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Consumer Loan Rate Dispersion and the Role of Competition: Evidence from the Turkish Banking Sector

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Abstract

This paper aims to examine the degree of dispersion in the loan pricing of commercial banks and its association with competitive conditions. To this end, an indexation mechanism processing a novel bank-level dataset is proposed to quantify the lending rate variability in general-purpose, vehicle, and housing loans for the period January 2007-April 2020. In panel convergence tests, we show that there exists heterogeneity in long-term co-movements in banks' loan pricing, while periods following the tightening in financial conditions display short-term deviations from general tendencies demonstrated by dispersion indices. The methodological setting also entails the construction of competition indicators for total and segment-based credit market developments. The competitive conditions monitored by Herfindahl-Hirschman Indicator (HHI) present that housing and vehicle loan segments have been concentrated in recent years. Quantile regression results further validate that improvements in the competition are associated with a lower level of lending rate dispersion in housing and vehicle segments in a statistically significant manner, whereas this relation is not applicable for general-purpose loans.

Özet

Bu çalışma ticari mevduat bankalarının kredi fiyatlamalarındaki uyum derecesini ölçmeyi ve faiz farklılıklarını rekabet koşullarıyla ilişkilendirmeyi amaçlamaktadır. Bu kapsamda, Ocak 2007-Nisan 2020 dönemi için banka bazlı özel bir veri setini işleyerek ihtiyaç, taşıt ve konut kredi kırılımlarında borç verme faizlerinin oynaklığını sayısallaştıran bir endeksleme yöntemi önerilmektedir. Ampirik bulgular bağlamında, panel kavuşma testleri kredi fiyatlamalarındaki banka bazlı davranışların uzun vadeli uyumunda heterojenliklere işaret ederken, faiz dağılım endeksleri kısa vadeli ayrışmaların finansal koşulların sıkılaştığı dönemleri takiben gerçekleştiğini göstermektedir. Çalışmanın metodolojik çerçevesi toplam ve kırılım özelinde rekabet göstergelerinin oluşturulmasını da içermektedir. HHI göstergeleri ile takip edilen rekabet koşulları taşıt ve konut gruplarında yoğunlaşmanın son yıllarda arttığına işaret etmektedir. Kantil regresyon sonuçları taşıt ve konut kredilerinde rekabet koşullarındaki iyileşmelerin daha düşük kredi faiz dağılımlarıyla istatistiki olarak anlamlı biçimde ilintili olduğunu gösterirken, ihtiyaç kredilerinde bu ilişkinin geçerli olmadığı tespit edilmiştir.

Keywords: Loan Rate Dispersion, Competition, Log-t Convergence Test, Quantile Regression

JEL Codes: C31, C33, G21, D40

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Non-Technical Summary

This paper mainly aims to quantify the degree of pricing dispersion in the consumer loan market and to analyze the relevance of competitive conditions on loan interest rate variation in the context of the Turkish banking sector. Previous literature entails the view that the lack of competitive forces might result in discretionary pricing which would accommodate wider loan rate dispersion. We utilized novel bank-level datasets including information for consumer loan balances (namely general-purpose, vehicle, and housing loans) and interest rates for the period 2007-2020 in our analyses.

In the first step of our methodological approach, we implemented panel convergence tests through log(t) regression model to identify whether long-term convergence applies to Turkish banks across different loan types and sample periods. It is found that there exist heterogeneities in the pricing behavior of Turkish banks in consumer segments in which some divergences are detected. In the second step, we augmented the method of Darracq-Paries et al. (2014) to calculate what is termed dispersion indices to monitor the short-term fluctuations in the loan pricing spectrum across banks. Index results display the amplified dispersion in loan rates, especially following the interest rate shocks and tightening in financial conditions. As the following step, the course of competition in the abovementioned consumer loan segments is characterized by calculating the Herfindahl-Hirschmann Index (HHI) proxies. The findings attached to recent observations of competition proxies show that concentration strengthens in vehicle and housing segments, whereas competitive conditions are stable in general-purpose loans.

The last phase of our methodological framework performed quantile regressions to analyze the association between loan rate dispersion and competition. After controlling for macroprudential policies as well as several loan demand and supply factors, empirical results indicate that worsening in the level of competition in total loans is correlated with amplified loan rate dispersion in vehicle and housing loans. When competition is measured by segment-wise loan balances, the statistical significance is only retained for housing loans. These results are robust across different quantiles of loan pricing variation. On the other hand, in contrast to expectations, competitive forces in general-purpose loans seem to be inversely related to pricing variance.

Overall, this study aims to contribute to the existing literature by introducing new monitoring methods to Turkish loan rate data. From a policymaking perspective, it is also considered to provide additional inputs as loan pricing is an integral component of financial stability and interest rate transmission mechanism.

1. Introduction and Literature Review

In a theoretical sense, price formations in any good market could be subject to instabilities given the behavior of the economic units and market structure. As argued by Stigler (1961), imperfect information among buyers may result in equilibrium price dispersion in the market for goods and initiate price heterogeneities even across relatively homogeneous products.[4] Since individual buyers might differ regarding their ability to search for lower prices, sellers can price discriminate and charge different customers variant prices for the same product. Thus, the resulting degree of price dispersion in a market might be shaped by the costly search of information (Salop and Stiglitz, 1982; Janssen and Moraga-González, 2004). Theoretical literature also covers other factors influencing the price dispersion in markets which can be listed as consumer switching costs, search costs, product differentiation, and macroeconomic outlook (Reinganum, 1979; Burdett and Judd, 1983; Schlesinger and von der Schulenburg, 1991; Kim et al., 2003).

As mentioned by Cerqueiro et al. (2011), the credit market is a suitable setting to analyze price dispersion since frictions such as imperfect information exist on both the demand and supply-side; banks face uncertainties in their assessment of borrowers' credibility, while borrowers face frictions in assessing how competitive a loan offer is. In credit markets, competitive structure and the existence of regulatory constraints can determine the limits to banks' bargaining powers. It is asserted that observed dispersion in loan rates can be attributed to the capability of lenders in ranking/sorting borrowers in terms of their debt repayment capacity in the context of adverse selection (Edelberg, 2006; Livshits et al., 2011). Credit risk (and how lenders perceive it) also contributes to the interest rate variability in loan markets because of agency costs incurred by the lenders given imperfect information between agents (Adams et al., 2009; Einav et al., 2013; Allen et al., 2014). At the same time, higher competition and the resulting decline in rates may increase the share of borrowers with better credibility, while they also reduce bank rents and therefore erode the incentive to screen by banks (Carletti, 2008). In other words, the customized nature of the screening process in financial intermediation can bring dispersion of the charged rates. The abovementioned factors are more pronounced in consumer financing markets as the frequency of obtaining loans -therefore the opportunity to observe past debt performance on the borrower- is lower, household finances lack the transparency of independently audited firm balance sheets, and there might be deficiencies in financial literacy (Campbell, 2016).

This issue has implications for financial stability as well since there exists evidence about the higher loan rate and credit growth dispersion induced by uncertainties about monetary policy stance and financial market developments (Ivashina and Scharfstein, 2010; Puri et al., 2011; Delis et al., 2014; Kosak et al., 2015). Altavilla et al. (2020) focus on the Euro-zone countries' banking systems and document that monetary policy pass-

[4] Throughout this paper, we use the term "dispersion" to describe the extent to which loan interest rates display variations across cross-sectional units such as banks.

through had been weakened in post-2008 period by using bank-level data. It is also found that, better lending conditions enhanced by non-standard policies resulted in credit easing and compensated the previous impacts of policy uncertainties by improving long-term pass-through and decreasing the loan pricing dispersions.

Apart from these factors, more relevant to our work, a particular strand of the literature focuses on the argument that the level of competition among banks can potentially lead to dispersion in loan interest rates. Previous literature predicts that more concentrated banking sectors can accommodate anti-competitive bank behavior to charge higher loan rates for profitability concerns (Bain, 1956). In other words, as stated by Baquero et al. (2018), the market power of individual banks might be translated into discretionary pricing in the loan rate-setting process, eventually creating wider rate dispersion. In highly competitive markets, banks tend to reduce interest rates for customers, while also maintaining acceptable credit risk levels. However, due to other factors such as funding costs and profitability, the degree of such rate cuts will be bounded resulting in a narrower dispersion. Since the extent of price variation for roughly standardized products is defined as the lack of perfect competition, the degree of price dispersion also serves as a proxy for the level of competition. Thus, a negative association is expected between loan rate variability and the extent of competition. Having stated that, the macroeconomic state of the economy or changes in the distribution of risk in the consumer pool can also affect the dispersion in rates. The rising share of risk in consumers, especially during times of financial distress may lead to rising interest rates guided by profit concerns, even when the level of competition in the market is high (Marquez, 2002). By the same rationale, loans with higher collateral level may be priced more competitively with less market-wide dispersion as they carry relatively lower credit risk.

In this context, there exist several empirical papers investigating this relationship. Earlier studies like Cottarelli and Kourelis (1994) and Borio and Fritz (1995) found that loan rates adjust sluggishly to shifts in market rates when the sector is less competitive. Cottarelli and Kourelis (1994) focused on a cross-country setting and described what is termed as "lending rate stickiness" corresponding to the smaller degree of variation in interest rates when policy rate is altered. In specific, it is found that competition is an important dimension of financial structure determining the rate stickiness and policies aiming to remove the barriers to competition would enhance the monetary policy transmission. Borio and Fritz (1995) investigated developed countries' data and the collusive behavior in short-term lending rates by evaluating the asymmetric responses of loan pricing to interest rate shocks derived from monetary policy stance. They handled the issue from the perspective of cost structure of financial intermediaries in terms of funding, while they also mentioned about the argument that stronger competition would result in less volatile loan pricing and smaller spread between lending and market rates.

As a more recent study, Baquero et al. (2018) analyzed microcredit markets for 67 countries for the period 2002-2008 by summarizing the level of competition in these

markets with HHI proxies. In order to document the loan rate variation they considered the differences between loan rates of individual institutions and average loan rate prevailed in a specific country during a specific time period. Their results are heterogeneous in the sense that reduced loan rates are observed together with improved competition for profit-based microfinancing institutions, whereas loan pricing tendencies of non-profit institutions are relatively insensitive to the level of concentration. Gropp et al. (2014) focused on European banking sectors to reveal that stronger competition facilitates the coherent loan pricing by enhancing the pass-through from market rates to loan rates. Their methodology embodied dynamics of deposit rates as well as different types of loan rates including short and long-term loans extended to non-financial companies as well as consumer credit and mortgage loans. An important finding is related to the retail loans as the degree of co-movement among loan rates in response to policy rate is higher in consumer and mortgage loans in compared to business loans.

More similar to our case regarding the loan types, De Haan and Sterken (2005) examined specifically the Dutch mortgage market by using high-frequency bank-level data for the period 1997-2003 to document the asymmetric pricing behavior, partly related to bank market power. Their results verified the notion that dominant banks with relatively higher market power can charge loan rates involving higher margins and their loan pricing follows the market rates less closely than other banks. Although it is not relevant to consumer loans, Moreno-Burbano et al. (2019) studied commercial loans extended to Colombian firms with micro-level datasets to evaluate the impact of banking sector competition in price dispersion. Apart from financial sector structure, they also controlled for the vast variety of firm and loan characteristics, while interest rate variation was captured by the relative spread of loan rate over opportunity cost of the lender which is specified as the term premium of the bond with equivalent maturity. However, their results for the impact of market concentration on the loan rate dispersion seemed to be inconclusive.

Similar to abovementioned studies, Mallett and Sen (2001) utilized survey data about Canadian small business loans and found that market concentration would result in higher pricing tendencies. Van Leuvensteijn et al. (2008) analyzed the impact of loan market competition on loan rates determined by European banks during 1994-2004. They revealed that banks tend to price the loans in accordance with market averages if competitive pressures are stronger. Bolt and Humphrey (2010) utilized the cross-country data of the European banking sector to assess the role of banking market competition in bank revenues.

Another strand of literature covers empirical studies being relevant to the statistical methods handling how to monitor loan rate variation. Some studies employing loan or bank-level datasets prefer to retrieve the difference between loan rates and reference mean/median values at specified time intervals (Baquero et al., 2018; Moreno-Burbano et al., 2019). Others utilizing micro-level data to calculate variability indicators like sub-sample standard deviation, inter-percentile ranges and coefficient of variation across

cross-sectional units like banks, loans, and countries. (Nakane and Koyama, 2003; Vajanne, 2007; Martin-Oliver et al., 2008). Another group of studies aims to capture the loan rate variation by adjusting the model specification. Cerqueiro et al. (2011) used a heteroscedastic regression model incorporating the precision of loan pricing by augmenting a variance equation. Kok and Lichtenberger (2007) analyzed the presence of loan rate dispersion across countries by checking for the equality of coefficients for country dummies in regressions taking the loan rates as the dependent variable. Few studies embrace alternative methods like calculating the marginal rate by taking the difference of individual loan interest rates over a benchmark, such as bond rate, (Allen et al., 2014) or adjusting the bank-level loan rate by credit risk indicators (Ushakova and Kruglova, 2018). On the other hand, we build our empirical setting for extracting loan rate dispersion on the method of Darracq-Paries et al. (2014) which benefit from a wider set of volatility indicators applied on cross-sectional distribution of loan pricing at each time point as well as the fitting of cumulative distribution function to undertake the indexation mechanism.

In this study, our main purposes are to analyze the degree of coherence in bank-level lending rates in consumer loan segments and to determine the impact of competition on rate dispersion using novel datasets. This paper contributes to the existing empirical literature on several fronts. First, it is the first attempt to document the consumer loan rate dispersion for the Turkish banking sector by using the bank-level interest rate data compiled by the CBRT at weekly frequency. Second, it is the first study aiming to quantify the degree of loan rate variations across commercial banks by implementing an indexation mechanism. In fact, this paper also undertakes the first empirical work to associate consumer loan rate variability with competitive conditions in the Turkish banking sector.

The rest of the paper is structured as follows. Section 2 describes the datasets utilized, and explains the methodological aspects. Section 3 presents the empirical results related to loan interest rate convergence, dispersion indices, competition indicators as well as the relationship between rate dispersion and competition. Section 4 makes conclusive remarks.

2. Data and Methodology

The sample period for this study is determined to cover the interval of January 2007-April 2020. One motivation for the starting date is the change in the monetary policy regime of the CBRT, into inflation targeting in 2006 after the disinflation process leading interest rates to enter a new plateau. Another motivation entails the inclusion of Global Financial Crisis in 2008, which influenced the domestic financial conditions and interest rate formations.

Our dataset is composed of the combination of two micro-level banking databases. The first database is a novel bank-level dataset containing consumer loan interest rates accrued on the flow of loans at a weekly frequency. We include 15 commercial deposit

banks operating in Turkey to map the dynamic volatilities in loan pricing.[5] We exclude investment and development banks as extending loans to the consumer segment is not the main focus of their operations. Participation banks are also omitted from the sample as their business operations, loan pricing mechanism and consumer segmentation are different from those of conventional commercial banks. We further evaluate the data availability of the remaining banks and form the ultimate sample that is also diverse in the sense that state banks, private banks, and foreign banks are covered. The resulting sample is representative of the entire sector; heterogeneous regarding bank size as well as the loans extended and deposits collected (Figure 1). Panel convergence analysis and construction of dispersion indices are conducted by using these series.

For the latter parts of the empirical analysis, in which competition indicators are retrieved and the association between loan rate dispersion and competitive forces are evaluated, another novel dataset describing the monthly loan stocks extended by these 15 commercial banks in general-purpose, vehicle and housing segments compiled by CBRT is employed.[6]

[**Insert Figure 1**]

We supplement these two micro-level datasets with macro-level data to be used as control variables in the analyses associating loan rate dispersion with competitive forces in quantile regressions. In this context, Turkey has implemented many counter-cyclical prudential measures targeting consumer lending during post-2008 period.[7] In order to account for the course of these macroprudential policies, we employed the macroprudential policy indices created by Eroğlu (2018).[8] These series are obtained through a comprehensive analysis of the macroprudential policies by assessing the relaxing/tightening features regarding policy instruments such as minimum payments, general provisions, risk weights, installment restrictions, FX loan limitations, debt-to-income ratios, loan-to-value ratios, and taxation. As it can be seen in the Appendix, upward movements of indices correspond to the enactment of tightening policies, whereas downward movements reflect the relaxations in macroprudential outlook.[9]

[5] There are a total of 34 deposit banks operating in Turkey. Domestic branches of foreign banks are left out of the analyses as they make up a very small share of loan issuance.

[6] Each loan issued in a month above a minimum of 1000TL is reported in the dataset. In fact, the representativeness of our sample can be observed from this data since, as of the beginning of 2020, the panel of banks included in this study contains around 97%, 71%, and 93% of total general-purpose, vehicle and housing loans given by the whole sector, respectively.

[7] The same period was rich in terms of macroprudential policy implementation across the globe (Cerutti et al., 2017).

[8] We gratefully acknowledge the courtesy of Egemen Eroğlu for sharing the updated version of macroprudential policy indices created for Eroğlu (2018).

[9] Several details on the sector's structure and regulatory landscape may help us form better linkages between the results. The early 2010s marked by high growth rates was seen as an opportunity by the regulatory authority to lay the foundations of several strands of macroprudential tools. At the end of 2013, a maturity cap for general-purpose loans was introduced and the loans were restricted to a maximum of 36 months. In the following period, the maturity cap was extended to 48 months before being restricted again by 36 months in 2016 and 2018, respectively. Finally, the cap was extended to 60 months in the first quarter of 2019. Loan to value (LTV) ceilings for vehicle and housing loans were also introduced. For vehicle loans, LTV caps were effective as of the first quarter of 2014 were determined between 50% and 70% depending on the price of the vehicle. In December 2017 and in January 2019, the LTV ratios were left unchanged but the price thresholds for the varying ratios were raised from 50,000 to 100,000 TL, and from 100,000 TL to 120,000 TL, respectively. For housing loans, LTV ratio, which was subject to no limitation until that date, was set at 75 percent in January 2011 and then raised to 80 percent in September 2016. In an accommodative outlook, the ratio was changed to range between 80% and 90% depending on the energy performance of the house in recent years.

