welfare perspective, price dispersion associated with discrimination motives can distort borrowing decisions by increasing the risk of default on consumers

with poor negotiation skills and by encouraging excessive borrowing. Higher default probability, can induce systemic risks and generate negative externalities on the overall market.

For policy makers trying to limit price discrimination, our results suggest that, not only is the number of banks in a market important, but so is consumers' ability to put banks into competition by searching over and negotiating with multiple lenders. By doing so, borrowers make price discrimination more difficult. These findings point to the need for policies aimed at increasing financial literacy in order to improve the negotiation abilities of borrowers. Deficiencies in this area can lead consumers to overpay for loans.

Our findings also suggest that policies designed to increase transparency or improve financial literacy may have distributional effects. Not all consumers will benefit from these policies. Borrowers who are able actively to engage in search and/or who are good at negotiation will not be helped by these policies, and may actually be hurt if prices are more uniform as they would be under a no-haggle policy. In contrast, policies designed to increase competition by bringing more negotiation partners to the table will serve only to benefit those consumers who engage in search and negotiation. Consumers who are unable or unwilling to obtain multiple quotes will not be affected by the level of competition in the market. The other side of this is that policies designed to limit concentration, for instance by preventing mergers, will provide limited benefit for those consumers paying the highest rates.

The paper is organized as follows. Section II presents an overview of the Canadian mortgage market and discusses pricing and negotiation. Section III presents a description of the household-level data. Section IV contains our main analysis. To frame our discussion, we begin by presenting a two-stage negotiation model and then we describe the empirical analysis. Section V concludes and discusses the policy implications of our findings. Tables and figures are presented in the Appendix.

II. THE CANADIAN MORTGAGE MARKET

II(i). *Market Structure*

The Canadian mortgage market is dominated by the 'Big 6' Canadian banks, a regional cooperative network—Desjardins—and a provincially owned deposit-taking institution—Alberta's ATB Financial.[2] Collectively, they control 90 per cent of assets in the banking industry and are called the 'Big 8'. Their dominance stems from the period of consolidation that

[2] The Big 6 are: Bank of Montreal, Bank of Nova Scotia, Banque Nationale, Canadian Imperial Bank of Commerce, Royal Bank Financial Group, and TD Bank Financial Group.

followed the 1992 Bank Act, when the large banks acquired nearly all of the trust companies. Until that point, trust companies played an important role in the mortgage market, controlling nearly 45% of all newly issued mortgages. In the mid to late 1990's, there was also entry of foreign banks such as ING, but their market share remains relatively small throughout our sample period.

The evolution of the banking system after 1992 has led Canadian households to treat their primary bank as a 'one-stop shop' (universal bank) where they purchase the majority of their financial services. Nowadays, 67% of Canadian households have their mortgage at the same financial institution as their main checking account. See Table I for a description of the distribution of financial services across households' main financial institutions.

Most Canadian banks operate nationally and post mortgage rates that are common across the country. Lenders typically post rates for their different products on a weekly basis in both national and local newspapers, as well as online. This is different than in the United States, where even national lenders such as Bank of America post different mortgage rates on their web-site depending on a consumer's zip code.[3] There is little dispersion in posted prices, especially among the Big 6 banks. In fact, the coefficient of variation on posted rates for the Big 6 during the early part of our sample period is always around zero (see Allen and McVanel [2009]).

II(ii). *Pricing and Negotiation*

In shopping for a mortgage contract, one option for consumers is to pay the posted rate. 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. The role of discounts is, on the one hand, to retain consumers who obtain competitive quotes from multiple lenders, and, on the other, to set a rate that reflects the characteristics of borrowers. Branch managers are also compensated in part by the size of loans and volume of discounts, which can influence their pricing decision (see KPMG [2008]). Importantly, Canadian lenders do not offer the option of buying points to reduce rates; it is the responsibility of consumers to negotiate discounts. It is also a reasonable assumption that this negotiation involves mostly the determination of the final interest rate since lenders directly control relatively few fees associated with housing transactions.[4] Rather than settle for the posted rate, consumers face two

[3] Canadian banks operating in the U.S. also use this strategy for their U.S. locations.

[4] Many fees required in the U.S. are not in Canada: home inspection fees (not required by lender), land registration fees and property taxes (paid to the municipality), and legal fees (paid to a notary or lawyer). Some other fees, may be negotiable, but anecdotal evidence

options. One approach is to hire a broker to search for the best rates on their behalf. Brokers penetrated the Canadian market starting in the mid 1990's, and by 2004 were responsible for negotiating roughly 40% of new contracts. Figure 1 presents the evolution of the share of transactions that were broker-assisted in our sample.

Unlike in the United States (with the exception of California), brokers in Canada have fiduciary duties. Brokers are compensated by lenders, but 'hired' by borrowers to gather the best quotes from multiple lenders. Typically, brokers are compensated between 1–1.3 per cent of the volume of mortgages that they bring to a lender in a month.[5] Borrowers could potentially hire several brokers, something we cannot observe. Recent surveys by Maritz Canada and CAAMP (Maritz [2012] and Dunning [2011]) suggest that mortgage brokers contact on average 4.5 lenders for each contract.

The second option is for borrowers to independently negotiate the rate, for instance by gathering quotes from multiple lenders. Our data do not provide information on the number of quotes gathered by borrowers, but survey evidence from CAAMP reveals that only 54% of consumers gather more than one quote. On average, these borrowers negotiate with 2.25 financial institutions when searching for a mortgage. Importantly, branch managers that are part of the same bank network are typically not allowed to compete by responding to each other's offers. Therefore, the level of competition facing each borrower is more accurately measured by the number of different financial institutions present in the same region, than by the number of local branches.

It is important to note that discounting has not always been the norm in Canada. Until the mid 1990's very few Canadians received any discount on their mortgage.[6] The move towards discounting coincided with important changes to the structure of the Canadian banking industry. Beyond the disappearance of trusts and the entry of foreign players and mortgage

suggests this is rare. For instance, a property assessment fee of 250 to 350 dollars is almost always waived by the lender unless the price of the home is substantially greater than the market value. Recently journalists at the *Globe & Mail* revealed through an access to information request that since 1996 borrowers who buy mortgage insurance in Canada have not had their properties assessed. *http://www.theglobeandmail.com/report—on—business/economy/housing/potentially—flawed—data—used—by—banks—and—lenders—bump—up—house—prices/article*4603237/ Before 2006, mortgage insurance providers charged an underwriting fee of 75 to 165 dollars for mortgage insurance, which could be waved by the lender. The lender could offer a preferable rate on property insurance rather than a mortgage rate discount; but this is unlikely as Canadian banks are not permitted to sell insurance inside their branch. There is also some evidence that lenders will in rare instances negotiate on the fraction of the contract that can be prepaid without penalty.

[5] In contrast, in the U.S., brokers receive both a cash fee from the borrower and a yield-spread premium from the lender. The yield-spread premium is an increasing function of both the loan size and the interest rate, therefore brokers in the U.S. do not have an incentive to find borrowers the lowest rate (e.g., Hall and Woodward [2012]).

[6] This was also true in the US. See for instance Duca and Rosthenal [1994] and Edelberg [2006].

brokers, several technological innovations occurred during this time including the advent of LAN and the internet, the automatization of underwriting processes, and the introduction in 1996 by the main insurance company, Canada Mortgage and Housing Corporation (CMHC), of an automated approval system. Overall, these changes have made it easier for lenders to decentralize pricing and lending decisions, and offer borrower-specific rates as a function of measurable characteristics.[7]

II(iii). *Default Risk and Insurance*

Canadian borrowers face two broad contract categories: conventional mortgages (low loan-to-value), that are typically uninsured but can be privately insured, and high loan-to-value mortgages, that require insurance. About 73 per cent of residential mortgages and over 80 per cent of new home-owner contracts require insurance coverage.[8] This is because mortgage insurance is required for households borrowing more than 75 per cent of the cost of the home. Mortgages are insured by either the government insurer CMHC, or a private insurer, Genworth Financial Canada.[9] The government of Canada explicitly backstops both insurers, and determines the insurance premiums. These are typically rolled into the mortgage and financed over the full amortization, and range from 1.75 to 3.25 per cent of the loan (strictly a function of the LTV).

When financing an insured mortgage contract, banks assume only the transaction-cost component associated with default risks. Except in the case of mortgage fraud, the mortgage insurer is responsible for covering the full amount of the claim and costs (including servicing costs, filing costs, delayed payment costs, etc.). In order to reduce moral-hazard risks associated with excess lending, the government sets minimum standards for insured mortgages, and the final decision on whether a mortgage application is accepted rests with the insurer. In addition to the 75 per cent LTV rule, the government requires that households have a debt service to gross

[7] Similar innovations have been associated with an increase in consumer-based pricing in other credit markets. The development of 'risk-based pricing' has been facilitated by technological advances that make credit scoring much less costly than it was twenty years ago and has been encouraged by the fact that it can be significantly more profitable than uniform pricing. Einav, Jenkins and Levin [2013] study pricing and contract design in the subprime auto-sales market and find that using credit scoring to determine down-payment sizes can increase profits by 42 per cent per applicant relative to uniform pricing. For a theoretical analysis of the benefits of information technology for bank profits see Hauswald and Marquez [2003].

[8] The percentage of government guaranteed mortgages is calculated as total insurance in force over total residential mortgage credit. As of 2009 CMHC had 473 billion CAD, Genworth 224 billion CAD and Canada Guaranty about 5 billion CAD of insurance in force in a market of 965 billion CAD.

[9] Genworth Financial entered the Canadian market in late 1995 and has grown to about one-third of the market.

income ratio of less than 32 and a total debt service ratio of less than 40.[10] These lending standards remained constant during our sample period, and were relaxed only slightly post-2006. As a result of these relatively strict lending rules, the rate of default in Canada has been extremely low.[11]

II(iv). *Mortgage Contracts*

Another feature of the Canadian market, is the relative simplicity of the menu of contracts offered by lenders. Since the 1960's, the standard contracts offered by Canadian lenders are fixed-rate mortgages with five, three, or one-year terms. These contracts must be renegotiated at the end of the term period, which in effect acts like an adjustable rate mortgage with a fixed time-frame to renegotiate.[12] During our sample period, over 92 per cent of mortgage contracts were fixed rates, among which over 80 per cent had a 5 year term (the second most common term was 36 months, with 13 per cent of the sample).

