Counteroffers and Price Discrimination in Mortgage Lending☆

Steven Ongena [a,*], Florentina Paraschiv [b], Endre J. Reite [c]

[a] *University of Zürich, Swiss Finance Institute, KU Leuven, NTNU Business School, and Centre for Economic Policy Research (CEPR)*
[b] *Zeppelin University, Department of Finance, University of St. Gallen*
[c] *NTNU Business School*

A R T I C L E   I N F O

A B S T R A C T

This study analyzes price discrimination and household switching in the residential mortgage market. Using a unique proprietary micro dataset from Norway, we examine the factors that influence a bank's choice to counter an offer from a competing bank and the difference between the loan rate paid by current clients when receiving a competing offer from another bank and the concurrent best rate offered to new customers by the current bank. The estimates show that a bank employs internal information to decide how to counter a competing offer and that current clients pay approximately 20 basis points more than new customers. We surmise that new regulations and digitalization enhance transparency and can reduce the rate differential. However, introducing new banking products and changes in the timing of rate differentiation —from immediate upfront to gradually over time —may be used to maintain a constant rate differential.

1. Introduction

Several factors contribute to banks' ability to differentiate prices. Among them are a client's search cost, the possible gain from a better rate for the client, and the time since the client's last mortgage. Moreover, these contribute both to the client's level of information about the rates offered and to the time the bank has to reset rates or introduce new products to differentiate prices between the existing client and new clients. According to Gary-Bobo and Larribeau (2004), a bank will be expected to capture risk-relevant characteristics in the probability of default (PD) model and measure collateral quality/loss given default. A different price could plausibly be ascribed to discrimination or use/misuse of information about the search cost, probability of switching/loyalty, and price sensitivity of different clients. Such a price differential between clients can be observed in the following situations: i) price differences compared to the average or best price marketed at the time of origination of a loan; ii) price changes for an existing client relative to new clients due to interest rate changes or new products; or iii) different bank strategies for matching competing client offers. This study focuses on the latter by exploring the factors that influence the home bank's strategy in competing for a client. Furthermore, it explores the changes in the development of price differences between new and existing clients over time.

While household risk and other household characteristics, as well as market structure and technology, determine mortgage rates, banks competing for clients, differentiation in pricing for current clients versus new customers[1], and the likelihood of borrowers switching banks are less explored. According to von Thadden (2004), interest rate differences between current and new borrowers arise as informational rent, since the currently lending "inside" bank observes repayment by a specific borrower, whereas "outside" banks (that do not lend to this borrower) do not. Consequently, banks are willing to offer increases when the severity of information asymmetry increases, resulting in uncertainty on the quality of the pool of borrowers —and a dispersion in the interest rates offered to current clients and new customers. Technically, this impact on dispersion is a corollary of banks' mixed pricing strategies.[2] Competition may drive banks to lend to new borrowers below the fair rate, generating losses that the lending bank expects to recuperate after obtaining an informational edge (see also Fischer (1990); Rajan (1992); Sharpe (1990)). Preliminary results from Reite (2022) show that the home bank considers internal information when determining a counteroffer price. Furthermore, the bank's informational edge over that of the client may depend on a client's sophistication and financial literacy Feng et al. (2019). Factors such as the probability of a client procuring or receiving a competing offer (i.e., the client's attractiveness to banks in general) and the bank's low counteroffer influence the price differential between clients with different characteristics. Our study is thus the first to explore the latter by analyzing the probability of a home bank offering a better counteroffer than the competing offer for clients with different levels of negative internal information and other characteristics.

The inclination of borrowers to switch banks is another manifestation of the information asymmetry between inside and outside banks.[3] While interest rate differentials and switching have been investigated for lending to (small) businesses,[4] few studies have investigated the residential mortgage market. Considering this gap in the literature, we investigate the price differentiation between current clients and new customers and the switching of borrowers in this market.

To this end, we utilize a unique micro dataset containing 13,080 current mortgage clients of a medium-sized Norwegian bank, henceforth designated as "the (home) bank," between 2007 and 2018. All clients in the dataset received mortgage offers from other banks. This dataset represents a period during which the Norwegian mortgage-lending market experienced a rapid digitalization of the switching process and increased transparency due to tightening regulations on pricing revelation.[5] This regulatory innovation has led to increased transparency and potentially limited bank ability to differentiate prices (Gaganis et al., 2020). However, over time, applying new technologies may also lead to new strategies to increase price differentiation (Bakos, 2001) and more complex dynamics. Our dataset comprises current clients' mortgage rates when they received a competing offer from another bank, the rate on comparable new mortgages for the new customers, and the offers from competing banks. Further, we investigate the factors that explain the price differentiation between current and new clients.

Our analysis concerns two sets of strategies. First, from the current client's perspective, we consider the choice to switch banks. We analyze the client's decision to either switch banks or accept the home bank's counteroffer in view of several client characteristics and the rate differential for the competing offer. Second, from the bank's perspective, we consider the willingness to counter an offer from a competing bank. We hypothesize that the willingness to counter a competing offer depends on credit risk. Furthermore, we explore if this will depend on credit scoring (i.e., from a credit scoring agency providing information to all banks) or internal information (i.e., information only available to the home bank based on the client's payment history in the home bank). First, we test the factors influencing the bank's willingness to counter an offer from a competing bank with an equal or lower rate. Second, we analyze banks' price strategies under digitalization, focusing on product differentiation, introduction, and subsequent repricing of new products, as well as banks' decision-making regarding the differentiation between groups and segments of clients. Finally, we examine how the levels of price discrimination, having a personal advisor, and client risk are relevant to understanding the likelihood that a client, upon receiving a compelling offer from a competing bank, leaves the current bank.

We also discuss several strategies that a bank can adopt to increase the loan rate differential between current and new mortgage

---

[1] For clarity, we differentiate between *current clients* and *new customers* based on a slight distinction in business language. A "client" may seek professional support or service from a bank, whereas a "customer" often refers to a person who simply purchases products or services from a bank. Hence, clients commit to a longer business relationship, which may or may not end after the first purchase. Nevertheless, customers can become clients.

[2] Hassink and Leuvensteijn (2007) finds that, in the Dutch mortgage market, the price dispersion within a bank's lending portfolio is larger than the dispersion across banks. Prices remain dispersed among lenders even after controlling for borrowers' characteristics and geographical information. While this dispersion cannot be linked to differences in risk and/or product characteristics, it suggests pricing linked to information asymmetry and uncertainty (see Cerqueiro et al. (2011)).

[3] In a recent study, using survey information, Brunetti et al. (2020) find that demographics, education, and market conditions may explain household switching in the Italian mortgage market. They show that a reform that reduced the "shoe leather type" switching costs in the retail banking market stimulated the more educated households, those with longer relationships with their bank, and those residing in less competitive banking markets to switch.

[4] Some studies have used annual observations at the bank and branch levels (Kim et al., 2003). Compared to current clients, new customers were found to receive discounts of between 30 and 80 basis points in Bolivia, Italy, Germany, and Portugal (Barone et al., 2011; Bonfim et al., 2021; Ioannidou and Ongena, 2010; Stein, 2015). Meanwhile, firms that have to leave a closing bank branch do not receive any such discounts from their new bank (Bonfim et al., 2021). Furthermore, small and young firms in longer relationships are more likely to switch banks (Ongena and Smith, 2001).

[5] From 2008 onward, all banks had to report all mortgage rates to a state-controlled price portal, www.finansportalen.no.

clients, which is a material source of profit[6]. Although the rate differential between current and new loans decreases over time for digital clients, we prove that the bank adapts to the reduced ability to differentiate under increased digitalization by employing new product strategies. One strategy is increasing search costs by introducing new products and marketing mortgages under multiple brands. Another strategy involves offering some clients preferential rates based on segmentation and differentiation by grouping clients based on constructed "qualification criteria." Mortgage clients are considered more likely to accept a rate differential if it is designated by a distinct criterion.

We employ a unique dataset of mortgage products and client characteristics to explore rate differentiation and bank switching behaviors in the mortgage market. To the best of our knowledge, this is the first study to comparatively analyze the rates offered to current clients when receiving a competing offer and to new customers for comparable mortgages by the same bank at a specific time point.[7] Our dataset offers unique insights into the rate difference between current clients and new customers within the same bank at the time when the former receive competing offers from other banks. The unique features of the recorded information on mortgage pricing to new customers at this time point enable us to examine whether the bank's price discrimination strategies persist, despite the enhanced probability of credit migration. Second, we approach the topic from two perspectives: analyzing both clients' switching behavior in the presence of alternative offers from competing banks and home bank's strategies to retain its clients. Earlier studies failed to consider the rate at which a bank is willing to offer new customers. Third, we employ a comprehensive set of client- and bank-specific characteristics, with mortgage product design details, to identify the factors influencing both the current bank's strategy for rate differentiation and clients' bank switching behaviors. Finally, we show that the results for our specific bank are representative for the largest banks in the Norwegian market with respect to their responsiveness to the increased transparency in mortgage pricing caused by digitalization.

The rest of this paper is organized as follows. Section 2 describes the Norwegian banking market, mortgage pricing, and strategies for increasing the price difference between clients. Section 3 presents the dataset. Section 4 introduces the setup of our paper, while Section 5 presents selected results. Finally, Section 6 concludes the paper.

2. Background

2.1. How banks price mortgages

Banks should set sufficiently low and high mortgage rates to ensure growth by attracting new customers and to maximize profit from the portfolio of current clients, respectively. If current clients gradually experience higher switching costs, the probability of them staying with the bank increases. The bank can exploit this increased probability of retaining these clients by increasing rates, thus boosting profit. Meanwhile, a potential new customer should be offered a sufficiently low rate to compensate for any cost related to bank switching. The existing research on the profitability of discounts to new clients is ambiguous and depends on the cost of discounting (Bester and Petrakis, 1996). A deadweight loss to society can result from discriminatory practices by offering initial preferable terms (Chen, 1997). Shaffer and Zhang (2000) points to discounting new clients being profitable for a firm facing symmetric demand. Exploring switching and counteroffer strategies can demonstrate how banks adapt to this theory in practice.

By targeting profit optimization, the bank applies price differentiation between its current clients and new customers. This is consistent with the findings from other industries, where the ability to foster opacity enables price discrimination (Jiang, 2007). Mortgages are more homogeneous and comparable than other bank business lending (see (Ongena and Smith, 2001)), hence the competition for mortgage loans is fiercer; this leads to easier price discovery and determines the rate difference for increasing clients' risk of switching to a competing bank.

The pricing of residential mortgages has been widely studied (e.g., Allen et al. (2012, 2019); Bhutta et al. (2015); Feng et al. (2019); Magri and Pico (2011); Wachter (2003)). Magri and Pico (2011) finds that the credit risk of households is duly reflected in residential mortgage rates.[8] A large component of mortgage pricing is only partially or remotely based on credit risk and is instead mainly dependent on other forms of price differentiation. Allen et al. (2014) shows that, even after fully accounting for differences in the risk of mortgage default, the interest rates of insured loans set by financial institutions can reflect the bargaining power of borrowers. Allen et al. (2019) examines rate differentiation in the Canadian mortgage market, and discovers that the rate differences between mortgage applicants with similar characteristics persist after controlling for all credit risk. Furthermore, Woodward and Hall (2012) finds that mortgage clients receive better mortgage rates (in the US market) if they simultaneously receive competing offers from other banks. However, while rate differentiation likely depends on some form of market power,[9] it can also occur in competitive markets (Levine, 2002) when search costs, which may depend on technology, are high.[10] For instance, in Hagberg et al. (2016), digitalization blurs the distinction between products and services and may reduce search costs.