Other controls are chosen based on the demand and supply-side determinants of loan pricing specific to consumer segments (Table 1). To this end, overall asset pricing formations, which could be influential for the wealth effects, and the value of collaterals are captured with the logarithmic growth of the BIST100 index. The income prospects and labor market conditions possibly governing the debt-repayment capacity of households are tracked with the employment ratio. General credit risk developments in consumer loans are represented by the consumer NPL ratio of the sector. In terms of the supply-side forces, we choose to utilize the capital adequacy ratio and liquidity ratio of the banking sector. The interest rate charged on TL deposits is also integrated into the list of covariates to control for funding cost risks and, to some extent, to capture the impact of the monetary transmission mechanism.[10]

[**Insert Table 1 and 2**]

The methodological approach follows a three-step procedure. We first investigate panel convergence across our sample of banks using an approach that allows for heterogeneous agent behavior. Next, we evaluate the weekly variance in loan pricing across banks to compose our baseline dispersion indices, and finally make the connection between loan rate dispersion and competition present in the market.

The first phase of our empirical setting is designed to statistically evaluate the joint movement of consumer loan interest rates among the panel of commercial banks through the implementation of the log(t) regression model.[11] As outlined in Du (2017), log(t) regression test developed by Phillips and Sul (2007) is superior compared to alternative convergence testing procedures (including panel unit root tests, co-integration, and dynamic panel estimations) and is known to integrate heterogeneous agent behavior (and its time-varying evolution) into the estimation procedure. Moreover, it does not make restrictive assumptions concerning the stationarity properties of the examined series. The method is also flexible in the sense that it is applicable to the sub-segments of the dataset to reveal the convergence dynamics. In this framework, panel convergence analysis is applied on different consumer loan segments with robustness analysis being iterated across bank ownership status, different phases of sample period as well as the large-small bank categorizations. The course of loan shares across these divisions are provided in the Appendix. Large banks are determined by ranking the sample banks according to total asset sizes.

The model initially decomposes the panel of consumer loan rates (X_{it}) with time ($t = 1, \dots, T$) and bank ($i = 1, \dots, N$) dimensions as follows:

[10] All series are transformed to induce stationarity and their forms embedded in quantile regressions turn out to be stationary as shown by the ADF test results (Table 2).

[11] In earlier studies, convergence hypothesis testing has been largely conducted in empirical growth literature to assess the notion that cross-country per-capita output will approach a common level (Barro and Sala-i Martin, 1997; Luginbuhl and Koopman, 2004; Pesaran, 2007). However, such methods have also been preferred to investigate long-term convergence outcomes in other cases such as house prices (Montanes and Olmos, 2013; Churchill et al., 2018; Ganioğlu and Seven, 2019), income inequality (Tian et al., 2016), corporate taxation (Regis et al., 2015), equity markets (Apergis et al., 2011), and bond yields (Antonakakis et al., 2017) among many others. Most similar to our case, Vajanne (2007) examined the convergence of retail banking credit interest rates charged on loans extended to households and firms in the pre-2008 period by examining the speed and depth of market convergence in the Eurozone through convergence tests based on panel unit root testing procedure.

$$X_{it} = g_{it} + a_{it} \tag{1}$$

where g_{it} stands for permanent components and a_{it} represents transitory components. The permanent component g_{it} could be capturing bank-specific factors that influence the setting of interest rates such as the bank's liquidity, credit risk, or market segment preferences. At the same time, they could also be embodying a common factor across banks, such as the country's access to international funds markets, which would impact all the banks in the sample. To reflect this fact, this equation could be further transformed as:

$$X_{it} = \left(\frac{g_{it} + a_{it}}{v_t}\right) v_t = \delta_{it} v_t \tag{2}$$

where v_t is the single common component derived from banks and δ_{it} can be defined as the time-varying idiosyncratic factor measuring the distance between common trend component v_t and panel data of the bank loan rates (X_{it}). As explained by Phillips and Sul (2007), since δ_{it} can not be directly estimated, common factor should be removed as follows:

$$h_{it} = \frac{X_{it}}{\frac{1}{N}\sum_{i=1}^{N} X_{it}} = \frac{\delta_{it}}{\frac{1}{N}\sum_{i=1}^{N} \delta_{it}} \tag{3}$$

Here, h_{it} is termed as the relative transition parameter monitoring the transition path of bank i regarding the panel average of all banks at a specific time t. This equivalence also implies that the cross-sectional mean of h_{it} should be unity and the cross-sectional variance of the same term should satisfy the following condition:

$$H_{it} = \frac{1}{N}\sum_{i=1}^{N}(h_{it} - 1)^2 \to 0 \; if \; \lim_{t\to\infty} \delta_{it} = \delta \; for \; all \; i \tag{4}$$

In this context, as mentioned by Phillips and Sul (2007), the panel convergence of bank loan rates (X_{it}) requires the following conditions:

$$\lim_{t\to\infty} \delta_{it} = \delta \; for \; all \; i \tag{5}$$

To test the convergence, a specific form is imposed on the time-varying loading coefficient δ_{it} as follows:

$$\delta_{it} = \delta_i + \sigma_{it}\varphi_{it}, \quad \sigma_{it} = \frac{\sigma_i}{L(t)t^{\alpha}}, \quad t \geq 1, \sigma_i > 0 \; for \; all \; i \tag{6}$$

where $L(t)$ is a slowly varying function and α is an arbitrary decay rate. The simulations conducted by Phillips and Sul (2007) show that $L(t) = \log(t)$ results in the best performance in terms of size distortion and test power. Consequently, given that $\alpha \geq 0$ the null hypothesis of the convergence can be established as follows, which would be tested against the alternative hypothesis of non-convergence for some bank i:

$$H_0: \delta_i = \delta \; and \; \alpha \geq 0$$
$$H_A: \delta_i \neq \delta \; or \; \alpha < 0 \tag{7}$$

This test is implemented through the following log(t) regression model via one-sided t-test and the limit distribution of the t-statistic can be formulated as follows, where r is the fraction of the sample T:

$$\log\left(\frac{H_1}{H_t}\right) - 2\log(\log(t)) = a + blog(t) + \varepsilon_t$$
$$for \; t = [rT], [rT]+1, \dots, T \; with \; r > 0 \tag{8}$$
$$t_b = \frac{\hat{b} - b}{s_b} \rightarrow N(0,1)$$

After evaluating the panel convergence behavior across banks, in the second phase of the empirical framework, we utilize the weekly bank-level loan rate to quantify the time-varying volatility in the consumer loan pricing. In this study, to construct the loan rate dispersion indices, we follow the method applied by Darracq-Paries et al. (2014) given its coverage and tractability of interpretation. In that work, cross-country lending rate heterogeneities are monitored by calculating 6 different volatility indicators and an index aggregation is performed by fitting a cumulative distribution function to keep track of the loan rate dispersion of Eurozone countries for the period 2003-2014, at monthly frequency. Our study builds upon this method, but deviates from Darracq-Paries et al. (2014) on four dimensions. We consider banks as our cross-sectional units (instead of countries), we introduce two additional volatility inputs (nominal and normalized values of the minimum-maximum range) and propose an alternative method (principal component analysis-PCA) for the ultimate index construction and we perform the analysis with data driven from a higher frequency (weekly rather than monthly). In the first step, for each weekly observation of consumer loan rates, following 8 volatility measures are created across the panel of 15 commercial banks in the sample:

$$Standard \; Deviation = \sqrt{\frac{1}{15} * \sum_{i=1}^{15} (Loan \; Rate_i - \mu)^2} \tag{9}$$

$$Coefficient \; of \; Variation = \frac{Standard \; Deviation}{\mu} \tag{10}$$

$$Range = Max - Min \tag{11}$$

$$Range \; Normalized = \frac{Max - Min}{Max + Min} \tag{12}$$

$$Interquartile \; Range = Q3 - Q1 \tag{13}$$

$$Interquartile \; Range \; Normalized = \frac{Q3 - Q1}{Q3 + Q1} \tag{14}$$

$$Median \; Absolute \; Deviation = Median(|Loan \; Rate_i - Median(Loan \; Rate_i)|) \tag{15}$$

$$Median \; Absolute \; Deviation \; Normalized = \frac{Median \; Absolute \; Deviation}{Median(Loan \; Rate_i)} \tag{16}$$

In the abovementioned definitions, $Loan\ Rate_i$ denotes the consumer loan interest rates of the individual banks (weighted over different maturities by loan amounts), μ stands for the average loan rate of the panel of sample banks; Min, Max, $Q1$ and $Q3$ demonstrate minimum, maximum, 25th percentile and 75th percentile values of the loan rate distribution across banks, at a specified week. Normalized indicators are combined with levels to enable the volatility comparison with different loan categories. Furthermore, range-based volatility measures are included since traditional indicators like $Standard\ Deviation$ and $Coefficient\ of\ Variation$ can be heavily influenced by outliers. In the following step, the cumulative distribution function (CDF) is fitted to these volatility inputs over the time horizon and the functions are then averaged to create the first version of our $Dispersion\ Index$. The $Dispersion\ Index$ is bounded by the [0,1] interval where higher values correspond to a greater discrepancy in loan pricing between banks. An alternative version of the index is also produced by combining the volatility indicators through a PCA and isolating the first static factor. Similar to the first version, larger values of the PCA Index indicate higher divergence in loan pricing across commercial banks. These two indices are obtained for each of the general-purpose, vehicle and housing loan segments. End-of-month values of the indices are considered for the subsequent analyses in this paper.

$$F(x) = P(X \leq x) = \sum_{x_i \leq x} P(X = x_i) \tag{17}$$

$$Dispersion\ Index\ 1 = \frac{1}{8} * (\sum_{s=1}^{8} F(x)_s) \tag{18}$$

$$Dispersion\ Index\ 2: First\ Principal\ Component\ of\ the\ Volatility\ Inputs \tag{19}$$

In the third phase of the empirical setting, the association between loan rate dispersion and competition is established. As both dispersion indices and competition indicators may display asymmetric and non-linear dynamics, we employ the quantile regression method.[12] More specifically, the following models are estimated in a stepwise manner:

$$Dispersion\ Index_t = \beta_0 + \beta_1 \Delta HHI\ Sector_t + e_t \tag{20}$$

$$Dispersion\ Index_t = \beta_0 + \beta_1 \Delta HHI\ Loan_t + e_t \tag{21}$$

$$Dispersion\ Index_t = \beta_0 + \beta_1 \Delta HHI\ Loan_t + \beta_2 Controls_t + e_t \tag{22}$$

[12] Unlike the standard linear regression techniques, the quantile regression, which was introduced by Koenker and Bassett (1978), can provide a better description of the data by considering the effect of covariates on the entire distribution of the response variable, not merely its conditional average. As another superiority over standard regression models, quantile regression is distribution agnostic. This implies that the regression does not assume parametric distribution for the response variable, nor does it assume a constant variance unlike ordinary least squares (OLS). This type of methodology is also known to be robust to outliers. While OLS aims to minimize the sum of squared errors, the quantile regression method minimizes a sum that gives asymmetric penalties for overprediction and underprediction. Thus, a quantile regression can investigate how the predictive relationship between loan rate dispersion and change in competitive conditions varies over different levels of rate dispersion.

In this context, $Dispersion\ Index$ refers to the two different indices created in the second step of our analyses, in equations (18) and (19), for each of the retail loan segments. Our sectoral and loan segment competition indicators are constructed as HHI. $\Delta HHI\ Sector$ represents the monthly change in the HHI calculated from our sample of banks' total loans capturing how competitive forces evolve on the sectoral level. In addition to this, $\Delta HHI\ Loan$ denotes the values the HHI takes in each of the specific loan segments and represents specifically the course of competition in general-purpose, vehicle, and housing loans. In the most comprehensive specification of the quantile regressions, we enrich the specification by accounting for other control variables reflecting supply and demand-side determinants of consumer loan pricing including the presence of macroprudential policies, asset prices, labor market conditions, credit risk, capital adequacy, and bank liquidity. These estimations are repeated for the two variants of dispersion indices, over three consumer loan categories, and five different quantile levels. In particular, we take the 10^{th}, 25^{th}, 50^{th}, 75^{th}, and 90^{th} percentiles in the conditional distribution of rate dispersion given explanatory variables to reflect excessively lower, moderately lower, median, moderately higher and excessively higher loan pricing variations, respectively. In the quantile regression model, for the specific quantile τ of the dependent variable, coefficients are estimated by solving the following minimization problem in a generalized multivariate setting:

$$Q_\tau(y_i) = \beta_0(\tau) + \beta_1(\tau)x_{i1} + \cdots + \beta_p(\tau)x_{ip} \tag{23}$$

$$\min_{\beta_0(\tau),\ldots,\beta_p(\tau)} \sum_{i=1}^{n} \rho_\tau(y_{i-}\beta_0(\tau) - \sum_{j=1}^{p} x_{ij}\beta_j(\tau))^2 \tag{24}$$

where $\rho_\tau(r)$ is referred as the check loss function and is defined as $\rho_\tau(r) = \tau \max(r, 0) + (1 - \tau)\max(-r, 0)$. For each specific quantile level τ, the solution to this minimization problem brings a unique set of regression coefficients.

To proxy the level of competition, we utilize HHI constructed by summing the square of market shares of all agents in the examined market (Hirschman, 1964). HHI measures are incrementally calculated for each of the consumer loan segment embodying general-purpose, vehicle and housing loans by using the bank-level credit data. In general, HHI can take values ranging from very close to zero, which indicates a very competitive market structure, to 10000 in the case of perfect monopoly structures, with lower values displaying diminishing concentration and improving competition. Values below 1500 are usually considered to indicate competitive market settings (Mehta et al., 2016).[13]

[13] Earlier studies in the competition literature put forward competitive measures derived from structural characteristics of the markets. Initially conceptualized by Bain (1956), what is termed as Structure-Conduct-Performance (SCP) paradigm argues that market structure shapes collusive tendencies among individual banks (Hannan, 1991). On top of this, structural features which influence pricing strategies and other decisions can create excess profit opportunities for banks. If the collusion phenomena result in a smaller number of entities that are independent in behavior, then the remaining ones can strive for higher profits given that the market structure may resemble that of an oligopoly. In the empirical literature, the analogy between market concentration and competition is established with a variety of measures, concentration ratio (CR) and HHI being the most widely used. While both of these measures aim to capture the market share dispersion in an industry, their focus area within a market is fundamentally different.

As surveyed by Leon (2015), there are valid criticisms against HHI competition measure in the context of scale economies, network formations, informational rents, operational efficiencies, and the ability of concentrated markets to be competitive if the cost of entry/exit is minimal. In line with such criticisms, other methods like H-statistic and Boone indicators are proposed in the literature (Panzar and Rosse, 1987; Boone, 2008). Having noted these points, we choose to proceed with the HHI given the following data-set driven reasons and practicalities. First, alternative indicators require cross-sectional or time-series estimations of specific parameters to formulate competition indices. Since our sample covers 15 banks as cross-sectional units, it would be statistically infeasible to make unbiased and robust inferences through such estimations. Second, the HHI is a very widely used method which makes our results very easy to interpret and compare. Last but not least, the HHI is suitable for extracting competitive conditions not only in total loans but also in different loan segments within the retail loan portfolio, The utilization of HHI enables us to make inferences from and comparisons across these sub-units as well.

3. Empirical Results

We first present the historical movements of bank-level loan rates in Figures 2 to 4 before moving into statistical inferences. On first observation, all three interest rates follow a similar pattern over the course of our period of interest. As expected, general-purpose loans have more sizeable fluctuations regarding cross-bank loan rate differences, compared to vehicle and housing loans. This finding is assessed to be caused by the uncollateralized nature of the general-purpose loans, and the banks' choice to reflect more of the expected risk into the pricing of the loan. Other than this, terms, conditions and maturity structure of housing loans are known to be similar across banks leading to more harmonious loan rate realizations. Vehicle loans extended by banks typically have an alternative financing method for vehicle purchases provided by financing firms, again at similar conditions. In addition to this, a common feature shared by all categories' loan rate distributions is that pricing dispersion gets narrowed down during the episodes defined by sizeable increases in average loan rates (coincided with macroeconomic and/or financial volatilities) and it increases in subsequent periods.

[**Insert Figures 2 to 4**]

Not only the average loan rates but also the pricing distribution across individual banks have displayed fluctuations over the sample period. Interestingly, the earlier part of our sample, immediately before the 2008, witnessed relatively volatile loan rate formations in the sector. Visualized by the sparks in our percentile series, this dispersion in loan pricing practices are seen in all of the examined consumer loan segments. In fact, that period was characterized with a different financial regulatory landscape, lower financial literacy in households combined with relatively subdued loan extension to households in nominal terms. In the wake of the 2008 Global Financial Crisis, global financial volatilities had an impact on local financial conditions and led briefly to rises in consumer loan rates despite the monetary policy loosening conducted by the CBRT. However, brief increases in loan rates had been reversed coherently in the following period; thanks to the rebound

in economic activity and income, the ongoing financial development process and accompanying improvements in access to bank financing for households. There was a large inflow of capital, which was channeled into local currency loan growth with longer-term horizons, in part due to the growing local derivative markets. These financial developments ensured price stability contributed to the households' improved borrowing conditions.

This trend continued until the beginning of 2012 when the initiation of macroprudential policies gave way to slight elevations in loan rates. To prevent the accumulation of macro-financial risks driven by excessive loan growth and rising indebtedness, authorities in Turkey have launched a comprehensive macroprudential framework introducing a combination of policy tools including reserve requirement ratios, installment restrictions, general provisions, and loan-to-value ratios. The utilization of such measures increased the costs associated with the rate-setting processes and market penetration for the commercial banks. The sudden shift in global risk appetite caused by the Fed's signaling of reversal in the expansionary monetary policy in 2013, otherwise known as Taper Tantrum, had also a strong impact on local financial conditions of the Turkish economy. The period following the Taper Tantrum was marked with the sudden depreciation of local currency followed by a considerable monetary policy tightening by CBRT starting at the beginning of 2014. A concordant increase in consumer loan rates was observed displaying the tightening in financial conditions.