In an effort to reduce pre-payment risks over the fixed-rate period, banks also impose substantial penalties for borrowers trying to renegotiate their contract before term.[13] Most lenders give borrowers a 15 per cent (and sometimes as high as 20 per cent) prepayment option per year. Any unused prepayment room expires at the end of each year. Beyond this amount, borrowers face penalties that amount to the greater of three months of interest or the interest rate differential (IRD) between the locked-in rate and the market rate times the number of remaining years (see Lascelles [2010]). This effectively neutralizes any financial incentive to renegotiate in quest of a lower borrowing rate as the cost precisely offsets the advantage.

III. MORTGAGE CONTRACT DATA

Our main data-set is a sample of insured mortgage contracts obtained directly from CMHC and Genworth. From the former, we obtained a 10

[10] Gross debt service (GDS) is defined as principal and interest payments on the home, property taxes, heating costs, annual site lease in case of leasehold, and 50 per cent of condominium fees. Total debt service (TDS) is defined as all payments for housing and other debt. Both measures are as a percentage of gross income. Mortgage insurance guidelines are such that the TDS and GDS calculations are based on the posted rate and not the discounted price. Otherwise, given mortgages are insured, lenders might provide larger discounts to borrowers above a TDS of 40 in order to lower their TDS below the cut-off. The guidelines are based on the posted rate to discourage this behavior.

[11] According to a recent report by the Royal Bank of Canada (Hardy and Mun [2009]), the historical average cost of mortgage default in Canada is 2 basis points per year. Historical delinquency rates in Canada are less than 0.5%, about ten times smaller than in the U.S.

[12] The term does not affect the amortization period, which is set to 25 years for 98% of contracts issued during our sample period.

[13] Findlay and Capozza [1977] use option theory to illustrate the cost to lenders of fixed-rate mortgages with an open option to prepay and therefore the advantages of variable-rate mortgages and also why there are prepayment penalties.

per cent random sample of new mortgage contracts issued between 1992 to 2004, sampled by Census Metropolitan Area (CMA).[14] Genworth provided us with their full set of loans issued between 1996 and 2004. Since these contracts are over-represented relative to CMHC's, we randomly selected Genworth contracts to match their aggregate market shares for each year.

Both CMHC and Genworth only began collecting key household-level information in 1998, and therefore much of our empirical analysis focuses on the 1999–2004 period. In total, we have access to 20 household/mortgage characteristics (see Table II), including all of the financial characteristics of the contract (i.e., rate, loan size, house price, debt-ratio, risk-type), the lender identity (for the 12 largest lenders), and some demographic characteristics (e.g., income, prior relationship with the bank, residential status, dwelling type). In addition, we observe the location of the purchased house up to the forward sortation area, which is a finer measure than the CMA. While the average forward sortation area (FSA) has a radius of 7.6 kilometers, the median is much lower at 2.6 kilometers.[15]

Since we are interested in explaining patterns of rate dispersion across households, we restrict our sample to contracts with homogenous terms. In particular, our analysis focuses on contracts with a 25 year amortization period, and 5 year fixed-rate term. This represents the largest category of contracts issued during our sample period. Our analysis focuses only on newly issued mortgages so we exclude home-owners that are either refinancing or renewing their mortgage contract.

Table III presents summary statistics of the discrete variables for our restricted sample of 5 year fixed rate mortgages amortized over 25 years. Over 20% of the borrowers in our sample owned a home at the time of the contract. These *previous owners* are obtaining a mortgage for a new property, but still do not have enough equity in the previous house to avoid paying insurance on their new one. The remaining *new home owners* are exiting from renting or living with their parents. We also find that the majority of Canadians buy detached homes, and that by the late 1990's, the market share of brokers was over 30%.[16]

Table IV displays the market share of brokers and branches by type of financial institution. The vast majority of mortgage contracts that are with the Big 6 banks are negotiated at branches, with only around 28% of

[14] Breslaw, Irvine and Rahman [1996] have previously used these data to study mortgage term and amortization choice between 1980–1988.

[15] The FSA is the first half of a postal code. There are over 1,300 FSA's in Canada, and over 850,000 postal codes.

[16] As far as we are aware, during our sample period all lenders except the largest in the country, RBC, processed broker-business. Rather than use mortgage brokers RBC relies more heavily on in-house mortgage specialists (most financial institutions have mortgage specialists in addition to using brokers). These are broker-like individuals that only work for one lender. In 2006 BMO stopped using independent brokers, following RBC's example.

contracts using brokers. In contrast, over half of contracts with trusts use brokers (57%), as do almost 80% of contracts with other financial institutions.

Summary descriptions of continuous variables are presented in Table V. We present the mean, median and standard deviation for (i) the full sample, (ii) a sub-sample of previous home-owners, and (iii) a sub-sample of new home-owners. The purpose of splitting the sample in this way is to explore the possibility that more experienced home-buyers have a different mortgage shopping experience than first-time home-buyers.

For the full sample, the mean borrower has been with his/her financial institution 48 months before the contract is signed, about 7 months more than the mean for new home-owners and 20 months less than the mean for previous home-owners. The difference between owner-types is more stark when looking at the median relationships, 1 month for new buyers and 40 months for previous owners. Previous owners are more loyal.

The average household income is different across residence groups: new home-owners are about $11,000 poorer than previous home owners (i.e., $65,692 versus $76,638). This difference is reflected also in the house price, and in the loan size. The mean loan is about $143,849 to purchase a $158,760 home (all in 2002 dollars). The LTV for new home-buyers is slightly higher than that of previous home buyers.

The majority of households in our sample invest the minimum down-payment of 5 per cent. Figure 2 plots LTV ratios. LTV ratios are highly localized around 90 and 95, and to a lesser extent 75, 80, and 85. This clustering reflects the piece-wise linear form of the insurance pricing schedule.

An average total debt service ratio (TDS) of 32 is relative low compared to the guideline maximum of 40. Figure 2 presents a histogram of borrowers' TDS ratios. Given the heavy right-skewness of the distribution the constraint does appear to be binding for a large number of households. Previous home-owners and new home-owners have similar TDS ratios. The full sample TDS is less than the TDS for the two sub-samples, suggesting that the TDS is slightly higher on average for households insured by CMHC than by Genworth Financial. From the TDS ratio, we construct a measure of *other debt* which is defined as TDS times income minus mortgage payments evaluated at the transaction rate.

In order to measure the degree of competition facing each borrower, we use data on the distribution of branches between 1998–2004. This information is provided by Micromedia-Proquest. We use this information to construct two key measures of concentration by local market. First, we construct a branch Herfindahl-Hirschman Index at the FSA level with a 5 KM radius around the centroid of the FSA. Summary statistics are presented in Table V. The mean HHI is 0.202 and the standard deviation is 0.111. The second market structure variable is a borrower-specific which we denote *Relative network*. It is calculated as the fraction of branches in

a neighborhood owned by the borrower's lender over the average branch network of other lenders. The mean relative network is 1.27 and the standard deviation is 0.99. For more details on the evolution of branch networks in Canada see Allen, Clark and Houde [2008].

IV. EMPIRICAL ANALYSIS

In an effort to frame our empirical investigation, we begin by presenting a simple two-stage negotiation model in which a borrower and a lender bargain over a mortgage interest rate. Formally, borrower i is matched with lender j, and together they negotiate a mortgage interest rate p_{ij}. The outcome of the negotiation depends on lender/borrower specific costs c_{ij}, and on the borrower's outside option generated by getting quotes from other lenders in his/her neighborhood if negotiations fail with j. The transaction surplus for consumer i is therefore given by the difference between the net utility of borrowing from j, $v_{ij} = \theta_j - p_{ij}$, and i's outside option, $v_{i0} = \theta_0 - p_{i0}$. To simplify the analysis we assume that lenders earn zero profits if negotiations fail.

The difference between v_{ij} and v_{i0} determines the bargaining leverage of consumer i. The value of the outside option θ_0 is a function of the characteristics of available lenders, and the search cost of getting additional quotes. The price p_{i0} that consumers can obtain by shopping is the outcome of a competition game between available lenders. Rather than explicitly modeling the outcome of the second stage, we assume that p_{i0} can be expressed as a reduced-form margin $\mu(u_i)$ over lender j's cost. Specifically, the outside option price is: $p_{i0} = c_{ij} + \mu(u_i)$. We index consumers by their ability to search for and negotiate good discounts, and so μ is a *decreasing* function of u_i. We use this notation to characterize the heterogenous ability of consumers to gather competitive quotes from multiple lenders. Notice that p_{i0} can be lower than c_{ij} when borrowers are able to contact more cost-efficient lenders, and borrowers have positive valuation for the first lender they visit (i.e., $\theta_j - \theta_0 > 0$).

We assume that information is symmetric and complete across both parties, and use a Nash bargaining solution concept with equal bargaining weights to approximate the outcome of the initial negotiation stage. The transaction price therefore equally splits the overall transaction surplus:

$$(1) \qquad p_{ij} = c_{ij} + \frac{1}{2}(\theta_j - \theta_0 + \mu(u_i)) \equiv c_{ij} + m_{ij}(u_i).$$

This reduced-form pricing equation highlights the two components of what we label *consumer-based pricing*: lending cost factors and price discrimination. Any differences in prices that are not related to differences in risk or differences in the cost of loan provision are a result of price discrimination on the part of lenders stemming from differences in search

costs, outside options, negotiation ability, etc. Both components are functions of observed and unobserved factors. We use the $m_{ij}(u_i)$ notation to emphasize the fact that the last component includes an inherently unobserved element. This is because we mostly observe financial characteristics of the transaction, and few measures of the actual negotiation process. However, as discussed in Section II(ii), we know that borrowers employ heterogenous search and negotiation strategies when shopping for mortgages, and so have heterogeneous outside options.

The first objective of our empirical analysis is to measure the importance of consumer-based pricing. In Section IV(i), we do so by quantifying the cross-sectional dispersion of transaction rates, as well as the relative contribution of borrower characteristics to the observed variance.

In Section IV(ii), we then study directly the reduced-form correlation between observed characteristics and transaction rates, by estimating a linear approximation of equation 1. This does not allow us to make causal statements, since the marginal effect of a variable X_{ij} on rates reflects both a change in the lending cost c_{ij}, and a change in the price discrimination profits m_{ij}. It is nonetheless an important empirical exercise, as it allows us to identify the winners and losers from the discounting pricing policies of Canadian financial institutions.

The third objective of our analysis is to provide empirical evidence in favor of the existence of price discrimination. More specifically, we are interested in testing whether or not banks set interest rates that reflects the heterogeneity in borrowers' outside options, measured by $m_{ij}(u_i)$ in equation 1. Our econometric tests are based on the idea that if this form of price discrimination exists, the marginal effect of observed covariates on m_{ij} should differ across groups of consumers with different levels of u_i.