A high mortgage rate relative to other banks' offers in the light of the increased ease of price discovery and perceived ease of

---

[6] According to Table 3 the rate difference between the mean rate offered to new clients and the mean rate in the portfolio of the bank is 0.36 basis points which constitutes a 29.5% higher margin

[7] Similarly, Carbo-Valverde et al. (2011) study the differences in the pricing of current and new deposits, employing the biannual disclosures of Spanish banks.

[8] Unsurprisingly, the risk-based pricing of mortgages is at the core of banking regulations worldwide.

[9] For instance, Gary-Bobo and Larribeau (2004) studies competition in the mortgage market using microdata.

[10] See also studies on public disclosure on denial rates to prevent discrimination, such as (Munnell et al., 1996).
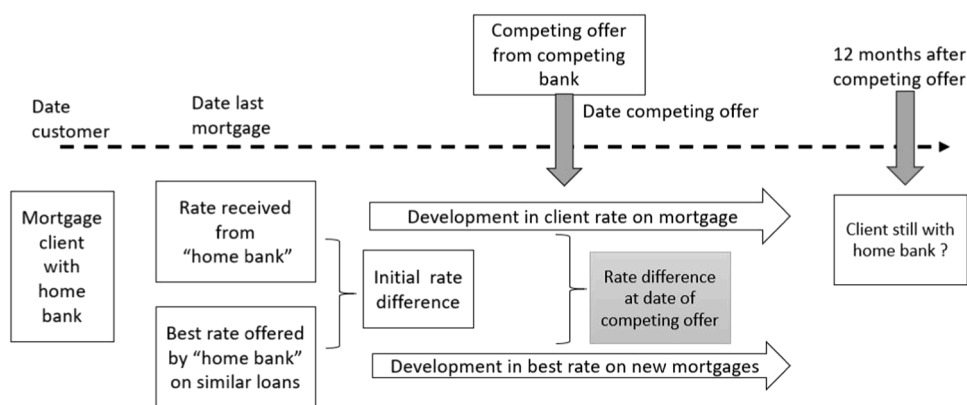
Fig. 1. Recorded data for a mortgage client with the home bank.

switching, can trigger client migration. The opportunity costs associated with clients' migration will increase a bank's losses.

Revenue from current clients dominates the income of a well-established bank. However, a bank's strategy of attracting new customers by marketing lower mortgage rates likely incentivizes current clients to demand a price reduction in case of large rate differences. This is further expected to occur under increased market transparency. Therefore, a bank's pricing strategy for attracting new customers should consider the possible counter-effects of the downward pressure on the loan rates for current clients. One strategy for discriminating prices in mortgage lending is lowering the initial rates and increasing resetting over time to increase profits from naive borrowers (Agarwal et al., 2019). As discussed in Section 1, price discrimination exists in the mortgage-lending industry (Al-Bahrani and Su, 2015; Allen et al., 2014; Calomiris and Pornrojnangkool, 2009; Magri and Pico, 2011). In Norway, new loans are priced approximately 20 basis points below the rate charged to current clients (Statistics Norway, 2019).

Extant studies have found that clients have limited knowledge about the terms of mortgage lending products and that financial literacy influences the choice regarding which products are more suitable to their needs (Bialowolski et al., 2020; Cox et al., 2015; Davidoff et al., 2017). This may shift power toward the bank and enable differentiating products in marketing without significantly changing their terms and properties. Thus, further price differentiation can be obtained by introducing new products at competitive prices. Current clients only migrate to the optimal product if they discover a price difference or, in the case of a mortgage rate, an adjustment in their disfavor. Therefore, introducing new products and sub-brands is a means of benefitting from structural price discrimination (i.e., establishing product structures, continuously introducing new products, and systematically increasing price differentials between these products) that can effectively increase the price difference between current clients and new customers.

Price discrimination based on segmentation and client characteristics is also found in digital banking (Bartlett et al. (2019); Vives (2019)). Structural price discrimination, which is based on differentiating between products and sub-brands and exploiting clients' switching abilities, can be identified using internal bank data. Our study examines how changes in digitalization and transparency may influence how a bank adapts to a changing environment. A new Financial Services Act came into effect in Norway in 2023, limiting banks' discretion in changing mortgage rates and margins. Our analysis provides insights into the need for such regulations and sheds light on the factors explaining price discrimination in mortgage lending.

2.2. The Norwegian mortgage market

Norway has one of the highest shares of homeownership globally, with more than 80% of households owning a home (Trading Economics, 2018). This is more than 10 percentage points over the average in the European Union and other Nordic countries. The Norwegian mortgage-lending market is highly competitive at the national level. Only one bank, DNB, has a market share as high as 25.6%, whereas all other banks have market shares below 12%. Six medium-sized regional banks with market shares between 2.3 and 4.3% and several smaller banks hold dominating positions in their regions. The latter have market shares of up to 50% (Statista, 2018), with only 8% of clients visiting branches monthly or more (Finance Norway, 2018). Signing loan documents and switching between banks are done digitally, within a few days, and at a low cost.

Mortgages in Norway are predominantly floating-rate (Statistics Norway, 2022). A mortgage rate is agreed at origination, but the bank has the discretion to change it by giving a six-week notice. This notice can take the form of a message in the clients' online bank inbox or a letter. The reason for the rate adjustment should be stated in the client notification; in most cases, it is explained as being related to wider changes in interbank rates or the central bank's policy rate. A rate change can then be implemented based on the client's passive consent. Policy and interbank interest rate changes are infrequent, occurring approximately twice a year on average. Consequently, mortgage rates are typically simultaneously reset for the entire mortgage portfolio.

Margin-based pricing is not used in mortgage lending to households, and less than 10% of mortgages are fixed-rate ones, which further favors borrowers' switching behaviors. Fixed-rate mortgages are excluded from our dataset.

Table 1
Summary of the selected variables in the sample.

Variable	Mean	Median	S.D.	25%	75%	N
Centrality location of realestate[a]	693	710	184	540	980	13,081
Years as customer[b]	6.25	5.00	5.62	1.51	17.2	13,081
Number of years since the last mortgage[c]	3.10	2.00	3.85	1.23	9.10	13,081
Percentage with advisor	55.1					
Percentage from the branch:	83.2					
Percentage male	75.9					
Percent retention after 12 months	44.3					

a Centrality on a scale of 0 to 1000 from the Statistics Norway Centrality Index (Statistics Norway, 2020). *b* The number of years the existing client has been with the bank before receiving a competing offer. *c* The number of years since the existing customer received their last loan in the home bank.

Table 2
Comparison of customer demographics and loan attributes between the dataset of mortgage clients who received offers versus the entire portfolio of mortgage loans of the bank.

	Portfolio of Home bank	In the dataset	Average in Home bank
	2017	set	2007-2017
Loan size	2.1 mill	2.4 mill	1.8 mill
Digital	9%	17%	5%
Clients' age	55	49	53
Centrality of the real estate location	623	684	631
N	67,930	13,081	59,880

3. Data

3.1. The dataset

Our dataset consists of 13,080 mortgages from a Norwegian medium-sized bank, whose clients received competing offers from other banks from 2007 to 2018. The dataset contains a complete record of all clients receiving a competing offer in the time period and is a non-random sub-sample of the bank's portfolio, which includes only clients who engaged in discussions with the home bank about switching after receiving competing offers. Therefore, the dataset encompasses an existing mortgage holder with the home bank receiving or requesting a competing offer from another bank. It only contains information related to clients' mortgages; however, details on other available products from the bank, such as those related to savings or insurance, which could further influence mortgage pricing, are not available. The dataset reflects a rapid change in the proportion of mortgage loans that originated digitally in the sample, from less than 1% in 2003 to more than 50% in 2017.

As illustrated in Fig. 1, after making an offer, the competing bank contacts the client's home bank to repay the existing loan. In many cases, the client simultaneously requests an updated offer from their current bank. Details of the competing offer, along with several variables, such as the home bank's best available rate for new customers, the existing rate for the client receiving the offer, and loan characteristics, are also recorded. Additionally, the dataset records if a client is still with the home bank 12 months after receiving the competing offer. The dataset also contains client characteristics such as the number of years since the last loan, years as a client, whether the client has an advisor, probability of default, number of debtors, the centrality of the location of the real estate posed as collateral, size group, and whether the loan originated in a branch or online. Table 1 exhibits the descriptive statistics for client characteristics. The centrality index is published by Statistics Norway (2020) and is used as a proxy for the level of competition, as many banks have strategies that only permit lending in areas with a medium-to-high centrality score.[11] The dataset includes a large proportion of male borrowers and of loans that originated in branches. Additionally, we consider the following variables: the mortgage rate on the loan at the time of receiving the competing offer, price offered to new customers on similar mortgages at that time, and alternative offer by the competing bank. The client may also receive a counteroffer from the home bank or stay on for other reasons, such as their relationship with the bank or the price of other products offered by the bank to the client.

Table 2 presents the characteristics of the bank's entire portfolio of mortgage loans observed on the last day of our sample, compared to the portfolio of mortgage clients who had the option of switching banks. The latter is observed both on the last day and as a sample average. Mortgage clients with larger loan sizes are sensitive to price increases and are more likely to ask for competing offers. Moreover, the increased centrality of the real estate location may further motivate banks to offer competitive prices to induce switching behavior. In our dataset, we observe a centrality score higher than the average for the entire bank portfolio, corresponding to larger loan sizes and a larger proportion of digital loans. Further, the average client is younger in our dataset. Therefore, the age of the mortgage holder, centrality of the real estate location, degree of digitalization, the measured share of loans that originated online, and

---

[11] The centrality of the real estate location is defined as a measure of how many jobs and service functions are available within a 90-minute commute.

Table 3
Comparison of margins on loans.

	Rate[a]	To new clients[b]	Competing offer[c]	Counteroffer[d]	Average of the home bank[e]
Mean	150	124	113	130	161
Median	147	120	109	124	155
St. dev.	66	69	70	75	71

a The loan a current mortgage client has with the bank at the time of a competing offer. *b* The margin offered to a new similar client at the time of a competing offer. *c* The competing offer from the outside bank to the client. *d* The counteroffer from the home bank at the time of a competing offer. *e* The average margin in the portfolio of the bank. *f* All margins are calculated by subtracting the inter-bank rate for comparability over time (NIBOR 3M).

Table 4
Overview of the variables used in the analysis.