The next phase of interest rate shock induced by local and global financial and geopolitical volatilities had recently taken place in 2018. Excessive currency depreciation coupled with increases in risk premia, worsened valuations in stock markets, deterioration in liquidity conditions, the loss of momentum in economic activity and inflationary pressures resulted in an unparalleled policy rate hike, which was quickly transmitted to consumer loan pricing. It should be emphasized that, during this period, loan rate formations diverging from the common trend has taken place in all three consumer segments. However, as liquidity conditions were improved, credit risk was contained, economic activity was re-accelerated on the back of domestic demand, monetary policy stance had been more accommodative, credit channel of monetary transmission mechanism was re-functioning, some of the restrictive macroprudential measures were reversed and credit incentive packages were introduced, consumer loan rates tended to return to historical averages.

Having summarized the landscape, we proceed with presenting panel convergence test results presented in Table 3. In the general case, our null hypothesis of panel convergence of bank-level interest rates is rejected at a 5% significance level on a one-sided test, when the test statistic is less than -1.65.

[**Insert Table 3**]

The first panel in this table indicates the log(t) regression test results for general-purpose loans. When all banks and the whole sample period are considered, results are in line with

the argument that in the Turkish banking sector overall, there exists a long-run equilibrium for which general-purpose loan rates converge to. However, it is possible that loan rates might diverge from their respective steady states within bank groups. Thus, we implement the same testing procedure over the whole sample by differentiating the pool with respect to state, private and foreign banks. Although this is not the case for the first two groups, foreign banks' general-purpose loan rates display statistically significant divergence. To further clarify the long-term behavior, we repeat log(t) regression tests over different phases of the sample period by separating the weekly interest rate data into two intervals of similar length: 2007M1-2013M12 and 2014M1-2020M4. It is surprising to see that divergent tendencies of foreign banks were evident in the first part of the sample, while that period also includes divergent behavior of state banks (which is not observed over the whole sample).

In the following step, a similar approach is followed for vehicle loans. Empirical results obtained from the overall sample indicate that the null hypothesis of panel convergence is rejected. In other words, bank-level interest rates have varied dynamics from each other in longer horizons. This result is particularly applicable for private and foreign banks and contains statistical significance in both sub-samples. More strikingly, even the state banks had been subject to divergence in the more recent part of the sample. We motivate this divergence with the size of the market as well as the differences in the value of the collateral, namely the vehicles themselves may have. Vehicle sales are lower in volume compared to the rest of the market, and banks make up about 50% of the vehicle loan market. So the results speak to the fact that a smaller sub-market size, even within a larger and competitive market, may lead to divergent pricing mechanisms. In addition, second hand cars -unlike second hand houses for instance- may be evaluated at very different price and risk premiums due to their individual wear and tear, which may also motivate the variation in lending rates through the collateral channel.

Lastly, the housing loan segment is evaluated for panel convergence. Although test results show the convergent trend when all banks are considered, further categorization points out that there exists a divergence across private banks' housing loan rates throughout the whole sample period. In sum, using a method that aims to capture the long-run variability exhibited by banks, we demonstrate sector-wide convergence in loan rates general purpose and housing loans display, however, our results support the view that there is no certain and uniform convergence behavior in consumer loan rate formation in the Turkish banking sector. As a result, it would also be informative to monitor the shorter-term variation in individual banks' loan rates through indexation techniques.

Some claims can made about possible heterogeneities in these results. For general-purpose loans, it is known that state banks generally implement campaign credit packages in different periods as countercyclical policies so that it might cause divergence among those banks' general purpose loan rates. Moreover, the asset sizes of foreign banks are relatively smaller than the other banking groups, eventually leading to possible divergence in their general purpose loan extensions and rates. In this regard, results for

private banks are more in line with the argument speculating the existence of a particular long-run equilibrium on which general-purpose loan rates converge. In relation to heterogeneous results for housing loans, we can say that, particularly in more recent times, the loss of competition does not only enable the state banks to increase its share in the sector, but it also causes heterogeneous reactions from other banks. While state banks implement coordinated strategies for providing housing loan facilities, other banks seem to be in a partial competition with state banks. Even others might not be in this competition, give up the business plan of asset growth via housing credit, and decrease its share in the sector. Additionally, during recent period providing housing loan facilities with higher interest rates to riskier customers might be another supporting factor for the divergence observed among private bank housing loan rates.

In addition to these results, panel-convergence tests are applied on the sub-groups formed based on bank size (Table 3). In terms of general-purpose loans, we see that there is a general tendency towards long-term joint movements with the exception of small banks in the earlier parts of the sample. However, the panel convergence turns out to be not preserved for vehicle loans as small banks' pricing tendencies differ from each other in a statistically significant way during the whole sample, whereas this divergence is even shared among larger banks towards the latter parts of the examined period. Again in contrast with general-purpose loans, banks are found to diverge from each other significantly in setting housing loan rates, which is more emphasized for smaller banks. Because foreign banks are small banks in the categorization, in terms of general-purpose loans, findings are also coherent with the argument of divergent movement of small banks in the earlier part of the sample. Similarly, considering that state banks are comparably larger, in terms of housing loans, there is a joint movement tendency of large banks in the earlier part of the sample.

The dispersion indices constructed for general-purpose, vehicle, and housing loans are given in Figures 5 to 7. The index values represent the position of the cross-sectional loan rate variation compared to all sample observations. In other words, an increase in the index signals wider loan rate dispersion whereas a decline implies the dispersion is getting narrower. One important finding is the robustness of the result to the index formation method. There seem to be minor differences between indices created by the CDF method and PCA technique in terms of the general course of the variability, except for housing loans where the PCA-based index is relatively more subdued for a few periods.

The general-purpose rate dispersion declined in the crisis episodes like the 2008 Global Financial Crisis and Taper Tantrum (in 2013) as well as the introduction of macroprudential measures by curbing household's FX borrowing in June 2009 to help promote more prudent borrowing behavior. Banks seem to follow similar risk pricing practices (or risk preferences) during episodes following these volatilities. One exception seems to be the second half of 2016 when elevated credit risk in this segment coupled with prominent uncertainties increased pricing dispersion between banks for a relatively longer period. From 2017 onwards, until the recent Covid-19 outbreak in 2020, banks'

pricing tendencies appear to be similar for general-purpose loans. During this period, initially, the dispersion between commercial banks collectively increased. This coincided with the early stages of the Treasury-backed credit guarantee scheme targeting SME loans, in which there were differences in adoption rates across different types of banks, and the scheme also created differences between banks in loan pricing in non-scheme loans. .As the scheme utilization was rolled out to the rest of the sector, the dispersion index decreased in tandem. Towards the end of our sample, during the Covid-19 period, we observe the difference of another Treasury-backed credit guarantee scheme, this time designed to allocate general-purpose loans to households. From another perspective, especially after 2018, the average interest rate charged on general-purpose loans raised rapidly, which might lead to a cross-segment transition of customer base from demand-side and this trend might be supported by the profitability concerns of the banks from supply-side.

[**Insert Figures 5 to 7**]

While the raw data suggests smaller dispersion compared to other segments, the in-sample historical ranking of vehicle loan rate variation quantified by dispersion index displays heterogeneities over the sample period. The higher level of dispersion is evident around 2012, probably due to the imposition of macroprudential measures in other retail loan segments which may have changed banks' pricing approaches in this segment as well. In addition, another important finding is that loan rate volatilities persist considerably after 2017. This outcome is characterized by volume developments at the time, as the vehicle loan stock was relatively stagnant, partially due to exchange rate movements and there were incidents of campaigns led by public banks to offer less costly vehicle financing. Besides this dynamic, the period is marked by rising competition from financing firms which extend approximately similar loan balances to deposit banks for this segment (see the Appendix).

The last set of dispersion indices is presented for the housing segment. The time-wise trend of the indices indicates volatile pricing behavior in earlier parts of the sample in line with less developed housing segment and lower credit volume during that era as well as the presence of FX-indexed housing loans which created a wedge in loan pricing.[14] Following the macroprudential policy step in 2009 which limited household FX borrowing, loan pricing behavior converged until the end of 2010. However, slightly volatile pricing tendencies are observed after the introduction of the LTV related macroprudential policy set from 2011 onwards. More prominent rises in dispersion index were experienced after 2016 during which house prices plummeted and house sales (including the sales financed by bank credits) declined drastically (see the Appendix). However, especially after the first half of 2019, credit impulse provided by the countercyclical use of state banks and later embraced by private banks resulted in

[14] The majority of FX-indexed loans were issued between March and September of 2008.

dispersed pricing in this segment, whereas house prices rebounded and sales were re-accelerated.

The level outcomes as well as the change in competition outlook measured by HHI indicators are given in Figures 8 to 12. Any upward movements in these indices are interpreted as the increasing concentration and downward movements as diminishing concentration. As a rule of thumb, it is considered that HHI values less than 1500 indicate a highly competitive sectoral structure, whereas values exceeding this level imply a less competitive structure. From a macro perspective, in total loans, we observe a relatively stable high competition outlook for the Turkish banking sector for the most of sample period. Nevertheless, it is not surprising to observe that the level of concentration is amplified after 2016 due to the heavier presence of state banks in the sector, especially through targeted loan campaigns as a countercyclical tool to offset the stagnation in economic activity. This lending practice of state banks came at a time when other bank types cutback on their overall lending momentum due to worsened expectations, increasing credit risk perceptions, and profitability concerns. In fact, even going beyond our sample of banks, the share of loans provided by state banks in total bank loans increased from 30% to almost 50% levels during the later phases of the examined period (see the Appendix).

Turning our attention to consumer loan segments as the focal point of this study, HHI proxies show that there are differences across the three segments in terms of the overall level of competition. Although the competitive performance of sample banks was slightly lower in earlier periods, credit allocation in general purpose loans seems to be distributed more evenly across the banks, particularly after 2012. This development coincides with higher economic growth and per-capita income, improved labor market conditions, relatively stagnant household indebtedness, and contained credit risks, all of which are factors that would contribute to the concordant credit supply by individual banks in this segment. This outlook has been preserved over the rest of the sample period. However, the same performance is not shared by housing and vehicle loan segments which are traditionally more concentrated credit groups as HHI values had been inherently higher. This can be attributed to the impact of lower volume and banking sector presence in vehicle loans after 2016, and the increasing role of state banks in credit extension seems to overturn the competition in those segments, and therefore signal a temporary change in the competition level in the market rather than a structural shift. One exception might be the downward trend of the HHI indicator for vehicle loans after 2019 during which the banking sector started to gain momentum compared to financing firms, thanks to credit impulses and campaigns with favorable credit terms, as mentioned before.

Changes in the indices monitoring total loans and vehicle loans have slightly right-skewed distributions indicating the tendency of a moderate decline in competitive conditions over throughout the sample period. Distributional features are somewhat different for general-purpose loans for which Kernel density estimates indicate a left-skewed distribution. This can be attributed to the improvements observed in general-purpose loan segment

regarding the level of concentration. As expected from the historical analysis, the distribution of HHI proxy in the housing segment is dominated with larger positive values demonstrating the easing in competitive forces in this credit group.

[**Insert Figures 8 to 12**]

When the correlation between HHI outcomes and loan rate dispersion indices is evaluated, results turn out to be heterogeneous across loan types and indexation method (Figure 13). In contrast to earlier findings in the empirical literature and economic intuition, there exists a negative correlation between general-purpose loan rate variation and HHI indices leading to the conclusion that deteriorations in competition coincide with less disperse loan pricing. Although this relationship is somewhat weak for total loan competition, when the HHI GP index is used, the direction of the relationship is more visible. Since potential nonlinearities may impact the relationship, quantile regression estimations specifically designed to capture the variant impact of HHI on loan rate variability over the sample period may add value as an additional observation, when HHI GP is preferred. Besides this, no significant differences are encountered when the indexation method for dispersion is switched from CDF fitting to factor analysis. In contrast with the abovementioned findings, there exists a positive relationship between vehicle loan rate dispersion and HHI indices. In other words, any worsening in the competition outlook coexists with the much wider loan pricing variations across commercial banks. The degree of association is much stronger when the sectoral competition is controlled for, while the asymmetric features are more explicit when competition exclusive to the vehicle segment is inspected. The historical co-movement between loan pricing formations and competitive conditions is more visible when the first indexation method (CDF fitting) is applied. A similar association is found for housing loans and is also driven by the existence of outliers for HHI changes.

[**Insert Figure 13**]

Quantile regression results formally testing the impact of HHI indices on the distribution of loan rate dispersion conditional on covariates are presented in Tables 4 to 9. As explained before, we followed an incremental approach including three different specifications for each version of the dispersion indices. The initial set of results presents the role of the HHI index capturing the competition in total loans across different percentiles of the distribution, while the second set analyzes the same association by utilizing the competition indicator tracking the segment-level competition.[15] In the broadest specifications, the impact of segment-level competition by also controlling for the other demand and supply-side factors. The quantile thresholds (10^{th}, 25^{th}, 50^{th}, 75^{th} and 90^{th} percentiles) are chosen to represent excessively low, moderately low, median, moderately high and excessively high rate dispersion observed in our data, respectively.

[15] Quantile process plots of the second group of specifications are presented in Figure 14. Green lines represent quantile regression coefficients, shaded areas represent 95% confidence intervals and dashed black lines display constant OLS coefficients.

Table 4 and 5 present estimation results for general-purpose loan rate dispersion with different indexation methods. When *Dispersion GP* 1 (obtained by CDF fitting) is taken as the dependent variable, the statistically significant negative relationship with sectoral HHI is only detected for the 50th percentile referring to the stable course of dispersion. However, when the segment-based HHI index is taken as the covariate, the negative impact is pronounced in almost all of the thresholds, except for the 90th percentile around which extreme rate variations are observed. These results preserve the significance when other factors are controlled for. Hence, it can be argued that, contrary to what is expected, improved competition in this loan segment does not unify the loan pricing tendencies of the banks. Regarding other controls, positive and significant coefficients are somewhat found across lower percentiles for variables representing macroprudential policies (10th percentile), employment (25th percentile), consumer NPL (10th and 25th percentiles) and liquidity ratio (10th and 25th percentiles). Thus, it can be deduced that macroprudential policy tightening, increases in employment ratio, worsening in consumer credit risk outlook and banks' preferences to hold more liquid assets contribute to much wider loan rate dispersion, albeit at lower parts of the condition distribution. Moreover, incremental increases in capital adequacy and deposit rates are relevant to narrowed loan pricing ranges, only when dispersion is considerably high across 75th and 90th percentiles. The results obtained with *Dispersion GP* 2 show that the abovementioned relations are mostly robust, even when the dispersion index is constructed with a different methodology. When competitive conditions are reinforced, general-purpose loan rates have larger dispersion and this effect is more pronounced when the segment-based competition is considered. One particular difference is related to control variables as the significance of labor market conditions is lost and the explanatory power of the asset prices is enhanced.

Table 6 and 7 present estimation results for vehicle loan rate dispersion. Regardless of the choice of index construction, both sets of results validate the positive relation between loan pricing dispersion and general competitive outlook stemming from total loans. This finding is robust across different dispersion levels as results are significant across all the threshold values. When segment-based competition is examined, this relationship is preserved only for 25th and 50th percentiles representing contemporaneous dynamics characterizing excessively and moderately low loan rate variation. However, when other controls are added, the significance of competitive forces is lost paving way for the overwhelming effects of the demand and supply-side determinants. In contrast to what is determined for general-purpose loans, for vehicle segment, *Employment* and *Consumer NPL* are found to have negative coefficients which are significant across almost all of the quantiles. Results indicate that increases in employment ratio and, consequently the possible improvements in household income, loan demand, and debt-repayment capacity would result in more harmonious loan pricing in the vehicle segment. A surprising finding, which is also in contrast to findings specific to general-purpose loans (and previous literature), is that increases in NPL ratio diminish the dispersion in loan

pricing. From the loan supply perspective, as another significant finding across all percentiles, highly capitalized banks tend to price vehicle loans in a similar manner.

Table 8 and 9 present estimation results for housing loan rate dispersion with different indexation methods. The changes in competition outlook, calculated from total loans and housing segment, have positive and significant coefficients reflecting the behavior that commercial banks conduct loan pricing at more dispersed intervals when the competition is eased. The findings specific to the segment-based competition are robust to the inclusion of other controls as well as the choice of threshold values. As a distinct result, macroprudential measures seem to be more influential for housing loan pricing compared to other segments and any tightening in macroprudential policy mix is transmitted to additional variability in loan rate dispersion, which is significant for all percentiles except for the first one. Similar to what is seen for general-purpose loans, deterioration in credit risk assessments would be channeled into more dispersed loan rate distribution but, for this particular segment, the finding is significant for moderate and excessive loan pricing deviations. The overwhelming majority of the results across different percentiles validate the negative and positive significant impacts of CAR and $Deposit\ Rate$, respectively.

[**Insert Tables 5 to 9**]

[**Insert Figure 14**]

Overall, our main findings for vehicle and housing loans support the view that policies and regulations designed to improve the competitive conditions might also reinforce the joint movements in lending rates. In other words, facilitating the capital inflows to banking sector with new banks becoming operationalized as well as encouraging banks to diversify their lending activities based on geographical, portfolio-based and product-related dimensions would all bring loan pricing behavior contributing to the financial stability.