The argument is as follows. We study mortgage contracts that are homogenous, and subject to common floors and ceilings (i.e., risk-free and posted rates). This implies that consumers with good negotiation skills (i.e. high u_i) are able to generate sufficient competition between lenders to pay rates that reflect the cost of lending. On the other hand, consumers with weak negotiation skills or high search costs face an outside option that reflects the minimum of the common posted interest rate (maximum quote), and their willingness to pay for renting a house. In the first case the value of m is zero, while it is equal to a constant for low u_i consumers. The following assumption summarizes these properties.

Assumption 1. The profit margin function satisfies the following three properties:

(1) $\frac{\partial m_{ij}(u_i)}{\partial u_i} \leq 0$

(2) $m_{ij}(u_i) = 0 \quad \forall \quad u_i > \overline{u}$

(3) $m_{ij}(u_i) = \overline{m} \quad \forall \quad u_i < \underline{u}$

These properties cannot be tested directly without observing $m_{ij}(u_i)$. However, we can test an implication of them with respect to the marginal effect of observed transaction characteristics on transaction rates. Consider a variable x_i that affects only the value of the outside option. Assumption 1 implies that the marginal effect of x_i on the transaction price is zero for consumers at the top and bottom of the distribution of negotiation ability u_i. Similarly, if a variable z_i determines solely the cost of lending, its marginal effect on price should be constant across all levels of u_i (up to the constraint imposed by the posted price where the marginal effect is zero). For variables that affect both functions, a non-zero effect for consumers with low u_i's identifies cost variations, while it reflects the sum of both a discrimination and cost effect for consumers with intermediate values of u_i. Overall, if there is price discrimination, the marginal effects should be decreasing in u_i for consumers who are not constrained by the ceiling ($u_i < \underline{u}$).

The previous argument rests on the assumption that the shape of the lending cost function is independent of unobserved negotiation skills, and of factors determining the quality of consumers' outside options. This is justified in our context by the Nash bargaining assumption, which implies an additive functional form, and by the fact that we can control for a rich set of financial characteristics that we think approximate well the lending cost component.

To implement this idea empirically, we provide two methods to identify groups of consumers with heterogenous u_i. In Section IV(iii) we use quantile regressions to test the stability of the reduced-form relationship between observed covariates and transaction rates across different percentiles of the unobserved components of transaction prices (i.e., u_i in the model). Then, in Section IV(iv) we compare the marginal effects across contracts that were negotiated with and without the help of a mortgage broker. These two groups of transactions differ if brokers, on average, search more effectively for quotes, and/or if brokers use a different 'search-technology' (e.g., different $\mu(u_i)$ function). We perform this analysis controlling for the endogeneity of the broker decision.

IV(i). *Measuring Price Dispersion*

From the *Globe & Mail* newspaper archives we collected posted-mortgage rates on a weekly basis. Using this information along with our transaction data, we can calculate discounts and study their prevalence in the Canadian mortgage market. Table V presents the sample means and standard deviations for both the transaction price less the adjusted bond rate and the posted price less the adjusted bond rate.[17] The difference between the two

[17] Banks use swaps to hedge the fact that they hold short-term liabilities (deposits) and long-term assets (mortgages). As the swap market developed, bond rates (including mortgage rates), became more closely linked to banks' funding costs at long maturities (Allen and McVanel [2009]).

is the mean discount. Over the full sample, the mean discount is 68 basis points and the median is 73 basis points. The average discount represents 11 per cent of the posted interest rate.

Figure 3 characterizes the weekly evolution of three interest rates between 1992 and 2004: the median transaction rate, the median posted rate by the Big-8 banks, and the five-year swap-adjusted bond rate. The figure illustrates how discounting has become the dominant pricing policy over the 12 years of our sample. The market transitioned from an environment in which the median borrower paid the posted interest rate for most of the weeks before 1997, to one in which there exists a spread of about 100 basis points between the posted interest rate and the median transaction rate after 1999. Note that prior to 1997, but especially in 1994, there are some weeks where the median transaction rate appears to be above the posted rate. In principle, we should never see this since negative discounts are not permitted in Canada.[18] However, the premiums we observe come about because of how our data are administered and rates are negotiated. Typically, a borrower will negotiate a rate several weeks prior to the purchase of the home, and this rate can be adjusted until the purchase date. Since we only observe the closing date on the house sale, we identify the negotiation week by calculating the absolute difference between the transaction rate and the posted rate for the weeks within 90 days of the closing date, and take the smallest value, and/or the closest in time in case of a tie.[19] Therefore, if the posted rate falls and the borrower does not renegotiate, the discount could be counted as negative.

The average profit margin has remained remarkably stable over the entire period. Excluding 1994, the average transaction margin oscillated between 82 and 165 basis points. In other words, despite the increase in discounting, the average borrower is as well off in 2004 as in the early 1990's. However, these trends hide the fact that not all borrower-types experience gains relative to the posted rate. This can be seen in Figure 4. The boxplot illustrates the cross-sectional dispersion in transaction rates for 5-year fixed rate mortgages. Since there is a substantial amount of price dispersion coming from week-to-week changes in posted rates, we subtract from the transaction rate the within-week median. The figure reveals a fairly steady increase in the amount of cross-sectional dispersion between 1992 and 2000. There is a slight increase in dispersion from 1993 to 1994 related to the rapid increase in interest rates.

Despite our interest in discounts, the focus of our analysis in the remainder of the paper is on margins because we do not have the posted rate for

[18] In the U.S., for example, these premiums for high-risk borrowers are called 'overage' and there is evidence that they are more likely to be charged to minorities, e.g., Courchane and Nicerkson [1997].

[19] From this, we estimate that 44% of contracts are negotiated within 1 week of the closing week, and the remaining are uniformly distributed between 1 week and 90 days.

some of the smaller financial institutions. Transaction-level margins are measured by subtracting a five-year swap-adjusted bond rate. To study the importance of consumer-based pricing, we decompose the observed margin dispersion between four groups of observed covariates: closing month, financial characteristics, location (i.e., FSA), and lender/network size. Each category divides borrowers into discrete groups, and continuous variables are discretized by quartiles. The closing month variable quantifies the importance of the posted-rate on the cross-sectional dispersion of prices, while the other three groups approximate observed characteristics of each transaction: financial, market structure, and lender.

The results in Table VI summarize this variance decomposition for two periods: 1992–1998 and 1999–2004. In columns (1) and (3), we report the predicted and observed standard-deviation of margins for each group, as well as the residual and nominal dispersion. The overall standard deviation of margins is around 64 basis points in both periods. Over time, the importance of the residual dispersion component increased by 10 points, from 46 to 55 basis points, while the role of the posted-price shrank considerably, from 41 to 27 basis points. The rise of the predicted dispersion from the transaction characteristics explains the difference. Individually, however, these characteristics predict a relatively small amount of dispersion.

The *Variance decomp* measure splits the observed margin variance into its different components. Columns (3) and (4) confirm the increase in consumer-based pricing over time. It is clear that there is an important shift away from month-to-month pricing, with the fraction of the variance explained by *closing month* falling to 18% from 42%. As Figure 3 illustrates, this decline is easily explained by the fact that the fraction of consumers paying a rate within 10 basis points of the posted rate went from 70% in 1992–1993, to 24% between 1999–2004. The overall contribution of consumer financial characteristics increased from 1.6% to 2.3%. The fraction explained by location dummies increased the most, suggesting an important role for local market characteristics in determining transaction rates, including the level of competition between lenders. Overall, the major shift between the two periods is the rise in residual dispersion, which accounted for more than 74% of the total variance between 1999–2004, compared to 53% between 1992–1998.

Having documented the existence of price dispersion, in the remainder of this section we outline which consumer, contract and market characteristics are associated with higher and lower rates, and determine the extent to which variation related to these characteristics simply reflects cost differences, or instead is indicative of price discrimination.

IV(ii). *Who Receives Discounts?*

In this subsection we examine the marginal effects of covariates on rates. This part of the analysis is purely descriptive, and is informative about the

size of discounts systematically given to certain groups of consumers. In order to decompose margins into loan, bank, consumer, and market effects we estimate the following linear approximation of equation 1:

$$\text{Margin}_i = X_i\beta + \varepsilon_i, \tag{2}$$

where Margin_i is measured relative to the five-year bond-rate at the negotiation date, and X_i is a set of observed borrower and contractual variables.

Estimation results are presented in Table VII. All specifications include bank and week fixed effects, along with the FSA-level census variables. Column (1) uses all of the contracts from 1999 to 2004 and from both insurers, while column (2) uses only the CMHC sample. The reason is that the Genworth sample is missing information on certain demographic characteristics. Comparing columns (1) and (2) we can see that results are essentially unchanged. Columns (3)–(4) further restrict the data to various subsamples. In column (3) we drop the period from November, 2002, to August, 2004. TD-Canada Trust was experimenting with a no haggle policy during this period, which could have an effect on our estimates. In column (4) we restrict attention to contracts signed with the Big 8 financial institutions.

We consider first the effect of market structure on margins. We find that, on average, rates are higher in more branch-concentrated neighborhoods (*HHI*). In the full sample, a one-standard deviation increase in market concentration is associated with a 1.1% increase in margin. *Relative network* is a borrower-specific variable and is calculated as the fraction of branches in a neighborhood owned by the borrower's lender over the average branch network of other lenders. We conclude that consumers who choose to transact with larger network banks pay more. A one standard deviation increase in relative size is associated with a 1.9% increase in the banks' margin.

Turning to household characteristics, we start by studying the relationship between household income and rates. If we do not condition on house prices, we find that richer households pay lower rates. However, once we condition on house price, as we do in the table, we find a positive relationship between income and rates, suggesting that the negative correlation is due to house price. The house price variable reveals that more expensive homes are associated with discounts of about 27 basis points. We also find that financially constrained consumers (*min.down*) pay a big premium relative to unconstrained consumers. Putting down the minimum payment is associated with a 11 basis points increase in rates.

Next we look at the effect of credit worthiness on rates. Two sets of variables measure this in Table VII: credit score categories and access to other forms of credit (other debt). The literature on 'risk-based pricing' suggests that interest rate dispersion in many credit markets can largely be explained by heterogeneity in borrower risk levels and the ability of

financial institutions to discriminate between borrowers according to these differences. In our data, *CREDIT* is a categorical variable with four risk categories. The highest risk category represents the most creditworthy borrowers (credit scoring in Canada is done by the same two companies as in the United States: Equifax and TransUnion). The omitted category, *CREDIT1* represents borrowers who are the least credit worthy. Despite the fact that contracts are insured, we find that borrowers with better credit scores receive larger discounts.