Variable name	Definition
Players:	
Home bank	Norwegian medium-sized bank
Client	Home bank's client soliciting and receiving alternative mortgage offers from other banks
Loan related variables:	
Rate difference	The difference between the mortgage rate the current client had with the home bank at the time of receiving a competing offer and the home bank's mortgage rate to a new client for similar loans at the time
Rate on existing mortgage	The mortgage rate the client had with thae home bank at the time of receiving the competing offer
Rate on a comparable new mortgage	The mortgage rate offered by the home bank to new clients at the time the current client received the competing offer
Rate updated on existing mortgage	The updated rate the home bank offers to the current client when confronted with/after learning about a competing offer from another bank
Digital	Dummy variable: 1 if the last loan to the client was sourced on a digital platform
Loan to value (LTV)	Loan to value of the last mortgage that the current client has with the home bank at the time of the competing offer
Loan size	Size of the loan the current client has with their home bank, grouped in five size groups
Centrality of the real estate location	Centrality of the client's home used as collateral for the loan in the home bank defined as the proximity to jobs and service functions
Date of competing offer	Date when the home bank's client receives an offer from a competing bank
Rate difference to competing bank	Difference between the rate for the current client and the rate offered by the competing bank
client variables:	
Number of years with the bank	Number of years the current client has been with the home bank
Number of years since the last loan the last loan	Number of years since the last mortgage of the current client in the home bank
Male	Dummy variable: 1 if the home bank's client is a male, or if the contact person on the mortgage is a male if there are two borrowers
Rank PD	The rank of the probability of default of the current client with the home bank at the time of the competing offer, divided in deciles
Advisor	Dummy variable: 1 if the current client has an advisor in the home bank
Retention	Dummy variable: 1 if the mortgage is still with the home bank 12 months after the current client communicated that they received a competing offer from a competing bank
Age	Age of the client, grouped in four age groups: youngest, young, middle aged, and older
Youngest	Dummy variable: 1 if the client is younger than 26 years at the time of a competing offer
Young	Dummy variable: 1 if the client is >= 26 and < 40
Middle aged	Dummy variable: 1 if the client is >= 40 and < 60
Older	Dummy variable: 1 if the client >= 60

size of the loan influence clients' willingness to request and examine offers from other banks.

3.2. Sample representativeness

Our sample includes only 25% of the total number of mortgage clients of the home bank. The dataset is a non-random sample, as the included clients have all opted to receive offers from a competing bank. These offers may either be a result of the competing bank targeting certain types of clients or the clients actively pursuing a competing offer for their mortgage.

As per Table 1, the average loan size in our dataset is larger than that of the home bank. This indicates that clients with larger loans than average for the home bank actively pursue competing offers, with the benefit of switching to a bank with lower rates. The average age of clients receiving competing offers is also lower than that of clients in the bank, while the percentage of loans sourced from digital platforms is higher. These factors may lead to lower search costs for identifying a new offer from a competing bank and lower switching costs. We further find that the average centrality of the location of the real estate posed as collateral for mortgages is higher in our dataset compared to the bank average. Higher centrality can lead to higher competition levels in the local mortgage market, with the added advantage of reducing search costs. Hence, the data selection bias is consistent with the factors assumed to increase the willingness and ability of clients to pursue competing offers. However, since the sample contains the complete set of all clients who chose to pursue a competing offer, the selection bias does not limit our ability to identify the distinguishing factors that influence switching behaviors in the presence of competing offers. Client sophistication can also lead to an increase in the willingness to pursue competing offers. Although not directly measurable in our dataset, client sophistication can be assumed to be linked to larger mortgages, lower age, more widespread use of digital platforms, and increased centrality of real estate location. All these measures are higher in our sample compared to the home bank averages. Similar data on the rate difference between new and existing clients are available from Statistics Norway (2021). As illustrated in Fig. 5 in the Appendix, these data display similar differences to what we observe in our sample.

Mortgage clients' willingness to pursue competing offers may be influenced by being subjected to more price discrimination than other mortgage clients or additional factors independent of the levels of price discrimination. From Table 3, the average and dispersion of the price differences for the home bank's clients outside our sample are larger than within the sample. This supports the hypothesis that the skewness of our data is not a result of increased price discrimination for mortgage clients. As indicated by the rates, the home bank has high market power. The counteroffers are higher than the competing offers and the rates on comparable new mortgages are higher than the competing offers from other banks. This is plausible, since the analyzed bank has a significant market share, being the largest mortgage bank in its home market and the largest bank in the region. Specifically, the home bank's market share is above 30% of the total mortgage market in the geographic region where it is headquartered. The client base is dominated by clients from one region, implying that clients are overall subject to the same changes in growth, economic outlook, and the housing market—as are the competing banks offering competing offers. The bank's strategy is also the same throughout the study period, and focuses on growth in mortgage lending. Further, we accessed data on funding and found that the bank has an average or above-average ability to finance mortgages through covered bonds with competitive rates and an above-average capitalization level.

3.3. The definition of a similar loan

The home bank has a pricing model based on the probability of the default loan size, loan-to-value ratio, and for clients below 34 years old. This model indicates the price of all loans in the loan-processing system and a minimum price. The advisor has the discretion to deviate upwards and downwards when offering the client a loan, as long as the price is above the minimum price. A branch manager must approve downward deviations beyond the minimum price. Thus, the price on a loan reflects advisors' assessment of the client's willingness to pay and the alternative offers or knowledge of the client on loan pricing. In our dataset, we gathered the suggested best price for all mortgages at the time of a competing offer from another bank. We further defined the prices of similar loans based on the suggested best price/minimum price of a loan at the time of a competing offer, obtained using the internal pricing model employed by the home bank.

Table 4 shows an overview of the variables employed in the analysis.

4. Methodology

The dataset contains observations of the home bank's customized mortgage loans collected over 10 years. Individual loans have large price differences based on criteria such as the collateral posed, product type, loan-to-value ratio, and loan-to-income ratio. Given the heterogeneity of observations between adjacent time periods, combined with the uneven distribution of the 13,080 observations over a period of 3,642 days, we initially analyze the data using a cross-sectional frame and employ separate tests to identify possible time trends (Salkind, 2010). Our goal is to use the data on client characteristics at the time of a competing offer to develop an understanding of the variables that explain the differences in rates. We further discuss whether changes in trends observed in the developments in the rate differences (Rate Difference) may be influenced by pricing strategy and transparency changes. Furthermore, we determine if the observed changes are also found in the case of other Norwegian banks.

Price discrimination occurs when a loan is priced based on client characteristics other than those plausibly connected to a client's risk or servicing cost. In the absence of price discrimination, a rational bank would set the price of a mortgage based on the expected profits and cover the costs and associated risks. Examining other factors that may prove relevant to rate differences, we test for indications of differences in the cost of servicing a client, search cost, loyalty of a client, and the risk of a client. Having a personal advisor

(Advisor) could result in higher costs owing to the compensation for personal service. The profit from a mortgage is the present value of the income the loan generates less the cost and capital to cover the risk the loan represents throughout this time period (Gary-Bobo and Larribeau, 2004). In our data, risk is considered by the probability of default (Rank PD) and loan-to-value ratio (LTV). Higher levels of risk can lead to a price increase. The costs are modeled as a decreasing function of loan size (Loan size), since, typically, cost factors are given per loan and not per volume unit. (Centrality of the real estate location) and (Digital) are the other factors utilized in pricing mortgages. The first is relevant in defining the collateral value, while the latter indicates the cost of originating the last loan. Furthermore, banks can introduce preferential rates to reflect higher potential future profits from the youngest clients, which is proxied by the dummy variable Youngest.

Therefore, the non-discriminated mortgage rate Rate i of any loan i at any time would be given by the following equation:

$$
\begin{aligned}
\text{Rate}_i &= \beta_1 \cdot \text{Rank PD}_i + \beta_2 \cdot \text{LTV}_i + \beta_3 \cdot \text{Loan size}_i + \beta_4 \cdot \text{Advisor}_i \\
&\quad + \beta_5 \cdot \text{Digital}_i + \beta_6 \cdot \text{Centrality of location real estate}_i + \beta_7 \cdot \text{Youngest}_i + c_i
\end{aligned}
\tag{1}
$$

Mortgage pricing is expected to follow Equation (1). However, as discussed in Section 2, price discrimination occurs in mortgage lending. Thus, we aim to identify the factors influencing the price difference between the mortgage rate for a client with the bank at the time of receiving a competing offer from another bank and the rate of a similar new mortgage at the time of the offer. Furthermore, we explain the probability of a client staying with the bank in the 12 months after receiving a competing offer.

To compare average mortgage rates for the entire sample, we use the spread with the average three-month Norwegian Interbank Offer Rate to adjust for price variation over time.

Previous studies limit the analysis of the price difference between different mortgage clients' observable client and loan characteristics and the assumption about the absence of credit risk in insured mortgages (Allen et al., 2012), or with the addition of factors perceived to influence the net present value of a client (Gary-Bobo and Larribeau, 2004). The novelty of our approach is in comparing the rate an existing client to that offered by the bank's internal pricing model to similar new client. Thus, the price differential between the clients' rate and the rate offered to a new similar client in the same market implicitly controls for factors the bank deems critical in determining the client's profitability and credit risk.

We hypothesize that, if a client has recently taken a mortgage, they would be more prone to checking the mortgage rate and comparing it to the rates offered by other banks and to other clients. Furthermore, we hypothesize that clients are more rate-sensitive when the loan is large and that older clients, clients with advisors, and clients performing less digital banking pay more than younger clients with larger loans and with a higher degree of digitalization.

The difference in loan rate (Rate Difference) is defined as follows:

$$
\text{Rate Difference} = \text{Rate Existing Mortgage} - \text{Rate New Mortgage}.
\tag{2}
$$

First, we analyze the factors significant in modeling the rate difference, Rate Difference, starting with a general cross-sectional regression expression:

$$
\text{Rate Difference}_i = \beta_i \cdot X_i + \epsilon_i
\tag{3}
$$

where Rate Difference$_i$ is measured relative to the rate of a comparable loan offered to new customers at the registration date of a competing offer for every loan i and X_i is a set of characteristics of the current clients (i.e., whether the loan is sourced digitally or in a branch and other loan variables). The elements of X_i are the independent variables.

$$
X_i =
\begin{bmatrix}
\text{Number of years since last loan} \\
\text{Rank PD} \\
\text{LTV} \\
\text{Male} \\
\text{Loan size} \\
\text{Digital} \\
\text{Advisor} \\
\text{Centrality location of real estate} \\
\text{Age}
\end{bmatrix}.
\tag{4}
$$

To preserve the anonymity of clients, variables Loan size, Age, and Rank PD are grouped in categories. Loan size is grouped by year, thus eliminating the need to adjust loans for inflation or for growth in housing prices.