As a side note, quantile regression results reveal profound findings for supply factors, other than market structure. Although it is not completely robust, we see that stronger capital buffers in the form of higher CAR can be associated with contained volatility in rate setting for some thresholds in general-purpose and housing loans. Hence, despite the fact that formal causality can not be established with this simple methodology, it is asserted that policies aiming to improve the capital position of the banking sector might contribute to the unified loan pricing in these segments. In this context, recent policy steps aiming to support the state banks through capital injections can be exemplified as a possible type of actions whose positive side-effects might be reflected in loan pricing. Similarly, $Liquidity\ Ratio$ is found to be negatively correlated with loan dispersion in the case of vehicle and housing loans for some thresholds. Because of this, one might infer that policies aiming to improve the access and cost of liquid funds for banking sector can also be related to less dispersed loan pricing, whereas this relation is not applicable for general-purpose loans. In this context, recent actions taken by CBRT to compound the liquidity of the banking system can also be considered as a channel supporting the unified

loan rate setting. Last but not least, the findings related to *Deposit Rate* (which is only significant for housing loans) implying the positive correlation between lending rate dispersion and deposit rate can be approached from a policymaking perspective. It can be speculated that accommodative monetary policy represented as a more stable deposit rate formation might pave way for an outlook in which outliers in rate setting is observed at low frequency. However, we also want to emphasize that empirical methodology used in this framework is rather limited and policy-based implications should also be investigated with more robust techniques capable of handling possible confounders.

4. Conclusion

In this paper, we analyze the degree of coherence in loan pricing for the Turkish banking sector in the retail loan segment. We first observe that during our study period there are more fluctuations in general-purpose loan rates across commercial banks, relative to vehicle and housing loan rates because of the uncollateralized nature of general-purpose loans. In particular, similar maturity structure and terms in housing loans across banks have played a part in more harmonious loan rate realizations across the sector. Moreover, after covering the descriptive information about average tendency and volatility in consumer loan rates, panel convergence tests are performed which show the presence of heterogeneity in terms of long-term co-movement of rates charged by the sample panel of banks.

The degree of loan rate variations across banks is quantified by implementing an indexation mechanism. Our findings imply that, for all sub-segments (general-purpose, vehicle, and housing loans), banks' pricing distributions get narrowed down (implies a lower index value) during episodes defined by sizeable increases in average loan rate tendencies, which are generally characterized by macroeconomic shocks or financial volatilities, and the distribution becomes more dispersed in subsequent periods.

In the second layer of our empirical setting, we investigate the role of competitive conditions on consumer loan rate variability. We find that, for general-purpose loans, the more competition there is the larger is the pricing distribution in the market. It is considered that the increase in the range of products offered during high competition periods and banks' attempt to increase their market share through new and differentiated products drive this result. On the other hand, pricing distribution in vehicle and housing loans decreases as competition increases, in line with expectations and the literature.

Overall these results have high significance for policymakers. This paper introduces a new tool to monitor the movement of loan interest rates at the bank-level, which is a relevant factor for financial stability. In terms of interactions with monetary policy, loan pricing tends to unify among banks when financial conditions are tightened supporting the monetary policy transmission mechanism. Last but not least, improvement in competitive conditions is highlighted as one way to contain lending rate dispersion, especially for housing and vehicle loans.

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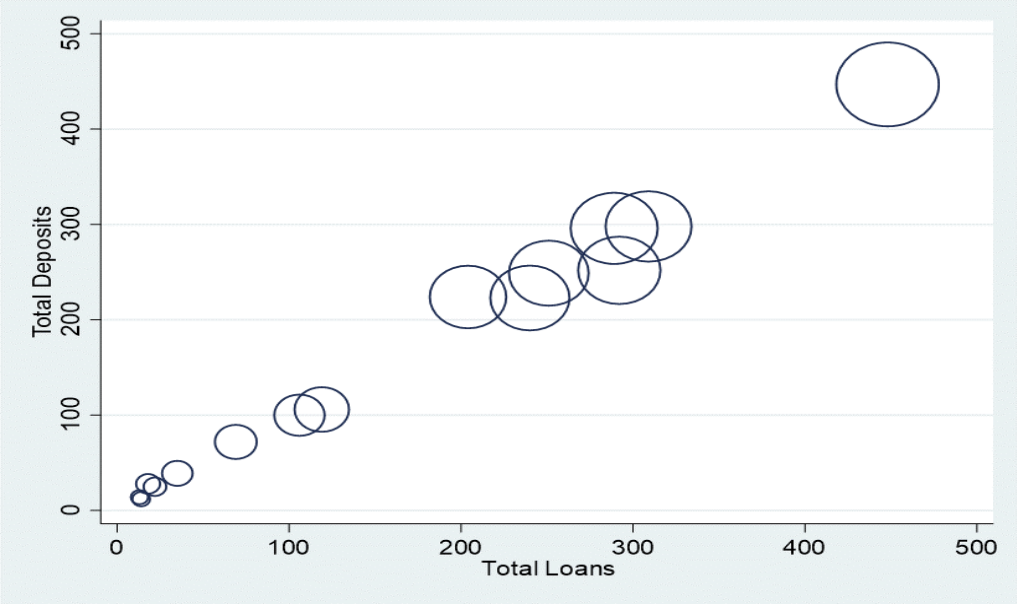
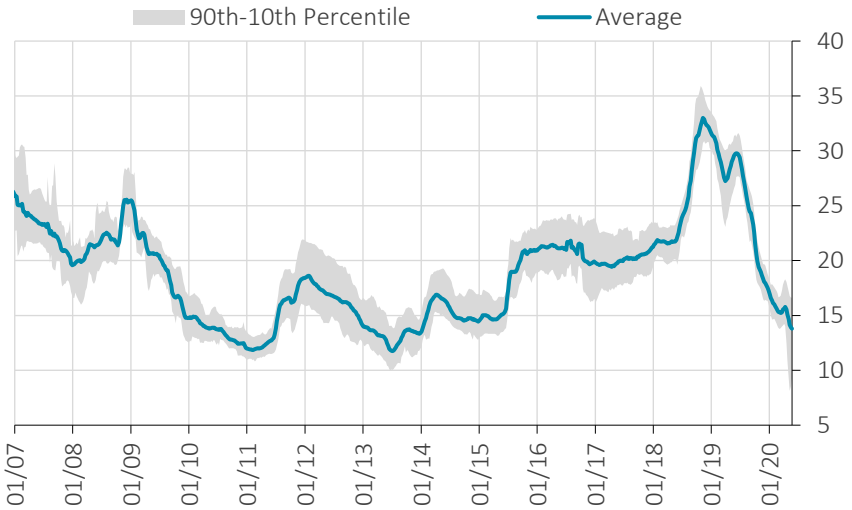
Figure 1: Loans and Deposits of the Banks in our Sample (December 2019, Billion TL)



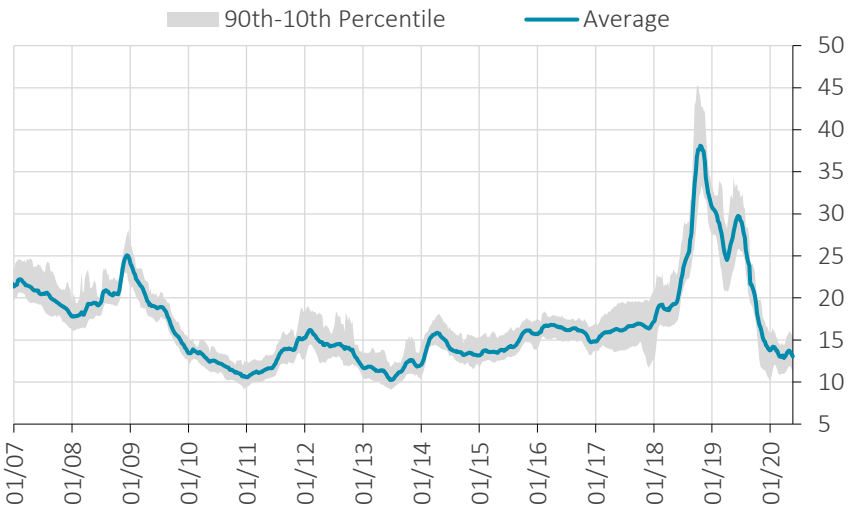
Source: Bank Association of Turkey
Notes: Sizes of the bubbles are scaled according to the total assets of the sample commercial banks.

Figure 2: General-Purpose Loan Interest Rates (4-Week MA)



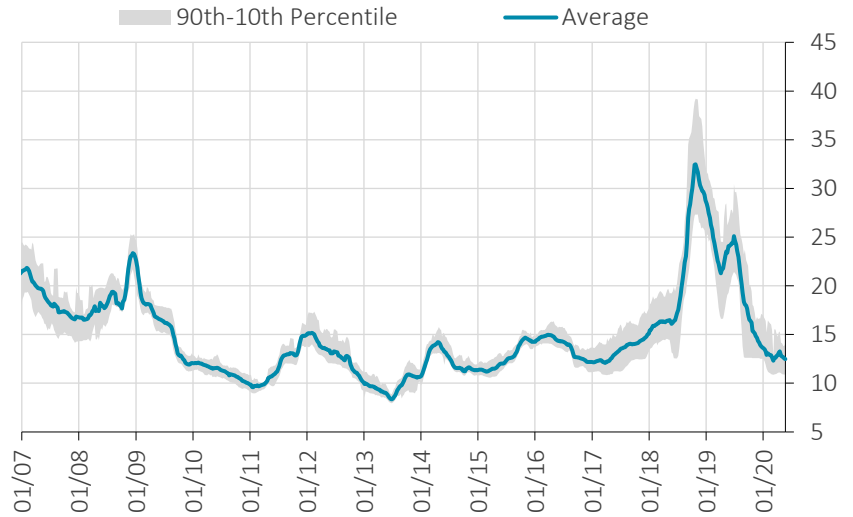
Source: CBRT

Figure 3: Vehicle Loan Interest Rates (4-Week MA)



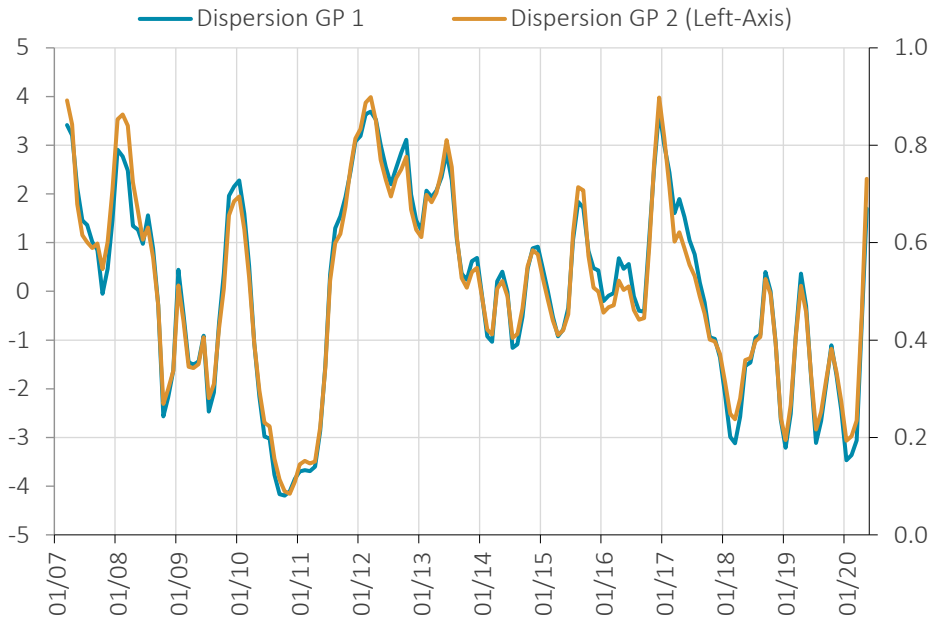
Source: CBRT

Figure 4: Housing Loan Interest Rates (4-Week MA)



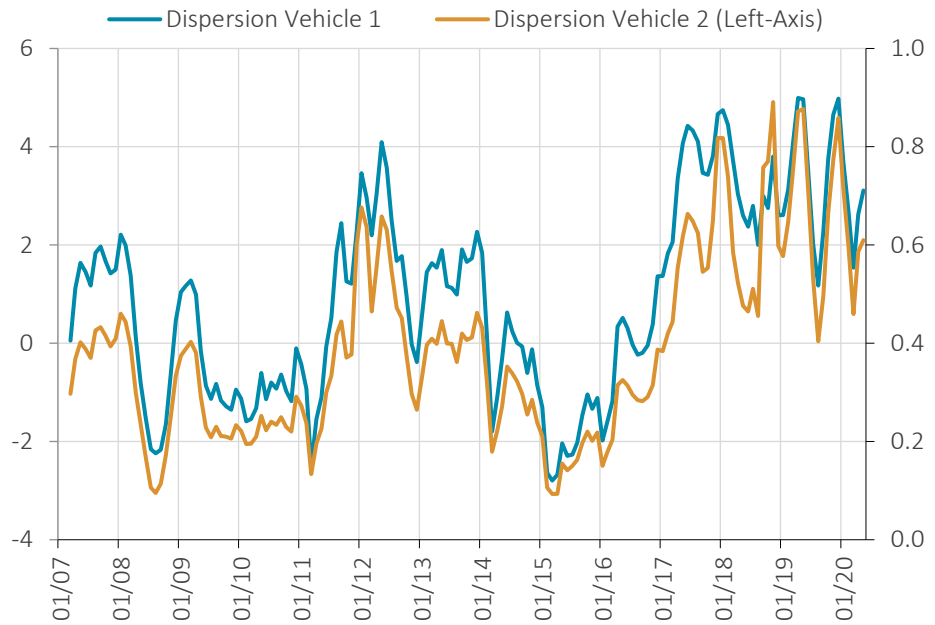
Source: CBRT

Figure 5: Loan Rate Dispersion Index (General-Purpose Loans, 3-Month MA)



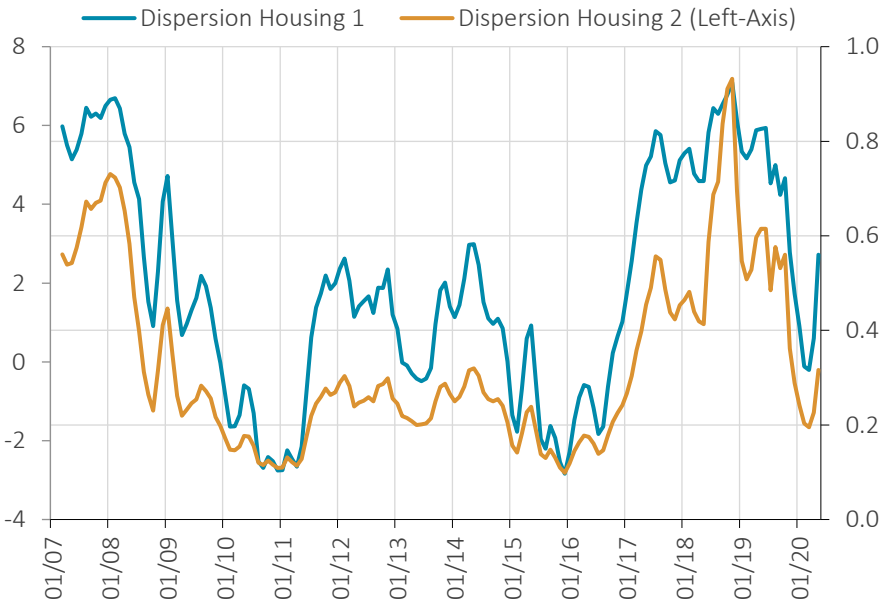
Source: CBRT, Authors' Calculations

Figure 6: Loan Rate Dispersion Index (Vehicle Loans, 3-Month MA)



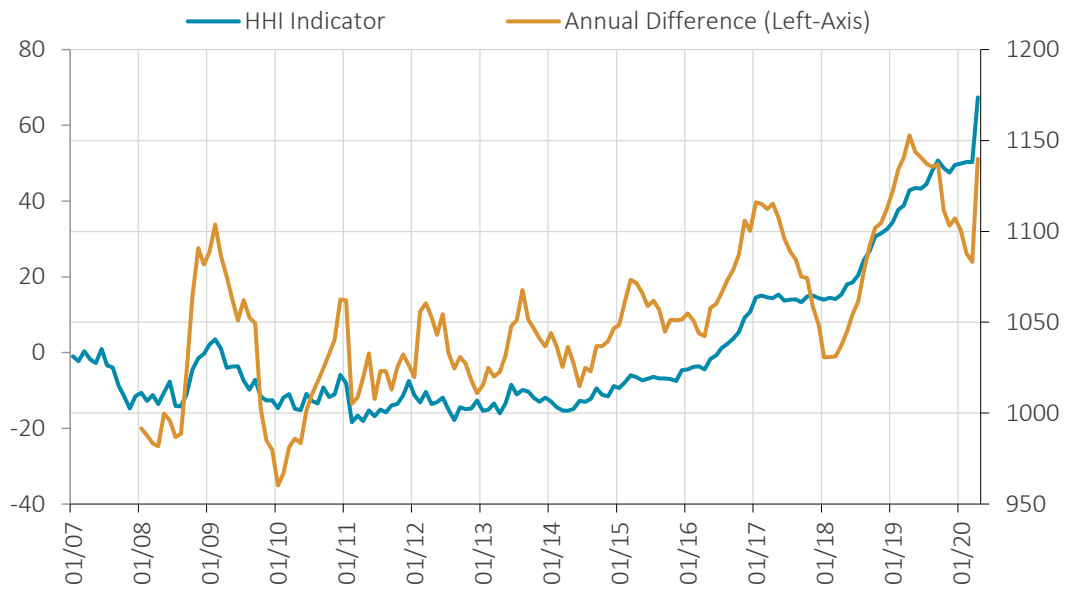
Source: CBRT, Authors' Calculations

Figure 7: Loan Rate Dispersion Index (Housing Loans, 3-Month MA)