The variable *Other Debt* measures consumers' access to other forms of credit, and our results suggest a similar negative relationship between rates and access: consumers with better access pay lower rates. However, it should be noted that this variable is subject to measurement error that biases the coefficient downwards. This error is related to the fact that we do not observe the actual negotiation date, and use the posted-rate at closing to recover an estimate of other debts from the TDS ratio. This creates a negative relationship between margins (also measured at closing), and other debts.

Renters, *Parents*, and *Switchers* all receive lower rates. The base category for *Renters* and *Parents* is *Previous home-owners*. Borrowers in the base category are likely older than in the other two categories. Our results suggest, therefore, that first-time buyers receive discounts relative to previous owners. The *Switcher* variable is an indicator equal to 1 if the borrower signs a mortgage with a financial institution that is not his/her main financial institution at the time of the mortgage origination. The lender is therefore attracting a new client. Our estimates suggest that new clients receive larger discounts than existing clients, on the order of 6.5 basis points over the full sample.

Over the full sample, the average impact of a mortgage broker is to reduce rates by 15 basis points. Using a broker, therefore, is associated with a reduction in monthly mortgage payments of about $19. In total, using a broker can save a borrower approximately $1,167 in interest costs over 5 years. Brokers are a significant factor, therefore, in driving discounts. This result is in sharp contrast to the mutual fund industry, for example, where Bergstresser, Chaimers and Tufano [2009] find that on a risk-adjusted basis, brokers actually delivered lower returns to consumers than direct channels between 1996–2004 in the U.S. It also appears to be in sharp contrast to the U.S. mortgage-broker experience where due to the lack of fiduciary duties, mortgage brokers led borrowers to sign unfavorable contracts (Hall and Woodward [2012] or Berndt, Hollifield, and Sandås [2010]). It should be pointed out that in our estimation there might be unobserved borrower characteristics that affect both the decision to shop with a broker and outcomes. For instance, financially literate borrowers are likely to get better rate quotes regardless of whether they use a broker or not. If these borrowers are also more prone to shop with a broker, this may

inflate the coefficient on the broker variable. On the other hand, the coefficient on the broker variable would be downward biased if poorer or more financially constrained households recognized that they would be at a disadvantage when bargaining and therefore more likely to hire a broker (similar to Scott Morton, Zettelmeyer and Silva-Risso [2003] in the car market). In Section IV(iv), we address this selection problem directly.

Columns (3)–(4) provide more disaggregated information. The results in column (3) are almost identical to those in (1) and (2) suggesting that the no-haggle policy of TD Canada Trust had little overall impact on the factors influencing discounting. Column (4) focuses on borrowers who sign mortgages at one of the eight largest mortgage providers (Big 8) in Canada. Given that the coefficients are largely the same across columns, the main conclusions are not being driven by the fringe institutions.

Our findings point to the possibility that the observed rate dispersion reflects price discrimination and not just cost differences across consumers/contracts. The fact that rates are higher in more concentrated markets suggests that financial institutions with greater market power can charge higher rates. Importantly, however, the number of competitors is not the only factor that influences rates. Our results are consistent with our hypothesis that the ability of consumers to put lenders into competition and to generate outside quotes may also play a role. Richer households pay higher rates, consistent with the fact that they are less inclined to engage in time-consuming search and negotiation. Switchers pay lower rates, a finding that is in line with the extensive literature documenting that loyal consumers' unwillingness to engage in search generates market power for firms (e.g., see Klemperer [1995]). Borrowers shopping through brokers, who typically search over more lenders, receive lower rates.

While differences in search costs may be a factor in explaining the positive income coefficient, it is also true that, conditional on loan size, richer households are more likely to pre-pay their mortgage early, yielding lower revenue for the lender. Also, the timing of home purchase creates a positive correlation between the interest rate levels and income: poorer households are more likely to qualify for mortgage insurance when interest rates are low. This is because the government/insurer imposes a maximum of 40% debt-service to income ratio.

Future profitability also explains our findings that financially constrained borrowers and borrowers with poorer credit scores pay higher interest rates. Our finding that first-time buyers pay lower rates is consistent with Goldberg [1996] who, in the context of the car market, finds evidence of price discrimination. She finds that households under the age of 30 who have not previously purchased a car receive discounts relative to experienced buyers. We can compare the dollar savings of our proxy for first-time buyers with Goldberg's proxy for first-time buyers. For the typical mortgage, first-time buyers save around $506 over 5 years. Goldberg [1996] finds that first-time

buyers receive a discount of approximately $440. The average car loan is approximately 70 months (*bankrate.com*), therefore the savings per year are $75, which is approximately what we find in the mortgage market.

While our findings are consistent with the presence of price discrimination in the mortgage market, so far we have only presented correlations. In the next two subsections our aim is to provide direct evidence of discriminatory behavior on the part of lenders.

IV(iii). *Quantile Regression Analysis*

We use quantile regression to implement our first test of price discrimination. For each covariate, we test whether or not the reduced-form marginal effect is constant across the percentiles of the unobserved components of transaction prices, and whether it is zero at the low end of the conditional distribution. Specifically, we re-estimate specification (1) from Table VII above for each conditional quantile:

$$(3) \qquad Q_\tau(\text{Margin}_i|X_i, \beta_\tau) = X_i\beta_\tau, \quad \text{for each} \quad \tau \in (0,1).$$

The conditional quantiles of the margin distribution capture the distribution of the outcomes of the negotiation, conditional on observed borrower and lender characteristics. Low quantiles represent borrowers who received a relatively large discount given the value of their covariates, while high quantiles are borrowers receiving almost no discount. By conditioning on a very rich set of financial characteristics that affect the profitability of the transaction, what is left largely reflects borrowers' unobserved bargaining leverage. If we assume for instance that differences in bargaining leverage stem from differences in search costs, then low quantiles are consumers with low search costs who are able to gather quotes from multiple lenders or with good negotiation skills, while higher quantiles are consumers with larger search costs.

The quantile regression results are presented in Table VIII. We estimate a separate quantile regression for each of five conditional percentiles: 5th, 25th, 50th, 75th, and 95th. For household characteristics such as income, credit scores, and other debt, a consistent non-linear pattern emerges where the marginal effect is smallest at the low end of the distribution, largest near the 75th percentile, and turns back toward zero at the top end. For example, the marginal effect of a better *CREDIT* score or of being a new consumer (*switcher*) on margins is increasing in the transaction rate up until the 75th percentile, at which point the marginal effect on margins begins to decrease. Differences in expected rates for consumers with good and bad credit-scores are larger in the middle of the margin distribution, than at the two ends. This particular non-linear shape implies less consumer-based pricing at the bottom and top of the conditional margin distribution.

In the last two columns of the table, we formally evaluate the statistical significance of this relationship by reporting the results of equality tests of coefficients at the 75th and 5th percentiles, and at the 95th and 75th percentiles. We chose the 75th percentile since it corresponds to the inflection point for most of the variables.[20] The majority of covariates are statistically different across the conditional distribution of rates. The exceptions are the *renter* and *parents* variables (where the omitted group is *previous home-owners*), and most of the LTV's.

What conclusions can we draw from the quantile analysis? At the top of the conditional margin distribution, the fraction of consumers paying the posted rate approaches one. Since the posted rate is effectively a price ceiling, and does not vary across banks or regions, the marginal effect of observed characteristics should be zero at the top. This interpretation is consistent with the fact that approximately 25% of consumers pay the posted rate, which implies an inflection point near the 75th percentile of the distribution. While we reject the null hypothesis of zero effect at the 95th percentile, the differences relative to the 75th percentiles are statistically significant almost everywhere. Most coefficients are between two and three times smaller in magnitude in column (5) than in column (4).

The fact that the coefficients are not all zero at the 95th percentile is reflecting the time-series variation in posted-rates, and the endogenous timing of home purchase. For instance, consumers are less likely to purchase expensive houses when interest rates are high, and poorer households are more likely to qualify for a loan when rates are low. Our results therefore suggest that inter-temporal variations in the posted rate affects the characteristics of consumers shopping for mortgages, especially the wealth and type of houses that are purchased.

As discussed above, differences between the bottom and middle of the distribution are consistent with discrimination. If transaction rates reflect solely consumer-specific lending costs, the marginal effects on rates should be constant across unobservable attributes of borrowers (up to the constraint imposed by the posted price). This is clearly not the case. Instead, for most characteristics, consumers at the bottom of the price distribution exhibit smaller marginal effects (in absolute values) than consumers near the 75th percentile. This suggests the presence of discrimination. Interpreting the distribution as stemming from search costs or bargaining ability leads us to conclude that lenders price differently depending on the bargaining leverage of borrowers.

Not all characteristics have a zero impact on margins at the bottom of the distribution. In fact only variables that we associate with the structure of the local market are such that the β_τ's are not statistically different from

[20] Figures of the same coefficients estimated across a finer percentile grid are available upon request.

zero at the top and bottom percentiles. This finding is consistent with our price discrimination interpretation: these variables should not affect the cost of lending, but rather the ability of consumers to gather competitive quotes. Consumers with good unobserved negotiation skills are therefore able generate enough competition between lenders to pay a rate equal to the lending cost, irrespective of how many lenders are present in their neighborhood. Similarly, consumers at the top of the distribution pay a rate that reflects the ceiling of the negotiation, either the posted price or the value of not buying a house, both of which are independent of our concentration measures.

For most of the other characteristics, the quantile estimates are different from zero across all percentiles. This suggests that borrower financial characteristics affect both the cost of lending, and the ability of lenders to price discriminate. Consider for instance the case of the coefficients associated with house-price. While consumers financing larger loans tend to receive larger discounts across all percentiles of the u distribution, consumers near the 75th percentile are particularly impacted by variations in house price. This is consistent with an interpretation that consumers financing larger loans have more incentive to actively search for discounts, and therefore, on average, have more bargaining leverage. This difference however is irrelevant for borrowers with good unobserved negotiation skills: for low percentile consumers consumers (i.e., high u_i's) the marginal effect of house price reflects only the impact of loan size on lenders' cost. Under this interpretation, the difference in this coefficient between the 75th-percentile and 5th-percentile borrowers isolates the effect of house price on consumers' incentive to gather more quotes.

Overall, we find evidence that consumers at the bottom of the price distribution exhibit smaller marginal effects than those near the middle of the distribution—market structure variables have zero effect at the bottom and other financial variables have smaller effects at the bottom than near the median. These findings suggest that, relative to borrowers at the bottom of the distribution, those in the middle are discriminated against.

IV(iv). *Broker Analysis*

Our second test compares the marginal effect of borrower and lender characteristics on rates across contracts that were negotiated with and without the help of a mortgage broker. These two groups of transactions differ because, as discussed in Section II, on average, brokers search for more quotes than do borrowers shopping independently. We therefore think of brokers as having more bargaining leverage than individual borrowers. In the context of the model, hiring a broker is akin to an upward shift in the distribution of u_i. If banks price discriminate, this should produce a change in the reduced form relationship between margins and

characteristics affecting the search effort of individual borrowers. This hypothesis is akin to the quantile test performed above.