The clients are divided by age using four dummy variables: Youngest, Young, Middle-Aged, and Older. This grouping follows the pricing structure of mortgages in Norway, which features heavy discounting of mortgages to the youngest clients and categorizes them into two groups. Both groups are believed to be more frequent digital banking users and less loyal. The probability of a client's default is divided into 10 deciles, Rank PD, describing the mortgage risk. Intuitively, an increase in Rank PD would lead to a higher risk premium and reduce the client's ability to get favorable rates with the home bank. Thus, it serves as a relevant measure for negotiating power and a client's attractiveness to other banks within a home bank and to the extent that other banks use the same model and have the same information to determine the PD. The loan-to-value ratio variable, LTV, considers the risk of loss given the default associated with the mortgage, where an increase in LTV is expected to lead to a higher risk premium and a lower ability to negotiate. Both Rank PD and LTV can be perceived as linked to each other and to several other variables employed in the analysis; however, this is not the case, since none of the variables are included in the model estimating Rank PD for the home bank. The time since the last loan granted
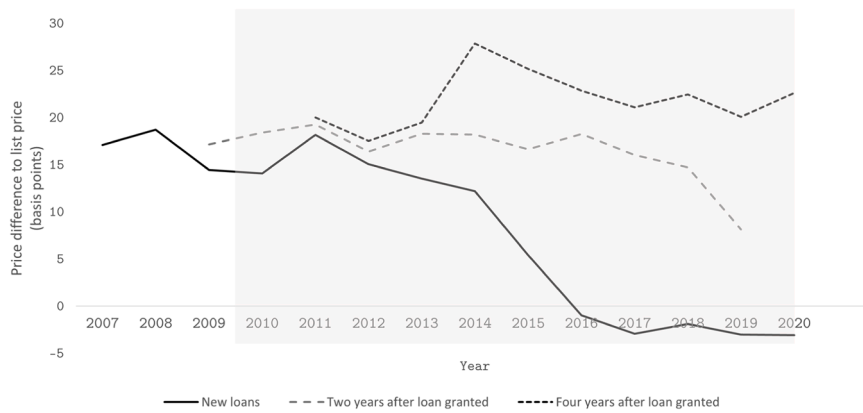
Fig. 2. Yearly average difference between the mortgage rates on current loans for clients receiving competing offers and the rates on similar new loans observed each year, expressed as the time since the last mortgage (N = 13,080).
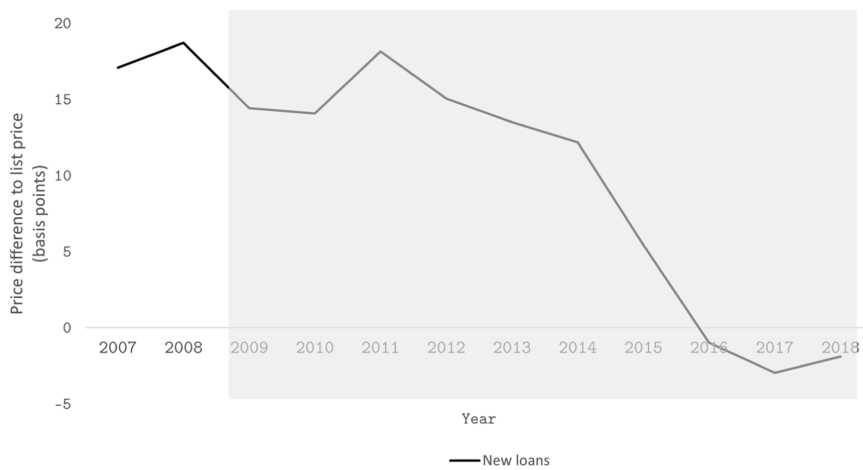

Fig. 3. Difference between the average mortgage rates at origination compared to the best price marketed on a similar product (N = 13,080) a There is a significant reduction in the margin after the introduction of Finansportalen (Δ from Equation 5 is significant at 5% confidence level (-2.44 (1.32)). b There is also a significant reduction over time after the introduction of Finansportalen (the interaction between Δ and Year Equation 5 is significant at a 5% confidence level (-3.42 (1.71).
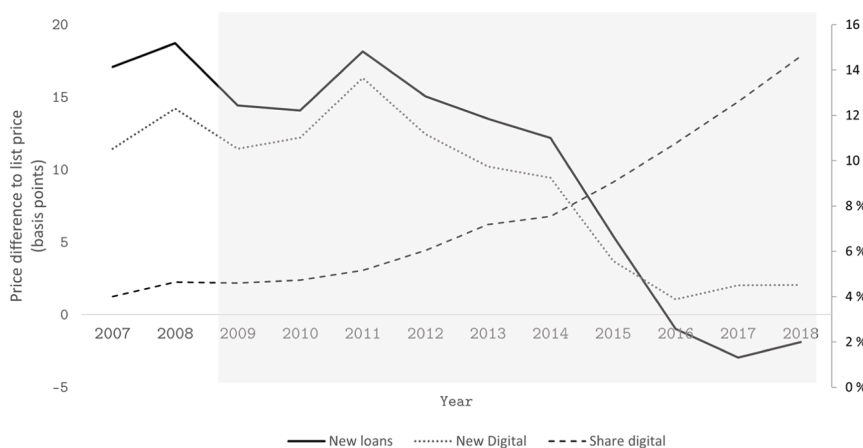

Fig. 4. The development in the average difference between the mortgage rates on current loans for clients receiving competing offers and the best rates marketed by the bank on similar new loans observed each year, expressed as the time since the last mortgage (N = 13,080).

to the client by the home bank is measured as the number of years, Number of years since the last loan, implying more opportunities for the home bank to increase the margin on a loan by changing the mortgage rates. Our hypothesis is more focused on competing offers and the best rates available at the time around refinancing, or taking on a new mortgage, but it is plausible that this rate sensitivity diminishes over time. The date at which the competing offer is received is recorded as Time of competing offer, and all other variables are also recorded at this time, considering the interactions between variables and time. The gender of the mortgage client indicates whether they were male or, in case of two borrowers, if the contact person on the mortgage was male. Male may thus influence price discrimination. Other factors, such as the size of the loan (Loan size), are also relevant in mortgage-pricing strategies and influence the nominal size of a rate difference and, thus, the economic importance of the difference to a client. Banks may set higher rates over time on smaller mortgages compared to larger ones, as fierce interbank competition for the latter reduces a bank's ability to increase profits. Another factor, Digital, negatively affects the bank's ability to increase mortgage rates for digital clients over time. If the client's last loan originated on a digital platform, they might be more inclined to use digital platforms and have a lower discovery and switching cost, while continuing to take advantage of the more transparent pricing on digital platforms. Moreover, a personal advisor (Advisor) from the bank can influence the price difference. An advisor can increase loyalty and perhaps make it less likely to obtain a better loan rate from another bank by helping the client navigate offers. We also consider the centrality score, Centrality of the real estate location, of the house posed as collateral, which is a possible indicator of how attractive a mortgage client is to other banks and of the level of competition. Increased centrality of the real estate location is, thus, expected to decrease the price discrimination between current clients and new customers for similar mortgages. Time trends are obtained for some of the independent variables by introducing interaction terms with time. Fig. 2 in the Appendix demonstrates an example of such a trend.

Finally, we investigate the development of changes in price discrimination patterns by exploring the time trends on the rate difference between rates offered to new clients and the best price marketed for a similar product. This analysis explores if this price difference changes after the introduction of Finansportalen (Finansportalen, 2020) using a dummy variable, Δ, which takes 1 for all years after 2009 and 0 for previous years, and an interaction between Δ and Year captures the gradual changes over time after 2009.

$$\text{Rate Difference}_{i,t} = \Delta_t + \text{Year} \cdot \Delta_t + \beta_{i,t} \cdot \text{X}_{i,t} + \epsilon_{i,t} \tag{5}$$

where the elements in control term $\text{X}_{i,t}$ in this equation exclude the Number of years since last loan since only the interest rate at origination is of interest in this analysis. We hypothesize that there is a significant change in the interest rate dispersion from the best rate marketed by the bank on similar products as transparency increases after the new regulations are imposed.

4.1. Modeling the probability of the bank offering a counteroffer that exceeds the competing offer

We model the probability of the bank's counteroffer exceeding the competing offer to explore what determines the home bank's willingness to retain a client. We define this probability of a Higher counteroffer as 1 if Counteroffer>competing offer, and 0 otherwise. Following Reite (2022), we divide PD Rank, into its two constituents, that is, Credit score from all external information sources and Internal information as the negative information from missed payments on the loan in the bank. This is done to separate the effect a Credit score has on all banks' willingness to offer a low rate to a client from the information solely available to the home bank.

Since Higher counteroffer has a binary outcome, we employ a logit model to analyze the factors potentially impacting the probability of a client remaining with the home bank after soliciting and receiving a competing offer:

$$P[\text{Higher counteroffer}] = \frac{\exp(\beta_0 + \beta_i \cdot \text{X}_i + \epsilon)}{\exp(1 + \beta_0 + \beta_i \cdot \text{X}_i + \epsilon)}, \tag{6}$$

$$\text{X}_i = \begin{bmatrix} \text{Centrality location of real estate} \\ \text{Internal information} \\ \text{Credit score} \\ \text{LTV} \\ \text{Age} \\ \text{Loan size} \\ \text{Advisor} \\ \text{YearCustomer} \end{bmatrix} \tag{7}$$

Our hypothesis regarding the bank's choice of the counteroffer relative to the competing offer is that the negative Internal information and large difference between a client's current rate and the offer from the competing bank, Rate difference competing bank lead to the counteroffer exceeding the competing offer. Furthermore, we expect the home bank to exploit loyal clients' higher switching barriers/loyalty effect by offering a higher counteroffer as Year customer increase.

4.2. Modeling the probability of client retention

We model the bank's probability of client retention, where the retention variable is observed 12 months after the current client received a competing offer. Since Retention has a binary outcome, we employ a logit model to analyze the factors potentially impacting the probability of a client remaining with the home bank after soliciting and receiving a competing offer.
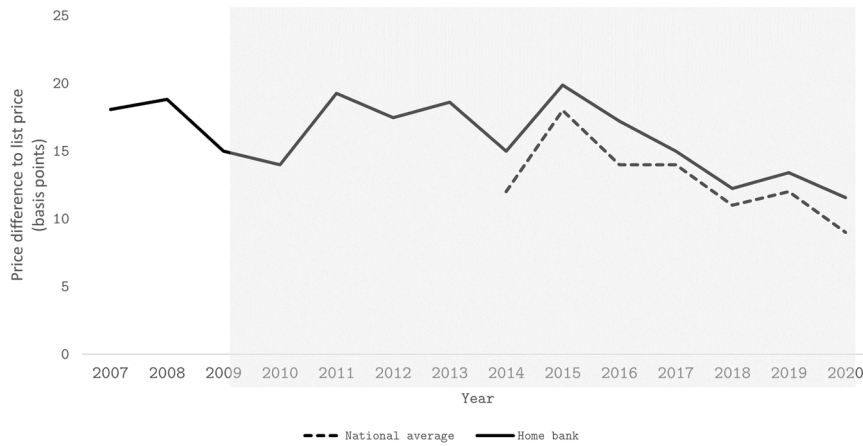
Fig. 5. Average margin difference between new and existing mortgages in the home bank compared to average margin difference between new and existing clients (interested and those not interested in switching banks) for all large banks in Norway (75%) from Statistics Norway (2021). National data only available from 2013.

$$P[\text{Retention}] = \frac{\exp(\beta_0 + \beta_i \cdot X_i + \epsilon)}{\exp(1 + \beta_0 + \beta_i \cdot X_i + \epsilon)}, \tag{8}$$

$$X_i = \begin{bmatrix} \text{Number of years since last loan} \\ \text{Rank PD} \\ \text{LTV} \\ \text{Male} \\ \text{Loan size} \\ \text{Last loan} \\ \text{Advisor} \\ \text{Centrality location of real estate} \\ \text{Age} \\ \text{Male} \\ \text{Rate difference competing bank} \end{bmatrix}. \tag{9}$$

Our main hypothesis is that clients with larger loans and those that are younger and more frequent users of digital banking are less loyal and that clients with high risk, as represented by Rank PD and LTV, to some extent, get less preferable treatment from the home bank, thus migrating to other banks to a larger extent.

We further hypothesize that Centrality is linked to higher competition and lower perceived switching barriers.