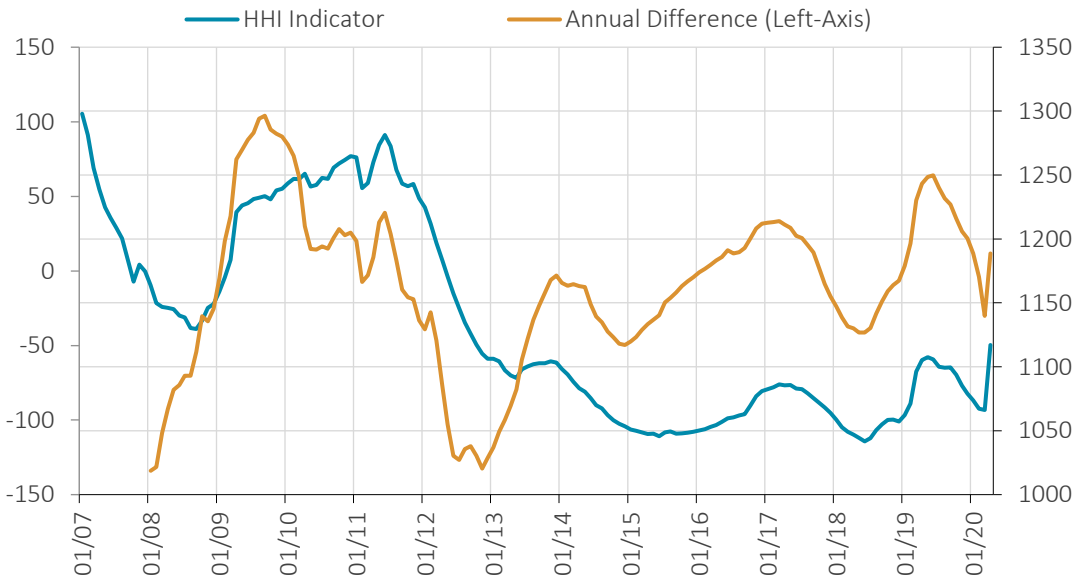
Source: CBRT, Authors' Calculations

Figure 8: Competition in Total Loans



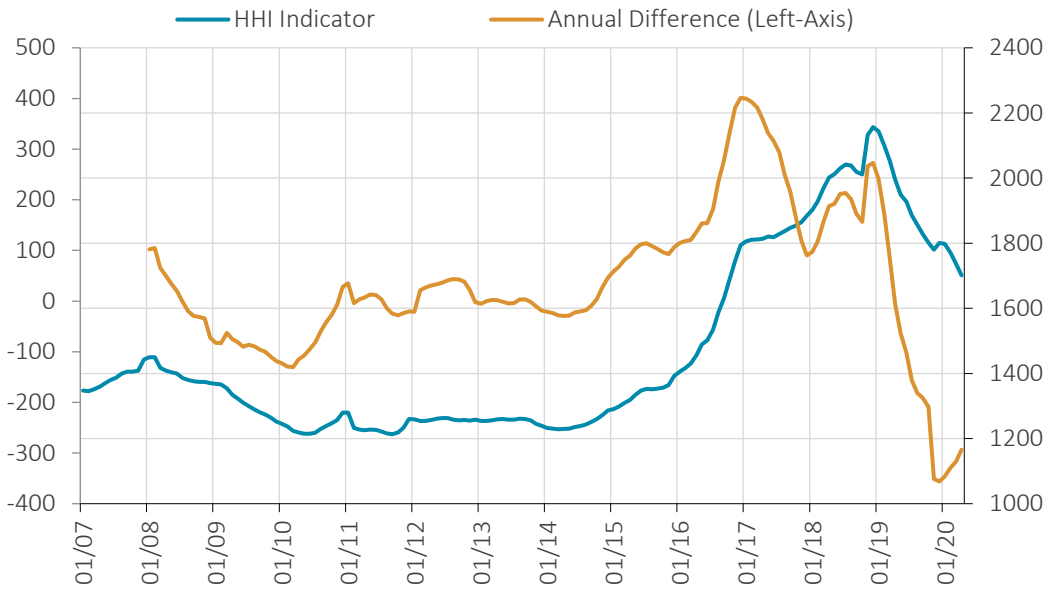
Source: CBRT, Authors' Calculations

Figure 9: Competition in General-Purpose Segment



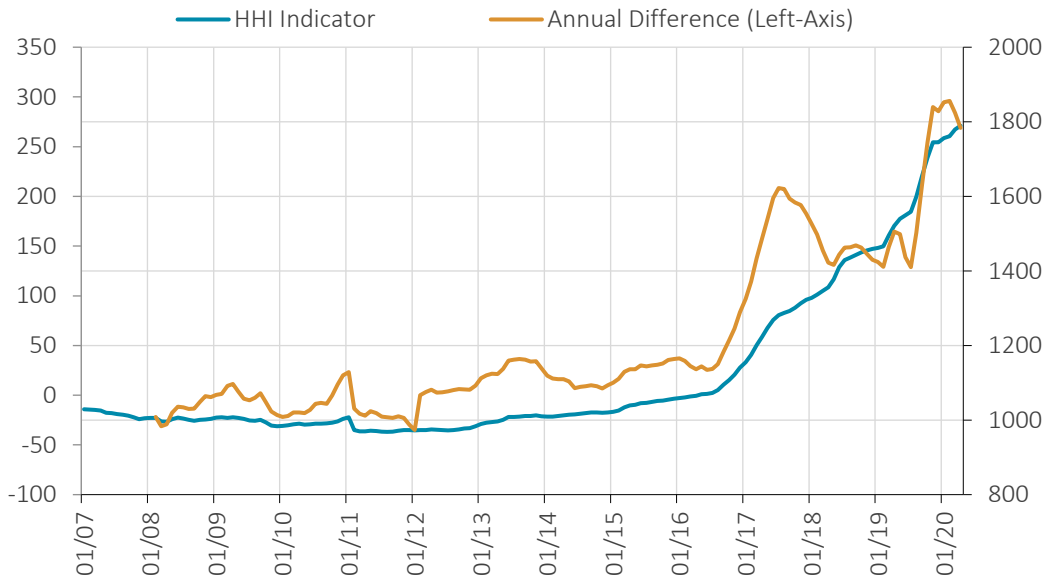
Source: CBRT, Authors' Calculations

Figure 10: Competition in Vehicle Segment



Source: CBRT, Authors' Calculations

Figure 11: Competition in Housing Segment



Source: CBRT, Authors' Calculations

Figure 12: Distribution of Competition Indicators (Kernel Density Estimates)

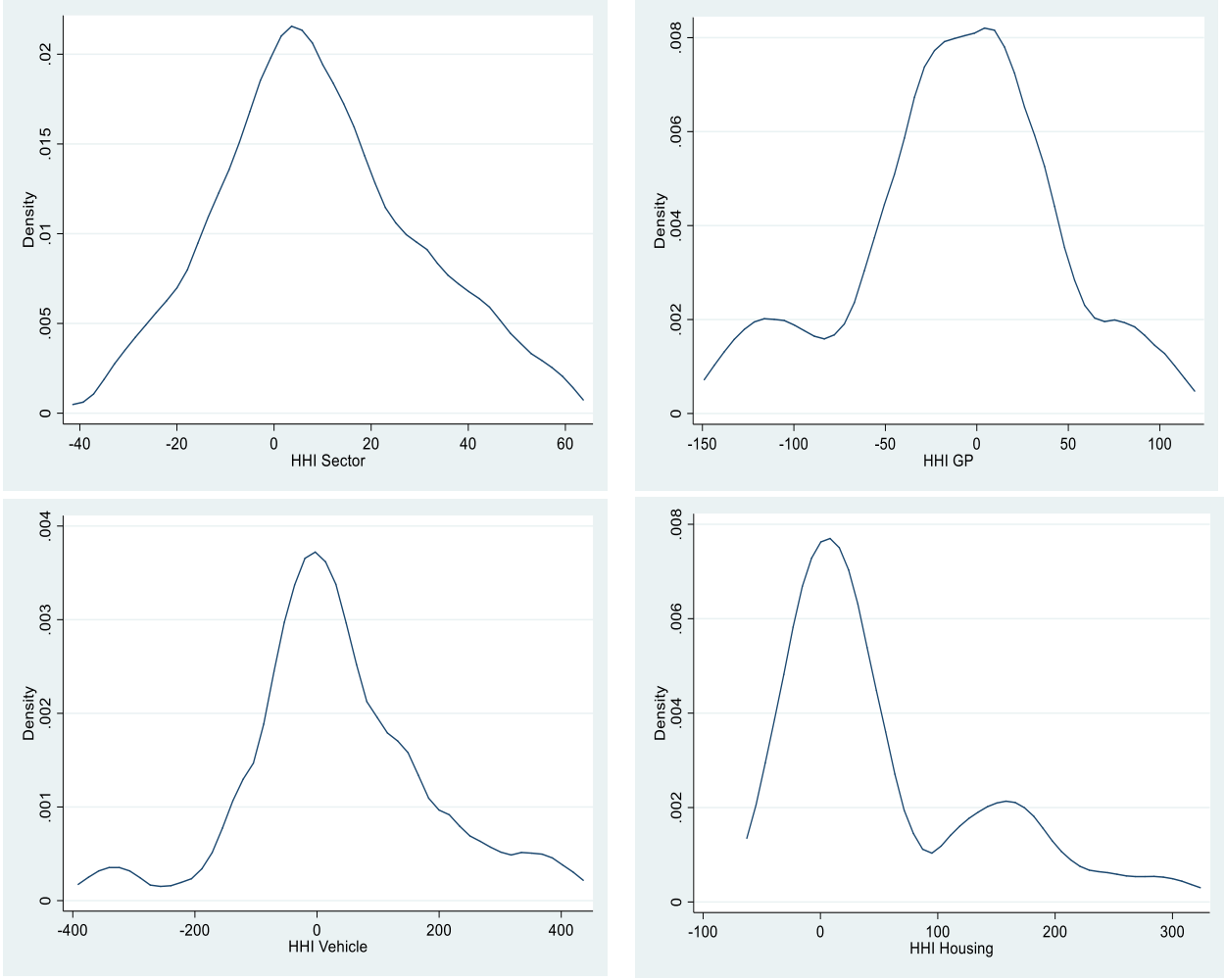


Figure 13: Scatter Plots

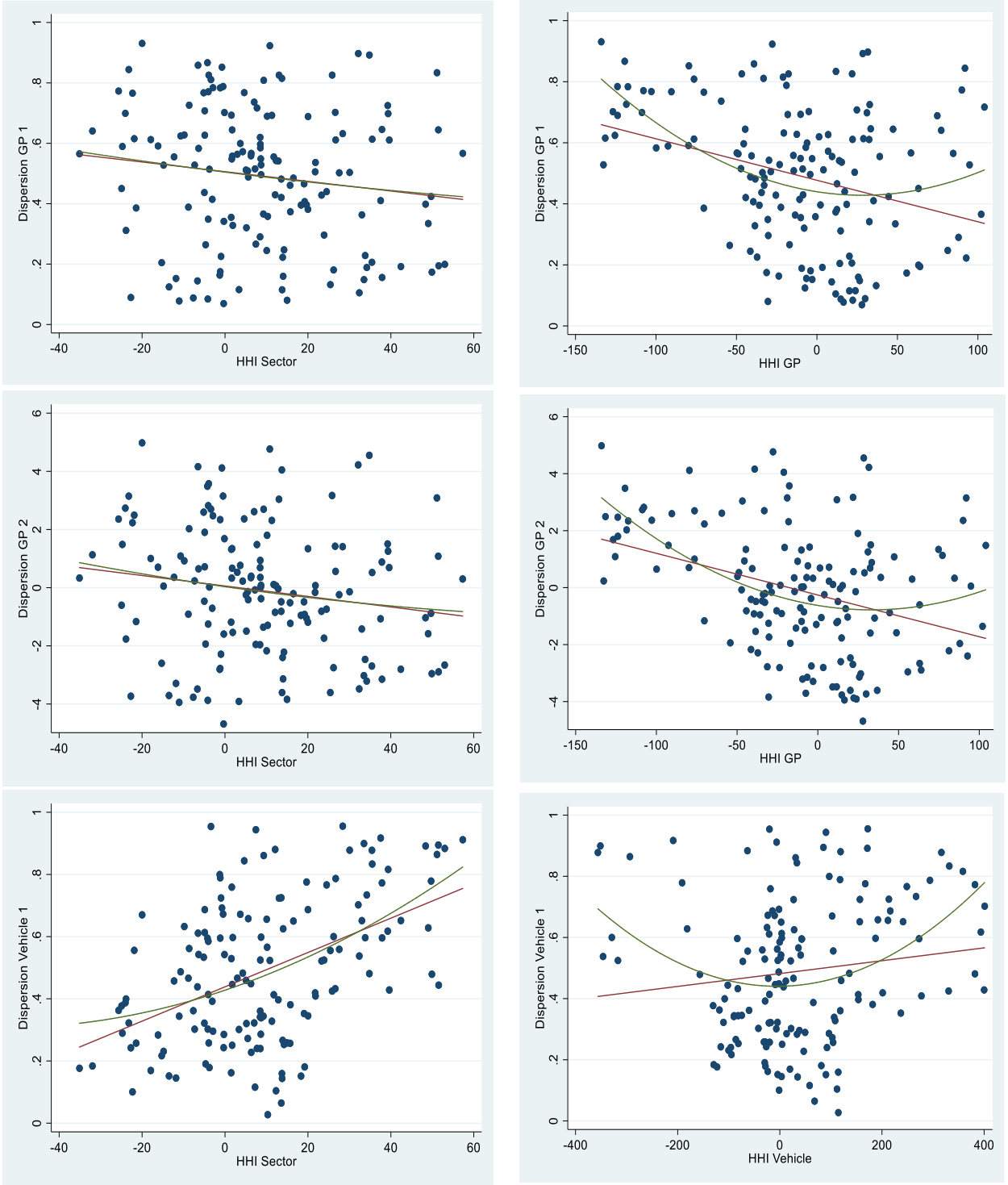
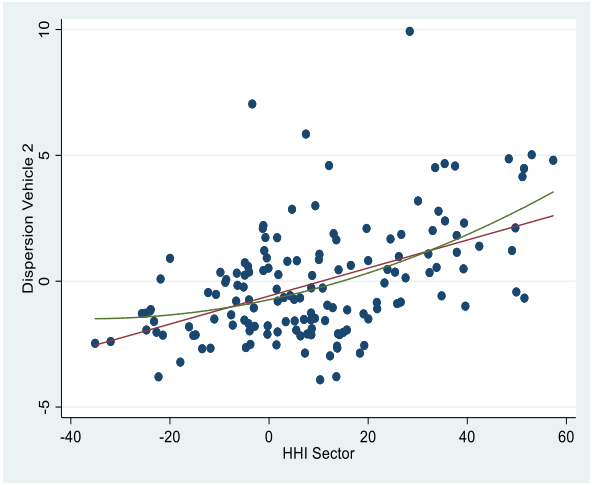
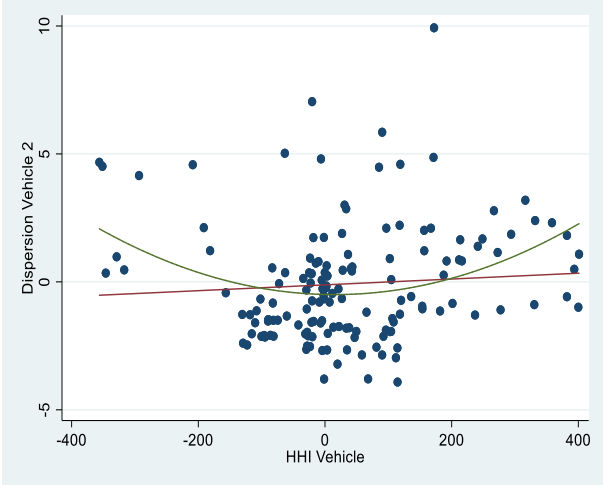
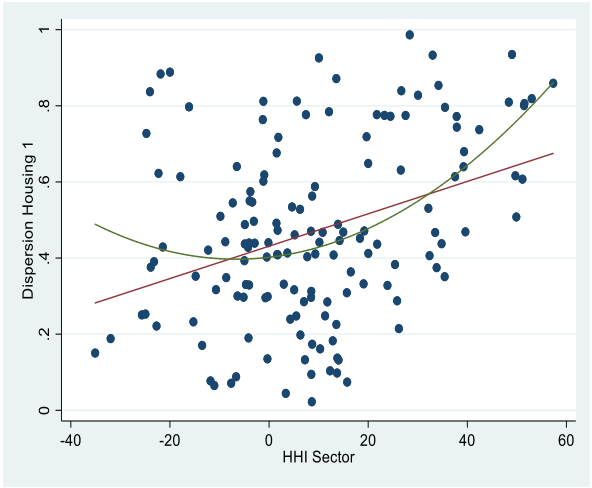
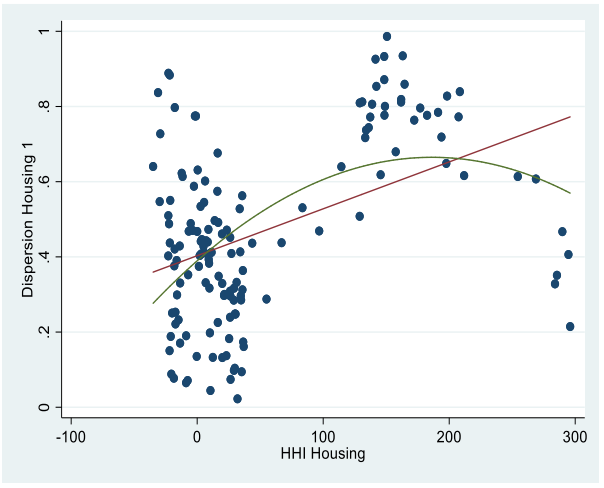