Alternatively, it may be that the effort put forth by brokers is independent of the characteristics that shift the search intensity of borrowers. Mortgage brokers tend to establish repeated relationships with the same group of lenders, and are motivated by the desire to establish a reputation as a 'good' negotiator. Table IV illustrates that brokers transact with different lenders than consumers negotiating on their own. In particular, many broker contracts are issued by fringe banks or trust companies. These factors could imply that brokers are more likely to use a 'blind' search approach and gather the same number of quotes irrespectively of consumer characteristics X_i. This would correspond to a change in the form of the markup function $\mu(\cdot)$, rather than a shift in the u_i distribution. Importantly, if lenders engage in price discrimination when individually negotiating contracts, this would also produce statistically different marginal effects across the two groups. This second interpretation of the role of brokers makes this test different from the quantile test performed above.

As with the quantile test, the broker test relies on the assumption that broker use does not modify the marginal effect of covariates on costs: $\left|\frac{\partial c_i}{\partial X}\right|_{B=1}\Big| = \left|\frac{\partial c_i}{\partial X}\right|_{B=0}\Big|$. Therefore, if we observe a difference between the marginal effect of covariates on rates with and without brokers, then it must be that $\left|\frac{\partial m}{\partial X}\right|_{B=1}\Big| \neq \left|\frac{\partial m}{\partial X}\right|_{B=0}\Big|$. In other words, transacting through a broker rather than shopping alone changes the bargaining leverage of borrowers.

So far we have implicitly assumed that broker selection is independent of unobserved bargaining abilities. However, it is likely that unobserved factors correlated with u_i also affect the likelihood with which borrowers choose to use a broker. For instance, borrowers with poor negotiation skills might be more inclined to hire a broker. This would bias the broker-effect downwards, and induce a shift in the u_i distribution that is not *caused* by the behavior of brokers, but rather by the type of consumers selecting into the broker category.

In the empirical implementation, we correct for the endogenous selection of brokers using a control-function approach. In particular, our main estimating equation is similar to equation 2, but allows for heterogenous effects of borrower and lender characteristics:

$$\text{Margin}_i = X_i\beta + (X_i \cdot \text{Broker}_i)\beta_{\text{Broker}} + Z_i\gamma + \sigma\hat{\lambda}_i + \varepsilon_i, \tag{4}$$

where $\hat{\lambda}_i$ denotes the inverse-mills ratio associated with the probability of choosing a broker, and Z_i is a vector of control variables that we assume have homogenous effects on margins (week fixed-effects, aggregate census variables, missing-value indicators, province fixed-effects, etc). The X_i vector includes every financial and demographic characteristic of the

borrower, variables measuring the structure of local markets, and lender fixed-effects.

We model the probability of using a broker using a Probit model. In this first-stage regression, we include the same control variables used to explain margins, and also control for the presence of brokers near the purchased house. This represents our exclusion restriction assumption: the presence of mortgage brokers does not affect the negotiated rates directly, but determines the ability of consumers to use brokers. Borrowers who do not have brokers in their neighborhoods or who have a small selection of brokers to choose from should be less likely to use a broker than borrowers with many broker options.

We use two measures of broker presence: the number of broker agents and the ratio of broker agents to brokerage firms (hereafter denoted by the broker share). Both variables are measured within a 5 km radius of a borrower's FSA; the same choice-set definition we use for lenders. Between 1999 and 2004, brokers progressively entered nearly every market in our data-set, and increasingly organized their services into regional firms. The two variables therefore capture regional differences in the diffusion of brokers, and the increase in the concentration of the broker market. Since we also control for week and province fixed-effects, the two variables do not exploit variation due to aggregate trends or systematic regional differences in rates and adoption.[21]

We gathered broker location information from a directory of brokers collected annually by the Canadian Association of Accredited Mortgage Professionals. The directory has information on the broker and his/her associated firm. We then use Mapquest and Google Maps to measure distances from the households in our main data set to each broker-agent. The directory is missing for three years: 1999, 2000 and 2002. We first impute the 2002 locations by interpolating the number of agents and firms using the 2001 and 2003 data. Next, we impute the missing values for 1999/2000, by estimating a log-linear regression model of the number of agents and number of firms by FSA using the 2001–2004 data, controlling for region-level log-linear trends and FSA fixed-effects. We use the fitted values to predict the number of agents and average share in 1999 and 2000.[22]

The results are presented in Table IX. In column (1) we present the coefficients from the broker selection equation. High income borrowers are

[21] A potential limitation of the instruments is that they may be correlated with the unobservable characteristics of borrowers in a neighborhood. Specifically, brokers may enter markets where they perceive consumers to have poorer negotiating skills. We include province fixed effects and FSA-level census variables, which should lessen this concern.

[22] Qualitatively the results are not sensitive to how we impute the broker locations. We also experimented with using data on locations from 2005–2009 as an out-of-sample instrument and the results are similar. Results are also similar if we just use locations in 2001 or 2004 as the instrument.

less likely to use brokers, as are high credit-score borrowers, borrowers in markets with a high concentration of lenders. Credit-constrained borrowers are more likely to use a broker, as are renters and borrowers exiting from living with their parents. Importantly the two variables measuring the presence of brokers are highly significant. The chi-square statistic testing the null hypothesis of joint zero effect is equal to 39, and both variables have economically significant effects on the probability of using a broker. A one standard-deviation increase in the number of brokers (i.e., an increase of 6.4) is predicted to increase the probability of using a broker by 1.9%.

In columns (2) and (3) we show the marginal effects on rates assuming that $\beta_{\text{Broker}} = 0$ for all variables but the intercept. Column (2) presents results from the OLS regression without controlling for selection (as in column (1) of Table VII), and column (3) controls for the inverse-mills ratio. The coefficient σ is positive and significant, suggesting that not only is there selection on observables, but there is also selection on unobservables.

Comparing columns (2) and (3) we can see that not correcting for selection leads to a downward bias in the broker coefficient. The sign of the bias suggests that households who would otherwise negotiate relatively smaller discounts on their own for unobserved reasons are more likely to hire a broker. This bias is sizeable: we estimate that brokers are able to negotiate rates that are on average 40 basis-points lower than individual borrowers, compared to 15 basis-points in column (2). Column (3) also shows that part of this difference is induced by a change in some of the coefficients affected by the inclusion of the inverse-mills ratio. This is especially the case for variables that are strongly correlated with the decision to use a broker, such as the *switcher* and new-home buyer variables (i.e., *renters* and *parents*). For instance, when controlling for selection we find that rates for *switchers* are no longer statistically different from those for loyal consumers. In contrast, they are found to be 11 bps lower without the correction.

Our discrimination test is based on the results reported in column (6), which calculate the difference between columns (4) and (5). These columns show the relative importance of contractual and demographic characteristics for broker transactions versus individual transactions. We do not report the average effect of brokers in this specification since the model allows for heterogenous effects of brokers across lenders.

The first thing to note from comparing columns (4) and (5) is that for most of the covariates, the coefficients in the broker sample are significantly different than those from the branch sample. As in the quantile regressions above, this suggests that banks are able to price discriminate between borrowers with different bargaining leverage.

The difference is most important for variables related to loan size and down-payment. For these groups of variables, we find that the marginal effects are closer to zero in the broker sample. Borrowers with smaller

down-payments pay significantly higher rates than those with bigger down-payments in the branch sample, but this difference is insignificant in the broker sample. The same is true of the *house price* variable. These findings are consistent with the fact that borrowers who are credit-constrained or financing larger loans are less likely to engage in time-consuming search and negotiation. Therefore, when shopping alone, these borrowers are discriminated against. Since brokers either search over more lenders and/or are unaffected in their effort by variables that influence the search intensity of consumers, price discrimination disappears or is diminished in the broker sample.

We also find that borrowers transiting out of renting or living with their parents pay lower rates than previous home owners in the branch sample, but this difference is insignificant in the broker sample. This difference is the largest for borrowers living with their parents. Recall that these are likely younger households shopping for their first mortgage. This suggests that younger households are putting relatively more effort in shopping for discounts than brokers, and/or that brokers do not use the age of borrowers when negotiating on their behalf. A survey conducted by Ipsos-Reid (Ipsos-Reid (1999–2006)) for the Bank of Canada confirms the first hypothesis. New home-buyers are 20 per cent more likely to gather multiple quotes than previous home owners and renewers (i.e., 70% versus 50%).

The same factors are at play when it comes to the market structure variables. The difference is negative and statistically significant, which implies that borrowers shopping alone in more concentrated neighborhoods have less bargaining leverage, and end up paying higher rates. However, concentration and the relative network of lenders does not affect rates negotiated by brokers. This is consistent with the idea that brokers typically transact with smaller financial institutions, and might gather quotes from lenders located in other markets.

Borrowers with higher credit scores pay significantly lower rates than those with poorer scores in both the branch and broker samples. Looking at the results in column (6) we see that, relative to the lowest credit-score category, choosing to use a broker lowers rates by roughly five basis points. This gain is constant across intermediate and high credit-score loans. The fact that this difference is constant implies that consumers in the lowest credit-score category pay higher rates when they transact with a broker than when they search on their own. In contrast, the intermediate and high credit-score types pay roughly the same rates with and without brokers. Therefore, price difference across credit-score types are amplified when using a broker, unlike what we see for loan size, downpayment and market structure.

Not all results are consistent with our conclusions from the quantile regressions. This is particularly the case for loyal consumers, and for the income variable. Contrary to the quantile regression results, the premium

paid by loyal consumers is not statistically different across the broker and non-broker contracts. The same is true of the income variable. These differences offer some support for our second interpretation of the role of brokers, namely that they engage in 'blind' search.

Finally, it is interesting to note that after interacting the variables with the broker dummy in columns (4) and (5), the inverse-mills ratio coefficient is not statistically different from zero. This suggests that the endogenous selection bias that we find in the first two specifications is mostly caused by the fact that the reduced-form pricing equation differs between broker and non-broker transactions. Unreported specifications clearly show that this is mostly due to the fact that banks offer *different* average discounts to brokers (e.g., some banks charge *more* to brokers on average), and that brokers tend to deal with different types of lenders.

Overall, our results suggest that brokers engage in more search, since the average interest rate is significantly lower in the sample of broker-negotiated contracts. Our analysis does not permit to say which of the two interpretations is more important (i.e., blind or better search), but our results are consistent with the notion that price discrimination is mitigated by brokers.