Demographic variables such as Young, Middle-Aged, Older, and Male and time-dependent variables Number of years since the last loan may directly impact the willingness to switch banks. Meanwhile, the loan-dependent and risk factors Rank PD, LTV, Loan size, and Centrality of the real estate location can influence the client's attractiveness to both the home bank and a competing bank. Having an Advisor can also increase the willingness to stay with the home bank via a stronger bond through a personal relationship with the home bank. Finally, Rate Difference Competing Bank measures the difference between the rate for a mortgage client with the home bank before they obtain a competing offer and the offer from the competing bank. A better offer for the client relative to the rate offered by the home bank may lead to a greater willingness to switch.

Finally, we analyze whether loan characteristics influence the Counteroffer of the home bank by employing Equation 3 but substituting the dependent variable Rate Difference with Counteroffer. We explore whether information asymmetry between the home bank and competing bank can lead to the home bank being less willing to compete for current clients with certain characteristics and, thus, contributing to the factors influencing retention.

5. Results and Discussion

5.1. Developments in loan rate differences over time

Fig. 2 illustrates how the differences in the annual average loan rates change as a function of the number of years since the last loan. The average annual difference between the rates on existing loans and similar new ones increases with the time since the last mortgage. However, there is a rapid decrease in the average price differences from 2012 until 2017 for a client with a brief time duration since the last mortgage (up to one year). In 2007, the home bank's mortgage rate for current clients was, on average, over 20 basis points above the best price offered to new customers on comparable new mortgages. Meanwhile, in 2017, the price difference at the time of origination dropped to zero. Thus, the mortgage rate for current clients approaches the best available price on similar mortgages over

Table 5

Comparison of the rate difference for different customer segments receiving competing offers.

	All	Advisor	Digital	Youngest
N	10,505	7,204	2,208	1,093
Number of years with the bank	0.7745	0.8064	0.6555	0.5597
	(0.174 5)	(0.1100)	(0.2205)	(0.3438)
	***	***	***	
Advisor	0.3723		0.8796	-3.1231
	(0.8224)		(1.2628)	(2.5234)
Rank PD	0.6791	0.5249	3.1202	1.8850
	(0.1340)	(0.0417)	(0.2203)	(0.4903)
	***	***	***	***
LTV	-0.0812	-0.0694	-0.0358	-0.4420
	(0.0277)	(0.0146)	(0.0253)	(0.0609)
	***	***		***
log Centrality of the real estate location	0.1669	-0.0360	0.5487	0.8225
	(0.6788)	(0.2835)	(1.9689)	(0.9113)
Loan size	-0.5713	-0.6882	-0.6440	4.1444
	(0.2817)	(0.2539)	(0.4349)	(1.0494)
	***	***		***
Male	- 1.9423	- 1.8066	- 1.4601	- 5.5958
	(0.8166)	(0.6799)	(1.1695)	(2.8048)
	***	***		**
Log Age	0.2091	0.2134	0.2143	
	(0.0226)	(0.0161)	(0.0276)	
	***	***	***	
Digital	-2.3150			-6.2820
	(3.2101)			(3.8035)
				*
Mean dependent variable	21.015	27.512	28.480	3.0167
R-squared	0.2781	0.4270	0.2124	0.1028
Control for time	✓	✓	✓	✓

Significance levels: $^*p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$

time. We further find that the rate increases more rapidly toward the end of our observation period, leading to a level of price differentiation similar to the one at the beginning of the time period. The bank compensates the lower initial rate differentiation by a more rapid increase in price differentiation over time.[12]

5.2. Factors explaining price differentiation

From Table 3, there is a notable difference between the rate on current mortgages with the home bank and the price offered simultaneously to new customers on comparable mortgages at the time current clients receive a competing offer. Thereby, the average price difference between current clients and new customers is 26 basis points. However, the difference between the bank's average mortgage rates between new customers on similar products and the average price of the competing offers received by the home bank's current clients is only 11 basis points.

To control for the differences between our data and a representative client portfolio unrestricted to those soliciting competing offers, we use data from the Financial Supervisory Authority (The Financial Supervisory Authority of Norway, 2019) and Statistics Norway (Statistics Norway, 2020). Fig. 5 depicts the mortgage rates for current clients and new customers over time for all large banks in Norway compared to our data for the overlapping time period where national data are available. Earlier research has also demonstrated such differentiation (Woodward and Hall, 2012). As such, our micro dataset reveals a higher price difference than the average in the representative portfolios of the largest Norwegian banks; this portrays the home bank's ability to increase profits by price differentiation by introducing new products.

Price differentiation between current clients and new customers has a significant impact on the total revenue of a bank. In practice, only a small proportion of the clients paying such excess prices on existing loans enjoy improved conditions through competing offers or by switching banks.

Table 3 reveals that, on average, the home bank gives up 20 basis points of its excess margin of 26 basis points in the counteroffers to current clients. This price adjustment contributes to the home bank retaining 44.3% of the clients propositioned by other banks 12

---

[12] Performing an independent sample Kruskal–Wallis test rejects the hypothesis that these different years are part of a sample with a homogeneous development at the 0.1% confidence level.

months after receiving competing offers.[13].

5.2.1. Overview of the determinants of rate differences for different groups of clients

We analyze the price differentiation drivers by employing a linear cross-sectional regression (Equation 1) considering age groups, credit risk measured by the probability of default and loan-to-value ratio, time since the last loan, centrality of the real estate location, size of mortgage, whether the client has a dedicated advisor, and whether the loan originated from a digital platform. After analyzing different groupings of mortgage clients, we use three distinct groups based on age, the presence of an advisor, and whether the last loan was sourced digitally. Table 5 presents the results. The number of years since the last loan (Number of years since the last loan) is a significant factor in expounding the price differentiation for all three groups. However, the magnitude and significance of the coefficient are larger for mortgage clients with an advisor. The difference between the prices on existing and comparable new mortgages increases with the number of years since the last loan. An increase in credit risk, measured by the probability of default Rank PD, leads to an increase in the price difference; conversely, the loan-to-value ratio LTV leads to a significantly smaller price difference.

Furthermore, the rate difference for all groups is significant and slightly lower if the mortgage client is Male.

The increased size of a loan (Loan size) leads to a lower price difference for mortgage loans with advisors and loans sourced digitally, but not for the youngest clients, where size instead leads to significantly higher rates. This may be due to the fierce competition on large new loans, which diminishes the bank's ability to increase margins by price differentiation. However, the size effect in the youngest group is not consistent with this hypothesis. For the youngest clients, mortgages are often priced at the same rate regardless of size, and this differs from other client groups.

Having an Advisor did not have a significant effect on Rate Difference in either group, for digital, or the youngest clients.

When considering the Centrality of the real estate location of the real estate posed as collateral for an existing loan, contrary to our hypothesis, the effect is non-significant at the 10% confidence level.

With respect to Age, Youngest clients have a significantly lower rate difference on their mortgages compared to the other groups and to those of the other factors in the regression. This can be explained by the fact that fixed-price products dominate the competition for young mortgage clients.

Rank PD has a high coefficient and is measured in deciles, leading to a large, combined effect. Similarly, the large coefficient and value of the average Number of years since the last loan, as per Table 4, lead to a large change in Rate difference as the Number of years since the last loan varies. Hence, these two factors have the propensity to dominate the others in terms of impacting the Rate Difference. Moreover, in exploring the relationship between Rate Difference and Rank PD, we identify a non-linear relationship between Rank PD and Rate Difference, which has a more substantial effect on the highest levels of Rank PD.

A bank has incentives to increase the mortgage rate over time, thus, implicitly increasing its profitability. The results in Table 5 are reasonable from a bank's perspective, which is expected to realize the potential to increase the price from all available options.

Furthermore, while several variables are highly significant, our model explains only less than a quarter of the total variation in loan rate differences between a current client and a comparable new loan for digital clients. This value is as low as one-tenth of the variation in the youngest group. Overall, our main findings on the effect of (Number of years since the last loan) and Rank PD are still robust for different sub-samples with diverse characteristics.

5.2.2. Loan rate differences on loans sourced digitally

We also investigate whether our findings can be applied to digitally sourced loans, which is relevant given that the share of digital clients is increasing rapidly. Therefore, we hypothesize that digitalization can influence search costs. In Table 5, we regress the price difference between existing mortgages and similar new loans for digital clients based only on Equation 1. From Table 5, the price difference is not lower for loans sourced digitally but is at the same level as that of mortgages with a personal advisor (28.480 compared to 27.512). Furthermore, Rank PD, with a coefficient of 3.1202 *(0.2203)*, has a dominating effect on the price difference at the 10-decile range of the factor. This is followed by the effect of the time since the last loan (Number of years since the last loan), which has a coefficient of 0.6555 *(0.2205)*, with a range of the factor of more than 7 years. The effect of Rank PD is six times as large as that of clients with advisors.

5.2.3. Price differentiation for mortgage clients with personal advisors

In the sub-sample of mortgages for which the client has a personal advisor, the results in Table 5 reveal that the effect of the number of years since the last loan (Number of years since the last loan) of 0.8064 *(0.1100)* is higher and more significant than that for the other groups. By contrast, the coefficient of 0.5249 *(0.0417)* on Rank PD is only one-fourth to one-sixth of the effect for the digital and youngest clients; nevertheless, it is highly significant. This may be explained by the personal relationship between the client and advisor, which leads to a more lenient repricing of mortgages as the credit quality of the mortgage decreases. Regarding the other factors, LTV and Loan size reduce the rate difference. This may be due to a higher focus on interest rates for clients with larger loans and the lower rates offered to younger clients on loans with a high loan-to-value ratio. Clients with a high loan-to-value ratio may also search for competitive rates more actively. The rate difference increases with Age, and Male customers with an advisor have a significantly lower rate difference.

---

[13] While the rate differences in this study are in the 20 basis point range, reflecting an annual price difference on the average loan in the data of around 4,800 NOK (EUR 440) per year, the price difference constitutes a present value of 30,000–40,000 NOK (EUR 3,000–4,000) over the expected duration of a mortgage

Table 6
Probability of the rate offered by the home bank to counter a competing offer from another bank being higher than the competing offer (N-13.080).

	Model 1	Model 2	Model 3
Centrality	0.063	0.065	0.063
	(0.041)	(0.041)	(0.041)
Internal information	0.294	0.319	0.289
	(0.069)	(0.069)	(0.069)
	***	***	***
Credit score	0.201	0.198	0.176
	(0.063)	(0.063)	(0.063)
	**	**	**
LTV	0.116	0.111	0.091
	(0.043)	(0.043)	(0.043)
	**	**	*
Advisor	-0.017	-0.017	-0.025
	0.041	0.041	0.042
Year customer	0.300	0.278	0.260
	(0.079)	(0.08)	(0.08)
	***	***	**
Mean dependent variable	0.229	0.24	0.244
	(0.021)	(0.021)	(0.022)
	***	***	***
Year		✓	✓
Age			✓
Pseudo R-squared	0.217	0.218	0.221

Significance levels: $^*p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$

Table 7
Difference between the counteroffer from a home bank when a client receives a competing offer from another bank and the competing offer (N-13.080).