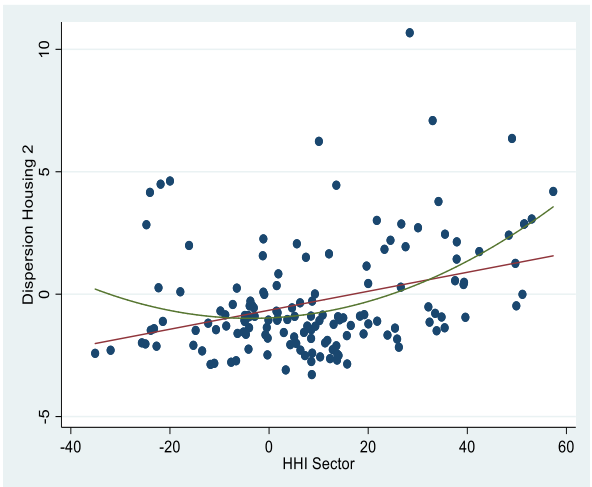
Figure 13 (contd.): Scatter Plots











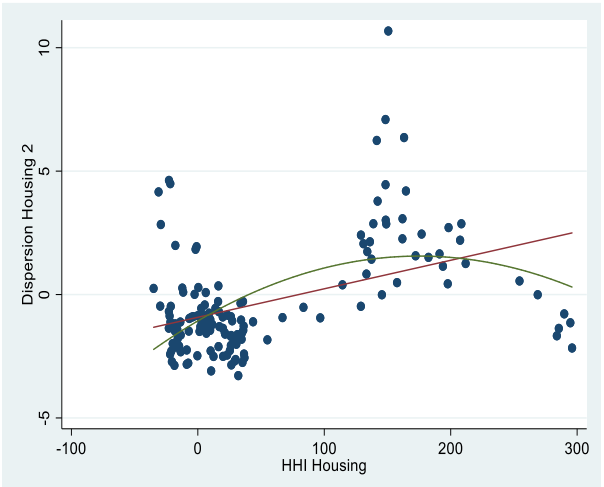
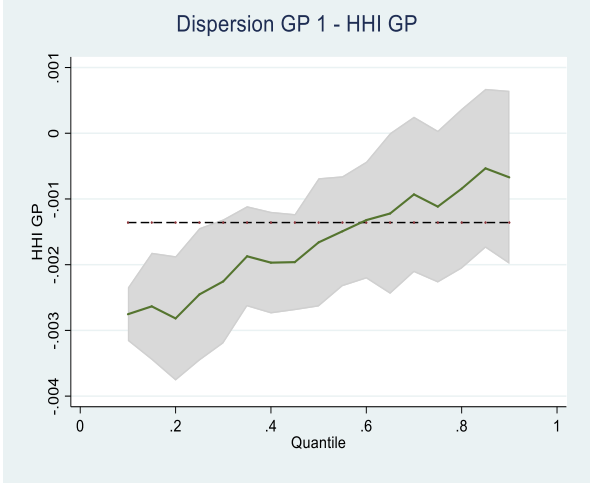
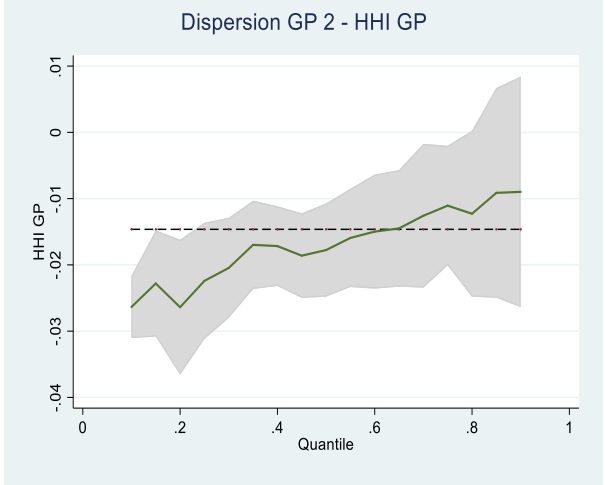
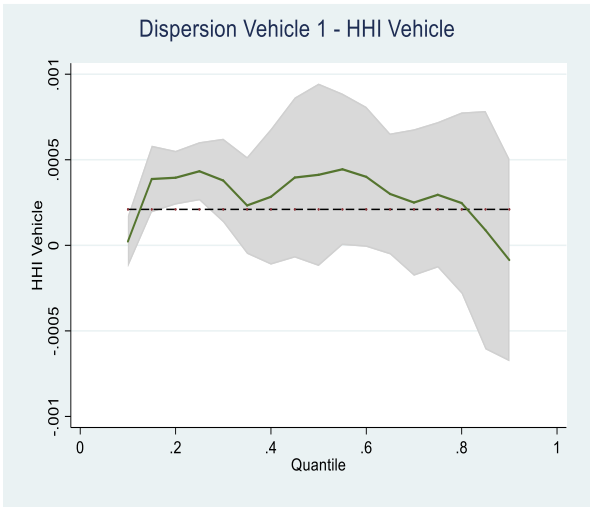
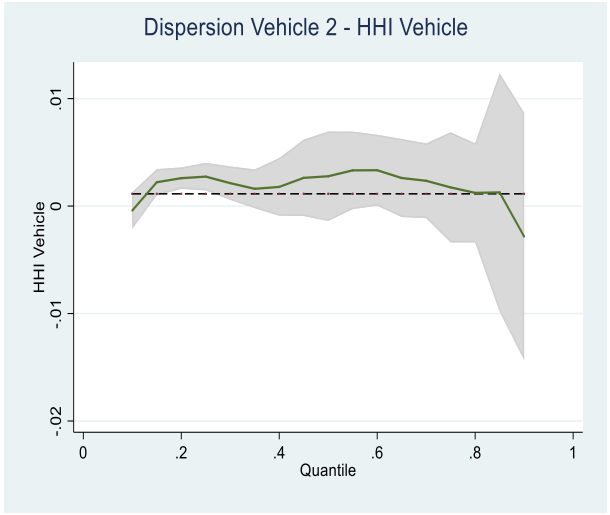


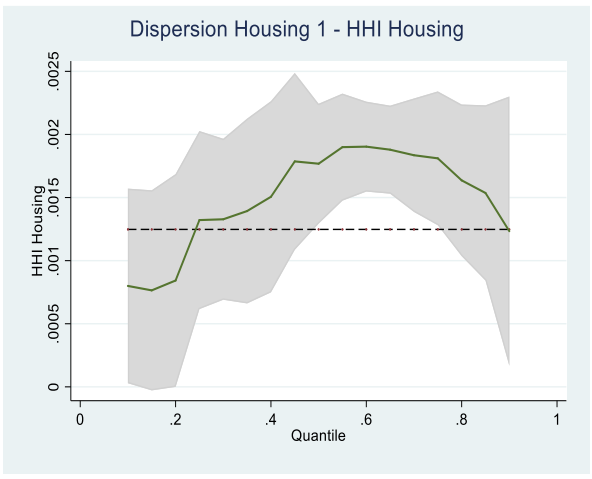
Figure 14: Quantile Process Plots for HHI Loan Covariates











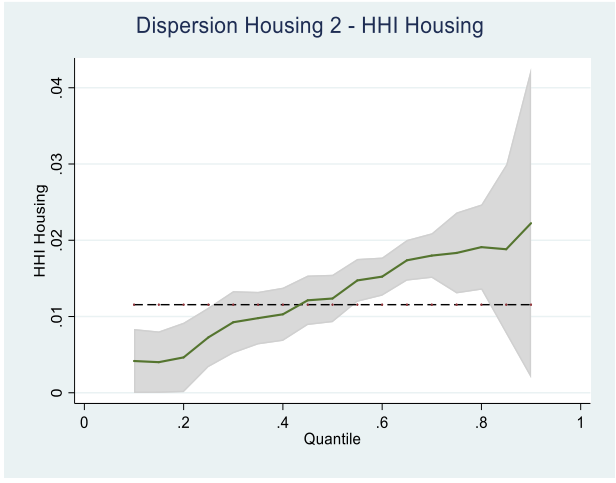


Table 1: Data Descriptions

Variable	Retrieval/Transformation	Source
Dispersion GP 1	Level, Dispersion index calculated for GP loans by using bank-level data and CDF method	CBRT, Authors' Calculations
Dispersion GP 2	Level, Dispersion index calculated for GP loans by using bank-level data and PCA method	CBRT, Authors' Calculations
Dispersion Vehicle 1	Level, Dispersion index calculated for vehicle loans by using bank-level data and CDF method	CBRT, Authors' Calculations
Dispersion Vehicle 2	Level, Dispersion index calculated for vehicle loans by using bank-level data and PCA method	CBRT, Authors' Calculations
Dispersion Housing 1	Level, Dispersion index calculated for housing loans by using bank-level data and CDF method	CBRT, Authors' Calculations
Dispersion Housing 2	Level, Dispersion index calculated for housing loans by using bank-level data and PCA method	CBRT, Authors' Calculations
HHI Sector	Year-on-Year Difference, Competition indicator calculated for total loans by using bank-level data	CBRT, Authors' Calculations
HHI GP	Year-on-Year Difference, Competition indicator calculated for GP loans by using bank-level data	CBRT, Authors' Calculations
HHI Vehicle	Year-on-Year Difference, Competition indicator calculated for total loans by using bank-level data	CBRT, Authors' Calculations
HHI Housing	Year-on-Year Difference, Competition indicator calculated for total loans by using bank-level data	CBRT, Authors' Calculations
MAP GP	Year-on-Year Difference	Eroğlu (2018)
MAP Vehicle	Year-on-Year Difference	Eroğlu (2018)
MAP Housing	Year-on-Year Difference	Eroğlu (2018)
Asset Prices	Year-on-Year Logarithmic Growth, BIST 100 Index	Bloomberg
Employment	Year-on-Year Difference, Seasonally Adjusted, Employment Ratio	TurkStat
Consumer NPL	Year-on-Year Difference, NPL Ratio of Consumer (General-Purpose, Vehicle and Housing) Loans	CBRT
CAR	Year-on-Year Difference, Ratio of Equity Capital to Risk-Weighted Assets	CBRT
Deposit Rate	Year-on-Year Difference, Weighted Average Flow Deposit Interest Rate Applicable to TL Deposits	CBRT
Liquidity Ratio	Year-on-Year Difference, The Ratio of Liquid Assets (Cash, Receivables, Securities) to Total Deposits	CBRT

Table 2: ADF Test Results

Variable	Test Statistic
Dispersion GP 1	-4.940***
Dispersion GP 2	-4.810***
Dispersion Vehicle 1	-4.919***
Dispersion Vehicle 2	-5.734***
Dispersion Housing 1	-3.219**
Dispersion Housing 2	-3.722***
HHI Sector	-2.733*
HHI GP	-3.101**
HHI Vehicle	-4.325***
HHI Housing	-4.768***
MAP GP	-3.319**
MAP Vehicle	-2.655*
MAP Housing	-2.698*
Asset Prices	-3.588***
Employment	-3.460**
Consumer NPL	-3.395**
CAR	-3.048**
Deposit Rate	-2.906**
Liquidity Ratio	-3.018**

Notes: ***, **, * denotes the statistical significance at 1%, 5% and 10% levels, respectively.

Table 3: Log(t) Convergence Test Results for Bank-Level Consumer Loan Rates

Sample Coverage	Coefficient	Standard Error	T-Statistic	Number of Observations
GP Loans, All Banks, All Sample	-0.049	0.179	-0.276	11,090
GP Loans, State Banks, All Sample	0.873	0.347	2.512	2,400
GP Loans, Private Banks, All Sample	0.116	0.216	0.539	4,959
GP Loans, Foreign Banks, All Sample	-0.456	0.271	-1.683*	3,731
GP Loans, State Banks, 2007M1-2013M12	1.167	0.557	2.096	1,389
GP Loans, Private Banks, 2007M1-2013M12	-0.357	0.221	-1.621	2,602
GP Loans, Foreign Banks, 2007M1-2013M12	-1.485	0.206	-7.187*	2,046
GP Loans, State Banks, 2014M1-2020M4	-0.483	0.241	-2.003*	1,011
GP Loans, Private Banks, 2014M1-2020M4	0.543	0.200	2.713	2,357
GP Loans, Foreign Banks, 2014M1-2020M4	0.151	0.294	0.511	1,685
Vehicle Loans, All Banks, All Sample	-0.812	0.117	-6.951*	10,982
Vehicle Loans, State Banks, All Sample	-0.019	0.357	-0.053	2,397
Vehicle Loans, Private Banks, All Sample	-0.615	0.168	-3.656*	5,087
Vehicle Loans, Foreign Banks, All Sample	-1.240	0.179	-6.927*	3,498
Vehicle Loans, State Banks, 2007M1-2013M12	0.134	0.594	0.225	1,388
Vehicle Loans, Private Banks, 2007M1-2013M12	-0.825	0.155	-5.323*	2,944
Vehicle Loans, Foreign Banks, 2007M1-2013M12	-1.256	0.166	-7.556*	2,110
Vehicle Loans, State Banks, 2014M1-2020M4	-0.622	0.345	-1.798*	1,009
Vehicle Loans, Private Banks, 2014M1-2020M4	-0.861	0.240	-3.582*	2,143
Vehicle Loans, Foreign Banks, 2014M1-2020M4	-1.223	0.187	-6.540*	1,685
Housing Loans, All Banks, All Sample	-0.154	0.292	-0.527	11,015
Housing Loans, State Banks, All Sample	2.622	0.406	6.451	2,403
Housing Loans, Private Banks, All Sample	-0.684	0.134	-6.927*	5,123
Housing Loans, Foreign Banks, All Sample	-0.144	0.289	-0.498	3,493
Housing Loans, State Banks, 2007M1-2013M12	2.696	0.595	4.527	1,389
Housing Loans, Private Banks, 2007M1-2013M12	-0.473	0.146	-3.234*	2,923
Housing Loans, Foreign Banks, 2007M1-2013M12	-0.135	0.328	-0.412	1,999
Housing Loans, State Banks, 2014M1-2020M4	-0.783	0.506	-1.546	1,010
Housing Loans, Private Banks, 2014M1-2020M4	-0.781	0.211	-3.698*	2,200
Housing Loans, Foreign Banks, 2014M1-2020M4	-0.157	0.130	-1.207	1,494

Notes: * denotes the rejection of the null hypothesis of convergence at 5% significance level.

Table 3 (contd.): Log(t) Convergence Test Results for Bank-Level Consumer Loan Rates

Sample Coverage	Coefficient	Standard Error	T-Statistic	Number of Observations
GP Loans, Large Banks, All Sample	-0.084	0.224	-0.374	5,429
GP Loans, Small Banks, All Sample	-0.093	0.218	-0.429	5,661
GP Loans, Large Banks, 2007M1-2013M12	-0.113	0.343	-0.331	3,072
GP Loans, Small Banks, 2007M1-2013M12	-0.851	0.173	-4.901*	2,965
GP Loans, Large Banks, 2014M1-2020M4	-0.145	0.210	-0.692	2,357
GP Loans, Small Banks, 2014M1-2020M4	0.299	0.248	1.207	2,696
Vehicle Loans, Large Banks, All Sample	-0.362	0.279	-1.299	5,563
Vehicle Loans, Small Banks, All Sample	-0.815	0.089	-9.125*	5,419
Vehicle Loans, Large Banks, 2007M1-2013M12	-0.250	0.414	-0.604	3,209
Vehicle Loans, Small Banks, 2007M1-2013M12	-0.949	0.125	-7.570*	3,233
Vehicle Loans, Large Banks, 2014M1-2020M4	-1.235	0.245	-4.993*	2,354
Vehicle Loans, Small Banks, 2014M1-2020M4	-0.762	0.098	-7.708*	2,186
Housing Loans, Large Banks, All Sample	0.660	0.463	1.426	5,568
Housing Loans, Small Banks, All Sample	-0.417	0.232	-1.796*	5,447
Housing Loans, Large Banks, 2007M1-2013M12	1.683	0.321	5.234	3,212
Housing Loans, Small Banks, 2007M1-2013M12	-0.391	0.225	-1.738*	3,099
Housing Loans, Large Banks, 2014M1-2020M4	-1.704	0.443	-3.839*	2,356
Housing Loans, Small Banks, 2014M1-2020M4	-0.423	0.231	-1.831*	2,348

Notes: * denotes the rejection of the null hypothesis of convergence at 5% significance level.

Table 4: Quantile Regression Results

Dependent Variable: **Dispersion GP 1**	10th Percentile	25th Percentile	50th Percentile	75th Percentile	90th Percentile	10th Percentile	25th Percentile	50th Percentile	75th Percentile	90th Percentile	10th Percentile	25th Percentile	50th Percentile	75th Percentile	90th Percentile
HHI Sector	0.0005	-0.0027	-0.0032**	-0.0021	-0.0019										
	(0.0011)	(0.0018)	(0.0012)	(0.0014)	(0.7999)										
HHI GP						-0.0027***	-0.0024***	-0.0016***	-0.0011**	-0.0006	-0.0024***	-0.0023***	-0.0018**	-0.0021**	-0.0008
						(0.0004)	(0.0006)	(0.0004)	(0.0005)	(0.0005)	(0.0006)	(0.0005)	(0.0007)	(0.0008)	(0.0007)
MAP GP											0.0488**	-0.0038	-0.0370	-0.0013	-0.0064
											(0.0224)	(0.0191)	(0.0285)	(0.0313)	(0.0279)
Asset Prices											0.0014	-0.0009	0.0005	-0.0008	0.0010
											(0.0015)	(0.0012)	(0.0019)	(0.0021)	(0.0018)
Employment											0.0132	0.0558***	0.0440	0.0216	0.0443
											(0.0247)	(0.0211)	(0.0314)	(0.0346)	(0.0308)
Consumer NPL											0.1563***	0.1578***	0.0675	0.0189	0.0432
											(0.0332)	(0.0283)	(0.0421)	(0.0463)	(0.0413)
CAR											-0.0114	-0.0084	-0.0017	-0.0059	-0.0638**
											(0.0207)	(0.0176)	(0.0262)	(0.0288)	(0.0257)
Deposit Rate											-0.0005	-0.0036	-0.0068	-0.0173**	-0.0107
											(0.0063)	(0.0053)	(0.0080)	(0.0088)	(0.0078)
Liquidity Ratio											0.0110*	0.0140**	0.0064	0.0163*	0.0055
											(0.0064)	(0.0055)	(0.0081)	(0.0089)	(0.0080)
Observations	148	148	148	148	148	148	148	148	148	148	148	148	148	148	148
Pseudo R-squared	0.004	0.024	0.034	0.011	0.002	0.093	0.103	0.069	0.045	0.017	0.246	0.242	0.126	0.089	0.113

Notes: Robust standard errors are given in parentheses. Constant terms are included in the regressions. ***, **, * denotes the statistical significance at 1%, 5% and 10% levels, respectively.