V. DISCUSSION

The evidence presented here shows that there is considerable rate dispersion in the Canadian mortgage market. Our findings suggest that once the effect of risk screening has been removed, dispersion in the mortgage market arises from the same sources as in traditional retail markets where a number of studies have documented important dispersion in prices (see for example Borenstein and Rose [1994], Goldberg [1996], Lach [2002], and Delgado and Waterson [2003]). Our tests provide support for the hypothesis that part of the observed dispersion in rates is caused by price discrimination in which lenders charge higher rates to borrowers with poor bargaining leverage. In particular, we find that consumers with poor financial characteristics and little leverage pay relatively higher rates than consumers with the same characteristics, but better leverage.

Our analysis is descriptive, and does not quantify the relative importance of price discrimination versus unobserved lending cost heterogeneity in explaining dispersion. However, our quantile analysis suggests that financial characteristics of borrowers affect the lending cost of banks, and therefore a sizeable fraction of the observed rate dispersion is due to borrower-specific cost heterogeneity. In particular, we find that borrowers financing larger loans, and those with low financial risks, obtain larger discounts. This is true even at the low-end of the price distribution.

There are a number of reasons that costs could differ across borrowers, despite the fact that we study insured contracts. Borrowers are allowed to

prepay a certain fraction of their mortgage, which can lower the expected revenue from the mortgage for the lender. Although we do not observe the *ex-post* performance of each contract, recent surveys suggest that annual pre-payment amounts and payment frequencies greatly vary across borrowers (Deng, Quigley and Order [2000]). There are also transaction costs associated with default and delinquency, and heterogeneity in the likelihood of default across borrowers. In addition there is heterogeneity in the future profitability of consumers to the lender. First, given the one-stop shopping nature of Canadian banking, there are profits stemming from the purchase of complementary services, with some borrowers consuming more of these other services. Second, because of the structure of Canadian mortgage contracts, there are profits arising from future contracts signed between the two parties, with some borrowers being more likely to renegotiate with their current lender than others, and having larger amounts remaining to finance.

Our findings have important implications for regulators designing mortgage market policies. Given the increasing levels of concentration in mortgage markets throughout the world, there is concern as to the extent to which these markets are competitive. Our results confirming the presence of price discrimination imply that mortgage markets, at least in Canada, are something less than competitive. However, this lack of competition is consumer specific. Consumers able to generate competition amongst lenders pay rates that reflect their effective marginal cost, while those who are unable to do so pay rates above this.

The theory literature on price discrimination provides ambiguous predictions with respect to the welfare impact of price dispersion, since it mostly involves monetary transfers between heterogeneous groups of consumers. In the context of mortgage lending however, the presence of significant residual rate dispersion can distort borrowing decisions by increasing the risk of default on consumers with poor negotiation skills and encouraging some consumers to borrow excessively. We find for instance that financially constrained borrowers pay a significant premium when negotiating on their own, and that consumers financing larger loans are able to obtain sizeable discounts by putting more effort into search. The resulting dispersion, if it leads to higher default probability, can induce systemic risks and generate negative externalities on the overall market.[23] These considerations are absent from the traditional welfare calculations judging the impact of price discrimination, but should be part of the policy debate surrounding the regulation of consumer financial markets.

Of course these welfare effects will differ depending on borrower characteristics. Borrowers paying higher rates with high credit risk may be more

[23] For example, if price discrimination leads to excessive leverage by certain households, then these will be more vulnerable to negative shocks, with potential macroeconomic effects through the demand channel (Main and Sufi [2012]).

likely to default than borrowers with high income paying higher rates. Note that there may also be related distributional effects from the conduct of monetary policy when mortgage rates are related to things other than cost, such as search or market power. For instance, our finding that financially constrained borrowers pay the highest rates suggest an amplification effect of monetary policy, since these are the borrowers who can least afford a rate increase. Survey evidence suggests that a significant fraction of borrowers would not be able to make their payments if interest rates rose even slightly.[24]

Our results also suggest that the number of banks in a market may be less relevant than consumers' ability to put whatever number of banks are present into competition by searching over and negotiating with multiple lenders. Search and negotiation makes discrimination more difficult. These findings point to the need for policies aimed at increasing financial literacy in order to improve the negotiation abilities of borrowers. Recent papers on literacy and the sophistication of borrowers, Hall and Woodward [2012], Campbell, Jackson, Madrian and Tufano [2011], Campbell [2009], Geraldi, Goette and Meier [2010], all point to the fact that deficiencies in this area can lead consumers to overpay for loans. Possible remedies for this problem include (i) improved transparency in the lending process and in particular in rate setting, (ii) fiduciary duties for brokers (where brokers do not yet have them), and (iii) no-haggle pricing. We discuss each in turn.

Greater transparency about rate setting could be achieved by having the government publish information on the distribution of discounts as a function of groups of characteristics. To this end, the Canadian government has just established a Code of Conduct for Federally Regulated Financial Institutions designed to enhance borrower awareness and to 'explain the differences between mortgage products, including ways to pay off a mortgage faster without incurring penalties.'

The evidence we have presented above suggests that brokers with fiduciary duty are able to generate better offers for borrowers transacting through them. Moreover, our results provide evidence that brokers make discrimination based on most financial characteristics more difficult: we observe less dispersion based on observed characteristics for contracts negotiated through brokers. These findings are in contrast to the results in Hall and Woodward [2012], which show that brokers without fiduciary duty benefit from confusion in the lending and rate setting processes to

[24] The 2011 CAAMP survey found that 4% of mortgage holders claimed that they would not be able to afford their mortgage if interest rates rose by 25 basis points. 21% of borrowers claimed they could not afford their mortgage if rates increased by anywhere from 25 basis points to 199 basis points. In 2010 only 2.6% and 15.5% answered the same questions, respectively.

charge higher rates. Recent initiatives in the U.S. have moved towards improving transparency and protecting consumers. These include the new Consumer Financial Protection Bureau which has as a goal to educate consumers about mortgages, the Secure and Fair Enforcement for Mortgage Licensing (SAFE) Act, which requires U.S. states to enforce licensing of mortgage brokers according to a national standard, and the Loan Officer Compensation rule, a Federal Reserve Board rule governing compensation of mortgage brokers.

The adoption by the banks of a no-haggle pricing policy would eliminate the need for consumers to engage in costly search and difficult bargaining, and in so doing, remove the possibility for lenders to discriminate on the ease with which different consumers can perform these functions.

It is important to note, however, that policies designed to increase transparency or improve financial literacy may have significant distributional effects, and that not all consumers will benefit. Borrowers with good leverage will not be helped by these policies, and may actually be harmed if prices are more uniform as they would be under a no-haggle policy. In contrast, policies designed to increase competition by bringing more negotiation partners to the table will serve only to benefit those consumers who engage in search and negotiation. Consumers unable or unwilling to obtain multiple quotes will not be affected by the level of competition in the market. The other side of this is that policies designed to limit concentration, for instance by preventing mergers, will provide limited benefit for those consumers paying the highest rates.

Our results are also relevant for the design of regulations for consumer financial markets more broadly. Our finding that credit scores are associated with price discrimination in the absence of credit risk suggests a dual role for credit scoring in traditional credit markets. Specifically, credit scoring not only improves the lender's signal about expected credit losses, but also reveals something about the extent to which the borrower will be discriminated against. Again, this suggests an increased role for transparency. Borrowers must be made aware of the benefits of generating more competition at the quote gathering stage. Individual characteristics will influence rates only for those borrowers able to generate competition.

In closing, we should point out that the results presented here may also be relevant for health and other insurance markets. In these cases, there is significant price dispersion, which could either be explained by cost/risk differences or price discrimination, or both. Consumers in these markets must also negotiate rates with individual firms and can search over and negotiate with competing players in order to achieve better rates.

APPENDIX A. FIGURES

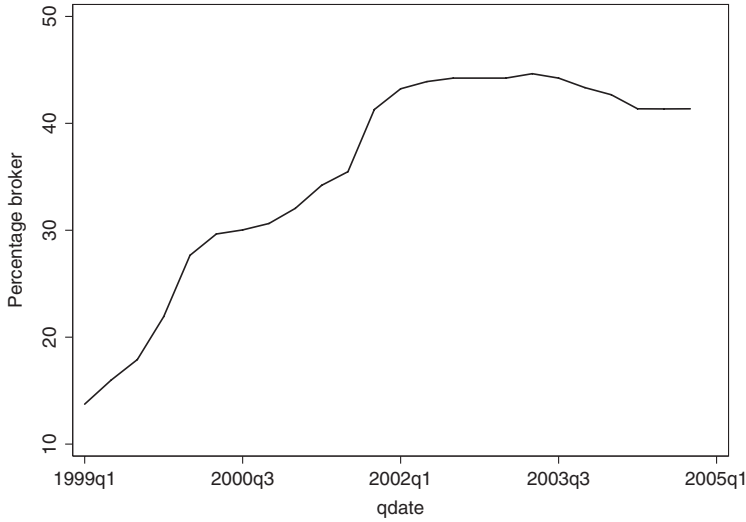
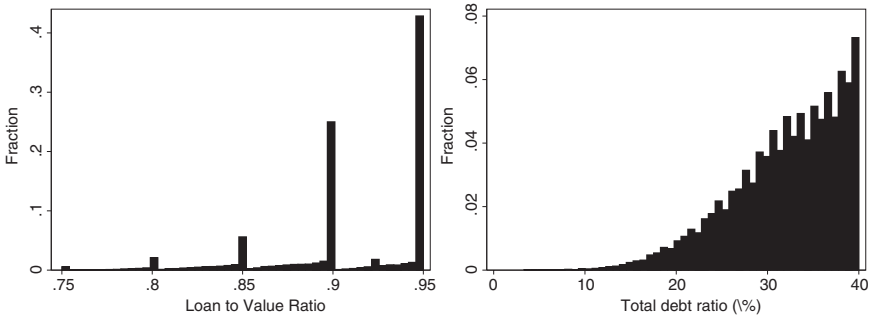