	Model 1	Model 2	Model 3			
Centrality	-0.002	-0.003	-0.003			
	(0.008)	(0.008)	(0.008)			
Internal information	0.198	0.208	0.206			
	(0.014)	(0.013)	(0.013)			
	***	***	***			
Credit score	0.167	0.172	0.172			
	(0.071)	(0.078)	(0.077)			
	**	**	**			
LTV	0.034	0.032	0.049			
	(0.008)	(0.008)	(0.008)			
	***	***	*** Advisor	0.018	0.018	0.022
	(0.008)	(0.008)	(0.008)			
	*	*	** Year customer	-0.041	-0.034	-0.032
	(0.015)	(0.015)	(0.015)			
	**	*	*			
Mean dependent variable	0.229	0.24	0.11			
	(0.021)	(0.021)	(0.022)			
	***	***	***			
Year		✓	✓			
Age			✓			
Pseudo R-squared	0.06	0.079	0.149			

Significance levels: $^*p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$

5.2.4. Price differentiation for younger mortgage clients

As Table 5 shows, the most notable difference in our results for the two other groups is that variable Loan size with a coefficient of 4.144 *(1.0494)* is positive and larger and that LTV, which has a coefficient of -0.4420 *(0.0609)* and a negative effect. Moreover, the coefficient of - 5.5958 *(2.8048)* for the client being Male is significantly larger. The mean rate difference is only 3.0167 basis points, that is, only approximately one-tenth of the level of the other two groups (27.512 and 28.480, respectively). Variable Youngest has the highest contribution in explaining the price difference (P diff) for different groups and segments. This is because most Norwegian banks have preferential and more transparent prices for their youngest clients and because all members of this age group qualify for these rates. Furthermore, the price difference increases in the years since the last loan, but the effect is slightly smaller and less significant.

Table 8
Log probability of a mortgage client remaining with the home bank 12 months after receiving a competing offer (N = 13,080).

Number of years since the last loan	0.0115
	(0.0144)
Advisor	0.3801
	(0.0377)
	***
Loan size	0.0222
	(0.0160)
Rank PD	-0.0585
	(0.0260)
	**
sq Rank PD	-0.0035
	(0.0026)
LTV	-0.0109
	(0.0027)
	***
sq LTV	1.01E-06
	(4.64E-07)
	***
log Centrality of the real estate location	- 0.07605
	(0.01578)
	***
Age	0.0421
	(0.0192)
	**
Digital	-0.3808
	(0.0522)
	***
Rate difference to competing bank	-0.0050
	(0.0009)
	***
sq Rate difference to competing bank	3.10E-06
	(1.20E-06)
	***
Number of years with the bank	0.0424
	(0.0069)
	***
Mean dependent variable	0.4246
S.D. dependent variable	(0.4943)
Uncentered R-squared	0.0201
Log-likelihood	-8710.5

Significance levels: $^*p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$

One possible interpretation is that the young age of clients limits the number of observations with more than three to five years since the last loan. Consequently, for most clients, the last loan represents their first loan.

Table 5 shows that the model has a weaker explanatory power (Adjusted R^2) compared to the results for the other two client groups. A higher credit risk represented by a higher Rank PD leads to a larger price differentiation, as indicated by the coefficient of 1.8850 (*0.4903*), which places it between the effect on clients with advisors and digital clients (0.5249 and 3.1202, respectively). Counter-intuitively, the price differences decrease with the loan-to-value ratio (LTV), while the coefficient of -0.4420 (*0.0609*) depicts a stronger significance level compared to those of clients with advisors and digital clients. This may be explained by the fact that banks make more attractive offers to first-time buyers, who typically show higher loan-to-value ratios than average young mortgage clients. Therefore, the overall results reveal that the bank does not price credit risk consistently and that the increase in the rate over time is not as prevalent for this age group as it is for the others.

5.3. The home banks' counteroffer strategies

Table 6 shows the probability of a counteroffer being higher than the competing offer. We find that the Centrality of collateral does not significantly influence the probability of a counteroffer being higher than the competing offer. Negative Internal information significantly increases the probability of a counteroffer being higher than the competing offer (0.294, *0.069*), and remains significant in all model specifications. Credit score available to all banks has a similar but slightly smaller and less significant effect (0.201, *0.063*). After controlling for Age and Year, LTV is significant at the 10 percent level (0.091, *0.043*).

We further expand the analysis of counteroffer strategies by exploring which factors influence the counteroffer relative to the competing offer in Table 7. We find no significant link between Centrality and the difference between the counteroffer and the

Table 9
Rate offered by the home bank as a counteroffer when a mortgage client receives a competing offer (N=9125).

Number of years since last loan	0.24241
	(0.32304)
Rank PD	2.2140
	(0.8592)
	***
sq Rank PD	- 0.2867
	(0.09435)
	***
LTV	0.15482
	(0.03063)
	***
Loan size	- 7.9508
	(0.57753)
	***
Male	- 4.7666
	(1.5450)
	***
Centrality location of realestate	- 0.0109
	(0.00317)
	***
Advisor	- 0.7876
	(1.6747)
Number of years with bank	0.1271
	(0.2214)
Age	1.1182
	(0.6918)
Mean dependent var	17.178
S.D. dependent var	(33.374)
Sum squared resid	2222716
S.E. of regression	31.800
Uncentered R^2	0.2021
Centered R^2	0.0958

Significance levels: $^*p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$

competing offer (-0.003, *0.008*). The negative Internal information significantly increases the counteroffer compared to the competing offer (0.198, *0.014*) in Model 1 and retains size and significance across Models 2 and 3. This effect is also slightly larger and more significant than the effect of Credit score (0.167, *0.071*), indicating the value of informational asymmetry to be a stronger signal than client rating. Furthermore, having an Advisor significantly increases the counter-offer relative to the competing offer, implying that the home bank perceives that the client is willing to stay with the bank despite a slightly higher price (0.018, *0.08*). Year as client; however, it leads to a lower counteroffer (-0.041, *0.015*). This is a rational choice, as loyal clients are more profitable but inconsistent for a bank seeking to exploit increased switching barriers from a longer client-bank relationship.

We further analyze the home bank's counteroffer without considering the competing offer. As per Table 9, the home bank's strategy depends on several factors. It offers a higher rate when competing for a client with a higher risk, as measured by Rank PD and LTV. However, the effect of risk on the counteroffer decreases slightly with an increase in risk, which is counterintuitive. The coefficients on Loan size (- 7.9507, *0.5775*) and Rank PD (2.2140, *0.8592*) display the largest overall marginal effects to the counteroffer, given the absolute size and dispersion of the variables. Neither Advisor nor Number of years with the bank is significant.

The combined results of these analyses of counteroffers support the hypothesis that the home bank employs information asymmetry to offer less favorable rates and that there is a lower probability of a bank offering a rate lower than the competing offer to a client with a high credit risk. This information asymmetry can lead to increasingly risky clients switching banks, thereby increasing the overall risk of a bank attracting a large number of new customers.

5.4. Factors explaining differences in client retention

Table 8 indicates that only 42.5% of current clients still have their mortgage with the home bank 12 months after receiving a new offer from a competing bank. Since client switching reduces the bank's profitability, it is important to identify factors contributing to client retention after having solicited a competing offer. This is highly relevant for business strategies.

Number of years since the last loan does not significantly increase the probability of retention. However, having an Advisor significantly increases the probability of retention 12 months after receiving a competing offer (0.3801, *0.0377*). Loan size does not impact retention at the 10% significance level. Meanwhile, increases in credit risk measured by both Rank PD and LTV reduce the probability of retention. The latter effect is smaller and diminishes slightly as LTV increases but is highly significant (-0.0109, *0.0027*). Centrality of the real estate location reduces the probability of retention and the Digital being sourced digitally has a similar effect,
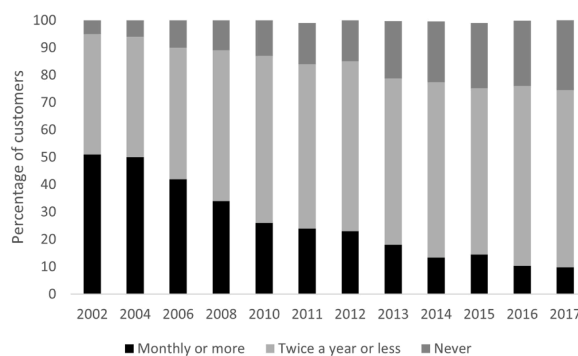
Fig. 6. Share of respondents using bank branches monthly or more frequently according to a survey conducted by Finance Norway.
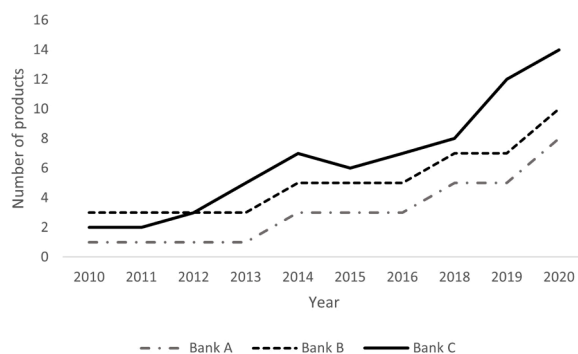

Fig. 7. Number of different mortgage products available to a client with a similar loan from three randomly selected banks from Finansportalen (Finansportalen, 2020).

which confirms our hypothesis that digital clients and high centrality have lower switching costs. Increases in Age and Number of years with the bank increase the probability of a client remaining with the home bank. The observed association between Age and the likelihood of retention appears inconsistent with the larger rate difference that accompanies older age, as indicated by Table 5. This discrepancy suggests that, despite the bank capitalizing on the higher age by raising rates, older clients exhibit higher loyalty.

Table 8 shows that a larger difference between the rate of the home bank and the rate of the competing offer measured by Rate difference to competing bank significantly affects the probability of retention. The coefficient of (-0.0050, *0.0009*) is small, but not negligible, given that Rate difference to competing bank is measured on a scale with an average value of 38 basis points—the effect on log likelihood. We also see that this effect is non-linear based on the significant coefficient of the square of Rate difference to competing bank.

Client loyalty leads to retention, whereas clients with high credit risk are more likely to switch. One possible explanation is that the new bank does not have all information about a client's risk profile; hence, it offers a more attractive price. Additionally, the log probability marginally decreases over time when considering retention as a function of time as a client. Furthermore, increasing the price difference so that a competing offer is much lower than the current rate (Rate difference to competing bank) raises the risk of losing the client when they receive a competing offer.

5.5. Outlook

We found that the pattern of price discrimination has changed over time. In the early years of the sample, there was a significant difference between the average and the best rate offered when granting a loan, which is consistent with the high levels of price discrimination at origination. However, this changed over time, given the more transparent market conditions which lowered banks' ability to use price discrimination. We further investigated whether the changes in our specific bank's price discrimination strategy are representative of banks in general. Finance Norway conducted surveys to measure the use of digital banking and physical branches (Finance Norway (2018)). The observed reduction in initial price discrimination in Fig. 2 coincides with the rapid decrease in the use of physical banking branches regularly, from 30% to below 10% (see Fig. 6).

Fig. 7 shows that the number of different mortgage product offerings is on the rise, and most of them have different prices, implicitly reducing transparency for mortgage holders. The introduction of new similar products can be a new form of bank strategy for price discrimination. Our bank follows the strategy of largest Norwegian banks to improve the rates offered to all clients after the introduction of Finansportalen in 2008. They have subsequently increased their offered rates compared to other banks, while also
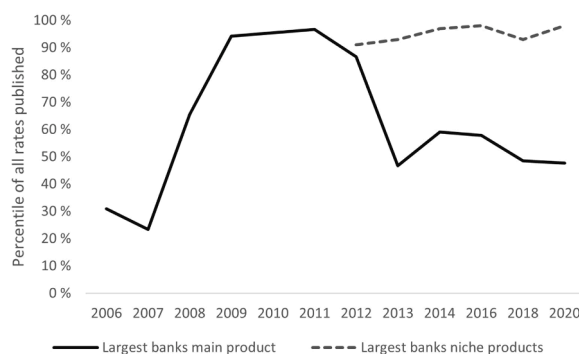
Fig. 8. Percentile placement of the best rate on niche products and the product offered to clients not part of any special organization, niche, or group by the largest Norwegian banks from Finansportalen (Finansportalen, 2020).

introducing preferential rates for certain top-ranking client groups, as shown in Fig. 8.