Table 5: Quantile Regression Results

Dependent Variable: **Dispersion GP 2**	10th Percentile	25th Percentile	50th Percentile	75th Percentile	90th Percentile	10th Percentile	25th Percentile	50th Percentile	75th Percentile	90th Percentile	10th Percentile	25th Percentile	50th Percentile	75th Percentile	90th Percentile
HHI Sector	0.0093 (0.0132)	-0.0295** (0.0149)	-0.0276*** (0.0104)	-0.0243* (0.0137)	-0.0138 (0.0194)										
HHI GP						-0.0263*** (0.0031)	-0.0224*** (0.0052)	-0.0177*** (0.0041)	-0.0111** (0.0048)	-0.0089 (0.0073)	-0.0224*** (0.0040)	-0.0240*** (0.0043)	-0.0189*** (0.0064)	-0.0227*** (0.0069)	-0.0144 (0.0091)
MAP GP											0.4089*** (0.1551)	0.1373 (0.1648)	-0.2185 (0.2485)	0.0632 (0.2676)	-0.3135 (0.3500)
Asset Prices											0.0287*** (0.0103)	-0.0019 (0.0109)	0.0082 (0.0165)	0.0023 (0.0177)	-0.0020 (0.0232)
Employment											-0.0642 (0.1712)	0.2895 (0.1819)	0.2822 (0.2743)	0.3123 (0.2954)	0.4418 (0.3863)
Consumer NPL											1.6611*** (0.2293)	1.6167*** (0.2438)	0.8099** (0.3675)	0.2861 (0.3957)	0.2973 (0.5176)
CAR											-0.2944** (0.1429)	-0.1668 (0.1519)	-0.2634 (0.2290)	-0.1317 (0.2466)	-0.6388** (0.3226)
Deposit Rate											0.0040 (0.0436)	-0.0156 (0.0464)	-0.0572 (0.0699)	-0.1432** (0.0743)	-0.1582 (0.0985)
Liquidity Ratio											0.0688 (0.0445)	0.1091** (0.0473)	0.0694 (0.0713)	0.1268* (0.0667)	0.1361 (0.1004)
Observations	148	148	148	148	148	148	148	148	148	148	148	148	148	148	148
Pseudo R-squared	0.006	0.021	0.035	0.027	0.003	0.120	0.103	0.085	0.072	0.018	0.277	0.253	0.147	0.131	0.135

Notes: Robust standard errors are given in parentheses. Constant terms are included in the regressions. ***, **, * denotes the statistical significance at 1%, 5% and 10% levels, respectively.

Table 6: Quantile Regression Results

Dependent Variable: **Dispersion Vehicle 1**	10th Percentile	25th Percentile	50th Percentile	75th Percentile	90th Percentile	10th Percentile	25th Percentile	50th Percentile	75th Percentile	90th Percentile	10th Percentile	25th Percentile	50th Percentile	75th Percentile	90th Percentile
HHI Sector	0.0044*** (0.0014)	0.0051*** (0.0011)	0.0054*** (0.0014)	0.0060*** (0.0010)	0.0047*** (0.0015)										
HHI Vehicle						0.0000 (0.0002)	0.0004*** (0.0001)	0.0004** (0.0002)	0.0003 (0.0002)	-0.0001 (0.0002)	0.0000 (0.0002)	0.0002 (0.0002)	0.0002 (0.0002)	0.0001 (0.0002)	-0.0001 (0.0002)
MAP Vehicle											-0.0357 (0.0263)	-0.0172 (0.0298)	-0.0061 (0.0251)	-0.0097 (0.0237)	-0.0078 (0.0239)
Asset Prices											-0.0018 (0.0015)	0.0020 (0.0016)	0.0017 (0.0014)	-0.0005 (0.0013)	0.0011 (0.0013)
Employment											-0.0010 (0.0293)	-0.0608* (0.0332)	-0.0858*** (0.0279)	-0.1138*** (0.0264)	-0.1273*** (0.0266)
Consumer NPL											-0.0843** (0.0342)	-0.1121** (0.0388)	-0.1461*** (0.0326)	-0.2498*** (0.0308)	-0.1992*** (0.0311)
CAR											0.0691*** (0.0196)	0.0493** (0.0222)	0.0409** (0.0187)	0.0502*** (0.0176)	0.0188 (0.0178)
Deposit Rate											0.0093 (0.0073)	0.0137* (0.0083)	0.0083 (0.0070)	0.0020 (0.0066)	0.0045 (0.0066)
Liquidity Ratio											-0.0017 (0.0052)	-0.0121** (0.0059)	-0.0103** (0.0050)	-0.0056 (0.0047)	-0.0043 (0.0047)
Observations	148	148	148	148	148	148	148	148	148	148	148	148	148	148	148
Pseudo R-squared	0.067	0.111	0.131	0.159	0.141	0.001	0.034	0.015	0.025	0.008	0.165	0.179	0.263	0.294	0.317

Notes: Robust standard errors are given in parentheses. Constant terms are included in the regressions. ***, **, * denotes the statistical significance at 1%, 5% and 10% levels, respectively.

Table 7: Quantile Regression Results

Dependent Variable: **Dispersion Vehicle 2**	10th Percentile	25th Percentile	50th Percentile	75th Percentile	90th Percentile	10th Percentile	25th Percentile	50th Percentile	75th Percentile	90th Percentile	10th Percentile	25th Percentile	50th Percentile	75th Percentile	90th Percentile
HHI Sector	0.0354*** (0.0092)	0.0282*** (0.0089)	0.0512*** (0.0120)	0.0709*** (0.0106)	0.0679*** (0.0136)										
HHI Vehicle						-0.0004 (0.0011)	0.0027*** (0.0008)	0.0028* (0.0015)	0.0017 (0.0018)	-0.0028 (0.0038)	0.0001 (0.0018)	0.0014 (0.0019)	-0.0009 (0.0017)	-0.0019 (0.0020)	-0.0044 (0.0034)
MAP Vehicle											-0.0526 (0.2197)	-0.0351 (0.2360)	-0.0511 (0.2062)	-0.0125 (0.2503)	-0.3559 (0.4137)
Asset Prices											-0.0134 (0.0121)	0.0157 (0.0130)	0.0190 (0.0114)	0.0014 (0.0138)	0.0219 (0.0229)
Employment											-0.2410 (0.2447)	-0.5544** (0.2628)	-1.1069*** (0.2296)	-1.3694*** (0.2787)	-1.3497*** (0.4607)
Consumer NPL											-1.0570*** (0.2859)	-0.9216*** (0.3070)	-1.0915*** (0.2683)	-2.1013*** (0.3257)	-1.9182*** (0.5382)
CAR											0.6342*** (0.1637)	0.4038** (0.1758)	0.2687* (0.1536)	0.4496** (0.1864)	0.2912 (0.3081)
Deposit Rate											0.0400 (0.0610)	0.1015 (0.0655)	0.1572*** (0.0572)	0.0856 (0.0694)	0.1523 (0.1148)
Liquidity Ratio											-0.0157 (0.0435)	-0.0881* (0.0468)	-0.0582** (0.0408)	-0.0208 (0.0496)	-0.0463 (0.0820)
Observations	148	148	148	148	148	148	148	148	148	148	148	148	148	148	148
Pseudo R-squared	0.061	0.089	0.134	0.194	0.223	0.001	0.027	0.010	0.014	0.021	0.145	0.156	0.251	0.298	0.357

Notes: Robust standard errors are given in parentheses. Constant terms are included in the regressions. ***, **, * denotes the statistical significance at 1%, 5% and 10% levels, respectively.

Table 8: Quantile Regression Results

Dependent Variable: **Dispersion Housing 1**	10th Percentile	25th Percentile	50th Percentile	75th Percentile	90th Percentile	10th Percentile	25th Percentile	50th Percentile	75th Percentile	90th Percentile	10th Percentile	25th Percentile	50th Percentile	75th Percentile	90th Percentile
HHI Sector	0.0055*** (0.0015)	0.0038*** (0.0014)	0.0057*** (0.0012)	0.0051*** (0.0017)	0.0016 (0.0019)										
HHI Housing						0.0008*** (0.0003)	0.0013*** (0.0004)	0.0018*** (0.0003)	0.0018*** (0.0003)	0.0012** (0.0005)	0.0013** (0.0005)	0.0016*** (0.0004)	0.0023*** (0.0004)	0.0029*** (0.0003)	0.0024*** (0.0002)
MAP Housing											0.0470 (0.0367)	0.0844*** (0.0316)	0.0761*** (0.0253)	0.0696*** (0.0199)	0.0600*** (0.0171)
Asset Prices											-0.0002 (0.0017)	0.0015 (0.0015)	0.0018 (0.0012)	0.0006 (0.0009)	0.0012 (0.0009)
Employment											-0.0205 (0.0379)	-0.0417 (0.0327)	-0.0160 (0.0262)	0.0051 (0.0206)	-0.0205 (0.0206)
Consumer NPL											-0.0532*** (0.0513)	0.0704 (0.0441)	0.1503*** (0.0353)	0.1738*** (0.0278)	0.1552*** (0.0238)
CAR											0.0632** (0.0265)	-0.0058** (0.0228)	-0.0543*** (0.0183)	-0.0943*** (0.0144)	-0.0817*** (0.0123)
Deposit Rate											0.0391*** (0.0074)	0.0319*** (0.0063)	0.0277*** (0.0051)	0.0196*** (0.0040)	0.0226*** (0.0034)
Liquidity Ratio											-0.0248*** (0.0062)	-0.0100* (0.0054)	-0.0045 (0.0043)	-0.0036 (0.0034)	-0.0046 (0.0029)
Observations	148	148	148	148	148	148	148	148	148	148	148	148	148	148	148
Pseudo R-squared	0.053	0.067	0.075	0.106	0.021	0.057	0.056	0.126	0.204	0.082	0.240	0.284	0.352	0.459	0.456

Notes: Robust standard errors are given in parentheses. Constant terms are included in the regressions. ***, **, * denotes the statistical significance at 1%, 5% and 10% levels, respectively.

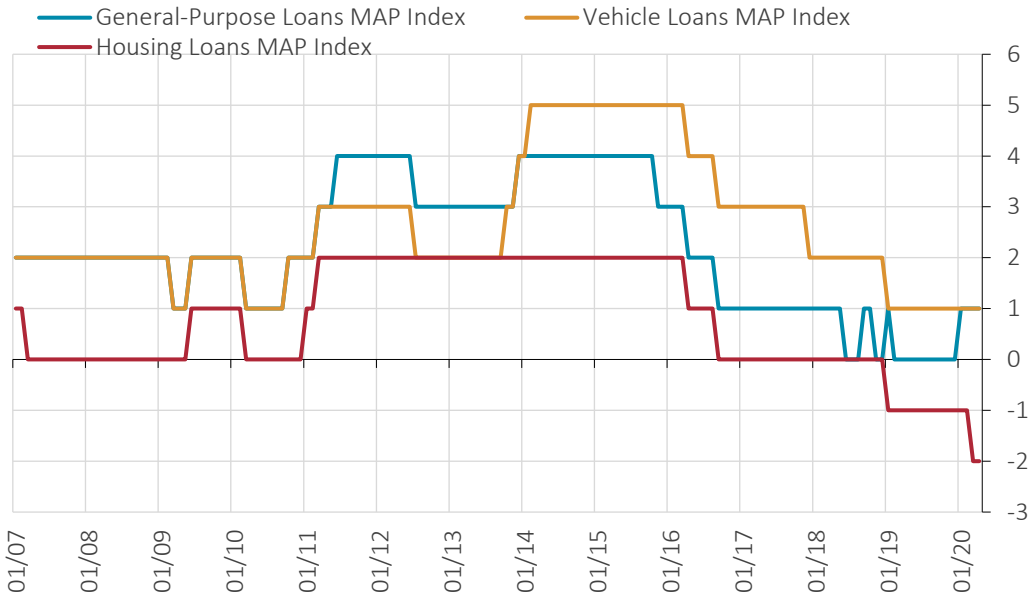
Table 9: Quantile Regression Results

Dependent Variable: **Dispersion Housing 2**	10th Percentile	25th Percentile	50th Percentile	75th Percentile	90th Percentile	10th Percentile	25th Percentile	50th Percentile	75th Percentile	90th Percentile	10th Percentile	25th Percentile	50th Percentile	75th Percentile	90th Percentile
HHI Sector	0.0245*** (0.0071)	0.0198*** (0.0067)	0.0350*** (0.0089)	0.0582*** (0.0140)	0.0413 (0.0391)										
HHI Housing						0.0041*** (0.0016)	0.0073*** (0.0021)	0.0124*** (0.0019)	0.0183*** (0.0024)	0.0222** (0.0094)	0.0066** (0.0028)	0.0088*** (0.0029)	0.0162*** (0.0029)	0.0238*** (0.0040)	0.0207*** (0.0049)
MAP Housing											0.2488 (0.1986)	0.4544** (0.2105)	0.5439*** (0.2047)	0.4743* (0.2852)	0.3788 (0.3521)
Asset Prices											0.0045 (0.0093)	0.0124 (0.0099)	0.0134 (0.0096)	0.0196 (0.0134)	0.0203 (0.0166)
Employment											-0.0655 (0.2052)	-0.3952* (0.2175)	-0.2618 (0.2115)	-0.1596 (0.2947)	-0.6037* (0.3638)
Consumer NPL											-0.2300 (0.2773)	0.2655 (0.2939)	0.7715*** (0.2858)	1.7076*** (0.3982)	1.9351*** (0.4916)
CAR											0.3649** (0.1433)	0.0155 (0.1519)	-0.2575* (0.1477)	0.9209*** (0.2058)	-0.9177*** (0.2541)
Deposit Rate											0.2045*** (0.0398)	0.2087*** (0.0422)	0.2267*** (0.0410)	0.2583*** (0.0572)	0.4151*** (0.0706)
Liquidity Ratio											-0.1207*** (0.0336)	-0.0489 (0.0356)	-0.0147 (0.0346)	0.0008 (0.0483)	0.0500 (0.0596)
Observations	148	148	148	148	148	148	148	148	148	148	148	148	148	148	148
Pseudo R-squared	0.034	0.046	0.055	0.135	0.036	0.036	0.045	0.119	0.215	0.102	0.176	0.227	0.327	0.464	0.537

Notes: Robust standard errors are given in parentheses. Constant terms are included in the regressions. ***, **, * denotes the statistical significance at 1%, 5% and 10% levels, respectively.

Appendix

Figure 15: Macroprudential Policy (MAP) Indices



Source: The updated version of the macroprudential indices created by Eroğlu (2018).