Figure 1
Share of New Contracts Negotiated with Mortgage Brokers



(a) LTV (b) TDS

Figure 2
Loan to Value and Total Debt Service Ratios: 1999–2004

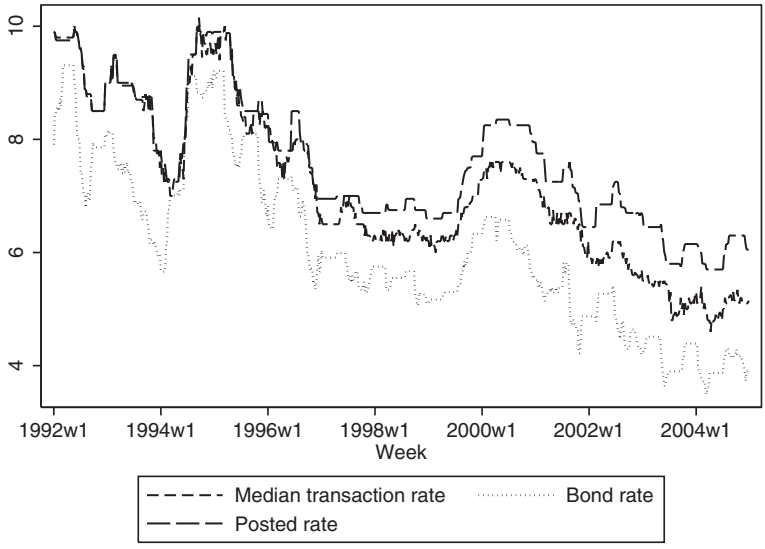


Figure 3
Evolution of Mortgage Interest Rates and the Five-Year Bond Rate between 1992 and 2004

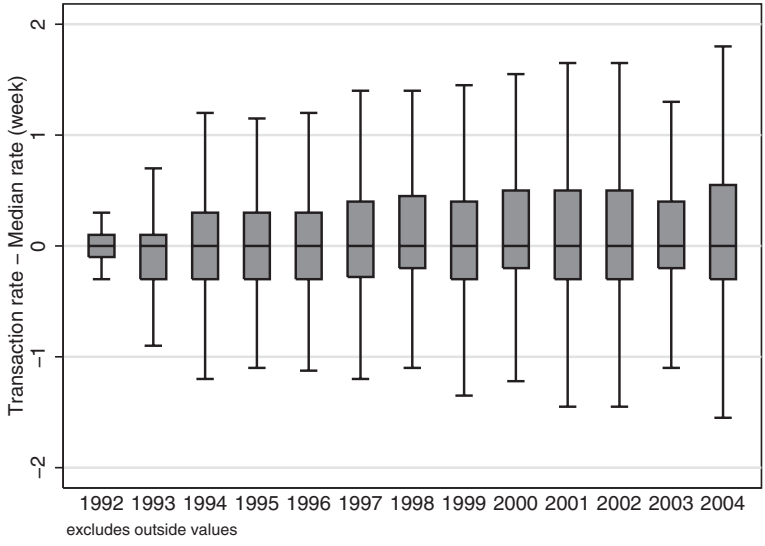


Figure 4
Transaction Rates for 5-year Fixed Rate Mortgage Minus the Within–Week Median Rate
Notes: Each vertical box represents the inter-quartile range of the transaction rate deviation from the weekly median. The whisker lines above and below the box represents the adjacent values determined by STATA box-plot routine.

APPENDIX B. TABLES

TABLE I
BANKING HABITS OF CANADIANS: 1999–2006

Account	Main FI	Second FI	All other FI
Mortgage (all)	67.4%	10.9%	21.7%[a]
Mortgage (no broker)	70.3%	10.8%	18.9%
Mortgage (broker)	37.3%	30.6%	32.1%
Loan	55.8%	9.6%	34.6%
Credit card[b]	77.9%	20.7%	1.4%
GIC or term deposit	72.8%	15.8%	11.4%
Bonds, t-bills, other guaranteed invest's	45.3%	7.8%	46.9%
Mutual funds[c]	38.8%	7.2%	54.0%

Notes: We report summary statistics on bank account(s) usage using data from an annual survey conducted by Ipsos-Reid called the Canadian Financial Monitor. The survey consists of approximately 12,000 households per year. Allen, Clark and Houde [2008] use this survey to analyze the diffusion of electronic banking in Canada between 1998–2006. We define a household's main financial institution as the institution corresponding to the most active checking account.
[a]Most mortgages classified as 'other' have the lender as category 'any bank' or 'any credit union', which does not match with the more specific name the respondent provided when responding to the question about their main financial institution. [b]The credit card category excludes retail cards. The average household has 2.5 cards although half of these are retail cards, which can only be used at the retail outlet that issued the card. GIC is an acronym for Government Investment Certificate. These are fixed term deposits, typically 1–3 years. [c]Investor Group Inc. has the largest market share of the mutual fund industry in Canada and they are not a deposit-taking institution which explains the relatively low share of mutual funds held at households' main financial institution.

TABLE II
DEFINITION OF HOUSEHOLD / MORTGAGE CHARACTERISTICS

Name	Description
FI	Type of lender
Source	Identifies how lender generated the loan (branch, online, broker, etc)
Income	Total amount of the borrower(s) salary, wages, and income from other sources
TSD	Ratio of total debt service to income
Duration	Length of the relationship between the borrower and FI
R-status	Borrowers residential status upon insurance application
FSA	Forward sortation area of the mortgaged property
Market value	Selling price or estimated market price if refinancing
Applicant type	Quartile of the borrowers risk of default
Dwelling type	10 options that define the physical structure
Close	Closing date of purchase or date of refinance
Loan amount	Dollar amount of the loan excluding the loan insurance premium
Premium	Loan insurance premium
Purpose	Purpose of the loan (purchase, port, refinance, etc.)
LTV	Loan amount divided by lending value
Price	Interest rate of the mortgage
Term	Represents the term over which the interest rate applies to the loan
Amortization	Represents the period the loan will be paid off
Interest type	Fixed or adjustable rate
CREDIT	Summarized application credit score (minimum borrower credit score).

Notes: Some variables were only included by one of the mortgage insurers.

TABLE III
SUMMARY DESCRIPTION OF DISCRETE VARIABLES: 1999–2004

Variable	Choice	Percentage of Contracts
Source	branch	64.5%
	broker	35.5%
Dwelling type	detached	63.3%
	semi-detached	12.3%
	row or mobile	11.9%
	apartment/condo	12.3%
Residential status[†]	own	21.6%
	rent	69.6%
	parents	8.8%

[†]Information on residential status is only available for CMHC-insured contracts.

TABLE IV
BROKER USAGE BY FINANCIAL INSTITUTION TYPE: 1999–2004

	Broker	Bank Branch
Big 6	28.0	72.0
Credit Unions	31.4	68.6
Trust companies	56.7	43.3
Other Financial institutions	79.8	20.2

TABLE V
SUMMARY DESCRIPTION OF CONTINUOUS VARIABLES: 1999–2004

Variable	Mean	Median	Std. Dev.
Borrower/lender relationship			
full sample	48.0 mth	2 mths	71.4 mths
home-owners	67.7 mths	40 mths	80.8 mths
non-home-owners	41.3 mths	1 mth	66.9 mths
Loan amount			
full sample	$143,849	$134,440	$60,908
previous owners	$153,270	$143,078	$65,516
new owners	$141,243	$131,156	$60,532
Buying price of house			
full sample	$158,760	$147,619	$68,943
previous owners	$171,847	$159,203	$75,611
new owners	$154,950	$143,327	$67,853
LTV			
full sample	91.1	91.6	4.47
previous owners	89.7	90.0	4.90
new owners	91.6	93.5	4.22
Household income			
full sample	$67,953	$63,846	$26,821
previous owners	$76,638	$72,125	$29,684
new owners	$65,692	$62,032	$25,287
TDS			
full sample	32.1	33.0	5.96
previous owners	32.9	34.1	5.77
new owners	32.4	33.3	5.78
Transaction price minus adjusted bond rate			
full sample	1.23%	1.17%	0.65%
previous owners	1.26%	1.20%	0.65%
new owners	1.24%	1.19%	0.63%
Posted price minus adjusted bond rate	1.91%	1.90%	0.43%
HHI (5KM)	0.2020	0.1797	0.1111
Relative network (5KM)	1.27	1.11	0.99

Notes: Nominal values are deflated using the consumer price index, base = 2002. The home-owner and non-home-owner categories are based on CMHC data, since CMHC is the only insurer to collect this information. The same is true for the borrower/lender relationship variable. The full sample is CMHC and Genworth combined. Cost of funding is based on the five year bond rate.

TABLE VI
VARIANCE DECOMPOSITION

	Period: 1992–1998		Period: 1999–2004	
	Group std-dev (1)	Variance decomp. (2)	Group std-dev (3)	Variance decomp. (4)
Groups				
Closing month	0.406	0.421	0.269	0.180
Financial charcteristics	0.079	0.016	0.096	0.023
Location	0.093	0.022	0.129	0.041
Lender/network size	0.061	0.009	0.085	0.018
Residual dispersion	0.456	0.531	0.546	0.738
Nominal dispersion	0.633		0.641	

Notes: The observed dispersion is decomposed between groups by projecting observed transaction margins on four groups of categorical variables: $y_i = \alpha + \sum_{x=1}^{4} \sum_{j=1}^{J_x} 1(x_i = j)\beta_{xj} + e_i$, where x refers to period dummies (weeks), discrete financial attributes (loan X LTV X Income quartiles), location dummies (FAS), and lender/network size categories (Lender X relative network size deciles). ***Group std-dev*** refers to the standard-deviation of β_{xj} across categories j within each group x, weighted by the number of observations within each category. ***Variance decomposition*** measures the share of the total variance attributed to each group.