6. Conclusions and further research directions

We documented the price discrimination practiced by a bank in mortgage lending. We limited our study to a non-random sample of mortgage clients pursuing a competing offer from another bank. The dispersion in rates and the deviation from the comparable rate available to new customers is larger outside our sample, supporting the overall pratice of price discrimination by the home bank. After controlling for economically relevant factors, such as the probability of default, mortgage size, and loan-to-value ratio, a price difference between current clients and new customers was still present. The most significant factors that explain the price differentiation between current clients and new customers are related to the time since the last loan.

Our findings contribute to the existing research by exploring how price differentiation continues and develops after loan origination in a bank. Additionally, we shed light on the impact of price discrimination on clients' switching behaviors by comparing prices to existing and comparable new mortgages with the same bank. We also determine that price discrimination gradually increases over time, even in a highly transparent market with low switching barriers. However, digitalization coincides with a significant decrease in the potential for differentiation from the best available list price at the time of mortgage origination.

Price differentiation can be controlled by enforcing current regulations. Regulations that enforce the equitable treatment of clients are one of the potential pitfalls of following a product introduction strategy to obtain excess profits from current clients. Furthermore, our findings support the enforcement of planned regulations that limit banks' discretion in changing the rates for current clients.

Furthermore, clients with higher risk are more susceptible to switching banks. While these clients pay a higher rate, there exists both a higher observed probability of switching and a lower willingness by the home bank to offer a competitive rate to retain a client. This may indicate an information asymmetry, in which the home bank acknowledges the client's risk, but the competing bank—which does not have access to the same information—offers more favorable rates to compete for the same client.

Our results provide stronger evidence for the fact that banks update their pricing strategies under increased transparency and digitalization. They also warrant further research on what may be an important link between digitalization and price discrimination and on how changes in pricing strategy can serve to maintain price discrimination between clients.

Credit Author Statement

All authors in their capacity contributed equally to the manuscript.

Appendix A. Additional motivation for methodological choices

This section aims to increase transparency and provide information necessary to explain the choices of control variables and robustness tests in the study.

A1. Reliability of reported interest rates from competing offers

To prevent under-reporting of competing offers, the home bank requested the mortgage client to provide documentation of the competing offer to receive a counteroffer. The bank also registered all competing offers and established a scale of reasonable offers to check client interest rates as an extra precaution to identify the misreporting of competing offers.

A2. The reason for acquiring a competing offer or switching

Employing information about clients' loan application when the loan originated from the home bank, we further explore if, when

Table A1

Factors influencing the duration of a client-bank relationship based on loan application data.

Characteristics	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Number of persons in household	0.2875 ***	0,2184 ***	0.2583 ***	0.3301 ***	0.2604 ***	0.3294 ***
	(0.0802)	-0.0822	-0.0824	-0.0785	-0.0823	-0.0782
AGE	0.0765	N/A	N/A	N/A	N/A	N/A
	-0.0502					
AGE2	0.0003	N/A	N/A	N/A	N/A	N/A
	-0.0005					
Youngest clients	N/A	-1.3395***	-1.3238 ***	-1.2897 ***	-1.3717 ***	-1.3439 ***
		-0.1986	-0.1985	-0.1999	-0.2032	-0.2064
Oldest clients	N/A	2.0582***	1.9816 ***	1.9465 ***	1.9347 ***	1.8967 ***
		-0.3822	-0.3806	-0.3805	-0.383	-0.3827
Loan Conditions						
Highest 20%	N/A	N/A	0.7735***	0.8487 ***	0.7008 ***	0.7658 ***
			0.2573	-0.2584	-0.2676	-0.2708
Bottom 20%	N/A	N/A	-0.6863***	-0.7144 ***	-0.6719 ***	-0.6975 ***
			-0.2342	-0.2354	-0.2344	-0.2357
Loan Amount	2.01e(-7) ***	2.19e(-7) ***	2.36 e(-7) ***	1.41e(-7) **	2.35e(-7) ***	1.44e(-7) **
	(6.40e(-8))	(6.58(-8))	(6.61e(-8))	(5.70e(-8))	(6.65e(-8))	(5.7e(-8))
Interaction Variable						
PD*LTV	N/A	N/A	N/A	N/A	0.0133	0.0145
					-0.0114	-0.012
Constant	3.5971	10.2104	10.2198	9.5429	10.6564	10.049
	-0.7483	-0.4948	-0.4901	-0.4324	-0.6283	-0.6175
R2	0.2595	0.2342	0.2408	0.2373	0.2423	0.2391
Observation N	2559	2559	2559	2559	2559	2559

a Dependent variable: duration of client-bank relationship *b* Significance levels: $^*p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$ *c* Loan conditions represent the clients' rate relative to the rate of other clients at the time of granting a loan. *d* Data analysis and preparation for this part of the analysis is performed by Rune Bach, Joakim Holst, Are Oust, and Endre J. Reite as part of a separate working paper.

Table A2

Herfindal-Hirschman index based on the market share of all banks in subregions in the sample period.

	Least central	Low centrality	Medium centrality	Highest centrality
2011	2,764	2,469	1,291	1,487
2014	2,406	2,361	1,349	1,517
2017	2,713	2,679	1,393	1,579

Data from Ambita of all houses posed as collateral, grouped in different centralities in the regions where the banks' client base is located, for different years in the sample period.

originating a mortgage, the client and loan characteristics can predict the duration of the client-bank relationship and any subsequent switching. Insights into how prone different clients are to switching are material in determining future profitability and focusing banks' efforts on retaining clients in a cost-efficient manner. We also employ detailed inside data on the client, mortgage, and credit risk. We find that a bank can predict switching at origination and that clients with high credit risk and discounted mortgages show reduced longevity. This robustness test is currently being prepared for submission as a separate paper co-authored by Are Oust, Jakob Holst, and Rune Bach. As illustrated in Table A1, high-risk clients are more prone to switch banks and the youngest clients also have a significantly shorter duration of the client-bank relationship. According to Table A1, the oldest clients are more prone to switch banks. The results support the significance of the variables found in Section 5.

A3. Changes in the local or regional bank competition

During the preparation of the paper, we created HH indexes for all regional submarkets to investigate significant changes in competition in Table A2. As illustrated in Table A2, HHI increased in the least and medium centrality areas from 2010 until 2014, but this changed as several national banks closed their branches between 2013 and 2015. However, the changes in the market share of different banks in the region are minor. They do not indicate a need to create a sub-market dummy to control for such changes in addition to the control variables in the regressions.

A4. Market developments, interest rates and house prices

As displayed in Fig. A1, housing prices grew steadily over our study period. From Fig. A2, mortgage interest rates have displayed small fluctuations and gradually declined over time. Any abrupt trends switch for any key market factors would merit a broader discussion on the impact of such changes.
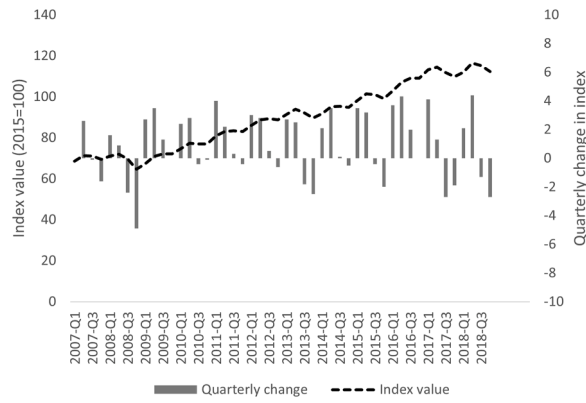
Fig. A1. Housing prices in Norway, and quarterly change (real) *Source*: OECD (2021).
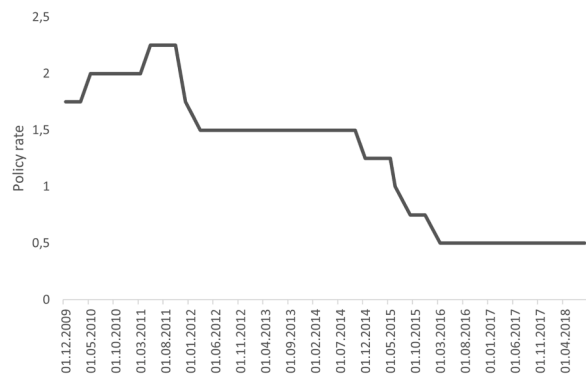

Fig. A2. Changes in policy rate from Norges Bank *Source*: Bank (2021).
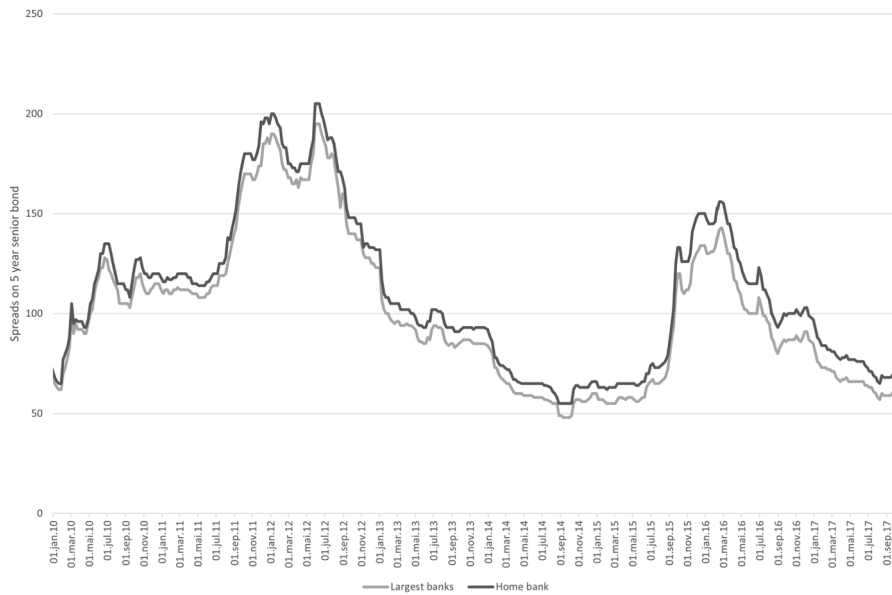

Fig. A3. Reported spreads on senior 5-year bonds *Source*: Home bank treasury.

A5. Changes in the bank strategy and growth in the period

The bank has been under the same management, with a growth strategy throughout the period under study. Capital adequacy has, according to the bank, been good throughout the period under investigation, and published financial reports from the banks make this statement plausible. Marginal funding through covered bonds has been available throughout the period, with a marginal funding cost in the capital markets slightly over that of the largest Norwegian banks, as illustrated in Fig. A3. The ownership structure also remained unchanged throughout the study period.