Figure 16: Market Shares in General-Purpose Loan Segment by Bank Ownership

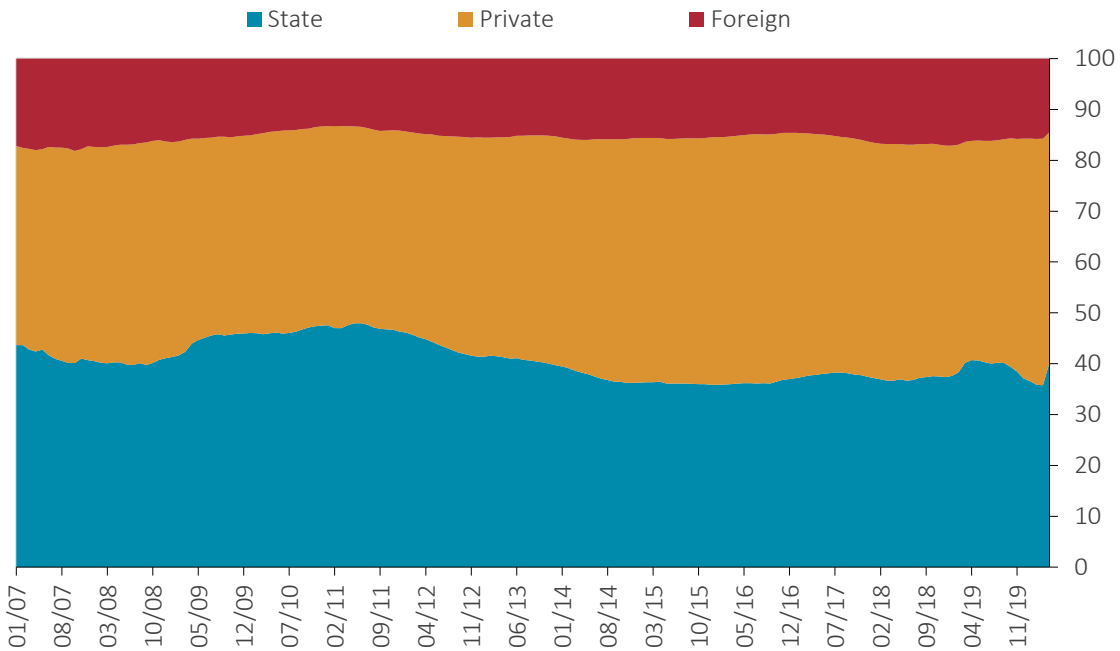


Figure 17: Market Shares in Vehicle Loan Segment by Bank Ownership

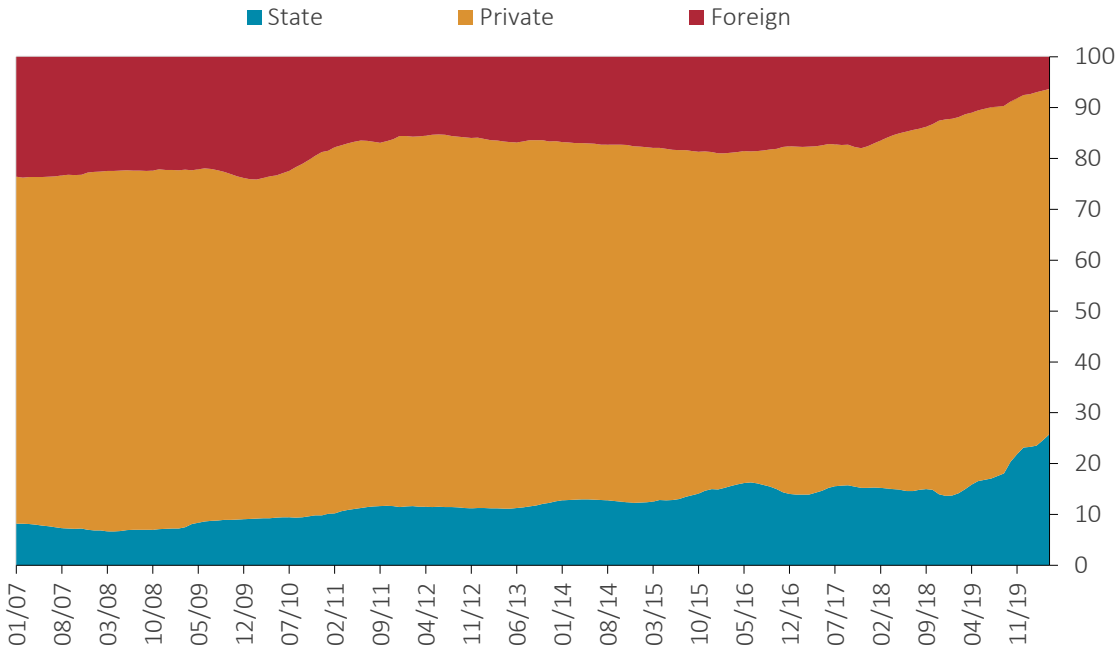


Figure 18: Market Shares in Housing Loan Segment by Bank Ownership

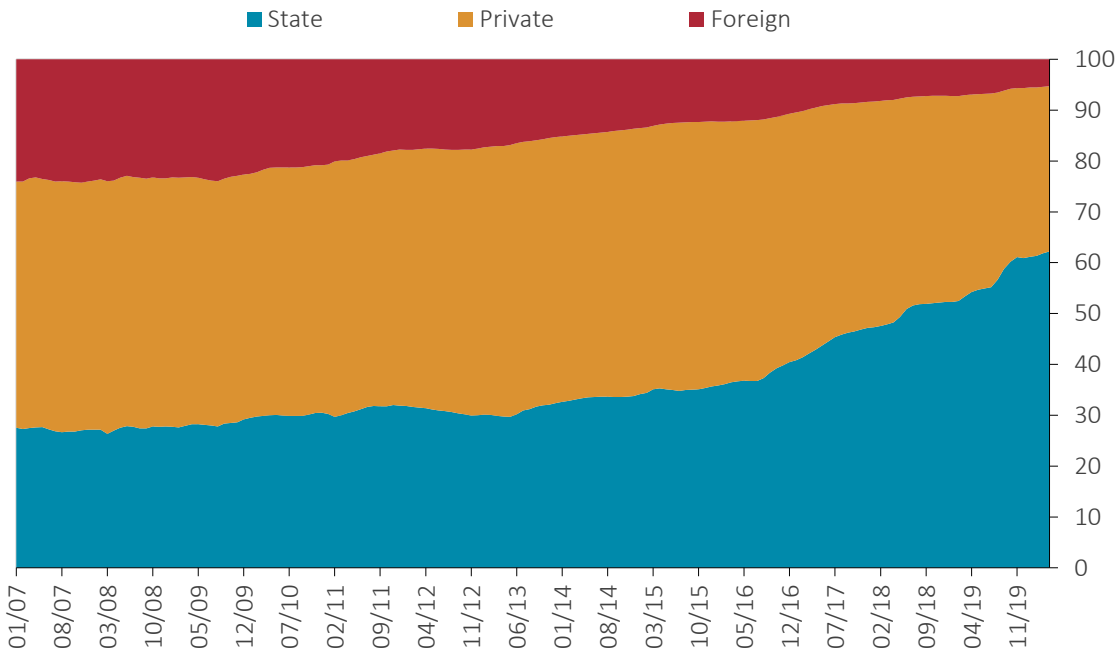


Figure 19: Market Shares in General-Purpose Loan Segment by Bank Size

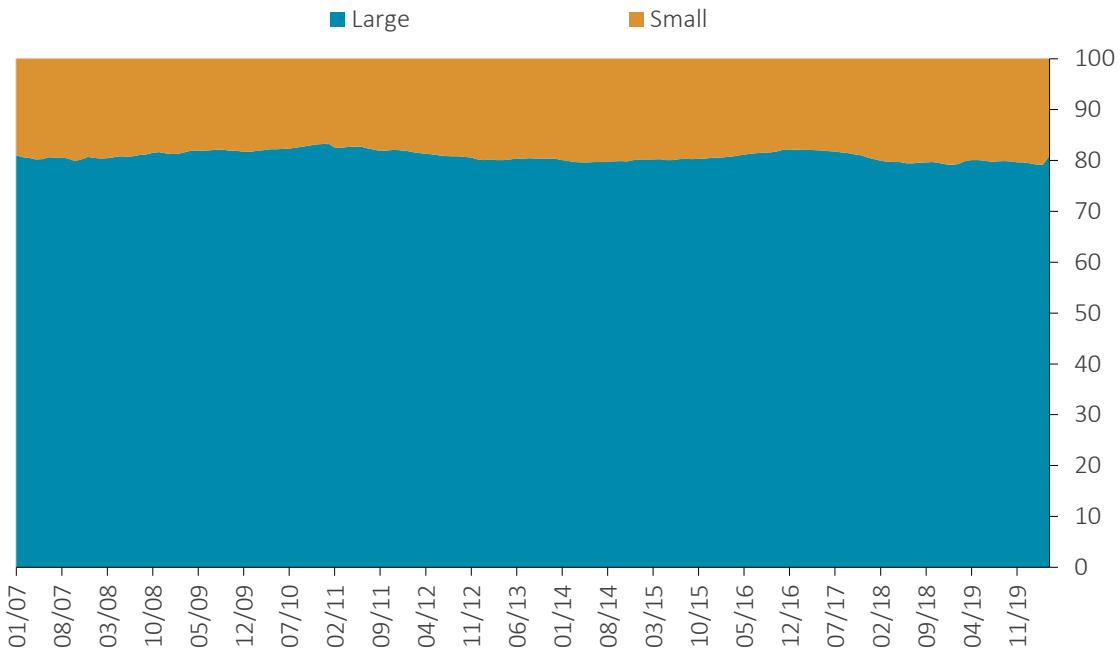


Figure 20: Market Shares in Vehicle Loan Segment by Bank Size

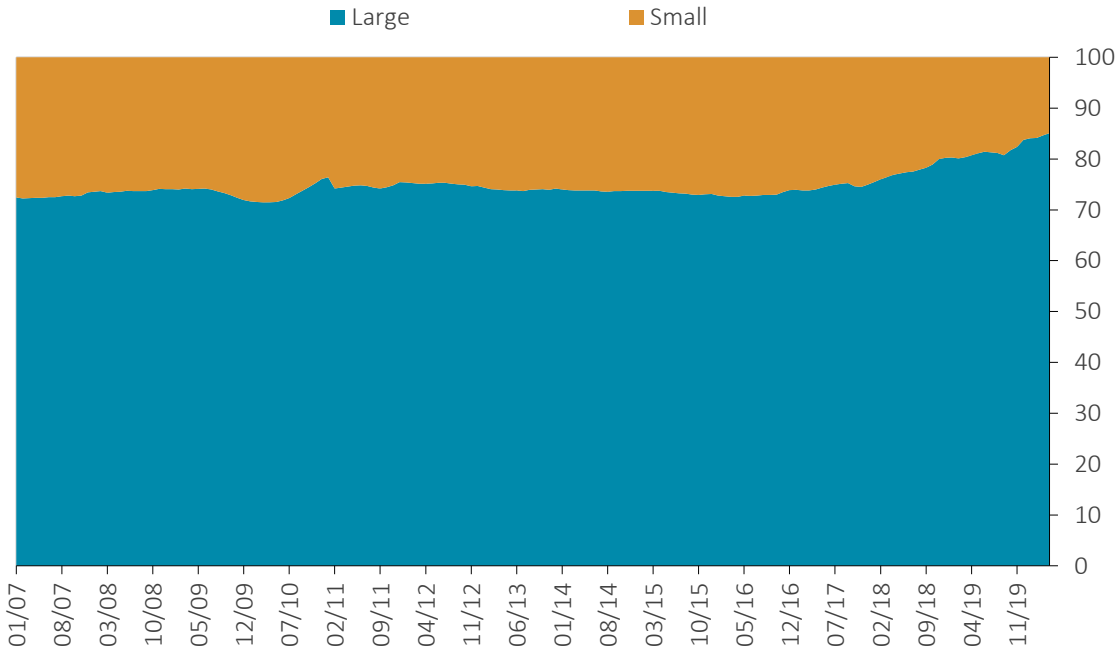


Figure 21: Market Shares in Housing Loan Segment by Bank Size

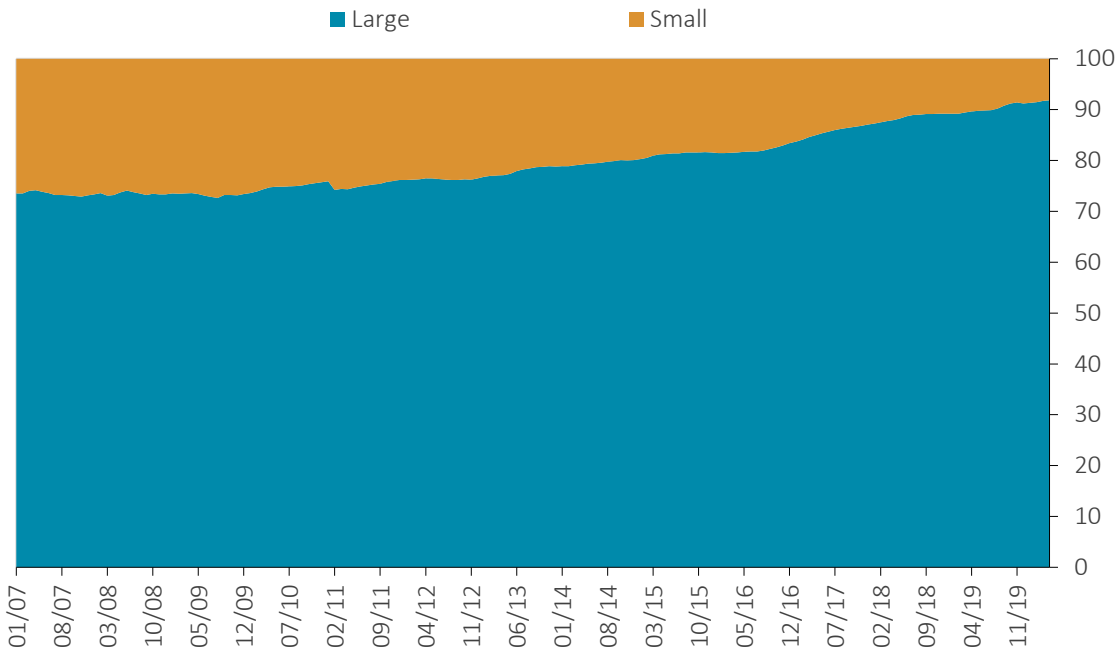


Figure 22: Vehicle Loans

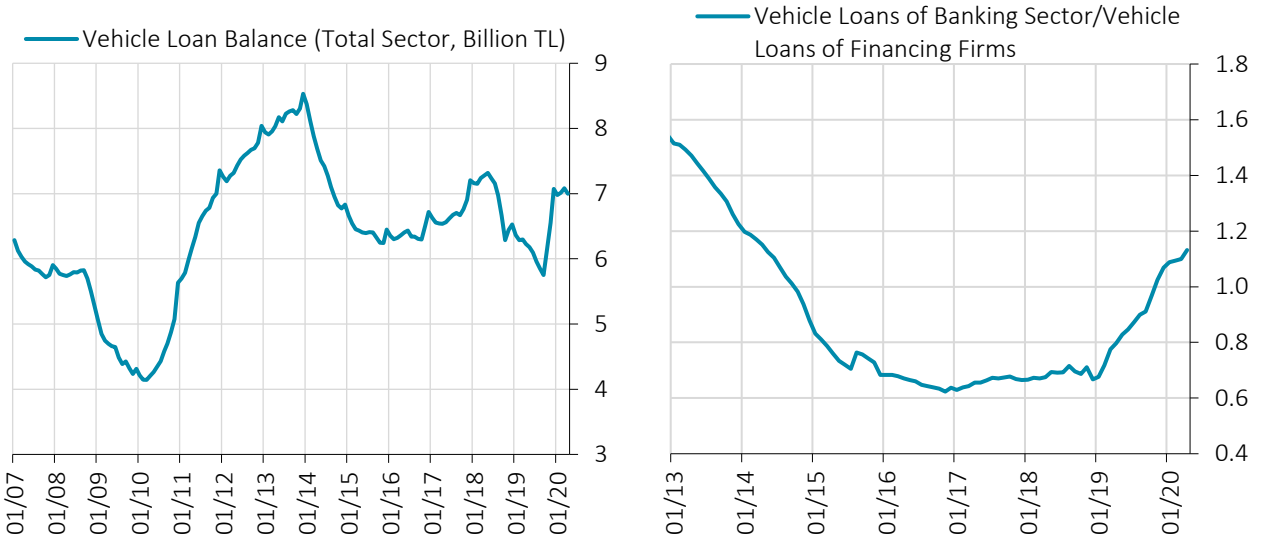


Figure 23: House Prices and Sales

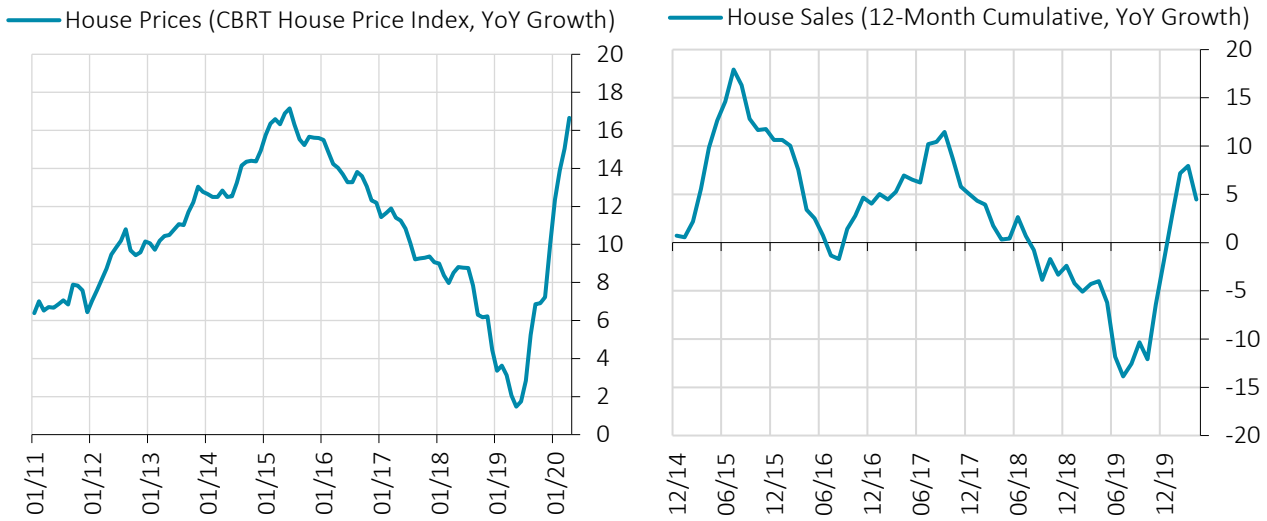
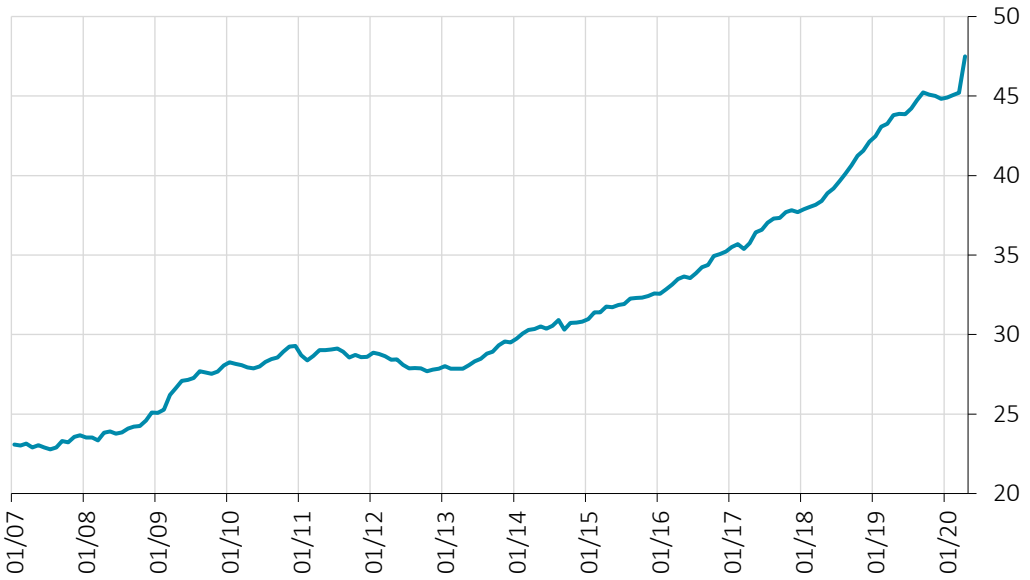


Figure 24: Market Share of State Banks in Total Loans (Percentage)



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