TABLE VII
REGRESSION RESULTS INCLUDING OBSERVABLE BORROWER/LENDER CHARACTERISTICS
(1999–2004)

Dependent Variable: Transaction Rate minus adjusted bond rate (margin)

VARIABLES	(1) Full	(2) CMHC	(3) Haggle	(4) Big 8
log(House price)	–0.27†	–0.26†	–0.28†	–0.27†
	(0.0085)	(0.0090)	(0.010)	(0.0095)
log(Income)	0.20†	0.21†	0.20†	0.19†
	(0.0099)	(0.010)	(0.012)	(0.011)
log(Other debt)	–0.075†	–0.076†	–0.076†	–0.077†
	(0.0042)	(0.0046)	(0.0049)	(0.0047)
$0.85 \leq LTV < 90$	0.018†	0.0076	0.030†	0.043†
	(0.0068)	(0.0074)	(0.0079)	(0.0073)
$0.90 \leq LTV < 0.95$	0.044†	0.036†	0.055†	0.081†
	(0.0086)	(0.0093)	(0.010)	(0.0090)
Min. down	0.11†	0.077†	0.10†	0.15†
	(0.0078)	(0.0083)	(0.0090)	(0.0081)
CREDIT2	–0.068†	–0.079†	–0.076†	–0.056†
	(0.0056)	(0.0059)	(0.0063)	(0.0066)
CREDIT3	–0.11†	–0.13†	–0.12†	–0.10†
	(0.0055)	(0.0061)	(0.0064)	(0.0061)
CREDIT4	–0.16†	–0.17†	–0.17†	–0.14†
	(0.0056)	(0.0060)	(0.0065)	(0.0062)
Renters	–0.016†	–0.015†	–0.014‡	–0.020†
	(0.0053)	(0.0053)	(0.0064)	(0.0060)
Parents	–0.065†	–0.061†	–0.067†	–0.067†
	(0.0086)	(0.0086)	(0.010)	(0.0094)
Switcher	–0.11†	–0.12†	–0.12†	–0.077†
	(0.0063)	(0.0064)	(0.0074)	(0.0070)
Relative network	0.020†	0.018†	0.019†	0.018†
	(0.0043)	(0.0048)	(0.0047)	(0.0044)
Branch HHI	0.064†	0.070†	0.062‡	0.075†
	(0.021)	(0.024)	(0.026)	(0.023)
Broker	–0.15†	–0.13†	–0.15†	–0.17†
	(0.0060)	(0.0067)	(0.0071)	(0.0065)
Observations	84,197	66,904	59,029	69,308
R-squared	0.320	0.325	0.349	0.323

Notes: *HHI* is the Herfindahl-Hirschman Index of branches in a borrowers 5KM neighborhood. *Relative network* is the fraction of branches owned by the lender in the borrowers 5KM neighborhood. *Renter* is a dummy variable equal to 1 if the borrower was a renter prior to applying for a mortgage. *Parents* is a dummy variable equal to 1 if the borrower was living with his/her parents prior to applying for a mortgage. Renters and Parents are relative to previous owners. *Switcher* is a dummy variable indicating a borrower has signed a mortgage with a financial institution that is not their main financial institution. *Broker* is a dummy variable equal to 1 if the borrower used a broker to facilitate the mortgage transaction. There are 4 credit categories, the base is *CREDIT1*. The highest credit category represents the most creditworthy borrowers. Income and the house price are divided by one hundred-thousands, and Other debt is measured in thousands of dollars. Column (1) has both Genworth and CMHC households while Columns (2)–(4) use only CMHC households. Column (3) excludes the Nov 2002–December 2004 period because TD Bank experimented with a no haggle pricing policy. Column (4) includes borrowers only at the largest 8 financial institutions. Controls include FSA census variables in 2001. We include week and bank fixed effects in all specifications. Standards errors are clustered at the FSA level. †$p < 0.01$.

TABLE VIII
QUANTILE REGRESSION RESULTS INCLUDING OBSERVABLE BORROWER/LENDER CHARACTERISTICS (1999–2004)

Dependent Variable: Transaction Rate minus adjusted bond rate (margin)

						P-Values	
VARIABLES	(1) Q-0.05	(2) Q-0.25	(3) Q-0.5	(4) Q-0.75	(5) Q-0.95	(1) = (4)	(5) = (4)
log(House price)	–0.14†	–0.17†	–0.25†	–0.31†	–0.18†	0.00	0.00
	(0.011)	(0.0052)	(0.0076)	(0.010)	(0.010)		
log(Income)	0.089†	0.11†	0.18†	0.25†	0.18†	0.00	0.00
	(0.013)	(0.0060)	(0.0086)	(0.011)	(0.011)		
log(Other debt)	–0.055†	–0.043†	–0.058†	–0.070†	–0.043†	0.08	0.00
	(0.0061)	(0.0027)	(0.0039)	(0.0053)	(0.0052)		
Low LTV	0.025†	0.012†	0.021†	0.024†	–0.003	0.95	0.00
	(0.0090)	(0.0043)	(0.0064)	(0.0091)	(0.0092)		
High LTV	0.046†	0.028†	0.039†	0.044†	0.0089	0.93	0.00
	(0.011)	(0.0054)	(0.0080)	(0.011)	(0.012)		
Min down	0.061†	0.051†	0.085†	0.14†	0.083†	0.00	0.00
	(0.0094)	(0.0045)	(0.0067)	(0.0095)	(0.0097)		
CREDIT2	–0.030†	–0.046†	–0.072†	–0.095†	–0.055†	0.00	0.00
	(0.0072)	(0.0035)	(0.0052)	(0.0074)	(0.0075)		
CREDIT3	–0.045†	–0.071†	–0.12†	–0.16†	–0.095†	0.00	0.00
	(0.0071)	(0.0035)	(0.0052)	(0.0073)	(0.0074)		
CREDIT4	–0.071†	–0.090†	–0.15†	–0.21†	–0.14†	0.00	0.00
	(0.0072)	(0.0035)	(0.0052)	(0.0073)	(0.0074)		
Renters	–0.008	–0.014†	–0.020†	–0.020†	–0.012	0.27	0.38
	(0.0074)	(0.0035)	(0.0053)	(0.0074)	(0.0076)		
Parents	–0.031†	–0.032†	–0.054†	–0.089†	–0.069†	0.00	0.17
	(0.012)	(0.0056)	(0.0084)	(0.012)	(0.012)		
Switcher	–0.054†	–0.064†	–0.096†	–0.15†	–0.085†	0.00	0.00
	(0.0073)	(0.0036)	(0.0053)	(0.0076)	(0.0081)		
Relative network	0.002	0.013†	0.023†	0.029†	0.014†	0.00	0.00
	(0.0034)	(0.0016)	(0.0024)	(0.0035)	(0.0035)		
Branch HHI	0.018	0.089†	0.13†	0.082†	0.02	0.01	0.02
	(0.024)	(0.012)	(0.018)	(0.024)	(0.024)		
Broker	–0.085†	–0.083†	–0.14†	–0.19†	–0.11†	0.00	0.00
	(0.0063)	(0.0032)	(0.0047)	(0.0067)	(0.0070)		
Observations	84,182	84,182	84,182	84,182	84,182		

Notes: The regressors are the same as in Table VII. All columns include week and bank fixed effects as well as province fixed effects and FSA level census variables. Columns (1)–(5) are estimated separately for each conditional quantile: 0.05, 0.25, 0.5, 0.75, and 0.95. The last two columns report the p-values corresponding to the tests that each coefficient evaluated at the 75th percentile is equal to its value evaluated at the 5th and 95th percentiles, respectively. The tests are constructed by jointly estimating three quantile regressions (5%, 75% and 95%), and performing 20 bootstrap replications. †$p < 0.01$.

TABLE IX
BROKER REGRESSION RESULTS INCLUDING OBSERVABLE BORROWER/LENDER CHARACTERISTICS (1999–2004)

Dependent Variable: Transaction Rate minus adjusted bond rate (margin)

VARIABLES	(1) Pr(Broker) Marginal effects	(2) Joint OLS	(3) Joint CF	(4) Non-broker CF	(5) Broker CF	(6) Difference (5)–(6)
log(House price)	0.19†	–0.27†	–0.25†	–0.31†	–0.18†	0.13†
	(0.025)	(0.0085)	(0.0086)	(0.0096)	(0.013)	(0.015)
log(Income)	–0.31†	0.20†	0.18†	0.20†	0.18†	–0.028
	(0.026)	(0.0099)	(0.0099)	(0.012)	(0.017)	(0.019)
log(Other debt)	0.0036	–0.075†	–0.075†	–0.071†	–0.079†	–0.0085
	(0.012)	(0.0042)	(0.0042)	(0.0052)	(0.0072)	(0.0090)
$0.85 \leq LTV < 90$	0.064†	0.018†	0.022†	0.041†	–0.028‡	–0.069†
	(0.020)	(0.0068)	(0.0068)	(0.0078)	(0.013)	(0.014)
$0.90 \leq LTV < 0.95$	–0.021	0.044†	0.042†	0.066†	–0.0026	–0.068†
	(0.023)	(0.0086)	(0.0086)	(0.010)	(0.015)	(0.018)
Min. down	0.12†	0.11†	0.12†	0.14†	0.058†	–0.078†
	(0.021)	(0.0078)	(0.0079)	(0.0088)	(0.014)	(0.016)
CREDIT2	–0.025	–0.068†	–0.069†	–0.049†	–0.10†	–0.052†
	(0.014)	(0.0056)	(0.0056)	(0.0072)	(0.0088)	(0.011)
CREDIT3	–0.085†	–0.11†	–0.12†	–0.095†	–0.15†	–0.053†
	(0.016)	(0.0055)	(0.0056)	(0.0069)	(0.0093)	(0.012)
CREDIT4	–0.085†	–0.16†	–0.17†	–0.14†	–0.20†	–0.068†
	(0.016)	(0.0056)	(0.0056)	(0.0069)	(0.0088)	(0.011)
Renters	0.31†	–0.016†	0.002	–0.030†	0.024†	0.054†
	(0.015)	(0.0053)	(0.0057)	(0.0066)	(0.0091)	(0.0098)
Parents	0.15†	–0.065†	–0.055†	–0.074†	–0.023	0.051†
	(0.025)	(0.0086)	(0.0086)	(0.0096)	(0.015)	(0.017)
Switcher	1.25†	–0.11†	–0.012	–0.087†	–0.080†	0.0065
	(0.023)	(0.0063)	(0.014)	(0.015)	(0.018)	(0.012)
Relative network	–0.12†	0.020†	0.012†	0.025†	–0.0011	–0.026†
	(0.020)	(0.0043)	(0.0044)	(0.0043)	(0.0060)	(0.0057)
Branch HHI	–0.31†	0.064†	0.04	0.094†	–0.02	–0.11†
	(0.079)	(0.021)	(0.021)	(0.023)	(0.035)	(0.038)
Broker	0.031	–0.15†	–0.40†			
	(0.016)	(0.0060)	(0.032)			
Inverse mills ratio	0.0091†		0.14†	0.025	0.025	0.025
	(0.0018)		(0.018)	(0.020)	(0.020)	(0.020)
Broker share	0.011*					
	(0.005)					
Nb. of agents	0.003†					
	(0.0006)					
Observations	84,197	84,197	84,197	84,197	84,197	84,197
R-squared		0.32	0.321	0.327	0.327	0.327
First stage χ^2	39.2					

Notes: The regressors are the same as in Table VII. All columns include week and bank fixed effects as well as province fixed effects and FSA level census variables. Column (1) shows the marginal effects from a Probit regression for broker choice. Column (2) shows the marginal effects from a least squares margin regression. Columns (3)–(5) shows the marginal effects from the same margin regression, but controlling for endogenous selection of brokers using the Inverse Mills Ratio. Columns (4)–(5) report the coefficients of regression specification in which the key explanatory variables are interacted with the branch-managers and brokers dummy variable (i.e. financial attributes and bank fixed-effects). Standard errors are clustered at the FSA level. First-stage χ^2 statistics test the null hypothesis that the broker share and number of agents have zero effects on broker choice probability. †$p < 0.01$, ‡$p < 0.05$, *$p < 0.1$.

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