A6. The decision to exclude fixed-rate mortgages

While fixed-rate loans dominate the mortgage industry in many countries (Kish, 2022), such loans only make up a small proportion of the mortgages in Norway (Statistics Norway, 2022). Switching in fixed-rate mortgages is also restricted to the end of the term, or charges to the home bank will be incurred or, in certain instances and for certain banks, made payable to the client. There are only 5.3% fixed-rate mortgages in the home banks' client base during the period, and they constitute only 1.3% of the clients receiving competing offers. Paying out net present value to clients on fixed-rate mortgages has radically changed between 2011 and 2014. There is also a minimal number of clients choosing fixed-rate mortgages in some periods making it difficult to establish time trends. Several clients also switch between floating rate offers from one bank and fixed rates offer from another, making calculations of rate/margin differences extremely complex.

References

Agarwal, S., Song, C., Yao, V.W., 2019. Banking competition and shrouded attributes: Evidence from the US mortgage market. Available at SSRN 2900287. https://doi.org/10.2139/ssrn.2900287.

Al-Bahrani, A., Su, Q., 2015. Determinants of mortgage pricing: A quantile regression analysis. Journal of Housing Economics 30, 77–85. https://doi.org/10.1016/j.jhe.2015.10.005.

Allen, J., Clark, R., Houde, J. F., 2012. Price competition and concentration in search and negotiation markets: Evidence from mortgage lending.

Allen, J., Clark, R., Houde, J.F., 2014. Price dispersion in mortgage markets. Journal of Industrial Economics 62 (3), 377–416. https://doi.org/10.1111/joie.12046.

Allen, J., Clark, R., Houde, J.F., 2019. Search frictions and market power in negotiated-price markets. Journal of Political Economy 127 (4), 1550–1598. https://doi.org/10.1086/701684.

Bakos, Y., 2001. The emerging landscape for retail E-commerce. Journal of Economic Perspectives 15 (1), 69–80. https://doi.org/10.1257/jep.15.1.69.

Bank, N., 2021. Key policy rates. https://www.norges-bank.no/en/topics/Monetary-policy/Policy-rate/Key-policy-rate-Monetary-policy-meetings-and-changes-in-the-policy-rate/:accessed:02/03/2021.

Barone, G., Felici, R., Pagnini, M., 2011. Switching costs in local credit markets. International Journal of Industrial Organization 29 (6), 694–704. https://doi.org/10.1016/j.ijindorg.2011.03.004.

Bartlett, R., Morse, A., Stanton, R., Wallace, N., 2019. Consumer-lending discrimination in the FinTech era. http://www.nber.org/papers/w25943.pdf. 10.3386/w25943.

Bester, H., Petrakis, E., 1996. Coupons and oligopolistic price discrimination. International Journal of Industrial Organization 14 (2), 227–242. https://doi.org/10.1016/0167-7187(94)00469-2.https://linkinghub.elsevier.com/retrieve/pii/0167718794004692

Bhutta, N., Fuster, A., Hizmo, A., 2015. Paying too much? Price dispersion in the US mortgage market. 10.2139/ssrn.3422904.

Bialowolski, P., Cwynar, A., Xiao, J.J., Weziak-Bialowolska, D., 2020. Consumer financial literacy and the efficiency of mortgage-related decisions: New evidence from the panel study of income dynamics. International Journal of Consumer Studies 1–14. https://doi.org/10.1111/IJCS.12646.

Bonfim, D., Nogueira, G., Ongena, S., 2021. Sorry, we're closed: Loan conditions when bank branches close and firms transfer to another bank. Review of Finance 25 (4), 1211–1259.

Brunetti, M., Ciciretti, R., Djordjevic, L., 2020. Till mortgage do us part: Mortgage switching costs and household's bank switching. Journal of Banking and Finance 119, 105904. https://doi.org/10.1016/j.jbankfin.2020.105904.

Calomiris, C.W., Pornrojnangkool, T., 2009. Relationship banking and the pricing of financial services. Journal of Financial Services Research 35 (3), 189–224. https://doi.org/10.1007/s10693-009-0058-7.

Carbo-Valverde, S., Hannan, T.H., Rodriguez-Fernandez, F., 2011. Exploiting old customers and attracting new ones: The case of bank deposit pricing. European Economic Review 55 (7), 903–915. https://doi.org/10.1016/j.euroecorev.2011.02.001.

Cerqueiro, G., Degryse, H., Ongena, S., 2011. Rules versus discretion in loan rate setting. Journal of Financial Intermediation 20 (4), 503–529. https://doi.org/10.1016/j.jfi.2010.12.002.

Chen, Y., 1997. Paying customers to switch. Journal of Economics & Management Strategy 6 (4), 877–897. https://doi.org/10.1111/j.1430-9134.1997.00877.x.

Cox, R., Brounen, D., Neuteboom, P., 2015. Financial literacy, risk aversion and choice of mortgage type by households. Journal of Real Estate Finance and Economics 50, 74–112. https://doi.org/10.1007/S11146-013-9453-9.

Davidoff, T., Gerhard, P., Post, T., 2017. Reverse mortgages: What homeowners (don't) know and how it matters. Journal of Economic Behavior & Organization 133, 151–171.

Feng, X., Lu, B., Song, X., Ma, S., 2019. Financial literacy and household finances: A bayesian two-part latent variable modeling approach. Journal of Empirical Finance 51, 119–137. https://doi.org/10.1016/j.jempfin.2019.02.002.

Finance Norway, 2018. Consumer and Finance Trends. https://www.finansnorge.no/aktuelt/nyheter/forbruker-og-finanstrender/forbruker--og-finanstrender-2018/forbruker--og-finanstrender-2018/.

Finansportalen, 2020. Historic mortgage rates. https://www.finansportalen.no/bank/boliglan-historikk.

Fischer, K., 1990. Hausbankbeziehungen als instrument der bindung zwischen banken und unternehmen - Eine theoretische und empirische analyse. Universitat Bonn.

Gaganis, C., Galariotis, E., Pasiouras, F., Staikouras, C., 2020. Bank profit efficiency and financial consumer protection policies. Journal of Business Research 118, 98–116. https://doi.org/10.1016/J.JBUSRES.2020.06.033.

Gary-Bobo, R.J., Larribeau, S., 2004. A structural econometric model of price discrimination in the French mortgage lending industry. International Journal of Industrial Organization 22 (1), 101–134. https://doi.org/10.1016/j.ijindorg.2003.07.002.

Hagberg, J., Sundstrom, M., Egels-Zandén, N., 2016. The digitalization of retailing: An exploratory framework. International Journal of Retail and Distribution Management 44 (7), 694–712. https://doi.org/10.1108/IJRDM-09-2015-0140.

Hassink, W.H., Leuvensteijn, M.V., 2007. Measuring transparency in the Dutch mortgage market. Economist 155 (1), 23–47. https://doi.org/10.1007/s10645-006-9045-7.

Ioannidou, V., Ongena, S., 2010. Time for a change: Loan conditions and bank behavior when firms switch banks. The Journal of Finance 65 (5), 1847–1877. https://doi.org/10.1111/j.1540-6261.2010.01596.x.

Jiang, Y., 2007. Price discrimination with opaque products. Journal of Revenue and Pricing Management 6 (2), 118–134. https://doi.org/10.1057/palgrave.rpm.5160073.

Kim, M., Kliger, D., Vale, B., 2003. Estimating switching costs: The case of banking. Journal of Financial Intermediation 12 (1), 25–56. https://doi.org/10.1016/S1042-9573(02)00005-0.

Kish, R.J., 2022. The dominance of the us 30-year fixed rate residential mortgage. Journal of Real Estate Practice and Education 24 (1), 1–16.

Levine, M.E., 2002. Price discrimination without market power. Yale Journal on Regulation 19.

Magri, S., Pico, R., 2011. The rise of risk-based pricing of mortgage interest rates in Italy. Journal of Banking and Finance 35 (5), 1277–1290. https://doi.org/10.1016/j.jbankfin.2010.10.008.

Munnell, A.H., Tootell, G.M., Browne, L.E., McEneaney, J., 1996. Mortgage lending in boston: Interpreting hmda data. The American Economic Review 25–53.

OECD, 2021. Household debt (indicator). https://data.oecd.org/hha/household-debt.htm.

Ongena, S., Smith, D.C., 2001. The duration of bank relationships. Journal of Financial Economics 61 (3), 449–475. https://doi.org/10.1016/S0304-405X(01)00069-1.

Rajan, R.G., 1992. Insiders and outsiders: The choice between informed and arm's-length debt. The Journal of Finance 47 (4), 1367–1400. https://doi.org/10.1111/j.1540-6261.1992.tb04662.x.

Reite, E.J., 2022. Information asymmetry between banks, rent extraction, and switching in mortgage lending. Finance Research Letters 50, 103339. https://doi.org/10.1016/j.frl.2022.103339.

Salkind, N., 2010. Encyclopedia of research design. Sage Thousand Oaks, CA.

Shaffer, G., Zhang, Z.J., 2000. Pay to switch or pay to stay: Preference-based price discrimination in markets with switching costs. Journal of Economics <html_ent glyph="@amp;" ascii="&"/> Management Strategy 9 (3), 397–424. https://doi.org/10.1111/j.1430-9134.2000.00397.x.

Sharpe, S.A., 1990. Asymmetric information, bank lending, and implicit contracts: A stylized model of customer relationships. The Journal of Finance 45 (4), 1069–1087. https://doi.org/10.1111/j.1540-6261.1990.tb02427.x.

Statista, 2018. Norway: bank's market share of loans, by type of lender 2018. https://www.statista.com/statistics/1054368/bank-s-market-share-of-total-loans-in-norway-by-type-of-lender/.

Statistics Norway, 2019. Interest rates on new and existing loans. https://www.ssb.no/bank-og-finansmarked/statistikker/renter.

Statistics Norway, 2020. Centrality Index - SSB. https://www.ssb.no/befolkning/artikler-og-publikasjoner/sentralitetsindeksen.oppdatering-med-2020-kommuner.

Statistics Norway, 2021. Interest Rates on New and Existing Mortgages - SSB. https://www.ssb.no/en/bank-og-finansmarked/finansinstitusjoner-og-andre-finansielle-foretak/statistikk/renter-i-banker-og-kredittforetak.

Statistics Norway, 2022. Percentage fixed-rate mortgages - SSB. https://www.ssb.no/en/bank-og-finansmarked/finansinstitusjoner-og-andre-finansielle-foretak/statistikk/renter-i-banker-og-kredittforetak.

Stein, I., 2015. The price impact of lending relationships. German Economic Review 16 (3), 367–389. https://doi.org/10.1111/geer.12057.

von Thadden, E.L., 2004. Asymmetric information, bank lending and implicit contracts: The winner's curse. Finance Research Letters 1 (1), 11–23. https://doi.org/10.1016/S1544-6123(03)00006-0.

The Financial Supervisory Authority of Norway, 2019. Financial Outlook December.

Trading Economics, 2018. Norway homeownership rate, 2003-2018. https://tradingeconomics.com/norway/home-ownership-rate.

Vives, X., 2019. Digital disruption in banking. Annual Review of Financial Economics 11 (1), 243–272. https://doi.org/10.1146/annurev-financial-100719-120854.

Wachter, S., 2003. Price revelation and efficient mortgage markets. Texas Law Review 82 (2), 413–419.

Woodward, S.E., Hall, R.E., 2012. Diagnosing consumer confusion and sub-optimal shopping effort: Theory and mortgage-market evidence. American Economic Review 102 (7), 3249–3276. https://doi.org/10.1257/aer.102.7.3249.